THE EFFECT OF TRADE LIBERALISATION AND FOREIGN DIRECT INVESTMENT IN MEXICO

by

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Abstract

This thesis analyses how trade liberalisation and Foreign Direct Investment (FDI) have impacted on Mexicoøs economy. Time series econometric estimations techniques and estimations of a dynamic simultaneous equations system were conducted using quarterly data (from 1980 to 2002). In a VAR framework, calculations showed that only exports do Granger cause GDP. Under NAFTA, it emerged that exports and GDP do Granger cause FDI. Variance decomposition and impulse response functions confirmed the relative importance of each variable in the system. 3SLS estimations including instruments of fiscal and monetary policies and inflation, demonstrated that the main determinants of GDP are capital accumulation, labour productivity and FDI. Other findings confirm that exports, differences in relative wages and currency depreciation are explicative of FDI. Exports are highly dependent on the world economy and exchange rate fluctuations. Labour productivity and FDI improve human capital. Similarly, GDP and human capital induce productivity gains and capital accumulation improves due to technology transfer, infrastructure, personal income and peso appreciation. Dynamic effects of government policies and exogenous variables were analysed via multiplier analysis. The real exchange rate and world economy exert the strongest acceleration on exports and FDI growth. Multiplier effects of the monetary base showed than an expansionary monetary policy has the capacity to decelerate the interest rate and thereby to enhance FDI and its spillovers.

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CHAPTER 1: GENERAL INTRODUCTION, OBJECTIVES AND ECONOMETRIC APPROACH

1.1 Introduction

Early in the 1980s, many governments from developing countries introduced outward-oriented strategies as a way to enhance production efficiency and increase the transmission of technology from developed countries. The main purpose was to achieve economic development that could stimulate competition and efficiency in the domestic industry. It was expected that a more open economy to international trade and capital flow would improve output growth and would alleviate structural macroeconomic problems. After more than two decades of applying this strategy, there is still not a general agreement about whether or not economic liberalisation achieved its goal. The general public conceive globalisation as a set of economic policies imposed by multinational organisations (the International Monetary Fund, the World Bank or the World Trade Organisation) to facilitate movement of capitals and goods. In the academic field, there are also different opinions between opponents and proponents of free trade and capital mobility, both trying to prove the benefits or costs with empirical evidence. In general, there is no a consensus about whether or not countries have benefited directly from trade liberalisation programmes. Nevertheless, many nations abandoned the protectionist policies that prevailed in the 1960s and 1970s and turned towards outward economic reforms.

This research provides empirical evidence about how economic liberalisation through international trade and FDI has impacted economic growth. The analysis is focused on Mexico during the period 1980-2002 (using quarterly data). Four general questions guide this research: 1) given the reforms introduced since 1986, have exports and Foreign Direct Investment promotion been successful mechanisms to improve economic performance in Mexico? 2) By which channels (if any) do FDI and manufacturing exports affect economic growth? 3) What exogenous variables are relevant to explain exports, economic growth, FDI, labour productivity, capital accumulation and human capital? And, 4) what monetary, commercial and fiscal policies are conductive to improving the economy as a whole?

This introductory chapter contains six sections. In Section 1.2 we discuss the relevance of doing empirical research on the link between growth, exports and FDI. Section 1.3 contains a brief review of the Mexican economy and policy development strategies which are later discussed in detail in Chapter 4. Section 1.4 states the specific objectives of the study. Finally, Section 1.5 contains a brief description of the methodological approach that was utilised on the empirical work.

1.2. An ongoing debate about liberalisation and economic growth

Globalisation is neither a new nor a complete process. According to Frankel (2000), this process had its origin at the beginning of the 20th century, when trade transactions between nations increased significantly and the level of trade as a share of GDP was high. In fact he argues, GDP was on average higher than the actual average growth in many countries. Between 1914 and 1944, this process stopped and even reverted as a result of the Great Depression and the First World War. Then, protectionism became widely accepted by nations that considered external influences dangerous to the economic development of less developed countries. Anne Krueger (1997) holds that the wide acceptance of protectionism (by academics and policy makers) was due to the ñmisapplication of good theoryò and by the assumptions of counterfactual observations that gave credibility and justification to protectionist measures. It was not until the 1980s when protectionism as a development strategy was abandoned and liberalisation was adopted by many nations.

Rodrik (1997) argues that it does not matter whether or not countries globalise their economies but how they do it. The success or failure to introduce liberalisation reforms, he says, depends on the existing social conflict and proper governmentôs administration. For example, to consolidate these changes, reforms in macroeconomic policy must be accompanied by reforms in social and political institutions. Otherwise, social conflicts will impede the positive effects of liberalisation because:

> *"such conflicts diminish the productivity with which a society's resources are utilized in a number of ways: by delaying needed adjustments in fiscal policies and key relative prices and by diverting activities from the productive and entrepreneurial sphere to the political sphere"* (pag. 8)

Theoretically and empirically, exports have been considered as a very important determinant of output growth. International trade theories state that countries are better off with free trade than with autarky, this is so due to specialisation in the production of goods in which they have comparative advantage. For example, specialisation allows better resource allocation and the expansion of consumption levels, which are considered as direct effects of international trade (the static gains from trade). It is through liberalisation that exports become the engine by which the economy can be stimulated. For example, export production leads to labour productivity changes, augmentation of technological innovation, competition, etc. This strategy is known as the Export-Led Growth (ELG) paradigm and its hypotheses are:

a) The export sector generates positive externalities in the non-export sector (Feder, 1982).
b) Higher access to new technologies, inputs and intermediate goods favours economies of scale, competition and externalities.
c) Exports increase long-run growth by increasing the adoption of technological innovation and by improving human capital (Romer, 1985).

This hypothesis has been put to the test but with inconclusive results, empirical studies are discussed in detail in Chapter 3. Another effect of economic liberalisation is through foreign capital in the form of direct and indirect (speculative) investment. In this research only

Foreign Direct Investment (FDI) will be discussed. FDI is recognised as an important source of new technologies transfer, learning-by-doing techniques and new management practices ï among the most important externalities- in host countries. The reason is that the existence of FDI in capital-intensive sectors enhances the absorption of technologies by domestic producers and suppliers at a higher rate than in a closed economy. However, it is not an automatic process; some authors suggest that FDI flow and the generation of externalities require the existence of a minimum stock of human capital because human capital determines the host countryốs absorptive capability (Borensztein et al., 1995). In this sense, FDIốs contribution to GDP and productivity may be higher than domestic investment if differences between domestic plants and foreign plants are large.

The promotion of exports production and foreign capital are two of the main mechanisms that have been considered in development policies. This strategy can be identified as an Investment and Export-Led Growth (ELG) strategy and its success as a development mechanism can only be determined by empirical evidence. Although the ELG strategy assumes that export production is the most important mechanism to accelerate output growth rates, its effects are extremely complex and involve a large number of variables that also determine the direction of the final outcome. Among other significant variables that should also be considered are price-demand elasticity, total investment, monetary and fiscal policies, world output growth, technology absorption and human capital.

At the moment, there is no a consensus on whether liberalisation in trade and FDI will automatically achieve economic growth; in fact, there is no general agreement as to whether openness rather than other macroeconomic variables is responsible for economic growth. The literature about trade liberalisation and economic growth is vast and is increasing (see Edwards (1993) for a survey). One of the first attempts to understand whether exports had a positive effect on output growth occurred in the 1970s with correlation analysis (Balassa, 1978) and in-depth case studies analysing liberalisation indicators against output growth. Some influential case studies were undertaken at the National Bureau of Economic Research (NBER) by Bhagwati & Krueger (1973), who analysed trade reforms in ten developing countries and found that growth performance was better in countries with outward policies than in countries with Import Substitution policies (ISP). During the 1980s, the analysis focused on groups of developing countries using cross-section regressions and panel data. The cross-country regressions usually supported the hypothesis that exports growth was the main mechanism to increase growth rates of GDP (see Feder (1982) and Ram (1987)).

Criticism of the methodologies used and their theoretical bases suggest that there is still more research to do. Rodrik (1999) argues that ñopenness by itself is not a reliable mechanism to generate sustained economic growthò, instead endogenous variables (such as competitiveness, human capital, domestic investment) and the austerity in macroeconomic policy have a higher impact on economic performance. Other authors, for example Sachs (1987) questions whether trade liberalisation is a necessary component of successful outward strategies.

The shortcomings of cross-country regressions (the oversimplification of the results) were one of the reasons that led researchers to analyse country specific cases and to introduce different econometric techniques. Thus, recent empirical research (in the 1990s and onwards) has favoured time series analysis over cross section analysis and has introduced Granger causality tests to determine the relationship among the variables. The purpose is essentially to reduce some of the shortcomings mentioned above; recent studies also include alternative channels by which openness may affect economic growth and question the basic cause-effect relationship between the variables.

1.3 Strategies of economic development: from protectionism to openness

The economic history of Mexico is quite similar to that of many developing countries in Latin America. During the first years of the 20th century, Mexico experienced macroeconomic problems due to international price fluctuations of primary goods, its main economic and financial resource. In the 1930s, there was an intense process of nationalisation of the most important natural resources, such as crude oil. In the 1940s, it was evident that the country required an industrialisation policy that could reduce the dependency on primary goods. Considering that protectionist policies of industrialisation were widespread across many Latin-American countries, the Mexican government considered that an Import-Substitution Industrialisation (ISI) would be the most viable strategy that could lead to economic development.

Protectionism determined the economic dynamic from the 1950s until the mid-1980s. During the 1960s and some part of the 1970s, the economic performance was impressive, the GDP annual growth rate was on average 7%, the annual inflation rate was on average less than 5% and the living standards of the population improved (see Table 1.1).

Table 1.1 Some socioeconomic statistics from Mexico (constant prices, 1993).

Year	GDP (Billion USD)	Annual Growth rate/1 (%)	Population (Millions)	Annual Growth rate (%)	GDP per head (US Dollars)	Inflation (%)
1970	136.27	6.5	50.6	3.6	2693	4.7
1975	201.48	5.7	60.1	3.4	3352	11.3
1980	304.82	9.2	69.6	3.1	4380	29.9
1985	335.63	2.2	77.9	2.1	4308	65.8
1990	366.96	5.0	83.2	1.9	4411	29.9
1995	395.43	-6.1	90.4	1.0	4374	52.0
2000	514.89	6.6	97.3	-0.7	5292	9.0
2002	518.02	0.8	101.9	1.5	5083	5.7

Source: INEGI, IMF and Bank of Mexico
/1 The growth rates correspond to constant pesos of 1980

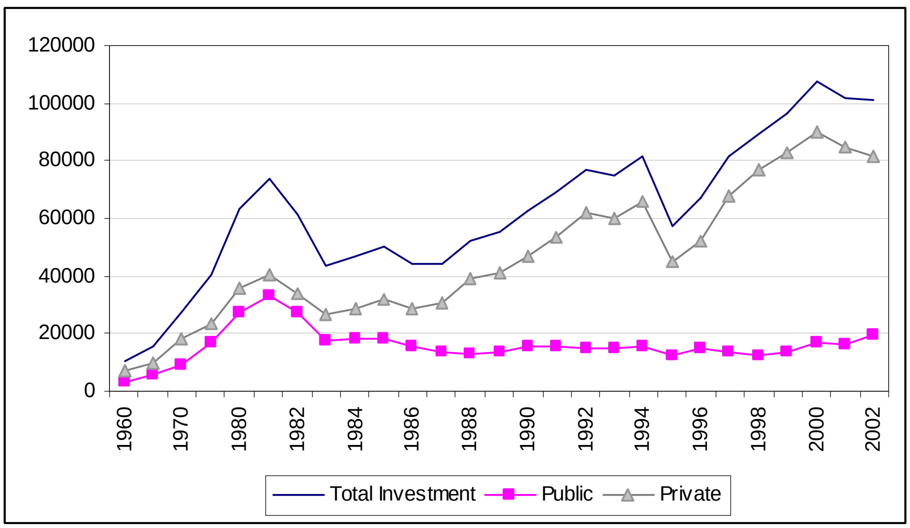
The average growth rate of GDP during the protectionism period (1940-1982) was around 5.9%, but after 1982 this average fell to 2%. GDP growth was the consequence, to a great extent, of increasing rates of public and private investment during the industrialisation period and price stability. Population growth (3.3% annual) and GDP were sufficient to guarantee a fair and growing income per capita. The highest levels of GDP growth were reached between 1977 and 1982, when new crude oil sources were discovered and its supply on the international market increased. The level of foreign exchange increased as a result of oil exports, this provided new financial resources that the government would use to increase public investment.

It was during the 1980s, when Mexico started experiencing lower GDP growth rates as a consequence of two different crises. Inflation increased enormously, going from an average of 0.6% in the 1960s to 4.7% in 1970 and 30% in 1980. In addition, population growth rate remained stable but living conditions deteriorated gradually as a result of high inflation in 1982 and thereafter (Dussel, 2000).

The apparent success of the ISP in the 1950s and 1960s might not have been necessarily caused by the economic policy itself but by macroeconomic policies applied at the same time. High levels of GDP could be explained in terms of policy manipulation instead of purely productive terms. For example, the Government deliberately manipulated monetary policy in order to keep a fixed exchange rate to control prices and foreign exchange flows (eventually, this policy led to overvaluation). From 1958 to 1975, the exchange rate stayed fixed at $12.5 pesos per dollar. As a result, during most part of the ISI, the peso´s overvaluation favoured imports of intermediate inputs and capital goods. At the same time, domestic prices remained low, for three decades inflation was only a one-digit percentage.

Another reason that explains high GDP growth rates was the increasing trend of private and ï to a great extent- public investment. Public and private investment had the same share in total investment during the 1960s and 1970s (around 50% each). Most of the public investment was led to the provision of infrastructure to the new-born industry (roads, ports, buildings, electricity, water, etc.), as well as the production of public goods and services. As a result of economic crisis and later due to privatisation of some public enterprises, from 1982 onwards private investment increased considerably in relation to public investment (see Figure 1.1).

Figure 1.1
Total, public and private investment in Mexico from 1960 to 2002
(Million dollars, 1993 prices).



Source: INEGI, Estadisticas Historicas de Mexico and Romero (2001).
Investment is measure as fixed investment formation.

The decision to liberalise the economy and introduce a different economic development model after the crisis in 1982, was influenced by the exhaustion of the protectionist strategy, the commitment signed with international creditors and by a new world trend that required openness to modernise the country and foreign capital to invest in the economy. In other words, the government required a development strategy that could avoid oil dependency and could stimulate manufactures. In 1986, Mexico joined the General Agreement on Tariffs and Trade (GATT), which immediately reduced average tariffs from 40% to 20%. In this way, the Mexican manufacturing sector became the most important export sector in the current account. The 1980s represented the most important period of structural change in the commercial and economic policy of Mexico.

A trade reform in 1986 implied not only a reduction in tariffs, quotas and non-tariff barriers but also an active role of the Government in promoting exports production[1] and the signing of trade agreements[2] with Mexicoôs most important trade partners. The contribution of trade to GDP, after trade liberalisation, is significant in terms of value and product diversification. For example, in 1980 exports represented 7.3% of GDP and imports represented 8.95%. In 2002, exports reached 27% of GDP. According to the WTO, in 1999 Mexico occupied the 8th position among the leading exporting countries in the world with an export value of $285 billions USD. On the other hand, imports represented 29.2% of GDP, from which Maquiladora contributed with 10.2%.

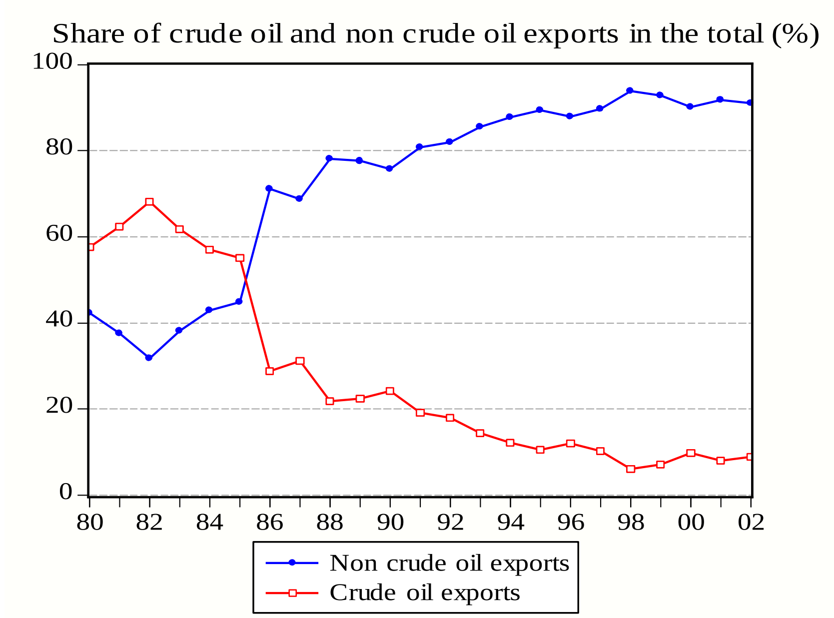
Another significant result of the trade reform was the export structure diversification: the composition of exports changed from crude oil -the main export good during more than four decades- to manufacturing goods in the last two decades. For example, crude oil exports in the composition of the export structure decreased dramatically in a short period of time. While in 1980, crude oil represented 59.8% of total exports, in 2002 it was only 9%, we can see the sharp decline in Figure 1.2. On the other hand, manufactures share in total exports rose

[1] Reforms in trade policy intensified in the 1990s with the application of commercial programmes to promote exports production and increase competitiveness of Mexican goods. Among the most important programmes were: PITEX (for inputs imported temporally), Draw Back (import tax devolutions), PRONEX (for suppliers to the export sector) and marketing instruments such as FEMEX (international fairs) and ALTEX.

[2] Mexico has signed 11 trade agreements with 32 countries. These are: NAFTA with the USA and Canada (1994), Bolivia (1995), Chile (1992), Costa Rica (1995), Colombia and Venezuela (1995), Israel (2000), Nicaragua (1998), European Union (2000), Uruguay (2001), EFTA (2001), Guatemala, Honduras and El Salvador (2001).

from 30.8% in 1980 to 88% in 2002 (Bank of Mexico). In this respect, trade liberalisation was successful as a mechanism to diversify exports and become less dependent on a primary good.

Figure 1.2



Source: Bank of Mexico

As mentioned previously, within the manufacturing sector there is a large diversification. Among the most important export goods are automobiles, machinery and electrical and electronics products. Most of these exports take place within the Maquiladora industry; in 2000 its share was 45% of total exports.

Trade reforms allowed increasing Mexicoôs total trade with the world. For instance, before 1986, trade as a share of GDP represented 24.6%, after joining the GATT, it rose to 31.3% (in 1990). Finally, after joining NAFTA, trade as a share of GDP represented 55.3% (in 2002).

On the other hand, foreign investment in Mexico was negligible during protectionism. In the mid-1980s and after the economic liberalisation, foreign capital flows favoured the stock market, as a result of attractive interest rates that prevailed during that time. For example in 1980, foreign portfolio investment was $60 million dollars while FDI was $2 billion dollars, in the capital account. In 1993, when the government promoted investment in the stock market, foreign investment in the former reached $28.9 billion dollars, the highest amount in Mexican history. In fact, it represented 86.8% of total foreign investment. However, the economic crisis in 1994 changed this proportion dramatically. In 2000, FDI became the main component of the current account, with $13.1 billion dollars while investment in portfolios became negative with $2.2 billion dollars (a debit for the country).

In summary, it seems that thanks to liberalisation reforms, international trade and FDI have increased their share in GDP; exports are more diversified and manufactured exports represent the highest source of export goods. Similarly, FDI has increased its level of investment in the most technological advanced industries and most of their production is for the world market. Due to this, the Mexican position in the world export market is hardly explained by the performance of its domestic industry (except by crude oil). Therefore, it is important to evaluate the real benefits from the outward-oriented strategy.

1.4 Specific objectives

1. Establish whether or not there is a long run equilibrium relationship between output and manufacturing exports, output and FDI, FDI and manufactured exports via cointegration analysis.
2. Determine whether or not exports and FDI have created spillovers through their effects on some endogenous variables like human capital, labour productivity, capital accumulation and GDP. In this way, we can see if the effect of liberalisation extends to the rest of the economy, or if they are only internal to the export industry and the foreign industry.

3. Determine whether or not movements in exchange rate, the world economy and government expenditure are likely to accelerate or decelerate changes in FDI, GDP and exports.

4. Establish whether or not the USôs GDP is an exogenous variable that has a significant effect on output growth, exports and FDI.

5. Establish the relationship between the exchange rate, exports and FDI.

6. Determine the multiplier effect of the exogenous variables such as technology transfer, government expenditure, infrastructure and the world economy.

7. Determine the implication of economic instruments applied by commercial policies (taxes, and trade agreements), fiscal policies (public expenditure) and monetary policies (exchange rate, interest rate and monetary base) to achieve macroeconomic objectives.

8. Determine whether or not GATT and NAFTA have created a significant effect on the economy.

1.5 Formalisation of the research questions through econometrics

Although the research questions are diverse, all of them converge to the general question about whether or not the Export Led-Growth paradigm and FDI promotion have impacted positively on output growth. The theoretical approach followed in this thesis is not based on a unique theory to explain the complex interaction between growth and economic liberalisation. The Heckscher-Ohlin postulates will provide the basis to understand how economic growth adjusts when international trade is introduced. The endogenous growth theory will provide the theoretical explanation for the role of foreign investment, human capital and technology transfer on output growth and labour productivity.

The hypotheses of FDI and ELG state that exports and foreign investment are the main mechanisms to stimulate output growth, to generate an efficient resource allocation, to create technological spillovers and productivity improvement on the economy. Exports and FDI exert these externalities on the economy by different channels and mechanisms. The procedure to achieve the specific objectives is the following:

- First, in a VAR framework, we test the nature of the causal relationship among FDI, Exports and GDP through Granger causality tests. In this way, we can determine which variables precede changes in the other endogenous variables.
- Second, using Impulse-Response Functions and Variance Decomposition, we analyse how these variables react to external shocks through the innovations and what proportion of their variance is explained by its own and other variables shocks.
- Third, it is recognised that the interaction between liberalisation and output growth is more complex than a system of three equations. To do this, a simultaneous equations model is estimated in which the interrelation between FDI, export and GDP is modelled by considering other endogenous and exogenous variables that might have a significant influence on them (for example exchange rate, infrastructure, government expenditure among others). In this way, we try to capture not only direct but also indirect effects of some relevant variables on output growth (through spillover effects). The specification and estimation of a simultaneous equations system will provide the mechanism to understand and answer some of the research questions.
- Four, a multiplier analysis will be applied to determine the response of the endogenous variables to changes in the exogenous variables like the world economy, government expenditure, exchange rate, relative wages, infrastructure, population and technological transfer. In this way, we can determine which variables have the

potential to accelerate or decelerate the growth rate of GDP, capital accumulation, FDI, exports, etc.

- Finally, instruments of fiscal, monetary and commercial policy are included in the system of equations as explanatory variables, so we can make a policy analysis and determine how the interrelationships between the variables change and how government policies contribute to improve the general economic performance. This is achieved with a simultaneous equations system and the analysis of immediate, interim and long-run multipliers.

The content of the thesis consists of eight chapters (including this one). Chapter 2 contains the theoretical framework and a description of policies of economic development applied in Mexico. Chapter 3 is a survey of some studies that have investigated how liberalisation has improved or deteriorated the economy of developing countries. We scrutinise their methodological approaches and discuss their findings. In Chapter 4, we present an analysis of the Mexican macro economy and the trajectory of most of the variables used in this thesis. Chapter 5 contains the results of Granger causality tests, Impulse-Response functions and variance decomposition. Chapter 6 presents the estimations of a simultaneous equations system and the analysis of dynamic multipliers. In Chapter 7, we present the estimations of an extended system of equations with the inclusion of commercial, monetary and fiscal policy variables. Finally Chapter 8 contains the general conclusions and a revision of the hypotheses put forward.

CHAPTER 2: THEORETICAL FRAMEWORK AND POLICIES OF ECONOMIC DEVELOPMENT

2.1. Introduction

The literature on international trade and economic growth is abundant and diverse; theories and models are frequently improved in order to explain the socioeconomic reality in a more precise way. There is no a single theory or model that can explain how international trade and economic growth relate to each other and how they affect the economy. The theoretical framework of this study will draw on more than one theory. On one side, we have the Heckscher-Ohlin (H-O) model which covers a wide range of international trade issues. This model -founded on the principle of comparative advantages- demonstrates that countries are better off with free trade and that gains from trade improve resource allocation and social welfare. However, this theory does not incorporate factor mobility into the analysis, which restricts the analysis of the effect of foreign capital flow on output growth. In recent times, the role of FDI in the productive process is considered as important as international trade in the economy. It is through flows of foreign capital that the stock of technological investment and human capital can improve without public intervention, especially in a developing country with limited resources. For that reason, to understand how economic growth responds to the mobility of capital, the postulates of the endogenous growth theory are considered. This theory allows the inclusion of technological investment and human capital as additional sources of growth. In this regard, it is possible to separate and determine the influence of foreign capital on changes in technological investment, labour productivity and human capital (that ultimately are going to affect output growth).

The purpose of this chapter is to describe the theoretical framework that will provide the basis for the specification of the model and analysis of the issues tackled in this research. Sections 2.2 and 2.3 contain the international trade theory principles that explain why countries trade, the gains from trade and the effects on economic growth. In Section 2.4 there is a discussion about the potential sources of economic expansion like technical progress, capital accumulation and capital mobility. In Section 2.5, we consider capital mobility and economic growth, and the relevance of endogenous growth theory. Section 2.6 describes the characteristics and determinants of FDI in developing countries. Section 2.7 contains a description of two economic development policies: Import-Substitution Industrialisation (ISI) and the Export-Led Growth model (ELG). In Section 2.8 we conclude.

2.2. General equilibrium with international trade

The argument for free international trade has its origin in classical economists like Adam Smith and David Ricardo. They criticised English mercantilists who were in favour of import restrictions as a measure to guarantee the protection of domestic producers. For mercantilists, exports were the means to increase the stock of gold and precious metals when those were measures of a nationŏs wealth. Adam Smith supported free trade because, according to factor endowments, countries have absolute advantage in the production of some goods. In free trade, if every country could specialise in the production of goods with absolute advantage, thus world trade would lead to lower prices and supply variety. However, the limitations of absolute advantages were evident, for example it was unable to explain the point of international trade when a country had absolute advantage in more than one good and others countries in none.

2.2.1 Ricardian theory of comparative advantage

David Ricardo contributed to this discussion when he extended and improved the original proposal of Adam Smith about the benefits of international trade. Ricardo based his theory on the idea that countries have advantage in the production of goods, not in absolute but in relative terms. So, a commodity has competitive advantage if its production process requires less quantity of factors (capital, natural resources or labour) than other production processes. Comparative advantage necessarily leads to complete specialisation if there is only one production factor and to incomplete specialisation if there are two production factors. Essentially, the Ricardian model uses labour as the main production factor that determines differences of labour productivity across countries. As a result, those differences determine commodity trade and relative prices. We can see how general equilibrium in autarky changes when international trade is introduced into the model. To do this, we show how countries are better off with trade than autarky. The assumptions of a basic model with no trade are the following:

A1. Agents exhibit rational behaviour

A2. Factor endowments (L, K) and technologies are constant

A3. There is perfect competition with no externalities

A4. Production factors are perfectly mobile between two industries

A5. Communityǿs preferences in consumption are represented by a set of Consumption Indifference Curves (CIC).

From assumptions A1 to A4, we have that a Production Possibility Frontier (PPF) represents the combination of goods (say x and m) produced with a fixed amount of production factors (capital, K and labour, L). The PPF is determined by technology and the combinations of production factors. From assumption A5, in an economy with only two goods; consumers choose a combination of goods that maximise their utility function. Assuming increasing opportunity costs, the general equilibrium[3] in autarky is reached where the PPF and a CIC are tangential in one point (x, m). This means that production and

[3] This is where levels of production, consumption, prices and trade are all determined simultaneously

consumption take place where the relative prices of goods (P_x/P_m) are identical for producers and consumers. In this model, prices are identical across countries and social welfare (measured by real GDP per capita) can only improve if GDP or national production grows (assuming no population growth). This also implies that countries posses the same levels of capital and labour.

In the Ricardian model international trade is possible. The previous assumptions hold except that in this case, labour is the only relevant factor, which determines the differences of productivity among countries. The Ricardian model incorporates the following assumptions:

A6. Labour is not mobile between countries.

A7. There are no barriers to trade.

A8. Exports pay for imports.

A9. Labour is the only relevant production factor.

A10. There are constant returns to scale between labour and output.

Assuming that there are many goods:

Consumption vector: $c = \begin{bmatrix} c_1 \\ \vdots \\ c_n \end{bmatrix}$

Production vector $x = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix}$

Vector of prices $p = [p_1 ... p_n]$

Vector of costs $w = [w_1$ é $w_n]$

Consumption minus production (m= c-x) equals the balance of trade:

$$m = \begin{bmatrix} m_1 \\ m_2 \\ \vdots \\ m_n \end{bmatrix} = \begin{bmatrix} c_1 - x_1 \\ \vdots \\ c_n - x_n \end{bmatrix}$$

In Autarky, all the production is consumed, so production equals consumption. Imports are zero.

Now, we proceed to determine equilibrium in Autarky and International Trade.

Superscripts are E: Equilibrium, A: Autarky and T: Trade.

Under perfect competition:

$\prod^E = p^E x^E - w^E x^E$ Profit maximisation (2.1)

$p^E c^E = p^E x^E$ Budget constraint (2.2)

$p^T m^T = 0$ Balance of payments equilibrium (2.3)

In autarky, consumption is equal to production $c^A = x^A$ (2.4)

From conditions above we imply that:

$$[p^T c^T = p^T x^T] \geq [p^T c^A = p^T x^A] \quad (2.5)$$

The value of consumption with international trade is higher than the value of consumption in autarky at international trade prices. This is because international prices are lower than the domestic prices. So the gains from trade come from the condition:

$$p^A c^T \geq p^A c^A \quad (2.6)$$

From (2.1) to (2.6)

$$p^A x^A + p^A c^T \geq p^A x^T + p^A c^A$$

$$p^A x^A = p^A c^A \quad (2.7)$$

Hence $p^A c^T \geq p^A x^T$ (2.8)

Therefore: $p^A c^T - p^A x^T \geq 0$ (2.9)

$$p^A (c^T - x^T) \geq 0$$

$$p^A m^T \geq 0 \tag{2.10}$$

The balance of payments is in equilibrium when $p^T m^T = 0$

So: $p^A m^T - p^T m^T \geq 0$

$$(p^A - p^T) m^T \geq 0 \tag{2.11}$$

Therefore on average a country will prefer to import goods that are cheaper than those produced in autarky. Trade is preferred to autarky and in the new general equilibrium with trade, both countries are better off.

Free trade allows countries to specialise in the production of its comparative-advantage good and to export the excess in exchange for the less competitive good. Thus, specialisation in production allows better use of production resources, the industry with the higher advantage will increase its production if the export world demand increases. From assumption A8, we have that not only production but consumption possibilities augment in both countries, since the availability of import goods is at lower prices increased. At the same time, differentials in prices disappear because the world supply and demand of traded goods lead to the equalisation of prices through the equilibrium between exports and imports. The world prices for each good traded is known as the international terms of trade, so it is assumed that movement in prices will lead to enhance the terms of trade if a country experienced an increase in its domestic price. One of the most important implications of the Ricardian theory is that international trade necessarily leads to complete specialisation in the production of goods.

2.2.2 The Heckscher-Ohlin model

In the last century the classical model of international trade was rapidly improved as a consequence of the inconsistencies between theory and reality. Economists like Heckscher and Ohlin (1991) developed a model where they removed two rigid assumptions from the Ricardian model (A9 and A10) and introduced the following:

A11. There are two factors of production, labour and capital (L, K) each receive a payment, wage and rent, respectively.

A12. The technological sets available to countries are identical, the choice of a production technique depends on factor production prices.

A13. One good (x) is relative labour intensive while the other good (m) is relative capital intensive: $L_x / K_x > L_m / K_m$.

A14. Production is subjected to Constant Returns to Scale (CRS). A given proportional change in the use of both production factors causes the same proportionate change in output.

A15. Countries (B, A) differ in factor production endowments: $K_A / L_A > K_B / L_B$

A16. Tastes are identical, the set of CIC are identical across countries.

The most important change in this model is that the relative difference in factor endowments is determinant in production and trade. In the H-O model what matters is not the quantity of factors but the ratio between capital and labour required to produce a unit good. The theorem states that:

> ñ*a country will have a comparative advantage in, and therefore will export, that good whose production is relatively intensive in the factor with which that country is relatively abundant"* (from Husted & Melvin (1995), pag. 96).

Hence, countries will specialise in the production of the good that requires relatively more of their abundant factor. Contrary to autarky, with free trade, the differences in relative prices cannot persist and no country will specialise completely. Therefore, incomplete specialisation in production prevails. From A11, it is possible to deduce that the shape of the

PPF differs from the shape in the classical model due to increasing opportunity costs, as factors are located between productions of the two goods.

From assumptions A13 and A15, we know that *m* is a capital intensive good and B is a relatively capital abundant country; while good *x* is a labour intensive good and country A is relatively labour abundant. Under these conditions, country A has comparative advantage in the production of *x* and country B has comparative advantage in the production of *m*. The price ratio between the two countries proves the H-O theorem:

$$(p_m / p_x)_A > (p_m / p_x)_B \tag{2.12}$$

Once trade begins, the difference in prices will lead to reallocate resources in both countries. Within each country, when goods are traded, the production of the relatively competitive commodity will rise, factors will be reallocated to that industry. At one point, the domestic supply exceeds the domestic demand, so the excess of production will be exported in exchange for cheaper goods. On the other hand, the partner country will buy the excess of production from country A if its relative price is lower than the domestic relative price. In this case, the resources of production in that industry will be reduced. The law of supply and demand determines the world price, the differences in prices will not persist.

Additionally, technological change shifts the PPF outward in favour of the good with comparative advantage. As production increases (GDP) so does the real income per capita (assuming no population growth) because the community consumption moves to a higher CIC. In this situation, the consumption bundle has more of both goods than in autarky.

Ford (1982) suggests that the Ricardian and the Hecksher-Ohlin theories are equivalent in the sense that if either of these paradigms is correct then predictions on comparative advantage are the same, as long as we know the labour productivity ratios. In empirical research it means that it is possible to assess trade patters with either of these theories if we know the labour productivity ratios for the commodities under analysis. A comprehensive review of empirical applications of the Ricardian and H-O theories can be found in Leamer (1994).

Based on comparative advantages, we would expect international trade only between countries with different factor endowments, in other words a predominance of inter-industry trade. However in reality we witness a large proportion of trade between countries with similar characteristics and between differentiated goods in the same industry. Paul Krugman (1981) asserts that economies of scale lead to the specialisation and trade of a subset of goods within the same industry. This answers the question about why countries with similar factor endowments still trade. He formalised this type of trade with a model of Chamberlian monopolistic competition. Since countriesô industries share similar factor ratios, they can differentiate products without costs (only limited by economies of scale). Gains from trade will occur if every differentiated good is produced by a single country.

Empirical studies on Mexico, have found that despite the existence of differences in factor rations between Mexico and its main trade partners, a large proportion of this is due to inter-industry trade. For example, Buitelaar and Padilla (1996) found that between 1990 and 1995, 40% of total international trade was explained by intra-industry transactions (in the automobile, electrical and electronic industries). This situation could be linked to the prevalence of foreign subsidiaries and Maquiladoras in Mexico that produced goods mainly for the export market but which have a high import content. Pacheco-Lopez (2005) found a bidirectional relationship between FDI and imports, which would support the intense import activity that these plants require to operate. Additionally, compared to local export firms, it has already been shown that foreign subsidiaries have a higher import-content (Jenkins, 1979). So, although in theory we would expect intra-industry transactions between countries with similar factor ratios, it is possible to find intra-industry trade between countries with different factor ratios if there is a high concentration of foreign subsidiaries in industries that operate under that scheme.

2.2.3 The Stolper-Samuelson Theorem

The Stolper-Samuelson theorem (1941) is an extension of the H-O model in the sense that under the theoretical propositions of H-O model, it explains what happens to the price of factors of production when good prices change. Assuming that there are only two sectors and two production factors (capital and labour) and full employment, the theorem states that the price of a factor of production will increase if the good that uses intensively that factor increases. For example, if the price of a good rises then that sector will experience an expansion at the expense of the other sector. Due to a relative higher demand for the factor used intensively in the production of that good, its price will also increase (either in the form of wages or capital returns).

In the context of international trade, the theorem is used to understand what happens when prices of trade goods change due to the imposition of tariffs on import goods. For example, a tariff on an import good that uses labour intensively will increase the domestic price of the import-competing good. As a result, resources will be allocated to the labour intensive sector and a higher demand for labour will raise real wages at the expense of capital returns. In other words, protectionism raises real wages if a tariff is applied on a labour-intensive import good. Similarly, protectionism will raise capital returns if the tariff is applied on a capital-intensive import good. This situation implies that ñunless compensation for income losses is actually paid, there are always both winners and losers from any change in trade policyò (Neary 2004, pag.2). In a general situation of many goods and many factors of production, the imposition of a tariff will always raise the real return of at least one factor of production and will reduce the real return of at least one other factor. The Stolper-Samuelson theorem confirms the prediction of international trade theory that countries are better off with tariff reductions and free trade.

In the case of a developing country like Mexico, during protectionism the production of import-substitutes was stimulated by the distortion on prices created by tariffs. The production of import substitutes intensive in labour (or capital) was the result of higher prices due to tariffs on imports. In certain way this situation explains the high growth rates of national output that Mexico experienced during that period (the average growth rate was 6.6% between 1960 and 1970). However this economic boom was at the expense of the production of export and non-tradable goods and the distortion of factor prices in industries that were highly protected. Similarly, the subsequent reduction and elimination of tariffs that occurred in the late 1980s had repercussions on factors prices and resource allocation. For example, the elimination of tariffs and the promotion of exports raised the domestic price of export goods because more resources were allocated to those sectors that were export-oriented. Liberalisation reduced prices of import competing goods, therefore a factor of production that was intensively used in the production of that good decreased. This situation led to a resource reallocation based on comparative advantages. Due to years of protectionism, many domestic firms who were producing capital intensive goods were unable to compete with the international market and disappeared. In the early stages of liberalisation, as a consequence of an adjustment in factor prices, Mexico specialised in goods that were relatively intensive in labour. It was in this period when in bond industries (Maquiladoras) increased their investment in Mexico.

2.3. Static and dynamic gains from trade

Nations experience gains from trade in two ways: one is from international specialisation (according to comparative advantage) that leads to resource reallocation. Moving resources toward industries or sectors, where national production is more efficient, eventually increases GDP. This is known as static production gains from trade. Another is the gain from international goods exchange that raises consumption at lower prices.

The static gains from trade can be large or small depending on how much the terms of trade differ from the pre-trade price ratio. In the two-country model, the country with the highest differential from the world price ratio will receive higher gains from trade. In equilibrium trade flows are balanced, exports in one country must equal imports in the other, therefore just one world price for each good must prevail.

On the other hand, dynamic gains from trade refer exclusively to the relationship between trade and economic growth. They explain for example, what happens to output when one or both factor endowments change. Assuming that both factors of production (K and L) grow, this causes national output not only to grow but also to affect positively the consumption level and international trade flows of that country. A rise in factor endowments shifts out the PPF, however the final location of the production and consumption vectors can be located at different points. New output combinations will determine the type of economic growth achieved by the country. Johnson (1962) classifies the outcome in three different types of economic growth:

- Pro-trade biased. Growth is caused by an increase in the factor used to produce export goods. The total effect is an increase in exports supply and imports demand more than proportionally to output growth.

- Anti-trade biased. Output growth is caused by an expansion in the factor used to produce import substitutes. The effect is a reduction in imports demand and export supply more than proportionally to output growth.
- Neutral or unbiased growth. The increase in production and consumption is proportional to the increase in output growth.

If free trade leads to a pro-trade biased growth then the relative importance of trade (measured by the ratio of exports to GDP for example) is significant. Relaxing the constant prices assumption, output growth may be harmful for a large country if the increase in output is large enough to change world prices of its exports and imports. In this case, Bhagwati (1981) asserts that the country experiences an immiserising growth, because the expansion of output leads to the deterioration of its terms of trade and thus reduces social welfare.

2.4. Economic expansion and its effect on international trade

Economic expansion affects imports[4] directly, whether a countryøs expansion is proportionally greater, lesser or equal to its demand for imports will depend on the source of such expansion, which can be due to capital accumulation, technical progress or population growth. According to Johnson (1965), in a world with two countries and incomplete specialisation, economic growth may create three different effects on international trade: pro-trade-biased, anti-trade-biased or a neutral effect. On the consumption side, a countryøs expansion can either stimulate or reduce the demand for imports or have no effect. On the production side, expansion can either stimulate or reduce the production of importables (the effects on trade are known as ultra-pro-trade-biased and ultra-anti-trade- biased respectively). The final result depends on the elasticities of total demand for imports and domestic

[4] This section only refers to the demand side of international trade (imports) but it also applies to the supply side (exports).

production of this good, as well as the ratio of total consumption to domestic production of this good.

2.4.1 Expansion due to technical progress

The assumptions still hold about countries Aôs and Bôs resource allocation and their relative comparative advantage in the production of *x* and *m* (please see Section 2.2.2). For practical reasons, in these sections we refer to *x* as primary goods and *m* as manufactures. There is incomplete specialisation so countries A and B produce both goods, but A is labour-abundant and B is capital-abundant. Any effect on international trade can be analysed from the consumption and production side.

Expansion due to technical progress in country A will be pro-trade-biased in the consumption side because it raises income per capita. It is assumed that at higher income level, peopleôs demand for manufactures increases proportionally more than their demand for primary goods, for example food. As a consequence, consumersô demand for manufactures raises their import demand from country B. On international trade, this creates a pro-trade-biased effect.

On the production side, if technical progress occurs in the production of primary goods (where country A has comparative advantage), this leads to a rise in the supply of exportables and a decrease in the production of importables. As country A reduces its production of import substitutes, then its demand for imports increases, creating an ultra-pro-trade biased effect. As soon as a labour intensive country develops technology used in its abundant-factor sector, international trade will increase. However the opposite result occurs if the technical progress occurs in the production of import substitutes (manufactures). This result seems to be odd, however since it is possible for country A to produce more manufactures, then its demand for imports decreased and creates an ultra-anti-biased effect. In other words, self-sufficiency reduces international trade.

2.4.2 Expansion due to capital accumulation

Expansion due to capital accumulation in country A will favour international trade on consumption goods because it raises income per capita and therefore the demand for manufactures (imports). On the production side, more capital means that country A is capable of increasing the production of import substitutes (manufactures) while reducing the production of exportables. This situation creates an ultra-anti-trade biased effect because Aǿs demand for imports drops. Assuming that exports pay for imports, Aǿs terms of trade improve (Johnson, 1962).

In the case of country B, the situation differs in the sense that expansion due to capital accumulation will create an anti-trade-biased effect in consumption, this is because as income improves, peopleǿs demand for manufactures increases more than their demand for primary goods (imports). Being country B abundant in capital, more resources are used in the production of manufactures, while production of importables (primary goods) drops. In the production side, more capital accumulation leads to an ultra-pro-trade-biased effect because as less import substitutes are produced, then the demand for imports increases. For country B, this situation implies that its terms of trade deteriorate. This is the specific case of the Rybczynski theorem (1955); which analyses the effects of increments in capital stock and labour (ceteris paribus) on production, consumption and the terms of trade. The theorem states that:

> ñ*the maintenance of the same rates of substitution in production, after the quantity of one factor has increased, must lead to an absolute expansion in production of the commodity using relatively much of that factor, and to an*

absolute curtailment of production of the commodity using relatively little of the same factor" (pag. 74)

Rybczynski stated that ñan increase in the quantity of one factor would always lead to a worsening in the terms of trade -relative price- of the commodity using intensively that factorò. From the theorem it can be deduced that when the capital stock augments, the production of the good relatively intensive in capital increases. Although the other good production at the original relative commodities and factor price falls, the PPF will shift out; most of this change occurs along the axis of the capital intensive good. Hence, the new equilibrium takes place where the PPF is tangent to the world prices, which remain constant. The deterioration of the terms of trade happens because the increment in export supply is large enough in relation to import supply.

In the specific case of Mexico, the Rybczynski theorem provides the foundations to understand how its terms of trade change when there is an expansion in capital accumulation, for instance due to foreign capital inflows. According to the postulates of the theorem, a source of foreign capital will increase the production of goods that are relatively capital intensive, in other words the production of importables. Being Mexico, relatively labour abundant, on the production side, it means that it can increase its production of import substitutes (manufactures) and reduce the production of labour intensive goods. In the rest of the world, this shift creates an anti-biased trade because it reduces Mexicoôs demand of importables, while its supply of exportables remains constant. In other words Mexicoôs terms of trade are expected to improve. On the consumption side, capital accumulation tends to improve population demand of manufactures, which induces higher import demand and thus creates a pro-trade biased effect.

The consequences of the Rybczynski theorem also apply to a developing country like Mexico when (instead of capital accumulation) its population grows while other things remain constant. In economic terms, this is translated to an increase in labour supply. Being labour abundant, the economic expansion due to population growth creates immiserising growth because it leads to higher production of exportables and higher demand for importables. This situation deteriorates its term of trade (*ceteris paribus*), while in the rest of the world it create an ultra pro-trade biased effect.

This theorem is relevant in the case of Mexico because as a developing country that is a recipient of FDI and labour abundant, it is important to analyse empirically the effect on its terms of trade when there is a rise in capital accumulation through FDI inflows or population growth. Although in this research, we are mainly interested on the effects of growth expansion due to FDI, it is relevant to notice that figures about income distribution and real wages show that the increasing levels of export production has not increased real living standards of the population in Mexico.

2.4.3 Effect of capital mobility and technology transfer on trade

In this section, capital mobility and the transmission of technical progress among countries is allowed. In regards to technological progress, country B improves its terms of trade if it transmits agriculture progress to country A. The reason is that it creates an ultra-pro-trade biased on the production side and pro-trade biased on the consumption side. In other words, countryôs A demand for imports (manufactures) increases because most of its resources are used in the production of exportables. On the contrary when country B transfers technological progress in manufactures to country A, its terms of trade deteriorate because it creates an ultra-anti-trade biased effect since it promotes expansion of manufactures in another country. As has been shown before, production of import substitutes makes a country self sufficient.

From the point of view of country B, diversification of country A due to the transmission of technological progress in manufactures does not improves country Bós terms of trade. In this framework, as country B is the only one who invests in technological knowledge, it seems that promoting specialisation in country A -through the transmission of agricultural progress- would be more beneficial than promoting diversification through the transmission of progress in manufactures. This theoretical framework is relevant for the analysis of technological transfer that occurs through FDI and its effect on the terms of trade of Mexico. Being Mexico a labour abundant country, we would expect that the transmission of progress to sectors that are capital intensive would improve the terms of trade since it would allow the production of import substitutes (manufactures) and therefore the reduction of importables (ceteris paribus).

Regarding capital mobility, economic expansion due to an increase of foreign capital in country A or B has the same effect as a rise in capital accumulation in one country and capital decumulation in the other. A rise of investment from country B to A represents an income transfer, as such the impact in consumption is to increase relatively more the demand for manufactures than for food. In this respect, the effect on international trade is pro-trade-biased. In the production side, it causes an ultra-anti-trade-biased due to rises in country Aós self sufficiency in the production of import-substitutes. Consequently, foreign investment in country A improves its terms of trade. On the other hand, capital decumulation in country B will reduce income per capita, consumers will reduce both their demand for manufactures and primary goods, however due to less capital accumulation, country Bós production of importables is higher. As a result, the demand for imports is lower, causing an ultra-anti-trade-biased effect.

2.5 Endogenous growth theory

Classical economists explained economic growth in terms of the expansion of production inputs such as labour, capital and land. In this sense, economic growth could only be achieved if any or all of the inputs increased. Solow (1957) drew attention to the fact that rises in output growth rates should also be attributed to technological change. However, in the production function, the only way to capture technological change was through the constant term A, which measures the exogenous effect on output growth. In the classical model, the assumption that changes in output could only be explained by labour and capital implied the existence of diminishing returns to capital. This means that at initial levels, capital per worker has higher returns and higher growth rates. As they move over time, those returns tend to decrease.

A new perspective on this matter highlighted the fact that the essential determinants of long run growth had to be endogenous. The propositions of the endogenous growth theory were developed first by modifying the classical production function where output depends only on capital and labour (K, L) and the residual (A). At the beginning, the origin of economic growth was explained by increasing returns to scale: production specialisation leads to increased growth which further leads to increased specialisation and thus growth. Contrary to the classical model where technical change is considered as exogenous, in the endogenous growth theory, growth is originated within a system where technology is the main explicative factor, which is the reason why it is endogenous. Kaldor and Mirrlees (1962) were one of the first to consider technological change as endogenous. Investment in technology was regarded as an important source for economic growth. For Arrow (1962), the learning coefficient (that represents the use of new technologies) was a function of cumulative investment; meaning that the learning function was not directly related to investment growth but to the level of knowledge accumulated by society. Following these ideas, Romer (1986) modelled economic growth driven by the accumulation of knowledge. His model revealed three characteristics: first, the cost of developing new knowledge comes with diminishing returns; second, investment in knowledge increases returns in marginal products and third, this kind of investment has a natural externality because it is a public good. The use of such knowledge in the production process leads to increasing returns due to spillovers created by public diffusion. In other words, while firms face constant returns to scale, the industry as a whole experiences increasing returns. Subsequently, Romer added two inputs to the production function: human capital and technology. Hence to promote growth, investment in new research and international trade should be pursued to enhance their effect on economic growth.

In an augmented production function ï to measure the impact of different kinds of investment- we have that production is a combination of L and K produced by nationals (K_d) and foreigners (K_w). *H* represents the overall stock of knowledge in the economy. Hence in the production function, output (y) is produced by the combination of these factors:

$$y = AK_d^{\beta} H^{1-\beta} \tag{2.13}$$

Where:

β is the output share of domestic physical capital. It is assumed that there are diminishing returns to domestic capital, $\beta<1$. *A* captures the efficiency of production.

The stock of knowledge (H) depends on domestic and foreign investment stocks:

$$H = (K_d K_w^{\alpha})^{\eta} \tag{2.14}$$

Where α and η are the marginal and inter-temporal elasticities of substitution between foreign and domestic capital stocks. Assuming that $\alpha>0$, if $\eta>0$ inter-temporal complementarity between foreign and domestic investment prevails and if $\eta<0$, then intertemporal substitution prevails.

Substituting (2.14) in (2.13) we have:

$$y = AK_d^{\beta+\eta(1-\beta)}K_w^{\alpha\eta(1-\beta)} \quad (2.15)$$

Applying logs and then differences to equation (2.15):

$$\Delta_y = \Delta_A + [\beta + \eta(1-\beta)]\Delta_d + [\alpha\eta(1-\beta)]\Delta_w \quad (2.16)$$

Where:

Δ_y = Growth rate of output

Δ_A = Total factor productivity growth rate

Δ_d, Δ_w = Growth rates of domestic and foreign capital stocks.

FDI is expected to affect the elasticity of output with respect to capital as much as knowledge and human capital change. A high estimate of the capital elasticity in growth equations like equation (2.15) could be attributed to the presence of FDI. Furthermore, FDI-related externalities would increase capital elasticity estimates by $\eta(1-\beta)$ if a complementary effect prevails ($\eta>0$) between domestic and foreign capital (De Mello, 1997).

Another exponent of the endogenous growth theory that proposed the existence of increasing returns to scale was Lucas (1988), who discussed the effects of learning by doing on human capital. He argued that -assuming investment in human capital- unit production costs will eventually decrease as experience is gained by the workers. This process takes place at two levels: at the internal level, because investment in human capital increases the individualôs productivity and at the external level, because workers with higher productivity interact with others for whom the only way to obtain new skills or more knowledge is through ñlearning by doingò.

Other exponents, Grossman and Helpman (1991), analysed the effects of exports expansion on economic growth. In the same fashion, they said that in the presence of differences in consumption and output, international spillovers of investment create the same effects as capital mobility. The intensity of spillovers created depends on the volume of international trade and foreign investment that occur between a nation and other countries. In this way, interactions with economic partners with higher levels of development will lead to convergence of output growth.

According to the endogenous growth theory, FDI and international trade play an important role in promoting higher levels of economic growth, especially in countries that do not have the technology and financial resources to enhance their own industrial base and labour force.

2.6 Determinants and characteristics of FDI in developing countries

In traditional growth models, FDI can affect the level of income but has no effect on the long run growth rate. In the new endogenous growth theory though, FDI can affect growth by generating increasing returns in production via externalities and productivity spillovers. In this way, investment in R&D is considered an input in the production function, so the higher the technological advance the higher is the effect on output growth. Foreign investment flows and imported goods are two important channels by which the stock of knowledge can increase.

According to existing literature, the characteristics and conditions prevailing in host countries determine the level of FDI flows and its effect on the economy (see Borensztein et al (1998) and De Mello (1997)). In general, the determinants of FDI vary according to economic development, human capital, absorptive capability, etc (Bende-Nabende, 1999). The higher the level of development, the higher FDI inflows will go to the host developing country. According to the World Investment Report (UNCTAD), in 2003 around 75% of total FDI to developing countries went to countries considered relatively more industrialised such as Hong Kong, China, Brazil, Mexico and Singapore. However, other successful experiences show that poorer countries can also attract FDI as long as they provide macroeconomic stability, a realistic exchange rate and institutional reforms (Moran, 2005). In both cases, the trade regime plays an important role in the decision that foreign investors make, some commercial policy work as an incentive or deterrent that may affect the returns to investment. For example, if trade protectionism exists, impeding free trade and home competition with the rest of the world, it acts as a deterrent for foreign investment. Constraints will probably decrease the profits of foreign investors, while a liberal regime will promote higher revenues. For example, multinational corporations usually establish twin plants in developing countries and maintain close links between them, by importing physical capital and inputs, or exporting the whole production to the mother plant. Trade barriers would eliminate any incentive to operate in the host countries. Ironically, it was common in developing countries to apply incongruent policies. On one side, FDI flows were desirable, while on the other side, regulations and restrictions imposed by the government represented a disincentive for foreign investors, such as minimum local content, equity requirements or explicit performance criteria. Nowadays, some authors maintain that positive technological effects of multinational corporations are likely to improve if the host country offers a competitive local industry which in some way ñstimulatesò foreign firms to remain in the leading position by increasing their technology transfer (Bromstrom and Kokko, 1996).

Another determinant of FDI, especially in developing countries, is the existence of economic policies designed to promote exports and facilitate the establishment of foreign firms. A government may apply fiscal incentives in the way of tax rebates, exemptions and financial facilities such as loans with favourable interest rates to transnational companies. Similarly, monetary policy may guarantee accessibility to foreign exchange and free capital movements because FDI responds negatively to balance of payments constraints (such as restrictions and access to foreign exchange). Although in the short run, inflation in the host country offers the possibility of reducing costs, in the long run what matters is if the countryôs macroeconomy guarantees returns to investment. Additionally, infrastructure that facilitates the access to inputs and world markets attracts more foreign flows. If some or all of these determinants are endogenous in the production function, then FDI is expected to affect growth by different channels and different intensities, for example:

- The impact of FDI on output growth depends on the degree of value added content and productivity spillovers. The total effect leads to increasing returns in domestic production.
- In a small open economy, FDI is an important source of human capital augmentation and technological change when it promotes the use of more advanced technology and enhances labour productivity.
- Foreign firmsô demand of local inputs leads to the creation of clusters where domestic firms respond to specifications of higher standards of production and organisational methods.

FDI in developing countries is not an automatic mechanism engendered by cheap labour or trade reforms. Besides the determinants mentioned above, foreign plants will seek countries that offer not only basic infrastructure but also minimum levels of human capital. Borensztein et al. (1995) found that in order for FDI to obtain returns to investment and higher productivity levels, transactions required ña minimum threshold stock of human capitalò. At the same time, a developing country could only perceive benefits from foreign plants if its development level allows technological absorption and the creation of local production networks. For FDI to enhance output growth and for countries to get the highest advantage from it, there must be a minimum technological absorption capacity and economic development in the host country.

Although, theory usually predicts a positive relationship between FDI and domestic investment, it is necessary to consider that the effect of FDI can either be complementary or substitutive. The complementary effect is achieved by the positive externalities on domestic investment when there is a dependency relation based on intermediate inputs supply and by technological transfer that provides domestic investment with higher levels of efficiency. A complementary relationship tends to be more plausible in developing countries with an intense reaction (Borensztein et al. 1995). On the other hand, the substitution effect of FDI is a crowding out effect that occurs when domestic investment has to compete with it for physical, financial resources and product markets. It is more likely that the substitution effect occurs in developed countries where there is greater similarity between firms that compete in the same industries and markets. The degree of complementarity or substitution between domestic and foreign investment will affect positively (in the first case) or negatively (in the second case) the output level. In theoretical models, the parameters α and η of the stock of human capital function, $H = (K_d K_w^{\alpha})^{\eta}$, will measure this effect.

2.7 Policies of economic development

The purpose of economic development is to use natural and human resources to reach the highest level of output growth and improve the quality of life of the population[5]. Over time, income per capita or GDP per head growth is a typical measure of national living standards. The development policies recognise that there is a close relationship between trade and growth. In order to improve the living conditions and achieve national targets, nations implement development policies that make use of instruments of fiscal, monetary and trade policies. In terms of commercial policy, nations can protect or liberalise the economy to improve economic growth, but when applied incorrectly they create distortions because the market is not allowed to operate freely. In this section, we briefly analyse two opposite development policies that were applied in developing countries in the last century: a protectionist policy known as the *Import Substitution Industrialisation* (ISI) and policies known as outward oriented policies.

2.7.1 Inward-oriented policies: the Import-Substitution Industrialisation (ISI)

In this section, we consider the development policies that were applied in Latin-American countries which are not radically different from other experiences, but have some specific characteristics. The theoretical ideas behind protectionism are based on a Marxist interpretation that capitalism would eventually spread to the less-industrialised countries. In this context, to the Dependency Schoolôs ideologues, the spread of capitalism would represent a constraint for economic development because capitalists would expropriate much of the surplus created in those countries to their own countries. For that reason, they hypothesized that income differentials between rich (centre) and poor (periphery) countries would diverge rather than converge.

Specialisation in the production of primary and luxury goods and the transfer of surplus by foreign firms would only worsen the terms of trade in developing countries. The international division of labour would keep the labour intensive countries in a permanent state of specialisation in primary goods. Foreign investment -from rich countries- was not seen as a source of positive externalities because such capital is attracted by high profits generated by the intensive use of cheap labour. It was assumed that most of the profits earned in the periphery would be transferred to the centre to the detriment of host countries.

Conditions prevailing after the First World War and the fall in international prices of primary good made developing countries sceptical of opening their economies. Nearly all developing countries concentrated their human and natural resources in few primary sectors: agriculture, petroleum and basic manufactures such as textiles. However this made them vulnerable to the long term downward trend in prices. The solution suggested, especially by Raul Prebisch (1959) and Hans Singer (1950), to the vicious circle of underdevelopment and dependency, was the implementation of a development strategy that could allow industrialisation and avoid the deterioration of the terms of trade. In practice, the policy of economic development implied measures to protect the domestic industry from foreign competition. The first measures were import restrictions[6] and an active government intervention in the economy to guarantee the achievement of national goals. Originally barriers to trade were intended to decrease gradually as the infant industry developed; however that did not happen. In Latin America, most of the countries embraced protectionist ideas supported by the United Nations Economic Commission for Latin America, an institution that provided cohesion to governmentsô policies.

[5] This means to increase the level of consumption, public services, the access to education, health services, etc.

[6] This was achieved through the application of high tariffs and non-tariff barriers to goods that would be produced domestically.

The empirical evidence shows that the predictions of the dependency scholars about the transfer of surplus from the poor to the rich countries, through the deterioration of the terms of trade and capital repatriation did not occur. For example, in the period 1952-1970, the terms of trade improved 14% for manufactures goods in low income countries and only 12% in high income countries. Michaely (cited by Balassa, 1989) found that low income countries improved by 19% the terms of trade for all exports; while high income countries experienced a deterioration of 15%.

The prediction about the extraction of surplus by foreign investors did not happen. On the contrary, in the period 1950-1984, US foreign investment in Latin American countries fell from 41% to 12%. In relation to the transfer of surplus, in the period 1983-1984, the USA reinvested 41% of the profits in those countries (Balassa, 1989). Although the ISI did not work in isolation from government intervention, the results seem to contradict the view that the spread of capitalism would be detrimental to the less developed countries. Recent evidence shows that economic growth in developed and developing countries is converging due to economic liberalisation. According to Dollar and Kraay (2000), in the decades of the 1980s and 1990s GDP growth in rich countries went down from 2.3% to 2.2%. On the other hand, ñpost-globalizersò[7] countries increased their GDP growth rates from 3.5% to 5% in the same period.

From 1973 to 1983, developing countries experienced two external shocks; the first was caused by the increase in oil prices and the subsequent economic recession in the world. As a consequent, higher interest rates created higher debt costs for these countries. In the second world shock, at the beginning of the 1980s, the oil price rose to 34 dollars per barrel, leading to a debt crisis in most developing countries including Mexico. Policy responses

[7] Developing countries classified according to tariff reductions after 1980. The tariff reduction was on average of 22 percentage points.

varied, but most nations redesigned their development strategies. Two were the reasons: the vulnerability of protectionism to sustain growth and the renegotiation of the external debt with international creditors (IMF and World Bank) who required the application of outward oriented policies.

2.7.2 Outward oriented policies: export-led growth

In the 1980s, many developing countries experienced radical transformations in their development policies from inward to outward oriented policies. In general terms, the outward strategy has its foundation in trade liberalisation and the reduction of government intervention in the economy. A more liberalised economy is expected to lead to better resource allocation, to greater capacity utilisation, to economies of scale, technological innovation and to higher labour productivity. In this way, economic policies ï fiscal, monetary and trade policies- are designed to achieve outward orientation objectives that promote free movement of capital and commodities. Among the most important measures taken in countries that adopted this strategy were:

- The opening of the domestic market to diminish the difference between domestic and world prices.
- The maintenance of a realistic exchange rate.
- The restriction of government intervention in the economy, especially in goods production and factor markets.
- The support of export activities through the improvement of the infrastructure and administrative facilities.

The specific effort to promote exports and achieve higher growth rates is known as an Export-Led Growth (ELG) strategy. A summary of the ELG hypotheses are:

1. International trade encourages an efficient factor resource allocation in the economy, according to comparative advantages.
2. Exports are the mechanism by which output growth rates can be higher in the long-run.
3. The rate of export growth will cause productivity gains due to economies of scale and specialisation.
4. The export sector may generate positive spillovers ï or linkage effects- to the non export sectors through technological transfers, productivity increases, technology adoption and suppliers demand.

At the same time, foreign investment is another potential source of growth. Some of the hypotheses are:

5. FDI flows enlarge the stock of domestic knowledge through technology transfers, learning by doing techniques and physical equipment. A higher level of technological stock is expected to affect output growth.
6. In a small open economy, FDI is an important source of human capital augmentation and technological change. Foreign firms promote the use of more advanced technologies and enhance productivity by labour training and skill labour acquisition.

Whether exports and FDI affect positively all these variables or not, has to be demonstrated empirically. The relationship between exports, FDI and growth is influenced and determined by variables surrounding them, such as exchange rates, economic policies, imports, income, relative prices, etc. This means that any analysis of the different relationships requires the inclusion of some variables that are affecting directly and indirectly the main endogenous variables.

2.8 Conclusions

The postulates of the H-O model, the Stolper-Samuelson and Rybczynski theorems can be used to test empirically their postulates in the analysis of the links between international trade and FDI and economic growth in the case of Mexico. For example, in an economy with no distortions, the Heckscher-Ohlin theory of comparative advantage predicts that free trade enhances the efficient allocation of production factors on the economy, reaching a higher equilibrium level of economic welfare than in autarky. The gains from trade come from the specialisation in the production of goods where the country has comparative advantage and from the concomitant gains in consumption. Both gains have a dynamic effect of increasing output growth in the long run, *ceteris paribus*. Additionally, the Stolper-Samuelson theorem provides the foundation to analyse how protectionism affects domestic prices of import competing goods which reallocate resources in the economy and therefore alter factor prices. These theoretical models allow testing hypothesis in the case of Mexico regarding whether or not free trade has improved the resource allocation in the production of comparative advantage goods and led to higher growth rates.

In the case of FDI, this can be approached by the postulates of the Rybczynski theorem regarding the effects of capital accumulation due to FDI inflows. It is expected that capital flows to a developing economy such as Mexico will intensify the production of capital intensive goods that compete with import goods. Other things constant this situation will improve the countryôs terms of trade, since its demand for imports will tend to decrease, thus becoming more self sufficient. The endogenous growth theory also provides the theoretical analysis to consider the role of technological investment, innovation and human capital as endogenous variables in a production function and then determine how they can affect economic growth. In this study, it is presumed that international trade and foreign capital stock speed-up output growth. Both are considered as the main channels by which diffusion, technological adaptation and human capital improvement occur.

The specific development policy to achieve higher rates of growth involves the promotion of export production and foreign investment. However, it also implies the application of economic policies that can ensure macroeconomic stability. A review of some empirical studies in the following chapter shows that there is not a unanimous position in this matter. Much of the difference between theory and reality lies in the fact that the outcomes that theory predicts assume most of the time the existence of no distortions and no market failures.

CHAPTER 3. A SURVEY ON METHODOLOGICAL APPROACHES TO ANALYSE THE RELATIONSHIP BETWEEN LIBERALISATION AND ECONOMIC GROWTH.

3.1 Introduction

Studies supporting trade reforms and FDI as the main mechanisms to increase economic development have been subjected to criticism on the measurement methods utilised so far. The question that guides some of these studies is whether or not international trade is an explicative factor of economic growth. The purpose of this chapter is to scrutinise the results of some empirical research on this topic and discuss the econometric methods applied in investigations about the link between trade and growth and FDI and growth.

Some authors are sceptical about the benefits of economic liberalisation. According to Rodrik (1999), the world output growth has been declining over the last years, in specific since trade liberalisation took place in the 1980s. For example, during the period 1980 to 1989, it was 3.1%, while from 1990 to 1996 the average annual rate was 1.8%. Both periods contrast with the average rates experienced by many protected economies in the years 1965 to 1980, which was 4.1%. Rodrik suggests that the ISI was actually a successful policy and its negative consequences have been exaggerated. Rodriguez & Rodrik (1999) scrutinised five empirical studies and the results showed that indicators of openness and trade policy either had measurement errors or were correlated with other economic sources. In fact, they doubt that "there is a strong negative relationship in the data between trade barriers and economic growth, at least for levels of trade restrictions observed in practice" (pag. 38).

Some others doubt about the empirical results that support a positive link between openness and growth. For Srinivasan & Bhagwati (1999) the main problem of cross-country studies lies on "their weak theoretical foundation, poor quality of their data base and inappropriate econometric methodologies" (p. 32). At the moment there is no a general measurement of openness or trade policy, therefore in many cases, the results might depend on the proxies and indicators used to identify liberalisation (Edwards, 1993).

In extreme cases, radical opponents to free trade –or globalisation- believe that if trade liberalisation is applied globally, then countries adopting the same strategy will lead to a situation of "beggar-thy-neighbour" (Palley, 2000). In other words, export increase in one country represents import increase in another, so if all countries export at the same time, there will be an effect of crowing out that will take some countries out of the world market. This extraordinary outcome may never occur because the conditions under which this is true are also extraordinary.

The structural change -from protectionism to openness- that many countries experienced in the 1980s -in some way- triggered a high academic interest in this topic. Many of these studies focused on determining whether or not trade reforms have improved output growth in developing countries. In the last decade, new econometric techniques as well as different theoretical approaches have been used in order to get a better understanding of how liberalisation affects the economy.

Section 3.2, contains a brief survey of the methodologies applied by different authors to study the link between exports and economic growth. Section 3.3 contains a survey on studies that have investigated how FDI impacts on the economy and also contains studies that identify some of the determinants of FDI, with special emphasis in Mexico. Finally, Section 3.4 contains some conclusions.

3.2. Exports and GDP, a survey on cross-country and case studies.

The following review is divided in two types of studies: cross-country analysis (that made an intensive use of cross section data) and case studies (with intensive use of time series).

In the last fifteen years, empirical research has favoured the application of time series over cross-section analysis. Changes in the methodological approach were introduced as a way to reduce the shortcomings of cross-section studies. For example, now it is common to test the causality relationship between exports and GDP instead of assuming that the relationship goes directly from exports to output. Another important addition is the frequent inclusion of alternative channels by which openness may affect output growth. For example, more variables have been included in the models, such as technological investment, human capital and externalities associated with foreign capital flows.

3.2.1. Cross-country studies about the link between exports and output growth

The main characteristics of cross-country regressions are basically three: first, most of the regressions usually find positive and significant effects from exports (or any other proxy of liberalisation) to output growth (or GDP). Second, the estimations tend to generalise the results to individual cases, the reason is that the estimated coefficients are considered constant across countries in the sample. And third, depending on the variables definition and the data set (cross-section or time series) results change within the same sample. For example, cross-section regressions have a tendency to support the existence of a positive impact of trade liberalisation on output growth (Ram, 1987). Table 3.1 contains a summary of some of the most representative studies that have investigated the economic relationship and effect of trade liberalisation on the economy. In this table, we briefly present the questions that were addressed, the data set, sample size, the econometric technique and the main findings.

Balassa (1978) was among the first economists to analyse the effects between openness and protectionism on growth in eleven developing countries. He applied Spearman rank correlations to test the hypothesis that outward-oriented policies had done better than

Table 3.1 Summary of studies about the relationship between exports and output growth

Author (year)	Question/Hypothesis	Data Analysis	Countries	Period	Econometric method	Findings
Balassa (1978)	Do export oriented policies lead to better output growth performance?.	Cross Section	11 (including Mexico)	1960-1966 and 1966-1973	Spearman rank correlation and OLS	There was high correlation between exports share and GNP growth, equal to 0.703 for the entire period. The correlation coefficient between exports growth and output growth was 0.888 for the whole sample. The addition of an export variable in the regression increased the coefficient of determination from 0.58 to 0.77. Capital-output ratios increased rapidly in countries with export orientation.
Feder (1982)	Are the marginal factor productivities equal in the export and non-export sectors?	Cross Section	31 (including Mexico)	1964-1984	OLS, Augmented Production Function	The results support the hypothesis that marginal factor productivities in the export sector are higher than in the non-export sector. Investment in the export sector showed higher social marginal productivity effects than investment in the non-export sector.
Ram (1987)	Do exports affect output growth?, what is the mechanism by which exports may influence the rate of economic growth?	Panel Data	88 (including Mexico)	1960-1972 & 1973-1982	OLS, Augmented Production Function	Results differ according to the data analysis but not regarding to the model specification. Using time series, exports coefficient is statistically significant in 70% of the sample. In countries with middle income, statistical significance was found in 80% of them. In low income countries, the model fits for 50% of them. On the other hand, with cross section data, in 61 countries (69% of the sample), the exports coefficient was statistically significant. Cross section analysis was better in countries for which time series F- statistics were not significant (i.e. low income countries).

Table 3.1 Cont.

Author (year)	Question/Hypothesis	Data analysis	Countries	Period	Econometric method	Findings
Sprout & Weaver (1993)	What is the relationship between exports, domestic investment and economic growth?	Cross Section	72 (including Mexico)	1970-1984	Simultaneous equations system	It was found that only in small non-primary exports countries and in large countries, exports affected output growth. Changes in output growth depend primarily on labour. Only among small non-primary export countries investment contributes to output growth; and only in large countries, output growth affects exports growth.
Dollar & Kraay (2001)	Can changes in decadal average growth rates be explained by changes in trade volumes?, Have post-1980 globalizers countries grown faster and reduced poverty over the past 20 years?	Cross section	73 (including Mexico)	Decades 1970-1980 and 1980-1990	OLS, Correlation and Gini Coefficient	They found a positive effect of trade volumes on income growth for the whole sample. Evidence suggests that open trade regimes lead to faster growth and poverty reduction. Positive correlation between trade volume and government consumption increased in both decades. In only 9 out of 23 globalisers countries, the Gini coefficient decreased (inequality).
Marin (1992)	Is there a causal link between exports and productivity?	Time Series	4	1960-1987	Cointegration and VAR	The F-test suggests that exports do Granger cause productivity. However, the quantitative impact of exports on productivity was negligible.
Hernandez (1993)	Are the effects of trade liberalisation on output growth permanent or transitory?	Time Series	Mexico	1980-1992	Box-Jenkins univariate model	Evidence suggests that trade liberalisation did not have any permanent effect on output growth rates. Output increments in 1989 and 1990 were temporary and were explained by capacity utilisation.
Sharma & Dhakal (1994)	What is the direct and indirect causal relationship between export and output growth? what is the effect of world output and exchange rate on exports and output growth?	Time Series	30 (including Mexico)	1960-1988	Granger Causality Tests	In eleven out of thirty countries, exports did prima facie cause output growth. In just five countries, there was a feedback causal relationship between exports and output. In eight countries, the exchange rate did prima facie cause output growth indirectly through exports. They also found in seven countries, world output indirectly did cause output growth through exports.

Table 3.1 Cont.

Author (year)	Question/Hypothesis	Data analysis	Countries	Period	Econometric method	Findings
Iscan (1997)	Do exports enhance capital accumulation and productivity growth?	Time Series	Mexico	1970-1990	Granger Causality Test and VAR	No evidence was found that exports lead to capital accumulation or that exports lead to higher labour productivity growth. Although, positive correlations among the variables were found.
Ghatak, Milner & Utkulu (1997)	Is the ELG hypothesis valid to explain the relationship between exports and output growth?. What kind of exports (manufactures, fuel and non-fuel primary goods) is the driving force of the ELG model?	Time Series	Malasya	1955-1990	Cointegration and causality tests	Real export growth does Granger cause real GDP growth and non-export real GDP. Results of the production function model support long run relationships, i.e. cointegration exists among the variables involved. In both equations, manufacturing exports were the most significant explanatory variable together with physical capital.
Palley (2000)	Is there a crowding out effect among countries that export to the USA?	Time series	7 (including Mexico)	1978-1999	OLS	He found a significant crowing out effect inter-country. Exports to the USA from the four tigers are subject to a large crowding out effect from China. Japanese exports to the US have experienced a large crowding out effect from Mexican exports. These results reveal a potential zero sum nature of the export led growth model when applied on a global basis.
Cuadros, Orts & Alguacil (2000)	Is the ELG hypothesis valid to explain output performance?, what is the nature and source of the causal relationship between FDI, exports and output?	Time Series	4 (including Mexico)	1975-1997	VAR and Granger Causality Test	In general, the results do not support the ELG hypothesis. However, only in Mexico they found a short run relationship going from exports to output and a short run and positive long run causal relationship from FDI to output. Evidence seems to confirm a complementary relationship between FDI and exports. Besides, there is a short-run Granger causality between FDI and exports in Mexico and Brazil. No clear evidence of ELG though.

Table 3.1 Cont.

Author (year)	Question/Hypothesis	Data Analysis	Countries	Period	Econometric method	Findings
Cuadros (2000)	What is the causal relationship between openness and economic growth?	Time Series	Mexico	1983-1997	Granger Causality Test	The tests showed that there is no Granger causality relation between exports and output growth. However, there was a causal relationship between imports and output growth, which suggests that openness has stimulated output growth through imports.
Richards (2001)	Is the ELG model valid to explain economic growth in Paraguay?	Time Series	Paraguay	1966-1996	Granger test Simultaneous equation model.	Results fail to confirm the applicability of an ELG model in Paraguay. Export's share is directly related to economic growth, land and labour force growth. In two out of three models, he detected a positive relationship running from exports to national product but the F-test failed to reject the null. In two out of three models he found a negative and significant relationship running from output growth to economic openness.
Medina-Smith (2001)	Does the ELG hypothesis explain output growth in Costa Rica?, is there a long-run relationship between exports and output?	Time Series	Costa Rica	1950-1997	Augmented Production Function and Cointegration	The ELG hypothesis is accepted, but no evidence was found to indicate that there is a long run relationship between exports and output growth.
Fragoso (2003)	What is the effect of trade liberalisation on total factor productivity in the manufacturing sector?, What is the effect of FDI, labour and technological investment?	Cross Section	Mexico	1980-1998	OLS	Net exports had a positive significant effect on TFP in the manufacturing sector. An increment of 1% on openness caused an increase of 0.25% in TFP. The coefficient of technological investment was statistically significant too. However, neither FDI nor labour were statistically significant.

inward-oriented policies in countries with an industrial base. He expected that different rates of exports would be associated with differences in trade policies. Indeed, the results showed high correlation between exports growth and growth of GNP, 0.888 for the whole sample. But the coefficient in the manufacturing sector was lower, 0.709. Furthermore, when an export variable was added to the production function, the R^2 increased from 0.58 to 0.77. The results led Balassa to conclude that trade orientation was an important factor in determining the performance of growth rates in countries that had liberalised their economies. It provided support for policy makers that wanted to introduce changes in the economies that still remained under protectionism.

In an attempt to demonstrate by which channels this effect had taken place, Feder (1982) estimated an augmented production function to identify the effects of the export sector and the non-export sector on GDP's growth rate. He tested the hypothesis that marginal factor productivities were higher in the export sector and the hypothesis that exports had generated positive externalities on the economy. Feder incorporated exports in a classical production function:

$$N = f(K_n, L_n, X) \tag{3.1}$$

N is a production function for the non-export sector, K and L are capital and labour and X is a production function for the export sector explained as:

$$X = f(K_x, L_x) \tag{3.2}$$

Therefore, output is equal to the sum of both sectors' output: $Y = N + X$. Gross investment (I) was used as a proxy for capital. Feder assumed that there was a linear relationship between the real marginal productivity of labour and average output per labourer in the economy.

Thus the source of GDP growth were separated into two components, the contribution of factor accumulation (growth of capital and labour) and the gains related to changes from a low productivity sector to a high productivity sector. Using cross section data, Feder found that for 31 semi-industrialised countries, the marginal factor productivities were higher in the export sector than in the non-export sector. These results provided evidence that investment should be directed to sectors with the strongest positive effects on GDP growth rates, i.e. the export-oriented sectors. Later Richards (2001) found that it is not sufficient to stimulate all economic sectors in a developing country unless these are from the secondary and terciary sectors such as manufactures and services. Contrary to primary goods, these sectors are less vulnerable to international price fluctuations, require more skilled labour and high levels of technology.

Another important characteristic of cross-country regressions is the fact than depending on the type of data (cross section vs. times series) and variables considered, the statistical significance of the coefficients can differ within the same sample. For example, Ram (1987) built two models based on Feder's augmented production function that included exports as an extra input. He regressed one model with time series and another with cross-section data for 88 developing countries (according to their income levels). Results were not robust. For example, with time series, Ram found that the export coefficient was positive and statistically significant in the majority of countries with middle income level (61% of the sample) but only in half of the sample of countries with low income (50%). On the other hand, with cross section data, results improved for countries for which F-statistics were not previously significant. In other words, exports impact for both models improved with cross-section analysis (it did for 61 countries approximately).

In an attempt to improve the definition of the variables and the methodology applied by the cross section regressions, Sprout and Weaver (1993) tried a different methodological approach. They built a simultaneous equation model with three endogenous variables: growth of real gross national product (*DGNP*), growth of gross domestic investment (*GDI*) and growth of exports (*D*), but in this case, they used two measures of exports: growth of real exports (*D 1*) and growth of exports as a share of GDP (*D 2* .

$$
\begin{aligned}
&DGNP = a_1 + a_2 GDI + a_3 DLABOR + a_4 D \\
&GDI = b_1 + b_2 GDPPC + b_3 DGNPPC + b_4 \quad SHARE + b_5 KI \qquad (3.3) \\
&D \quad = c_1 + c_2 DGNP + c_3 PRICE + c_4 TPGROWTH + c_5 TPCON + c_6 TSCOMP
\end{aligned}
$$

Other variables included *DLABOR,* growth of labour; *GDPPC,* real GDP per capita; *SHARE,* exports as a share of *GDP KI,* capital inflow as a share of GDP; *PRICE,* price competitiveness; *TPGROWTH,* trade partner's growth; *TPCON,* trade partner concentration and *TSCOMP,* trade structure composite.

The estimation of the model was applied according to the size of the countries and the exported good. Estimations showed that only in small countries that exported non-primary goods and in large countries the exports coefficient (*D 1*) was positive and statistically significant (in 43 out of 72 countries). This seemed to support the thesis that exports diversification is an important element to improve GNP. However, when the variable exports share was used (*D 2*) only large countries obtained statistically significant coefficients (24). Regarding the rest of the endogenous variables' determinants, the coefficients showed better results when *D 1* was used and within the group of large and small countries than in countries with non-primary exports. Labour growth was the only statistically significant variable in the GDP equation for the whole sample.

Dollar & Kraay (2001) tried to find evidence to support the claim that developing countries that liberalised their economies in the 1980s (they called them "Post-1980 globalizers") achieved higher output growth rates and lower income inequality. Economic indicators showed that in the 1990s, the GDP of the post-globalizers grew on average 5% per capita per year, while rich countries grew on average at 2% and non-globalizers at 1.4% per year. In order to prove that most of this increment was a direct consequence of outward-oriented policies, they regressed trade volumes (a proxy for trade policy) on income, and some control variables such as FDI, investment, government consumption (all of them as a share of GDP), inflation, contract-intensive money and a dummy variable for Revolutions. The equation estimated was:

$$y_{ct} = \beta_0 + \beta_1 y_{c,t-k} + \beta_2' \quad {}_{ct} + \eta_c + \gamma_t + \nu_{ct} \qquad (3.4)$$

Where: y_{ct} is the log-level of GDP per capita in country c at time t, k =lags (k=10), ${}_{ct}$ is a set of control variables measure as decadal averages, η_c is a disturbance term, γ_t is an unobserved period effect and ν_{ct} a component that varies across countries and years.

They regressed income on trade volume and then incorporated other independent variables. Estimations showed that only trade volume and FDI as a share of GDP were positive and statistically significant at the 1% level of significance. None of the other variables showed statistical significance. On the other hand, empirical evidence showed no correlation between globalisation and poverty or inequality, for example in a simple regression between changes in inequality (using a Gini coefficient) as the dependant variable and changes in trade volumes as independent variables, the coefficient was negative but statistical insignificant (-0.039). In addition, in 4 out of 29 post-1980 globalizers countries, the Gini coefficient increased in over a period of 20 years (in the 1980s and 1990s). However, the authors concluded that there was no good evidence that globalizers had on average increased income inequality. Later, Rodrik (2000) challenged these findings by pointing out the inadequacy of using trade volume as a proxy for trade policy because policy makers cannot control trade flows *per se*. Furthermore, according to Rodrik, both trade and income are really endogenous variables.

Therefore, it is not only the premise that outward policies increase output growth has been questioned but also the methodology used to measure such potential relationship. At a great extent, the inconclusive results of the multi-country analyses are believed to be the result of model misspecification, the diversity of trade liberalisation indices and the lack of dynamics models that consider the short and medium run effects (Greenaway et al., 2002). In an evaluation of the empirical evidence provided by some studies, Edwards (1993) concluded that in general the most common limitations of the cross-country regressions are of two kind: the problem in calculating adequate indices of trade orientation to isolate its effects from other factors and the inability to provide a theoretical framework that explains the link between trade policy and economic growth. Both limitations seem a problem that many economics have not overcome and which diminish the reliability of such results. Srinivasan and Bhagwati (1999) assert that the cross-country regressions are not a reliable vehicle to support the conclusion that there is a positive relationship between trade and growth. They provide almost the same reasons as Edwards; the weak theoretical foundation, the poor quality of the data and the misspecification of econometric methodologies.

In an effort to scrutinise the robustness of the evidence provided by these multi country studies, Rodriguez & Rodrik (1999) found that five influential cross-country studies could not be taken as reliable proof that free trade policies were significantly associated with economic growth. Basically, the most important problem they found is that indicators of trade policy were not only misrepresented but also highly correlated with other variables. Levine & Renelt (1992) tested the robustness of coefficients of some cross-country regressions and found that very few economic variables were robust to small changes in the right-hand side variables[8]. The only robust correlations were between output growth and the share of investment in GDP and between investment share and the ratio of international trade to GDP.

The shortcomings of cross-country regressions (the oversimplification of the results) were one of the reasons that led some researchers to consider countries' cases and to introduce different econometric techniques to capture the effect of trade through different channels. Rodrik (1999) holds that "openness by itself is not a reliable mechanism to generate sustained economic growth", instead endogenous variables (such as competitiveness, human capital, domestic investment) and the austerity in the macroeconomic policy may have a higher impact on economic performance.

3.2.2. Case studies and time series analysis

The contributions of an approach based on case studies are four. First, the classical assumptions were reconsidered; i.e. that a positive causal relationship only goes from exports to output. Second, the validity of the paradigm that exports were the engine of growth was put into question. The generalisation of coefficients across countries implied that the achievement of trade policy was overestimated. Third, the export variable was not taken as the sole indicator of openness and economic liberalisation; instead variables such as foreign direct investment were included in the analysis as another source of output growth. Similarly, the inclusion of FDI introduced new channels by which economic liberalisation could affect output growth. Among the most important were labour and total factor productivity,

[8] The study also found that fiscal, monetary and political policies were not robustly correlated with growth.

technology investment, human capital and FDI spillovers. And finally, these changes in the theoretical approach made it necessary to use different econometric techniques and data sets.

During the 1990s and onwards, there has been a proliferation of different econometric methods. Those include Granger causality tests, simultaneous equation models and cointegration. For example, some studies do not assume that the causal effect only goes from exports to output growth but assume a feedback relationship between those variables. In this respect, Sharma & Dhakal (1994) applied a variation of the classical Granger causality test introduced by Granger in 1969, the purpose was to measure direct and indirect effects between exports, growth, exchange rate and world output in 30 developing countries (from 1960 to 1988). They found that exports did Granger cause output in 11 countries, output Granger caused exports in 13 countries and exchange rate did Granger cause exports in 15 countries. In the case of Mexico, they found an indirect effect from exchange rate to output through exports as well as an indirect effect of world output on domestic output through exports. These results do not seem to support a general effect of exports on growth but an interrelationship between these two variables.

Cuadros (2000) applied Granger causality test to determine if there was a causal relationship between different measurements of exports and net GDP (GDP without exports) in the case of Mexico. The null hypothesis of no causality was not rejected, as no causal relationship was found between exports and net GDP. On the other hand, contrary to the expected, the only positive and statistically significant causal relationships were from imports growth to output growth and from growth of intermediate goods to output growth. Furthermore, there was a reverse relationship going from output growth to capital goods growth. These results suggest that liberalisation in Mexico affected positively economic growth by means of imports and capital goods.

Another characteristic of country case studies is to show that trade liberalisation is not an automatic mechanism that leads to achieve higher levels of economic growth and development. The reason is that the success of a trade policy or FDI promotion depends on the countries' natural and human resources and the sort of export market in existence. For example, in countries where primary goods are the main export good, it is unlikely that a positive influence of exports on the economy might be found. Richards (2001) tested the ELG hypothesis in Paraguay, a country that introduced liberalisation policies but whose main export good was a primary good (non-fuel product). He built a simultaneous equations model with three endogenous variables (growth of gross domestic product, growth of exports and the ratio of investment spending to GDP) and also applied Granger causality tests. The results failed to confirm the validity of the ELG model in Paraguay's economy. As it was expected by the author, for an economy that relies on agriculture and export of primary goods, the estimations showed that two of the explicative variables, labour and land, were statistically significant.

On the other hand, a capital-intensive export sector will create higher externalities for the rest of the economy, the reason is that an industry that depends on technology, capital and skilled labour tends to generate higher levels of value-added. Furthermore, the high dynamic effects and spillovers of these industries can have an important influence on the non-export sectors.

Ghatak et al. (1997) tried to differentiate the effects of exports and other non export sectors. They applied cointegration and causality tests to analyse the Malaysian economy. Two production functions (one for the non-export and another for the export sector) were estimated with different categories of export goods (manufactures, fuel and primary goods). They estimated the following equations:

$$L\ \ _t = \alpha_0 + \alpha_1 LK_t + \alpha_2 LH_t + \alpha_3 L\ \ m_t + \alpha_4 L\ \ f_t + \alpha_5 L\ \ p_t + \mu_t \quad (3.5)$$

$$LN\ \ _t = \lambda_0 + \lambda_1 LK_t + \lambda_2 LH_t + \lambda_3 L\ \ m_t + \lambda_4 L\ \ f_t + \lambda_5 L\ \ p_t + \mu_t^{'} \quad (3.6)$$

Where LY and LNY are the natural logarithms of real GDP and non-export real GDP, LK and LH are natural logarithms of physical capital and human capital. LXm_t, LXf_t, LXp_t, are the natural logarithms of real exports of manufactures, fuel products and primary goods; μ is a disturbance term. Test for cointegration showed that there is a long run relationship between the variables. The estimations showed that only the coefficient of manufactures was statistically significant as explicative factor of output growth in both equations. Additionally, it was found that export growth did Granger cause real GDP growth, so the test proved that the causal relationship goes from exports to output. In summary, in an outward oriented policy, the stimulation of exports based on manufactures (and not in primary goods or crude oil) provides evidence of a positive effect on output growth.

Another approach in recent economic research is the inclusion of more than one variable to measure the effect of economic liberalisation. For instance, FDI is one of the most frequent explicative variables incorporated into the analyses. Cuadros et al. (2000) used a VAR and cointegration to test the hypothesis of the ELG model with FDI included as another determinant of GDP. The sample was integrated by three developing countries, Argentina, Mexico and Brazil. The regression country by country did not provide clear evidence of exports and FDI's significant effects on output growth, except in the case of Mexico. Granger causality test only found a short-run relationship going from exports to output in Mexico, the other two countries did not show causality links among the variables. The results of cointegration showed that only in Mexico and Argentina there was a long-run relationship among the variables. The relevance of this methodology is that it does not assume a causal relationship, it allows the system to determine in which direction one variable affects the other. It opens the possibility to examine if GDP and exports explain FDI flows or other variables that were initially assumed to be independent variables.

3.3 Foreign direct investment and output growth

For many years, the classical and neoclassical theory regarded production of goods mainly determined by the combination of capital and labour without any distinction about the origin of the capital or quality of labour. This situation has changed in recent times and now empirical studies show that the distinction between domestic and foreign capital and between skilled and unskilled labour matters.

In Table 3.2 we present a summary of some studies that have analysed how FDI might affect output growth directly and indirectly through its spillover effects. Additionally, it contains the research questions, data set, sample, econometric techniques and the main findings.

Contrary to the analysis of the ELG paradigm that provides no conclusive results, the empirical evidence tends to support the hypothesis that FDI flows have a strong influence on the economy. For example, Ramirez (2000) measured the influence of FDI flows on output growth and labour productivity in Mexico using a dynamic labour productivity function. The equation allowed distinguishing the effect of domestic and foreign investment on the rate of labour productivity growth and other control variables such as exports and government expenditure. The estimations of an ECM showed that exports, government expenditure and domestic private investment had a positive and significant effect on productivity while the

Table 3.2. Summary of studies about the relationship between FDI, output growth and productivity.

Author/year	Question/Hypothesis	Type of Data	Countries	Period	Econometric Method	Findings
Blomstrom (1986)	How does foreign investment affect the performance of domestic manufacturing industries?	Cross Section	Mexico	1970 and 1975	OLS	Foreign share in the manufacturing industry improves the structural efficiency of domestic industries in Mexico. The competitive pressure created by FDI is considered the most important source of spillover efficiency.
Aitken, Hanson and Harrison (1994)	How foreign plants that are export-oriented affect domestic firms?	Panel Data	Mexico	1986-1990	Logit specification	Foreign firms reduce the entry costs for potential local exporters (the sample contained 2113 manufacturing plants). This occurs because local firms benefit from learning by doing techniques and the buyer-supply networks created by foreign corporations. They found that the concentration of foreign export companies in a location raises the probability that a local plant exports.
Blomstrom, M., Kokko, A. and Zejan (1994)	What are the determinants of technology imports of foreign firms in Mexico?	Cross section	Mexico	1975	OLS	The analysis of 144 manufacturing industries showed that skilled labour, local competition and output growth were statistical significant determinants of technology imports done by foreign companies.
Borensztein et al. (1995)	What is the role of FDI in the process of technology diffusion and economic growth in developing countries? Does the inflow of foreign capital crowd-out domestic investment?	Cross Section	69	1970-1979 and 1980-1989	Endogenous growth model and SUR	The results suggest that FDI is a vehicle for the transmission of technology, contributing relatively more to growth than domestic investment. There is a strong complementary effect between FDI and human capital in the host country. There is a crowding in effect, which means that FDI favours the expansion of domestic firms.
Kim (1997)	What are the effects of NAFTA and FDI on the manufactures sub-sectors' total productivity?	Cross Section	Mexico	1984-1990	Parametric and Non parametric method	After NAFTA, manufacturing firms with foreign capital experienced a rise in productivity at a greater extent than domestic firms. However, foreign capital from countries outside NAFTA had a higher effect on productivity than those firms with capital from the USA and Canada.

Table 3.2 Cont.

Author (year)	Question/Hypothesis	Type of Data	Countries	Period	Econometric Method	Findings
Love and Lage-Hidalgo (2000)	What are the determinants of FDI from the US in Mexico? How domestic demand and relative differences in wages and capital costs affect FDI?	Time Series	Mexico	1967-1994	Cointegration	Statistical significance shows that domestic demand and the difference of relative wages between the US and Mexico are positive determinants of FDI. The negative sign of the coefficient of capital costs, indicate that FDI decreases as the US cost of capital rises relative to that of Mexico.
Chan (2000)	What is the role of FDI in explaining economic growth? What is the effect of fixed investment and export volume on output? Does FDI affects output growth through technology transfers, fixed investment and/or exports?	Time Series Panel data	Taiwan	1973-1994	Granger causality, Bivariate and multivariate models	There is a causal relationship from FDI, fixed investment and exports to economic growth. The hypothesis that FDI affects economic growth by inducing more investment and exports is not supported by the results. FDI promotes economic growth through technological improvement instead of capital accumulation and exports growth.
Kim and Hwang (2000)	Does FDI enhance efficiency and thus contribute to sustainable growth? What are the productivity spillover effects on the manufacturing sector?	Time Series and Cross section	Korea	1962-1998	OLS, Random effect model with instruments.	The coefficient of FDI growth rate was positive but statistically insignificant. The industry aggregated data did not show a positive effect of FDI on productivity.
Ramirez (2000)	Does FDI enhance economic growth and labour productivity in Mexico? Does the accumulated stock of FDI exert a positive and significant effect on economic growth and labour productivity?	Time Series	Mexico	1960-1995	Endogenous growth model and Cointegration	The effect of changes in private capital stock's growth rates on productivity is positive and statistically significant, while changes in employment growth have a negative impact on the growth rate of labour productivity. Foreign capital stock has a positive and significant effect on productivity when lagged 3, 4 and 5 periods. The exports coefficient had a positive and significant effect on labour productivity.

Table 3.2 Cont.

Author (year)	Question/Hypothesis	Type of Data	Countries	Period	Econometric Method	Findings
Zhang and Felmingham (2000)	What is the impact of FDI, exports, domestic investment and labour in China's regions?	Cross Section	China	1984-1998	OLS, Augmented Production Function	Evidence suggests that FDI and domestic investment have a positive effect on all the Chinese regions. Exports stimulate growth of all China except the Western region. Labour has a strong effect on regions with low intensive use of capital (for example the Western).

influence of FDI was positive and statistically significant only when it was lagged 3, 4 and 5 periods. A possible explanation of this result is that most of FDI in Mexico is characterised as high tech investment that requires a certain level of skilled labour to operate the production processes. Strangely, growth of labour had a negative coefficient that was statistically significant, meaning that labour productivity responded negatively to labour growth.

In another attempt to study the particularities of FDI, Chan (2000) analysed the role of FDI in Taiwan's output performance with Granger causality tests and bivariate and multivariate models. He distinguished two channels by which FDI could affect output: by increasing technology transfers and by inducing fixed investment and exports. Using information of the manufacturing sector only, both estimations supported the hypothesis of a causal relation between FDI and GDP. The effect was mainly through technology transfers by the operations of foreign plants in Taiwan. Fixed investment and exports also had a statistically significant effect on output growth. Sometimes, the existence of FDI does not guarantee positive effects on the domestic economy, not only in terms of GDP but also in terms of productivity and employment. In the case of Korea, Kim and Hwang (2000) analysed how FDI affects total factor productivity (TFP) by estimating a random-effect model with instruments. Even though the coefficient of FDI was statistically significant, it was considered as insufficient to support the hypothesis of a positive impact of influence of FDI on TFP. According to Kim and Hwang, the results are a consequence of the data aggregation that does not take into account the experience of individual firms.

Some have shown that the presence of multinational corporations that are export-oriented can induce positive externalities to local firms located close to these corporations. Aitken et al (1994) estimated a logit model using data from more than two thousand manufacturing plants in Mexico. They found that those local plants close to a concentration of multinational corporations improved their chance of exporting. The reason seemed to be the creation of foreign markets, distribution of information and services, etc. that tend to lower entry costs for potential exporters.

3.3.1. Studies about host country characteristics that determine FDI inflows

Most of the theoretical literature about the impact of FDI on developing countries agrees that foreign firms tend to create positive externalities when there is insufficient local investment or technology, as long as the country has locational and labour advantages. In this context, FDI not only represents increasing capital inflows but also a source of knowledge, technological transfer, managerial skills, new production processes and other qualitative resources that create spillovers to the domestic economy.

There are many elements that influence the success of some developing countries in attracting a specific sort of foreign investment. Generally speaking, FDI depends on the state of economic development of the host country and the existence of minimum conditions to operate efficiently, like human capital, physical infrastructure, macroeconomic stability and an economy relatively open to international trade (i.e. low or zero tariffs). These conditions seem to facilitate efficient operations by foreign plants and therefore are quicker at creating positive effects on output growth. Contrary to the traditional belief that abundant cheap labour was enough to guarantee high levels of FDI flows, such consideration does not seem to be a significant determinant for foreign corporations. Nowadays, positive externalities created in the economy by a firm that requires relatively skilled labour are higher than those created by firms that employ unskilled cheap labour.

The promotion of FDI (as well as exports) does not imply automatic and positive effects on the domestic economy. Some studies suggest that there must be favourable economic conditions to create positive externalities. FDI also requires the existence of certain conditions in the host country to operate and therefore affect the economy positively. In this sense, in the literature we also see an increasing interest to investigate and analyse the determinants of FDI in developing countries. These empirical studies provide valuable information that can be used to design economic policies that stimulate certain areas that are likely to improve FDI inflows. Some studies have found that minimum conditions are required to attract foreign capitals, for example economic stability, physical infrastructure, human capital, and favourable economic policies among the most important. For example, Borensztein et al. (1998) found, in a sample of 69 developing countries, that foreign firms contributed more to output growth -than domestic firms- in those countries that had a minimum stock of human capital. This is so because most multinational corporations concentrate in manufacturing industries, in intensive in capital sector and which production is usually for the international market. These characteristics are more likely to demand higher levels of skilled labour. Therefore, some FDI requires the existence of a labour force with minimum adaptation conditions and learning capability.

Spillovers from FDI in host countries can vary across countries and industries, but Bromstrom and Kokko (1996) maintain that the evidence suggests that positive technological effects of multinational corporations are likely to improve in the presence of competition and local capability. This suggests that multinational corporations react strongly (and therefore increase technological transfers) in the presence of domestic competition that forces them to maintain the leading the position. In a same fashion, Bromstrom et al. (1994) in the specific case of Mexico found that skilled labour, local competition and growth in the manufacturing industries were positive determinants of technology transfers by foreign plants. While Love and Lage-Hidalgo (2000) found that FDI from the US was positively determined by domestic demand and the differences in relative wages, this finding regarding relative wages supports the contention that cheap labour is still an important incentive to invest in Mexico.

The formation of a trade agreement area has been considered as conducing to improve foreign capital flows to developing countries. The empirical evidence suggests that there is an important link between FDI and trade liberalisation (Bende-Nabende, 1999). A country that belongs to a free trade area seems to offer more potential to increased profitability, since international integration lowers trade costs and increases market size. In this regard, foreign firms will tend to favour countries that belong to international trade areas because it reduces the risks associated with operating from a host country, it also offers higher rates of return and the certainty that trade tariffs will not increase. In a study of five Southeast Asian countries with different levels of development, Bende-Nabende et el. (2001) found that the formation of a preferential trade agreement had a positive lagged influence on FDI flows to the more developed countries and a negative influence on the flows to the less developed countries.

In the case of Mexico, trade agreements and FDI inflows seem to be closely related, especially since Mexico joined GATT in 1986 and NAFTA in 1994. For example, Blomstrom and Kokko (1997) assert that the Mexican accession to NAFTA in 1994 had a strong impact on FDI inflows because it provided the environment to produce and export from Mexico due to locational advantages, the provision of cheap labour and the creation of commercial opportunities among the most important (especially for foreign investors outside NAFTA).

These findings suggest the relevance of considering different channels and microeconomic aspects through which trade liberalisation and FDI may occur. Only in this way it will be possible to understand the context in which FDI can affect the host economy.

3.4 Conclusions

The history of studies related to the measurement and analysis of the effects of trade liberalisation has shown some interesting aspects that should be considered in future investigations. The main characteristic of multi-country studies was the intensive use of cross section data and the overgeneralization of the results to a large number of countries. In most cases, the overgeneralization led to obtain positive results that supported the assertion that trade liberalisation was indeed a growth engine in most developing countries, when in fact most of the results depended on the methodological techniques and the influence of large countries in the sample. One of the most important disadvantages of these studies was the assumption that regression coefficients were constant across countries. So, the positive effects of openness was rather apparent than real.

On the other hand, recent economic research is focused on the analysis of specific cases of countries that have experienced trade reforms. Most of them apply causality tests in order to determine first the direction of the causality effect and include a large number of variables on the right hand side of the equation. This approach recognises the existence of different channels by which liberalisation might impact output growth and also recognises the interdependency between the variables (GDP, exports and FDI for example), therefore the popularity of simultaneous equation models and VARs in country case studies.

However, in both sorts of studies a problem persists with the definition of variables and data sets that affect the results. In short, the cross country regressions and the case studies have shown that the approach applied does matter in this regard.

CHAPTER 4: MACROECONOMIC ANALYSIS: 1960-2002

4.1. Introduction

In 1994, it appeared that economic liberalisation had succeeded when Mexico became a member of the Organisation for Economic Cooperation and Development (OECD), occupying the 9th position among the 25 richest economies and reaching a GDP of $360 billions dollars. NAFTA had become effective and inflation was only 7% (after 20 years of a two-digit percentage inflation). However, an Indigenas Movement (known as EZLN) that appeared the same year brought attention to the existence of 36.2 million people that were still living in extreme poverty (40% of total population). Later, severe political events and the mismanagement of monetary policy led to peso's devaluation in more than 100%. This was interpreted as a contrast between the promising boom of an apparent successful economy and its political and social instability.

Mexico has experienced economic and social transformation in the last fifty years. As a major developing country (1,972,550 km2), its population has grown fast, from 25 million in 1950 to 102 million in 2005. Today, Mexico is considered one of the world's top manufacturing exporters and receivers of Foreign Direct Investment (FDI). However, the situation in 1950 was radically different; half of its labour force was working in the primary sector and exports of crude oil represented the main source of foreign exchange.

Industrialisation through import substitution was the strategy followed from the 1940s to the 1970s, a period known as "*Desarrollo Estabilizador*" (Development with Stability). The reasons for that nomenclature were the high level of economic growth and low inflation achieved over that period.

The economic performance, in the period 1960-2002, shows four different characteristics: from 1960 to 1970, a period of high growth rates and stability in prices (average growth rate was 7.2% and 2.6% for inflation); from 1970 to 1982, a period with high growth and inflation (6.6% and 23.5% respectively), from 1983 to 1997, a period with low growth and high inflation (1.9% and 52%); finally in the last years, from 1998 to 2002, macroeconomic stability prevails with an average growth rate of 3.3% and 11.7% of inflation.

The industrialisation strategy was first conceived during President Lazaro Cardenas' administration in the 1930s, after the world depression. In those years, Mexico experienced educational and agricultural reforms, foreign oil companies were nationalised and some institutions were created to promote domestic production (such as *Nacional Financiera*). Substantial public investment became the instrument to stimulate production and employment, investment increased 57% in comparison to the previous administration. Most of it went to the provision of social services and the creation of infrastructure to provide the basis for the new born-industry. As an economy in an early stage of industrialisation, protectionism from external competition was considered appropriate to provide the domestic industry the economic environment in which they could operate and eventually expand. For this reason, imports covered by import licences increased from 10% in the 1940s, to 68% in the 1970s and 100% in the 1980s, (Flores, 1998).

The monetary policy maintained a fixed exchange rate[9] in order to guarantee the provision of raw materials and capital goods that the industrialisation process required. As a result, at the end of the 1960s, the current account had accumulated a deficit of $1.3 billion USD.

In the 1970s, President Luis Echeverria (1970-1976) promoted economic growth through expansionary policies. The persistent lack of equilibrium in the balance of payments (it had reached $4.5 billion USD by 1976) led to devaluation in 1976 for the first time in twenty years. The reason to devaluate was to avoid a growing deficit in the current account. However, devaluation was not enough to finance this deficit, not only in the current account

[9] The exchange rate is taken as the ratio peso-dollar.

but also in the fiscal balance; this would be the precedent to borrow external funds. In just three years, from 1973 to 1976, external debt increased 128%. The stability of prices that dominated most of the protectionist period disappeared.

In the mid 1970s, after the balance of payments crisis, there was an attempt to liberalise the economy and stimulate non oil-exports. However, in 1982 oil prices declined and international interest rates rose which made difficult to introduce liberalisation measures since external foreign reserves were needed. The oil external shock and the macroeconomic instability led to declare a moratorium and to reconsider the reliability of continuing with an inward oriented strategy.

The economic crisis in 1982 was an indication that protectionism had not been efficient to achieve industrialisation and growth. Government intervention in the economy represented a high cost for the fiscal budget and exports of a primary good were insufficient to support economic development.

Miguel de la Madrid (1982-1988) was the first president to formally introduce *neo-liberal* policies to achieve economic growth. On one hand, the economic crisis in 1982 made impossible to prolong a strategy that required public investment to stimulate domestic production. On the other hand, the external debt crisis forced Mexico to consider economic liberalisation as a condition imposed by international creditors to renegotiate its debt. In 1986, Mexico received a loan package of $12.2 billion dollars and accepted the compromise to implement macroeconomic adjustments to achieve stability and structural reforms with outward oriented policies. The first action was to reduce the fiscal deficit by means of increasing tax revenues and reducing public intervention in the economy. The second action was Mexico's subscription to the General Agreement on Tariffs and Trade (GATT) which implied the elimination of import permits, official prices, the reduction of tariffs and the simplification of the regulatory framework applicable to trade transactions. At the same time, the monetary policy eliminated interest rate and exchange rate controls as a measure to reduce public deficit and the intervention of the Central Bank in the money market. However, bottlenecks created by years of protectionism led the country to reach the highest deficit in the current account in 1994 ($30 billion dollars) and the highest external debt in 1995 ($169 billion dollars).

After liberalisation in 1986, exports have diversified (from crude oil to manufactures) and have increased their share in world trade. For instance, according to the World Trade Organisation, in 2000 Mexico occupied 13th position in the world exports/imports of manufactures and the 6th position in the world trade of automotive products.

At the same time, Mexican population experienced deterioration in income distribution during the austerity programmes implemented since the economic crises in 1982, 1987 and 1994 and the subsequent economic pacts that used wages and social investment to control prices and to stabilise the economy.

Openness has enabled resource re-allocation and a reduction of governmental intervention in the economy. However, most foreign investment still maintains few linkages with national suppliers, limiting its potential to generate spillovers to the rest of the economy. Some explain this as a result of new ways of international organisation that have favoured subcontracting forms in which there is little learning effects. Additionally, this has been intensified by the lack of complementary industrial programs to stimulate efficiency and competition between domestic industries (Dussel, 2000).

The purpose of this chapter is to analyse the macroeconomic history of Mexico in the last forty two years - from 1960 to 2002- in order to determine the role that policy orientation (outward and inward) has played in economic growth, not only in terms of GDP but in terms of other relevant macroeconomic variables. International trade theory assures that countries are better off when they liberalise their economies and as a consequence improve their terms of trade. We should ask if the Mexican macroeconomy improved after liberalisation and what were the costs of resource allocation.

The rest of this chapter is divided in five sections. Section 4.2 contains a detailed analysis of seven major variables: economic growth, manufactures, the external debt crisis, employment and income distribution, interest rates and the exchange rate. Section 4.3 is focused on the Balance of Payments and its components, such as the current account and capital account. Section 4.4 contains an analysis of the particular combinations of strategies (ISI and outward orientation) and policies (monetary and fiscal) that were implemented to achieve higher levels of development. We also determine the weakness and strengths of liberalisation and its potentialities for the economic development of Mexico. Finally Section 4.5 concludes.

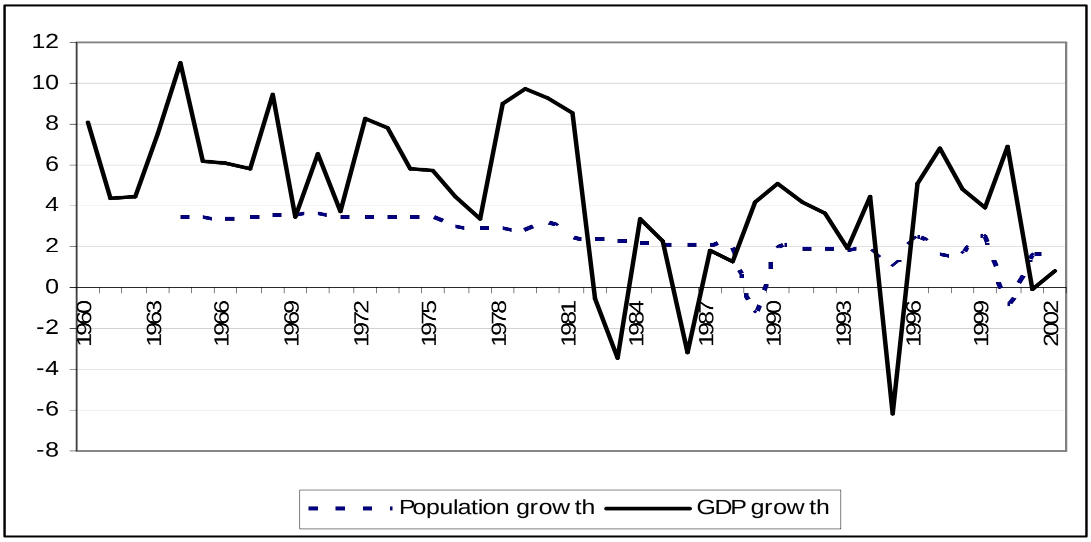
4.2 Main macroeconomic issues: 1960-2002

This thesis analyses empirically the economic performance with data from 1980 to 2002. However, in order to understand the changes that occurred in the mid 1980s, it is necessary to consider the economic policies that were implemented before.

4.2.1. Gross Domestic Product (GDP)

During the *Desarrollo Estabilizador* (from 1960 to 1970)[10], GDP average growth was 6.6% while population growth rate was 3.5% (see Figure 4.1). This was an excellent performance considering that production was mainly based on agricultural activities and petroleum; industrialisation was at its early stage. At the beginning of the industrialisation period, the government invested in public projects, such as construction, roads, energy, water supply and education. These conditions favoured employment creation and low inflation rates that had little impact on real wages. However, the economic boom did not affect all economic activities equally, protectionist policies were discretionary and favoured some sectors (such as manufactures) while some others were neglected (such as agriculture, housing, education and technological research).

Figure 4.1
Real GDP and population growth rates in Mexico (%).



Source: Bank of Mexico, IMF & INEGI

During protectionism, the value of GDP increased from $15.6 billion dollars in 1960 to $194.3 in 1980. The composition of GDP by economic sectors has not changed significantly between 1960 and 2002. In general, the most important economic activities are *Services*, *Retailing, Restaurants and Hotels* and *Manufactures* (see Table 4.1). However, some other economic activities have reduced their role significantly such as *Agriculture, Livestock and Fishery*, this sector reduced its share from 15.6% in 1960 to only 5.7% in 2002.

[10] In reality the period called as *Desarrollo Estabilizador* started a little bit earlier, in the mid 1950s.

The reforms in 1986 generated a structural change that modified substantially the composition of trade and capital flows; however it altered the domestic production structure slightly.

Table 4.1 Distribution of GDP by economy sector (%).

	1960	1965	1970	1975	1980	1985	1990	1995	2000	2002
Total ( )	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*
1 Agriculture, Livestock & fishery	15.6	13.7	11.2	9.6	8.2	8.5	7.8	6.6	5.5	5.7
2 Mining	3.3	2.8	2.6	2.5	3.2	3.7	3.6	1.4	1.3	1.3
3 Manufactures	**20.3**	**22.1**	**23.0**	**22.7**	**22.1**	**21.4**	**22.8**	**19.2**	**21.5**	**20.4**
4 Construction	5.2	5.3	6.2	6.4	6.4	5.4	5.1	4.1	4.3	4.1
5 Electricity, Gas & Water	0.4	0.6	0.8	0.9	1.0	1.3	1.5	1.7	1.8	1.8
6 Retailing, Restaurants & Hotels	22.6	23.5	24.2	25.2	28.0	26.7	25.7	20.1	21.8	21.4
7 Transportation, Storage & Communications	5.1	4.7	4.9	6.0	6.4	6.2	6.6	9.8	11.2	11.8
8 Services	27.3	27.4	27.0	26.7	24.7	26.9	27.0	37.1	32.8	33.5

Source: INEGI, Sistema de Cuentas Nacionales de México and Bank of Mexico.

The shift from Agriculture to Manufactures was part of an international mainstream that considered primary good prices as more volatile than manufactures and vulnerable to international prices. External shocks and the decline in some international prices caused a crisis in the industrialisation of cotton[11], henequen and sorgo at the end of the sixties. For this reason investment in agriculture was insignificant. In fact it amounted to $42 million current pesos compared to the investment worth $3.9 billion pesos in the rest of the economic sectors. In the following decades this trend went downward.

In the 1970s, GDP's performance was closely related to expansionary policies. The discovery of oil sources in the southeast region and a rise in international prices in 1973, provided financial funds to afford excessive public spending. New sources of foreign exchange were not accompanied of a fiscal reform.

[11] The crisis in the agricultural sector was the cause to introduce an alternative economic program to reduce unemployment. Government elaborated an industrialisation program on the USA-Mexican border to attract foreign investment, mainly in-bond industries (maquiladoras).

In the early 1980s, President Lopez Portillo (1976-1982) continued with former President Echeverria's expansionist economic policy. Many public enterprises were created to produce and supply a wide range of products –their number increased from 300 to 1200 in only few years. The public activities were diverse, ranging from selling basic products such as milk, sugar, to investing in the media and paper industry.

In these years, GDP average growth was more or less the same as in the 1960s, 6.4% annual, however the current account deficit and the fiscal deficit were higher than before and inflation reached an average rate of 15.2%. With oil prices falling in 1982, Mexico experienced a period of economic recession. For the first time, output growth fell below population growth (see Figure 4.1). GDP started a downward trend as a result of the lack of stability in the macroeconomic variables. The external shock left the country devoid of financial resources and, consequently national production decreased drastically. While in 1982 there was high economic growth (8.4%), the following year it became negative (-0.58%).

Economic openness in 1986 required the creation of a positive political and economic environment to promote viable exports production and international investment. Devaluation and inflation (159%) created by a speculative attack against the currency in 1987 made it necessary to introduce stabilisation policies (economic pacts); which indirectly reduced domestic output. In the 1990s as a result of negotiation with international creditors, the fiscal policy became more restrictive in order to achieve fiscal equilibrium. Public spending was restricted, as a result, many public enterprises were privatised, tax revenues increased and official prices that prevailed for many public goods were liberalised. The application of stabilisation measures continued until 1994, when inflation decreased to 7% and GDP showed a slight recovery. However, a series of speculations and social conflicts led to peso devaluation at the end of 1994. In 1995, GDP experienced a negative growth rate, –6.17%. From then on, even though there were no more economic pacts, a flexible exchange rate has contributed to stimulate foreign capital in the productive sector and inflation has remained realistic with money supply and demand. In 2002 GDP growth rate was 0.7%.

4.2.2 Manufactures

In recent years, the manufacturing sector has been the most dynamic sector in terms of FDI absorption, employment and export production. However, its contribution to GDP has been moderate if we compare its average share in the period 1970 to 2002. Basically, it has remained around 20%.

Among the manufacturing sector there is a significant diversity in terms of output creation. *Food, Beverages and Tobacco* has one of the highest shares in manufactures which has fluctuated from 33.2% in 1960 to 25.9% in 2002 (see Table 4.2). Another important industry is *Metallic goods, Machinery and Equipment*; which has increased its share considerably, from 13% in the 1960s to 23.9% in the 1990s and then to 30.7% in 2002. One of the reasons behind this expansion is that economic and commercial policies were focused on developing the most modern sectors in order to generate greater spillovers to the rest of the economy. Besides, most of FDI went directly to this sector, especially to the automobile, auto parts, electric and electronic production. The automobile industry established in Mexico before economic openness. However, GATT and NAFTA increased considerably its share in the manufacturing sector.

Table 4.2 Manufactures distribution, as a share of GDP and exports.

	1960	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2002**
Manufactures (Million dollars, 1993 prices)	13873	20382	31343	45536	53648	56722	66042	69916	101892	97366
Share in GDP (%)	**20.3**	**22.1**	**23**	**22.6**	**17.6**	**16.9**	**18**	**17.6**	**19.7**	**18.7**
Share in total exports (%)	**n.a**	**n.a**	**na**	**na**	**19.5**	**23**	**52**	**82.7**	**87.1**	**88**
Manufactures (%)	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
I Food, beverages and tobacco	33.2	29.5	27.8	26.5	24.6	26.2	26	28.2	23.8	25.9
II Textiles and leather	17.5	16.1	15.8	14.9	13.8	12.8	9.4	8.4	8.3	7.5
III Wood goods	4.9	4.9	4.1	4.0	4.3	3.9	3.4	3.1	2.6	2.4
IV Paper and printing	5.1	5.5	5.6	5.2	5.5	5.8	5.2	5	4.4	4.4
V Chemicals and petroleum based products	9.5	10.2	11.2	13.2	14.9	17.5	16.9	16.5	14.5	14.5
VI Non metallic minerals	6.1	5.9	7.2	7.3	7.0	6.9	7.6	7.5	6.5	7
VII Basic Metallic Industry	5.5	5.7	5.6	5.8	6.1	5.8	4.7	4.9	4.8	4.7
VIII Metallic goods, machinery & equipment	13.1	16.6	17.3	19.9	21.3	18.5	23.9	23.8	32.1	30.7
IX Miscellaneous	5.1	5.7	5.4	3.2	2.6	2.6	2.8	2.8	3	2.9

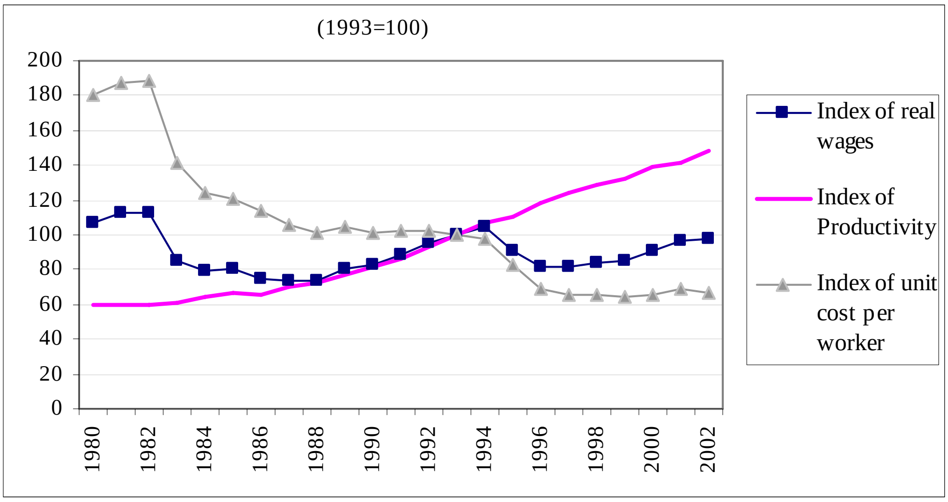
na: no available.
Source: INEGI. Sistema de Cuentas Nacionales de México & Bank of Mexico.

On the other hand, among the sectors that have lost predominance are *Textiles and Leather,* these activities were important contributors to output in the 1960s and 1970s (their share was around 16%). However, the structural change resulting from trade liberalisation undermined their share in the economy (see Table 4.2). This is despite originally being the favourite sector for foreign investment (under the programme Maquiladora). In 2002 their share in GDP just reached 7.5%. The structural change in manufactures shows that labour intensive activities have reduced their share over the last years while capital intensive activities have increased.

Although –as a whole- the manufacturing sector does not have the highest position in terms of GDP share, in terms of exports value, its share has increased dramatically in the last years, especially after the trade reforms in 1986 and later in 1994. For example, it went from 23% in 1985 to 88% in 2002. Within this sector, the industries with the highest share in total manufacturing exports were *Metallic Goods, Machinery and Equipment* in the first place (with 74% of total share), *Textiles and Leather* in the second place (8.5%) and *Chemical Products* (4%). In general terms, the most exported good in the last years -excluding Maquiladora- were automobiles (19.1%), crude oil (17%) and trucks (5.5%). Meanwhile, the most imported goods were automobile supplies (10%), machinery for information systems (5.7%) and automobiles (4%), these results suggest that most of the trade flows consist of intra-industry transactions.

In terms of real wages, the labour force in manufactures has not experienced the same growth according to its productivity. The difficulty with a productivity–wage link lies in the existence of price fluctuations that erode gains in real wages. For example, due to the last economic crisis, wages fell 21.7% in real terms from 1994 to 1997, while productivity maintained its growing trend (see Figure 4.2). Unit costs per worker also declined.

Figure 4.2
Trajectory of real wages, productivity and unit costs per worker in manufactures

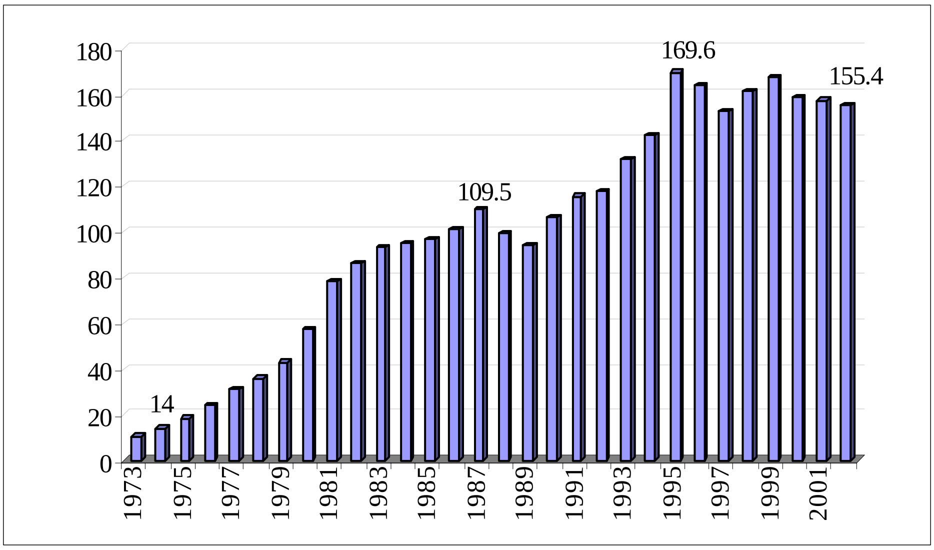


Source: Bank of Mexico

4.2.3. External debt to finance growth

The external debt crisis has its origin in the decision of the government to improve economic growth by increasing public expenditure while no fiscal reform was considered to finance this expansion. Instead of applying restrictive measures, President Echeverria's administration borrowed money from international creditors to finance deficits in the current account and fiscal balance. External debt was seen as the solution to obtain financial resources because neither exports nor foreign investment could provide them *ipso facto*. During Echeverria's and Lopez Portillo's presidencies (1970-1982) the average growth rate of external debt was 28.7% annual. In Figure 4.3 we can see how for many years, external debt amounted to less than 50 billions. Then there was a rapid growth early in the 1980s. In only four years, the external debt doubled.

Figure 4.3
External debt (billion US dollars), 1973-2002.



Source: World Bank & Bank of Mexico

The fluctuation of international interest rates inevitably increased the external debt service that Mexico was obliged to pay. International interest rates rose due to a world oil shock in 1982, credits and their service became more expensive. In August 1982, President Lopez Portillo declared a moratorium on debt servicing. The external debt reached $86 billion dollars, which was an increment of 225% just in six years of his administration.

The debt crisis and the oil-price shock showed that protectionism and dependency on oil exports could not longer be the basis for economic growth. This period was also known as *La Decada Perdida* (lost decade) because even though Mexico was rich in oil resources, a bad mismanagement of its earnings did not prevent the economic crisis. Nevertheless this was a general phenomenon for other Latin American countries. Some analysts think that the debt crisis was self-inflicted due to the government's reluctance to adjust expenditure when international forces required austerity in budget management (Little et. al. 1993).

After the debt crisis, Mexico signed an agreement with its international creditors (IMF and World Bank) to manage the debt servicing in subsequent years. In order to restore its condition as a debtor, Mexico became the first recipient of the IMF loan package. This implied that Mexico had to introduce changes in its development strategy, in specific to apply an outward oriented policy to finance its deficit on current account and to limit the government intervention in the economy. For the first time economic growth would be financed through liberalisation. The renegotiation of the external debt, after the moratorium in 1982 changed the terms of indebtness in the following years. The privatisation of public enterprises (950 out of 1155) and the supply of credit in the stock market modified the characteristics of the external debt.

Investment in the stock market became a common practice in the mid-1980s as an alternative source of financial resources, international interest rates were competitive and the national interest rates were attractive. However, a speculative attack unleashed capital flights in 1987. The peso was devaluated and the nation experienced another economic crisis. On September 1989, in the context of the Brady Deal, international banks offered a menu of options to renegotiate the external debt with Mexico, the option chosen included two more debt funds and facilities to reduce the debt service (Claessens et al., 1993).

However, the liberalisation process intensified the exposure of the public and private sectors to external debt. Due to privatisation, new entrepreneurs looked for financial resources in external creditors and in the stock market. According to the World Bank, in 1990 the external debt to GDP ratio reached 39.8%. In just three years, the private sector doubled their debt, from $13 billion dollars in 1990 to $27 billion dollars in 1993, although the public sector was still the most important debtor (its share was 70.5% compared to 25% from the private sector)[12].

The economic stimulus prompted by the government also contributed to commercial banks seeking funds from foreign loans. In the first quarter of 1993, commercial banks increased their external debt by 22%, the private sector by 15% and the public sector by 3.8%, (Girón, 1994). This situation forced the central bank to introduce some guidelines to reduce the growing trend of indebtness for example, the diversification of financing sources, the reduction of financial costs and the consideration of the discount rate in the secondary market.

According to the Ministry of Finance in 1994, part of the high external debt was due to the currency instability: 44% of its increase was explained by exchange rate fluctuations at the beginning of that year. After the peso devaluated in 1994, the external debt reached the highest level in the economic history, $169 billion dollars in 1995. In recent years, the renegotiation of external debt has reduced debt service as a share of export revenues from 45.4% in 1980 to 32.7% in 2000. Nowadays, according to the government, 90% of the public external debt is long-term. On the other hand, external debt still represents a very important factor in the economy; its ratio to GDP has not changed significantly. For example, in 1980, it was 25.7%, while in 2002 it still represented around 30% of GDP.

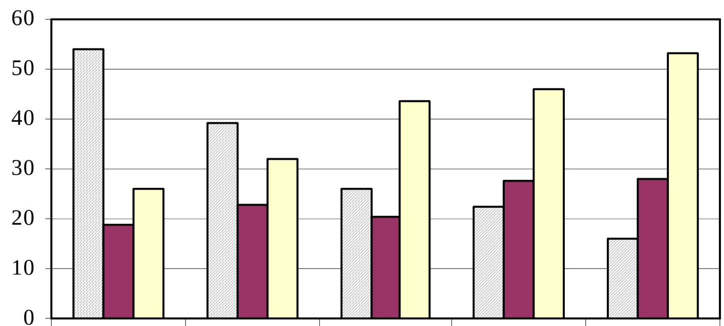
[12] In the same period, private debt had an average growth rate of 40% while public debt had a growth rate of 4.3%.

4.2.4. Employment and income distribution

The labour market reacted quickly to structural changes experienced when the ISI was implemented, moving from agriculture to manufactures -where wages were higher- and from rural to urban cities. From 1950 to 1969, total employment rose 265%. In Figure 4.4, we can observe that in the 1960s around 54% of the labour force was employed in the primary sector, while the industry captured around 19%. The ISI affected this distribution increasing employment in industrial activities. In the 1970s, it employed around 23% while the primary sector reduced its share to 39.4%. For the following years, commercial activities and services have become the economic activities that have maintained the largest share of labour.

Figure 4.4

Distribution of labour force by economic sector (%)



	1960	1970	1980	1990	2000
Primary sector 1/	54.2	39.4	26.0	22.6	15.9
Secondary sector 2/	19.0	23.0	20.4	27.8	27.9
Terceriary sector 3/	26.1	31.9	43.8	46.1	53.3

Source: INEGI
1/ Primary sector includes: Agriculture, livestock, fishing and hunting
2/ Secondary sector includes: Mining, oil-extraction, manufactures, electricity and construction.
3/ Tertiary sector includes: Commercial activities, Services, Transportation, governmental and other services.
Note: The remaining percentage corresponds to unidentified activities.

Jobs creation reached its highest growth rate in the 1960s (4.5% annual growth) but for subsequent years, for example in the period 1973-1982, it decreased to 1.9% annual growth. The economic stimulus to manufactures and the agricultural crisis in the mid 1960s were the main causes of labour's redistribution from primary to secondary and tertiary activities.

Besides the effort of the government to improve employment and wages, Mexico still maintains a high income inequality. For example, in the period 1984-1996, the two poorest deciles of population accounted for 5.3% of total income, which seems rather small compared to the two deciles of the richest population which accounts for 50% of total income (Dussel, 2000). The situation that prevailed before an outward oriented strategy was implemented shows that income inequality has increased, for example De la Torre (2000) calculated a Gini Index[13] for the period 1984 to 1996 and found that it has gradually increased. In 1980 the Gini coefficient was 0.39, in 1989 it was 0.42 and 1996 it was 0.48.

In a close examination, poverty has suffered little change from 1980 to 2002, it is evident that economic liberalisation has not reduced either poverty or income inequality as some statistics suggest. For example, according to the ECLAC (2004), in 1980, 34% of total households[14] in Mexico lived below the poverty line[15]. In 1989 when Mexico had already joined GATT, this percentage increased to 39% and later due to the economic crises, but after NAFTA, this percentage again increased to 43.4%. It is not suggested that poverty is a consequence of liberalisation; however a more open economy has not been capable of alleviating the population's income deterioration. Other studies show that these percentages are in fact higher (Boltvinik 1999), however they all coincide that unequal income distribution and poverty have increased.

The decline of real wages was more intense during the *neo-liberal* policy in the 1990s because it gave priority to control of prices more than the social conditions of the population.

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[13] This index measures the degree of income inequality. The index fluctuates between 0 and 1. 1 indicates maximum inequality.
[14] The average size of a household was 5.1 family members in 2002.

For example, rises in nominal wages and public investment were restricted during the application of the economic pacts[16] (1987-1994). Real wages growth fell drastically from 1982 onwards, despite labour productivity staying constant. According to the Bank of Mexico, average decline in real wages was 20.8% in 1995 and 16.9% in 1996. This strict policy on wage rises was recognised by authorities of the Bank of Mexico:

> "*Wage flexibility has played a positive role towards the rebound in employment. Had this flexibility not existed, perhaps real wages would be higher than those currently observed, but the number of people without any income would also be larger"* (Banxico, 1997).

In that sense, the economic crisis in 1995 brought back the country to the same levels of poverty that prevailed in Mexico before industrialisation. While in 1994, 61.7 million people lived under the poverty line, in 1996 amount was 72.2 million. The most shocking effect was the effect on the number of population in extreme poverty[17] which increased from 36.2 million to 50.2 million in just two years[18].

At the same time, general unemployment was rising due to economic recession, (unemployment reached 7.6% in 1995) and devaluation had a temporary positive effect on maquiladoras. Being maquiladoras mainly financed by foreign capital, the peso devaluation made labour costs relatively cheaper, contrary to the rest of the economic activities, these industries were able to create jobs in difficult times.

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[15] Poverty is measured as the minimum income the members of a household must have in order to meet their basic needs. Poverty lines are based on the cost of a basket of goods and services that cover basic needs.
[16] Economic pacts were created as a measure to control prices, especially after every economic crisis. Pacts were agreements signed by all economic agents (such as workers, entrepreneurs and government) in which they assumed a compromise to maintain wages and prices low.
[17] The family income for this population was 66% below the poverty line.
[18] "Pobres, 72% de los Mexicanos". *La Jornada*, 25 de Noviembre de 1999. Mexico.

4.2.5 Interest rates

The interest rates are an important indicator of the availability of financial resources that determine the level of national production. During the 1960s, the short term real interest rates, (28 to 30 days) were on average 0.85%, much of it due to low inflation. On the other hand, the long run real interest rate was 4.29%. However, real interest rates became negative in the 1970s when inflation increased and the balance of payments deteriorated. Due to the need to finance public deficits -caused by excessive expenditure- in 1978, a Treasury bill (CETES) was introduced and became one of the most important instruments of the money market.

During the 1980s, commercial banks worked in a protectionist environment in which the government imposed high average reserve requirements to finance its own deficits. Liberalisation and stabilisation programmes used the exchange rate as a nominal anchor, leading to high real interest rates. In Table 4.3 we present different interest rates that prevailed in different periods. As other macroeconomic variables, in periods of high speculation, average interest rates rose significantly, i.e. between 1980 and 1990.

Table 4.3 Interest rates in Mexico (%).

Period	Average cost of Funds/1	Treasury Bill Rate /2
1975-1979	14.1	12.7
1980-1985	42.2	45.1
1986-1990	54.1	42
1991-1995	20.1	22.5
1996-2000	20.8	22.5
2002	5.3	7.1

1/ Average interest rates calculated on deposits and *pagares*.
2/ At 28 days. They were first issued in 1978.
Source: INEGI and IMF

When the *Solidarity* economic pact was introduced in 1987, real interest rates rose considerably due to the objectives of this pact to reduce inflation and therefore the money supply. At the same time, the government was interested in attracting foreign investment in the stock market, and attractive real interest rates were a powerful instrument to achieve this.

From 1990 to 1994, short-run and long-run interest rates experienced a drastic reduction after the collapse of the stock market in 1987, average interest rates were 4.31% and 5.45%. The volatility of short-run interest rates seems higher in years of high inflation, so the average long-run interest rates tend to be negative while, short run interest rates are usually positive and higher. In recent years, the Bank of Mexico does not fix the interest rates, instead it imposes quantitative restrictions on the money supply.

4.2.6. Exchange rate

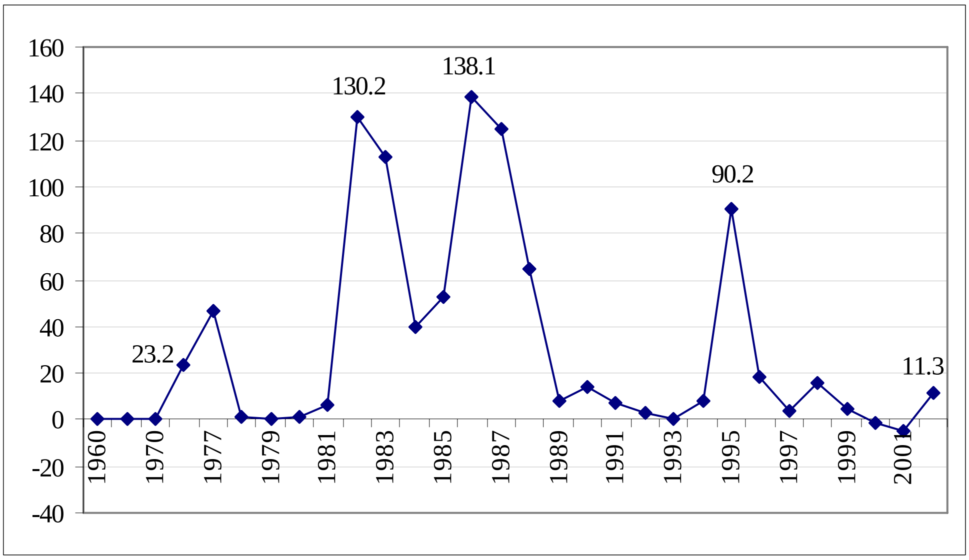
The exchange rate maintained a fixed parity during the protectionism years to support the new born industry that required raw materials and technology from abroad. For more than 20 years the exchange rate remained $12.5 old pesos[19] per dollar. However, the lack of sufficient national supply, not only in intermediate goods but in final goods, led to higher demand for imports. At the end of the 1960s, the deficit on the current account was $938 million dollars.

In 1976, with the Balance of Payment crisis, the incapability to finance the deficits led the Bank of Mexico to devaluate the peso and set the exchange rate in $15.4 old pesos per dollar. Some suggest that a fixed exchange rate could have remained for more years if the national production and the expenditure had grown at the same growth rate (Wilford and Zecher, 1979). However, nothing of this kind happened and the deficits in the Balance of Payments led to devaluation. In Figure 4.5, we present the trajectory of the nominal exchange rate percentage fluctuation for the whole period. As can be seen, for many years, since 1960,

[19] In 1992, the Central Bank eliminated three zeros in the peso value, so $1000 old pesos were equivalent to $1 new peso.

it remained unaltered. Although the first devaluation occurred in 1976, the most drastic fluctuation happened between 1982 and 1987.

Figure 4.5
Exchange rate (peso/dollar) fluctuation (%).



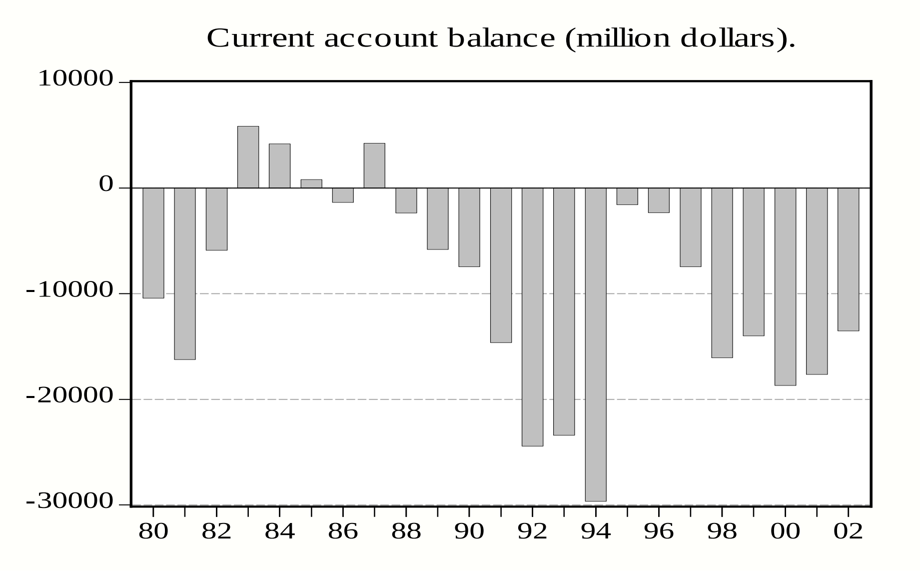
Note: the exchange rate fluctuation also represents peso's devaluation.
Source: IMF

Between 1988 and 1994, to keep prices under control, the monetary policy instrumented a floatating exchange rate that would keep the peso-dollar rate within a minimum and maximum range. In Figure 4.5 we can observe that it remained more or less constant, however this required a frequent intervention of the Central Bank to keep the exchange rate within the floatation band. In 1994, the exchange rate was liberalised due to a drastic decline in the international reserves since these could no longer support the floatation range. Without the Central Bank's intervention, the nominal exchange rate increased 90.2% at the end of 1994.

4.3. alance of payments

At a great extent, the performance of the balance of payments is closely related to the exchange rate fluctuations more than specific development strategies to substitute imports or promote exports. Devaluation reduced the current account deficit in 1977, 1983, 1987 and 1995 (see Figure 4.6).

Figure 4.6



A negative amount represents a deficit.
Source: Bank of Mexico

4.3.1. Exports and imports

In the 1960s the government tried to stimulate exports by different instruments of trade policy such as, the “subsidio triple” (tax reimbursement) and credits for export projects through a program known as FOMEX (Exports Foment)[20]. The impact on export performance was negligible thought, not only due to the anti-export bias created by protectionism, but also due to the monetary policy’s decision to keep an overvalued exchange rate. However, exports showed a positive performance in the period 1983-1985 and 1987, in part due to devaluation and in part due to trade liberalisation that favoured non-oil exports. For the first time in 1983,

[20] FOMEX was a tax reimbursement to help producers to engage in export projects.

there was a surplus in the current account of $5.8 billion dollars and $4.2 billion dollars in 1987. Both events occurred immediately after devaluation though.

Since the 1990s, Mexican exports have diversified; the production structure experienced a transformation from crude oil-exports to manufactures in a relatively short period of time (which was intensified when Mexico joined GATT and NAFTA). In Table 4.4 we can see that the share of crude oil in total exports dropped from 57.9% in 1980 to 24.8% in 1990. Slowly, crude oil lost its leading position as the highest export good; in 2002 its share reached only 9%. On the other hand, manufactures increased their share progressively. Between 1980 and 1985, manufactures only represented around 30.8% to 38% of total exports, after GATT, its share jumped to 68% in 1986 and then to 88% in 2002. However much of these transactions have taken place through intra-industry trade, until 1995 according to Buitelar and Padilla (1996) it amounted to 40%.

Table 4.4 Export goods (in million dollars) and distribution by economic sector (%).

	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002
Exports (USD)	18031	26757	40711	79542	96000	110431	117460	136391	166455	158443	160763
%	100	100	100	100	100	100	100	100	100	100	100
Crude Oil	57.9	55.2	24.8	10.6	12.1	10.3	6.1	7.3	9.8	8.1	9.0
Agric. & Liv.	8.5	5.3	5.3	5.0	3.7	3.5	3.2	2.9	2.5	2.5	2.4
Extraction	2.8	1.9	1.5	0.7	0.5	0.4	0.4	0.3	0.3	0.2	0.2
Manufactures	30.8	37.6	68.4	83.7	83.7	85.8	90.3	89.5	87.3	89.2	88.3
(Maquiladoras)	14.0	19.0	34.1	39.1	38.5	40.9	45.2	46.8	47.7	48.5	48.6

Source: Bank of Mexico.

As it is clear from Table 4.4, the distribution of exports has changed in the last fifteen years in favour of manufactured goods and against oil exports. In the same way, within manufactures the distribution has changed in favour of automobile products and machinery and equipment. For example, in 2002 two industries contributed with around 46% of total export goods; the first was automotive products, where according to the World Trade

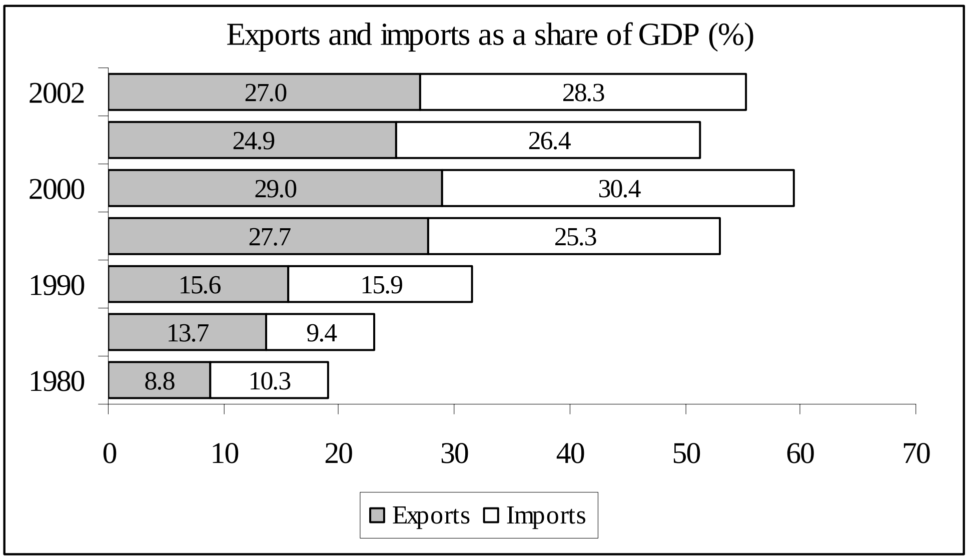
Organisation (WTO), Mexico reached 5th world position (export value was 30.91 billion dollars) and the second was *office machines and telecommunications*, where it reached the 9th world position (export value was 32.25 billion dollars).

In 2002 Mexico was among the world's top 15 leading exporters and importers of manufactures (WTO). Among manufactures, the most traded products were *machinery, equipment and metallic products* (65.16%), which include transportation and communication parts (45.3%). However, in context this says little about the domestic industry. Most of the automobile and electronic industry is integrated by foreign investment, especially under the regimen in-bond industry (Maquiladora). For example in 2002, 47.7% of total exports value was from multinational corporations.

One of the disadvantages that analysts find in maquiladora's investment is that the labour force employed is cheap and relatively un-skilled. Maquiladoras usually create jobs to assembly "temporally-imported" parts that are later exported as final goods. So the added value is mainly through wages and not through domestic intermediate goods. On average, according to INEGI, they acquire around 2% of total raw materials from the domestic market. However, this industry has a relevant role in the export market. For example, from 1990 to 2000, they had the highest export value. Their average share in exports' revenues was 50% in manufactures and 37.8% in total exports. To a certain extent, Maquiladoras are the result of economic liberalisation, even though the first plants established in 1965, they experienced a boom in the 1980s when Japanese auto competition in the US forced many corporations to reduce production costs. They found profitable to locate twin plants in the US-Mexico border. They are not only important in export volume but also in employment creation; for example, from 1987 to 1994, their average annual growth in employment was 10%, while the rest of the manufacture sector experienced a negative annual growth (-2%).

On the other hand, if we take in-bond industries out from the statistics, we still have –according to the Bank of Mexico- that the most exported goods in 2000 were automobiles (19.1%), followed by crude oil (17.1%.). Besides oil, the Mexican manufacturing industry represents a small proportion in total exports. In Figure 4.7, we can see how international trade as a share of GDP has increased significantly. Both imports and exports keep more of less the same proportion, despite the stimulus that export production has received from government programs.

Figure 4.7



Source: INEGI

At the beginning of the industrialisation period, many intermediate and capital goods were imported due to a more intense productive activity. Additionally, liberalisation and the reduction of import licences favoured a rise in imports of intermediate goods. In Table 4.5 we show that contrary to exports, the structure of imports has not changed radically. Intermediate goods still maintain the highest proportion, although growth rates of final goods have increased. Since liberalisation in 1986, the availability and competitive prices of a high number of imports were an opportunity for consumers to discriminate against domestic goods.

The access to an international market led consumers to increase the demand for final goods. From 1987 to 1988, there was a dramatic boom in the demand for final consumption goods (150%), while intermediate goods grew 43% and capital goods, 53%. From 1988 to 1991, the average growth rate of final consumption goods was 71.3% annual, while capital goods' growth rate was 34.3% and intermediate goods' growth rate remained more or less similar to previous years at 26.4%. Nevertheless, the import structure remained stable, intermediate goods still maintain the highest share in total imports, fluctuating between 71% and 75%.

Table 4.5 International trade structure, (million dollars).

Source	1980	%	1990	%	2000	%
Total Exports (fob)	**16,284**	**100**	**40,711**	**100**	**166,455**	**100**
Oil	10,441	64.1	10,104	24.8	16,383	9.8
Agriculture	1,528	9.4	2,162	5.3	4,217	2.5
Manufactures	3,802	23.3	27,828	68.4	145,334	87.3
Total imports (fob)	**19,342**	**100**	**41,593**	**100**	**174,458**	**100**
Consumer goods	2,448	12.7	5,099	12.3	16,691	9.6
Intermediate goods	11,720	60.6	29,705	71.4	133,637	76.6
Capital goods	5,174	26.8	6,790	16.3	24,130	13.8

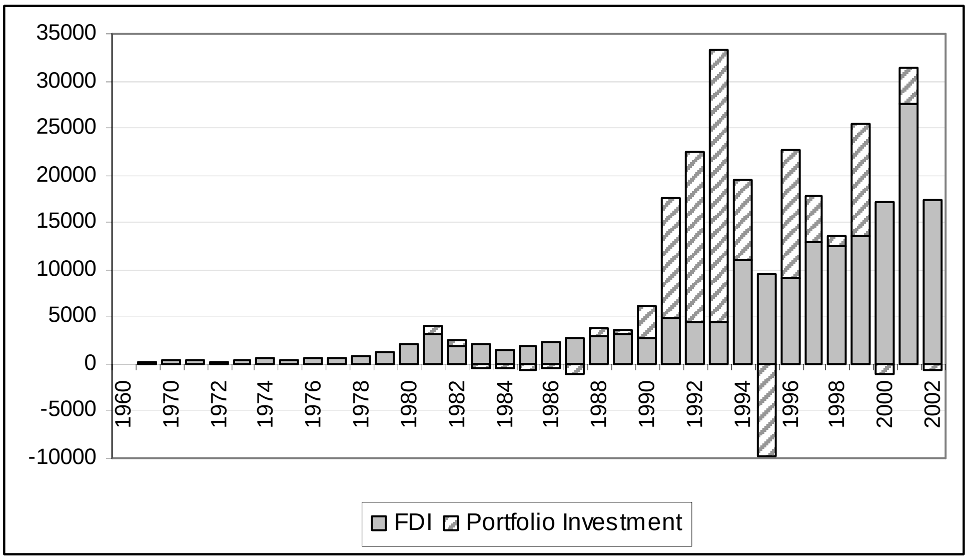
Source: World Bank

4.3.2. Foreign direct investment and investment in the stock market

FDI has not always been considered as relevant to finance economic growth. In the 1960s, protectionist policies restricted FDI from owning enterprises in Mexico and equity shares in corporations. The expropriation of foreign oil-companies experienced in the 1930s during Lazaro Cardenas´ administration was a strong antecedent of the reluctance to open up the economy to foreign investors. These restrictions remained for the following years, thanks to economic reforms introduced in 1986 and then in 1993, some public enterprises were sold off and FDI was seen as a desirable source to finance industrialisation. President Carlos

Salinas (1988-1994) tried to increase their participation in the economy. In Figure 4.8, we can see the trajectory of FDI and foreign investment in the stock market, before 1977 both were negligible. After the law reforms, and the first attempt to open the economy in the mid 1980s, both kinds of investments increased.

Figure 4.8
Foreign Investment in Mexico (million dollars).



Source: Bank of Mexico

The most intense period of incoming FDI was in the 1980s when multinationals decided to invest in the manufacturing industry, especially in electronics and automobiles. However, as we can see in Figure 4.8, from 1990 to 1993, the relative share of FDI in the capital account started a downward trend due to the high interest rates that prevailed in those years and which enticed foreign capital into the stock market.

After devaluation in 1994, FDI again increased its share in total investment. Since 1995, FDI has taken the leading position in the capital account. Most of it comes from the US, and around 80% goes to the manufacturing industry.

On the other hand, foreign investment in the stock market was not significant during the 1960s and 1970s. It was in the mid-1980s and 1990s, especially during the administration of Carlos Salinas, according to data from the Bank of Mexico from 1990 to 1991, it increased by 278%. However, this situation put the economy in a vulnerable position. Monetary policy manipulated the exchange rate and used interest rates as an instrument to attract financial resources from abroad. The capital account in the early 1990s was mainly composed by foreign investment in the stock market. Real interest rates were higher than in other countries (30% in 1991), so foreign investment in the stock market reached its highest level in 1993 with $29 billion dollars. Many social and economic events in 1994 created a speculative scenario such as: the *Indigena* Movement (EZLN) in Chiapas, the assassination of presidential candidate Luis D. Colosio and the reduction of international reserves. These events increased speculation about the economic and political stability in Mexico, and finally triggered capital flights, causing international reserves to fall by 40%. At the end of 1994, the international reserves found difficult to maintain a band of floatation, especially considering there was a growing deficit in the current account. The huge loss of foreign exchange forced the Bank of Mexico to abandon the floatation band for the exchange rate. In December of 1994, few days after the new President was in charge[21], the peso devaluated more than 75%, it went from 3.5 to 6.2 pesos per dollar.

To a certain extent, the economic crisis in 1994 was a result of an irrational dependency on foreign investment in the stock market, which represented more than 70% in the capital account in 1993. Regardless of the empirical evidence, there was reluctance to admit the mistakes in the monetary policy. According to Gil Diaz and Carstens (1996),

[21] In Mexico, since the late 1970s, there was a recurrent "sexenal" crisis at the end of every administration, usually related to political and economic mismanagement of the government in change. In order to secure the winning of elections, the former President would usually keep the economy in apparent "equilibrium" and the new president would be responsible to make the necessary adjustments.

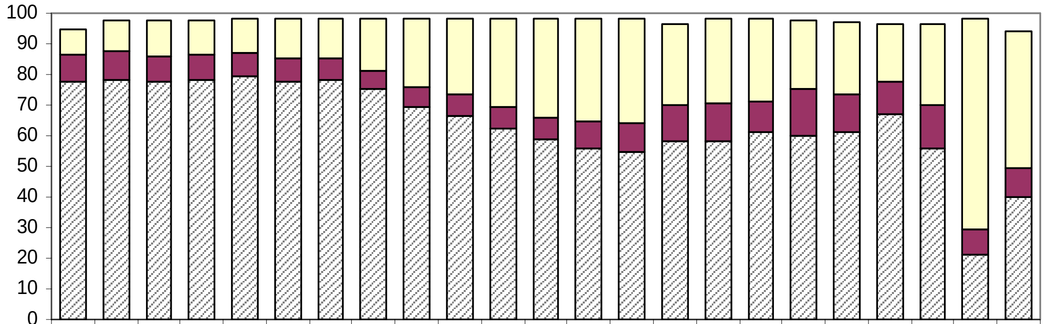
"Mexico experienced a politically triggered speculative attack that snowballed into a financial crisis. It was not a crisis based on the misalignment of real phenomena", (pag.168).

Devaluation had a political origin, but it was also a result of a constant disequilibrium in monetary policy that relied on an overvalued currency and high interest rates to achieve economic growth.

Foreign investment in the stock market reached only 8.2 billion dollars the following year (1995), which meant a drastic drop of 71.6%. The freely floatating exchange rate scheme adopted by the central bank induced FDI to increase its share in the economy in the years following the economic crisis. If we analyse FDI as a share of GDP, then its evolution is not that impressive. For example in 1965, FDI as a share of GDP was 1.1%; in 1980 it was 1.4% and in 2000 it was only 1.3%. It was during the subsequent years following the last economic crisis when FDI reached its highest share in GDP (4.2% in 1997). The rising growth of FDI flow in the 1990s was caused by two factors: the economic policy introduced to promote foreign investment in strategic sectors (recently privatised) and the amendment of the foreign investment regulation that allowed an increase in the proportion of foreign ownership and investment in sectors previously protected.

The characteristics of FDI in Mexico seem to follow the general pattern in developing countries: they are usually focused on manufacturing activities, their plants are located close to economic centres and they produce for the external market. In 1980, 77% of FDI was located in manufactures, however since 1987 this proportion has been decreasing in favour of services. Services have attracted a large amount of investment, mainly to commercial banks, as a result of the openness of this sector (see Figure 4.9).

Figure 4.9
Foreign Direct Investment by economic sector (%).



	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998 p/	1999	2000	2001	2002
Services	8	10	12	11	11	13	13	17	23	25	29	32	34	34	26	28	27	22	24	19	27	69	44
Commerce	9	9	9	9	8	8	7	6	6	7	7	7	9	9	12	12	10	15	12	10	14	8	10
Manufactures	78	78	77	78	79	78	78	75	69	67	62	59	56	55	58	58	61	60	61	67	56	21	40

Source: INEGI
p/ preliminary
Note: the rest of FDI goes to construction, mining, electricity and livestock among others.

Another characteristic of FDI is that multinationals tend to locate their plants in strategic economic areas to take advantage of economic "poles". One of those strategic geographical areas is located along the border with the US and cities with high levels of industrialisation (for example Mexico City, Guadalajara, Monterrey and Puebla). Finally, multinationals in the manufactures tend to produce basically for the world market and additionally most of their trade consists of intra-industry transactions.

Trade reforms and changes in the foreign investment regulation were probably the main factors that boosted FDI, especially in industries such as automobiles, electronics and telecommunications. Each one of them has affected the domestic economy in a different degree. For example, most of the electronics plants are under the Maquiladora program, and according to INEGI, inputs from local producers to these plants represent around 2%. On the other hand, the automobile industry (which includes transnational corporations such as Ford, Chrysler and General Motors) has created more externalities to the local economy due to the regulations that establish minimum value added. These companies intensified their operations in Mexico during the 1980s as a consequence of the US strategy to compete with cheap Japanese cars. Contrary to maquiladoras, the automobile industry had a stronger regulation, for instance it was subjected to minimum requirements of domestic value added (which was 34%). Eventually, these regulations became compatible with NAFTA and now the requirement is 62.5% of regional (rather than local) content (Dussel, 2000). Local content requirements and a horizontal oriented production have created substantial spillovers to the domestic economy. The introduction of advanced technology and the application of new management methods constitute the main sources that have enhanced human capital development.

4.4. Evaluation of development strategies

This section is focused on the economic policies promoted by the government to induce growth and development. An analysis of two planning strategies is presented: the ISI and the outward orientation policy.

4.4.1. Import Substitution Industrialisation (ISI)

When the ISI was implemented after the Second World War, most of its fiscal, commercial and monetary policies focused on propelling national industrialisation to satisfy the domestic market. In the mid 1950s, scholars from the Dependency School, like Prebish (1959) and Singer (1950), pointed out that it was necessary to have in mind the structural differences between central economies and periphery countries before applying development policies. They thought that infant industries in developing countries required protectionism from international competition, especially from developed countries.

For Latin American countries, the deterioration in the terms of trade and foreign ownership were the main mechanism for the transfer of surplus value from the periphery to the centre. The ISI had two major objectives: to improve the balance of payments and industrialise the country through import substitutes' production. Some arguments in favour of the ISI were that the low demand for agricultural goods from the industrial nations, the fluctuation of their international prices, and the dependency on traditional exports could not guarantee high rates of economic growth and equilibrium in the balance of payments.

In the case of Mexico, it is said that this process intensified when the production of cotton and its commercialisation - the main activity in the north- collapsed in the mid-1960s due to synthetic goods. Additionally, the end of a temporary job programme between Mexico and the US increased unemployment. This situation was the main reason to elaborate an alternative programme applicable along the border, known as *Programa de Industrializacion Fronteriza*[22].

In addition to the agricultural sector, crude oil extraction and the petro-chemical industry were the main sources of financial resources. International oil price fluctuations were another key factor influencing the vulnerability of the economy. Meanwhile, across Latin America the instability and low levels of development were a common issue. The *Dependency* school in Latin America provided the theoretical and political basis to explain why underdevelopment was the result of the centre-periphery unequal relationship. Basically, they predicted that this relation of exploitation could not be broken, unless periphery countries limited the influence of external forces. The best way to achieve industrialisation and protect the economy at the same time was conceived under the ISI. It was expected that

[22] Among other objectives, this programme established an industrialisation scheme with preferential trade tariffs in order to allow temporary import of raw materials. At the same time, the US would concede preferential import tariffs and tax reductions to investors along the border. This was the antecedent of the assembly industry (or maquiladoras).

industrialisation would occurred in three phases, first the national industry would produce final goods; second they would produce intermediate goods and thirdly, the country would be able to produce capital goods (Flores, 1998).

During this period, the instruments used by trade policies were: quantitative restrictions, import licences, official prices, import tariffs and subsidies on capital goods and public services and final goods. On the other hand, national exporters received some fiscal and economic stimuli such as: certificates to reclaim taxes, tax exemptions in raw material imports and short-term credits. However, it became clear that it was more profitable to invest in import substitution goods that assured high revenues than to produce export goods and compete in the international market.

In the long run, the limitations of domestic markets did not permit exploitation of large-scale economies; and national investors had little incentives to improve product quality and technical methods. Prices were not really determined by the free market. Discrimination against exports affected economic growth because their decline restrained the possibility of financing deficits in the current account and also limited economic development.

At the same time, public investment growth rate increased dramatically for example, from 43% (between 1960 and 1965) to 70%, (between 1965 and 1970). On the other hand, the average growth rate of private investment average rate was 36% and 43%, in the same periods. Total investment experienced an abrupt rise in 1971, when President Luis Echeverria applied an expansive public policy to stimulate the economy. Such policy implied a strong government intervention financed by resources obtained from oil exports and external debt. Eventually, this untenable rising trend ended when international oil prices drop.

The economic crisis experienced in 1982 was the result of a set of many unsolved structural problems that automatically led the country to declare a moratorium on external debt. The debt renegotiation with international creditors made it necessary to reduce the public deficit and therefore public investment in the economy. From them on, the country experienced a structural change that favoured private investment in many sectors that were considered previously as national property.

The end of the ISI had many causes, protectionism created a dependent national industry on public funds while fiscal and commercial stimuli were unable to promote competitiveness and efficiency. Additionally the fixed exchange rate represented the strongest instrument of monetary policy to stimulate production as it allowed imports at competitive prices. Ultimately, all these instruments distorted market prices and did not reflect efficiency and real costs. On the contrary, they caused inadequate resource allocation that ended up affecting export production.

4.4.2. Outward oriented policy: investment and trade as sources of growth

Formally, the liberalisation process began during the administration of President Miguel de la Madrid (1982-1988), however other attempts to liberalise trade occurred between the years 1971-1975 and 1977-1980 but the opposition of domestic producers that have benefited from protectionism and subsidies along the years and an economy policy incongruent with the demand for structural changes led those attempts to fail (see Quiroga (1998) for a historical review). During the balance of Payment crisis (in 1976), President Jose Lopez Portillo (1976-1982) introduced a moderate liberalisation to diversify exports. Import licences were replaced by tariffs, official prices for imports and exports were removed and imports subjected to permits were reduced gradually (from 90% to 60%). At the same time, export production was stimulated through fiscal incentives and trade credits. Despite of these efforts, the current account still presented high deficits and crude oil remained as the most important export good during this period. When oil prices fell in 1982, the government abandoned this attempt to liberalise the economy and again introduced import licences to reduce imports.

President Miguel de la Madrid was a neo-liberal economist who differed from the Dependency School ideology regarding protectionism and industrialisation. He introduced economic reforms that included the privatisation of public enterprises, fiscal reforms, subsidy reductions and foreign investment promotion. In general terms, he instrumented an open strategy reliant on external sources (non-oil exports) and he would later implement measures to bring back the period of stabilisation but without protectionism. The crisis in 1982 had shown that the country could not longer rely on oil exports as its most important source of foreign exchange.

As it was mentioned before, the outward oriented policy was also the consequence of different circumstances that prevailed in the 1980s. The IMF intention letter signed by Mexico due to the external debt, was a preliminary step to open the economy to international competition. This was translated in a reduction of protectionism and the possibility of foreign capital to invest in areas that were considered restricted. To solve the problems of lack of resources after the moratorium on debt servicing, the government set as an objective to reach positive GDP growth rates. In 1984, the coverage of imports subject to license reduced from 83% to 27%, and tariffs on intermediate and capital goods were adjusted downward. In 1986 a tariff reduction was established to go from 100% to 30% in four stages but the Mexican accession to the GATT in that year accelerated this reduction to a maximum of 20%. In 1991 only 8.9% of imports value was subject to permits and the average tariff was 11%.

President Carlos Salinas who was also a neo-liberal economist, followed the same strategy to open the economy and to join international trade agreements. Salinas continued the privatisation process, so public enterprises were sold off or closed, they went from 449 enterprises in 1988 to 216 in 1994. Commercial banks were privatised as well as important companies such as Telefonos de Mexico, Fertilizantes Mexicanos, Aeromexico and Altos Hornos de Mexico. President Salinas introduced changes in the foreign investment law to allow foreign corporations and investors to own businesses and increase their share in financial assets. Article 27 in the Mexican Constitution was also modified to change the system of land tenure (ejidos) and facilitate foreign investment in this resource.

When liberalisation was first considered in 1976, national business lobbies lacked sufficient strength and perhaps motives to force entry to the GATT. By 1986, those businesses that were most likely to benefit from freer trade had increased significantly. Some suggest that Mexico moved rapidly toward free trade for four reasons: a institutional arrangement change, asymmetric information, commitments of policymakers and the shift in macroeconomic expectations of policy (Pastor and Wise, 1994).

One of the most important achievements of liberalisation was Mexico's integration to NAFTA in 1994. This was a result of an openness process that looked for regional and international integration to the world markets where Mexico had comparative advantages. NAFTA has increased even more Mexican exports to the North-America market but it has also diverted exports from third countries. At the same time, the geographical situation also favoured preferential tariffs among both countries even before NAFTA (a preferential agreement already existed since the early 1920s in the US-Mexican border).

Inevitably, the structural change caused affected many productive sectors that were inefficient and had large production costs. Many domestic producers reconsidered their role in the economy as a more open economy meant that they would have to compete with others. On the other hand, it forced them to use economic resources efficiently in order to remain in the market. Remaining enterprises had to invest in technological processes, in economies of scale and in satisfying international quality standards (for example ISO9000, Just in time, etc.). The reallocation of resources also created social costs due to jobs and production losses. According to Pastor and Wise (1994):

> "*While there are some direct beneficiaries from open trade, such as northern exporters with strong ties to US markets, most small and medium-sized producers largely have failed to cash in on the Mexico's recent export boom*" (pag. 467).

On the other hand, liberalisation has also led to an administration reform capable of supplying the infrastructure and regulatory schemes required for global and domestic investment. In some way it also forced a sensible management of government policies to guarantee economic and political stability, something that became determinant to attract international capital and gain credibility. This issue is controversial when the stability in nominal variables becomes the most important target for policy makers, more than solving urgent claims from the population. This sort of decision appears unfair to many anti-globalisation organisations and generates controversial opinions about the subordination of social investment.

It is evident that liberalisation has reduced the government's intervention in the economy. When Mexico entered the OECD (June 1994), it was seen as an event that consolidated the reforms started in the mid 1980s. Since then, there has been a process of economic openness leading to the reduction of administrative regulation, control of prices, the establishment of property rights and the compromise to keep minimum governmental intervention and, at the same time, to promote economic growth. According to the Fraser Institute (2001), there is a positive correlation between economic freedom and growth. They calculated a trade openness index (TOI)[23] that measures the degree of government

[23] The index is based on tariff rates, black market exchange rate premium, restrictions on capital movement and the actual trade size compared to its expected size. It goes from 0 to 10, 10 is the maximum level of openness.

intervention in international trade and it revealed that Mexico experienced the largest increase in its TOI from 1.8 (1980-1982) to 7.5 (1995-1997). Apparently the estimates indicate that every one-unit change of the index increases growth by two tenths of a percentage. During NAFTA, 57% of tariffs were eliminated, there are no more subsidies for national producers, or requirements to create value added (except regional content). The financial sector was opened to international capital, however the oil sector (in the hands of *Petroleos Mexicanos*) remained as a public property as well as other key industries.

4.5 Conclusions

At the beginning of the ISI period, Mexico experience high GDP growth rates (6.6% annual) and social conditions improved, however the economic dynamism was also accumulating structural problems that later would originate the first of many economic crisis. At the end of the 1960s, there was a significant deficit in the current account, an inefficient national industry, overvaluation and excessive public expenditure. Many adjustments were needed to maintain the same production dynamism as well as the same planning regimen. However, in the 1970s, the oil boom and the availability of cheap international loans led the government to depend strongly on oil exports, public spending and external debt to stimulate economic growth.

The weak national industry created by protectionism and the dependency in primary goods such as crude oil put the country in a vulnerable situation. During the 1970s and early 1980s, there was an intense increase in deficits not only in the current account but also in the fiscal balance. The oil prices decline in 1982 and the moratorium on the debt service were an indication that a strategy based on a paternalist economic model had come to an end. The debt crisis was the most important factor to re-evaluate protectionism. The renegotiation of the debt service and the transition to a neo-liberal administration were the precedents for considering the viability of an outward oriented strategy.

Openness was a feasible way to achieve growth through the promotion of international trade and foreign investment. Both were seen as ways to improve welfare conditions as well as the production structure. Liberalisation in the 1980s has led Mexico to become member of international organisations as well as to sign free trade agreements with its most important trade partners in America and Europe. Through this process, Mexico has achieved diversification in its export structure, from oil to manufactured goods. In general, international trade and FDI have increased their share in GDP.

On the other hand, trade liberalisation and foreign investment represent a two-side situation for the Mexican economy. Openness by itself cannot solve structural problems if there is not an effort to maintain macroeconomic stability. Poverty has not been alleviated and real wages have deteriorated despite rises in productivity.

Exports and foreign investment now play an important role in the economy due to stability policies to achieve inflationary and output growth targets. However, as a developing country, the role of the government is essential in this process. Openness by itself is not enough to take Mexico to the next development stage, government intervention (in a very different perspective from the predictions of the Keynesian or Dependency scholars) is needed. Intervention is still necessary to guarantee equilibrium in the fiscal balance, in the resource allocation, in the provision of infrastructure, in the control of money supply but at the same time in the creation of economic conditions to stimulate domestic and foreign investment.

CHAPTER 5: ANALYSIS OF EXPORTS, FDI AND OUTPUT GROWTH THROUGH GRANGER CAUSALITY, IMPULSE- RESPONSE FUNCTIONS AND VARIANCE DECOMPOSITION

5.1. Introduction

The outward oriented strategy placed foreign capital and exports as important mechanisms to affect output growth directly and indirectly through positive externalities. In this chapter, we investigate the nature of these relationships through a Vector Autoregressive framework and different analysis techniques that derive from it, such as Granger causality tests, impulse-response functions and variance decomposition.

Since the late 1970s, it is possible to test the validity of the export-led growth theory in developing countries due to the availability of sufficient data. In the specific case of Mexico, we want to investigate in a multivariate framework if exports and FDI have been crucial elements to explain economic growth, this implies to test the hypothesis that both exports and FDI have a positive and statistically significant effect on output growth. Considering the relevant role of NAFTA as trade agreement signed with the most important partners (the US and Canada), we investigate if it has made a difference in the way exports, FDI and GDP interact. Finally, a dynamic analysis through impulse-response functions is presented in which we analyse how the variables respond to shocks occurring in the innovations and in this way, determine if policy changes are likely to create a positive response in the long-run.

The specific questions we seek to answer are: Is there a meaningful causal relationship among exports, foreign direct investment and GDP? What is the nature of such relationship? Are there any cointegrating vectors that suggest a long-run relationship? Has NAFTA improved the effect of exports and FDI on growth? What is the response of GDP, FDI and exports to shocks in the innovations? And, are the responses consistent with exogenous policy shocks?

The econometric procedure to answer these questions required testing for stationarity through unit root tests (ADF and Phillips-Perron tests). Then we estimated a VAR system and determined the lag structure that satisfied mathematical stability and residual tests such as normality, serial correlation and heteroskedasticity. Due to the non-stationarity of the series, we also tested for cointegration. Finally, from the appropriate set of equations we estimated the impulse-response functions and variance decomposition to analyse how the variables respond to shocks in the innovations.

The series employed are GDP, FDI (taken as its four moving average (4) to smooth the high fluctuations[24]) and exports. Exports do not include crude oil to avoid overestimating its effect on output. For many years (before and after liberalisation), crude oil represented the main exported good in Mexico and our interest was to measure the effect of non-oil exports linked to liberalisation (i.e. manufactures and services). Otherwise, the effect of total exports on economic growth would be overestimated.

All the series are presented in quarterly frequency starting from 1980:01 and ending in 2002:04. They were converted from nominal to real terms using the implicit price index and export index (1993=100). All the series were measured in million dollars and transformed to natural logarithms to reduce the variance. See appendix 5A for a detailed explanation on how they were computed and the source of information.

This chapter contains apart from the introduction, six sections. Section 5.2 presents the econometrics of the VARs, the way it can be used to analyse the interactions between the variables and the property of the residuals. The three techniques derived from VARs are explained in this section: Granger Causality Tests, Impulse-Response Functions and Variance Decomposition. Section 5.3 contains the modelling of liberalisation and output growth in Mexico, the criteria followed to estimate the VAR and the diagnostic tests on the residuals. In Section 5.4, we present the results of Granger causality tests and show the statistical

[24] FDI is measured in quarterly flows.

significance of the estimates. Section 5.5 contains the estimations of the Impulse-Response functions. Section 5.6 presents the Variance Decomposition analysis and finally Section 5.7 concludes with an evaluation of the empirical findings.

5.2 Econometric analysis with a Vector Autoregressive (VAR)

A standard VAR is a useful mechanism to determine the interactions between different variables because it does not impose *a priori* restrictions on the causal relationship between the variables. Instead, the variables are considered endogenous and only further analysis can tell the cause-effect relationship that prevails[25]. A VAR is normally expressed in reduced form rather than the structural form[26]. In general, with multiple variables and lags:

$$y_t = \Pi_0 + \Pi_1 y_{t-1} + \Pi_2 y_{t-2} + ... + \Pi_p y_{t-p} + \varepsilon_t \qquad (5.1)$$

where $y_t = (y_{1t}, y_{2t} ... y_{nt})'$ is an (nx1) vector of n endogenous variables, Π_0 is an (nx1) vector of constants, Π_j is an (nxn) matrix of autoregressive coefficients[27] for j 1 p, where p is the lag length and ε_t is an (nx1) vector of white noise innovations:

E(ε_t)=0

E(ε_t $\varepsilon_T^{'}$)= $\begin{cases} \Omega, t = T \\ 0, otherwise \end{cases}$

The innovations are independent Gaussian, this means that they have mean zero and variance Ω, situation that implies that the errors are serially uncorrelated but correlated across equations.

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[25] We only refer to unrestricted standard VARs. However it is also possible to impose restrictions on some variables for specific purposes and even include exogenous variables in the system.

[26] In the structural form, a variable is not only regressed against lagged values but also against contemporaneous values of other variables in the system.

[27] Π_j is an (nxn) matrix of autoregressive coefficients. j 1,2…p. j the superscript indicates the corresponding lag. When the system has only one lag, the superscript is usually omitted.

For convenience in this study we specify the VAR in the companion form[28] (see Hamilton, 1994 and Patterson, 2000), which is a representation of a VAR(p) as it only contained one lag.

$$ {}_t = A_0 + A_1 \; {}_{t-1} + E_t \qquad (5.2)$$

Y_t (in capitals) is a vector of stack endogenous variables at the same lag order. For example, a VAR(p) with n endogenous variables in the companion form is equal to:

$$\underset{(nxp)x1}{} = \begin{bmatrix} y_t \\ y_{t-1} \\ \vdots \\ y_{t-p-1} \end{bmatrix} \qquad \underset{(nxp)x1}{A_0} = \begin{bmatrix} \beta_t \\ 0 \\ \vdots \\ 0 \end{bmatrix} \qquad \underset{(nxp)x(nxp)}{A_1} = \begin{bmatrix} \Pi_1 & \Pi_2 & \Pi_3 & \dots & \Pi_p \\ I & 0 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & I & \dots & 0 \end{bmatrix}$$

and $$\underset{(nxp)x1}{E_t} = \begin{bmatrix} \varepsilon_t \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

I is a (nxn) identity matrix, O is a (nxn) null matrix and A_1 is the matrix of the characteristic polynomial.

An important condition that the VAR must satisfy is mathematical stability, this guarantees that regardless of any shock causing a disturbance in the system, it will eventually return to its long run equilibrium. Stability is obtained if all the roots of the characteristic polynomial are less than one in absolute value. In other words, it has to satisfy: $|A_1 - \lambda I| = 0$. The number of roots in the model equals the number of endogenous variables times the number of lags (*nxp*).

A moot point in the estimations of VAR is the lag order selection. There is not a unique way to decide on what grounds we should select the lag order, one way is to compute

[28] The companion form transforms a p[th] order VAR(p) to a VAR(1).

different lag criteria such as the sequential modified likelihood ratio (LR), Akaike information criterion (AIC), Schwarz information criterion (SC), etc and use one or a combination of them to select the lag order that best fit those criteria. An inconvenience of this procedure is that the lag order selected may or may not satisfy the stability condition or some of the diagnostic tests. For this reason, we combined the lag order criteria with the residual tests and stability condition of the system. In conflicting cases, we gave priority to the latter.

5.2.1 Property of VARs

This section contains a brief description of the diagnostic tests that are usually applied to the VAR as a system and to each equation. The tests on the residuals guarantee that the usual assumptions about the errors are satisfied and the estimates are consistent and unbiased.

5.2.1.1 Serial correlation

The existence of autocorrelation in the residuals is an indication that the assumption $E(\varepsilon_i \varepsilon_j) = 0$ has been violated. It is important to be sure that there is no autocorrelation in the residuals because, otherwise the standard errors will be invalid. A general test for high order serial correlation is the Lagrange Multiplier (LM) test which is asymptotically distributed as Chi-square with k^2 degrees of freedom, where k is the number of variables in the original equation. The test is computed using the auxiliary regression:

$$\hat{u} = \sum_{i=1}^{k} y_{it}\gamma + \sum_{i=1}^{p} \hat{u}_{t-1}\rho_i + \eta_t \tag{5.3}$$

$$\eta \sim IN(0, v^2)$$

where $\hat{u}$ are the residuals from the estimations, y_{it}, are the right-had regressors, γ the coefficients, p is the number of lags and η_t is an error term. In this model we test the null hypothesis that there is no serial correlation up to lag order p: $H_0 : \hat{\rho}_1 = \hat{\rho}_2 = ... = \hat{\rho}_p = 0$.

5.2.1.2 Heteroskedasticity

The existence of heteroskedasticity in the errors implies that the assumption of constant variance in the errors is violated, this means that $V(\varepsilon_t) \neq \sigma^2$. If this is the case, heteroskedasticity in the errors will not affect the unbiasedness of the OLS estimates but it will affect their precision. The standard errors will be biased and the tests of statistical significance cannot be valid.

A test for heteroskedasticity is the *White Test* which requires an auxiliary regression with the squared residuals obtained from the VAR estimation on all the variables, their squares and their cross products. For instance, if there are only two independent variables then the residuals square (RES^2) will be regressed on the following variables, $y_{1t}, y_{2t}, y_{1t}^{\ 2}, y_{2t}^2, y_{1t}y_{2t}$.

$$\text{RES}^2 = \beta_1 x_t + \beta_2 y_t + \beta_3 x_t^2 + \beta_4 y_t^2 + \beta_5 x_t y_t \qquad (5.4)$$

Sometimes it is optional to exclude the cross products of the variables, since it reduces the degrees of freedom, especially when there are too many variables in the system. The null hypothesis states no heteroskedasticity in the errors and the distribution is Chi-square. To accept the hypothesis, the *obs* R^2 statistic (computed as the R^2 of the regression multiplied by the number of observations), the coefficients should not be statistically significant. This test can be applied to the individual equations, but for the system as a whole; we use a vector heteroskedasticity test which amounts to regress the endogenous variables on all squared regressors by GLS. Then we test the statistical significance of the coefficients.

5.2.1.3 ormal distribution

It is also important to check that the residuals are normally distributed, this is done with the Jarque-Bera (J-B) statistic. This statistic measures if there is a significant difference of skewness and kurtosis of the residuals from the normally distributed residuals. The null hypothesis is that the residuals are normally distributed. The J-B has a Chi-square distribution. Two components of this statistic are Skewness and Kurtosis. Skewness measures the symmetry of a normal distribution and its expected value is zero. Regarding Kurtosis, this is an indicator that measures how peaked and flat the distribution is, a normal distribution is expected to have kurtosis equal to 3.

5.2.1.4 Structural change

When we run a regression we are implicitly expecting that the assumptions of the model will apply to all the observations in the sample. In other words, the disturbance variance is expected to be the same every time we regress a model using different subsets (for example in different samples or periods). Stability tests such as the Breakpoint Chow and Forecast Chow tests show if the parameters are stable and if there is no structural change among different subsets of the data.

5.2.2 Granger causality test

In the literature, there is a large number of bivariate analyses using this method (Iscan (1997), Marin (1992) and Thornton (1996)) and more complete studies applying Granger causality in a multivariate framework (Love and Chandra (2004) and Cuadros et al. (2000)). The purpose of applying the Granger causality test (Granger, 1969) is to find the nature of the causal relationship among the variables. This technique does not imply a proper measure of causality but an investigation of whether past information of x improves the forecast of y. Statistically speaking, it tries to measure if the inclusion of past information on x reduces the mean square error of the equation.

Formally, Granger causality can be obtained by estimating the following equations (as an illustrative example we consider two variables):

$$y_{1t} = \sum_{j=1}^{p} a_j y_{1,t-j} + \sum_{j=1}^{p} b_j y_{2,t-j} + \varepsilon_{1t} \tag{5.5}$$

$$y_{2t} = \sum_{j=1}^{p} c_j y_{1,t-j} + \sum_{j=1}^{p} d_j y_{2,t-j} + \varepsilon_{2t} \tag{5.6}$$

In this model, y_{1t} and y_{2t} are stationary time series, p is the lag length and ε_{y1t} and ε_{y2t} are uncorrelated white noises. According to Granger, the definition of causality implies that y_{2t} (y_{1t}) does Granger cause y_{1t} (y_{2t}) if we reject the null hypothesis that b_j =0, ($c_j = 0$). What this test tells us is that if changes in y_{1t} are to cause changes in y_{2t}, then changes in y_{1t} must precede a change in y_{2t}. In this sense, we should talk about precedence instead of causality. There are two possible outcomes to the test results: if we reject at least one of the two hypotheses then there is a unidirectional relationship between y_{1t} and y_{2t}. If we reject both hypotheses then there is bidirectional causality going from y_{1t} to y_{2t} and from y_{2t} to y_{1t}. Alternatively, in a system of three equations, there is a possibility of indirect causality between two variables, this indirect causality has already been applied empirically (see Sharma et al, 1994).

The test requires stationary series. If the series are found to be nonstationary in levels, then according to the Granger representation theorem an ECM should be included in the stationary model if the series are cointegrated. The objective is to capture the short term deviations from their long term equilibrium path. The system would have to be estimated as a Vector Error Correction (VEC) such as:

$$\Delta y_{1t} = \sum_{j=1}^{p} a_j \Delta y_{1,t-j} + \sum_{j=1}^{p} b_j \Delta y_{2,t-j} + \kappa_1 ECM_{t-1} + \varepsilon_{1t} \qquad (5.7)$$

$$\Delta y_{2t} = \sum_{j=1}^{p} c_j \Delta y_{1,t-j} + \sum_{j=1}^{p} d_j \Delta y_{2,t-j} + \kappa_2 ECM_{t-1} + \varepsilon_{2t} \qquad (5.8)$$

The presence of cointegration means that two or more I(1) variables have a linear combination that is stationary ~ I(0). It indicates if non-stationary variables do not drift apart from each other and tend to come back to a long run relationship. To estimate the number of cointegrating vectors (*r*) in a multivariate system, the most popular method is the Johansen procedure developed by Johansen (1991) and Johansen and Juselius (1990). This technique applies maximum likelihood to a VAR model under the assumption that the errors are white noise. The procedure relies on two test statistics: the trace statistic and the maximum eigenvalue statistics:

$$Trace = -N \sum_{i=r+1}^{m} \ln(1 - \hat{\lambda}_i)$$

$$\lambda_{\max} = -N \ln(1 - \hat{\lambda}_{r+1})$$

N is the number of observations, *m* is the number of endogenous variables and $\hat{\lambda}_i$ is the i-th largest estimated eigenvalue of the characteristic polynomial. The trace statistics tests the null hypothesis that there are at most *r* cointegrating vectors while the alternative is that there are more than *r* cointegrating vectors. The maximum eigenvalue tests the null that there are *r* cointegrating vectors against the alternative that there are *r*+1 cointegrating vectors.

On the other hand, if the series are I(1) but no cointegration is found, then estimations of the VAR in first differences can provide valid results of Granger causality.

5.2.3 Impulse-response functions

One important aspect of dynamic multivariate systems is that –provided they are mathematically stable- they can be used for dynamic policy simulation. The impulse-response functions are important tools that portray the expected path over time of the variables to shocks in the innovations; these functions indicate which variables respond stronger to certain external shocks. In different empirical studies impulse response functions have been used to distinguish temporal from permanent shocks (Bayoumi and Eichengreen, 1994), in our case they will be used to determine the extent to which every endogenous variable reacts to an innovation of each variable.

The impulse response functions are generated by a Vector Moving Average (VMA), a representation of a VAR in standard form in terms of current and past values of the innovations (ε_t). We derive the VMA from equation (5.1), assuming there is only one lag and no constant term:

$$y_t = \Pi_0 + \Pi_1 y_{t-1} + \varepsilon_t \tag{5.9}$$

Π_1 is a matrix of coefficients from the reduced form and Π_0 is a vector of constants. Lagging this system one period and substituting for y_{t-1}:

$$y_t = \Pi_0 + \Pi_1(\Pi_0 + \Pi_1 y_{t-2} + \varepsilon_{t-1}) + \varepsilon_t \tag{5.10}$$

$$= (I + \Pi_1)\Pi_0 + \Pi_1^2 y_{t-2} + \Pi_1 \varepsilon_{t-1} + \varepsilon_t$$

if we keep on substituting *n* times, eventually we get the following expression:

$$y_t = (I + \Pi_1 + ... + \Pi_1^n)\Pi_0 + \Pi_1^{n+1} y_{t-n+1} + \sum_{i=0}^{n} \Pi_1^i \varepsilon_{t-i} . \tag{5.11}$$

If we assume that there is stability in the model (the characteristic roots of Π have modulus less than one) then in the limit $\lim_{n\to\infty} \Pi_1^n = 0$ holds, under these conditions we end up expressing y_t as a process generated by an infinite sum of lagged random errors weighted by diminishing coefficients plus a mean μ:

$$y_t = \mu + \sum_{i=0}^{\infty} \Pi_1^i \varepsilon_{t-i} \tag{5.12}$$

This is known as a VMA representation and from this, it is possible to trace out the time path of different shocks to the variables in the VAR. Using the lag operator, the VMA is equal to:

$$y_t = \mu + \Psi(L) \in_t \tag{5.13}$$

Matrix Ψ contains the impulse-response functions; a coefficient in Ψ will describe the response of an endogenous variable y_i at time t+s to a one unit change in the innovation $\in_{jt}$, ceteris paribus. Or:

$$\frac{\partial y_{i,t+s}}{\partial \in_{jt}} = \Psi_s \tag{5.14}$$

s refers to the period. So we have that each coefficient measures the response of the modelled series to shocks in the innovations. Depending on the number of periods used in the equations, the impulse response functions will show the time path due to shocks in the error terms. If the stability condition is satisfied, the response of a variable to a shock in the system will move it away from its equilibrium but eventually will tend to return to it. The speed of adjustment will depend of the influence of each shock in the variable.

Unfortunately the residuals in the VAR are correlated and the model is under identified; for this reason it is necessary to apply a transformation to the innovations so that they become uncorrelated. One way is by transforming the VAR in a model where the errors are not contemporaneously correlated, this can be done through the orthogonalisation of the innovations (Charemza and Deadman, 1997). Another way –which is used in this study- is the Cholesky decomposition. This is a matrix decomposition of a symmetric matrix into a lower triangular matrix and its transpose. In this case, using the residual covariance matrix (Ω) as the symmetric matrix, we can decompose it into:

$$\Omega = PP^T \quad \text{where } P = AD^{1/2} \tag{5.15}$$

A is a lower triangular matrix with 1's along the principal diagonal and *D* is a unique diagonal matrix whose (j, j) element is the standard deviation of the residual j. *P* is a lower triangular matrix. Using matrix *A*, we can express v_t as a vector of uncorrelated residuals $v_t = P^{-1} \in_t$. The reason is that *D* is a diagonal matrix that contains only uncorrelated elements. Every column in *P* (denoted as p_j) will capture how the forecast of all innovations changes as a result of new information (besides the information contained in the system). If we incorporate this component in (5.14) we get:

$$\frac{\partial y_{t+s}}{\partial v_{jt}} = \Psi_s p_j \tag{5.16}$$

Each coefficient in the expression above will describe the response of the endogenous variable to a unit change in the innovations over time.

5.2.4 Variance decomposition

Generally VARs become over-parameterised with the inclusion of many lags on the right-hand side of the equation, which makes short-run forecasting difficult to achieve. To overcome this situation and understand the relationship among the variables it is common to analyse the properties of the forecast error. The variance decomposition analysis provides useful information about the relative importance of each innovation in affecting the variables in the system. This means that it is possible to separate the proportion of the movements in a sequence due to its own shocks and other variables' shocks. We can obtain the variance decomposition using the same VMA representation that was previously obtained (equation 5.13), if we forecast y_{t+n} n periods ahead, the ahead forecast error will be:

$$y_{t+n} = \mu + \sum_{i=0}^{\infty} \phi_i \in_{t+n-i} \tag{5.17}$$

The n-period forecast error is equal to the difference between the realisation of y_{t+n} and its conditional expectation:

$$y_{t+n} - E_t(y_{t+n}) = \sum_{i=0}^{n-1} \phi_i \in_{t+n-i} \tag{5.18}$$

The variance of the n-step ahead forecast error, denoted as $\sigma_{yt}(n)^2$, for each variable in the vector $y_t = [y_{1t}, y_{2t}, ... y_{nt}]'$ is equal to:

$$\sigma_{yt}(n)^2 = \sigma_{y1t}^2[\sum_{i=0}^{n-1} \phi_i^{\ 2}] + \sigma_{y2t}^2[\sum_{i=0}^{n-1} \phi_i^{\ 2}] + ... + \sigma_{ynt}^2[\sum_{i=0}^{n-1} \phi_i^2] \tag{5.19}$$

From this expression it is possible to decompose the variance of the forecast error and isolate the different shocks, specifically we can separate the different proportions of the variance due to shocks in the sequence $\{\in_{yt}\}$. For example, in the case of having only two variables, (y_{1t} and y_{2t}), the variance decomposition of the forecast error of y_{1t} can be found by dividing equation (5.19) by $\sigma_{y1t}(n)^2$, (for a detailed explanation see appendix 5B). In this way we can get the proportions of $\sigma_{y1t}(n)^2$ due to movements in its own sequence $\{\in_{y1t}\}$ and sequence $\{\in_{y2t}\}$:

$$1 = \frac{\sigma_{y1t}^2[\phi_{11}(0)^2 ... \phi_{11}(n-1)^2]}{\sigma_{y1t}(n)^2} + \frac{\sigma_{y2t}^2[\phi_{12}(0) ... \phi_{12}(n-1)^2]}{\sigma_{y1t}(n)^2}$$

It is usual that $\in_t$ shocks to a specific variable will explain most of its own forecast error variance, especially at short horizons. Eventually, this proportion tends to decrease.

5.2.5 Testing for unit root

A series is considered to be stationary if its mean, variance and autocovariance are independent of time. Nonstationarity is a common problem likely to be found in macroeconomic variables; the reason is that macroeconomic series tend to increase over time, especially in long periods of time. Sims (1980) showed that contrary to the traditional idea that macroeconomic aggregate variables in the US follow and move around a trend, those variables could really be modelled as random walks.

At the end of the 1970s there was a growing concern about estimating regressions with time series that were really statistically independent random walks. The problem was that traditional significance tests tended to show statistical significance and high coefficients of determination (R^2), even though the regressions were spurious (Phillips, 1986). In response to this, Dickey and Fuller established a procedure to test formally for unit roots and provided critical values that should be used to ascertain if a series had a unit root. Technically speaking a time series is a collection of random variables. In a simple generating process such as an AR(1), a variable $_t$ is equal to $\beta \; _{t-1} + \varepsilon_t$, where the errors have zero mean and constant variance, $\varepsilon_t \sim N(0, \sigma^2) \forall t$. If β is zero, then the value of in time t will be equal to the error term and past values of   will not have an influence on it. A random walk is a special case of an AR(1), where β =1. This implies that the value of   in one period will be equal to its value in the preceding period plus a random error. In economic terms this means that a variable will carry permanent shocks into the future, creating apparent trends that are not really there. Using nonstationary series to estimate an equation will provide spurious regressions. It is also likely that the residuals show autocorrelation because the assumption that the error terms from successive observations are uncorrelated will not be valid.

In order to check for stationarity the following general model is considered, which is the Augmented Dickey-Fuller (ADF) regression:

$$\ _t = c + \beta t + \gamma\ _{t-1} + \gamma_1 \Delta\ _{t-1} + \ldots + \gamma_p \Delta\ _{t-p} + \varepsilon_t \qquad (5.20)$$

where *c* is a constant, *t* is a time trend and γ_p is an autoregressive coefficient. The disturbance in the model is assumed to be white noise, this is $\varepsilon_t \sim N[0, \sigma^2]$ and $Cov[\varepsilon_t, \varepsilon_s] = 0 \ \forall t \neq s$.

The null hypothesis to test is $H_0 : \gamma = 1$, and the test statistics for the ADF test is:

$$ADF_\tau = \frac{\hat{\gamma} - 1}{SE_\gamma}$$

A more popular way to test the significance of the coefficient is by subtracting $_{t-1}$ from both sides of equation (5.20):

$$\ _t - \ _{t-1} = c + \beta t + \gamma\ _{t-1} - \ _{t-1} + \gamma_1 \Delta\ _{t-1} + \ldots + \gamma_p \Delta\ _{t-p} + \varepsilon_t$$

$$\Delta\ _t = c + \beta t + (\gamma - 1)\ _{t-1} + \gamma_1 \Delta\ _{t-1} + \ldots + \gamma_p \Delta\ _{t-p} + \varepsilon_t$$

$$\Delta\ _t = c + \beta t + \gamma^*\ _{t-1} + \gamma_1 \Delta\ _{t-1} + \ldots + \gamma_p \Delta\ _{t-p} + \varepsilon_t \qquad (5.21)$$

Where $\gamma^* = \gamma - 1$, now the t-test is $ADF_t = \frac{\hat{\gamma}^* - 0}{SE_{\gamma^*}}$. In this case we are testing the null hypothesis that $\gamma^* = 0$.

Phillips (1986) developed an asymptotic theory to show that *t* and *F*-radio tests statistics do not have limiting distributions as the sample size goes to infinite. It seemed that traditional tests failed to detect that statistically significant parameters could produce spurious regressions. In this context, Phillips and Perron (1988) elaborated a non-parametric test for detecting unit roots in time series models. Basically, they estimate the ADF regression but controlled for serial correlation. This implied a modification of the t-ratios. In this study, both tests are applied to see the consistency of the results.

5.3. Modelling of GDP, FDI and exports with VARs

In this section, the series are modelled in a VAR framework in order to investigate the dynamics among them. Even though one of the purposes is to test the Export-led growth hypothesis, we assume no direction in the potential causal relationship since it is possible that a growing host economy may influence FDI or exports. The convenience of using VARs to model these interactions is crucial as it allows treating all the variables as endogenous.

A visual examination of Figures 5.1, 5.2 and 5.3 suggest that the logs of GDP, exports, and to a lesser extent FDI, may be non-stationary as they follow a tendency to grow over time. These variables seem to be linearly trended so unit root tests can detect if the variables' means are really time-dependent.

Figure 5.1

Log of Gross Domestic Output (LGDP)

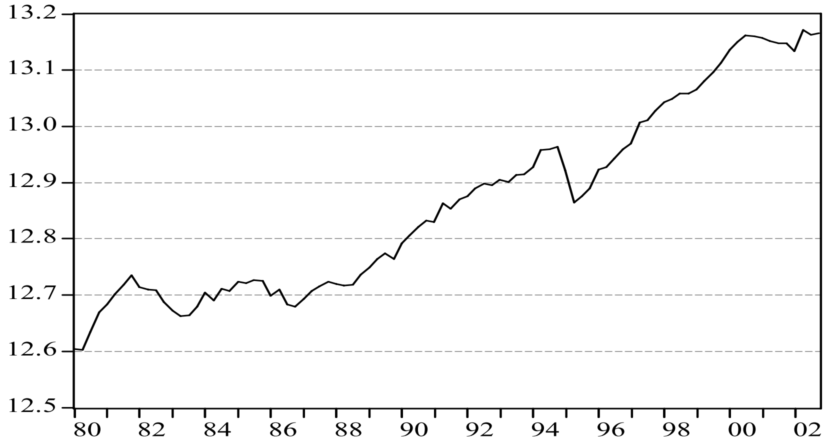


Figure 5.2

Log of Foreign Direct Investment (LFDI)

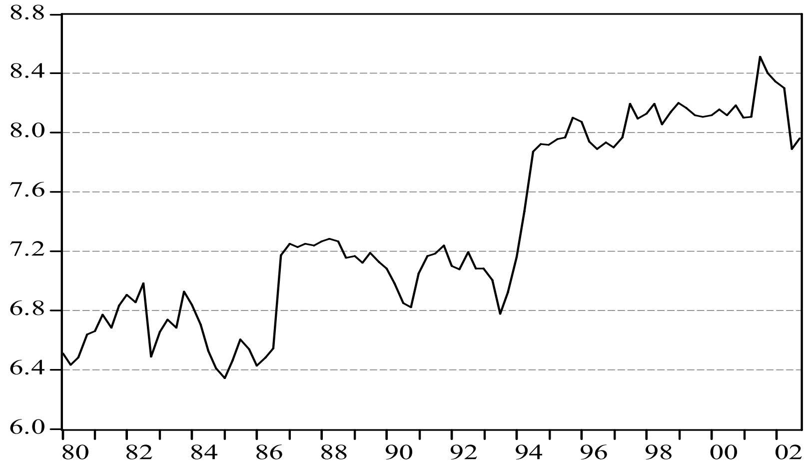
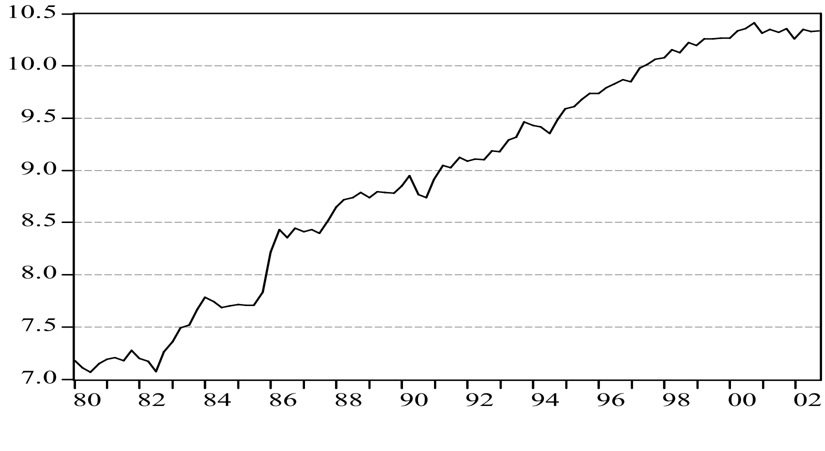


Figure 5.3

Log of Exports (LEX)



The following table contains the results of the ADF and Phillips-Perron tests statistics and probabilities in parenthesis.

Table 5.1 Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) statistics and probabilities. Series are in levels.
Null hypothesis: there is unit root.

	ADF	P-P
	Constant & Trend	Constant & Trend
LGDP	-1.6640 (0.7591)	-2.0328 (0.5754)
LFDI	-2.6131 (0.2757)	-2.9290 (0.1585)
LEX	-1.6020 (0.7847)	-1.7494 (0.7209)

Notes: LGDP, the log of GDP; LFDI, the log of Foreign Direct Investment and LEX, the log of exports. Computations were performed using E-views.
Test critical values: -4.06 (at 1%) and -3.45 (at 5%). MacKinnon (1996) one-sided p-values.

Table 5.1 shows that the ADF test statistics failed to reject the null of a unit root. The same occurs with the Phillips-Perron test. Finding unit roots has important implications for the accuracy of any analysis that we attempt to do. For example, a non-stationary GDP implies that the errors have a memory and will carry permanent shocks to future values; regressions with this sort of variables will be spurious. Therefore, it is required to transform the series into stationarity by making its moments independent of time. One way is by stabilising the variance which requires transforming the series into logarithms; this reduces the fluctuation across time. Another way is by transforming the series to first differences. This solution has the advantage that the new series will not have a changing mean through time and then the assumptions of the OLS are likely to be valid.

We applied both unit root tests to the series in first differences and this removed the problem of non-stationarity (see Table 5.2).

Table 5.2 Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) statistics and probabilities. Series are in first differences.
Null hypothesis: there is unit root.

In first differences	ADF	P-P
	Constant & Trend	Constant & Trend
DLGDP	-7.7880*** (0.000)	-7.8635*** (0.000)
DLFDI	-6.7030*** (0.000)	-8.8106*** (0.000)
DLEX	-5.9553*** (0.000)	-9.3672*** (0.000)

Notes: DLGDP, the first difference of log of GDP; DLFDI, the first difference of log of Foreign Direct Investment; DLEX, the first difference of the log of exports.
Levels of statistical significance: 1% (***).
MacKinnon (1996) one-sided p-values.

The results show that first differentiation solves the problem of non-stationarity. LGDP, LFDI and LEX are integrated of order one ~ I(1).

According to the Granger Representation Theorem, if nonstationary variables are cointegrated, then an ECM should be included in the system. Therefore, we applied the Johansen Cointegration test to determine if there was a long run relationship among the variables. The test required the estimation of an unrestricted VAR in levels such as:

$$y_t = \Pi_0 + \Pi_1 y_{t-1} + \Pi_2 y_{t-2} + ... + \Pi_p y_{t-p} + \varepsilon_t$$

In our case, $y_t' = (LGDP_t, LFDI_t, LEX_t)$ and p is the lag order. The chosen number of lags followed the criteria previously described (i.e. the system has to be mathematically stable and the residual tests have to be satisfactory). In this way, we found that a VAR containing six lags was the best system to test for cointegration, the diagnostic tests showed no serial correlation, heteroskedasticity and the system was mathematically stable (see appendix 5C for stability condition and diagnostic tests). The VAR also met lag order criteria such as AIC and LR test statistic.

In Table 5.3 we present the results of the Johansen Cointegration test to the VAR(6), the third column reports the trace and the maximum eigenvalue statistics and the last two columns, the critical values at 95% and 99%.

Table 5.3 Results of Johansen's cointegration test
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 to 5

Hypothesized No. of CE(s)	Eigenvalue	**Trace Statistic**	95 %	99%
None	0.170842	27.53601	29.68	35.65
At most 1	0.077809	11.42438	15.41	20.04
At most 2 *	0.050518	4.458096	3.76	6.65
		Max-Eigen Statistic	95 %	99%
None	0.170842	16.11163	20.97	25.52
At most 1	0.077809	6.966280	14.07	18.63
At most 2 *	0.050518	4.458096	3.76	6.65

* denotes rejection of the hypothesis at the 5% level
Trace test indicates no cointegration at both 5% and 1% levels
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels

Both, the trace statistics and the max-eigenvalue fall inside the critical values at 5% and 1% levels of significance. These results indicate that we cannot reject the null hypothesis of no cointegrating vectors; the rank of the long run vector is zero. Under these circumstances, an ECM should not be included in the system. Instead, Granger causality can be tested by running the VAR in first differences.

Using the standard form of the VAR with three endogenous variables in first differences, $y_t' = (DLGDP_t, DLFDI_t, DLEX_t)$, the system to estimate is:

$$DLGDP_t = \pi_{10} + \sum_{i=1}^{p} \pi_{1i} DLGDP_{t-i} + \sum_{i=1}^{p} \pi_{1i} DLE_{t-i} + \sum_{i=1}^{p} \pi_{1i} DLFDI_{t-i} + \varepsilon_{1t} \quad (5.22)$$

$$DLFDI_t = \pi_{20} + \sum_{i=1}^{p} \pi_{2i} DLGDP_{t-i} + \sum_{i=1}^{p} \pi_{2i} DLE_{t-i} + \sum_{i=1}^{p} \pi_{2i} DLFDI_{t-i} + \varepsilon_{2t} \quad (5.23)$$

$$DLE_t = \pi_{30} + \sum_{i=1}^{p} \pi_{3i} DLGDP_{t-i} + \sum_{i=1}^{p} \pi_{3i} DLE_{t-i} + \sum_{i=1}^{p} \pi_{3i} DLFDI_{t-i} + \varepsilon_{3t} \quad (5.24)$$

Where $DLGDP_t$ is the first difference of the log of GDP; $DLFDI_t$: the first difference of the log of FDI and $DLEX_t$: the first difference of the log of exports; π_{kk} : Autoregressive coefficients; ε_t : disturbance term and p: lag length

Granger causality can be derived in two alternative ways, one is to apply an F-test or Chi-square test of joint significance (*Wald test*) to the VAR and then test the null hypothesis of statistical significance of the corresponding coefficients in each equation. Another way (which should be used only when no cointegration was found) is applying F-test to a pairwise of variables directly to the VAR estimations.

To determine the number of lags, the general to specific approach (Hendry, 1974) was considered, which implies the estimation a VAR using a large number of lags and then reduce it as the estimations improve (based on mathematical stability and diagnostic tests). Following this procedure, it was found that the best system contained eight lags. The lag structure was also suggested by the Likelihood Ratio (LR) criterion (at 5% level), which was equal to 5.843[29].

Regarding the stability of the VAR, the eigenvalues of matrix A_1 (see equation 5.2) were calculated in order to obtain the roots and moduli and then evaluate if they are less than one in absolute value. Table 5.4 presents these results. We confirm that none of the roots are higher than one in absolute value; the VAR is mathematically stable. Accordingly, no shock to the system will have an infinite memory and so will not persist forever in time, making policy analysis (e.g. impulse response functions) possible.

[29] Other lag order selection criteria such as the Final Prediction Error (FPE) and Akaike Information Criterion (AIC) suggested four as the lag order for the VAR. However, with this lag order, diagnostic tests showed the presence of serial correlation and heteroskedasticity in the residuals.

Table 5.4 Stability Condition of the VAR(8).
Roots of Characteristic Polynomial

Root	Modulus
0.957504	0.957504
-0.948239	0.948239
-0.759905 - 0.512767i	0.916725
-0.759905 + 0.512767i	0.916725
0.023361 + 0.901398i	0.901701
0.023361 - 0.901398i	0.901701
0.442513 - 0.783493i	0.899821
0.442513 + 0.783493i	0.899821
0.660877 + 0.600669i	0.893063
0.660877 - 0.600669i	0.893063
0.821997 + 0.340095i	0.889575
0.821997 - 0.340095i	0.889575
-0.473417 + 0.736578i	0.875598
-0.473417 - 0.736578i	0.875598
0.404723 + 0.743340i	0.846378
0.404723 - 0.743340i	0.846378
-0.760673 + 0.366722i	0.844457
-0.760673 - 0.366722i	0.844457
-0.483068 - 0.580570i	0.755259
-0.483068 + 0.580570i	0.755259
0.668775 - 0.295179i	0.731020
0.668775 + 0.295179i	0.731020
-0.269434 + 0.674349i	0.726182
-0.269434 - 0.674349i	0.726182

In the following section, we present the diagnostic tests on the residuals. Later, the residual tests for each equation will be presented in section 5.4.

5.3.1 Diagnostic tests on the residuals

Serial Correlation.- In this case, we tested up to lag 8 for the VAR. Table 5.5 shows the statistics and probabilities obtained. The LM statistics show that the null hypothesis of no serial correlation at lag order 1 to 8 cannot be rejected. The residuals from the VAR(8) are not serially correlated.

Table 5.5 Serial Correlation LM Test

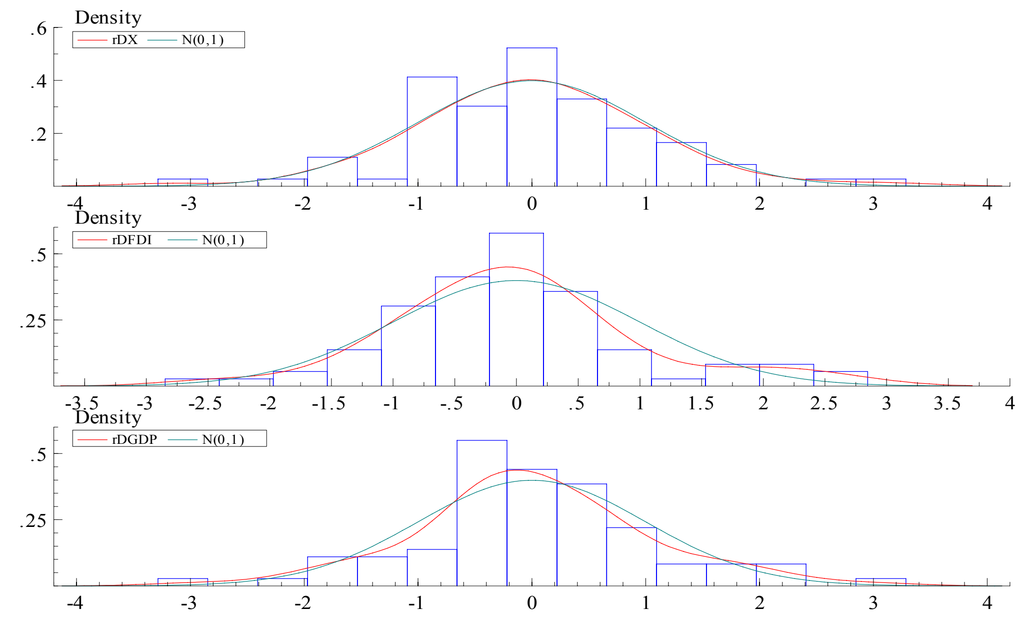
H0: no serial correlation at lag order p Included observations: 83		
Lags	LM-Stat	Prob
1	10.71015	0.2961
2	9.707458	0.3747
3	8.339708	0.5003
4	14.54867	0.1041
5	7.560467	0.5790
6	8.996157	0.4376
7	5.424636	0.7958
8	12.39151	0.1921

Probs from chi-square with 9 df.

Heteroskedasticity.- Due to the existence of many lags in the VARs, the cross product terms were omitted from the auxiliary regression. The results of the White Heteroskedasticity test showed a Chi-square statistic equal to 306.84 and a probability of 21.2%. This result indicates that we cannot reject the null of no heteroskedasticity, the residuals are homoscedastic.

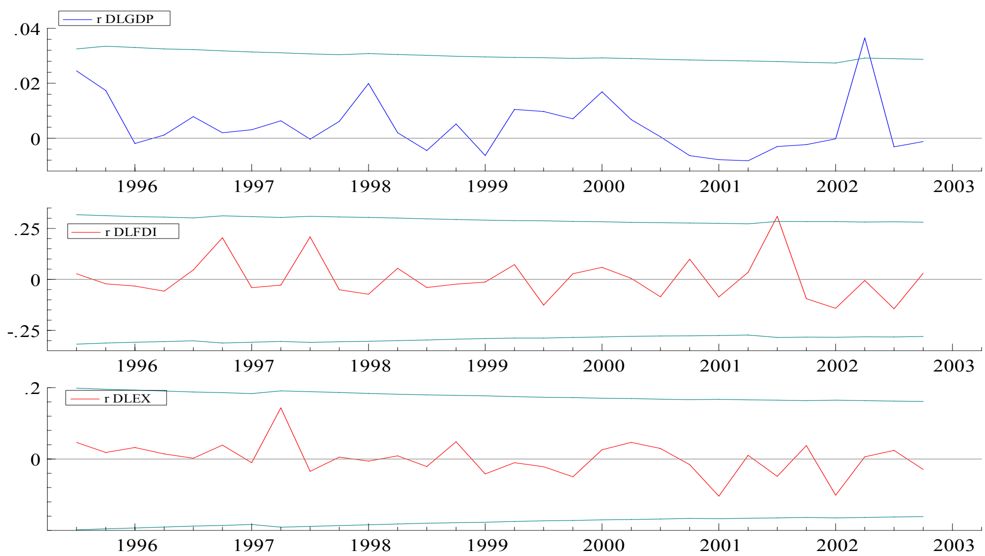
Normal distribution.- The results of the J-B statistics using the Cholesky orthogonalisation method showed that the joint statistic was 11.579 with probability 7.2%; meaning that we cannot reject the null hypothesis that the residuals are normally distributed, at the 5% critical value. The following set of figures confirms normal distribution graphically.

Figure 5.4.
Residual densities, histograms and normal distribution of the VAR(8).



In the histograms, we can observe the bell shape of the residuals distribution. It does not appear to have skewness or kurtosis. At the same time, the one-step residual figure shows that the majority of the residuals from each equation fall inside the range of 2+/- standard errors.

Figure 5.5
One step residuals, +/- 2 standard errors



Testing for structural change.- Figures 5.6 and 5.7 show graphically the results of the Breakpoint and Forecast Chow tests applied to each equation and to the system (for the latter see the fourth graph of each figure).

Figure 5.6
Graphic results of the "Breakpoint Chow Test" to the VAR(8).

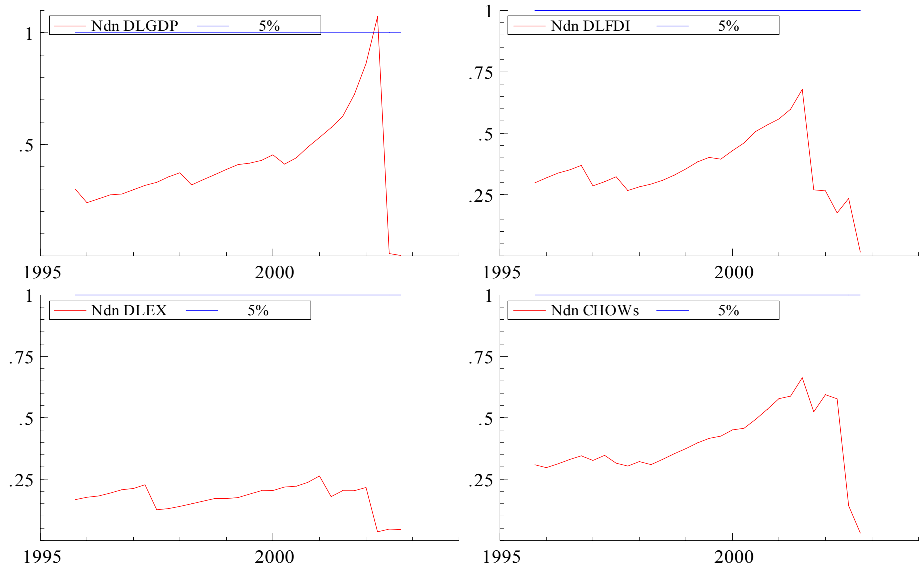
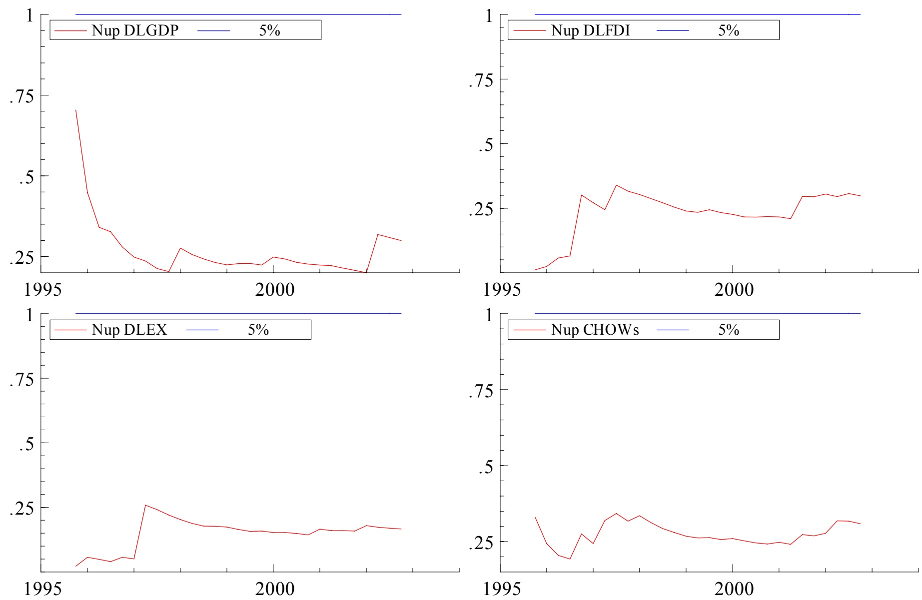


Figure 5.7
Graphic results of the "Forecast Chow Test" to the VAR(8).



The information provided by these figures is straightforward. None of the values are higher than the critical values at 5% level of significance; the results support the hypothesis of no structural change. This means that the parameters are consistent using different sub-samples.

5.4 Analysis of Granger causality

The following equations could be estimated either as a VAR or equation by equation with OLS, both methods provide the same results. For convenience, we estimated the equations by OLS.

5.4.1. Granger causality on GDP

In the case of output growth, measured as the first difference of the log of GDP, coefficients DFDI and DLEX were tested for joint significance. In Table 5.6, we present the estimations of this equation, the standard errors, probabilities and diagnostic tests. The diagnostic tests show that the residuals are free from serial correlation, heteroskedasticity and are normally distributed. The estimations allow testing whether or not changes in GDP are Granger caused by past changes in FDI and exports. To do this, a Wald test for the joint significance was applied on coefficients DLFDI and DLEX (see Table 5.7).

Table 5.6 Test regression for Granger causality.
Dependent variable: DLGDP

Variable	Coefficient	Std. Error	Prob.
DLGDP(-1)	0.1397	0.1252	0.2690
DLGDP(-2)	0.1752	0.1231	0.1599
DLGDP(-3)	-0.0085	0.1269	0.9463
DLGDP(-4)	-0.1696	0.1236	0.1750
DLGDP(-5)	0.2751	0.1224	0.0283
DLGDP(-6)	-0.1259	0.1189	0.2936
DLGDP(-7)	0.0917	0.1169	0.4360
DLGDP(-8)	-0.1171	0.1089	0.2863
DLFDI(-1)	-0.0064	0.0127	0.6159
DLFDI(-2)	-0.0206	0.0129	0.1137
DLFDI(-3)	-0.0052	0.0130	0.6893
DLFDI(-4)	-0.0129	0.0127	0.3117
DLFDI(-5)	-0.0133	0.0132	0.3176
DLFDI(-6)	0.0073	0.0133	0.5836
DLFDI(-7)	0.0123	0.0131	0.3532
DLFDI(-8)	0.0169	0.0132	0.2044
DLEX(-1)	-0.0219	0.021	0.2997
DLEX(-2)	0.0277	0.0225	0.2227
DLEX(-3)	0.0074	0.0223	0.7401
DLEX(-4)	0.0623	0.0225	0.0075
DLEX(-5)	0.0205	0.0238	0.3916
DLEX(-6)	-0.0194	0.0243	0.4273
DLEX(-7)	0.0376	0.0245	0.1295
DLEX(-8)	-0.0124	0.0239	0.6046

	Diagnostic Tests
R-squared	0.39807
Adj R-squared	0.16341
AR 1-8 F(8, 51)	0.6055 (0.7684)
Normality (J-B Stat)	4.4130 (0.1101)
ARCH F(4,51)	0.8663 (0.4905)
White Test F(48,10)	0.4681 (0.9606)

Probabilities are in parenthesis.
Note: the parenthesis next to the coefficients represents number of times the variable was lagged.

Table 5.7. Wald test for the joint significance of coefficients in equation DLGDP.

Null hypothesis	F-stat & (%)	Chi-square stat & (%)
DLFDI does not Granger cause DLGDP	1.3557 (0.2349)	10.8463 (0.2106)
DLEX does not Granger cause DLGDP	1.9563* (0.0682)	15.6505** (0.0477)

Asterisks indicates the rejection of the null hypothesis at 5% (**) and 10% (*) level of significance.

The results show that we have to reject the null hypothesis that exports does not Granger cause GDP. This indicates that the explanation of changes in GDP improves by past changes of exports. In this context, it provides evidence that exports play a relevant role to explain economic expansion and also supports the export-led growth hypothesis. Other studies (with Mexico as a case study) have shown similar results, for example in a bivariate analysis and with a longer period, from 1895 to 1992, Thornton (1996) found a positive Granger causality from exports to output.

On the other hand, FDI does not Granger cause GDP. Nevertheless this is not necessarily an indication of a lack of positive impact of FDI on GDP since the equations do not incorporate possible indirect effects of FDI on GDP via spillover effects, for instance through production efficiency and human capital. Contrary to this outcome, Cuadros et al (2000) found that FDI does Granger cause output growth in Mexico, they used a VAR with 4 lags and quarterly data from 1975 to 1997. This suggests that the results might be sensitive to the lag order selection. Alternatively, they also found that export did Granger cause output.

5.4.2. Granger causality on FDI

In the case of FDI, we followed the same procedure. Table 5.8 contains the estimations of this equation, the statistical significance and the diagnostic tests on the residuals. A quick look at the coefficients' probabilities in Table 5.8 provides an indication of null statistical significance in almost all the coefficients. Wald tests of joint significance to coefficients DGDP and DLEX confirm that the coefficients are not statistically different from zero (see Table 5.9).

Table 5.8 Test Regression for Granger causality.
Dependent variable: DLFDI

Variable	Coefficient	Std. Error	Prob.
DLGDP(-1)	-1.2185	1.2206	0.3222
DLGDP(-2)	0.0241	1.1999	0.9841
DLGDP(-3)	0.3232	1.2372	0.7948
DLGDP(-4)	-0.2889	1.2045	0.8113
DLGDP(-5)	-0.9507	1.193	0.4287
DLGDP(-6)	0.4843	1.1588	0.6775
DLGDP(-7)	0.9466	1.1399	0.4096
DLGDP(-8)	-0.4573	1.0614	0.6682
DLFDI(-1)	0.0988	0.1234	0.4264
DLFDI(-2)	0.0458	0.1253	0.7158
DLFDI(-3)	-0.0108	0.1264	0.9317
DLFDI(-4)	-0.566	0.1234	0.0000
DLFDI(-5)	0.1772	0.129	0.1746
DLFDI(-6)	0.1042	0.1294	0.4242
DLFDI(-7)	-0.0738	0.1281	0.5667
DLFDI(-8)	-0.3269	0.1289	0.0138
DLEX(-1)	0.1986	0.2044	0.3352
DLEX(-2)	-0.0815	0.2192	0.7113
DLEX(-3)	0.4763	0.2172	0.0323
DLEX(-4)	0.0519	0.2191	0.8133
DLEX(-5)	-0.0294	0.2322	0.8997
DLEX(-6)	0.2948	0.2364	0.2173
DLEX(-7)	-0.0489	0.2387	0.8383
DLEX(-8)	0.0239	0.2328	0.9184

	Diagnostic Tests
R-squared	0.4158
Adj R-squared	0.1880
AR, 1-8 F(8, 51)	1.3428 (0.2443)
Normality (J-B Stat)	4.8621 (0.0879)*
ARCH, F(4,51)	0.3990 (0.8084)
White Test, F(48,10)	0.4096 (0.9809)

Probabilities are in parenthesis.
Level of significance: 10% (*)

Table 5.9 Wald test to test the joint significance of coefficients in equation DLFDI.

Null hypothesis	F-stat & (%)	Chi-square & (%)
DLGDP does not Granger cause DLFDI	0.3008 (0.9628)	2.4066 (0.9659)
DLEX does not Granger cause DLFDI	1.0684 (0.3974)	8.5475 (0.3819)

Neither past changes in GDP nor exports provide evidence that they do Granger cause FDI. Both hypotheses cannot be rejected as we can see the probabilities are too high. In certain way, this result is not surprising if we consider that FDI flows to developing countries such as Mexico depend strongly on their origin's countries conditions and strategies associated with economies of scale. It is likely that specific conditions that prevail in the host country exert some influence on FDI's decision to locate in such country -as it has already noted by Borensztein et al., (1995)- however it is necessary to include a wider set of explanatory variables to measure the effect on FDI, possibly via indirect effects.

5.4.3. Granger causality on exports

The estimations of the test equation for exports showed similar result that the previous estimations. A quick glance at the probabilities of coefficients in Table 5.10 indicates that most of them are not statistically different from zero. The F-statistic and Chi-square statistic (in Table 5.11) show that neither past changes in GDP nor in FDI do Grange cause changes in exports. It seems that exports growth is not explained by FDI growth as it was expected, considering that a large share of exports are produced by foreign companies.

A possible explanation to these results could be that the recent acceleration of FDI growth in the whole period of analysis only happened after 1994 (see Figure 4.8). Therefore, its effect on export growth seems negligible or insignificant if we consider the whole period. In the same way, according to these results, previous changes in GDP are not explicative of exports growth, meaning that exports might be driven by other variables.

Table 5.10 Test Regression for Granger causality.
Dependent variable: DLEX

Variable	Coefficient	Std. Error	Prob.
DLGDP(-1)	-1.4612	0.7027	0.0419
DLGDP(-2)	0.7033	0.6908	0.3128
DLGDP(-3)	-0.0701	0.7123	0.9219
DLGDP(-4)	-0.0894	0.6935	0.8979
DLGDP(-5)	-0.5354	0.6868	0.4388
DLGDP(-6)	0.9609	0.6671	0.1550
DLGDP(-7)	-0.3253	0.6563	0.6219
DLGDP(-8)	0.4355	0.6111	0.4788
DLFDI(-1)	-0.0585	0.0710	0.4130
DLFDI(-2)	0.0284	0.0722	0.6951
DLFDI(-3)	0.0223	0.0728	0.7603
DLFDI(-4)	0.0138	0.0711	0.8459
DLFDI(-5)	-0.1472	0.0743	0.0522
DLFDI(-6)	-0.0036	0.0745	0.9613
DLFDI(-7)	-0.0024	0.0738	0.9746
DLFDI(-8)	0.0281	0.0742	0.7058
DLEX(-1)	0.3222	0.1177	0.0082
DLEX(-2)	-0.0761	0.1262	0.5487
DLEX(-3)	0.0152	0.1251	0.9039
DLEX(-4)	0.2343	0.1262	0.0683
DLEX(-5)	-0.1735	0.1337	0.1993
DLEX(-6)	0.1397	0.1361	0.3088
DLEX(-7)	-0.0531	0.1374	0.7006
DLEX(-8)	0.4626	0.1340	0.0010
	Diagnostic Tests		
R-squared	0.29734		
Adj R-squared	0.02343		
AR, 1-8 F(8, 51)	1.7937 (0.1000)		
Normality (J-B Stat)	8.1689 (0.0168)***		
ARCH, F(4,51)	0.2750 (0.8928)		
White Test, F(48,10)	0.1965 (1.0000)		

Probabilities are in parenthesis.
Level of significance: 1% (***)

Table 5.11 Wald test to for the joint significance of coefficients in equation DLEX.

Null hypothesis	F-stat & (%)	Chi-square & (%)
DLGDP does not Granger cause DLEX	0.82022 (0.5879)	6.5617 (0.5846)
DLFDI does not Granger cause DLEX	0.5919 (0.7806)	4.7356 (0.7854)

From the empirical evidence, we can only assert that the results from the Granger causality methodology confirm the Export-led growth paradigm about the precedence of exports to explain GDP changes. These results suggest that liberalisation in a developing country such as Mexico has had a significant impact on the economy thanks to higher levels of exports as a result of a more flexible trade policy.

On the other way, the performance of GDP does not seem to have any significant effect neither on FDI nor on exports. This result is not surprising if we consider that in similar studies no statistical significance was found in the parameters that capture a causal relationship from GDP growth to exports or FDI growth (Cuadros et al., 2000).

The poor performance of FDI as explanatory variable, in part can be attributed to changes in its composition. Until 1999, FDI in industrial activities represented 65% of total inflows and most of the production in these firms were exported under the "Maquiladora" program. However, in the last years due to privatisation of the banking system and telecommunications, a large proportion of FDI has gone to services. Services' share in total FDI grew from 18% in 1995 to 36% in 2002 (INEGI).

5.4.4. Granger causality before and after AFTA

Due to the poor interaction between FDI and exports and GDP, we considered whether or not the North American Free Trade Agreement (NAFTA) has exerted a significant influence on the relationship among the variables. Maybe there has been a structural change due to NAFTA which has changed the way in which exports and FDI affect the economy. To investigate this, we split the sample in two periods: from 1980:1 to 1993:4 which are the years before NAFTA and from 1994:1 to 2002:4 when it became effective.

We followed the same procedure employed for the selection of the lag structure and found that an unrestricted VAR with 4 lags satisfied mathematical stability and all the diagnostic tests. To test the joint significance of the coefficients, only the Chi-square statistic was considered due to space restrictions.

Table 5.12 contains a summary of the null hypotheses, Chi-square statistics and probabilities. In the third and fourth column we compare the results before and after NAFTA. The last four rows contain the diagnostic tests, showing that there is no serial correlation or heteroskedasticity and the residuals are normally distributed. The system was also stable.

Table 5.12. Summary of Granger causality tests before and after NAFTA. Number of lags: 4.

Null hypothesis	**efore AFTA 1980:1 to 1993:4**	**After AFTA 1994:1 to 2002:4**
	Chi-square (%)	Chi-square (%)
DLFDI does not Granger cause DLGDP	5.1312 (0.2741)	4.1944 (0.3803)
DLEX does not Granger cause DLGDP	0.6891 (0.9527)	23.748 (0.0001)***
DLGDP does not Granger cause DLFDI	5.1841 (0.2689)	11.5168 (0.0213)**
DLEX does not Granger cause DLFDI	2.2491 (0.6900)	16.3267 (0.0026)***
DLGDP does not Granger cause DLEX	1.2820 (0.8644)	3.4646 (0.4833)
DLFDI does not Granger cause DLEX	4.5274 (0.3393)	6.5213 (0.1634)
	Diagnostic tests	
LM test F(6,51)	8.7130 (0.4642)	13.5171 (0.1406)
Normality (J-B stat)	5.3642 (0.4980)	9.6383 (0.1407)
White Test Chi-square	159.789 (0.1743)	132.083 (0.7527)
Stability Condition	Satisfied	Satisfied

Probabilities are in parenthesis.
Levels of significance: 1% (***) and 5% (**).

The results show some interesting aspects about the influence of NAFTA. For example, we can see that before NAFTA, exports did not Granger cause GDP. However, once a trade agreement that liberalised more than 90% of trade goods between Mexico and North

America was considered, the exports´ coefficient became statistically significant as explanatory of changes in output.

The most evident result was for equation DLFDI. Before NAFTA neither GDP nor export did Granger cause FDI, only when we divided the sample to differentiate the effect of NAFTA, the test captured their impact on FDI. This provides evidence that trade liberalisation was conductive to improve foreign capital flows to Mexico. Although, FDI also responds to external variables such as the world economy, it is interesting to notice that the macroeconomic performance and the existence of an export market seem to be explicative of positive changes in FDI.

Finally, the results of Granger causality are consistent with the previous evidence that neither past values of output nor of FDI growth explain export performance before or after NAFTA.

5.5 Analysis of impulse-response functions

To calculate the impulse response functions, we followed the procedure described in section 5.2.3. The unrestricted VAR in first differences that satisfied most of the diagnostic tests and the stability condition contained 8 lags (see Section 5.3.1), therefore this system was used to calculate the VMA and the impulse-response functions. In a first attempt to obtain the functions, the calculations showed that the standard errors of these functions were very large and therefore most of the estimations were statistically insignificant (results are not shown in this study). As has been noted by Hamilton (1994), "because so many parameters are estimated in a vector autoregression, the standard errors for inferences can be large" (p. 351). Authors such as Runkle (1987) assert that the large standard errors of insignificant coefficients "will imply large and growing standard errors on the estimates of variance decompositions and impulse response functions" (pag. 438).

A possible solution to this problem was to restrict the VAR(8) to contain only coefficients that were statistically significant. The purpose of this restriction was to reduce the sum of squared residuals that affect the standard errors. The procedure required the elimination of those coefficients with probabilities higher than 10% and the re-estimation of the system with the remaining variables, (deleted variables were specified as zero in the companion matrix). From the companion form, we evaluated the eigenvalues of the characteristic polynomial (matrix A_1) and found that all roots lied inside the unit circle, which confirmed the stability of the system. Additionally, diagnostic tests on the residuals of the restricted system were satisfactory (see Appendix 5D for stability condition and residual tests). Then, we followed the procedure described in section 5.2.3 regarding the Cholesky decomposition and designed a program to compute the impulse-response functions and variance decomposition.

The calculations of the impulse response functions and standard errors (S. Errors) are shown in Tables 5.13 to 5.15. The results confirm that -on average- there is a strong response to a shock in the innovations during the first periods, eventually the intensity of the response tends to die out. The simulation was done for a horizon of 35 periods. Since all the variables are endogenous, any shock in one equation's innovation is transmitted to the rest of the system. In Table 5.13 we can see the responses of DLGDP, DLFDI and DLEX to a unit shock in DLGDP.

According to these results, in the first period a shock in DLGDP has a negligible effect on DLGDP and DLFDI but DLEX reacts negatively (-0.017). In the fourth period, the response of DLGDP is positive (0.00098) but remains negative for the rest of the horizon. The estimations also showed that high standard errors persist despite the elimination of insignificant coefficients from the unrestricted VAR and the reduction of the sum of squared residuals. For this reason, the results should be taken with caution.

Table 5.13. Impulse-responses to Cholesky one S.D due to a shock in DLGDP.

Period	DLGDP	S. Error	DLFDI	S. Error	DLEX	S. Error
1	0.00000	0.0207	0.00000	0.1484	-0.01714	0.0873
	0.00000	0.0204	0.00000	0.1457	-0.00377	0.1446
	0.00000	0.0203	-0.00065	0.1310	-0.00083	0.1089
	0.00098	0.0139	-0.00198	0.0826	-0.00271	0.0966
5	0.00000	0.0483	0.00000	0.1480	0.00000	0.0407
	-0.00024	0.0155	-0.00044	0.1418	-0.00248	0.0606
	-0.00005	0.0097	0.00010	0.1077	-0.00044	0.0552
	-0.00003	0.0054	0.00342	0.0467	-0.00062	0.0451
	-0.00019	0.0123	-0.00030	0.0659	-0.00787	0.0443
10	-0.00002	0.0051	-0.00001	0.0607	-0.00352	0.0706
	-0.00006	0.0053	-0.00018	0.0519	-0.00117	0.0607
	-0.00005	0.0064	-0.00419	0.0321	-0.00053	0.0527
	-0.00051	0.0227	-0.00111	0.0601	-0.00341	0.0387
	-0.00025	0.0125	-0.00048	0.0491	-0.00202	0.0576
15	-0.00008	0.0056	-0.00022	0.0483	-0.00045	0.0527
	-0.00004	0.0039	-0.00069	0.0264	-0.00038	0.0446
	-0.00023	0.0117	-0.00041	0.0430	-0.00380	0.0344
	-0.00020	0.0103	0.00001	0.0410	-0.00191	0.0476
	-0.00006	0.0045	-0.00003	0.0353	-0.00057	0.0439
20	-0.00004	0.0036	-0.00040	0.0204	-0.00030	0.0371
	-0.00025	0.0122	-0.00046	0.0219	-0.00228	0.0307
	-0.00016	0.0078	-0.00016	0.0232	-0.00128	0.0451
	-0.00007	0.0041	-0.00007	0.0196	-0.00033	0.0439
	-0.00003	0.0027	-0.00079	0.0173	-0.00023	0.0379
25	-0.00015	0.0074	-0.00031	0.0243	-0.00218	0.0295
	-0.00012	0.0061	-0.00009	0.0252	-0.00109	0.0376
	-0.00004	0.0030	-0.00007	0.0232	-0.00031	0.0364
	-0.00002	0.0024	-0.00063	0.0178	-0.00018	0.0315
	-0.00015	0.0070	-0.00027	0.0210	-0.00141	0.0260
30	-0.00009	0.0047	-0.00007	0.0200	-0.00078	0.0352
	-0.00004	0.0026	-0.00003	0.0180	-0.00020	0.0356
	-0.00002	0.0019	-0.00019	0.0144	-0.00013	0.0312
	-0.00009	0.0048	-0.00018	0.0189	-0.00122	0.0247
	-0.00007	0.0038	-0.00005	0.0200	-0.00063	0.0297
35	-0.00003	0.0021	-0.00003	0.0181	-0.00018	0.0299

Cholesky Ordering: DLGDP, DLFDI, DLEX.

Practically the most intensive responses take place during the first seven periods after the initial shock and eventually –in all cases- they tend to approach zero, in general this situation reflects the stability of the system. However, this convergence to zero is not the same for every variable neither in time nor intensity.

A shock in FDI has a strong positive effect on DLEX during the first four periods as it can be observed in Table 5.14. The response of DLGDP tends to be also intense at the beginning but this is relatively smaller and becomes negative shortly afterwards. It is also evident that any shock in FDI's innovation will have a strong effect on this own equation. In all cases, it is noted that between periods 5 and 10, there is a decline due to a shock in DLFDI, an indication that a external influence that is affecting FDI negatively is transmitted to the system in the same way.

Table 5.14. Impulse-responses to Cholesky one S.D due to a shock in DLFDI.

Period	DLGDP	S. Error	DLFDI	S. Error	DLEX	S. Error
1	0.00000	0.1753	0.00000	1.2586	0.00114	0.7402
	0.00000	0.1729	0.00000	1.2355	0.00025	1.2263
	0.00000	0.2017	0.00273	1.1124	0.00006	0.9238
	0.00034	0.4582	-0.06374	0.8737	0.00110	0.8463
5	0.00007	0.1334	0.00013	1.5690	-0.01656	0.5007
	0.00002	0.1032	0.00003	1.5811	-0.00367	0.5340
	0.00000	0.0887	-0.00080	1.1871	-0.00081	0.4130
	0.00007	0.1206	-0.01439	0.7321	0.00209	0.3062
	-0.00103	0.0685	-0.00199	0.9895	0.00580	0.1836
10	-0.00023	0.0555	-0.00044	0.7844	0.00176	0.3237
	-0.00005	0.0564	0.00069	0.6069	0.00049	0.2652
	0.00014	0.1049	0.02937	0.3658	0.00122	0.2755
	0.00039	0.0853	0.00189	0.9192	-0.00445	0.3266
	-0.00003	0.0698	0.00047	0.8034	-0.00248	0.3790
15	0.00000	0.0683	0.00053	0.7702	-0.00022	0.3112
	0.00007	0.0761	-0.01290	0.3699	0.00113	0.2249
	-0.00027	0.0434	-0.00166	0.6185	-0.00210	0.1562
	-0.00011	0.0364	-0.00022	0.6381	0.00005	0.1277
	-0.00002	0.0297	0.00012	0.4779	0.00012	0.1045
20	0.00007	0.0305	-0.00334	0.1928	0.00073	0.1047
	-0.00013	0.0281	0.00030	0.2660	-0.00080	0.1728
	-0.00003	0.0179	0.00003	0.2162	-0.00092	0.1955
	-0.00001	0.0145	0.00016	0.1603	-0.00005	0.1728
	0.00004	0.0222	0.00512	0.0945	0.00066	0.1358
25	-0.00004	0.0247	-0.00014	0.2870	-0.00070	0.1485
	-0.00008	0.0184	0.00003	0.2585	-0.00021	0.1570
	-0.00001	0.0189	0.00023	0.2435	0.00004	0.1264
	0.00004	0.0361	-0.00196	0.1287	0.00045	0.1108
	-0.00004	0.0176	-0.00013	0.1817	-0.00119	0.1403

Cholesky Ordering: DLGDP, DLFDI, DLEX.

Table 5.14 Cont.

Period	DLGDP	S. Error	DLFDI	S. Error	DLEX	S. Error
30	-0.00002	0.0121	0.00000	0.1804	-0.00045	0.1460
	-0.00001	0.0089	0.00007	0.1352	-0.00002	0.1285
	0.00003	0.0135	-0.00116	0.0882	0.00037	0.0976
	-0.00007	0.0116	-0.00013	0.1124	-0.00032	0.1080
	-0.00003	0.0071	-0.00002	0.0926	-0.00017	0.1080
35	0.00000	0.0063	0.00009	0.0700	0.00002	0.0919

Cholesky Ordering: DLGDP, DLFDI, DLEX.

The responses to a shock in DLEX are diverse (see Table 5.15), but in general we can see that DLGDP reacts positively after the initial shock. DLFDI also responds well five periods after the shock. Exports have a stronger impact on FDI than in GDP. These results are congruent with results from the Granger causality tests in the sense that exports were indistinguishable the explicative variables of changes in FDI and GDP.

Table 5.15. Impulse-responses to Cholesky one S.D due to a shock in DLEX.

Period	DLGDP	S. Error	DLFDI	S. Error	DLEX	S. Error
1	0.00000	0.7976	0.00000	0.7164	0.01588	0.4212
	0.00000	0.2043	0.00000	0.7458	0.00349	0.7357
	0.00000	0.1150	0.03791	0.6922	0.00077	0.6483
	0.00468	0.0607	0.00833	0.4194	0.01527	0.5526
5	0.00103	0.1858	0.00183	0.6830	0.00142	0.3078
	0.00023	0.1409	0.00040	0.6877	-0.00011	0.3535
	0.00005	0.0563	-0.01117	0.5437	-0.00012	0.3322
	0.00099	0.0935	-0.00347	0.2987	0.03155	0.2801
	0.00074	0.3462	-0.00099	0.2182	0.01238	0.4217
10	0.00014	0.1655	-0.00027	0.2755	0.00324	0.7182
	0.00002	0.0731	0.01090	0.2697	0.00084	0.6937
	0.00205	0.0537	0.00577	0.2979	0.01528	0.5993
	0.00094	0.1772	0.00165	0.5384	0.00475	0.4244
	0.00031	0.1125	0.00045	0.5329	0.00074	0.5170
15	0.00007	0.0496	0.00584	0.4869	0.00015	0.4765
	0.00099	0.0517	0.00062	0.3094	0.01636	0.4059
	0.00059	0.1842	-0.00015	0.2834	0.00596	0.3909
	0.00018	0.0964	-0.00007	0.2691	0.00144	0.6021
	0.00005	0.0452	0.00238	0.2377	0.00036	0.5996
20	0.00107	0.0364	0.00110	0.2184	0.00972	0.5195
	0.00053	0.1115	0.00034	0.3202	0.00337	0.3960
	0.00018	0.0701	0.00009	0.3446	0.00066	0.4894
	0.00005	0.0339	0.00216	0.3150	0.00016	0.4669
	0.00064	0.0323	0.00103	0.2396	0.00929	0.4012
25	0.00037	0.1055	0.00022	0.2692	0.00332	0.3434
	0.00012	0.0581	0.00006	0.2521	0.00076	0.4838
	0.00003	0.0304	0.00308	0.2308	0.00019	0.4889
	0.00061	0.0253	0.00089	0.1910	0.00616	0.4265
	0.00030	0.0719	0.00019	0.2633	0.00212	0.3346
30	0.00010	0.0445	0.00004	0.2781	0.00044	0.4080
	0.00003	0.0245	0.00103	0.2510	0.00010	0.4012
	0.00040	0.0211	0.00035	0.1923	0.00518	0.3479
	0.00022	0.0596	0.00007	0.2073	0.00186	0.2851
	0.00007	0.0354	0.00002	0.2067	0.00042	0.3701
35	0.00002	0.0202	0.00128	0.1875	0.00010	0.3783

Cholesky Ordering: DLGDP, DLFDI, DLEX.

Graphically, Figures 5.8, 5.9 and 5.10 present in a clearer way, the pattern followed by the impulse-response functions.

Figure 5.8

Response to a shock in DLGDP

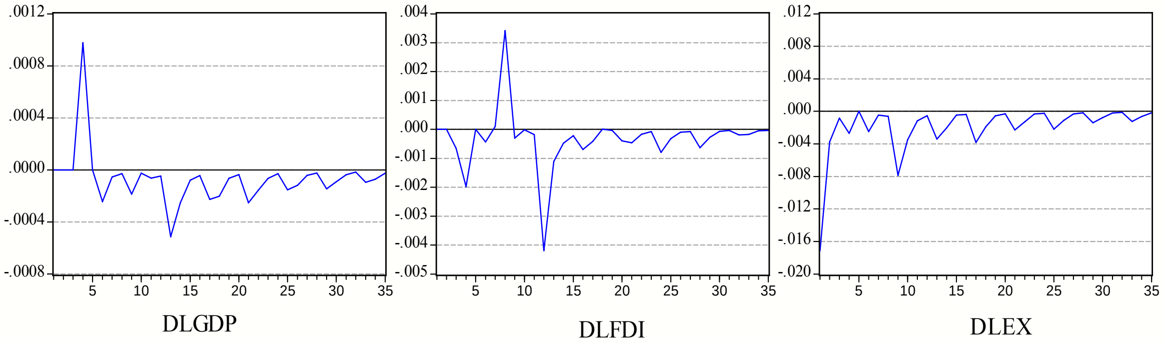


Figure 5.9

Response to a shock in DLFDI

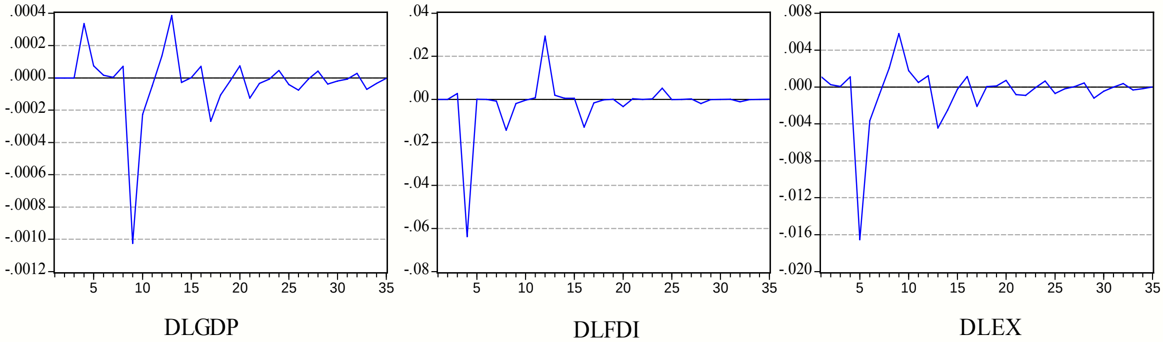
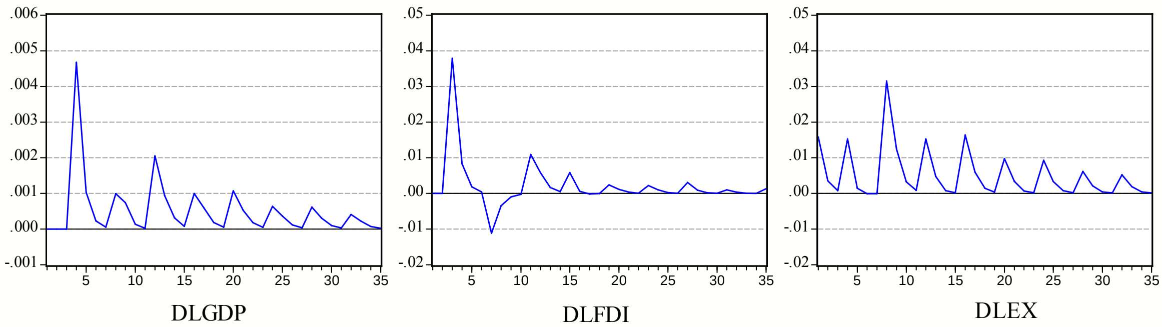


Figure 5.10

Response to a shock in DLEX



Cholesky ordering: DLGDP, DLFDI, DLEX

If we analyse the figures column by column, we can see the response of GDP to different shocks, including its own innovations. We can see for example, that the strongest response of GDP was to shocks occurring in exports; this impact seems to have lasting effects, as it tends to stay positive.

Similarly, besides the response to its own shocks, FDI responds relatively more to shocks coming from exports and its impact seems to have longer positive effects (except for a decline in the 7th period). The evidence suggests that there is a strong impact of exports growth on FDI and possible shocks in this equation will affect the behaviour of foreign investment flows in the horizon.

The findings confirm the results of the Granger causality analysis which showed that in different samples, exports consistently do Granger cause output growth (see tables 5.6 and 5.12).

5.6 Analysis of variance decomposition

In the same way to the impulse response functions, to identify the $\{\in_{y1t}\}$ and $\{\in_{y2t}\}$ sequences, matrix A_1 must have some restrictions, this is done with the Cholesky decomposition. To calculate the variance decomposition we used the same restricted system described in Section 5.5 (a VAR with 8 lags).

In the following three tables, we present the results of the variance decomposition for a horizon of 35 periods, only eight periods are reported (1, 5, 10,15, 20, 25, 30 and 35) since there is not a strong variation in the percentage distribution of each variable. From the estimations, it is evident that each variable explains most of its own forecast error variance, especially during the first periods. Table 5.16 shows the proportions of the forecast error variance of DLGDP explained by each variable. For example, in the first period the total variance was 0.00054, 82.7% of it was explained by a shock in its own innovation, 16.6% by a shock in DLFDI and 0.57% by a shock in DLEX.

Table 5.16 Variance decomposition of an error variance in DLGDP

Period	Variance Decomposition (%)				
	Variance	SE	DLGDP	DLFDI	DLEX
1	0.00054	0.0232	82.75	16.68	0.57
5	0.00061	0.0248	36.79	12.57	50.64
10	0.00071	0.0266	32.09	13.17	54.74
15	0.00075	0.0275	30.05	14.84	55.11
20	0.00077	0.0278	29.30	14.55	56.14
25	0.00078	0.0280	29.01	14.53	56.46
30	0.00079	0.0281	28.70	14.45	56.86
35	0.00079	0.0282	28.60	14.41	56.99

Cholesky Ordering: DLGDP, DLFDI, DLEX.

This trend does not persist for long though. After the first period, the variance of DLGDP is explained mainly by a shock occurring in DLEX, which also tends to grow over time. On the other hand, GDP's explanation of its variance drops to 36.8%, while DFDI suffers no drastic reduction. These findings support the results previously shown about the strong relationship that exists between GDP and exports.

As would be expected, the case of DLFDI supports the previous findings about the negligible influence from DLEX and DLGDP to explain FDI's variance. Around 98% of its forecast error variance is due to a shock in its own innovation and at a lesser extent, exports (see table 5.17). These proportions remain almost the same for the whole horizon.

Table 5.17 Variance decomposition of an error variance in DLFDI.

Period	Variance Decomposition of DLFDI (%)				
	Variance	SE	DLGDP	DLFDI	DLEX
1	0.03237	0.1799	0.00	99.83	0.17
5	0.02026	0.1423	0.00	99.85	0.15
10	0.02080	0.1442	0.01	98.28	1.71
15	0.02169	0.1473	0.01	98.21	1.78
20	0.02187	0.1479	0.01	98.20	1.79
25	0.02191	0.1480	0.01	98.19	1.80
30	0.02192	0.1480	0.01	98.18	1.81
35	0.02192	0.1480	0.01	98.18	1.81

Cholesky Ordering: DLGDP, DLFDI, DLEX.

In the same way, we can see in Table 5.18 that DLEX explains a large percentage of its own forecast error variance. Although at the beginning, DLEX explains 100% of its error variance eventually, DLFDI explains a reasonable 20% of this variation. On the other hand, DLGDP explains less than 0.4%.

Table 5.18 Variance Decomposition of an error variance in DLEX.

Period	Variance Decomposition (%)				
	Variance	SE	DLGDP	DLFDI	DLEX
1	0.01043	0.1021	0.00	0.00	100.00
5	0.00724	0.0851	0.30	20.81	78.89
10	0.00854	0.0924	0.29	19.31	80.41
15	0.00896	0.0947	0.33	20.11	79.55
20	0.00931	0.0965	0.33	19.80	79.87
25	0.00951	0.0975	0.35	19.45	80.20
30	0.00958	0.0979	0.35	19.43	80.22
35	0.00961	0.0980	0.35	19.37	80.27

Cholesky Ordering: DLGDP, DLFDI, DLEX

The following figures show graphically the variance decomposition for a horizon of 35 periods. The vertical axis represents the percentage explanation of the forecast error variance of DLGDP, DLFDI and DLEX.

Figure 5.11

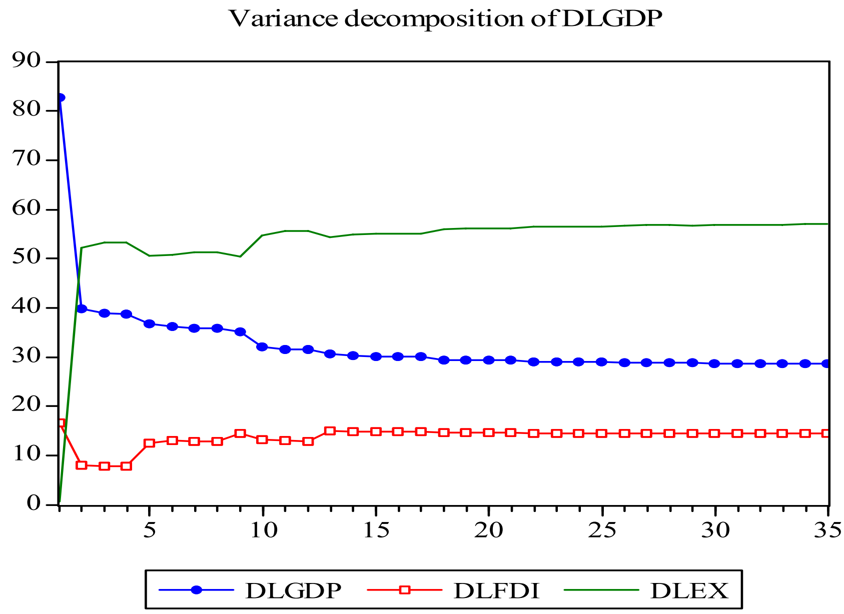


Figure 5.12

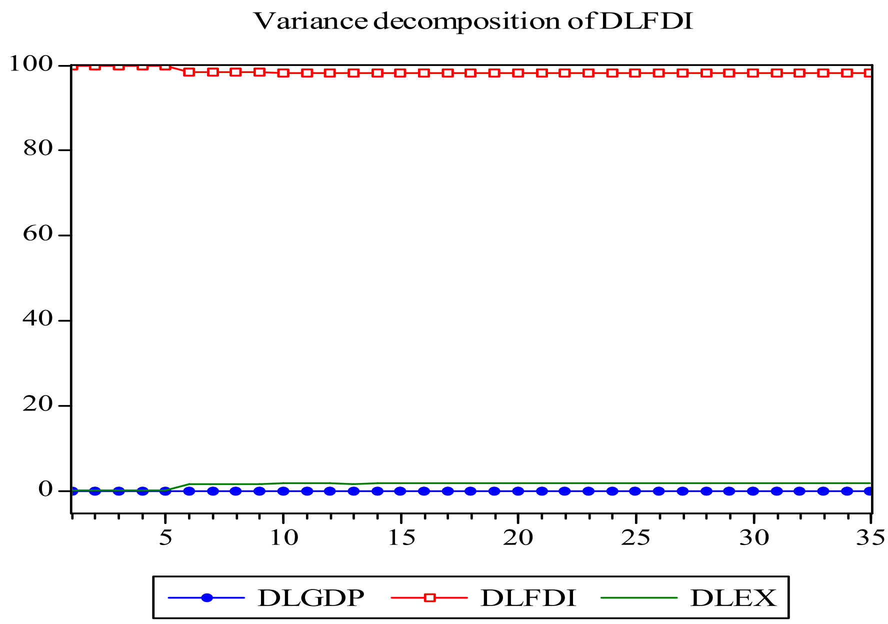
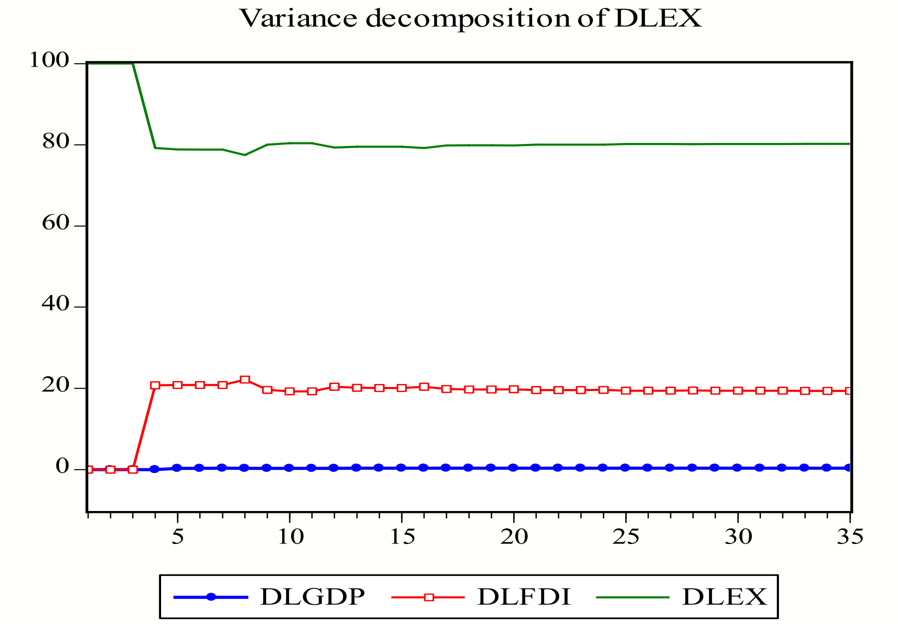


Figure 5.13



5.7 Conclusions

The purpose of this chapter was to investigate (using a multivariate framework) if exports and FDI have been crucial elements to explain economic growth in Mexico. Granger causality tests showed that the explanation of output changes improves with the inclusion of past changes in exports. In this context, it could be taken as empirical evidence that the export-led growth paradigm applies to the Mexican case. Trade liberalisation through its positive effect on exports has improved economic growth.

On the contrary, no Granger causality was found from GDP and FDI to exports. A possible reason could be the limitation in the number of variables in the system, it might be necessary to explain the performance of exports growth in terms of other variables besides FDI and GDP so we can capture indirect effects and improve the estimates. A different result emerged when we considered the influence of NAFTA on the relationship between the variables. This trade agreement brought immediate and gradual significant reductions in trade tariffs, quotas between Mexico, the US and Canada. It also became a stimulus for foreign capitals to take advantage of low production costs in Mexico and the reduction or elimination of tariffs in North America. Under these considerations, we expected to find a significant difference in the results before and after NAFTA. The estimations confirmed that this was the case. Trade liberalisation appeared to generate a significant effect on export that was transmitted to the economy. On the other hand, the negligible effect of FDI on the other variables seems to be consistent independently of the sample size, whether or not NAFTA occurs, no Granger causality effect was found. A tentative explanation is that especially during the 1980s and 1990s a large proportion of FDI concentrated in low capital intensive activities (i.e. Maquiladoras) that create few spillovers to the economy. However, this could also be the result of excluding relevant variables that could capture in a better way the interrelationship between the variables.

It is also important to note that the explanation of changes in FDI improved considerably when NAFTA was considered. When the free trade agreement was accommodated, both exports and GDP improved the explanation of FDI growth in Mexico. This result provides support to the hypothesis that a more open economy attracts more foreign capital. It also shows that it is important the inclusion of control variables that contribute to explain better how one variable affects the others.

Impulse-response functions were estimated to track down the time path of exports, FDI and GDP due to shocks in their own and other variables innovations. These functions are useful tools to understand how policy changes might influence the response and patterns of the variables under scrutiny. In general, the impulse-response functions provide additional evidence to the previous findings with Granger causality tests. For example, the response of DLGDP to a shock in DLEX is more intense and positively signed than its response to a shock in DLFDI. DLGDP's response was even stronger than its reaction to a shock in its own innovation.

DLFDI responds strongly and positively to shocks in DLEX's innovations. This result indicates that a policy that promotes exports production and facilitates a positive environment to international trade has the potential to improve FDI growth. Finally, DLEX showed a poor response to shocks in DLGDP, which only confirms in part the previous findings about the negligible influence on this variable.

Regarding variance decomposition of the forecast error, this analysis provided information about the relative importance of each innovation to affect the variables in the system. The results indicate that most of the forecast error variance is explained by the variables own innovations. The proportion and reduction of their share in explaining the total variance are also an indication on how much a variable responds to shocks from other variables. For example, except for the first period, most of GDP variance is explained (around 55%) by a shock in exports, which again supports the relevant role of exports as an explanatory variable of GDP. At the same time, it was found that 98% of DLFDI's error variance is explained by its own shock. Finally, around 20% of exports' variance is explained by a shock in FDI. Although the results from impulse response functions and variance decomposition support the results with Granger causality tests, they should be taken with caution as the standard errors of the estimations remained relatively high despite the restrictions made to the system.

CHAPTER 6: DIRECT AND INDIRECT EFFECTS OF FDI AND EXPORTS ON THE MEXICAN ECONOMY: A SIMULTANEOUS DYNAMIC ANALYSIS

6.1 Introduction

Although it is likely than an open economy reacts positively to higher levels of exports and FDI than a closed economy, there is no guarantee that exports will become the growth engine as predicted by the advocates of the Export-led growth hypothesis. For example, Iscan (1997) analysed the manufacturing industry in Mexico (between 1970 and 1990) and found weak evidence that exports lead to capital accumulation or faster labour productivity growth. Although it does not rule out the possibility that exports and FDI are important factors in the economy's performance, openness does not lead automatically to higher levels of development. Other variables related to government policy may interfere or facilitate the impact of openness on the economy. For example, when the real exchange rate was considered in Iscan's model, the regressions showed "strong links among exports, investment and labour productivity growth", (pp. 27). This is one of the reasons why in the next chapter, policy variables are included in the model.

In this chapter, we work with the general hypothesis that economic growth is - at a great extent- stimulated by the effect of economic liberalisation in foreign investment and manufactured exports. However this effect does not necessarily occurs directly but in alternative ways through positive effects in key variables that are explicative of FDI and exports. It is possible that FDI has a positive impact on output growth throughout its spillover effects on the economy. Equally, exports are expected to improve growth by exploiting comparative advantages and labour productivity. It is difficult to separate the effects of FDI and exports on output growth, since they seem to be interconnected. Although, the distinction is difficult to make, we identified some variables that are potentially attributable to FDI spillovers and exports. The hypotheses that we want to test that: a) exports and FDI are strong positive determinants of GDP. Such influences are expected to occur not only directly but also indirectly through spillovers created by FDI, specifically through its effect on human capital and technological investment. b) Technology transfer and FDI have a positive impact on labour productivity. c) The real exchange rate has a negative effect on GDP but a positive effect on FDI and exports and the hypothesis that d) GDP is also conductive to improvements in FDI and exports.

The analysis in this chapter is theoretically framed on some of the postulates of the H-O model, the Stolper-Samuelson and the Rybczynski theorems in the analysis of international trade and its effect on growth and factor prices. At the same time, the role of increasing rates of foreign capital, technology and human capital in the economy is analysed from the perspective of the predictions of endogenous growth theory. Due to the complexity of the system of equations that was estimated, the postulates of more than one theory complement and enrich the analysis that otherwise would require the assumptions that would limit the analysis of the expected interrelationships.

This chapter has two objectives. The first is to estimate a model that captures not only the determinants of GDP but also the determinants of FDI, exports and other endogenous variables associated with the spillovers effects of the previous two. In other words, while we have implicitly assumed that FDI and exports are explicative variables of GDP, these are now taken as endogenous variables and as such they are estimated simultaneously with GDP. We also assume that the effects of FDI and exports may occur through the indirect effects of FDI and exports' spillovers. For example, to identify their impact, we consider how they affect (and are affected by) human capital, productivity, capital accumulation and real relative wages. Exogenous variables are also included in the system such as the world economy, population, real exchange rate, infrastructure and government expenditure. In this respect, the specific questions we seek to answer are: have exports and FDI had a significant positive effect on GDP? Has FDI enhanced human capital? Has FDI improved labour productivity and capital accumulation? And, has GDP induced increases in FDI and exports?

The second objective is to investigate the effects of changes in the control variables to determine what happens when there is a unit change in the exogenous variables (such as the world economy, technology investment and population) and in some policy related variables such as investment in infrastructure, government expenditure and the exchange rate. The inclusion of policy related variables are limited to the last three variables because in this chapter there is an implicit assumption that the government intervention in the economy is minimum. Our goal is to investigate economic relationships that occur as a consequence of free interaction between economic agents. In Chapter 7, we consider a wider number of instruments of monetary and fiscal policy to analyse these policy changes. In this context, the specific questions to answer are: what is the reaction of FDI and exports to changes in infrastructure, government expenditure, relative wages and the exchange rate? What is the magnitude of these multipliers effects? And, what is the cumulative effect of a *ceteris paribus* unit change in the exogenous variables in the long run?

The methodology applied in this chapter is based on the estimation of a dynamic simultaneous equations model with six endogenous variables: GDP, exports, FDI, human capital, labour productivity and capital accumulation. The reason of estimating simultaneous equations was the existence of simultaneity bias in the right-hand side of some equations. Additionally, to investigate the time path followed by the endogenous variables to changes in the exogenous variables, we analysed the dynamic multipliers, which required the calculation of the impact, interim and total multipliers from the *final form* of the 3SLS estimations.

This rest of the chapter is organised as follows: in Section 6.2 we enrich the analysis done in Chapter 4 (Sections 4.3.1 and 4.3.2) about the trajectory of FDI in Mexico with a detail review of its characteristics and a discussion about exports growth. In Section 6.3 we present the theoretical framework that is pertinent to analyse the issues under concern and which was mostly described in Chapter 2. The theories of international trade and endogenous growth and empirical studies on similar issues provide the justification to include explicative variables and hypothesize their expected effects on the endogenous variables. In Section 6.4 we formalise the functional relationships of six endogenous variables to measure the dynamic direct and indirect effects of liberalisation on economic growth. Section 6.5 describes the econometric method followed to estimate the system of equations and some of the properties of this methodology such as simultaneity bias and the order and rank conditions for identification. In section 6.6, we report the estimations, the stability condition and residual tests of the simultaneous equations system. Based on these estimations, Section 6.7 contains an analysis of the response endogenous variables' response to a one unit changes in the exogenous variables. This is done with dynamic multipliers. Finally, Section 6.8 concludes with a discussion of the empirical results, there we emphasize the statistical significance of capital accumulation, productivity and human capital and to a lesser extent FDI as important determinants of GDP growth. Although exports did not show a direct effect on growth, its positive impact on FDI indicates that they do influence growth indirectly through the former.

6.2 A review of foreign investment and exports in Mexico

The first attempt to relax the restrictions on foreign investment occurred in 1984, when changes to administrative regulations were introduced, but the law was not modified significantly thought (Kehoe, 1995). There is empirical evidence showing that FDI reacted positively in the years following 1984. For example, Ross (1995) analysed capital flows to Mexico during 1960 to 1992 to ascertain if massive inflows of foreign capitals (direct and portfolio) in that period were the result of changes introduced in 1984. He estimated used a dummy variable to capture any potential structural change in FDI inflows. The results showed statistical significance.

In 1989, President Carlos Salinas (1988-1994) intensified the process of economic liberalisation to attract international flows of capital. During his government there was a strong effort to privatise public enterprises and allow private investment in sectors previously considered as strategic. To do this, in 1993 the law of foreign investment was substantially modified. Contrary to the law of 1973 which was mainly regulatory and discretional, the *New Law of Foreign Investment* established the basis to foster a more competitive environment for foreign and domestic investment. Foreign investment was granted access to sectors previously considered as strategic, such as communications and financial services; however, the extraction of petroleum and natural gas remained as national property. The new law also provided juridical security to the FDI already located in Mexico. However, the most important contribution was to define the economic activities open to foreign firms. It established the activities where it would be possible to receive from 10% to 49% of foreign funds while other sectors were open to receive more than 49% of foreign investment, both under the authorization of the Foreign Investment National Commission (FINC). It also defined a number of unrestricted industries that required neither a maximum share of foreign investment nor registration to the FINC[30].

In practice, the reforms had a strong impact on foreign inflows in the following years: from 1993 to 1997 they increased 17%. However, contrary to expectations it was portfolio investment that responded positively to the new economic conditions that prevailed in Mexico. Figure 6.1 shows the trend followed by current FDI and foreign portfolio investment

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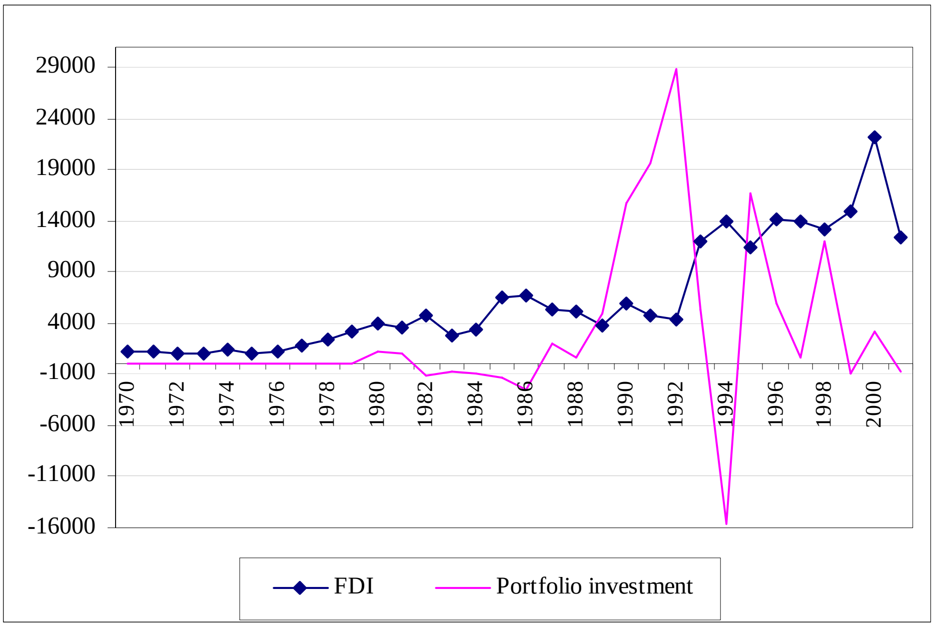
[30] See a summary of this law in “Informe Anual 1993”, Bank of Mexico.

for the period 1970 to 2002. There is a sharp rise in foreign investment in the stock market, starting from 1989 until 1993. In those years, it increased from 562 million dollars to 28 billions dollars; a dramatic increase of 5035%, to a great extent caused by the decision of the FINC and the National Stocks Commission to approve trust funds. This allowed foreign investors buying equities issued by Mexican firms without getting any shareholder voting rights. In this scenario, and considering the monetary policy that maintained an exchange rate with a maximum 12% of floatation, share prices increased 77.1% in term of dollars during 1991, 49.4% in 1992 and 10.6% in 1993 (Kahoe, 1995). However a series of political problems in 1994 and the announcement by the Bank of Mexico that the international reserves could not longer maintain an over-valued peso led to uncertainty and eventually to massive foreign capital outflows in 1994, (see Figure 6.1).

Figure 6.1.
FDI inflows and investment in the stock market (million dollars, constant prices).



Source: Bank of Mexico and IMF.

On the other hand, FDI showed a more stable growth rate that ironically would be stimulated by devaluation in 1994. In Figure 6.1 we can observe from 1970 to 1993, regardless of the economic policy of promotion or restriction, FDI maintained a very stable growth and increased only significantly in 1985 and then after 1993. Some of the reasons were changes in the law, lower production costs and exports rise due to devaluation and the intensive economic liberalisation and integration to NAFTA.

A feature of FDI in Mexico is that most of it comes from the US. Although FDI inflows were intensive during the 1990s, this process started in the mid-1980s when a number of multinational companies from the US reallocated part of or the entire production process in Mexico. Table 6.1 shows that for the whole period (from 1980 to 2002) the highest source of FDI comes from the US, followed by Germany, France and Canada.

Table 6.1 FDI by country (in million dollars and percentages, %).

	1980	1985	1990	1991	1995a	1996	1997	1998p	1999	2000	2001	2002
Total	1,623	1,729	3,722	3,565	8,339	7,748	12,197	8,303	13,189	16,597	26,843	14,671
Percentage %	100	100	100	100	100	100	100	100	100	100	100	100
US	66.5	76.7	62.0	66.9	65.8	67.0	61.4	65.1	53.6	71.9	76.5	63.9
Great Britain	3.0	3.3	3.1	2.1	2.6	1.1	15.0	2.2	-1.5	1.6	0.3	7.8
Germany	10.5	3.2	7.7	2.4	6.6	2.6	4.0	1.7	5.7	2.1	-0.6	4.0
France	1.2	0.6	4.9	14.0	1.5	1.6	0.5	1.5	1.3	-15.2	1.4	1.2
Spain	4.9	0.8	0.3	1.2	0.6	1.0	2.7	4.2	7.6	11.5	2.9	3.8
Canada	1.1	2.0	1.5	2.1	2.0	7.0	2.0	2.5	4.7	4.0	3.7	1.3
Other	12.8	13.4	17.2	7.9	11.9	13.5	11.5	10.0	21.0	8.6	6.1	9.9

Source: INEGI-Banco de Informacion Economica.
a: From this year a new methodology was used to capture FDI flows. The flows represent amounts reported to the National Registry of Foreign Investment that were in effect materialised as well as the imports of fixed assets by the maquiladora industry in that year.
p: preliminary.

Around 80% of FDI goes to the industrial sector, especially to the manufacturing of electronics and the automobile industry. In Table 6.2 we can observe that FDI concentrates in the industrial sector and services (on average both account for more than 70% of total foreign investment). This could be explained by the change in the law that allowed privatisation of commercial banks at the end of the 1980s and telecommunications in 1991. Most of the companies that own these banks are foreign corporations.

Table 6.2 Distribution of FDI by economic sector (million dollars).

	1980	1985	1990	1995a	1996	1997	1998p	1999	2000	2001	2002
Absolute	1623	1729	3722	8339	7748	12197	8304	13190	16598	26843	14672
%	100	100	100	100	100	100	100	100	100	100	100
Agriculture and livestock	0.06	0.02	1.64	0.13	0.41	0.08	0.35	0.63	0.55	0.05	0.04
Mines and extraction	5.34	1.04	2.52	0.95	1.08	1.07	0.51	0.97	1.15	0.17	1.49
Industry	79.24	67.43	32.05	69.12	67.11	66.43	69.25	71.79	44.24	34.79	52.98
Retailing	7.27	6.33	4.60	12.13	9.41	15.89	11.61	9.49	13.87	5.85	9.61
Services	8.09	25.18	59.18	17.67	21.98	16.53	18.28	17.12	40.19	59.14	35.88

Source: INEGI-Banco de Informacion Economica

a: From this year a new methodology was used to capture FDI flows. The flows represent the amounts reported to the National Registry of Foreign Investment that were in effect materialised as well as the imports of fixed assets by the maquiladora industry in that year.

p: preliminary.

In short, the reduction and subsequent elimination of trade tariffs, the integration to a trade agreement area and the change in the law of foreign investment appear to be the most important determinants that have improved operating conditions of foreign corporations in Mexico.

In a developing country like Mexico, globalisation has restructured the traditional production process in which individual firms operated independently of each other to firms that operate as part of an international production network. Low or no barriers to movement of capitals and goods have promoted new ways to create intra-industry or intra-firm transactions, productive networks and international subcontracting forms. Foreign firms in Mexico have created few linkages to the local and regional market because globalisation has favoured different forms of long and short-term subcontracting. Most foreign firms import their main components, parts and raw materials due to the inability of domestic suppliers to provide large volumes of inputs and the lack of quality certification. Vertical organizations in the host country impede these firms from creating linkages to the local and regional levels. Even successful stories that have stimulated transactions with local suppliers like the electronic industry does not have the potential to create a strong long term effect in the economy (Dussel, 2000). In part this outcome is due to the globalisation process that has given place to international production networks and subcontracting structures that serve the purposes of transnational corporations. However it is also a result of lack of government strategies at the regional and local levels to integrate successfully the domestic industry to these international networks.

Regarding the trajectory of Mexican exports, during protectionism there was an attempt to stimulate export production of durable goods but the results showed that the impact on export performance was negligible. The reason were the anti-export bias created by protectionism and the decision to keep an overvalued currency, among others. The current account had a deficit for most of the period, except for the years following devaluation in 1983 (when there was a surplus of $5859 million dollars) and 1987 (a surplus of $4239 million dollars). In the year following devaluation in 1994, the current account did not register a surplus, but its deficit declined from $29662 million dollars to $1576 million dollars.

The domestic manufacture sector still keeps a low profile, a large proportion of manufactures is produced by foreign firms. For example, the automobile industry belongs to transnational corporations such as Volkswagen, Chrysler and General Motor. Meanwhile, the electronics industry is to a great extent integrated by Maquiladoras. This type of activity dominated the export market from 1990 to 2000. In 2002 their average exports share represented around 55.3% in the manufacturing sector and 48.6% of total exports (see Table 4.4 last row).

In the next section we try to provide the theoretical background that explains and justifies the inclusion of economic variables in an equation and the expected relationship between dependant and independent variables. In other cases, the inclusion of some variables is supported by empirical studies that have found positive and statistical significant relationships.

6.3 Theoretical framework of the empirical analysis on liberalisation and growth.

According to the theoretical propositions described on Chapter 2, we know from the Ricardian and Hecksher-Ohlin models (see Sections 2.2.1 and 2.2.2) that countries are better off with free trade than in autarky. Under free trade countries reallocate resources to produce goods in which they have a comparative advantage and prefer to import goods that are cheaper than domestic goods. Under the H-O theorem what matters is not the quantity of factors but the ratio between capital and labour. In this sense, a country specialises in the production of the good that requires relatively more of their abundant factor. These predictions are relevant in the case of Mexico because we want to determine if liberalisation stimulated export production in which Mexico has comparative advantage and thus raised domestic output. Accordingly, a positive relationship between output growth and exports is expected.

In classical economic theory, production could only be expanded by increasing one or both of the production factors, labour or capital. It was assumed the existence of decreasing returns to scale; an assumption that implied that subsequent increases of output could not be attributed to inputs' growth. Therefore, technical progress was explained by the residual in the production function, which was usually very large when there was technological change. The predictions of the endogenous growth theory (see Section 2.5) regarding the potential positive effects of FDI, human capital and technology transfer on output growth give good reasons to include them as explanatory variables in the equation of GDP. Romer (1986) introduced the idea that investment in knowledge could represent increasing returns to accumulation of capital because knowledge and R&D become public domain after a while. In the long run, it creates positive spillovers to the whole industry because the access to public knowledge expands the possibility frontiers of other firms; therefore it creates increasing returns to capital. This new approach was an endogenous approach because it focused on increasing returns to a factor or factors of production usually associated with accumulation of knowledge, technological progress and human capital that were previously related to external influences.

According to Grossman and Helpmann (1991) a country can benefit from international trade because exchange of goods and services gives access to a large market, access to accumulated knowledge and stimulates innovation in products and techniques. In such environment, growth rates are expected to be faster mainly because technical knowledge moves freely through international trade and foreign investment. In this context, we hypothesise that foreign investment affects economic growth positively by improving the productivity of physical resources. For example this can occur by bringing new technological processes to the host country and by implementing more efficient organisational methods. However, the transfer of technology, training, and rises in productivity created by international corporations are more likely to take effect if the host country possesses favourable conditions to adapt and react successfully. The formation of linkages backwards and forwards by foreign firms is expected to be higher as long as the local agents get involved in the activity of the foreign corporations and not only react passively. For instance, productive activities that require unskilled labour force, as a result of the production process, will create employment and generate wages, but it will have less multiplicative effects than an activity that demands skilled labour due to higher technological processes.

Romer (1986) also pointed out the important role of human capital as a source of increasing returns. In this study, it is assumed that new plants are on average technologically more developed than domestic plants in the same industry. The production processes used by those plants are expected to expose workers to new and different management techniques and *know-how*. In this sense, not only are these firms more likely to increase the demand for skilled labour but also to improve the quality of their workers by providing training that enables them to acquire new skills. In the long run, foreign investment increases the efficiency of the plants and other firms with which they interact, especially if they have local suppliers.

Regarding the determinants considered as relevant to explain FDI, some empirical studies presented in Chapter 3 (see Section 3.3) showed that among the most important determinants of FDI in host developing countries are the membership to a free trade region (Bende-Nabende et al., 2001), differentials in real wages (Blomstrom and Kokko, 1997 and Love and Lage-Hidalgo, 2000), human capital (Borensztein et al., 1998) and local competition (Bromstrom et al., 1994). The specification of the determinants of FDI was based not only on the results of some of these studies but also in the economic analysis of the trajectory of FDI in Mexico (see Sections 6.2 and 4.3.2). Based on the empirical studies, there is an indication that it is convenient to explain FDI in terms of relative wages between Mexico and the US, output growth and human capital. A positive relationship between the variables is expected. The analysis of FDI in Mexico also indicates that most of this investment has a strong participation in the export sector and most of this investment comes from the main trade partner, the US. Since most of the production of foreign corporations is sent to the world market (mainly the US) then it was pertinent to consider the state of the world economy as explicative of FDI. Additionally, the provision of infrastructure (roads, telecommunications, energy, industrial parks, etc.) by the government is also considered as positive determinant of FDI.

The analysis of the trajectory of exports in Chapter 4 (Section 4.3.1) showed that additionally to its link with trade policy, there is a close reaction to movements in the real exchange rate peso-dollar. In periods when the monetary policy maintained the domestic currency overvalued the consequences on exports were negative, this occurred during most of time under protectionism. On the other hand, in periods of currency devaluation and free floatation, exports production increased. The analysis carried out in Section 6.2 showed that there is also close positive relationship between FDI and the world economy due to large financial and commodity transactions between Mexico and the US. It was also noted that due to the strong role of foreign investment in the export sector, the differential in real wages between both countries affects production costs in this sector. In short, the real exchange rate, FDI, the world economy and real relative wages are considered pertinent as determinants of exports.

From the H-O theorem (Section 2.2.2), it is expected that openness will stimulate the production of goods in which the country uses intensively the factor in which is relatively abundant. So it is expected that resources (capital and labour) will be reallocated to the sector that has comparative advantage under the theorem's postulates. Thus, capital accumulation and labour productivity are likely to affect export production. Finally, output growth can also influence exports in the sense that it is a measure of the dynamism of the economy, it reflects the disposition of economic resources to be employ in the export sector.

Human capital represents that part of the population that has minimum levels of schooling education and technical abilities that allow them to adapt relatively easy to sectors that required skilled labour. Therefore the access to the education system is determined by different factors. Lucas (1988) provides the theoretical model that explains some of the determinants of human capital under the assumptions of the endogenous growth theory (see Section 2.5). FDI improves human capital under the assumption that foreign companies are likely to introduce technologically intensive processes that might require training and adaptation of the worker population. In the same fashion, technology transfer and rises in labour productivity are expected to improve human capital development. It is also expected that human capital is positively determined by government expenditure in the provision of infrastructure and services that facilitate the access to education. Disponsable income is a relevant explicative variable to consider since it affects the individual's capacity to finance his education and training for a longer period of time.

Regarding the explanation of labour productivity, the specification of its determinants is mainly based on the empirical review about similar studies that have tried to measure how productivity reacts to economic liberalisation. In the specific case of Mexico, Ramirez (2000) analysed the determinants of productivity found that FDI, government expenditure and domestic private investment had a positive effect. Additionally to these variables, we have included the potential effect of an increase in human capital, since a better education and more working skills tend to increase the worker's productivity. Technology transfer is also considered as an important determinant assuming that it creates positive spillovers and learning by doing capabilities. Finally, under the postulates of classical economy, productivity is posited as dependant on output (GDP). In all cases, the expected effect is positive.

The endogenous growth theory predicts that trade will have a positive effect on output growth through rises in capital accumulation. According to Baldwin (1992) trade liberalisation has a dynamic effect on output because it raises the rate of return and this induces more capital accumulation. In this context, we want to determine how a more open economy has affected capital accumulation in Mexico and so how this impacts on output growth. Among its most important determinants, we expect to find foreign capitals in the form of FDI, technology transfers, public spending, the provision of infrastructure and raises in labour productivity, all are likely to improve returns to capital and therefore stimulate its accumulation. Furthermore, rises in income per capita are likely to affect people's capacity to save and accumulate capital, GDP divided by total population used as a proxy in real terms, will try to capture if positive changes in this variable lead to increase accumulation.

6.4 A structural approach to analyse the direct and indirect effects of liberalisation in Mexico

The interaction and effect of liberalisation in the Mexican economy can be formalised by functional relationships that establish the potential links between the variables. Contrary to Chapter 5, where all possible external influence (on exports, GDP and FDI) could only occurred through shocks in the innovations; in this chapter we incorporate exogenous variables to account for these effects. The purpose is to investigate, through a simultaneous equations system, the direct and indirect effects from exports, FDI, human capital, capital accumulation and labour productivity on GDP and vice versa. It means that some of the endogenous variables are also explicative of other endogenous variables. We describe the following six equations based on the theoretical grounds and empirical analysis described in the previous section.

Equation 6.1 describes the determinants of output growth (GDP) as a function of FDI, exports, capital accumulation, human capital and labour productivity. The international trade theory predicts that a country will expand its output due to free trade because it stimulates the export production (EX) and therefore increases its PPF. Alternatively, the endogenous growth theory predicts that besides the standard production factors such as capital (CA) and labour (PRO), foreign capital in the form of FDI and human capital (HC) affect positively domestic output (see Romer, 1986). All the variables are expected to have a positive effect on GDP. All the equations include a constant term *c*.

$$GDP \quad f \;\; c, FDI, E \;\;, CA, HC, PRO \qquad (6.1)$$

where $FDI, E \;\;, CA, HC, PRO > 0$

Equation (6.2) explains FDI as a function of GDP, exports, human capital, real relative wages (RWAGES), the real exchange rate (RER), infrastructure (INF_SA) and the world economy (US, proxied by the US's GDP)[31]. All effects are expected to be positive, except relative wages, for which there is an inverse relationship because lower relative real wages in the host country is likely to attract FDI. The opposite is also true, high relative real wages translate to higher production costs compared to those paid in the investor's country.

$$FDI \quad f \;\; c, GDP, E \;\;, HC, RWAGES, RER, INF \;\; SA, US \qquad (6.2)$$

where $GDP, E \;\;, HC, RER, INF \;\; SA, US > 0$ and $RWAGES < 0$

Exports (EX) are posited to depend potentially on GDP, FDI, capital accumulation, labour productivity, relative wages, exchange rate and the world economy. It is expected that exports will respond positively to changes in these variables; except to relative wages because rises in real wages may raise export production costs. In the same way, we hypothesise that exports are dependent on the economic growth of Mexico's main trade partner. In this respect, we expect that a growing US economy will increase its demand for imports (Mexican exports). The real exchange rate accounts for how exports react to peso devaluation, a positive link is expected.

$$E \quad\;\; f \;\; c, GDP, FDI, CA, PRO, RWAGES, RER, US \qquad (6.3)$$

[31] The reason to consider US's GDP as a proxy of the world economy is based on the relative importance of Mexican exports to that country, which represent more than 80%, and the share of foreign investment from the US, which represents between 50% and 70%.

where $GDP, FDI, CA, PRO, RER, US > 0$ and $RWAGES < 0$

Human capital (HC) is specified as positively dependent on FDI, capital accumulation, labour productivity, technological transfer (TT), government expenditure (GE_SA), infrastructure and GDP per capita (GDP/POP). All the coefficients are expected to have positive signs. Among the most strong determinants, we expect to find technological transfer if it creates positive externalities and GDP per capita since part of an individual's education depends on his or her disposable income to finance his/her education and training.

$$HC = f(c, FDI, CA, PRO, TT, GE\_SA, INF\_SA, GDP/POP) \quad (6.4)$$

where $FDI, CA, PRO, TT, GE\_SA, INF\_SA, GDP/POP > 0$

Labour productivity (PRO) is specified to be a positive function of GDP, FDI, capital accumulation, human capital, technological transfer and government expenditure. For example, higher levels of technology and FDI may facilitate the introduction of capital intensive processes and training that raise the efficiency of the labour force.

$$PRO = f(c, GDP, FDI, CA, HC, TT, GE\_SA) \quad (6.5)$$

where $GDP, FDI, CA, HC, TT, GE\_SA > 0$

Finally, capital accumulation (CA) is a positive function of FDI, labour productivity, technological transfer, GDP per capita, government expenditure, infrastructure and a negative function of the real exchange rate. The latter assumption implies that a peso's depreciation will affect capital accumulation negatively. This effect operates through interest rates, as peso depreciation puts pressure on interest rates and therefore reduces returns on capital.

$$CA = f(c, FDI, PRO, TT, RER, GE\_SA, INF\_SA, GDP/POP) \quad (6.6)$$

where $FDI, PRO, TT, GE\_SA, INF\_SA, GDP/POP > 0$ and $RER < 0$

In Table 6.3 we present the six equations with the respective explicative variables and the expected functional relationship based on the discussion in Sections 6.3. All series are in quarterly frequency (from 1980:1 to 2002:4), for a more detailed description and sources of information, please see Appendix 6B.

Table 6.3. Endogenous, exogenous variables and expected linkage.

		Equations					
Endogenous variables	Notation	EQ6.1 GDP	EQ6.2 FDI	EQ6.3 EX	EQ6.4 HC	EQ6.5 PRO	EQ6.6 CA
Gross Domestic Product	GDP		√	√	√	√	√
Foreign Direct Investment	FDI	√		√	√	√	√
Export goods	EX	√	√				
Capital accumulation	CA	√		√	√	√	
Human Capital	HC	√	√			√	
Labour Productivity	PRO	√		√	√		√
Exogenous variables							
Technological Transfer	TT				√	√	√
Relative Wages	RWAGES		√	√			
Real exchange rate	RER		√	√			√
Government Expenditure	GE_SA				√	√	√
Infrastructure	INF_SA		√		√		√
World economy	US		√	√			
Population	POP				√		√

The following section describes the measurement of exogenous and endogenous variables used in the system.

6.4.1 Definition and measurement of the variables

Most of the series were deflated by an implicit price index (GDP deflator) and export price index and then converted to US dollars in order to eliminate the effect of inflation and homogenise the unit of measurement. 1993 was chosen as the reference year in accordance with national statistics from INEGI and the Bank of Mexico (which are the main sources of information).

Gross Domestic Product (GDP): It is measured in real million dollars.

Foreign Direct Investment (FDI): It is measured as flows, in real million dollars. The series was transformed to its moving Average (4) in order to smooth its fluctuation.

Exports (E): Export goods excluding crude oil (flows), in real million dollars. As it was mentioned in Chapter 5 (section 5.1), crude oil was excluded from exports because until 1985, it represented more than 50% of total exports. Although, its share decreased later, it was still relevant. Considering that our main interest is to measure the effect of exports (especially manufactures) on output the inclusion of crude oil would overestimate these effects.

Human capital (HC): It is measured as the number of students enrolled in secondary and technical schools.

Labour productivity (PRO): Labour productivity is measured as the monthly output produced by a worker in the manufacturing industry. In real dollars.

Capital accumulation (CA): It is gross fixed capital formation, in real million dollars.

Technology transfer (TT): Imports of capital goods by the private and public sector, in real million dollars.

Real exchange rate (RER): Pesos per dollar. It was calculated as $er \quad CPI_{US} \quad CPI_{ME}$, where *er* is nominal exchange rate (peso-USD) and CPI refers to the Consumer Price Index of Mexico and the US. The base year was 1993=100.

Government expenditure (GE SA): Public spending in social infrastructure, in real million dollars. It was seasonally adjusted[32].

Infrastructure (I F SA): Public spending in physical infrastructure, in real million dollars. The series was seasonally adjusted[33].

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[32] The series is registered as flow per quarter, however the patterned followed by the series indicates that flows are relatively lower in the first quarter and gradually increased throughout the year. This creates higher amounts in the last quarter of every the year. To eliminate this pattern, the series was seasonally adjusted using the X-12 quarterly seasonal adjustment method elaborated by the US Census Bureau.

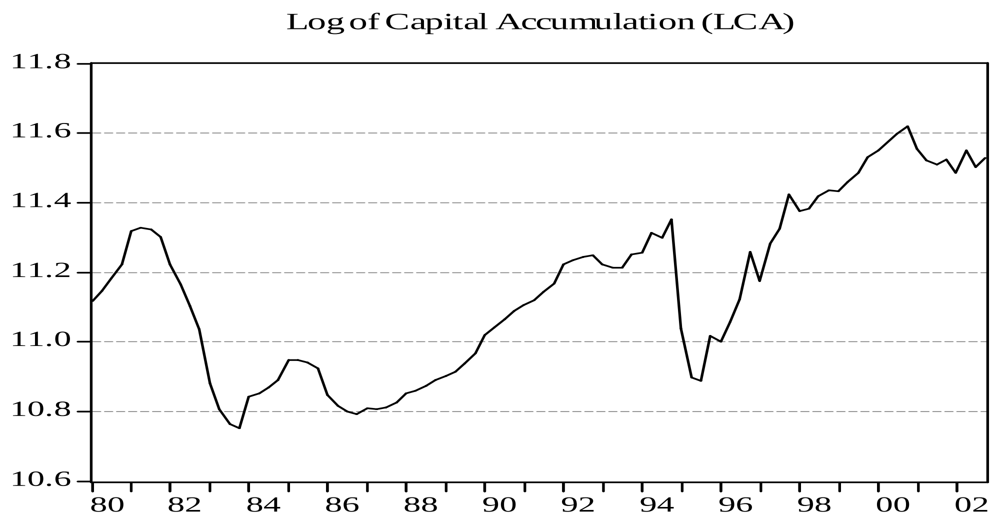
Real relative wages (R AGES): Real relative wages between Mexico and the US in the manufacturing sector, measured in dollars. It was calculated as real wages paid in Mexico divided by real wages paid in the US. The series was seasonally adjusted[34].

orld economy (S): It was proxied by the US's real GDP, in real million dollars. The series was seasonally adjusted[35].

Population (POP): Residents in Mexico.

All the series were converted to natural logarithms[36] to stabilise the variance. The following figures show the time-path followed by the variables during the period of analysis, from 1980:1 to 2002:4. LGDP, LFDI and LEX were omitted as they are Figures 5.1, 5.2 and 5.3 from Chapter 5.

Figure 6.2



[33] Ibid.
[34] Ibid.
[35] The original series was already seasonally adjusted.
[36] To denote a variable in natural logs, an "L" has been added to the notation.

Figure 6.3

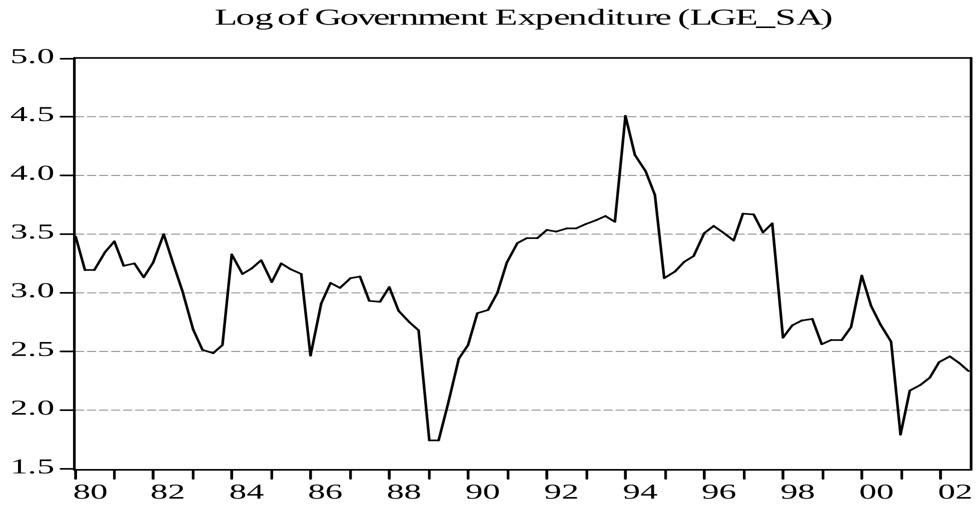


Figure 6.4

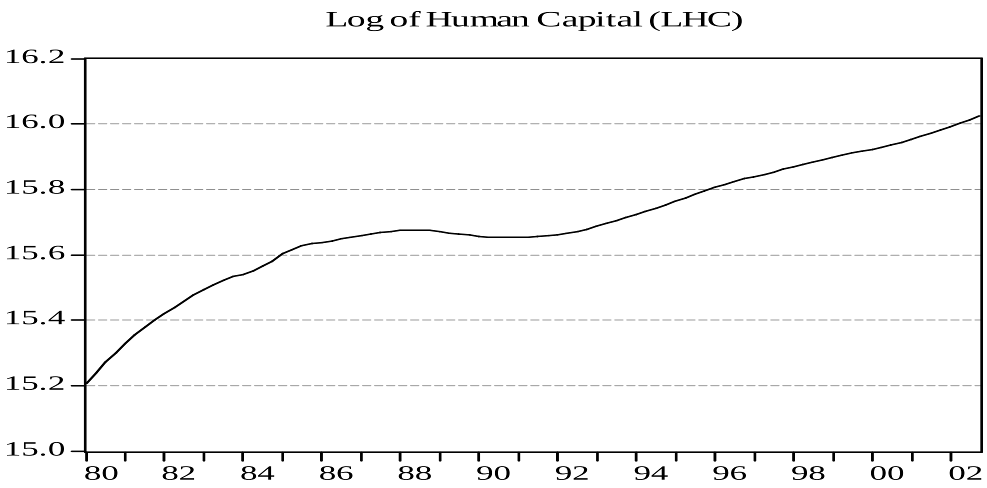


Figure 6.5

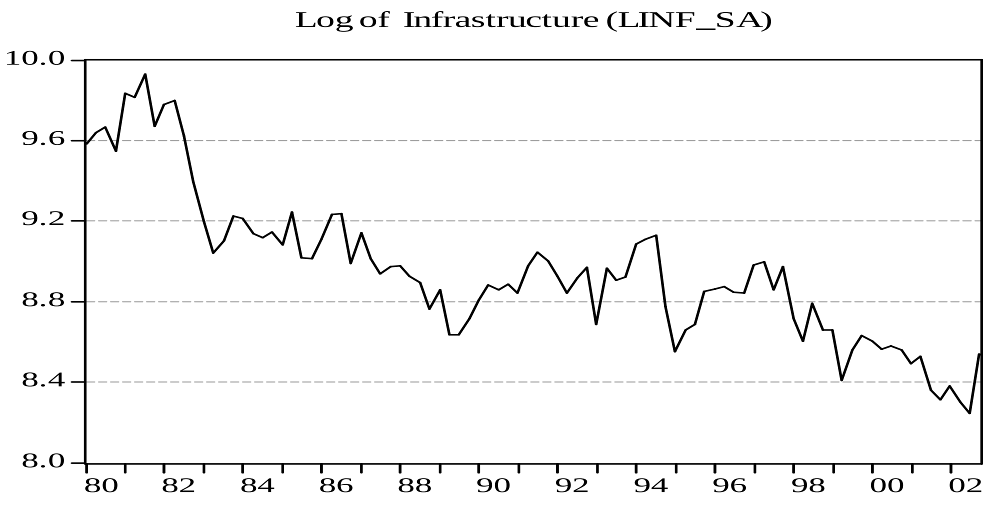


Figure 6.6

Figure6.7

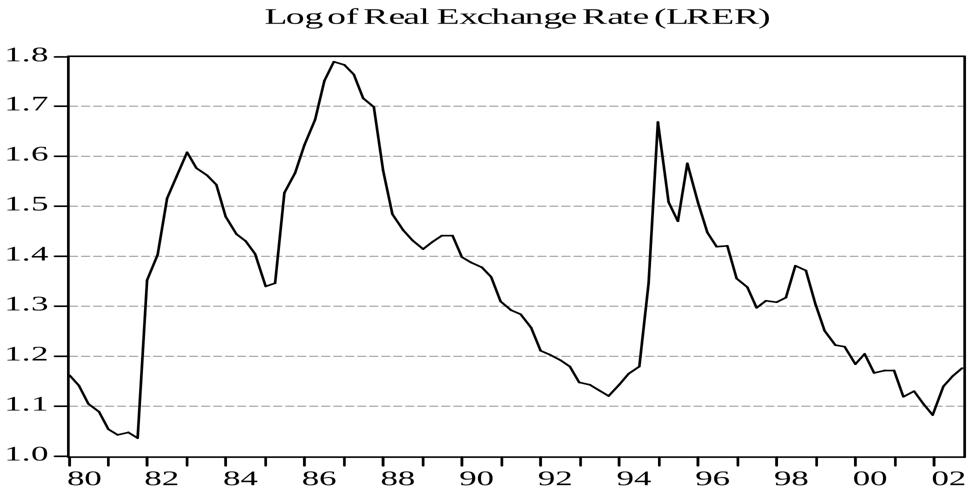


Figure 6.8

Figure 6.9

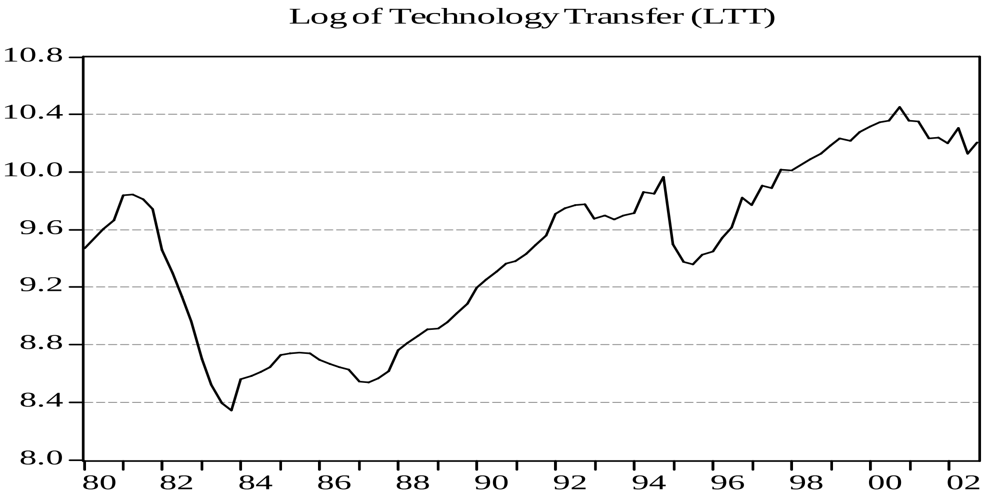


Figure 6.10

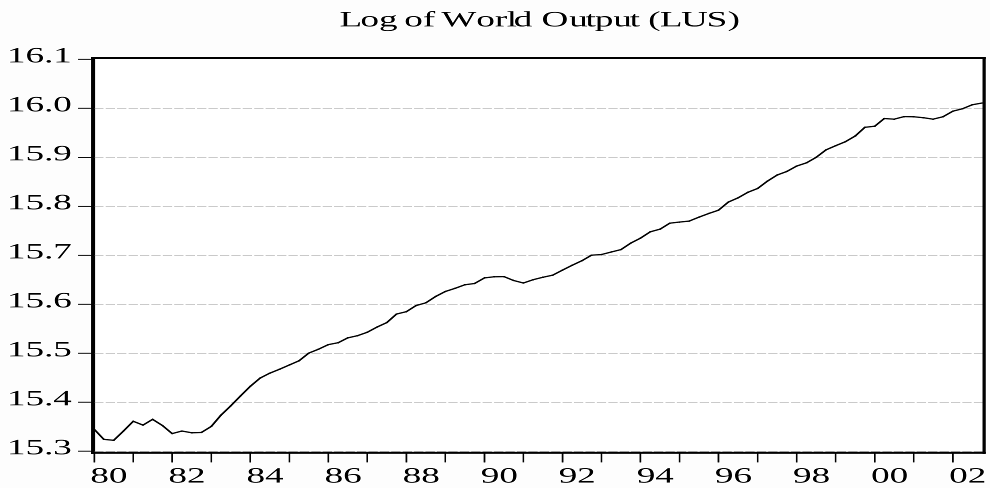
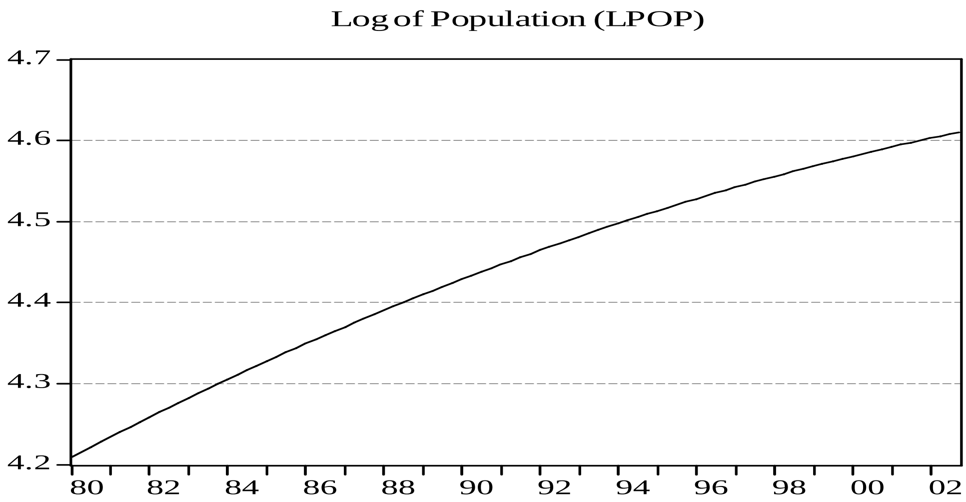


Figure 6.11



6.4.2 System specification

The model specification is similar to other specifications that try to measure the direct and indirect effect of liberalisation on output growth and other relevant economic variables (for example Bende-Nabende et al. (2001) and Iscan (1997)). The specification of the dynamic model follows the criteria proposed by Hendry & Richard (1983) in the sense that it must be data admissible, it must be consistent with theory and regressors must be at least weakly exogenous (in the case of a simultaneous model this criterion is applied to the regressors in the reduced form). Considering the functional relationships detailed in Table 6.3, we have the following dynamic system of equations:

$$LGDP_t = \alpha_0 + \sum_{i=0}^{p} \alpha_1 LFDI_{t-i} + \sum_{i=0}^{p} \alpha_2 LE_{t-i} + \sum_{i=0}^{p} \alpha_3 LHC_{t-i} + \sum_{i=0}^{p} \alpha_4 LCA_{t-i} + \sum_{i=0}^{p} \alpha_5 LPRO_{t-i} + v_1 \quad (6.7)$$

$$LFDI_t = \beta_0 + \sum_{i=0}^{p} \beta_1 LGDP_{t-i} + \sum_{i=0}^{p} \beta_2 LE_{t-i} + \sum_{i=0}^{p} \beta_3 LHC_{t-i} + \sum_{i=0}^{p} \beta_4 LRWAGES_{t-i} + \sum_{i=0}^{p} \beta_5 LRER_{t-i} + \sum_{i=0}^{p} \beta_6 LINF\_SA_{t-i} + \sum_{i=0}^{p} \beta_7 LUS_{t-i} + v_2 \quad (6.8)$$

$$LE_t = \delta_0 + \sum_{i=0}^{p} \delta_1 LGDP_{t-i} + \sum_{i=0}^{p} \delta_2 LFDI_{t-i} + \sum_{i=0}^{p} \delta_3 LPRO_{t-i} + \sum_{i=0}^{p} \delta_4 LCA_{t-i} + \sum_{i=0}^{p} \delta_5 LRWAGES_{t-i} + \sum_{i=0}^{p} \delta_6 LRER_{t-i} + \sum_{i=0}^{p} \delta_7 LUS_{t-i} + v_3 \quad (6.9)$$

$$LHC_t = \omega_0 + \sum_{i=0}^{p} \omega_1 LFDI_{t-i} + \sum_{i=0}^{p} \omega_2 LCA_{t-i} + \sum_{i=0}^{p} \omega_3 LPRO_{t-i} + \sum_{i=0}^{p} \omega_4 LTT_{t-i} + \sum_{i=0}^{p} \omega_5 LGE\_SA_{t-i} + \sum_{i=0}^{p} \omega_6 LINF\_SA_{t-i} + \sum_{i=0}^{p} \omega_7 (LGDP - LPOP)_{t-i} + v_4 \quad (6.10)$$

$$LPRO_t = \varpi_o + \sum_{i=0}^{p} \varpi_1 LGDP_{t-i} + \sum_{i=0}^{p} \varpi_2 LFDI_{t-i} + \sum_{i=0}^{p} \varpi_3 LCA_{t-i} + \sum_{i=0}^{p} \varpi_4 LHC_{t-i} + \sum_{i=0}^{p} \varpi_5 LTT_{t-i} + \sum_{i=0}^{p} \varpi_6 LGE\_SA_{t-i} + v_5 \quad (6.11)$$

$$LCA_t = z_0 + \sum_{i=0}^{p} z_1 LFDI_{t-i} + \sum_{i=0}^{p} z_2 LPRO_{t-i} + \sum_{i=0}^{p} z_3 LTT_{t-i} + \sum_{i=0}^{p} z_4 LRER_{t-i} + \sum_{i=0}^{p} z_5 LGE\_SA_{t-i} + \sum_{i=0}^{p} z_6 LINF\_SA_{t-i} + \sum_{i=0}^{p} z_7 (LGDP - LPOP)_{t-i} + v_6 \quad (6.12)$$

where:

v_t are the disturbance terms

$\alpha, \beta, \delta, \omega, \varpi$ and z are coefficients.

i= 0,…p where p=lag order

There is not a unique criterion to select the lags structure in a dynamic simultaneous model. Most of the time, the selection responds to economic intuition, the search for regularities in the data, historical trends or reasons that are rarely discussed in the literature. The procedure we established consisted in the estimation of various systems of equations containing different number of lags, from a relative large number to only few. The criterion to select the best lag length was based on mathematical stability that requires that all roots of the characteristic polynomial are less than one in absolute value and satisfactory residual tests of serial correlation (Q-statistic), normality (Jarque-Bera Statistic) and the i.i.d. residual test (BDS independence test). Because no restrictions have been imposed on the number of lags of each predetermined variable, we considered this system as *unrestricted*. In a second stage, from the unrestricted system only statistically significant coefficients were retained in order to reduce the number of parameters in the system (which then became a *restricted* system).

Finally, the restricted system had to go again through the analysis of stability condition and the standard diagnostic tests on the residuals. Before the estimations, we checked for unit roots in the variables to decide if the series had to be first differentiated or not.

6.4.3 nit root tests

Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) tests were applied to every series in the system (in section 5.3, it was already shown that exports, GDP and FDI are I(1)). The selection of the test equation was not always straightforward; first a visual examination of the plots was carried out (to decide whether or not considering a constant or a constant and a trend). Then, we checked the statistical significance of the coefficients from the unit root test regressions, both with the ADF and P-P test. The results are presented in Table 6.4.

Table 6.4 Augmented Dickey Fuller (ADF) and Phillips-Perron (P-P) statistics and probabilities. Series are in levels.
Null hypothesis: there is unit root.

Series	ADF		P-P	
	Constant	Constant and a trend	Constant	Constant and a trend
LCA		-3.2288 (0.0857)		-2.1139 (0.5309)
LRER	-3.0775 (0.0319)		-2.2357 (0.1953)	
LGE_SA	-2.5282 (0.1122)		-2.6040 (0.0959)	
LHC	1.1833 (0.997)		-2.7245 (0.0738)	
LINF_SA		-3.3440 (0.0658)		-3.2713 (0.0777)
LPRO		-1.7615 (0.7152)		-1.5309 (0.8117)
LRWAGES	-2.0193 (0.2782)		-2.0067 (0.2835)	
LTT		-3.3112 (0.0711)		-2.2059 (0.4803)
LUS		-2.5634 (0.2979)		-2.7194 (0.2315)
LPOP		-0.3681 (0.9873)		-1.4020 (0.8541)

Notes: MacKinnon critical values for rejection of hypothesis of a unit toot for ADF and P-P tests: 1%=-4.063, 5%= -3.459, 10%= -3.156 (with trend and constant) and 1%=-3.503, 5%= -2.893, 10%= -2.583 (with a constant).

The presence of unit root in levels was detected in all the series, except LRER which rejected the null hypothesis with the ADF test at 5% level of significance; however it passed the P-P test. Due to this inconsistency, we consider LRER as nonstationary in levels. LINF_SA also passed the test but at the 90% critical value, which is not strong enough to suggest that it is stationary.

The same tests to the first differences showed that the null hypothesis of unit root had to be rejected (see Table 6.5); therefore the series are non-stationary in levels but stationary in first differences. They are integrated of order one, I(1).

Table 6.5 Augmented Dickey Fuller (ADF) and Phillips-Perron (P-P) statistics and probabilities. Series are in first differences.

Null hypothesis: there is unit root

	ADF		**P-P**	
Series	Constant	Constant and a trend	Constant	Constant and a trend
DLCA		-4.7954 (0.001)		-7.4377 (0.000)
DLRER	-7.6772 (0.000)		-7.8054 (0.000)	
DLGE	-9.9074 (0.000)		-9.9076 (0.000)	
DLHC	-3.2314 (0.021)		-3.4118 (0.013)	
DLINF		-10.829 (0.000)		-11.289 (0.000)
DLPRO		-10.1997 (0.000)		-10.1997 (0.000)
DLRWAGES	-6.5039 (0.000)		-6.5039 (0.000)	
DLTT		-3.8823 (0.016)		-6.7493 (0.000)
DLUS		-3.9101 (0.015)		-7.2104 (0.000)
DLPOP		-11.2222 (0.000)		-21.844 (0.000)

Notes: MacKinnon critical values for rejection of hypothesis of a unit toot for ADF and PP tests: 1%=-4.063 and 5%= -3.459 (with constant and trend) and 1%=-3.504 and 5%= -2.893 (with constant).

6.4.4 Estimations with non-stationary variables: Hsiao s approach

It is known that the existence of non-stationary series in levels might lead to spurious regression (i.e. when it is likely to find statistically significant coefficients despite inexistent true relationship between the variables). Granger and Newbold (1974) found that spurious regressions occurred when independent random walks are regressed on each other. Phillips (1986) analysed the asymptotic distribution of standard statistical tests and found that they diverge while the Durbin-Watson converges to zero. In other words, it made the presence of trends in the variables being interpreted as meaningful relationships.

However, there is a contention on whether or not the problem of non-stationarity still matters when the parameters are estimated in a simultaneous equations framework. For example, Hsiao (1997a) argues that in estimations with 2SLS, using non-stationary variables that are cointegrated, Wald type test statistics remain asymptotically chi-square distributed. According to Hsiao, non-stationarity does not require new estimation methods or statistical inferences procedures. The only concern, he says, is to check for identification and simultaneity bias, just as the Cowles Commission's recommendations.

Hsiao's (1997b) approach is based on two assumptions; first that the variance-covariance matrix of the exogenous variables converges to a matrix that is non-singular, which requires no multicollinearity among the variables; second, that the roots of the characteristic polynomial of the dynamic system lie inside the unit circle or $|\Delta - \lambda I| = 0$, this demands the stability of the system. According to Hsiao, the second assumption is equivalent to the condition that there should be M cointegrating vectors among the endogenous and exogenous variables in the system (where M is the number of presupposed endogenous variables in the system). In this regard, cointegration is an indication that the stochastic trends in the exogenous variables "cause" the stochastic trends (nonstationarity) in the endogenous variables. Under this condition, it is possible to estimate an unrestricted VAR with all the variables entered as endogenous variables and obtain *M* cointegrating vectors. If this is the case, the system of six equations can be estimated with nonstationary variables.

To decide if we could estimate the system using non-stationary variables, we checked Hsiao's assumptions about no multicollinearity and stability. First, we obtained the variance-covariance matrix of the exogenous variables and calculated its determinant (see appendix 6C). The determinant was equal to 1.33 e-13, a result that satisfied the condition of no multicollinearity. Second, to test for the stability of the system, we ran the system of equations with 2SLS and made sure that the properties of the residuals were satisfactory (see appendix 6D for diagnostic tests). The stability condition requires that all the eigenvalues of the characteristic polynomial are less than one in absolute value. If both assumptions are achieved then the estimations in levels are valid and the Wald statistics remains asymptotically distributed. To calculate the eigenvalues, the structural system of equations was transformed to the reduced form and specified in the companion form. In this way, it was possible to obtain the characteristic polynomial and test the stability condition. The calculation of the eigenvalues showed that there are two roots higher than one in absolute value (see Table 6.6). This is an indication that the system is mathematically unstable.

Under these circumstances, one of Hsiao's assumptions is violated and the system cannot be estimated with non-stationary variables. The I(1) series need to be first differentiated to obtain valid estimations and achieve stability[37]. It is also required to consider the Cowles' recommendation about identification and simultaneity bias to decide if the estimation method is the appropriate.

[37] This condition is extremely important not only to obtain valid estimates but also to calculate the multiplier effects since these can only be meaningful when the system is stable.

Table 6.6 Stability condition of the 2SLS estimations in levels.
Eigenvalues of the companion matrix.

Root	Modulus
.431526095+.871775143*I	0.972732
.4315260954-.871775143*I	0.972732
.9143667360+.319804546*I	0.968680
.9143667360-.319804546*I	0.968680
.9573725371+.204497666*I	0.978970
.9573725371-.204497666*I	0.978970
.6696200825+.634366926*I	0.922395
.6696200825-.634366926*I	0.922395
0.862581	0.862581
.5905274111+.600315739*I	0.842082
.5905274111-.600315739*I	0.842082
-0.45227669+0.9701577*I	1.070402
-.4522766906-.970157729*I	1.070402
-.1191853439+.907064193*I	0.914861
-0.119185343-0.90706419*I	0.914861
.1431396437+.7990331658*I	0.811753
.1431396437-.7990331658*I	0.811753
-.9328391446+.343147665*I	0.993951
-.9328391446-.343147665*I	0.993951
-0.980933	0.980933
-.7239717241+.555363867*I	0.912449
-.7239717241-.555363867*I	0.912449
-.2119085266+.648464408*I	0.682211
-.2119085266-.6484644080*I	0.682211
-.6064317264+.4906078214*I	0.780036
-.6064317264-.4906078214*I	0.780036
-.4263154955+.5658175647*I	0.708445
-.4263154955-.5658175647*I	0.708445
-.6656888407+.1865901405*I	0.691345
-.6656888407-.1865901405*I	0.691345
.5208625755+.39593924e-1*I	0.522365
.5208625755-.39593924e-1*I	0.522365
0.137674	0.137674
-.743905263e-1+.41114789*I	0.417824
-.743905263e-1-.41114789*I	0.417824

In the following section we proceed to describe the methodology used to estimate the system of simultaneous equations detailed in section 6.4.

6.5 System of simultaneous equations

In the standard regression model: $y = \quad \beta + \varepsilon$, it is assumed that the errors are uncorrelated with the exogenous variables ( ), i.e. that the conditional expectation of ε given is equal to zero. A violation of this assumption implies that the estimates are biased. In equations where the error terms are correlated with the right-hand side variables, the parameter estimates by OLS will be biased and inconsistent. A solution to this problem requires a method of simultaneous equations model to take endogeneity in consideration. In this method, the estimates of the structural model are not estimated directly but obtained from the reduced form equations using instrumental variables. The instrumental variables are regressed against all the exogenous variables in the system. This procedure guarantees uncorrelated instrumental variables with the error term but correlated with the explanatory variables. In matrix form (Maddala (2001) and Greene (2003)), the structural model is:

$$\Gamma y_t + Bx_t = \varepsilon_t \qquad (6.13)$$

Where y_t and x_t are vectors of endogenous and exogenous variables and Γ and B are matrices of coefficients of the endogenous and exogenous variables, respectively. ε_t is a vector of error terms. The solution is the reduced form equation:

$y_t = -\Gamma^{-1}Bx_t - \Gamma^{-1}\varepsilon_t$ or simplifying,

$$y_t = \Pi x_t + v_t \qquad (6.14)$$

where $\Pi = -\Gamma^{-1}B$ and $v_t = -\Gamma^{-1}\varepsilon_t$.

In matrix form:

$$y_t = \begin{bmatrix} \pi_{11} & \pi_{12} & \cdots & \pi_{1K} \\ \pi_{21} & \pi_{22} & \cdots & \pi_{2K} \\ \vdots & \vdots & \vdots & \vdots \\ \pi_{M1} & \pi_{M2} & \cdots & \pi_{MK} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_K \end{bmatrix} + \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_M \end{bmatrix} \qquad \begin{aligned} y_t &= (Mx1) \\ \Pi &= (MxK) \\ x_t &= (Kx1) \\ v_t &= (Mx1) \end{aligned}$$

Here M=number of endogenous variables and K=number of exogenous variables.

In this system, it is assumed that that the errors have zero mean, are independent and have a common covariance; $E(\varepsilon_t) = 0$ and $E(\varepsilon_t \varepsilon_{t'}) = \Sigma$. The solution of the reduced form (6.14) requires Γ to be a non-singular matrix, and the identification of each equation in the system.

We were interested in the dynamic form of this model because some variables are likely to have lagged effects on the endogenous variables. As this is the case, the system specification changes slightly to allow for lagged endogenous and exogenous variables. The structural model (6.13) changes to:

$$\Gamma y + Bx + \Phi y_{t-1} = \varepsilon \tag{6.15}$$

Where, **y** is a vector of endogenous variables times the number of lags that appear in current and lagged form. **x** is a vector of exogenous variables times the number of lags that appear in current and lagged form. y_{t-1} is a vector of lagged endogenous variables times the number of lags. ε is a vector of disturbances independently, identically distributed with mean 0 and covariance matrix Ω. Expressing (6.15) in its reduced form:

$$y = \Pi x + \Delta y_{t-1} + v \tag{6.16}$$

where: $\Pi = -\Gamma^{-1} B$, $\Delta = -\Gamma^{-1}\Phi$ and $v = -\Gamma^{-1}\varepsilon$

Lagged variables are now considered as predetermined and therefore are part of the instrumental variables. The assumptions of this model state that there is no multicollinearity and the stability condition is satisfied, i.e. the roots of the characteristic polynomial lie inside the unit circle, $|\Delta - \lambda I| = 0$.

6.5.1 Estimation method: 3 Stage Least Squares (3SLS)

Estimation methods of simultaneous equations models can be categorised in two groups: the limited information and full information methods, both based on instrumental variables. The first group is referred to as limited information because every equation in the system is estimated separately; the estimations only consider the restrictions imposed on the coefficients of that specific equation. On the other hand, full information methods use all the restrictions on the equations in the system to estimate the parameters of the equations. In this case, the system is estimated jointly and not equation by equation. While the limited information technique is consistent, it is not as efficient as the full information technique. The reason is that the latter takes in consideration the possibility of cross correlations between the error terms in different equations and predetermined variables that are excluded from the equation under consideration.

The 3SLS procedure to estimate the system of equations encompasses 2SLS. In a very similar way to the instrumental variables method, the 2SLS implies a first stage where the regressors (right-hand side variables) are regressed on all the predetermined variables in the system. Their predicted values from the reduced-form equations are:

$$\hat{y}_t = \Pi x_t + v_t \qquad (6.17)$$

In the second stage, the endogenous regressors are replaced by their predicted values ($\hat{y}_t$) in the structural system and then the coefficients are obtained by OLS. The third stage requires using the residuals -from the second stage- to get an estimate of the error covariance matrix, then a method of Generalised Least Squares (GLS) is applied.

6.5.2 Simultaneity bias

Prior to the estimations, it is necessary to check if there is simultaneity bias, which justifies the application of simultaneous equations system. This procedure shows whether the right-hand side variables are endogenously determined with the left-hand side variables. If this is the case, OLS estimates will be inconsistent and biased and a different method of estimation should be applied. This test is usually applied when we want to run every equation of the system with OLS and it is necessary to prove that there is no simultaneity bias. Hausman (1978) constructed a specification error test to check whether or not the assumption that the originally defined exogenous variables are uncorrelated with the error term ($E(\varepsilon / \quad) = 0$) or, in large samples, whether $p\lim \frac{1}{T} \quad ' \varepsilon = 0$ is violated. The test requires the estimation of an extended regression:

$$y = \quad \beta + \tilde{\quad} \alpha + v \qquad (6.18)$$

Where $\tilde{\quad}$ is a vector of predicted values from the reduced-form equations. To test the null hypothesis that $H_0 : \alpha = 0$ (in other words that is weakly exogenous) we can either apply an F-test for the joint significance of a set of coefficients or a *t*-test if we are testing the exogeneity of one variable. If the null is rejected, then the variables under analysis are not weakly exogenous since $\tilde{\quad}$ is correlated with the disturbance term. If we cannot reject the null, then $\tilde{\quad}$ is not correlated with ε, meaning that the estimators from OLS are unbiased. Otherwise, a different method of estimation should be considered.

6.5.3 Rank and order condition for identification

Identification is another important matter to consider when we estimate a system of equations. Identification provides information on whether estimates can be obtained of the structural parameters (order condition) and whether or not they are unique (rank condition). The order condition states that the number of exogenous variables excluded from an equation (K-k) must be at least as large as the number of endogenous variables included in that equation less 1, (m-1). K is the number of predetermined variables in the system plus any constant, k is the number of predetermined variables in the equation and m is the number of endogenous variables in the equation. In general, this condition is considered to be a simple counting rule which helps to find if an equation is under, just or over-identified according to the following criterion:

If $(K-k) < (m-1)$, the equation is under-identified.

If $(K-k\ = (m-1)$, it is just identified.

If $(K\text{-k}) > (m-1)$, it is over-identified.

This condition ensures that there is at least one solution but does not show if the equation has a unique solution. This makes it necessary but not a sufficient condition. Most of the time it is applied when the number of variables in the system is relatively large and it becomes complicated to determine the rank condition (Johnston & Dinardo, 1996). However, evaluating only this condition may lead to the possibility of getting meaningless estimators that might be the result of linear combinations of the parameters in the system.

On the other hand, the rank condition for identification ensures that there is a unique solution for the structural parameters given the reduced-form estimates. This condition states that an equation is identifiable if the rank of the coefficient matrix with the excluded endogenous and predetermined variables in the equation is equal to the total number of endogenous variables minus one: Rank$[\Pi^{*}_{j}]$ = M-1. M is the total number of endogenous variables minus one in the system and j refers to the specific equation. Under the rank condition, an equation is identified if there is at least a non-zero determinant in an (M-1)(M-1) matrix that contains the coefficients of excluded variables -from the equation under consideration- but included in other equations in the model (Mukherjee et al, 1998). The rank condition is necessary and sufficient for identification.

6.6 A dynamic analysis of Mexico s liberalisation: specification and estimations

Once it was confirmed that the series are non-stationary and the system cannot be estimated in levels, first differentiation was applied to the system of equations (6.7 to 6.12). To select the lag structure, we followed the procedure described in Section 6.4.2. Different systems of equations were estimated with 6, 5 and 4 lags, all of them were tested for mathematical stability and residual tests. Only the system with six lags (see Appendix 6E for specification) satisfied the stability condition; it was also confirmed that the structural residuals were free from serial correlation and most of them passed normality and i.i.d tests (Appendix 6F). This unrestricted system was taken as a reference to retain coefficients with statistical significance. In this way, we ended up with a restricted system of equations that contained lagged and current variables that were statistical significance in the unrestricted system. In the same way, the estimations of the new restricted system passed stability condition and the tradition residual tests (see Appendix 6G). In short, the purpose of this procedure was to improve the estimates and reduce the sum of squared residuals. The restriction of the model led to the following specification (expressed in matrix form):

$$
{}_t = C + M_1\, {}_t + M_2\, {}_t + M_3 DLGDP_{t-i} + M_4 DLFDI_{t-i} + M_5 DLE_{t-i} + M_6 DLHC_{t-i}
+ M_7 DLPRO_{t-i} + M_8 DLCA_{t-i} + M_9 DLGE_{t-i} + M_{10} DLINF_{t-i} + M_{11} DLTT_{t-i} +
M_{12} DLWAGES_{t-i} + M_{13} DUS_{t-i} + M_{14} DLRER_{t-i} + M_{15} D(LGDP - LPOP)_{t-i} + AR(p) \quad (6.19)
$$

Where:

${}_t$= Endogenous variables

${}_t$= Exogenous variables

C= Constant

t= Observation

i= 1 … 6. Number of lags

$$
{}_t = \begin{pmatrix} DLGDP_t \\ DLFDI_t \\ DLE_t \\ DLHC_t \\ DLPRO_t \\ DLCA_t \end{pmatrix} \quad C = \begin{pmatrix} 0 \\ 0 \\ 0 \\ \surd \\ \surd \\ \surd \end{pmatrix} \quad {}_t = \begin{pmatrix} DLGE_t \\ DLINF_t \\ DLTT_t \\ DLWAGES_t \\ DLUS_t \\ DLRER_t \\ DLPOP_t \end{pmatrix}
$$

$$
M_1 = \begin{pmatrix} 0 & 0 & 0 & \surd & \surd & \surd \\ 0 & 0 & \surd & 0 & 0 & 0 \\ 0 & \surd & 0 & 0 & 0 & 0 \\ \surd & 0 & 0 & 0 & 0 & \surd \\ \surd & 0 & 0 & \surd & 0 & 0 \\ 0 & \surd & 0 & 0 & 0 & 0 \end{pmatrix}
M_2 = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \surd & 0 & 0 & 0 & \surd & 0 \\ 0 & 0 & 0 & \surd & \surd & 0 & 0 \\ 0 & 0 & \surd & 0 & 0 & 0 & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & \surd & 0 & 0 & 0 & \surd \end{pmatrix}
M_3 = \begin{pmatrix} \surd & \surd & 0 & \surd & 0 & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
M_4 = \begin{pmatrix} 0 & 0 & 0 & 0 & \surd & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & 0 & \surd & 0 & \surd & \surd \\ 0 & 0 & 0 & 0 & \surd & 0 \\ 0 & 0 & 0 & 0 & \surd & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
$$

$$
M_5 = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \surd & 0 & 0 & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
M_6 = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
M_7 = \begin{pmatrix} \surd & 0 & 0 & \surd & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & 0 & 0 & \surd & 0 & 0 \\ \surd & \surd & \surd & \surd & 0 & 0 \\ 0 & 0 & 0 & \surd & 0 & 0 \\ \surd & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
M_8 = \begin{pmatrix} \surd & 0 & \surd & \surd & 0 & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & 0 & 0 & 0 & 0 \\ 0 & 0 & \surd & 0 & \surd & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
$$

$$
M_9 = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \surd & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & 0 & \surd & \surd & 0 & 0 \end{pmatrix}
M_{10} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \surd & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \surd & \surd & \surd & \surd & \surd \end{pmatrix}
M_{11} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & 0 & 0 & 0 & 0 & \surd \\ 0 & 0 & 0 & 0 & \surd & 0 \\ \surd & 0 & 0 & \surd & \surd & 0 \end{pmatrix}
M_{12} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \surd & 0 & 0 & 0 & \surd \\ \surd & 0 & \surd & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix}
$$

$$M_{13}=\begin{pmatrix}0&0&0&0&0&0\\ \surd&0&0&0&\surd&\surd\\ 0&0&0&0&0&0\\ 0&0&0&0&0&0\\ 0&0&0&0&0&0\\ 0&0&0&0&0&0\end{pmatrix}\quad M_{14}=\begin{pmatrix}0&0&0&0&0&0\\ 0&0&0&0&0&\surd\\ 0&0&0&0&0&0\\ 0&0&0&0&0&0\\ 0&0&0&0&0&0\\ \surd&\surd&\surd&0&0&\surd\end{pmatrix}\quad M_{15}=\begin{pmatrix}0&0&0&0&0&0\\ 0&0&0&0&0&0\\ 0&0&0&0&0&0\\ \surd&\surd&0&0&\surd&0\\ 0&0&0&0&0&0\\ \surd&0&\surd&\surd&0&0\end{pmatrix}\quad AR(p)=\begin{pmatrix}0&0&0&0&0\\ \surd&\surd&0&0&0\\ \surd&0&0&0&0\\ \surd&\surd&\surd&\surd&\surd\\ \surd&0&0&0&0\\ \surd&\surd&0&0&0\end{pmatrix}$$

The instrumental variables used in the estimations were the same across the six equations. They correspond to all exogenous and lagged endogenous variables plus a constant[38].

6.6.1 Simultaneity bias

Hausman's specification error test was applied to check the null hypothesis of no misspecification. Basically, it tests the null hypothesis that the variables are weakly exogenous and there is no endogeneity. If this is so, then the left-hand side variables could be treated as exogenous when they appeared in the right-hand side of the equation. Hausman's test requires regressing each variable whose exogeneity is under scrutiny on all the predetermined variables[39]. The fitted values from these regressions are then included in the expanded regression (6.18) which contains the original regressors. Obviously, the test is applied to each equation of the system (6.19). For example, in the case of the first structural equation (DLGDP), the expanded regression was:

$$\begin{aligned}&DLGDP_t=\beta_1 DLCA_t+\beta_2 DLHC_t+\beta_3 DLPRO_t+\beta_4 DLGDP_{t-1}+\beta_5 DLGDP_{t-2}+\\&\beta_6 DLGDP_{t-4}+\beta_7 DLGDP_{t-6}+\beta_8 DLFDI_{t-5}+\beta_9 LCA_{t-1}+\beta_{10} LCA_{t-3}+\beta_{11} LCA_{t-4}+\\&\beta_{12} DLCA_{t-6}+\beta_{13} DLPRO_{t-1}+\beta_{14} DLPRO_{t-4}+\beta_{15} DLC\hat{A}+\beta_{16} DLH\hat{C}+\beta_{17} DLPR\hat{O}\end{aligned}$$

[38] The instrumental variables were: C, DLTT, DLGE, DLRER, DLINF, DWAGES, DUS, DLPOP, DLGDP(-1 TO -2), DLGDP(-4), DLGDP(-6), DLFDI(-1), DLFDI(-3), DLFDI(-5 TO -6), DLEX(-3), DLEX(-6), DLCA(-1 TO -6), DLHCC(-1 TO -6), DLPRO(-1 TO -4), DLTT(-1), DLTT(-4 TO -6), DWAGES(-1 TO -3), DWAGES(-6), DLRER(-1 TO -3), DLRER(-6), DLGE(-1), DLGE(-3 TO -4), DLINF(-2 TO -6), DUS(-1), DUS(-5 TO -6), DLPOP(-1 TO -5). The number in parenthesis are the number the series was lagged.

[39] This includes the exogenous variables, the lagged endogenous and lagged exogenous variables and a constant (in total 62).

We tested the hypothesis that DLCA, DLHC and DLPRO were weakly exogenous, rejection of this hypothesis would imply that they are in fact endogenous and an estimation method of simultaneous equations is justified. A joint significance test on the coefficients of the fitted variables β_{15}, β_{16} and β_{17} showed an F-statistic equal to 1.9329 with probability 0.1325. This leads to the non rejection of the null, meaning that there is no simultaneity bias and the variables can be taken as weakly exogenous. The same procedure was followed for the rest of the structural equations in the system. Table 6.7 contains the variables, the F and T statistics and their probabilities.

Table 6.7 Hausman's test for weak exogeneity (restricted system).

Equation	Variable to test for exogeneity	F-Statistic / Chi-squared T-test	H0: $\alpha = 0$ It is weakly exogenous
DLGDP	DLCA DLHC DLPRO	F-stat= 1.9329 (0.1325) Chi-sq. = 5.7989 (0.1218)	Do not reject
DLFDI	DLEX	T-stat=-1.2122 (0.2296)	Do not reject
DLEX	DLFDI	T-stat=-1.1982 (0.2348)	Do not reject
DLHC	DLCA, DLGDP	F-stat= 0.5675 (0.5702) Chi-sq. = 1.1350 (0.5669)	Do not reject
DLPRO	DLGDP DLHC	F-stat= 7.6539 (0.0010)*** Chi-sq. = 15.3079 (0.0005)***	Reject
DLCA	DLFDI, DLGDP	F-stat= 2.1359 (0.1280) Chi-sq. = 4.2719 (0.1181)	Do not reject

The asterisks represent the rejection of the null at 1% level of significance (***)

In general, the null hypothesis was not rejected, which indicates that there no is simultaneity bias and OLS could be applied individually to some equations but not to the system. For example, equation DLPRO shows that there is simultaneity bias, DLGDP and DLHC cannot be considered as weakly exogenous since they are correlated with the residuals. This indicates that the best way to handle the problem is by estimating the system in a simultaneous equations framework where the endogeneity of variables DLGDP and DLHC is taken in consideration properly.

6.6.2 Order and rank conditions for identification

To estimate the system of six equations, it is necessary to investigate if they are identified. First, the order condition was calculated according to the following rules:

If (K-k) < (m-1), the equation is under-identified

If (K-k = (m-1), it is just identified

If (K-k) > (m-1), it is over-identified

A summary of the results are in Table 6.8. All the equations are overidentified, meaning that there are more than enough variables to use as instruments in order to estimate the coefficients. The order condition ensures that there is at least one solution but it does not show if the equation has a unique solution.

Table 6.8 Order condition for identification

Equation	(K-k)	(m-1)	Status (K-k) > (m-1)
DLGDP	(62-13) =49	(4-1)= 3	Over-identified
DLFDI	(62-12) =50	(2-1)=1	Over-identified
DLEX	(62-11) =51	(2-1)=1	Over-identified
DLHC	(62-15) =47	(3-1)=2	Over-identified
DLPRO	(62-8) =54	(3-1)=2	Over-identified
DLCA	62-23=39	(3-1)=2	Over-identified

Notes: K: numbers of predetermined variables in the system.
k: number of predetermined variables in the equation.
m: number of endogenous variables in the equation.

On the other hand, the rank condition for identification ensures that there is a unique solution for the structural parameters given the reduced-form estimates. It states that the equation is identifiable if the rank of the coefficient matrix that contains the excluded endogenous and predetermined variables in the equation is equal to the total number of endogenous variables minus one (5). To find the rank order, the system was normalised in relation to the six endogenous variables. We examined the relevant sub-matrices that contained excluded endogenous and predetermined variables in each equation (Π_j^*). Due to the existence of many predetermined variables in the system, there was a large number of choices to find at least one possible (5x5) matrix with a non-zero determinant. In Table 6.9 we show the determinants of at least one sub-matrix found in each equation. The system satisfied the rank condition of identification.

Table 6.9 Rank condition of identification.

Equation	Determinant of sub-matrix (5x5), Π_j^*	Rank condition
DLGDP	-0.001159	Satisfied
DLFDI	-0.000010	Satisfied
DLEX	0.000037	Satisfied
DLHC	0.000047	Satisfied
DLPRO	0.002539	Satisfied
DLCA	0.000142	Satisfied

The next seven sections contain the results of the stability condition and residual tests on the 3SLS estimations. We tried to highlight the most relevant information provided by the estimations. Each table contains the coefficients, standard errors, probabilities, un-weighted statistics and diagnostic tests on the residuals.

6.6.3 Stability condition and residual tests

Different tests to the system and to the structural residuals were applied to check that the assumptions of the model were satisfied. First, the system was checked for mathematical stability. To do this, we built the companion form of the system of equations to obtain the characteristic polynomial and calculated the eigenvalues, then we obtained the roots and moduli. The results showed that all roots are less than one in absolute value. Second, we checked the residual properties. The Ljung-Box Q statistic at lag order k was applied to test the null hypothesis that there is no serial correlation up to 6 lags (the statistics is denoted as Q(6)). To test the null that the residual are normally distributed, we applied the Jarque-Bera (J-B) statistic. Another test was the Brock, Dechert, Scheinkman and LeBaron (BDS) test for independence, which tests the null that the residuals are independent and identically distributed (iid), (see Appendix 6G for tests on the whole system).

In summary, besides satisfactory stability condition and residual tests, the system of equations also complies with the Cowles econometric recommendations (Christ, 1994), such as the solution of the identification problem (both order and rank conditions are o.k) and passes the misspecification error test (proposed by Hausman (1978)). The estimations are reported in Tables 6.10 to 6.15 for each equation; the tables also contain the un-weighted statistics and the diagnostic tests on the residuals.

Since the series are in first differences, the coefficients should be interpreted as the positive or negative effect that a change in an explanatory variable has over a change in the endogenous variable.

6.6.4 Determinants of changes in GDP (DLGDP)

The first equation of the system explains the determinants of DLGDP (see Table 6.10). The estimations showed that changes in output responds positively to changes in capital accumulation, labour productivity, human capital and FDI. This also includes some lagged effects of those variables. The fact that this is a dynamic model allows measuring different effects from the same variable in current and lagged form. This is so because there is also an adjustment effect due to lagged effects on the system that takes time to consolidate.

According to the results, neither in current or lagged form, exports were statistically significant. It seems that when other explicative variables are taken in consideration the direct effect of exports disappears. However being a simultaneous equations system, indirect effects on GDP can also take place through other explicative variables.

Table 6.10 Dependent variable: DLGDP

Explanatory Variable	Coefficient	Std. Error	Prob.
$DLCA_t$	0.1995	0.0174	0.0000
$DLHC_t$	0.4582	0.1200	0.0002
$DLPRO_t$	0.2723	0.0387	0.0000
$DLGDP_{t-1}$	-0.2998	0.0843	0.0004
$DLGDP_{t-2}$	0.0340	0.0571	0.5522
$DLGDP_{t-4}$	0.3050	0.0872	0.0005
$DLGDP_{t-6}$	-0.2071	0.0725	0.0045
$DLFDI_{t-5}$	0.0206	0.0068	0.0024
$DLCA_{t-1}$	0.0777	0.0208	0.0002
$DLCA_{t-3}$	0.0514	0.0171	0.0028
$DLCA_{t-4}$	-0.1057	0.0201	0.0000
$DLCA_{t-6}$	0.0673	0.0193	0.0006
$DLPRO_{t-1}$	0.0868	0.0349	0.0133
$DLPRO_{t-4}$	-0.1193	0.0346	0.0006
Un-weighted statistics:	R-squared= 0.7366, Adjusted R-squared= 0.688, S.E. of regression=0.008.		
Diagnostic tests:	J-B= 19.956 (0.000), Q (6)= 5.514 (0.480), BDS=0.11 (0.518)		

Note: J-B is the Jarque-Bera statistic of normality. Q (k) is the Ljung-Box Q statistic of serial correlation at lag order k. BDS it is the test for independence. Probabilities are in parenthesis.

6.6.5 Determinants of changes in FDI (DLFDI)

Regarding equation DLFDI, the estimations showed positive lagged effects from exports and mixed effects from relative wages. The lagged effect of export was statistically significant at 5% level and positively signed (see Table 6.11). The fact that most foreign investment concentrates in the export market explains why this variable is an important determinant of positive changes in FDI. In a way, it suggests that a policy that favours trade liberalisation will have a direct impact not only on exports but also on FDI flows.

Table 6.11 Dependent variable: DLFDI

Explanatory Variable	Coefficient	Std. Error	Prob.
$DLEX_t$	-0.0485	0.1923	0.8010
$DLRER_t$	-0.0684	0.2564	0.7899
$DLINF_t$	-0.0692	0.1131	0.5408
$DLEX_{t-3}$	0.5697	0.2055	0.0058
$DLEX_{t-6}$	0.3855	0.1885	0.0415
$DWAGES_{t-2}$	-1.7869	0.5234	0.0007
$DWAGES_{t-6}$	0.9601	0.4679	0.0408
$DLRER_{t-6}$	-0.6158	0.2260	0.0067
$DLINF_{t-2}$	0.1762	0.1174	0.1342
$DLUS_{t-1}$	-0.0890	2.1519	0.9670
$DLUS_{t-5}$	-0.4168	2.1918	0.8493
$DLUS_{t-6}$	-1.5607	2.0105	0.4380
AR(1)	0.1882	0.1137	0.0987
AR(2)	-0.0403	0.1246	0.7466
Un-weighted statistics:	R-squared= 0.2744, Adjusted R-squared= 0.1377, S.E. of regression= 0.1442		
Diagnostic tests:	J-B= 9.549 (0.008), Q (6)= 8.125 (0.229), BDS=0.015 (0.427)		

Note: J-B is the Jarque-Bera statistic of normality. Q (k) is the Ljung-Box Q statistic at lag order k. BDS it is the test for independence. Probabilities are in parenthesis.

The empirical findings support some of the hypotheses put forward, for example that foreign capital responds positively to relatively low wages as they reduce production costs and increase returns to capital, which are important considerations in firms' decision making. All things constant, investment of foreign plants in Mexico is strongly influenced by the difference in real wages between the US and Mexico in the manufacturing industry (this coefficient was -1.78 when lagged two periods). This effect also seems to be influenced by lagged changes in real wages six periods back, although it is a positive effect. A possible explanation could be that well paid labour force could be an indication that as labour gains more skills its remuneration rises, part of foreign plants that require skilled labour could interpret this as a favourable sign.

Finally, the coefficient that measures the lagged effect of the real exchange rate indicates that there is a negative link with the real exchange rate (-0.615), in other words, it is possible that after six periods of devaluation, real prices have adjusted and then it becomes relatively expensive to operate in Mexico. This effect could be attributed to the fact that although in the short-run, currency depreciation might reduce labour and input costs, in the long run it cannot sustain those benefits because real prices will tend to adjust.

6.6.6 Determinants of changes in exports (DLE)

Regarding exports, the estimations showed current changes in the world economy (DLUS) as the strongest determinant of positive changes in exports, its coefficient was positively signed (3.52) and statistically significant at 1% level (see Table 6.12). Considering than more than 80% of total exports have as a destination the US market, this finding supports the hypothesis that exports growth is highly dependant on Mexico's main trade partner.

Another important determinant was the change in labour productivity (DLPRO) although with mixed results. Short run changes in productivity tend to have a negative effect on exports however after four periods of the initial rise, exports react favourably.

Table 6.12. Dependent variable: DLEX

Explanatory Variable	Coefficient	Std. Error	Prob.
$DLFDI_t$	-0.0169	0.0551	0.7599
$DWAGES_t$	-0.2115	0.2355	0.3697
DLUS	3.5165	0.8200	0.0000
$DLFDI_{t-1}$	-0.0536	0.0532	0.3140
$DLFDI_{t-3}$	0.0551	0.0496	0.2672
$DLFDI_{t-5}$	-0.1053	0.0551	0.0569
$DLFDI_{t-6}$	-0.0939	0.0553	0.0905
$DLPRO_{t-1}$	-0.8165	0.2475	0.0011
$DLPRO_{t-4}$	0.8170	0.2545	0.0014
$DWAGES_{t-1}$	-0.3843	0.2362	0.1045
$DWAGES_{t-3}$	-0.2498	0.2451	0.3088
AR(1)	0.1023	0.1070	0.3395
Un-weighted statistics:	R-squared= 0.335, Adjusted R-squared= 0.233, S.E. of regression= 0.0717		
Diagnostic tests:	J-B= 9.608 (0.008), Q (6)= 3.052 (0.802), BDS=0.007 (0.682)		

Note: J-B is the Jarque-Bera statistic of normality. Q (k) is the Ljung-Box Q statistic at lag order k. BDS it is the test for independence.
Probabilities are in parenthesis.

This result is likely to be related to the way labour productivity has fluctuated in the period. While exports maintained a stable growing trend along the years -despite the economic crisis in the 1980s and 1990s- labour productivity experienced a significant declined in 1987 (see Figure 6.6). It took some years to return to the same level of productivity. Another possibility is that rises in productivity might be pushing real wages up, therefore causing a negative effect on exports.

An unexpected finding was the negative effect from lagged FDI on exports. All things constant, this result could be linked to changes in the distribution of FDI in different sectors. For example, since 1986 (thanks to privatisation of commercial banks and telecommunications), the presence of FDI in services has increased, sometimes reaching 59% (in 1990) of total inflow. In the last years, the share of foreign investment in services is on average 45%. If we consider that exports are mainly manufactured goods, then the relative reduction of FDI in this sector has impacted on exports negatively.

6.6.7 Determinants of changes in human capital (DLHC)

The estimations of this equation showed consistency with some of the hypotheses put forward. For example, the positive effect of changes in human capital due to changes in FDI, productivity, personal income and government expenditure (see Table 6.13). One relative strong influence comes from the lagged effect of productivity and personal income (proxied by GDP per capita). In some way the results provide evidence that rises in productivity and better disposable income represent important stimuli to invest in education and training.

Table 6.13 Dependent variable: DLHC

Explanatory variable	Coefficient	Std. Error	Prob.
C	0.0060	0.0016	0.0002
$DLCA_t$	0.0066	0.0052	0.2077
$DLTT_t$	-0.0064	0.0038	0.0925
$D(LGDP\text{-}LPOP)_t$	0.0144	0.0171	0.4002
$DLFDI_{t-5}$	0.0028	0.0012	0.0196
$DLCA_{t-1}$	0.0005	0.0053	0.9222
$DLCA_{t-2}$	0.0023	0.0041	0.5830
$DLPRO_{t-1}$	0.0064	0.0076	0.3995
$DLPRO_{t-2}$	0.0132	0.0082	0.1113
$DLPRO_{t-3}$	0.0052	0.0077	0.5037
$DLPRO_{t-4}$	0.0121	0.0070	0.0864
$DLTT_{t-1}$	-0.0012	0.0039	0.7655
$DLTT_{t-6}$	-0.0035	0.0022	0.1177
$DLGE_{t-4}$	0.0015	0.0005	0.0030
$D(LGDP\text{-}LPOP)_{t-1}$	0.0048	0.0217	0.8259
$D(LGDP\text{-}LPOP)_{t-2}$	0.0078	0.0168	0.6440
$D(LGDP\text{-}LPOP)_{t-5}$	0.0187	0.0111	0.0936
AR(1)	0.9238	0.0952	0.0000
AR(2)	-0.0199	0.1200	0.8681
AR(3)	0.1855	0.1200	0.1227
AR(4)	-0.6731	0.1222	0.0000
AR(5)	0.4655	0.0942	0.0000
Un-weighted statistics:	R-squared= 0.892, Adjusted R-squared= 0.853, S.E. of regression= 0.001		
Diagnostic tests:	J-B= 6.392 (0.041), Q (6)= 7.740 (0.258), BDS=0.064 (0.002)		

Notes: J-B is the Jarque-Bera statistic of normality. Q (k) is the Ljung-Box Q statistic at lag order k. BDS it is the test for independence. Probabilities are in parenthesis.

The lagged effect of government expenditure ($DLGE_{t-4}$) also contributes to improve the living conditions and quality of life of human resources. A positive change in this variable allows –at a great extent- increasing the options offered to the population as it provides the infrastructure and the mechanisms required to satisfy the demand for education.

Additionally lagged FDI's coefficient was positively signed (0.0028). In this respect, it indicates that lagged changes in FDI provide incentives to improve human capital. More foreign investment works as an important mechanism to stimulate the number of students enrolled in secondary and technical school, since it offers a greater opportunity to access the labour market, especially in areas oriented to the sort of activities favoured by FDI.

6.6.8 Determinants of changes in labour productivity (DLPRO)

Labour productivity is determined positively by current and lagged changes in GDP. This suggests that a growing economy is more likely to offer opportunities to improve labour efficiency. A positive change in DLGDP brings an expansion to the economy that is reflected in higher output per worker (see Table 6.14).

Additionally, the estimations show that there is a feedback relationship between labour productivity and output growth and vice versa (see Table 6.10), the same occurs with human capital (see Table 6.13).

$DLFDI_{t-5}$ was found to have a negative impact on productivity (-0.0502). Although FDI changes were expected to improve job opportunities in which personnel can gain experience and skills, the negative sign could be attributed to foreign capitals not having yet a strong impact on production activities with the potential to boost labour productivity. For example, this happens when FDI concentrates in assembly-oriented sectors instead of sectors that require relatively more skilled labour. It is possible that its demand for cheap labour is relatively higher than for skilled labour. At the same time, past changes in capital accumulation ($DLCA_{t-3}$) also showed a negative effect on productivity; a possible explanation is that investment in the acquisition of infrastructure may not be directly related to labour efficiency.

Table 6.14 Dependent variable: DLPRO

Explanatory variable	Coefficient	Std. Error	Prob.
C	-0.0092	0.0046	0.0458
$DLGDP_t$	1.0212	0.1878	0.0000
$DLHC_t$	0.7752	0.4687	0.0989
$DLGDP_{t-6}$	0.4015	0.2392	0.0940
$DLFDI_{t-5}$	-0.0502	0.0185	0.0069
$DLFDI_{t-6}$	-0.0267	0.0187	0.1549
$DLCA_{t-3}$	-0.1199	0.0467	0.0106
$DLCA_{t-5}$	-0.1296	0.0934	0.1661
$DLCA_{t-6}$	-0.0412	0.0614	0.5027
$DLTT_{t-5}$	0.0773	0.0563	0.1704
AR(1)	-0.1120	0.1156	0.3335
Un-weighted statistics:	R-squared= 0.436, Adjusted R-squared= 0.359, S.E. of regression= 0.025		
Diagnostic tests:	J-B= 1.444 (0.486), Q (6)= 5.756 (0.457), BDS=0.037 (0.013)		

Note: J-B is the Jarque-Bera statistic of normality. Q (k) is the Ljung-Box Q statistic at lag order k. BDS it is the test for independence. Probabilities are in parenthesis.

6.6.9 Determinants of changes in capital accumulation (DLCA)

The estimations indicate that most of its determinants were statistically significant (see Table 6.15). The results support the hypothesis about the significant role of current technology transfer, government expenditure, GDP per capital and infrastructure to explain positive changes in capital accumulation. The cause-effect relationship between DLCA and its determinants has already been explained (see section 6.4). Here, we only highlight some results.

Table 6.15 Dependent variable: DLCA

Explanatory variable	Coefficient	Std. Error	Prob.
C	0.0047	0.0014	0.0010
$DLFDI_t$	-0.0301	0.0119	0.0116
$DLTT_t$	0.3111	0.0233	0.0000
$DLGE_t$	0.0109	0.0056	0.0519
$DLINF_t$	0.0033	0.0157	0.8341
$D(LGDP\text{-}LPOP)_t$	1.0461	0.1413	0.0000
$DLPRO_{t-1}$	-0.1421	0.0664	0.0329
$DLTT_{t-1}$	-0.1181	0.0210	0.0000
$DLTT_{t-4}$	0.0841	0.0211	0.0001
$DLTT_{t-5}$	-0.0750	0.0198	0.0002
$DLRER_{t-1}$	-0.1119	0.0327	0.0007
$DLRER_{t-2}$	-0.0724	0.0267	0.0070
$DLRER_{t-3}$	0.0843	0.0261	0.0014
$DLRER_{t-6}$	-0.0638	0.0266	0.0170
$DLGE_{t-1}$	0.0198	0.0056	0.0004
$DLGE_{t-3}$	-0.0143	0.0070	0.0400
$DLGE_{t-4}$	-0.0341	0.0065	0.0000
$DLINF_{t-2}$	0.0372	0.0168	0.0271
$DLINF_{t-3}$	0.0542	0.0171	0.0017
$DLINF_{t-4}$	0.0485	0.0209	0.0209
$DLINF_{t-5}$	0.0431	0.0178	0.0158
$DLINF_{t-6}$	0.0420	0.0162	0.0100
$D(LGDP\text{-}LPOP)_{t-1}$	0.8627	0.1525	0.0000
$D(LGDP\text{-}LPOP)_{t-3}$	-0.2218	0.1272	0.0819
$D(LGDP\text{-}LPOP)_{t-4}$	-0.3641	0.1163	0.0019
AR(1)	-0.0658	0.0901	0.4655
AR(2)	-0.6106	0.0887	0.0000
Un-weighted statistics:	R-squared= 0.940, Adjusted R-squared= 0.912, S.E. of regression= 0.017		
Diagnostic tests:	J-B= 0.143 (0.931), Q (6)= 3.895 (0.691), BDS=0.026 (0.092)		

J-B is the Jarque-Bera statistic of normality. Q (k) is the Ljung-Box Q statistic at lag order k. BDS it is the test for independence. Probabilities are in parenthesis.

For example, it is relevant to note that among the independent variables, GDP per capita (D(LGDP-LPOP)) had the strongest significant effect, as it can be observed by the current coefficient value (1.04). It shows that the government's effort to improve population's income and infrastructure will eventually impact on the country capacity to accumulate capital and therefore affect GDP indirectly. Regarding real exchange rate, most of its lagged impact is negative which proves that peso depreciation deteriorates the capacity to accumulate. Contrary to the expected, FDI did not appear as significant in the unrestricted system and therefore it did not appear in the restricted system.

6.7. Impact, interim and total dynamic multipliers

Multipliers are helpful to study how endogenous variables respond to a unit change in the exogenous variable over time. They are particularly useful when we want to compare how a variable responds to different shocks in the exogenous variables or how the latter affects in different ways and intensities a set of endogenous variables. In our case, the six structural equations estimated by 3SLS served for the purpose of describing part of the economy's structure. However, in terms of economic analysis, it is convenient to go beyond the structural relationships and obtain the direct and indirect effects that might exist among the variables. This can be achieved by reducing the structural model to its more basic determinants; it means to put the endogenous variables in terms of all predetermined variables in the system. In this way, we can track down their response to changes in the exogenous variables. However, the reduced form is not convenient for this purpose since it also includes the effect of lagged endogenous variables. All we can obtain from the reduced form equation is the impact multiplier effect of the current exogenous variables. It provides information at one point in time, but we cannot measure what happens when there are subsequent changes in the exogenous variable. To do this, it is necessary to construct the final form of the structural system. The final form eliminates the influence of the lagged endogenous variables and allows the calculation of the dynamic multipliers to measure impact, interim and long- run effects.

The questions that we want to answer in this context are: a) what is the impact-response of GDP, FDI, exports, capital accumulation, human capital and labour productivity to changes in technology transfer? b) What is the response to changes in government expenditure? c) What is the response to changes in the real exchange rate? d) How intense is the response to a unit change in the world economy? And, e) how do these endogenous variables respond to a unit change in population? We expect that some of the strongest response occurred to changes in the world economy, relative wages and population as they were some of the most important determinants in the system of equations.

To calculate the time-path followed by DLGDP, DLFDI, DLEX, DLCA, DLHC and DLPRO due to changes in the exogenous variables, the procedure was the following:

- First, the estimated structural equations were solved in order to obtain the reduced form equations. The reduced form coefficients only provide the impact multipliers (i.e. the effect of the current exogenous variables).
- Second, the final form of the system was built to obtain the interim and long-run multipliers.

The dynamic structural model estimated previously contains six endogenous variables and seven exogenous variables, we represent this system in the companion form to facilitate the calculation of the multipliers:

$$\Gamma y + A + Bx + \Phi y_{t-1} = \varepsilon \qquad (6.20)$$

Where, **y** is a (36x1) vector of endogenous variables that appear in current and lagged form.

x is a (49x1) vector of exogenous variables that appear in current and lagged form.

y_{t-1} is a (36x1) vector of lagged endogenous variables.

Γ is a (36x36) matrix of coefficients of the current endogenous variables

A is a (36x1) vector of constants

B is a (36x49) matrix of coefficients of current and lagged exogenous variables

Φ is a (36x36) matrix of coefficients of lagged endogenous variables

ε is a (36x1) vector of errors

In reality, many of the coefficients were equal to zero, but in terms of the companion form this is the way the model had to be specified.

$$\begin{bmatrix} \Gamma_t & 0 & 0 & 0 & 0 & 0 \\ 0 & I & 0 & 0 & 0 & 0 \\ 0 & 0 & I & 0 & 0 & 0 \\ 0 & 0 & 0 & I & 0 & 0 \\ 0 & 0 & 0 & 0 & I & 0 \\ 0 & 0 & 0 & 0 & 0 & I \end{bmatrix} \begin{bmatrix} y_t \\ y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ y_{t-4} \\ y_{t-5} \end{bmatrix} + \begin{bmatrix} A_t \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} + \begin{bmatrix} B_0 & B_1 & B_2 & B_3 & B_4 & B_5 & B_6 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_t \\ x_{t-1} \\ x_{t-2} \\ x_{t-3} \\ x_{t-4} \\ x_{t-5} \\ x_{t-6} \end{bmatrix} +$$

$$\begin{bmatrix} \Phi_1 & \Phi_2 & \Phi_3 & \Phi_4 & \Phi_5 & \Phi_6 \\ I & 0 & 0 & 0 & 0 & 0 \\ 0 & I & 0 & 0 & 0 & 0 \\ 0 & 0 & I & 0 & 0 & 0 \\ 0 & 0 & 0 & I & 0 & 0 \\ 0 & 0 & 0 & 0 & I & 0 \end{bmatrix} \begin{bmatrix} y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ y_{t-4} \\ y_{t-5} \\ y_{t-6} \end{bmatrix} = \begin{bmatrix} \varepsilon_t \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

By solving for **y**, we obtain the reduced form equation:

$$y = K + \Pi x + \Delta y_{t-1} + v \qquad (6.21)$$

where: $K = -\Gamma^{-1}A$, $\Pi = -\Gamma^{-1}B$, $\Delta = -\Gamma^{-1}\Phi$ and $v = -\Gamma^{-1}\varepsilon$. We can ignore the vector of constant terms (K) since they are not relevant to the calculations of the multipliers.

6.7.1 The final form

The procedure to build the final form described by Theil and Boot (1962) requires the elimination of lagged endogenous variables from the reduced form equation $y = \Pi x + \Delta y_{t-1} + v$. This is achieved by lagging this equation one period and substituting y_{t-1} with this result. By doing this, we obtain:

$$y = \Pi x + \Delta(\Pi x_{t-1} + \Delta y_{t-2})$$

Simplifying:

$$y = \Pi x + \Delta\Pi x_{t-1} + \Delta^2 y_{t-2} \qquad (6.22)$$

We can continue in the same way to eliminate y_{t-2} from this expression and so on. If the matrix Δ^t converges to a zero matrix ($\lim_{t\to\infty} \Delta^t = 0$)[40], then the final form of the system is equal to:

$$y = \Pi x + \Delta\Pi x_{t-1} + ... + \Delta^r \Pi x_{t-r} \qquad (6.23)$$

From the final form we can obtain the impact, interim and total multipliers, from the leading submatrices:

- Π contains the impact multipliers. They represent the response of the endogenous variables to changes that occur in the first period.
- $\Delta\Pi$, $\Delta^2\Pi$, …, $\Delta^r\Pi$ contain the interim multipliers for the 2nd, 3rd,…, up to r periods.
- The total multipliers cumulative effects are given by the elements of the matrix $(I-\Delta)^{-1}\Pi$. They describe the accumulated impact of an exogenous change from *t* time to infinity.

6.7.2 The stability condition

One of the properties of dynamic models is the stability condition. The condition requires that all the roots of the characteristic polynomial are less than one in absolute values, i.e. $|\Delta - \lambda I| = 0$. Due to this, the multipliers all converge to zero in the long run (Greene, 2003).

We obtained the eigenvalues of the characteristic polynomial which is a (36x36) matrix, $\Delta = -\Gamma^{-1}\Phi$. To do this, the restricted system of equations was expressed in the

[40] This will occur provided the latent roots of Δ are all less than 1 in absolute value.

companion form in order to obtain matrix Δ. Calculations of the eigenvalues showed that there are 36 real roots. The moduli of the complex numbers were less than one in absolute values (see appendix 6G for results). In this case, the presence of complex numbers means that the system will oscillate but eventually will tend to zero. We conclude that the system is mathematically stable, for the purpose of our analysis it implies that if the system is disturbed by an exogenous shock it will eventually return to its long-run equilibrium.

6.7.3 Analysis of the dynamic multipliers: impact, interim and total multipliers

Considering that the 3SLS estimations were carried out using series in first differences, the multiplier should be interpreted as the acceleration on the endogenous variable as a result of a unit change in a change in the exogenous variable. The signs indicate whether there was an acceleration (positive) or deceleration effect (negative). The results from the estimated interim and total multipliers were calculated for a period of 30 quarters (our data are in quarterly frequency). For this reason, the multipliers might appear small if taken individually, since they only represent quarterly changes. If we add up four multipliers, we will obtain the acceleration effect of one year on the endogenous variable. We only highlight the most important multipliers that showed a strong impact on the endogenous variables, the rest of the multipliers were relatively small to be noticed in the figures (appendix 6H contains the tables with the final form multipliers, up to 30 quarters).

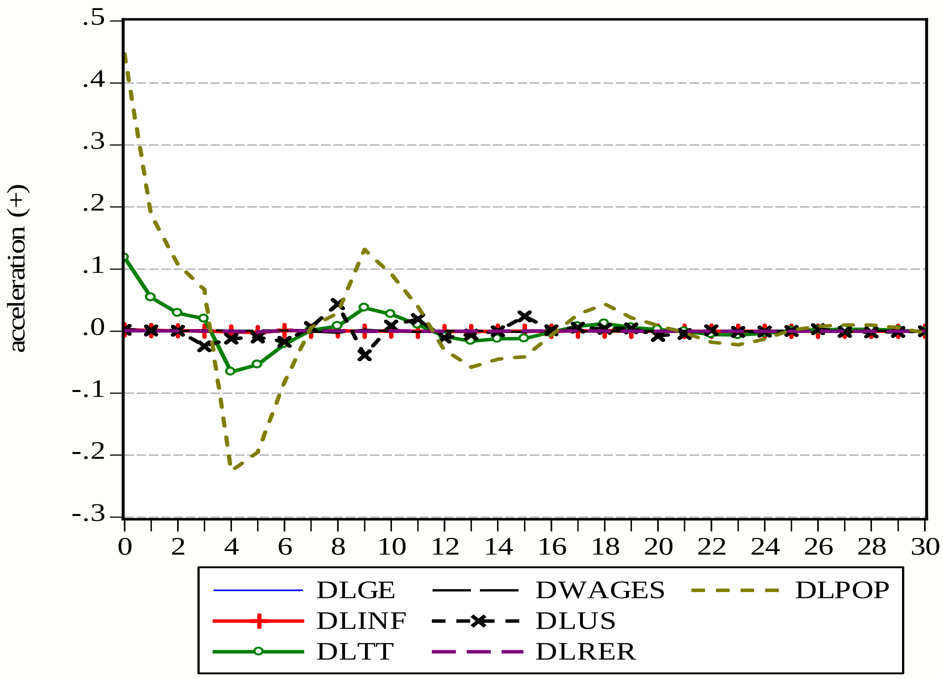
6.7.3.1 Dynamic multiplier effects on GDP, FDI, exports, human capital, productivity and capital accumulation

The multiplier effects on GDP measure the change in GDP during a given period attributable solely to a unit change in a change in every exogenous variable that appear in

Figure 6.12. In it, we can see that the multiplier of population[41] had the strongest acceleration effect on GDP (0.4468). This impact is direct but it could also be attributable to the positive effect that population had on capital accumulation and labour productivity (see Tables 6.14 and 6.16). And as we have seen GDP is determined by the former variables. This acceleration tends to decrease in time, until it becomes negative, a reasonable situation if no capital accumulation or government expenditure occur at the same time to satisfy the demands of that population.

Figure 6.12

Multiplier effect on GDP



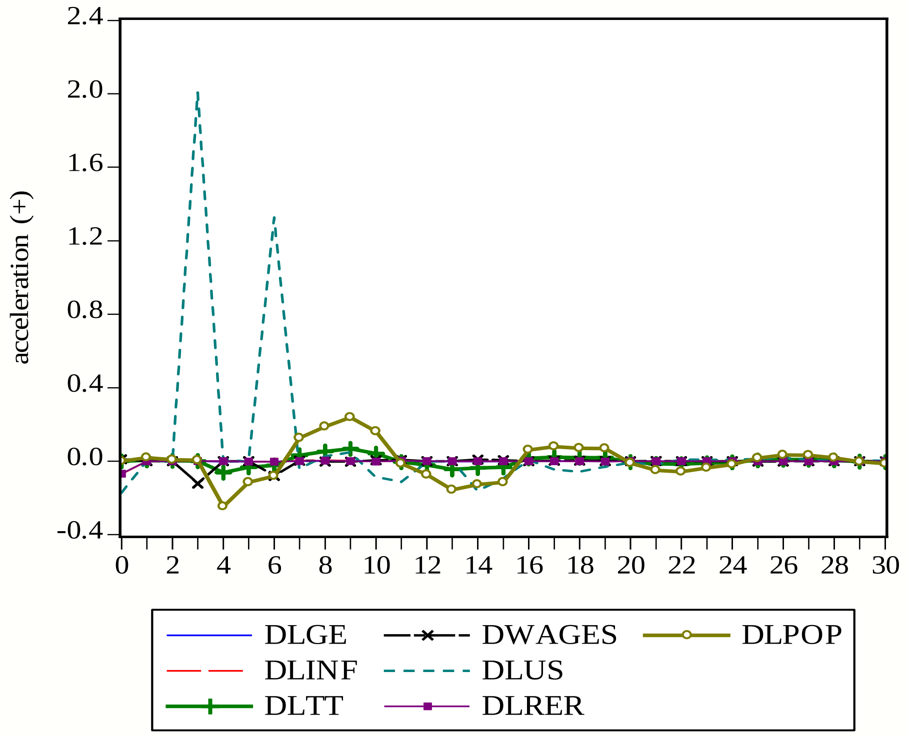
Another positive effect on GDP is created by a unit change in a change in technology. However, its quick deceleration indicates that it takes time to adapt new technology to the specific country conditions and therefore sustain the positive effect on the economy.

[41] Population is a component of the variable GDP per capita (LGDP-LPOP), the system takes POP as the exogenous variables but in doing so, POP carries the same quantitative effect from the 3SLS estimations.

Regarding FDI, two interesting observations arise from its multipliers; first as we can see in Figure 6.13, DLUS creates the strongest acceleration impact on FDI in the third and sixth period. This peculiar response could be because the full impact is felt after a change in DLUS modifies investors' strategies and induces demand for Mexican exports; eventually it has been shown that lagged changes in exports stimulate FDI (see Table 6.11). These dynamic interrelationships are understandable considering that positive growth rates in the US economy will not have an immediate effect on FDI. It was also found that a rise in relative wages between Mexico and the US tends to decelerate FDI, for example by 0.12% on the 3rd period (this is shown by the negative multiplier). This is an indication that relative wages still play an important role in determining foreign flows to Mexico.

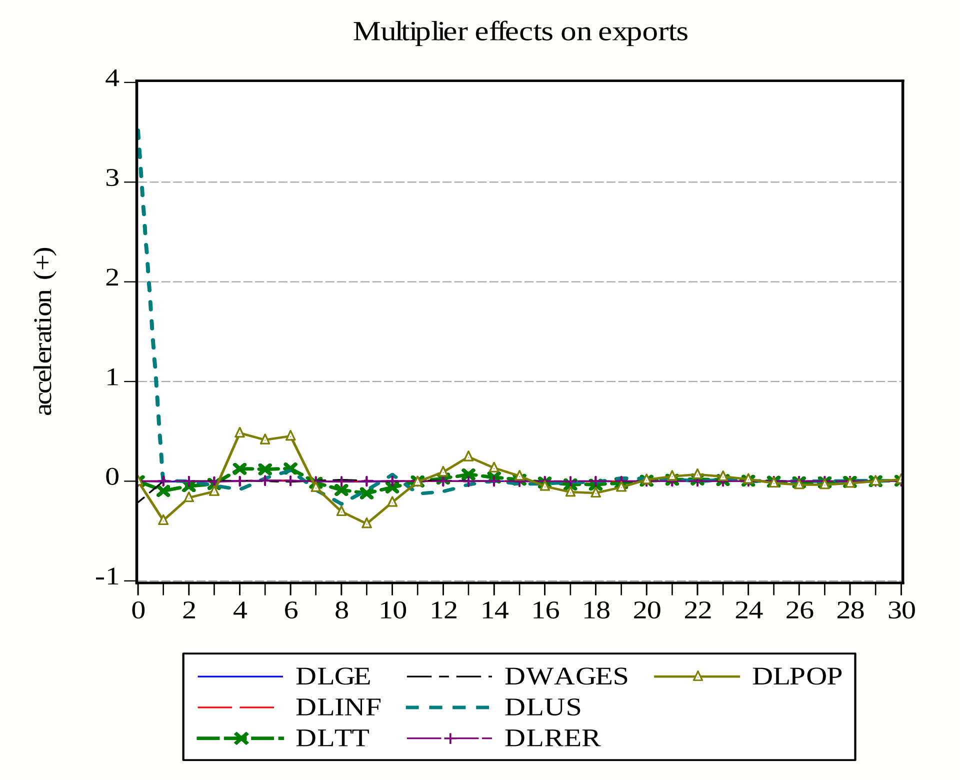
Figure 6.13

Multiplier effects on FDI



Regarding the response of exports, in Figure 6.14 is evident that DLUS has an immediate impact, as exports accelerate by 3.4%. This response shows the strong link between the US economy and Mexican exports. However, this response dies out quickly in the following periods. Nevertheless, the cumulative effect –at the end of the whole period- is positive and it is also the exogenous variable with the highest overall impact on DLEX (later shown in the chapter). Alternatively, we can see that the world economy affects GDP through its indirect effect in exports. In the literature other studies have reached similar conclusions in the sense that it is through exports that the world economy impacts positively output growth, this is because higher export demand increases domestic production (Sharma and Dhakal, 1994). In our case, this indirect effect also occurs through FDI.

Figure 6.14

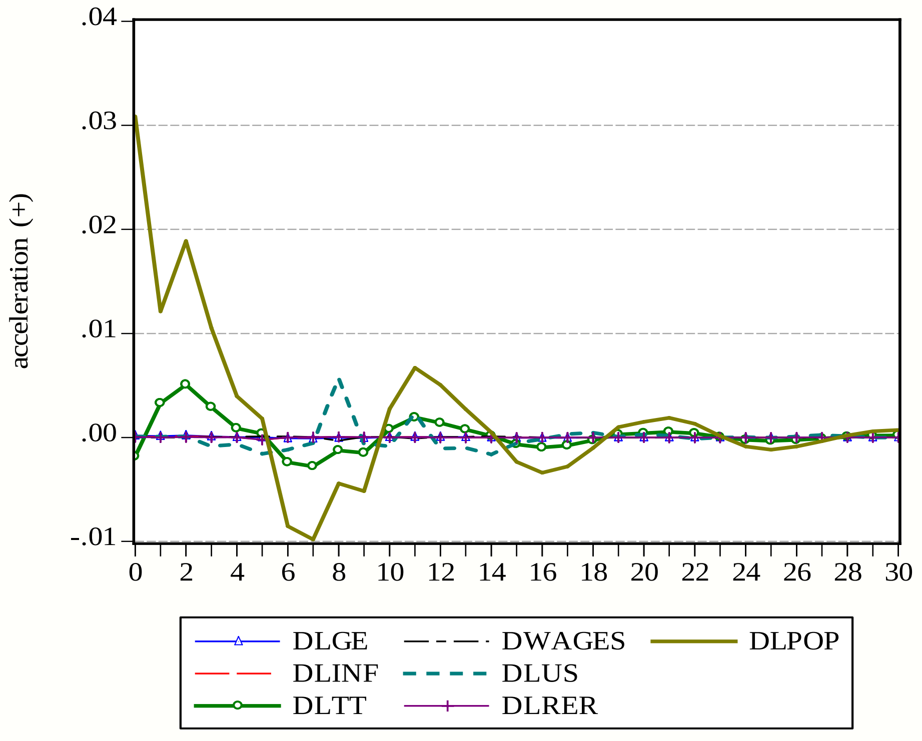


In the case of population, regardless of causing a decelerating response, subsequently exports accelerate by 0.34% (after four periods of the initial shock). This could be explained by the positive effect that changes in population have on capital accumulation and labour productivity, which indirectly and directly stimulate exports production. The multiplier effect of technology transfer indicates that initially it decelerates by 0.097%, but eventually its deceleration impact slows down, as more technology is absorbed by the export production and translated to higher growth rates.

The multipliers of population and, at a lesser extent, technology transfer indicate that they generate the strongest acceleration on human capital (Figure 6.15). Neither government expenditure nor relative wages showed any relevant impact as expected. It seems that rises in technology transfer tend to accelerate human capital development, maybe because high tech industries require more skilled labour and this works as an incentive to invest in education and training.

Figure 6.15

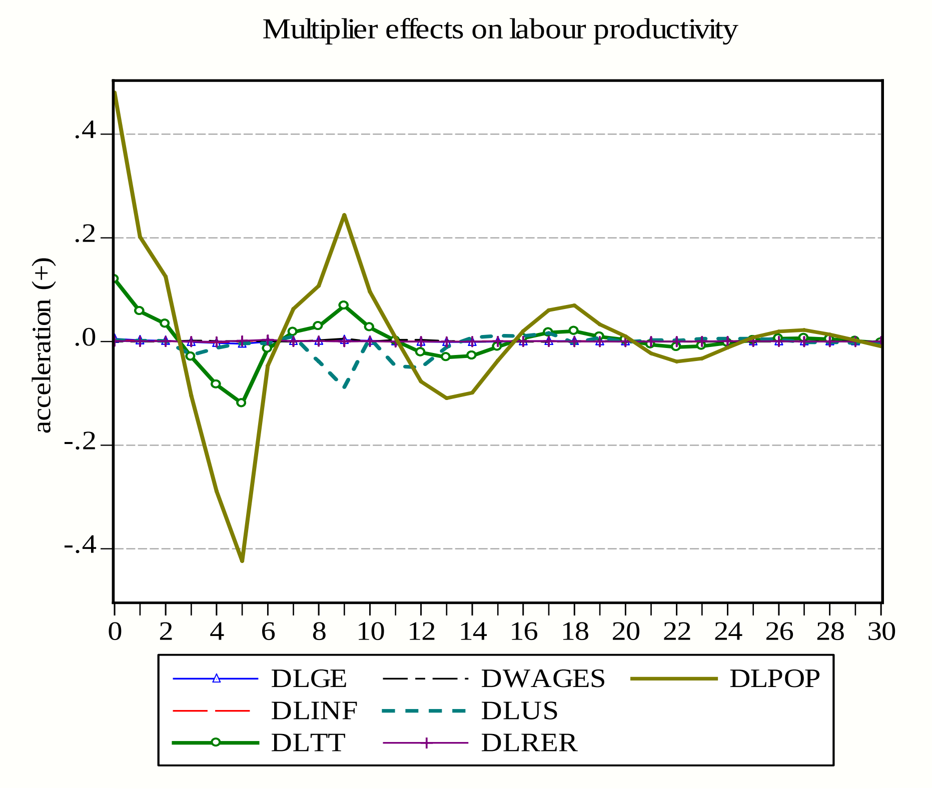
Multiplier effects on human capital



An interesting finding was the positive acceleration of DLHC due to the multiplier effect of DLUS in the 8th period. This outcome could be related to the incentives that the domestic economy obtains from higher world economic activity. Indirectly, it stimulates investment in human resources since a growing world economy stimulates FDI and exports and then they might create a potential demand for skilled labour.

The multiplier effects on labour productivity follow a similar pattern to human capital, but the intensity in absolute terms is stronger (see Figure 6.16). For example, a unit change in DLPOP accelerates productivity by 0.48% (compared to an acceleration of 0.03% in DLHC), but this acceleration tends to decrease until -in the 3rd period- it decelerates. This situation is possible if the economy is not capable of absorbing potential workers that are joining the labour market. The same happens with changes in DLTT, although at the beginning technology boosts productivity its effect decelerates until it becomes negative.

Figure 6.16

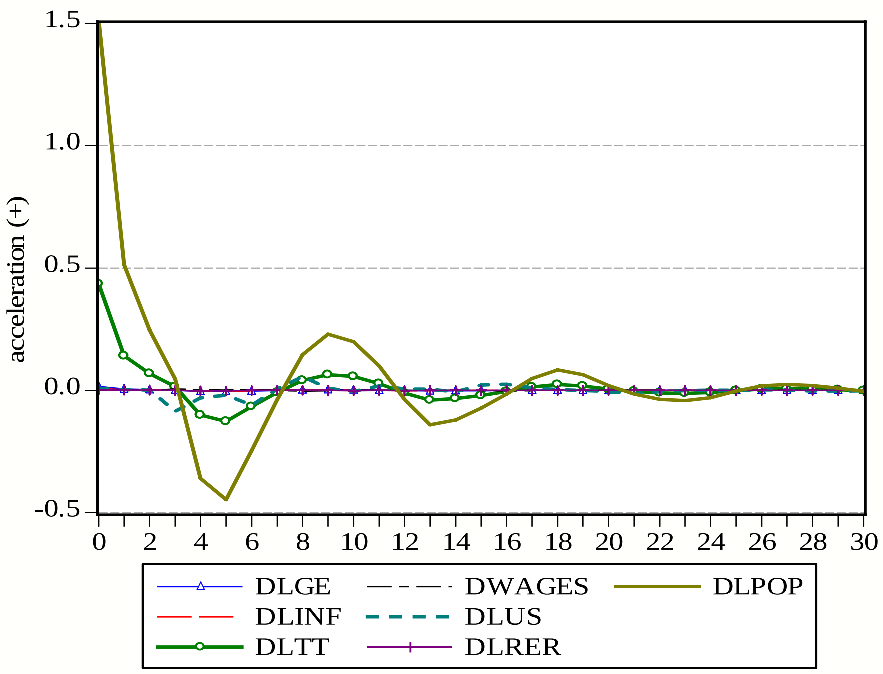


In the case of capital accumulation, the multiplier effect of population had the strongest impact on changes in this variable (1.51% in the first period) however this effect is cyclical due to complex numbers found in the characteristic polynomial. Other multipliers like government expenditure, infrastructure or exchange rate did not show strong effects.

The multiplier of technology transfer (DLTT) was also an important element that indicates that more investment has accelerated capital accumulation by 0.43% and eventually slowed down.

Figure 6.17

Multiplier effects on capital accumulation



This is consistent with the fact that most of capital accumulation depends on the acquisition of technology and rises in personal income.

6.7.3.2 Cumulative multipliers

The calculation of the cumulative multipliers (the sum of all dynamic multipliers on a particular endogenous variable) presents a clearer picture of the long-run effects of changes in the exogenous variables (see Table 6.16). In general, we can see that government expenditure has a relative low but positive impact on the endogenous variables. In the long run, the strongest accumulated impact occurs in capital accumulation (0.017%). Apparently this shows that an expansionary policy will have little effect on the system. The same happened with the multiplier effect of infrastructure, in the long run FDI experienced a relative deceleration of 0.057%, while exports had an acceleration cumulative effect of 0.012%.

In the long run, the strongest impact of a unit change in a change in technological transfer will occur on capital accumulation (by 0.47%) and at a lesser extent in GDP (by 0.13%). As expected, technological transfer induces a long run positive effect on human capital, however this effect is very small (0.006%).

Table 6.16 Cumulative multipliers. Long-run cumulative impact.

On endogenous variables:	Multiplier effect of the exogenous variables						
	DLGE	DLINF	DLTT	DWAGES	DLUS	DLRER	DLPOP
DLGDP	0.00494	0.00175	0.13233	0.00072	-0.01196	0.00026	0.49009
DLFDI	0.00000	-0.05796	0.00002	-0.16050	2.66895	-0.05723	0.00010
DLEX	0.00000	0.01244	0.00002	-0.17702	2.94360	0.01229	0.00011
DLHC	0.00048	0.00017	0.00612	0.00008	-0.00127	0.00003	0.06208
DLPRO	0.00241	0.00515	0.05388	0.01226	-0.20380	0.00437	0.26362
DLCA	0.01713	0.00662	0.47848	0.00404	-0.06714	0.00144	1.65690

We assumed the existence of a close relationship between DLUS, DLFDI and DLEX and the 3SLS estimations have proved that this is the case. This close link is based on the fact that most of foreign capital comes from the US and most of the Mexican exports are sent to that market. In general, because the level of dependency is strong, it is expected that a growing US economy will improve growth rates of most of the variables under analysis. According to the total multipliers, the world economy’s (DLUS) long-run multiplier indicates that DLFDI and DLEX experienced the strongest acceleration due to a unit changes in this variable. For instance, the accumulated effect accelerated FDI by 2.66 and exports by 2.94. In this context, the initial hypothesis about how FDI and exports respond to the world economy is confirmed. However it has an accumulated negative effect on the rest of the system.

Finally, regarding the long-run impact of LPOP, its cumulative effect shows that it generates a positive acceleration process in most of the endogenous variables, especially in capital accumulation (1.65) and GDP (0.49).

6.8. Conclusions

The purpose of this chapter was to measure how exports and FDI affect output growth and other key economic variables not only directly but also indirectly throught their externalities. They were endogenised to understand what domestic and external factors are explicative of how well exports and FDI do.

Contrary to the expected, exports did not have a direct significant effect on GDP. The empirical results showed that output growth is mainly determined by FDI, capital accumulation, labour productivity and human capital. At first sight, the results seem to confirm the classical postulates more than the export-led growth hypothesis. However, if we examine exports' positive effect on FDI, it is possible to find an indirect effect on output growth. For example, DLEX had a significant positive lagged effect on DLFDI, which -at the same time- was a positive explanatory variable of DLGDP. Then, although there is no a direct effect, exports represent an important source of output growth.

Some empirical findings show that the coefficient that measures the influence of the world economy on export growth confirms the strong dependency on the US demand, this coefficient was 3.408. Other findings confirm the hypothesis that FDI flows depend on relative wages, and the existence of an export market. The difference of real wages between

Mexico and the US indicates that cheap labour continues to exert an important incentive to locate or relocate plants in Mexico. At the same time, despite being most of FDI from the US, this coefficient was not statistically significant. This could be an indication that potential foreign invertors are taking into account characteristics of the host country. However, if we examine its indirect effects through exports, then in some way DLUS has an influence on DLFDI. In fact, this influence is evident when we measure DLUS's cumulative multiplier. This outcome highlights one of the characteristics of foreign investment in Mexico, it is part of an integrated network where intra-firm and inter-firm trade prevails (Dussel, 2000) and as a consequence its integration to the local economy is not as strong as desired. NAFTA has intensified the existence of these networks because it facilitates free trade but at the cost of reducing the chances to create linkages with the host country.

Changes in relative wages were significant determinants of export growth, i.e. a rise in real relative wages reduces export growth as it may increase production costs. The results help to understand why relative wages can be determinant in decision making strategies. The difference in real wages can exert an important influence as an incentive or disincentive to relocate activities that can benefit from these differences, especially those located along the US-Mexican border.

Another finding that supports the hypothesis put forward is the positive effect of government expenditure on human capital. Public investment that favours human development is more likely to facilitate human capital as it provides easier to access to the education system and later to the labour marker. Labour productivity was positively determined by current and lagged DLGDP and DLHC. There is evidence that personal income (proxied by GDP per capita) represents the most important variable to explain changes in capital accumulation. Other variables such as technology transfer, government expenditure and infrastructure and technology transfer were also statistically significant, however their impact was relatively smaller.

The estimation and analysis of dynamic multipliers show that in general, the most intense response occurs in the first six periods. In the majority of the cases, the shock tends to generate relatively strong acceleration or deceleration effects but eventually –after 15 periods- they adjust to equilibrium. Although a rise in technological transfer is beneficial for the country as a whole, more technology also requires a process of adaptation to sustain its effect on some variables (for example, in productivity).

The state of the US economy showed a large influence on Mexico. There is a strong link between how well the US economy does and how well FDI and exports do in Mexico. The multiplier effect and the accumulated impact confirm that DLEX and DLFDI accelerate in response to a shock in the world economy (DLUS).

This result is an indication that a growing US economy is an important element to promote investment abroad and to increase its demand for imports (or in this case, for Mexican exports).

The strongest total multiplier effect of technological transfer happened in capital accumulation (0.47), followed by output growth (0.13). The reason is that technology is an essential part of the country's production capacity; it shows the country's ability to translate higher levels of technology into higher levels of production.

The empirical findings confirm some of the hypotheses initially postulated. They suggest that the effect from exports to GDP growth should not be measured directly but indirectly through other variables, for example variables where exports are an important determinant. There is also an indication that GDP reacts favourably to FDI and the classical components, labour productivity and capital accumulation.

CHAPTER 7: ECONOMIC DEVELOPMENT IN MEXICO: A DYNAMIC ANALYSIS OF FISCAL AND MONETARY POLICY INTERVENTION

7.1 Introduction

In this chapter we analyse the effects of fiscal and monetary policies applied by the Mexican government to achieve economic development and promote trade and foreign investment. In Chapter 6, it was implicitly assumed that the economic events develop in a free economy with no government intervention. In this chapter, this assumption is modified to consider the influence of government intervention through three types of policy: monetary, fiscal and commercial policy. In this respect, the specification of the system of equations has been extended to include relevant endogenous and exogenous variables attributable to those economic policies. The purpose is to evaluate the influence that some instruments of monetary and fiscal policy have on the economy. In the 1980s, the Mexican government still had a strong intervention on all sorts of ambits, from owing public enterprises to controlling prices and exchange rate fluctuations. Although it has eventually reduced its role in the economy, it is important not to ignore the positive and negative consequences of public intervention in the economy.

In the literature there are studies that have found that policies favouring public investment in infrastructure and liberalisation have positive multiplier effects on FDI (Blomstrom and Globerman, 2000) and output growth (Bende-Nabende and Ford, 1998). It is recognised that government intervention may deepen macroeconomic problems; at least in the Mexican case, it has been noted that economic crises in 1976 and 1982 were due to an excessive public spending that led to fiscal deficits, while the crisis in 1994 was attributed to the mismanagement of monetary policy (Lusting, 1999).

The objectives of this chapter are mainly two. First, to identify in which way government policies and trade reforms have altered the links between growth, FDI, exports, growth, capital accumulation, productivity and human capital. Second, to investigate the dynamic impact of policy changes and identify the instruments with the strongest potential to accelerate or decelerate growth.

In summary, we want to answer the following questions: what type of economic policies might be conductive to improved performance of FDI, exports, output, relative wages, labour and capital accumulation? Has trade liberalisation in general, and NAFTA in specific, had any significant effect on output growth, exports and FDI? What adjustments in monetary base, public spending, inflation and exchange rate have the potential to stimulate the economy? And, which endogenous variables are more responsive to monetary policy changes and which are more responsive to fiscal policy changes?

We identified a set of policies and instruments related to the specific objective of economic development which could be considered as the most representative of fiscal and monetary policies in Mexico. In Chapter 6 a limited number of instruments were considered, here we analyse them more systematically. Regarding monetary policy, the instruments considered in the system are the exchange rate, monetary base and inflation. Regarding fiscal policy, the instruments added to the system were taxes (tax revenues as a share of GDP was used as a proxy) besides government expenditure and investment in infrastructure. Finally, the influence of commercial policy is considered through Mexico's entry to GATT in 1986 and to NAFTA in 1994.

There are seven sections in this chapter including this introduction. Section 7.2 contains a brief background on the fiscal and monetary policies used as mechanisms of economic development in Mexico. Section 7.3 presents the methodological approach, which is an extension of the simultaneous equations system estimated in Chapter 6 but with the inclusion of policy variables. It also contains unit root and diagnostic tests on the residuals. Section 7.4 contains the estimates and their analysis. In Section 7.5, we present an analysis of policy changes and their impact through dynamic multipliers. Finally in Section 7.6, we conclude.

7.2 Fiscal and monetary policy during liberalisation

In a closed economy, the Harrod-Domar model explains economic growth in terms of the level of savings and capital productivity. Therefore, government policies that encourage savings and capital will be conductive to increase growth. These policies include raising savings, introducing tax reforms, attain monetary stability, etc. The Harrod-Domar model is useful to predict short-run growth because one of its implications is that if we know the level of capital/savings in the future, then it is possible to predict output and income growth rates, but this is unrealistic. Long run growth should also consider technological change and education (Siggel, 2005). For example, in an open economy, economic growth is not only financed by domestic investment but also is likely to be financed by external debt and foreign investment.

The objective of this section is to analyse the macroeconomic situation and the management of economic policies before the introduction of an outward oriented strategy. We need to identify the main mechanisms applied by the government to achieve economic targets and later, under liberalisation, the mechanisms applied to improve export performance and foreign investment.

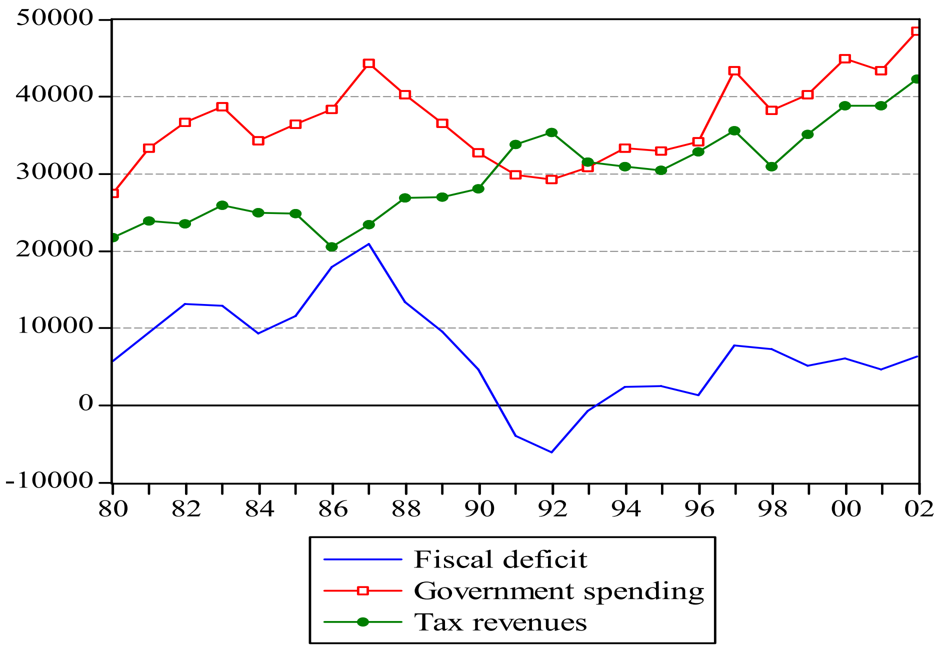
7.2.1 Fiscal policy in Mexico: growth and recession

As has been explained in Section 4.4.1, during the ISI strategy, fiscal policy was prioritised as an instrument of economic development over monetary policy. In this period, an expansionary policy through public spending was one of the main instruments to stimulate growth. As a consequence, it led to create excessive public spending without equivalent tax revenues. At the beginning of the 1980s fiscal deficit became a major concern.

In Figure 7.1, we can see a close relationship between an increasing fiscal deficit and subsequent economic crisis in 1982 and 1987. In 1986, the large public deficit (16% as a share of GDP) contributed to push up real interest rates (20-25% on average) and inflation (80%), and subsequently created considerable difficulties for private firms that required financial resources. The fiscal deficit reached its highest level in 1987, a little more than 20 billion dollars (in real terms).

Figure 7.1

Fiscal balance in Mexico (million dollars, constant prices)



Source: Bank of Mexico

To cope with economic crises and encourage productive investment demand from the government there was an attempt to implement a program to attain macroeconomic stability and to introduce a fiscal reform. In December 1987, President De la Madrid launched an inflation-combating economic pact[42] to promote external competition as a way to restrict domestic price growth. The agreement was signed by four economic agents: government, entrepreneurs, agriculture representatives and union labours. It was known as *Pacto de Solidaridad Economica* (Economic Solidarity Pact.), it was the first of subsequent economic pacts that were used as guidelines to reduce inflation mainly through an austerity policy. The final macroeconomic targets were the reduction of inflation and stimulus of output growth. While some of the intermediate targets were: fiscal constraints, the control of the nominal exchange rate, the control of general wages, the liberalisation of public sector prices, the acceleration of trade openness and the privatisation of some public enterprises.

During his government, President Carlos Salinas considered macro stability as a final target. Salinas continued with the fiscal and monetary reforms started by former President Miguel De la Madrid. Once liberalisation was introduced and plans for joining NAFTA were considered, stability in prices and reduction of government intervention became the main objectives of his government. From 1988-1993, another economic pact was signed, known as *Pacto para la Estabilidad y Crecimiento Economico*[43]. One of the results of this pact was the reduction of real wages growth, which only experienced a rise of 4.2% in relation to 1988. Then a third economic pact was introduced for the period 1993-1994, *Pacto para la Estabilidad, la Competitividad y el Empleo* [44] to continue with restrictive policies to control prices growth.

It was evident that the deterioration of real wages was one of the social costs of these corrective measures and as such it also reduced human capital development. It is undeniable that government intervention affects positively the efficiency of human capital and labour

[42] An economic pact was an agreement signed by different representatives of workers, entrepreneurs and the government to reduce prices and spending.
[43] Pact for Stability and Economic Growth
[44] Pact for Stability, Competitiveness and Employment

through public investment in infrastructure, health services, education and training. More investment in these areas improves the living and working conditions of the potential labour force and increases the quality of their work. Skilled labour is relevant to attract foreign investment as it improves the absorption capacity and facilitates technology adaptation and new organisational methods. By improving human resources in certain activities, foreign investment can be diverted to sectors or industries with higher possibilities to create spillovers and improve labour force conditions. Macroeconomic stability in general and fiscal and monetary policies in particular provide the institutional framework that makes possible to maximise spillover effects. In this sense, to avoid becoming a passive receptor of foreign investment, the government had to pursue economic policies that stimulated and increased investment to sectors or industries where development was needed and it also tried to facilitate the economic conditions to provide higher returns.

7.2.2 Monetary policy and exchange rate as a nominal anchor

Monetary policy relies on a variety of instruments to either expand or contract money supply. Those instruments can be monetary base, interest rates, the exchange rate and reserve requirements among others. In Mexico, the interest rate is set by open market operations, the Central Bank intervenes in the economy mostly through the expansion or contraction of the monetary base and at a lesser extend through exchange rate controls.

As part of the *Pacto de Solidaridad Economica* (in 1987), monetary and credit policies became restrictive. Control of prices was one of the main priorities of the government due to high rates of inflation experienced in the 1980s. The reduction of inflation was seen as a means to bring back economic stability and reduce income deterioration. The Central Bank used mechanisms of credit and money policies and exchange rate intervention to reduce money supply and therefore avoid prices escalation (Dussel, 2000).

After devaluation in 1994, Mexico faced two challenges: to adjust the macroeconomic variables to refinance short-term debt in dollars and to lower inflation. Consequently, the main objective of monetary policy became the reduction of inflation (see Figure 7.2). As inflation depends on the growth rate of money, the Bank of Mexico established quantitative targets of monetary base growth and net domestic credits in accordance with inflation targets. According to the Bank of Mexico's strategy, the money supply would depend on the demand for the monetary base that was expected as part of a national programme. In the 1990s, instead of fixing a short-run interest rate and manipulating the exchange rate, they decided to use a monetary instrument to reduce money supply, these instruments were known as "*cortos*"[45]. When the Central Bank offered *cortos*, its purpose was that commercial banks got negative accumulated balances and in this way reduce money supply. The Central Bank offered bonds and credits in the money market. Any excess of money demand by commercial banks was supplied at a punished interest rate. As a result, only money supply and demand would determine the interest rate.

The empirical evidence suggest that there is not always a clear relationship between the monetary base and inflation growth, for that reason some analysts recommend the Central Bank not to use it as an instrument to target inflation (Martinez, Sanchez & Werner, 2001). The application of monetary *cortos* kept inflation expectations down and restored the lack of equilibrium in the exchange rate. This indicates that the manipulation of the monetary base played a relevant role to influence economic variables.

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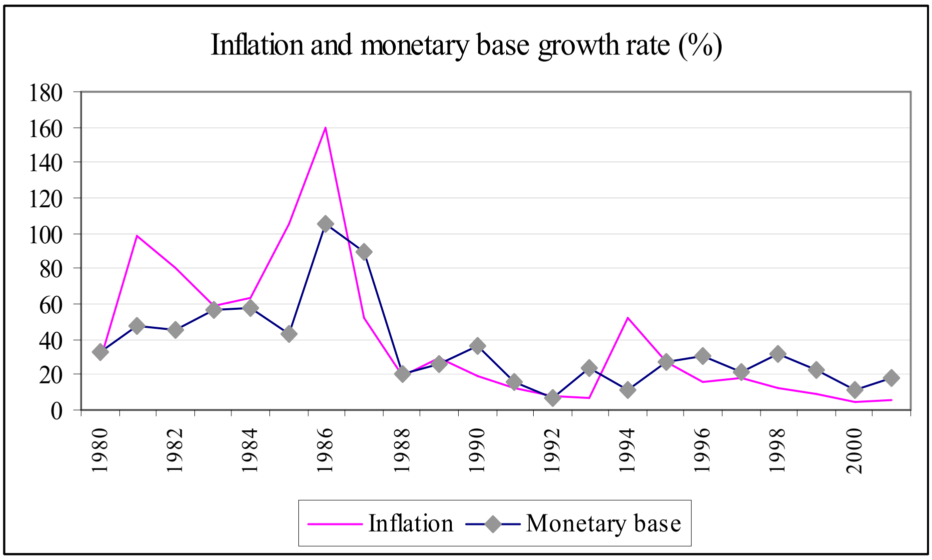
[45] In Spanish "cortos" comes from the verb "cortar" ("to cut" in English). In this context, the term refers to the action of cutting or reducing money supply.

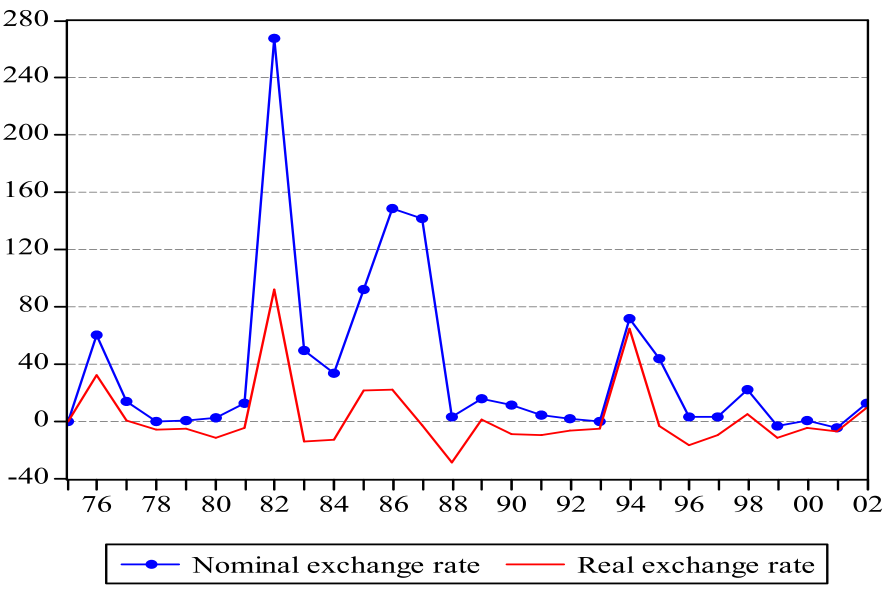
Figure 7.2



Regarding the exchange rate, during the economic crisis of 1982, due to high public spending and high deficit in the current account, the exchange rate experienced the greatest depreciation against the dollar. It devalued 267% in nominal terms in 1982, but due to inflation in the US, in real terms the exchange rate only devalued 92% (see Figure 7.3).

Figure 7.3

Percentage change of the exchange rate (peso/dollar)



Source: Bank of Mexico.
Note: 1993 was taken as the base year to calculate the real exchange rate.

In 1987, during the first economic pact, again the monetary policy fixed the exchange rate to lead inflation downward, in this sense it was used as a nominal anchor. The negative impact on the Balance of Payments made necessary to introduce in 1989 a regimen of floatation band. The fluctuation of the exchange rate was restricted to a controlled fluctuation of 12% and the parity was set according to the supply and demand. In practice, the Central Bank intervened on numerous occasions to keep the floatation to no more than its maximum limit. This policy was the result of financing the government debt with short-term investment that was dollar-indexed. International reserves were unable to support the peso at such devaluation margin, when the real exchange rate indicated that more than 12% devaluation was required.

The result of the government manipulation of the exchange rate was not exclusive of President Salinas' administration. In the economic history of Mexico, it has been part of the monetary policy to achieve macroeconomic stability and therefore impact on inflation and foreign investment. However, contrary to other times, when the economy was relatively closed to foreign capital, the manipulation of the exchange rate became counterproductive. Once the economy was opened and foreign investment privilege the stock market, this sort of policy became a threat for macroeconomic stability.

Under these conditions, in 1994 the peso became overvalued due to the floatation band that did not represent the real supply and demand for foreign currency. At the same time, excessive short-run debt in foreign currency put extra pressure on international reserves. Monetary authorities thought that capital flight was a transitory event after the assassination of Presidential candidate Luis Colosio, but the Central Bank refused to modify its monetary policy (Salinas, 2000). Eventually, at the end of 1994, the exchange rate depreciated 72%. Since then, the exchange rate regime has fluctuated freely. The Bank of Mexico does not intervene in the foreign exchange market except for operations carried out under the options mechanism. This mechanism implies that commercial banks can sell foreign currency to the central bank when there is an excess supply, keeping the accumulation of international reserves within a regimen of a freely floating exchange rate.

Studies such as that of Iscan (1997) have shown that monetary policy on the exchange rate may be conductive to increased capital accumulation and export growth. This is because as long as the monetary policy maintains an undervalued real exchange rate, exports and capital accumulation show significant positive correlations with economic growth. Findings like this highlight the possibility that it might be through monetary policy and not directly through export promotion and FDI that it is possible to foster output growth and labour productivity. For this reason, it is important to identify instruments that have positive impact on exports and FDI and therefore a potential positive impact on the economy as a whole.

Economic policies are designed on the basis that exports and FDI require the macroeconomic conditions to impact favourably on the rest of the economy. They require for example, fiscal incentives, tax exemptions, trade agreements, infrastructure, easy access to potential markets, etc. Regarding monetary incentives, FDI can be very sensitive to balance of payments constraints and to foreign policies such as the trade and investment regime of the host country. Therefore the economic policy of the host country has potentially an important role in determining FDI and exports production. In a stable environment, where there are no constraints or they are minimum, it is quite likely that the return on capital will be higher. For example, inflation is expected to increase capital costs which would represent a reduction in investors' profitability.

7.3 Modelling economic policies

In the model specification that follows we tried to include the relevant variables and functional relationships in order to achieve the objectives stated in Section 7.1. Basically the objectives are: to identify how monetary and fiscal policies have improved economic growth and determine if the links between GDP, FDI, exports, capital accumulation, productivity, interest rates and human capital have altered as a consequence of government intervention and trade reforms. Additionally, the model specification is designed to investigate the dynamic multiplier the effects of policy changes, so we can measure the impact-response on the endogenous variables. This is also a way to measure the potential of some policy variables to accelerate or decelerate the economy in the short and long-run.

Considering the objectives and the review of the macroeconomic history in the period 1980 to 2002, we identified some policy variables more frequently used by the government. For example, to measure the impact of monetary policy intervention we consider as the main instruments the manipulation of the exchange rate, monetary base and prices control (inflation). To measure the impact of fiscal policy, we consider instruments like public expenditure in social services, infrastructure and tax revenues as a percentage of GDP (as a proxy of taxes). The effect of trade reforms has been included as two dummy variables, one for liberalisation in 1986 with the entry to the GATT and the other for the effect of joining NAFTA in 1994. In the literature there is not a consensus about how to capture trade liberalisation (see Edwards 1997), sometimes it is measured as the share of trade to GDP, the growth of exports or a dummy variable. In some cases, it depends on how clearly this process has taken place. In the case of Mexico, it was clear that joining the GATT in 1986 reduced tariff and quotas considerably and promoted trade to a great extent. The proportion of import goods subjected to import licences reduced from 100% in 1982 to 19.7% in 1987, which was a very significant reduction at that time. The average trade tariff also decreased from 27% in 1982 to 10% in 1987 (Quiroga, 1998).

Later in 1994, NAFTA boosted exports and FDI and somehow consolidated the liberalisation process. Assessment of NAFTA has shown that between the three countries in this region, flows of commodities, capital and services have increased dramatically. For example, exports to the US almost doubled from $75 to $130 billion dollars in the period 1996-2001 and FDI increased from $3 to more than $14 billions dollars in the same period (Weinstein, 2004). For this reason, we use dummy variables to take in consideration the effect of commercial policy.

Additionally, in congruence with the extension of the system to include the effect of monetary and fiscal policy, the interest rate was incorporated to measure its direct effect on capital accumulation and FDI. Contrary to the other variables, the interest rate has remained freely determined by the market. For this reason, it is modelled as endogenously determined by the system.

Table 7.1 contains a list of exogenous and policy related variables that are potential determinants of GDP, human capital, exports, FDI, productivity, capital accumulation and the interest rate. All series are measured in quarterly frequency (from 1980:1 to 2002:4). For a more detailed description of the newly introduced variables and sources of information, please see Appendix 7A.

Table 7.1 Endogenous, exogenous variables and expected linkage.

		Equations						
Endogenous variables:	Notation	EQ7.1 GDP	EQ7.2 FDI	EQ7.3 EX	EQ7.4 HC	EQ7.5 PRO	EQ7.6 CA	EQ7.7 IR
Gross Domestic Product	GDP		√	√	√	√	√	√
Foreign Direct Investment	FDI	√		√	√	√	√	
Export goods	EX	√	√					
Capital accumulation	CA	√		√	√	√		
Human Capital	HC	√	√			√		
Labour Productivity	PRO	√		√	√		√	
Interest rate	IR		√				√	
Exogenous variables:								
Technological Transfer	TT				√	√	√	
Relative Wages	RWAGE		√	√				
World output	US		√	√				
Population	POP				√		√	
Fiscal policy variables:								
Government expenditure	GE_SA				√	√	√	
Infrastructure	INF_SA		√		√		√	
Tax Revenues	TX		√				√	
Monetary policy variables:								
Real exchange rate	RER		√	√			√	
Monetary Base (MB)	MB							√
Inflation	INFL						√	√
Trade policy variables:								
Liberalisation	D_{86}	√	√	√				
NAFTA	D_{94}	√	√	√				

In functional form (where *c* represents the intercept), we have seven equations in the system:

$$GDP = f(c, FDI, EX, CA, HC, PRO, D_{86}, D_{94}) \quad (7.1)$$

$$FDI = f(c, GDP, EX, HC, RWAGES, RER, INF\_SA, US, IR, (TX/GDP), D_{86}, D_{94}) \quad (7.2)$$

$$EX = f(c, GDP, FDI, CA, PRO, RWAGES, RER, US, D_{86}, D_{94}) \quad (7.3)$$

$$HC = f(c, FDI, CA, PRO, TT, GE\_SA, INF\_SA, (GDP/POP)) \quad (7.4)$$

$$PRO = f(c, GDP, FDI, CA, HC, TT, GE\_SA) \quad (7.5)$$

$$CA = f(c, FDI, PRO, TT, RER, GE\_SA, INF\_SA, (GDP/POP), (TX/GDP), IR, INFL) \quad (7.6)$$

$$IR = f(c, GDP, MB, INFL) \quad (7.7)$$

Most of the functional relationships and their positive or negative effect have already been discussed in Chapter 6 (see section 6.4), now we discuss the functional relationships of the policy-related explicative and endogenous variable added to the system.

Equation (7.1) explains GDP as a function of the usual explicative variables plus the dummies that account for the impact of liberalisation (D_{86}) and NAFTA (D_{94}). Logically, our hypothesis is that thanks to a more open economy and trade agreements, GDP growth has improved.

Equation (7.2) for FDI includes the additional impact of liberalisation and NAFTA and a positive effect is expected. This equation also includes the potential negative effect of rises in the interest rate and in taxes imposed by the government.

The export's equation (7.3) remains almost the same except for the inclusion of the dummy variables of liberalisation and NAFTA. This is so to determine if there has been a significant difference in exports due to the deregulation of trade barriers.

Equations (7.4) of human capital and (7.5) of labour productivity remained functionally the same. This does not mean that economic liberalisation has not modified levels of labour productivity and human capital; it only means that this effect is likely to occur indirectly through other explicative variables.

Equation (7.6) of capital accumulation was expanded to determine how changes in the interest rate affect it, which in some way will impact on the country's capacity to invest in productive processes. Inflation was also included in this equation to account for the impact of peso's deterioration. A proxy for the effect of taxes on income and profits was added, in this case measured as tax revenues as a share of GDP (TX/GDP). We had to assume that a rise in tax collection is closely related to higher taxes or tax payment enforcement. It is expected that positive changes in these variables will create lower returns on capital and therefore will have a negative effect.

Finally, equation (7.7) is the equation for the interest rate (IR), this is determined endogenously by the system because there is no evidence of deliberate attempts of the Central Bank to fix this variable. The interest rate posited to be a function of GDP, monetary base and inflation. Although it only appears as an explicative variable of capital accumulation and FDI, interest rates also affects indirectly other variables, for example GDP, productivity and exports.

7.3.1 Definition and measurement of the variables

Most of the variables in table 7.1 have already been described in Chapter 6 (see section 6.6.1). Here, we describe briefly the additional variables included in the system of equations.

Monetary ase (M): Amount of domestic currency in circulation such as banknotes and coins plus bank reserves. It is converted to million dollars, constant prices. The series was seasonally adjusted.

Interest Rate (IR): Nominal interest rate paid on a six-month deposit.

Tax Revenues (T): Total amount of tax revenues (on income, good and services, exports, imports, etc) collected by the government. In million dollars, constant prices. It was seasonally adjusted due to the original series being in average accumulated flows.

Inflation (I FL): It is the quarterly annual growth rate of consumer price index (CPI), (1993=100), in percentage.

Liberalisation (D_{86}): Dummy variable for liberalisation, D_{86}=0 if year < 1986 and D_{86} =1 if year >1985. The year of reference is 1986, when Mexico joined the General Agreement on Tariffs and Trade (GATT).

AFTA (D_{94}), Dummy variable, D_{94}=0 if year < 1994 and D_{94}=1 if year >1993. This trade agreement with the US and Canada is effective since January 1st, 1994.

Finally, most of the series were transformed to natural logs in order to reduce their variance and for comparative purposes with results in Chapter 6. The following are the figures in logs, the others have already been described graphically (see Figures 5.1 to 5.3 and Figures 6.2 to 6.11)

Figure 7.4

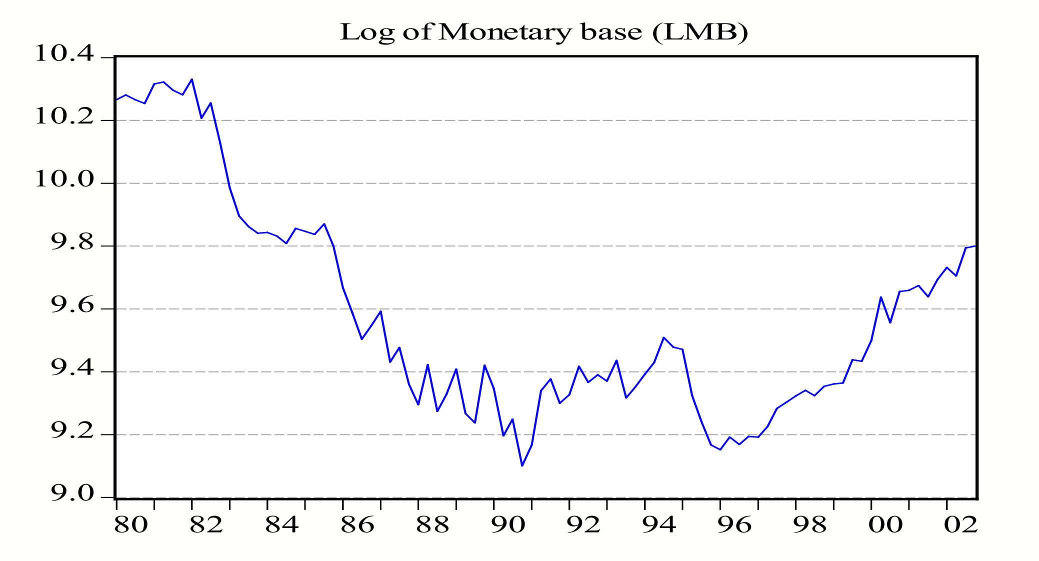


Figure 7.5

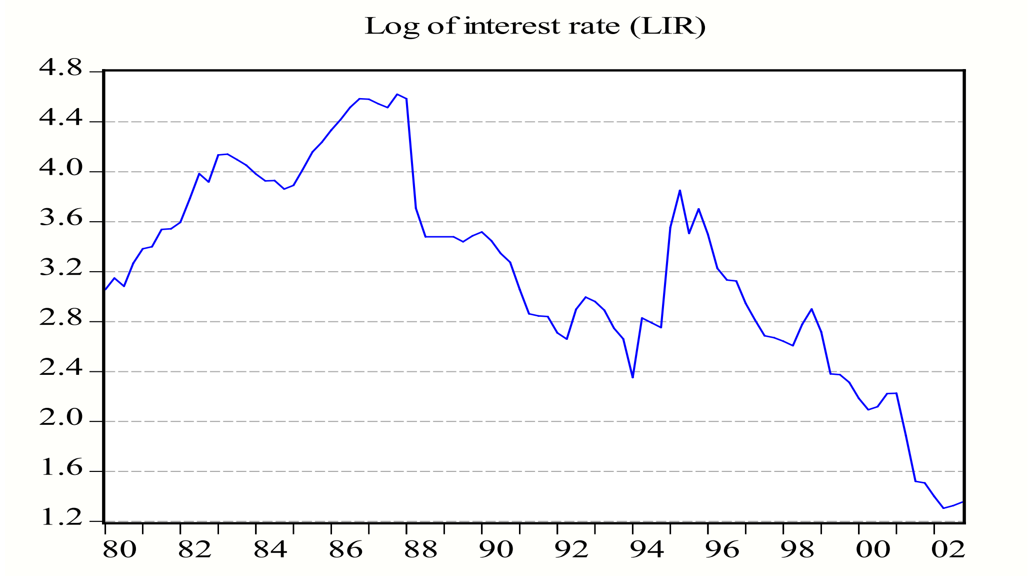


Figure 7.6

Log of tax revenues (LTX)

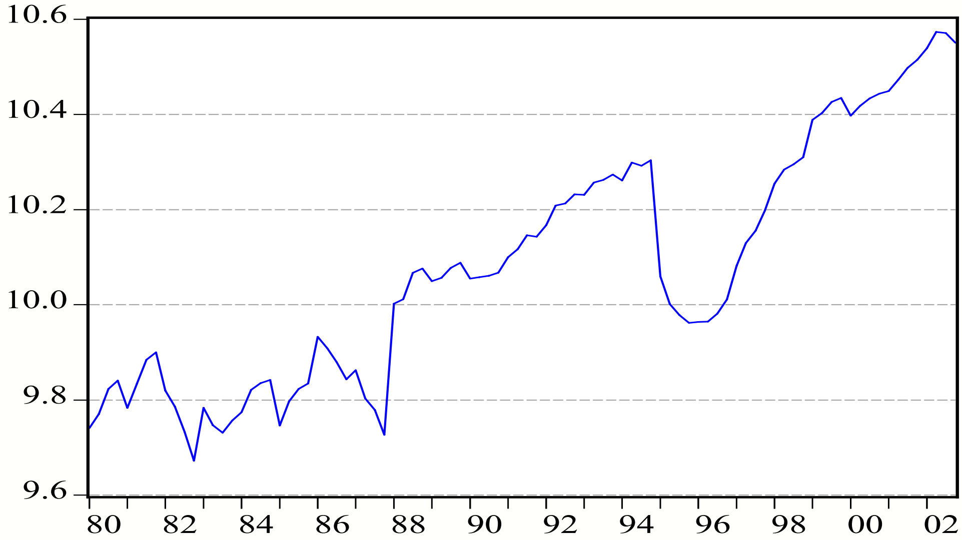
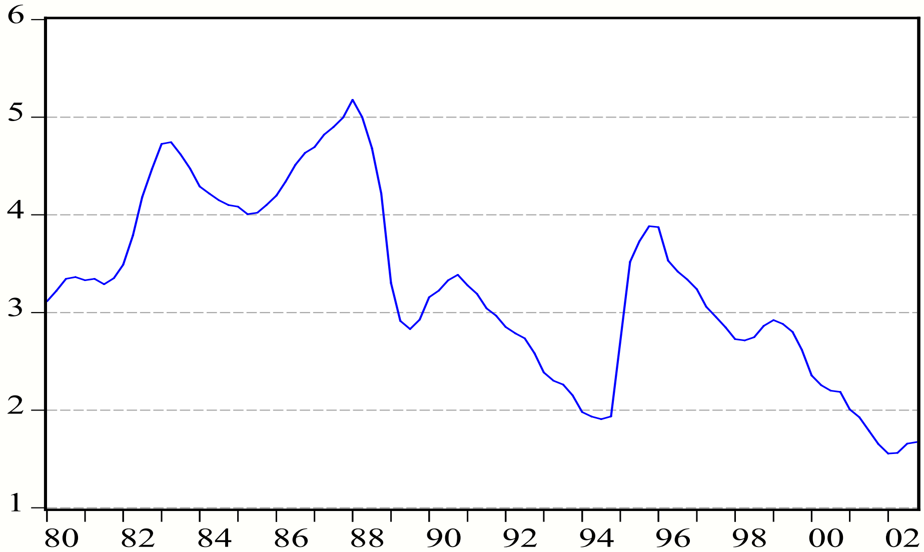


Figure 7.7

Log of inflation (LINFL)



Source for all figures: Bank of Mexico

7.3.2 Model specification

The system of equations (7.1) to (7.7) required a method of estimation that took in consideration endogeneity in the right-hand side of the equations. Again, the estimations were done through a method of simultaneous equations like 3SLS. This method required transforming the structural system to its reduced form. The representation of the structural system in the companion form is:

$$\Gamma y + A + Bx + \Phi y_{t-1} = \varepsilon \tag{7.8}$$

In matrix form:

$$\begin{bmatrix} \Gamma_t & 0 & 0 & 0 & \dots & 0 \\ 0 & I & 0 & 0 & \dots & 0 \\ 0 & 0 & I & 0 & \cdots & 0 \\ 0 & 0 & 0 & I & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \dots & I \end{bmatrix} \begin{bmatrix} y_t \\ y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ \vdots \\ y_{t-p-1} \end{bmatrix} + \begin{bmatrix} A_t \\ 0 \\ 0 \\ 0 \\ \vdots \\ 0 \end{bmatrix} + \begin{bmatrix} \beta_0 & \beta_1 & \beta_2 & \beta_3 & \dots & \beta_{np} \\ 0 & 0 & 0 & 0 & \dots & 0 \\ 0 & 0 & 0 & 0 & \dots & 0 \\ 0 & 0 & 0 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \dots & 0 \end{bmatrix} \begin{bmatrix} x_t \\ x_{t-1} \\ x_{t-2} \\ x_{t-3} \\ \vdots \\ x_{t-p} \end{bmatrix} +$$

$$\begin{bmatrix} \Phi_1 & \Phi_2 & \Phi_3 & \Phi_4 & \dots & \Phi_{np} \\ I & 0 & 0 & 0 & \dots & 0 \\ 0 & I & 0 & 0 & \dots & 0 \\ 0 & 0 & I & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \dots & 0 \end{bmatrix} \begin{bmatrix} y_{t-1} \\ y_{t-2} \\ y_{t-3} \\ y_{t-4} \\ \vdots \\ y_{t-p} \end{bmatrix} = \begin{bmatrix} \varepsilon_t \\ 0 \\ 0 \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

Where: Γ_t , β_{np} , Φ_{np}, are matrices of coefficients, I is an identity matrix and O is a null matrix. Γ_t , I and Φ_{np} are matrices of order (7x6) and β_{np} are (7x12) matrices. A_t and ε_t are vectors of constants and errors respectively. y_t and x_t are vectors of endogenous[46] and exogenous variables[47], in our case these vectors are:

$y_t = \quad LGDP_t, LFDI_t, LE \quad _t, LHC_t, LPRO_t, LCA_t, LIR_t$

[46] LGDP, is the log of GDP; LFDI, is the log of FDI; LEX, is the log of exports; LHC, is the log of human capital; LPRO, is the log of labour productivity; LCA, is the log of capital accumulation and, LIR is the log of the interest rate.

[47] LTT, is the log of technological transfer, LWAGES, The log of relative wages; LRER, is the log of real exchange rate; LGE, is the log of government expenditure; LUS, is the log of the world economy; LMB, is the log of monetary base; LINF, is the log of Infrastructure; LTX, is the log of tax revenues; LPOP, is the log of population; LINFL, is the log of inflation; D_{86}, is a dummy variable for liberalisation and, D_{94} is a dummy variable for NAFTA.

$x_t^{'} = [LTT_t, LRWAGES_t, LUS_t, LPOP_t, LGE\_SA_t, LINF\_SA, LT \quad _t, LRER_t, LINFL_t,$
$LMB_t, D_{86}, D_{94}]$

As has been shown before (see sections 5.3 and 6.4.3), most of the series are I(1). To find the order of integration of the five remaining variables, unit root tests were applied.

7.3.3 nit root test results

We tested for unit roots in the logs of the monetary base, inflation, interest rate and tax revenues. The usual ADF tests and P-P tests were applied, the results are in Table 7.2. It can be observed that none of the statistics reject the null of unit root which indicates that the variables are non-stationary in levels. To find the order of integration, the same unit root tests were applied to the series in first differences, results are shown in Table 7.3.

Table 7.2 Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) statistics and probabilities. Series are in levels.
Null hypothesis: there is a unit root.

Series	ADF		P-P	
	Constant	Constant and a trend	Constant	Constant and a trend
LMB	-1.9508 (0.3080)		-1.9496 (0.3085)	
LINFL	-2.373 (0.1521)		-1.2888 (0.6320)	
LIR		-2.856 (0.1817)		-2.391 (0.3816)
LTX		-2.141 (0.5163)		-2.449 (0.3550)

Key notes: LMB, log of monetary base; LINFL, log of inflation; LIR, log of interest Rate and LTX, log of tax revenues.
MacKinnon critical values for rejection of the hypothesis of a unit toot for ADF and PP tests: 1%=-4.062, 5%= -3.459 (with trend and constant) and 1%=-3.503, 5%= -2.893 (with a constant).

Table 7.3 Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) statistics and probabilities. Series are in first differences.
Null hypothesis: there is a unit root.

Series	ADF		P-P	
	Constant	Constant and a trend	Constant	Constant and a trend
DLMB	-10.226 (0.0000)		-10.196 (0.0000)	
DLINFL	-5.6769 (0.0000)		-4.247 (0.0010)	
DLIR		-7.983 (0.0000)		-7.958 (0.0000)
DLTX		-8.141 (0.0000)		-8.149 (0.0000)

Key notes: DLMB, first difference of the log of monetary base; DLINFL, first difference of the log of inflation; DLIR, log of interest rate; DLTX, first difference of the log of tax revenues.
MacKinnon critical values for rejection of hypothesis of a unit toot for ADF and PP tests:
1%=-3.504,d 5%= -2.893 (with trend and constant) and 1%=-4.063 and 5%= -3.460 (with a constant).

In this case, all the test statistics led to the rejection of the null hypothesis. The results confirms that the series are I(1) and as a consequence the system has to be estimated in first differences.

The procedure to estimate the equations and the multiplier effects is similar to the one applied in Chapter 6. First, an unrestricted system with a maximum of six lags was estimated, residual tests on this system showed satisfactory results. Then only statistically significant coefficients were retained to estimate a restricted system. This was found to be mathematical stable as all the roots of the characteristic polynomial were less than one in absolute value. The structural residuals were tested for serial correlation, normality and i.i.d (see appendix 7B for stability condition and diagnostic tests).

7.3.4 Simultaneity bias and identification

One of the reasons to apply a method of estimation that takes in consideration the endogeneity of some variable is precisely due to the existence of this problem. Hausman's test for weak exogeneity is a way to find if this is the case. The results are in Table 7.4, we can see that the tests statistics exceed the critical values, leading to the non rejection of the null hypothesis. This might be caused by the large number of predetermine variables that were used in the test regression, which provides fitted values not statistically different from zero. Apparently there is no simultaneity bias and the system could be estimated equation by equation with OLS. The results only confirm that there is no misspecification biased and therefore complies with one of the recommendations of the Colews Commission.

Table 7.4 Hausman's test for weak exogeneity.

Equation	Variable to test for exogeneity	F-Statistic / Chi-square T-test	H0: $\alpha = 0$ It is weakly exogenous
DLGDP	DLCA DLPRO	F-stat= 0.1609 (0.851) Chi-sq.= 0.322 (0.851)	Do not reject
DLFDI	DLEX DLGDP	F-stat= 1.668 (0.197) Chi-sq.= 3.337 (0.188)	Do not reject
DLEX	DLCA DLGDP	F-stat= 0.446 (0.642) Chi-sq.= 0.893 (0.639)	Do not reject
DLHC	DLCA	T-stat= -0.533 (0.596)	Do not reject
DLPRO	DLGDP DLHC	F-stat= 0.022 (0.977) Chi-sq.= 0.045 (0.977)	Do not reject
DLCA	DLGDP DLIR	F-stat= 1.308 (0.279) Chi-sq.= 2.616 (0.270)	Do not reject
DLIR	DLGDP	T-stat= -0.205 (0.837)	Do not reject

Note: the numbers in parenthesis are probabilities.

Identification of the system was carried out to know if estimates of the structural parameters can be obtained and whether or not these are unique. The former is the order condition and the latter the rank condition of identification. For details about the procedure please refer to Section 6.5.3. According to the order condition of identification, all the equations in the system are overidentified (see Table 7.5). The existence of many predetermined variables make possible to find a large number of possible solutions.

Table 7.5 Order condition for identification

Equation	(K-k)	(m-1)	Status (*K*-k) > (*m*-1)
DLGDP	68-6=62	3-1=2	Over-identified
DLFDI	68-19=49	3-1=2	Over-identified
DLEX	68-18=50	3-1=2	Over-identified
DLHC	68-20=48	2-1=1	Over-identified
DLPRO	68-7=61	3-1=2	Over-identified
DLCA	68-29=39	3-1=2	Over-identified
DLIR	68-7=61	2-1=1	Over-identified

Notes: K: numbers of predetermined variables in the system.
k: number of predetermined variables in the equation.
m: number of endogenous variables in the equation.

On the other hand, the rank condition of identification guarantees that the solution that we find is unique. To check if that condition was achieved, the system was normalised with respect to the endogenous variables and a coefficient matrix was constructed with the excluded endogenous and predetermined variables in the equation. The condition states that there be at least one (6x6) non-singular sub-matrix in every equation (i.e. the determinant must not be zero). Table 7.6 contains at least one determinant in the sub-matrices of each equation.

Table 7.6 Rank condition for identification.

Equation	Determinant of sub-matrix (6x6) Π_j^*	Rank condition
DLGDP	-0.000594	Satisfied
DLFDI	0.000101	Satisfied
DLEX	0.0000349	Satisfied
DLHC	0.000215	Satisfied
DLPRO	-0.0000031	Satisfied
DLCA	-0.0000783	Satisfied
DLIR	0.0000423	Satisfied

Additionally to the misspecification biased, the identification of the system also complies with the recommendation of the Cowles Comission. Regarding the properties of the system estimates and the residuals, it was mathematically stable and the diagnostic tests showed no serial correlation. Most of the residuals passed normality and independence tests (see Appendix 7B).

7.4. Estimations of the system of equations

The estimations of the simultaneous equations through 3SLS reveal that in general, most of the original economic relationships (reported in Chapter 6)\still prevail. The inclusion of policy variables did not alter substantially the influence of the explicative variables, however in some cases it did show the significance of some variables related to changes in monetary and fiscal policy (estimations of each equation appear in Appendix 7C).

The estimations again showed that capital accumulation, productivity and FDI are statistically significant determinants of DLGDP, although this time human capital was not significant. According to these estimations, the entry to GATT has improved positively GDP, while NAFTA has induced a reduction. Although we accounted for trade reforms that could explain better the influence of exports on GDP, this was not the case.

After more than ten years, some assert that NAFTA has favoured intra-regional trade at the expense of intra-regional FDI (Rugman, 2004). For example, in 2000, intra-regional trade was 55% versus a declining 18.2% intra-regional FDI. The reason seems to be that activities in which there are still restrictions (for instance services) tend to attract FDI as an alternative way to compete in another market, while reduction or elimination of trade barriers allows access to those markets through commodity trade so foreign investment falls. This situation is evident in the economic relationship between the US and Canada, however statistical evidence shows that under NAFTA, FDI from the US to Mexico has increased relatively more compared to Canada. This could explain why FDI consistently explains positive changes in GDP. More than a trade partner, for the US, Mexico represents a platform to invest and produce export goods at competitive prices for the international market. Furthermore, the existence of regulations and difficulties in trade of services implies that access to Mexico's service sector has to be through FDI.

Most of the original determinants of FDI remained statistically significant; these are exports, relative wages and the exchange rate. When the interest rate was added to this equation, a significant negative effect was found (-0.19). Although most of this kind of investment is financed with resources from its country of origin, the significant effect indicates that the link to the money market in Mexico is relevant and any rise in the interest rate affects FDI negatively.

Additionally, commercial policies that led to liberalisation and NAFTA created two different reactions in FDI flow. Despite both being statistically significant, under liberalisation, FDI decreased. Different factors could be attributed to this outcome and not necessarily are linked to trade liberalisation; first it would not be until 1993 when significant reforms to the law regulating foreign investment were introduced. Second, before the crisis in 1994, most of foreign investment considered the stock market as more profitable than direct investment. Third, the US economy (the main source of foreign flows to Mexico) was having a period of moderate growth.

On the contrary, NAFTA has exerted a positive effect on FDI, this coincides with the economic crisis in 1994 though. Peso devaluation had an immediate and positive lagged effect in this model, this indicates that fluctuations of the exchange rate against the Mexican currency are a strong positive determinant of FDI. For a foreign investor devaluation translates in relatively cheap production costs and if it is participating in the international market, it improves its terms of trade. Again, it is worth to reiterate that reforms to the law were effective in 1993, and this was one of the most important elements that boosted FDI (see Figure 5.2).

Public spending in infrastructure (measured by DLINF) has also a significant positive lagged effect in FDI. In this respect, fiscal policy that promotes public investment in roads, services, means of communication, etc. has worked as an important element to facilitate international transactions. Other studies support this finding in the sense that host countries characteristics such as competitiveness of the market, openness to imports and technical capability of local firms, among others are elements that are being taking in consideration by foreign investors (Blomstrom and Globerman, 2000). But in the estimations, it was also found a strong lagged influence of the world economy (DUS_{t-1}), meaning that a positive US economy has contributed to increase foreign investment in Mexico (its quantitative impact was 4.48). According to these estimates, FDI reacts positively to both, the host country conditions and the state of the world economic.

Estimations for exports equation do not differ significantly from the original estimations. Again it was confirmed that Mexican exports are strongly dependent on the state of the US economy (the coefficient was 5.10). In the same way, currency depreciation stimulates exports as they become more competitive in the international market; however lagged effects of the exchange rate fluctuations show that this positive effect does not last for long. Eventually, the lagged effect of peso depreciation reduces exports because prices of other goods will tend to adjust to devaluation. Lagged effects of productivity gains also induce positive changes in exports (1.159), in fact quantitatively this was the second most important determinant of exports.

Trade reforms have mixing results, for example both GATT and NAFTA coefficients were statistically significant, but only GATT with a positive effect on exports (0.093). It is evident that trade has benefited from reductions and eliminations of tariffs and quotas, but quantitatively reductions in 1986 were relatively more intense compared to reductions due to NAFTA. This relative difference could be translated in exports' response to liberalisation in 1986 as positive versus the negative effect due to NAFTA.

A fiscal policy based on government spending on human resources does seem to improve human capital. Although public investment in infrastructure is also important, the estimations show it does not have a significant effect. Again labour productivity (lagged four periods) and FDI (lagged five periods) show that they improve human capital (in this way it confirms previous empirical finding provided in Table 6.13). Equally in the case of labour productivity, the original findings are confirmed. GDP and human capital favour positive changes in productivity.

Findings in the equation of DLCA reveal that the exchange rate real appreciation, technology transfer, GDP per capita and investment in infrastructure enhance the accumulation of capital. Other variables related to fiscal policy like taxes as a share of GDP and monetary policy like interest rates and inflation do not indicate that they induce significant changes in capital accumulation. This outcome is very important for the system, since capital accumulation is also an explicative variable of GDP, exports and productivity for instance. Therefore any deliberate action to alter taxes, the interest rates or price has little effect on a wider range of economic variables. However, in general we can see that those variables related to fiscal policy like public expenditure and infrastructure do seem to affect some of the endogenous variables in this study. For example, in the specific case of capital accumulation, spending in infrastructure confirms the important role of the government's provision of roads, means of communications, services, etc. that facilitates investment and improves FDI and exports.

Finally, the equation that represents the interest rate and which was also endogenously determined by the system showed that changes in this variable can be explained by current and lagged changes in GDP and inflation. Coefficients of both explicative variables provide mixing results about their negative and positive effects. No conclusive evidence can be extracted from the estimations.

7.5 Dynamic analysis of policy changes

The econometric procedure to estimate the dynamic multipliers was explained in section 6.7. It is only important to add that the calculations required the stability of the system to ensure that responses to any shock will tend to return to the long run equilibrium. This condition was satisfied (see Appendix 7B for results). In the following section, we only present the multipliers effects of the exchange rate, the monetary base, inflation and tax revenues which are the policy related variables that were added to the system of equations in this chapter. Multiplier effects of the other exogenous variables do not differ quantitatively from those effects already discussed in Section 6.7.3.

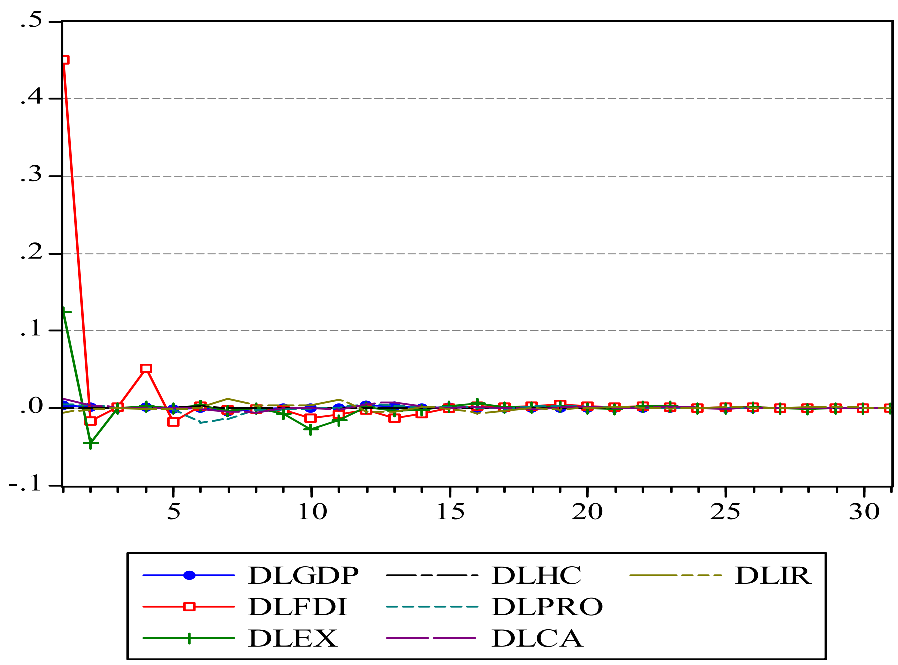
7.5.1 Dynamic multiplier effects of the exchange rate, the monetary base, inflation and tax revenues.

As was mentioned previously, the analysis of dynamic multipliers is a tool that allows measuring how a unit change in an exogenous variable accelerates or decelerates changes in the endogenous variable. Under this method, we can observe how changes in instruments of fiscal and monetary policy and inflation will affect key economic variables. The purpose of carrying on this analysis is to investigate the dynamic impact of changes in government policies and identify the instruments with the strongest potential to accelerate or decelerate growth, exports, capital accumulation, labour productivity, human capital and interest rates. Appendix 7E contains tables with the multiplier effects of the twelve exogenous variables. Here we only present the graphical trajectory of these multipliers.

Figure 7.8 shows the multiplier of DLRER (i.e. real exchange rate) and its impact on the eight endogenous variables. Graphically we can only observed responses that were quantitatively stronger. For example, a unit change in peso depreciation accelerates changes in FDI and exports immediately. Although currency depreciation stimulates export production because they become internationally more competitive it rapidly adjusts to the long-run equilibrium. In the case, of FDI, its acceleration effect prevails longer, until the four periods after the initial shock.

Figure 7.8

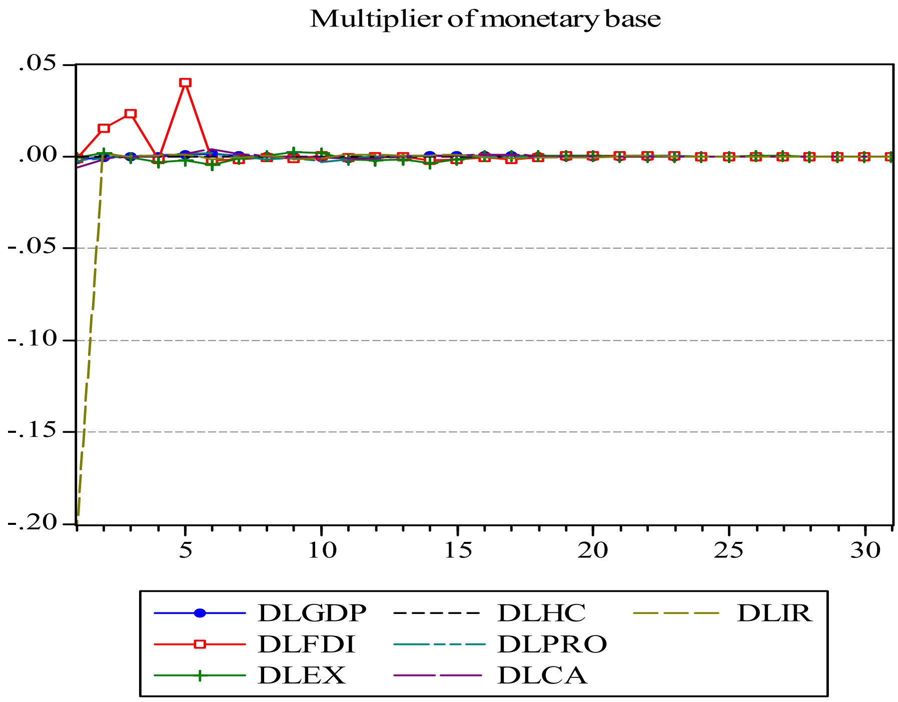
Multiplier effect of real exchange rate



The multiplier effect on other variables was negligible, which indicates that monetary policies designed to manipulate or intervene in the exchange rate market will tend to affect mainly FDI and exports with more intensity.

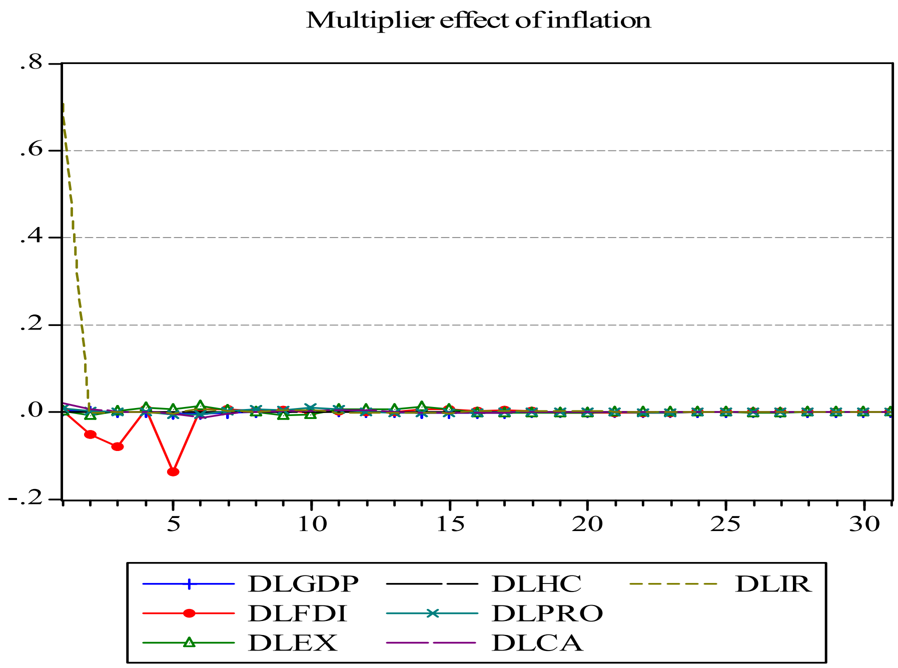
The manipulation of the monetary base was an instrument with a strong impact on interest rates as can be seen in Figure 7.9 This multiplier effect supports the affirmation that an expansionary monetary policy tends to decelerate changes in the interest rates (the negative sign shows a reduction). As a consequence, this has the potential to create a positive effect on the rest of the economy, since the interest rate is an explicative variable of FDI for example. In fact, we can observe that an expansion in the monetary base accelerates FDI growth by 0.02% in the third period and 0.04% in the fifth period. This positive relationship could be an indication that the effect of a unit change in the monetary base may occur through its effect on the interest rate.

Figure 7.9



Inflation has been a target variable for most part of the period of analysis. Although efforts by the Mexican government to reduce prices growth have been successful (through economic pacts and a restrictive fiscal policy), during periods of high levels of inflation, interest rates have increased. The multiplier effect of a change in DLINF has an immediate acceleration effect on the interest rate that overshadows the graphical reaction of other endogenous variables (see Figure 7.10). Considering that the interest rate is an important determinant of FDI, again we see that rises in inflation will lead to create a deceleration effect on FDI. If we take in consideration that FDI is a determinant of GDP, human capital, exports and productivity then the negative consequences of inflation on the interest rate are evident and explain why monetary policy targeted inflation in the 1980s and 1990s, becoming one of the most important macroeconomic goals.

Figure 7.10

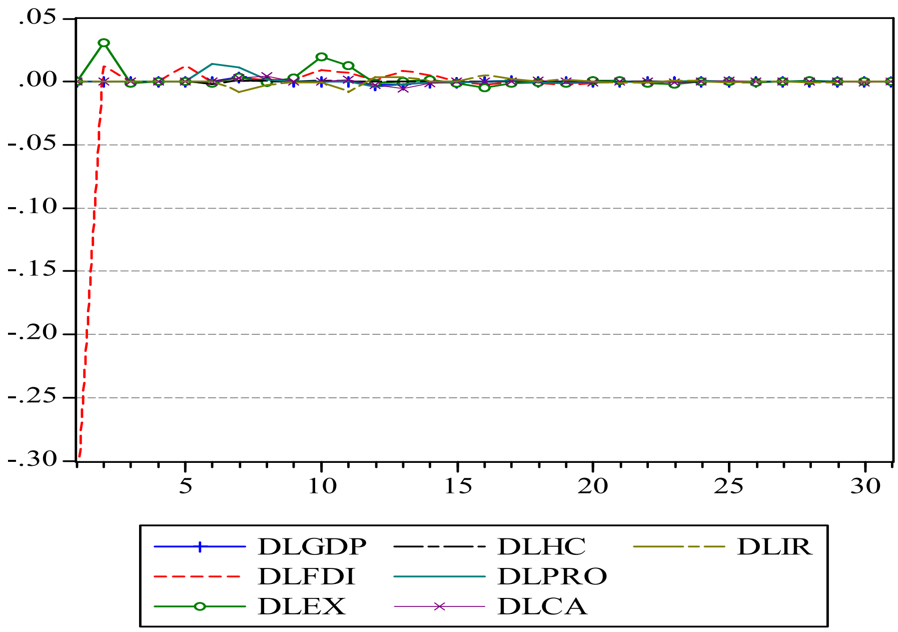


Finally, the multiplier effect of tax revenues –which was used partially as a proxy to measure the potential impact of taxes on the economy- shows that a unit change (an increase) in DLTX decelerates FDI growth right away (see Figure 7.11). Relatively speaking this reduction in is very strong (equal to -0.33%) in relation to other variables, for example GDP and capital accumulation also reduce their growth rate but this is very low and not immediate (-0.00017 and -0.00014 respectively). It confirms that –other things constant- higher taxes slow down investment and reduce growth, since it means that operation costs in Mexico increase and any possible returns will be relatively lower. However, the multiplier effect of tax revenues also shows that it does not prevail for long.

Unusually, exports show an acceleration response as a result of higher taxes. One possible explanation is that some of tax revenues could be using to increase public investment that favours export production and in general facilitates transactions.

Figure7.11

Multiplier effect of tax revenues



7.5.2. Cumulative multipliers

Calculations of the cumulative multipliers (the sum of all dynamic multipliers of the exogenous variable on a particular endogenous variable) present a clearer picture of the long-run effects. In general, it is noted that the strongest multiplier effect on DLFDI and DLEX is from the world economy (DLUS). Both variables experienced positive cumulative accelerations equal to 3.45 and 4.41 respectively (see Table 7.7). The initial hypothesis about how FDI and exports respond to the world economy is confirmed.

Table 7.7 Cumulative long-run multipliers.

Multiplier effect of:	Endogenous variables						
	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
DLTT	0.0966	0.1473	-0.0467	0.0025	0.1061	0.5196	-0.4021
DWAGES	-0.0033	0.8213	-0.8025	0.0002	-0.0582	-0.0024	0.0137
DLRER	0.0008	0.4328	0.0365	0.0006	-0.0272	0.0112	-0.0031
DLGE	0.0024	0.0045	-0.0002	0.0005	0.0031	0.0123	-0.0101
DLUS	-0.0138	3.4547	4.4120	0.0008	-0.2446	-0.0101	0.0576
DLMB	-0.0007	0.0673	-0.0135	-0.0001	-0.0054	-0.0025	-0.2077
DLINF	-0.0070	-0.0129	0.0005	-0.0013	-0.0089	-0.0353	0.0291
DLTX	0.0012	-0.2909	0.0580	-0.0001	0.0206	0.0009	-0.0049
DLPOP	-0.2314	-0.4285	0.0164	-0.0431	-0.2957	-1.1708	0.9635
DLINFL	0.0025	-0.2294	0.0462	0.0002	0.0185	0.0087	0.7079
D_{86} (Liberalisation)	0.0113	0.0680	0.1131	0.0017	0.0158	0.0152	-0.0470
D_{94} (NAFTA)	-0.0015	-0.0126	-0.0621	-0.0002	-0.0019	-0.0020	0.0062

Key notes: DLGDP, is the change in GDP; DLFDI, the change in FDI; DLEX, the change in exports; DLHC, the change in human capital; DLPRO, the change in labour productivity; DLCA, the change in capital accumulation; DLTT, the change in technological transfer, DWAGES, the change in real relative wages; DLRER, the change in real exchange rate; DLGE, the change in government expenditure; DLUS, the change in the world economy; DLMB, the change in monetary base; DLINF, the change in infrastructure; DLTX, the change in tax revenues; DLPOP, the change in population; DLINFL, the change in inflation; D_{86}, dummy variable for liberalisation; D_{94} dummy variable for NAFTA.

Another relevant cumulative effect was from relative wages (DLWAGES), its negative sign and magnitude indicate that disparities of real wages between the US and Mexico stimulate export production. Although this response was expected, it is surprising to find that quantitatively both exports and FDI react more to the world economy than to specific economic policies oriented to improve their performance.

The long run multipliers of the monetary base indicate that a unit change in a change in this variable has a negative effect on the interest rate because more money in the economy directly increases inflation and then leads to lower interest rate. As a result, FDI also shows a positive cumulative effect due to unit changes in DLMB and a negative cumulative effect due to DLINFL, which is understandable since the interest rate is an explicative variable of FDI.

Regarding the cumulative effect of commercial policy, it is clear that trade reforms that led to liberalisation in 1986 had a positive long run effect in the economy, this is in GDP, exports, FDI, human capital, etc. This can be seen by the positive sign (except for interest rates which decelerated as a consequence). On the other hand, the cumulative multiplier effect from NAFTA not only is quantitatively smaller but also negative for most of the variables.

7.6 Conclusions

In this chapter we tried to analyse the influence of government intervention through instruments of monetary, fiscal and commercial policy on the economy. The empirical analysis with a system of simultaneous equations and multipliers helped to identify the way government policies and trade reforms have altered the links between growth, FDI, exports, growth, capital accumulation, productivity and human capital. We also identified the dynamic impact of policy changes and instruments with the strongest acceleration and deceleration effect on some relevant variables.

The results indicate that the inclusion of some instruments of monetary and fiscal policy like the monetary base, the interest rate, inflation and tax revenues did not modify substantially the existing links between growth, FDI, exports, capital accumulation, productivity and human capital. But the extension of the system of equations did provide additional information about direct and indirect effects of government policies in the system.

Trade reforms introduced in 1986 were more conducing to produce positive changes in exports and GDP. This can also be noticed in the long run multipliers, which indicate that most of the economic variables reacted positively to liberalisation introduced in 1986, but was not always the case for NAFTA.

The multiplier of inflation was found to generate a strong acceleration effect in the interest rate, it is evident that any monetary policy used to target inflation will indirectly affect important variables such as the interest rate and FDI. Being a dynamic simultaneous equations and FDI an important determinant of GDP, exports and human capital for example, then any economic policy conduced to reduce inflation will have the potential to stimulate the economy. Finally, exports and FDI were the most sensitive variables to a unit change in a change in tax revenues and the exchange rate, while interest rate was the most sensitive variable to a shock in inflation and the monetary base.

In general, we can see that instruments related to fiscal policy like public expenditure and investment in infrastructure do seem to affect some of the endogenous variables analysed in this study. For example, in the specific case of capital accumulation, spending in infrastructure confirms that the provision of roads, means of communications, services, etc. is going to facilitate investment; and also tend to attract more FDI and improve human capital development.

CHAPTER 8: GENERAL CONCLUSIONS

8.1 Introduction

The literature review and the empirical analysis presented in the previous chapters put in evidence that the specific country characteristics matter since they determine whether an outward oriented strategy will be successful. The current globalisation process, that has intensified the free movement of goods and capitals, seem to confirm the predictions of the Hecksher-Ohlin theorem that commodities and relative factor prices will tend to equalise.

In Chapter 3, it was discussed that it is common to find in the literature proponents and sceptics on the benefits of economic liberalisation (also referred as *openness* or *outward oriented strategy*) especially in developing countries. It was this discrepancy that prompted an interest to find how well Mexico has done in this respect. This is a study on a developing country with a relative short experience of economic liberalisation but which has already generated structural changes in exports' distribution, foreign investment, and other relevant macroeconomic variables.

8.2 Contributions of the thesis

This study has contributed to the literature on the understanding of liberalisation as a strategy to improve economic growth. This contribution can be categorised in two ambits: by the scope of analysis and by the econometric approach used to capture much richer interrelationships. Previous empirical studies on the links between exports and output or FDI and output have approached these relationships with traditional and new econometric techniques but with a limited framework, either using cross section data (Balassa (1978), Feder (1982), Ram (1987)) or estimating bivariate models (Marin (1992), Sharma and Dhakal (1994), Medina-Smith (2001)). The first group tends to over generalise the statistical significance of coefficients –related to liberalisation- to the whole group of developing countries. Most of the time, the outcome is positive, leading to overestimate the impact of liberalisation on economic growth. The second group privileges cases studies but using simplistic approaches with models that include two or three variables. As a consequence, their models require a number of assumptions to isolate the effects of exports and FDI on output growth. No more variables enter in the system and the causal relationship occurs one by one.

- In this thesis, we tried to overcome these shortcomings: first by considering the specific economic characteristics of Mexico and how this process has taken place and second, by recognising that there are alternative channels and mechanisms in which trade and FDI might affect or improve the economy. The potential effect of openness cannot be isolated in bivariate or multivariate models with a limited number of variables. We estimated an appropriate dynamic model where different mechanisms and spillover effects were possible, either from exports and FDI on a series of macroeconomic variables or the other way around.
- In the specific case of Mexico, there is not yet a formal cited work in the literature investigating the determinants of GDP, exports, FDI, capital accumulation, labour productivity and human capital in a simultaneous equations framework, or the analysis of dynamic multipliers to determine how the system reacts to changes in the exogenous variables.
- Instruments of monetary and fiscal policy were introduced in the system to investigate how the economic relationships under liberalisation have altered; in this way this study acknowledges the important role of government policies that have dominated most of the economic history. This approach is convenient to determine which government policies and economic targets facilitate or obstruct the interrelationships in the system.

- Despite the limitations in the data, this research provides the basis to understand the mechanisms that determine the channels by which openness operates and then provide the tools to apply effective strategies to stimulate economic development.

8.3 Main empirical results

The empirical results throughout the chapters answered the questions posited in the general introduction and which are related to how liberalisation -through changes in exports and FDI- has affected economic growth and whether or not this impact has been positive. The period of analysis covered from 1980 to 2002. The main feature of our framework is that is based on a supply side approach.

In Chapter 5, times series analysis in a multivariate framework was applied to analyse the effect of liberalisation in a model with three endogenous variables: exports, FDI and GDP. We found that all the variables are integrated of order one, I(1). Despite the series being nonstationary, according to the Johansen cointegration test results no long-run relationship exists between them. Questions that were raised in the introduction about the existence and direction of causal relationships were answered in the context of Granger causality. It was found that in the period 1980 to 2002, exports did Granger cause output growth, a finding that on its own could be taken as evidence of the Export led growth paradigm. In studies about Mexico with the same methodology, similar results were obtained by Thornton (1996) and Cuadros et al. (2000). On the other hand, neither exports nor GDP did Granger cause FDI. However when NAFTA was considered in the system to see if it has created a structural difference, only then GDP and exports did Granger cause FDI. In this respect, it could mean that an open economy is more likely to attract greater capital flows, in specific the state of the host economy and its export market become attractors of foreign capital.

The analysis of external shocks on the system –measured by the impulse response functions- supported the Granger causality findings and provided information about the intensity and length of each response. The impulse-response functions showed that GDP reacts stronger to a shock in exports than to a shock FDI's innovations. Similarly, FDI responds stronger and positively to shocks in exports' innovations, which is an indication that a policy that promotes exports production and facilitates a positive environment to international trade has the potential to improve FDI and output growth.

In Chapter 6, the hypothesis that we tried to test stated that FDI and exports were the mechanisms to stimulate output growth, generate an efficient resource allocation, create technological spillovers and improve labour productivity. As such this study considered not only direct effects between the variables but also the alternative channels and mechanisms that lead to achieve higher economic development. These indirect effects or spillovers can occur through productivity gains, capital accumulation and technology transfer. The model specification and results of Hausman's test for weak exogeneity proved that estimations had to be carried out through a system of simultaneous equations. Just as the Cowles Commission's recommends (Christ, 1994) the problem of endogeneity bias and identification of the system of equations were handled accordingly. Besides this, the system passed the stability condition, tests of serial correlation and most of normality and independence tests on the residuals.

We worked under the assumption that it is possible that FDI has a positive impact on output growth through its spillover effects on the economy, but it was also assumed that FDI is endogenously determined by the system. This approach is based on empirical findings that recognise that some characteristics of the host economy are indeed explicative of FDI inflows such as human capital (Borensztein et al., 1995) or the existence of regional economic blocs

(Bende-Nabende, 1999) among others. Equally, exports' indirect and direct effects on the system were considered and this variable was endogenised.

3SLS estimations showed that positive changes in FDI, capital accumulation, labour productivity and human capital explain changes in output. At first sight, it appeared that traditional determinants of output (besides FDI) confirmed classical postulates, however being a simultaneous equations system it was feasible to identify indirect effects. For example, exports were not statistically significant as explanatory variable of changes in GDP, something that could be interpreted as contradictory to the Granger causality results. However this is not necessarily so, since it was possible to identify indirect effects on GDP through exports' positive impact on FDI.

It was evident that the world economy exercised a positive influence on export growth, confirming the strong dependency on the US demand, as was hypothesized. The difference in relative wages between Mexico and the US and the existence of an export market were explicative factors of FDI. This result proves that the difference in real wages continues to exert an important incentive to locate or relocate plants in Mexico. Despite the fact that most foreign investment comes from the US, the coefficient DLUS was not statistically significant. Initially, it was an indication that potential foreign invertors are taking into account characteristics of the host country to take opportunity investments. However, we could spot that the state of the world economy is still explicative of FDI performance but this effect occurs indirectly through the effect that DLUS has on DLEX. In other words, the US demand for Mexican exports stimulates foreign investment, since most of the export market destination is the US and a large proportion of export goods are produced by foreign companies.

Another finding that supports the hypothesis put forward is that human capital responds positively to changes in government expenditure and the lagged effect of FDI. This is an important indication that efforts of the government to provide the infrastructure and services can improve human capital development. Similarly, FDI stands as a positive source of improvement in education and training of the potential labour force.

Capital accumulation was explained by technology transfer, government expenditure, infrastructure and GDP per capita. All were positive determinants that stimulate capital accumulation and therefore a wide range of other macroeconomic variables such as GDP.

The dynamic multiplier analysis confirmed the large influence of the state of the world economy on Mexico, not only directly but also indirectly through the impact that it had on FDI and exports growth. In the long run, the accumulated multiplier indicated that DLFDI and DLEX had a strong acceleration response to a unit change in DLUS (the total effect was 2.66 and 2.94 respectively). This is because a growing US economy represents an important element that promotes investment abroad and increases its demand for imports (or Mexican exports).

The strongest total multiplier effect of technological transfer occurred in capital accumulation (0.47), followed by output growth (0.13). The reason is that technology is an essential part of the country's production capacity; it shows the country's ability to translate higher levels of technology into higher levels of production.

The analysis in Chapter 6 implicitly assumed none or negligible government intervention in the economy, in essence the purpose was to measure how liberalisation would affect the economy as a whole in a free economic environment. In Chapter 7, this assumption was relaxed to account for the relevant influence of government intervention that occurs through the manipulation of instruments of monetary, fiscal and commercial policy. The objective was to identify how economic policies have altered the relationship between growth, FDI, exports, capital accumulation, productivity and human capital. It was also of interest to investigate the dynamic impact of policy changes to identify those instruments with the strongest potential to accelerate or decelerate growth.

The inclusion of instruments and targets of monetary and fiscal policy like monetary base, interest rate, inflation and tax revenues did not modify substantially the existing links found in Chapter 6. However it did provide relevant information about which instruments of fiscal and monetary policy are conducive to growth. For example, an expansionary monetary policy based on increments in monetary base decelerates interest rate, being this one an explanatory variable of FDI, it is expected that foreign flows will increase. However an expansionary policy also represents a threat for prices stability; which was a macroeconomic target that dominated most of the 1980s and 1990s. The estimations showed that instruments of fiscal policy (government expenditure and investment in infrastructure) are more likely to create significant direct and indirect effects in the system.

FDI has created positive spillovers through its effect in human capital and GDP, which coincides with other studies that found positive FDI's positive spillovers to the Mexican industry (Blomstrom, 1986). The empirical evidence has shown that the role of FDI in Mexico is a consequence of both domestic and international factors. Deregulation in 1993 was a major event that represented the beginning of a very dynamic sector in the economy. According to the estimations, domestic determinants of foreign flows were the provision of infrastructure, the existence of an export market and the traditional attractors for a developing country such as the difference of real relative wages and exchange rate fluctuations.

The multiplier effect due to inflation accelerated the interest rate significantly. The evidence suggests that targeting inflation is a macroeconomic strategy that has the potential to reduce the acceleration created on interest rate and therefore reduce the negative impact that could cause on other variables that are affected by changes in the cost of money. Obviously, being this a simultaneous system, higher interest rates will tend to reduce FDI and therefore will have repercussions on those variables that contain FDI as an explanatory variable (for example GDP and human capital). We could say that any economic policy conductive to reducing inflation will have the capacity to stimulate the economy. Finally, exports and FDI were the most sensitive variables to a unit change in a change in tax revenues and the real exchange rate, while the interest rate was the most sensitive variable to a shock in inflation and the monetary base.

Trade reforms introduced in 1986 produced positive changes in exports and GDP, which can be observed in the long run multipliers, in some way it is an indication that most of the economic variables considered in this analysis reacted positively to liberalisation. However this was not always the case for NAFTA. A possible explanation is that reforms introduced when Mexico joined GATT represented a strong structural change in the economy. At that time, reductions in trade barriers, quotas and import licences were relatively more intense that the subsequent reductions due to NAFTA.

8.4 Policy recommendations

While this research has shown that liberalisation and a more open economy have contributed to improve human capital, output growth and other variables through its spillover effects, it does not imply that FDI and in specific exports should be considered as the “engines” of growth. Instead, the empirical findings acknowledge that economic liberalisation and economic reforms in Mexico have stimulated FDI and exports and therefore the subsequent effects of these variables have contributed to improve the mechanisms by which the Mexican economy has become more efficient and competitive. In this sense, the following policy recommendations are addressed to promote and maintain an economic environment that encourages more investment, productivity, etc.

- Since the literature review and empirical finding have shown that FDI facilitates the economic growth process not only directly but through its spillover effects, then it is desirable that economic policies pursue its promotion. However, it is recommended to make its impact more effective by diverting investment to those sectors with higher potential to generate spillover effects and with stronger links with domestic industries and input suppliers. This cannot be pursued by restricting foreign investment to certain economic activities but by providing locational incentives, facilities, industrial parks, tax exemptions, etc in sectors that the government wants to promote.
- The results from the structural model suggest that positive changes in output and labour productivity occur due to human capital improvement. This stresses out the need to impulse human capital development through the modernisation of the education system, the introduction of new mechanism of learning by doing, the adaptation to the new demands of international production processes and public investment in physical and social infrastructure.
- The estimations showed that technology transfer has not impacted positively either in labour productivity or in human capital proving that technology transfer on itself does not lead automatically to its successful diffusion and exploitation. Efforts are needed to provide the conditions in which new methods, techniques, and knowledge in general are diffused and absorbed by the productive sector.
- Finally, it is recommended that the aims of the strategy for economic development be revaluated to reconsider whether what matters is efficiency and competitiveness of the

industrial sector or the reduction of income inequality and improvement in living standards of the population. From this point of view, the outward strategy has been successful in improving the role of Mexico in the international markets, but this might also be at the expense of a deep polarisation in the productive sectors, in income distribution, in local and foreign entrepreneurs and in regional development (see Dussel, 2000).

8.5 Future research

Our empirical research has contributed to reduce the hitherto over-simplified analysis of the relationship between liberalisation and growth in Mexico. However to establish more conclusive results, future research should perhaps be conducted on:

- The investigation of spillover effects of exports and FDI by economic sectors to recognise differences between manufactures and services for example. Services have been growing considerably in the last years. Future research should contemplate the role of franchises, joint ventures, and know-how techniques which are alternative ways in which external agents can affect the economy.
- Making a distinction between domestic and foreign industries to identify weaknesses and strengths of the national industrial plant. This would allow drowning out the difficulties that the domestic sector faces in integrating successfully with the globalisation process.
- The inclusion of social variables that can measure the impact of liberalisation on the well being of the population. This could involve the inclusion of variables such as income distribution (reductions in Gini coefficient), education, employment, provision of public services, etc.

- A more systematic analysis on whether monetary and fiscal policies have helped to accomplish the given socioeconomic objectives under an outward oriented strategy.
- The calculation of reaction functions to analyse how the Bank of Mexico and the Secretary of Finance might adjust the interest rate and the fiscal deficit to respond to deviations of current inflation and current output from target levels.

APPENDICES

5A. Data description and sources of information.

Tabla 5A.1 Definition of variables and sources of information, (1980:1 to 2002:4).

Series	Unit	Description	Deflated by:	Source	Observations
1. GDP: Gross Domestic Product	Million dollars, real prices	Average per quarter	Implicit price index	1/ and 2/	The series was deflated by an implicit index price, 1993=100. To transform the series to USD, it was multiplied by an exchange rate from 1993.
2. FDI: Foreign Direct Investment	Million dollars, real prices	Flows per quarter	Implicit price index	3/	The series was converted to pesos and then deflated by an implicit price index. Finally, it was converted to dollars by an exchange rate from 1993. A moving average (4) was calculated to reduce the fluctuations.
3. EX: Export goods	Million dollars, real prices	Flows per quarter	Export price index	3/	The series was originally in dollars, so it was deflated by an export price index. It does include maquildora's exports but excludes oil.

1/ Sistema de Cuentas Nacionales, INEGI.
2/ International Financial Statistics, International Monetary Fund, several issues.
3/ Indicadores Economicos y Financieros, Bank of Mexico.

5 . Calculation of variance decomposition

Using as an example a vector y_t that contains two endogenous variables (taken from Enders (1995)). $y_t' = (y_{1t}, y_{2t})$ is a vector that contains only two variables. The n-step ahead forecast errors are equal to:

$$y_{1t+n} - E_t y_{1,t+n} = \phi_{11}(0) \in_{y1,t+n} + \phi_{11}(1) \in_{y1,t+n-1} + \ldots + \phi_{11}(n-1) \in_{y1,t+1} + \phi_{12}(0) \in_{y2,t+n} +$$
$$\phi_{12}(1) \in_{y2,t+n-1} + \ldots + \phi_{12}(n-1) \in_{y,t+1}$$

$$y_{2t+n} - E_t y_{2,t+n} = \phi_{21}(0) \in_{y1,t+n} + \phi_{21}(1) \in_{y1,t+n-1} + \ldots + \phi_{21}(n-1) \in_{y1,t+1} + \phi_{22}(0) \in_{y2,t+n} +$$
$$\phi_{22}(1) \in_{y2,t+n-1} + \ldots + \phi_{22}(n-1) \in_{y2,t+1}$$

The variance of the n-step ahead forecast error, denoted as $\sigma_{y1}(n)^2$ for variable y_{1t} and $\sigma_{y2}(n)^2$ for variable y_{2t} is:

$$\sigma_{y1}(n)^2 = \sigma_{y1}^2[\phi_{11}(0)^2 + \phi_{11}(1)^2 ... \phi_{11}(n-1)^2] + \sigma_{y2}^2[\phi_{12}(0)^2 + \phi_{12}(1)^2 ... \phi_{12}(n-1)^2]$$

$$\sigma_{y2}(n)^2 = \sigma_{y1}^2[\phi_{21}(0)^2 + \phi_{21}(1)^2 ... \phi_{21}(n-1)^2] + \sigma_{y2}^2[\phi_{22}(0)^2 + \phi_{22}(1)^2 ... \phi_{22}(n-1)^2]$$

From both expressions we can decompose the variance of the forecast error and isolate the shocks, specifically we can separate the proportions of the variance due to shocks in sequences $\{\in_{y1t}\}$ and $\{\in_{y2t}\}$. So in the case of variable y_{1t}, the variance decomposition of the forecast error is equal to:

$$1 = \frac{\sigma_{y1}^2[\phi_{11}(0)^2 ... \phi_{11}(n-1)^2]}{\sigma_{y1}(n)^2} + \frac{\sigma_{y2}^2[\phi_{12}(0) ... \phi_{12}(n-1)^2]}{\sigma_{y1}(n)^2}$$

This expression provides the proportions of a unit change in the variance due to its own shocks and other's variable's shock.

5C Stability condition and diagnostic tests on the VAR(6) used for cointegration.

Table 5C.1 Stability condition

Roots of the characteristic polynomial	
Root	Modulus
0.982507	0.982507
0.950131	0.950131
-0.908966	0.908966
-0.647917 - 0.613107i	0.892018
-0.647917 + 0.613107i	0.892018
0.430535 + 0.736026i	0.852699
0.430535 - 0.736026i	0.852699
0.819363 - 0.230098i	0.851059
0.819363 + 0.230098i	0.851059
-0.134273 - 0.815921i	0.826895
-0.134273 + 0.815921i	0.826895
0.653808 + 0.493393i	0.819086
0.653808 - 0.493393i	0.819086
-0.648723 - 0.412998i	0.769031
-0.648723 + 0.412998i	0.769031
0.296935 + 0.546552i	0.622005
0.296935 - 0.546552i	0.622005
0.534223	0.534223

Table 5C.2 Diagnostic tests to the residuals

Test	Statistics and probabilities
LM test of serial correlation up to lag order 6.	LM-Stat=10.4948 (0.3121)
White Heteroskedasticity test	Chi-sq. Stat= 238.38 (0.1415)
Normality, Jarque-Bera test	J-B Stat = 6.4886 (0.3707)

5D. Estimations of the restricted system (equation by equation) and stability condition.

Table 5D.1 Equation DLGDP
Included observations: 86 after adjustments

	Coefficient	Std. Error	Prob.
DLGDP(-5)	0.1390	0.0990	0.1640
DLEX(-4)	0.0648	0.0189	0.0010
R-squared	0.0386		
Adjusted R-squared	0.0272		
S.E. of regression	0.0155		
Durbin-Watson stat	1.6540		
Diagnostic tests:	Statistic	Prob.	
LM Test(5)	8.0691	0.1525	
Heteroskedasticity, White Test	0.1969	0.9393	
Normality J-B stat	28.09	0.0000***	

*** Statistically significant at 1%

Table 5D.2 Equation DLFDI
Included observations: 83 after adjustments

	Coefficient	Std. Error	Prob.
DLFDI(-4)	-0.5062	0.1008	0.0000
DLFDI(-8)	-0.2987	0.1051	0.0057
DLEX(-3)	0.5249	0.1588	0.0014
R-squared	0.3159		
Adjusted R-squared	0.2988		
S.E. of regression	0.1301		
Durbin-Watson stat	1.7527		
Diagnostic tests:	Statistic	Prob.	
LM Test(8)	7.4123	0.4928	
Heteroskedasticity, White Test	25.291	0.0003***	
Normality J-B stat	2.345	0.3095	

*** Statistically significant at 1%

Table 5D.3 Equation DLEX
Included observations: 83 after adjustments

	Coefficient	Std. Error	Prob.
DLGDP(-1)	-1.12319	0.52795	0.0365
DLFDI(-5)	-0.13106	0.06048	0.0333
DLEX(-1)	0.21986	0.09365	0.0214
DLEX(-4)	0.20907	0.09893	0.0378
DLEX(-8)	0.46264	0.10401	0.0000
R-squared	0.17828		
Adjusted R-squared	0.13614		
S.E. of regression	0.07578		
Durbin-Watson stat	2.04448		
Diagnostic tests	Statistic	Prob.	
LM Test(8)	10.7958	0.21355	
Heteroskedasticity, White Test	7.18038	0.70831	
Normality J-B stat	15.603	0.0004***	

*** Statistically significant at 1%

Table 5D.4 Stability Condition
Roots of the Characteristic Polynomial

Roots	Modulus
0	0
0	0
0	0
0.967513	0.967513
0.788847	0.788847
0.7690956491+.4397209166*I	0.885925
0.7690956491-.4397209166*I	0.885925
0.6469989481+.5985798308*I	0.881422
0.6469989481-.5985798308*I	0.881422
0.4410880577+.7635723919*I	0.881817
0.4410880577-.7635723919*I	0.881817
0.307512751e-1+.94180253*I	0.942304
0.30751275e-1-0.941802532*I	0.942304
0.2409337436+.7240011351*I	0.763038
0.2409337436-.7240011351*I	0.763038
-0.9113837494,	0.911384
-0.4358758394+.766335009*I,	0.881622
-0.4358758394-.766335009*I,	0.881622
-0.763779892+.4367033707*I,	0.879812
-0.7637798921-.436703371*I,	0.879812
-0.562188747+.6099391292*I,	0.829507
-0.5621887475-.609939129*I,	0.829507
-0.628406311+.4412240061*I,	0.767837
-0.628406311-.441224006*I	0.767837

All the roots lie inside the unit circle.

6A Correlation matrix

Table 6A. Correlation matrix of all endogenous and exogenous variables.

	LGDP	LFDI	LEXP	LHC	LPRO	LCA	LGE_SA	LINF_SA	LPOP	LRER	LWAGES	LTT	LUS
LGDP	1	0	0	0	0	0	0	0	0	0	0	0	0
LFDI	0.88	1	0	0	0	0	0	0	0	0	0	0	0
LEXP	0.93	0.90	1	0	0	0	0	0	0	0	0	0	0
LHCC	0.87	0.85	0.93	1	0	0	0	0	0	0	0	0	0
LPRO	0.62	0.54	0.42	0.51	1	0	0	0	0	0	0	0	0
LCA	0.83	0.64	0.61	0.49	0.59	1	0	0	0	0	0	0	0
LGE_SA	-0.17	-0.20	-0.16	-0.31	-0.10	-0.04	1	0	0	0	0	0	0
LINF_SA	-0.75	-0.73	-0.86	-0.89	-0.27	-0.34	0.44	1	0	0	0	0	0
LPOP	0.94	0.89	0.99	0.94	0.43	0.62	-0.14	-0.87	1	0	0	0	0
LRER	-0.47	-0.21	-0.25	-0.06	-0.23	-0.78	-0.11	0.04	-0.26	1	0	0	0
LWAGES	-0.06	-0.19	-0.31	-0.47	0.06	0.35	0.39	0.49	-0.28	-0.59	1	0	0
LTT	0.85	0.70	0.69	0.51	0.53	0.97	0.01	-0.39	0.68	-0.77	0.35	1	0
LUS	0.96	0.90	0.99	0.94	0.49	0.67	-0.21	-0.86	0.99	-0.30	-0.29	0.72	1

6 . Data description and sources of information

Table 6B.1 Data description and sources of information, (1980:1 to 2002:4).

Series	Unit	Description	Deflator	Source	Observations
GDP: Gross Domestic Product	Million dollars, real prices	Gross Domestic Product	Implicit price index	1/, 2/	The series was deflated by the implicit price index, 1993=100. A quarterly exchange rate from 1993 was used to transform the series in USD.
FDI: Foreign Direct Investment	Million dollars, real prices.	Foreign Direct Investment (flows).	Implicit price index	3/	The series was converted from dollars to current pesos. Then it was deflated by an implicit price index and divided by an exchange rate from 1993. A moving average (4) was calculated to reduce its fluctuations.
EX: Export goods	Million dollars, real prices.	Merchandise exports without oil (flows).	Export price index	3/	It was deflated by an export price index, 1993=100. The series includes maquiladora's exports but excludes oil exports.
HC: Human Capital	Persons.	Students enrolled in secondary school, preparatory and technical schools	-	4/, 5/	Series was interpolated from annual to quarterly data.
LPRO: Labour productivity index	Index, 1993=100	Labour productivity in the manufactures	Implicit price index	4/, 6/	GDP in manufactures was divided by the number of remunerated workers in the same industry. An exchange rate from 1993 was used to transform the series in dollars and then an index was obtained.
CA: Capital accumulation	Million dollars, real prices	Gross fixed capital formation	Original was deflated	1/, 4/, 8/	From 1980 to 1993 series was interpolated to quarterly data. An exchange rate from 1993 was used to transform the series into dollars.
TT: Technology Transfer	Million dollars, 1993 prices	Imports of machinery and equipment by public and private sectors.	Original was deflated	4/, 8/	The series was interpolated from 1980 to 1992. An exchange rate from 1993 was used to transform the series in dollars
RER: Real Exchange Rate	Peso per dollar, 1993=100	It is equal to the USA CPI divided by the Mexican CPI and then multiplying by a nominal exchange rate peso per dollar.	CPIs are based on year 1993	3/	Original series was in monthly data; therefore an average per quarter was calculated. An increase of this number means peso depreciation and a decrease means a peso appreciation.

Table 6B.1 cont.

Series	Unit	Description	Deflator	Source	Observations
GE_SA: Public investment in social resources	Million dollars, 1993 prices	Public investment in hospitals, education, research, housing services, job centres, etc.	Implicit price index	4/, 9/	The series was interpolated from annual to quarterly data from 1980 to 2002. An exchange rate from 1993 was used to transform the series in dollars. It was seasonally adjusted.
INF_SA: Infrastructu re	Million dollars, 1993 prices	Public investment in industrial resources (energy, electricity, gas iron and steel industry) and means of communication (roads, railway, telecommunicatio ns, airways, etc.).	Implicit price index	4/, 9/	The series was interpolated from annual to quarterly data from 1980 to 2002. An exchange rate from 1993 was used to transform the series in dollars. It was seasonally adjusted.
RWAGES: Relative real wages.	Index , 1993 =100	Real relative wages between Mexico and the USA in the manufacturing industry	CPI	2/,3/, /11	The original Mexican series was an index of remunerations per worker in nominal prices and monthly data. It was interpolated to quarterly data and converted to dollars. Then it was transformed to an index with 1993 as a base year. The USA series was an index that required changing it to 1993. Both indexes were divided to obtain a ratio.
US: World Economy	Million dollars, real prices	USA's GDP.	Implicit price index	10/	The series was originally in constant dollars, 2000 prices, so it was converted to 1993 prices.
POP: Population	People	Population	-	1/, 2/	Original series was in annual frequency, it was interpolated using a regression on a constant and time.

1/ Sistema de Cuentas Nacionales, INEGI.
2/ International Financial Statistics, International Monetary Fund, several issues.
3/ Indicadores Económicos y Financieros, Bank of Mexico.
4/ Estadísticas Históricas de México, Tomo I and II, 1999. INEGI.
5/ Estadísticas de la Educación, Edición 2002. INEGI.
6/ 1er Informe de Gobierno, Miguel de la Madrid, 1983.
7/ Villareal, Rene (1997).
8/ 4to. Informe de Gobierno, José López Portillo, 1980.
9/ El Ingreso y el Gasto Publico en México, 2003.
10/ Bureau of Economic Analysis, US. Department of Commerce.
11/ Bureau of Labor Statistics. Employment Cost Index, Wages and salaries only.

6C. Variance-covariance matrix

Table 6C.1 Variance-covariance matrix of the exogenous variables

	LGE_SA	LINF_SA	LRER	LRWAGES	LTT	LUS	LPOP
LGE_SA	0.2699	0.0843	-0.0112	0.0288	0.0044	-0.0230	-0.0086
LINF_SA	0.0843	0.1354	0.0027	0.0259	-0.0853	-0.0671	-0.0375
LRER	-0.0112	0.0027	0.0373	-0.0162	-0.0883	-0.0122	-0.0058
LRWAGES	0.0288	0.0259	-0.0162	0.0204	0.0295	-0.0086	-0.0047
LTT	0.0044	-0.0853	-0.0883	0.0295	0.3546	0.0907	0.0480
LUS	-0.0230	-0.0671	-0.0122	-0.0086	0.0907	0.0445	0.0246
LPOP	-0.0086	-0.0375	-0.0058	-0.0047	0.0480	0.0246	0.0139

Note: The determinant of this matrix was 1.33e-13

6D. Diagnostic tests on the residuals from the 2SLS estimations.

Table 6D.1 Diagnostic tests on the residuals: serial correlation, iid and normality tests.
Method of estimation: 2SLS (non-stationary variables).

		Serial Correlation		Independent and identically distributed residuals (iid).			Nomality
	Lag order	Q-Stat	Prob	Dimen-sion	BDS Statistic	Prob.	J-B Stat.
Resid01	1	0.009	0.925				
	2	0.868	0.648	2	0.002	0.767	1.600
	3	0.909	0.823	3	0.001	0.897	0.449
	4	4.424	0.352	4	0.004	0.732	
	5	5.596	0.348	5	0.007	0.608	
	6	6.377	0.382	6	0.009	0.489	
Resid02	1	0.066	0.797				
	2	0.088	0.957	2	-0.004	0.483	1.874
	3	0.345	0.951	3	-0.01	0.319	0.392
	4	2.519	0.641	4	-0.002	0.839	
	5	2.68	0.749	5	0.004	0.737	
	6	4.501	0.609	6	0.001	0.083	0.934
Resid03	1	0.162	0.687				
	2	3.381	0.184	2	0.007	0.35	0.020
	3	4.5	0.212	3	0.015	0.192	0.990
	4	4.5	0.343	4	0.019	0.187	
	5	4.837	0.436	5	0.009	0.536	
	6	5.005	0.543	6	0.007	0.641	
Resid04	1	0.139	0.71				
	2	2.103	0.349	2	0.004	0.644	1.398
	3	2.106	0.551	3	0.013	0.277	0.497
	4	4.15	0.386	4	0.022	0.138	
	5	5.638	0.343	5	0.024	0.129	
	6	5.644	0.464	6	0.027	0.075	

Table 6D.1 cont.

	Lag order	Serial Correlation		Independent and identically distributed residuals (iid).			Nomality
		Q-Stat	Prob	Dimen-sion	BDS Statistic	Prob.	J-B Stat.
Resid05	1	0.041	0.84				
	2	0.980	0.613	2	-0.006	0.440	0.924
	3	1.642	0.65	3	0.006	0.647	0.630
	4	4.676	0.322	4	0.003	0.816	
	5	4.699	0.454	5	0.016	0.302	
	6	10.994	0.089	6	0.019	0.194	
Resid06	1	0.0405	0.841				
	2	0.4823	0.786	2	-0.012	0.150	8.247
	3	3.1843	0.364	3	-0.023	0.086	0.016
	4	4.084	0.395	4	-0.028	0.079	
	5	4.8622	0.433	5	-0.018	0.291	
	6	5.4668	0.485	6	-0.010	0.539	

6E Specification of the system in first differences (unrestricted model).

$$DLGDP_t = \alpha_0 + \sum_{i=0}^{p} \alpha_1 DLFDI_{t-i} + \sum_{i=0}^{p} \alpha_2 DLE_{t-i} + \sum_{i=0}^{p} \alpha_3 DLHC_{t-i} + \sum_{i=0}^{p} \alpha_4 DLCA_{t-i} + \sum_{i=0}^{p} \alpha_5 DLPRO_{t-i} + AR(1) + v_1$$

$$DLFDI_t = \beta_0 + \beta_1 DLGDP_t + \sum_{i=0}^{p} \beta_2 DLE_{t-i} + \sum_{i=0}^{p} \beta_3 DLHC_{t-i} + \sum_{i=0}^{p} \beta_4 DLWAGES_{t-i} + \sum_{i=0}^{p} \beta_5 DLRER_{t-i} + \sum_{i=0}^{p} \beta_6 DLINF_{t-i} + \sum_{i=0}^{p} \beta_7 DUS_{t-i} + AR(1) + AR(2) + v_2$$

$$DLE_t = \delta_0 + \delta_1 DLGDP_t + \sum_{i=0}^{p} \delta_2 DLFDI_{t-i} + \sum_{i=0}^{p} \delta_3 DLPRO_{t-i} + \sum_{i=0}^{p} \delta_4 DLCA_{t-i} + \sum_{i=0}^{p} \delta_5 DLWAGES_{t-i} + \sum_{i=0}^{p} \delta_6 DLRER_{t-i} + \sum_{i=0}^{p} \delta_7 DUS_{t-i} + AR(1) + v_3$$

$$DLHC_t = \omega_0 + \sum_{i=0}^{p} \omega_1 DLFDI_{t-i} + \sum_{i=0}^{p} \omega_2 DLCA_{t-i} + \sum_{i=0}^{p} \omega_3 DLPRO_{t-i} + \sum_{i=0}^{p} \omega_4 DLTT_{t-i} + \sum_{i=0}^{p} \omega_5 DLGE_{t-i} + \sum_{i=0}^{p} D(LGDP - LPOP)_{t-i} + AR(1) + v_4$$

$$DLPRO_t = \varpi_o + \sum_{i=0}^{p} \varpi_1 DLGDP_{t-i} + \sum_{i=0}^{p} \varpi_2 DLFDI_{t-i} + \sum_{i=0}^{p} \varpi_3 DLCA_{t-i} + \omega_4 DLHC_t + \sum_{i=0}^{p} \varpi_5 DLTT_{t-i} + \sum_{i=0}^{p} \varpi_6 DLGE_{t-i} + AR(1) + v_5$$

$$DLCA_t = z_0 + z_1 DLFDI_t + \sum_{i=0}^{p} z_2 DLPRO_{t-i} + \sum_{i=0}^{p} z_3 DLTT_{t-i} + \sum_{i=0}^{p} z_4 DLRER_{t-i} + \sum_{i=0}^{p} z_5 DLGE_{t-i} + \sum_{i=0}^{p} z_6 DLINF_{t-i} + \sum_{i=0}^{p} z_7 D(LGDP - LPOP)_{t-i} + AR(1) + AR(2) + v_6$$

where:

v_t are the disturbance terms

$\alpha, \beta, \delta, \omega, \varpi$ and z are coefficients.

i=0,1,2…p. Where p is the lag order equal to 6.

The instrumental variables are DLTT, DWAGES, DLRER, DLGE, DLINF, DUS, DLPOP, DLGDP(-1 TO -6), DLFDI(-1 TO -6), DLEX(-1 TO -6), DLCA(-1 TO -6), DLHC(-1 TO -6), DLPRO(-1 TO -6), DLTT(-1 TO -6), DWAGES(-1 TO -6), DLRER(-1 TO -6), DLGE(-1 TO -6), DLINF(-1 TO -6), DUS(-1 TO -6) and DLPOP(-1 TO -6)

6F. Stability condition and diagnostic tests on the residuals: unrestricted system.

Table 6F.1 Stability condition
Roots and modulus of the characteristic polynomial

Root	Modulus
-.8958404967+.3427806212*I	0.959181291
-.8958404967-.3427806212*I	0.959181291
-.3111741304+.8953389995*I	0.947871966
-.3111741304-.8953389995*I	0.947871966
-.4868663291+.7492796765*I	0.89356525
-.4868663291-.7492796765*I	0.89356525
-.6219956751+.4781273219*I	0.78452811
-.6219956751-.4781273219*I	0.78452811
-0.770484091	0.770484091
-0.728799136+0.2154892594*I	0.759989343
-.7287991360-.2154892594*I	0.759989343
-.5653709129+.3293853823*I	0.654323314
-.5653709129-.3293853823*I	0.654323314
-.5232231470e-1+.8579337743*I	0.859527769
-.5232231470e-1-.8579337743*I	0.859527769
-0.441132064	0.441132064
.4139857097+.7862201631*I	0.888552932
.4139857097-.7862201631*I	0.888552932
-.1060327045+.6545755467*I	0.663107895

Table 6F.1 Cont.

Root	Modulus
-.1060327045-.6545755467*I	0.663107895
.1699190305+.7432074265*I	0.762384257
.1699190305-.7432074265*I	0.762384257
0.958329945	0.958329945
.5475132546+.5724378960*I	0.792121145
.5475132546-.5724378960*I	0.792121145
.8174828273+.3211346839*I	0.878297022
.8174828273-.3211346839*I	0.878297022
.7457059490+.1855547340*I	0.768445133
.7457059490-.1855547340*I	0.768445133
.2962195555+.5075125016*I	0.587635061
.2962195555-.5075125016*I	0.587635061
.5047735873+.1709599056*I	0.532938705
.5047735873-.1709599056*I	0.532938705
-0.087111434	0.087111434
.2284914244+.3852797434*I	0.447938402
.2284914244-.3852797434*I	0.447938402

Table 6F.2 Diagnostic test on the residuals: serial correlation, iid and normality test.

Residual	Serial Correlation			Independence test				Nomality
	Lag order	Q-Stat	Prob	Dimen-sion	BDS Statistic	z-Statistic	Prob.	J-B Stat.
Resid01	1	0.271	0.602					
	2	0.516	0.772	2	-0.006	-0.762	0.446	2.0301
	3	0.517	0.915	3	0.006	0.470	0.638	(0.362)
	4	0.595	0.964	4	0.001	0.088	0.930	
	5	0.703	0.983	5	-0.006	-0.385	0.700	
	6	0.906	0.989	6	-0.009	-0.555	0.579	
Resid02	1	0.098	0.755					
	2	0.098	0.952	2	0.002	0.291	0.771	2.4914
	3	0.928	0.819	3	-0.016	-1.168	0.243	(0.287)
	4	5.141	0.273	4	0.003	0.178	0.859	
	5	6.466	0.263	5	0.011	0.643	0.520	
	6	9.110	0.168	6	0.024	1.458	0.145	
Resid03	1	0.008	0.929					
	2	0.196	0.907	2	0.011	1.362	0.173	1.7339
	3	5.848	0.119	3	0.017	1.281	0.200	(0.420)
	4	6.273	0.180	4	0.037	2.289	0.022	
	5	6.419	0.268	5	0.030	1.757	0.079	
	6	8.261	0.220	6	0.021	1.296	0.195	
Resid04	1	0.006	0.937					
	2	0.172	0.918	2	0.005	0.546	0.585	5.0066
	3	0.900	0.825	3	-0.006	-0.398	0.691	(0.081)
	4	1.632	0.803	4	0.003	0.170	0.865	
	5	4.084	0.537	5	0.000	-0.018	0.986	
	6	4.510	0.608	6	0.008	0.420	0.675	
Resid05	1	0.064	0.800					
	2	0.275	0.871	2	0.001	0.086	0.932	0.3123
	3	0.338	0.953	3	0.018	1.278	0.201	(0.855)
	4	4.509	0.342	4	0.019	1.133	0.257	
	5	4.711	0.452	5	0.028	1.569	0.117	
	6	5.893	0.435	6	0.038	2.250	0.025	
Resid06	1	0.319	0.572					
	2	1.450	0.484	2	0.002	0.195	0.845	1.2416
	3	1.951	0.583	3	0.003	0.212	0.832	(0.537)
	4	3.588	0.465	4	0.007	0.459	0.646	
	5	3.808	0.577	5	0.009	0.541	0.589	
	6	4.122	0.660	6	-0.009	-0.565	0.572	

6G. Stability condition and diagnostic tests on the residuals: restricted system.

Table 6G.1 Stability condition.
Roots of the characteristic polynomial

Root	Modulus
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
.6791654447+.5692062865*I	0.886150
.6791654447-.5692062865*I	0.886150
.8096946925+.2158577954*I	0.837974
.8096946925-.2158577954*I	0.837974
.7005327203+.2042422220*I	0.729699
.7005327203-.2042422220*I	0.729699
.2035638690+.7842958628*I	0.810283
.2035638690-.7842958628*I	0.810283
.4831685987+.5458099372*I	0.728945
.4831685987-.5458099372*I	0.728945
.4063900509+.5411891363*I	0.676785
.4063900509-.5411891363*I	0.676785
-.0912396111+0.870004359*I	0.874776
-.912396111e-1-.870004359*I	0.874776
-.2522262756+.7607530945*I	0.801476
-.2522262756-.7607530945*I	0.801476
-.4359931604+.6423703210*I	0.776357
-.4359931604-.6423703210*I	0.776357
-.5547210426+.4707562484*I	0.727549
-.5547210426-.4707562484*I	0.727549
-.7658809834+.2705661209*I	0.812268
-.7658809834-.2705661209*I	0.812268
-.7591677195+.1680464099*I	0.777544
-.7591677195-.1680464099*I	0.777544
-.3945456985+.1471619820*I	0.421097
-.3945456985-.1471619820*I	0.421097
.51e-8+.7197221686e-4*I	0.000072
.51e-8-.7197221686e-4*I	0.000072

Table 6G.2 Diagnostic tests on the residuals: serial correlation, iid and normality test.

	Serial Correlation			Independence test				Nomality
	Lag order	Q-Stat	Prob	Dimen - sion	BDS Statistic	z-Statistic	Prob.	J-B Stat.
Resid01	1	2.409	0.121					19.956
	2	4.105	0.128	2	0.009	1.047	0.295	(0.000)
	3	4.505	0.212	3	0.031	2.283	0.022	
	4	4.930	0.295	4	0.031	1.874	0.061	
	5	5.487	0.359	5	0.017	0.972	0.331	
	6	5.514	0.480	6	0.011	0.647	0.518	
Resid02	1	0.031	0.860					9.549
	2	0.080	0.961	2	0.009	0.912	0.362	(0.008)
	3	0.219	0.975	3	-0.012	-0.761	0.447	
	4	5.358	0.252	4	-0.001	-0.033	0.973	
	5	5.424	0.366	5	0.013	0.687	0.492	
	6	8.125	0.229	6	0.015	0.794	0.427	
Resid03	1	0.001	0.982					9.608
	2	1.559	0.459	2	0.016	1.779	0.075	(0.008)
	3	2.292	0.514	3	0.025	1.702	0.089	
	4	2.333	0.675	4	0.025	1.437	0.151	
	5	2.839	0.725	5	0.007	0.356	0.722	
	6	3.052	0.802	6	0.007	0.410	0.682	
Resid04	1	0.540	0.462					6.392
	2	2.503	0.286	2	0.035	3.411	0.001	(0.041)
	3	3.133	0.372	3	0.053	3.229	0.001	
	4	3.410	0.492	4	0.062	3.122	0.002	
	5	5.193	0.393	5	0.064	3.046	0.002	
	6	7.740	0.258	6	0.064	3.117	0.002	
Resid05	1	0.023	0.881					1.444
	2	0.261	0.877	2	-0.003	-0.426	0.670	(0.486)
	3	3.279	0.351	3	0.009	0.705	0.481	
	4	4.883	0.300	4	0.008	0.576	0.565	
	5	4.891	0.429	5	0.027	1.767	0.077	
	6	5.756	0.451	6	0.037	2.498	0.013	
Resid06	1	0.000	0.985					0.143
	2	2.593	0.273	2	0.017	2.168	0.030	(0.931)
	3	2.639	0.451	3	0.024	1.906	0.057	
	4	3.411	0.492	4	0.034	2.254	0.024	
	5	3.859	0.570	5	0.039	2.487	0.013	
	6	3.895	0.691	6	0.026	1.686	0.092	

6H. Final form multipliers

Table 6H.1 Multiplier effect of a unit change in a change in government expenditure (DLGE)

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
0	0.0045	0.0000	0.0000	0.0002	0.0047	0.0156
1	0.0019	0.0002	-0.0038	0.0001	0.0021	0.0052
2	0.0011	0.0001	-0.0017	0.0002	0.0013	0.0025
3	0.0007	0.0000	-0.0010	0.0001	-0.0011	0.0005
4	-0.0023	-0.0024	0.0048	0.0000	-0.003	-0.0037
5	-0.0020	-0.0012	0.0043	0.0000	-0.0043	-0.0046
6	-0.0008	-0.0008	0.0046	-0.0001	-0.0005	-0.0025
7	0.0001	0.0013	-0.0006	-0.0001	0.0006	-0.0004
8	0.0003	0.0019	-0.0031	0.0000	0.0011	0.0015
9	0.0014	0.0025	-0.0044	-0.0001	0.0025	0.0024
10	0.0010	0.0016	-0.0022	0.0000	0.0010	0.0021
11	0.0004	-0.0001	0.0000	0.0001	0.0001	0.0010
12	-0.0003	-0.0007	0.0009	0.0001	-0.0008	-0.0004
13	-0.0006	-0.0016	0.0025	0.0000	-0.0011	-0.0014
14	-0.0005	-0.0013	0.0014	0.0000	-0.0010	-0.0012
15	-0.0004	-0.0012	0.0005	0.0000	-0.0004	-0.0007
16	-0.0001	0.0006	-0.0005	0.0000	0.0002	-0.0002
17	0.0003	0.0008	-0.0011	0.0000	0.0006	0.0005
18	0.0004	0.0007	-0.0012	0.0000	0.0007	0.0009
19	0.0002	0.0007	-0.0006	0.0000	0.0003	0.0007
20	0.0001	-0.0001	0.0002	0.0000	0.0001	0.0002
21	0.0000	-0.0005	0.0005	0.0000	-0.0002	-0.0001
22	-0.0002	-0.0006	0.0007	0.0000	-0.0004	-0.0004
23	-0.0002	-0.0004	0.0005	0.0000	-0.0003	-0.0004
24	-0.0001	-0.0002	0.0002	0.0000	-0.0001	-0.0003
25	0.0000	0.0002	-0.0002	0.0000	0.0001	0.0000
26	0.0001	0.0003	-0.0004	0.0000	0.0002	0.0002
27	0.0001	0.0003	-0.0004	0.0000	0.0002	0.0002
28	0.0001	0.0002	-0.0002	0.0000	0.0001	0.0002
29	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001
30	0.0000	-0.0001	0.0002	0.0000	-0.0001	0.0000

Table 6H.2 Multiplier effect of a unit change in a change in infrastructure (DLINF)

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
0	0.0022	-0.0693	0.0012	0.0001	0.0023	0.0077
1	0.001	-0.0001	0.0018	0.0001	0.0010	0.0026
2	0.0005	0.0000	-0.0008	0.0001	0.0006	0.0012
3	0.0003	0.0009	-0.0043	0.0001	-0.0005	0.0002
4	-0.0012	0.0009	0.0023	0.0000	-0.0015	-0.0019
6	0.0010	-0.0024	0.0072	0.0000	0.0030	-0.0011
7	0.0000	0.0021	-0.0028	0.0000	0.0004	0.0005
8	0.0005	0.0051	-0.0019	0.0001	0.0011	0.0013
9	-0.0001	0.0025	-0.0016	0.0000	0.0003	0.0007
10	0.0004	-0.0008	0.0022	0.0000	0.0005	0.0000
11	-0.0001	0.0025	0.0005	0.0000	-0.0007	0.0000
12	-0.0006	0.0018	0.0014	0.0000	-0.0003	-0.0008
13	-0.0003	0.0002	-0.0003	0.0000	-0.0008	-0.0008
14	-0.0001	-0.0004	0.0005	0.0000	-0.0003	-0.0004
15	0.0001	0.0002	-0.0003	0.0000	0.0000	0.0002
16	-0.0001	0.0007	-0.0005	0.0000	0.0001	0.0002
17	0.0003	0.0005	-0.0012	0.0000	0.0003	0.0004
18	0.0002	0.0004	-0.0007	0.0000	0.0000	0.0004
19	0.0000	-0.0004	0.0001	0.0000	0.0000	0.0002
20	-0.0001	-0.0005	0.0002	0.0000	-0.0002	-0.0001
21	0.0000	-0.0006	0.0004	0.0000	-0.0001	-0.0002
22	-0.0001	-0.0001	0.0000	0.0000	-0.0002	-0.0001
23	-0.0001	-0.0004	0.0001	0.0000	-0.0001	-0.0001
24	0.0000	-0.0001	-0.0001	0.0000	0.0000	0.0000
25	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001
26	0.0001	0.0001	-0.0002	0.0000	0.0001	0.0002
27	0.0000	0.0001	-0.0001	0.0000	0.0001	0.0001
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.0000	-0.0001	0.0001	0.0000	0.0000	0.0000
30	0.0000	-0.0001	0.0001	0.0000	-0.0001	-0.0001

Table 6H.3 Multiplier effect of a unit change in a change in technology transfer (DLTT)

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
0	0.1185	0.0000	0.0000	-0.0018	0.1196	0.4351
1	0.0543	0.0047	-0.0978	0.0033	0.0579	0.1419
2	0.0290	0.0023	-0.0476	0.0051	0.0336	0.0688
3	0.0200	0.0013	-0.0275	0.0029	-0.0295	0.0149
4	-0.0656	-0.0617	0.1230	0.0009	-0.0833	-0.1005
5	-0.0543	-0.0329	0.1194	0.0004	-0.1198	-0.1267
6	-0.0213	-0.0218	0.1269	-0.0024	-0.0144	-0.0664
7	0.0012	0.0332	-0.0158	-0.0028	0.0179	-0.0088
8	0.0081	0.0539	-0.0876	-0.0012	0.0293	0.0413
9	0.0376	0.0675	-0.1206	-0.0015	0.0687	0.0646
10	0.0269	0.0414	-0.0611	0.0008	0.0267	0.0571
11	0.0103	-0.0038	-0.0010	0.0019	0.0010	0.0281
12	-0.0087	-0.0210	0.0259	0.0014	-0.0213	-0.0111
13	-0.0161	-0.0443	0.0690	0.0008	-0.0308	-0.0396
14	-0.0124	-0.0361	0.0375	0.0002	-0.0276	-0.0335
15	-0.0121	-0.0324	0.0140	-0.0007	-0.0104	-0.0203
16	-0.0017	0.0164	-0.0134	-0.0010	0.0061	-0.0046
17	0.0079	0.0225	-0.0308	-0.0008	0.0170	0.0138
18	0.0122	0.0196	-0.0331	-0.0003	0.0196	0.0238
19	0.0057	0.0198	-0.0171	0.0003	0.0092	0.0180
20	0.0025	-0.0033	0.0046	0.0004	0.0028	0.0052
21	-0.0006	-0.0142	0.0144	0.0005	-0.0065	-0.0041
22	-0.0052	-0.0158	0.0195	0.0004	-0.0110	-0.0103
23	-0.0063	-0.0099	0.0131	0.0000	-0.0091	-0.0119
24	-0.0036	-0.0048	0.0057	-0.0002	-0.0032	-0.0085
25	0.0006	0.0048	-0.0048	-0.0003	0.0022	-0.0007
26	0.0020	0.0097	-0.0099	-0.0002	0.0054	0.0053
27	0.0028	0.0093	-0.0098	-0.0001	0.0062	0.0067
28	0.0028	0.0050	-0.0055	0.0001	0.0038	0.0054
29	0.0015	-0.0006	0.0004	0.0002	0.0006	0.0028
30	-0.0009	-0.0036	0.0045	0.0002	-0.0027	-0.001

Table 6H.4 Multiplier effect of a percentage change in a change in relative wages (DWAGES)

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
0	-0.0001	0.0103	-0.2116	0.0000	-0.0001	-0.0004
1	-0.0001	0.0000	-0.0004	0.0000	-0.0001	-0.0001
2	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0001
3	0.0015	-0.1207	0.0026	0.0001	0.0016	0.0052
4	0.0007	-0.0005	0.0051	0.0000	0.0008	0.0019
5	0.0006	0.0001	-0.0017	0.0001	0.0002	0.0012
6	0.0010	-0.0798	-0.0065	0.0001	0.0002	0.0037
7	-0.0004	0.0025	0.0053	0.0000	-0.0006	-0.0003
8	-0.0026	-0.0016	0.0137	-0.0003	0.0023	-0.0033
9	0.0023	-0.0029	0.0054	0.0000	0.0054	-0.0005
10	-0.0005	0.0052	-0.0040	0.0001	-0.0004	0.0003
11	-0.0012	0.0068	0.0077	-0.0001	0.0028	-0.0011

Table 6H.4 Cont.

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
12	0.0006	0.0003	0.0063	0.0001	0.0031	-0.0003
13	0.0003	-0.0003	0.0021	0.0001	0.0007	-0.0003
14	0.0000	0.0097	-0.0002	0.0001	-0.0004	0.0004
15	-0.0014	0.0056	0.0018	0.0000	-0.0006	-0.0013
16	-0.0001	-0.0004	0.0015	0.0000	-0.0006	-0.0015
17	-0.0003	0.0028	0.0009	0.0000	-0.0010	-0.0005
18	-0.0002	0.0034	0.0005	0.0000	0.0002	-0.0002
19	-0.0003	0.0018	-0.0019	0.0000	-0.0005	0.0000
20	0.0005	0.0005	-0.0016	0.0000	0.0001	0.0004
21	0.0003	0.0011	-0.0012	0.0000	-0.0002	0.0008
22	-0.0001	-0.0005	0.0001	0.0000	-0.0001	0.0003
23	0.0001	-0.0005	-0.0009	0.0000	-0.0003	0.0000
24	0.0000	-0.0005	-0.0001	0.0000	-0.0003	-0.0001
25	0.0000	-0.0007	-0.0001	0.0000	-0.0003	0.0000
26	-0.0002	-0.0011	0.0000	0.0000	-0.0002	-0.0001
27	0.0001	-0.0005	-0.0001	0.0000	0.0001	-0.0001
28	0.0001	0.0000	-0.0002	0.0000	0.0001	0.0002
29	0.0001	-0.0003	-0.0003	0.0000	0.0002	0.0002
30	0.0000	-0.0001	-0.0002	0.0000	0.0001	0.0001

Table 6H.5 Multiplier effect of a unit change in a change in world output (DLUS)

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
0	0.0021	-0.1707	3.5194	0.0001	0.0022	0.0073
1	0.0009	-0.0004	0.0074	0.0001	0.0010	0.0025
2	0.0005	0.0000	-0.0008	0.0001	0.0006	0.0012
3	-0.0243	2.0069	-0.0437	-0.0009	-0.0264	-0.0859
4	-0.0120	0.0083	-0.0844	-0.0007	-0.0130	-0.0310
5	-0.0100	-0.0019	0.0290	-0.0016	-0.0039	-0.0193
6	-0.0173	1.3267	0.1080	-0.0012	-0.0035	-0.0608
7	0.0065	-0.0409	-0.0887	-0.0006	0.0101	0.0052
8	0.0434	0.0273	-0.2286	0.0057	-0.0384	0.0554
9	-0.0390	0.0490	-0.0904	-0.0006	-0.0892	0.0081
10	0.0087	-0.0863	0.0660	-0.0009	0.0064	-0.0044
11	0.0194	-0.1128	-0.1285	0.0023	-0.047	0.0182
12	-0.0104	-0.0048	-0.1044	-0.0011	-0.0509	0.0055
13	-0.0055	0.0051	-0.0349	-0.001	-0.0109	0.0046
14	-0.0003	-0.1615	0.0027	-0.0016	0.0072	-0.0061
15	0.0238	-0.0929	-0.0298	-0.0006	0.0108	0.0216
16	0.0012	0.0068	-0.0253	-0.0002	0.0099	0.0251
17	0.0055	-0.0473	-0.0144	0.0003	0.0161	0.0089
18	0.0038	-0.0568	-0.0090	0.0005	-0.0035	0.0029
19	0.0042	-0.0294	0.0321	0.0001	0.0077	0.0001
20	-0.0075	-0.0084	0.0258	0.0003	-0.0022	-0.0068
21	-0.0045	-0.0176	0.0206	0.0001	0.0027	-0.0132
22	0.0013	0.0086	-0.0015	-0.0002	0.0017	-0.0054
23	-0.0013	0.0085	0.0142	0.0000	0.005	-0.0006
24	-0.0008	0.0082	0.0009	0.0000	0.0052	0.0009
25	0.0004	0.0114	0.0014	0.0000	0.0048	0.0000
26	0.0032	0.0181	-0.0003	0.0001	0.0034	0.0022

Table 6H.5 Cont.

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
27	-0.0012	0.0084	0.0014	0.0002	-0.0017	0.0014
28	-0.0019	0.0000	0.0041	0.0001	-0.0017	-0.0026
29	-0.0013	0.0051	0.0045	0.0000	-0.0028	-0.0038
30	-0.0001	0.0010	0.0033	0.0000	-0.0014	-0.0017

Table 6H.6 Multiplier effect of a unit change in a change in real exchange rate (DLRER)

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
0	0.0008	-0.0684	0.0012	0.0000	0.0009	0.0029
1	0.0004	-0.0001	0.0030	0.0000	0.0004	0.0010
2	0.0002	0.0000	-0.0003	0.0000	0.0002	0.0005
3	0.0001	0.0009	-0.0040	0.0000	-0.0002	0.0001
4	-0.0005	0.0016	0.0008	0.0000	-0.0006	-0.0008
5	-0.0016	-0.0006	0.0079	-0.0002	0.0012	-0.0021
6	0.0012	-0.0021	0.0058	0.0000	0.0032	-0.0003
7	0.0000	0.0017	-0.0026	0.0000	0.0002	0.0006
8	0.0004	0.0044	-0.0009	0.0001	0.0007	0.0008
9	-0.0005	0.0018	-0.0002	0.0000	-0.0004	0.0000
10	0.0002	-0.0013	0.0028	0.0000	0.0002	-0.0006
11	-0.0003	0.0025	0.0005	0.0000	-0.0007	-0.0003
12	-0.0005	0.0020	0.0011	0.0000	-0.0001	-0.0007
13	-0.0001	0.0007	-0.0011	0.0000	-0.0005	-0.0004
14	0.0000	-0.0001	0.0000	0.0000	0.0000	-0.0001
15	0.0002	0.0006	-0.0005	0.0000	0.0002	0.0004
16	0.0000	0.0005	-0.0003	0.0000	0.0000	0.0003
17	0.0002	0.0003	-0.0009	0.0000	0.0001	0.0003
18	0.0000	0.0002	-0.0004	0.0000	-0.0002	0.0002
19	0.0000	-0.0006	0.0003	0.0000	-0.0001	0.0000
20	-0.0001	-0.0005	0.0001	0.0000	-0.0002	-0.0001
21	0.0000	-0.0004	0.0002	0.0000	0.0000	-0.0001
22	0.0000	0.0000	-0.0002	0.0000	-0.0001	0.0000
23	0.0000	-0.0003	-0.0001	0.0000	0.0000	0.0000
24	0.0000	0.0000	-0.0002	0.0000	0.0001	0.0001
25	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001
26	0.0001	0.0000	-0.0001	0.0000	0.0001	0.0001
27	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.0000	-0.0001	0.0001	0.0000	0.0000	-0.0001
29	0.0000	-0.0001	0.0001	0.0000	0.0000	-0.0001
30	0.0000	-0.0001	0.0001	0.0000	0.0000	0.0000

Table 6H.7 Multiplier effect of a unit change in a change in population (DLPOP)

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA
0	0.4468	0.0000	0.0000	0.0309	0.4802	1.5135
1	0.1883	0.0190	-0.3924	0.0121	0.2017	0.5136
2	0.1080	0.0080	-0.1659	0.0189	0.1250	0.2466
3	0.0675	0.0050	-0.1026	0.0105	-0.1045	0.0468
4	-0.2251	-0.2470	0.4826	0.0040	-0.2884	-0.3594
5	-0.1950	-0.1147	0.4159	0.0018	-0.4235	-0.4463
6	-0.0823	-0.0804	0.4537	-0.0085	-0.0467	-0.2460
7	0.0053	0.1266	-0.0612	-0.0098	0.0625	-0.0372
8	0.0296	0.1877	-0.3043	-0.0044	0.1070	0.1462
9	0.1316	0.2396	-0.4264	-0.0052	0.2440	0.2300
10	0.0923	0.1614	-0.2107	0.0027	0.0954	0.1993
11	0.0399	-0.0127	-0.0057	0.0067	0.0074	0.0996
12	-0.0308	-0.0724	0.0907	0.005	-0.0775	-0.0367
13	-0.0583	-0.1556	0.2463	0.0027	-0.1094	-0.1403
14	-0.0453	-0.1271	0.1342	0.0005	-0.0989	-0.1208
15	-0.0416	-0.1153	0.0521	-0.0023	-0.0369	-0.0728
16	-0.0066	0.0615	-0.0504	-0.0034	0.0197	-0.0153
17	0.0267	0.0795	-0.1083	-0.0028	0.0602	0.0483
18	0.0437	0.0704	-0.1186	-0.001	0.0696	0.0838
19	0.0214	0.0692	-0.0605	0.001	0.0330	0.0647
20	0.0089	-0.0106	0.0141	0.0015	0.0099	0.0199
21	-0.0028	-0.0499	0.0508	0.0019	-0.0232	-0.0145
22	-0.0179	-0.0573	0.0691	0.0013	-0.0389	-0.0367
23	-0.0222	-0.036	0.0469	0.0002	-0.0328	-0.0418
24	-0.0130	-0.0178	0.0204	-0.0009	-0.0118	-0.0302
25	0.0019	0.0169	-0.0171	-0.0012	0.0075	-0.003
26	0.0074	0.0339	-0.0351	-0.0009	0.0193	0.0187
27	0.0100	0.0329	-0.0352	-0.0004	0.0220	0.0241
28	0.0096	0.0178	-0.0196	0.0002	0.0134	0.0194
29	0.0054	-0.002	0.0013	0.0006	0.0023	0.0097
30	-0.0030	-0.0129	0.016	0.0007	-0.0094	-0.0034

7A. Data description and source of information

Table 7A.1 Data description and source of information of the added series (1980:1 to 2002:4).

Series	Unit	Description	Deflated by:	Source	Observations
TX: Tax Revenues	Million dollars, 1993 prices	Average accumulated flows of total tax revenues	Implicit price index	1/	The series was deflated and transformed to dollars. Due to the accumulated flows, it was seasonally adjusted.
IR: Interest Rate	Percentage	Real interest rate of a 6-month deposit .		1/	The original was in monthly frequency. An average per quarter was calculated.
MB: Monetary Base	Million dollars, 1993 prices	Domestic notes and currency plus bank reserves	Consumer price index	1/	The series was seasonally adjusted.
INFL: Inflation	Percentage	Growth rate of consumer price index.		1/	The original series was in monthly frequency, an average inflation rate per quarter was calculated.

1/ Indicadores Económicos y Financieros, Bank of Mexico.

7 Stability condition and diagnostic tests on the residuals: restricted system.

Table 7B.1 Stability condition.

Root	Modulus
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
0	0
.8060513507+.2532170609*I	.8448891406
.8060513507-.2532170609*I	.8448891406
.6557589738+.5607872255*I	.8628453766
.6557589738-.5607872255*I	.8628453766
.2494057297+.7783161999*I	.8173000214
.249405729-.77831619*I,	.8173000214
.6591337868	.6591337868
.5684660162	.5684660162
.404276738+.512237085*I	.6525538395
.404276738-.512237085*I	.6525538395
-.199290252+.82001994*I	.8438893929
-.199290252-.82001994*I	.8438893929
.194011746+.5244885*I	.5592215781
.194011746-.5244885*I	.5592215781
-.553103525+.59003719*I	.8087443329
-.553103525-.59003719*I	.8087443329
-.71567429+.23598360*I	.7535767797
-.71567429-.23598360*I	.7535767797
-.4346702003+.3725825*I	.5724997007
-.43467020-.372582506*I	.5724997007
-.7087839440	.7087839440
-.4585407640	.4585407640
-.167271931+.551820454*I	.5766157409
-.167271931-.551820454*I	.5766157409
-.135597579+.401025846*I	.4233301700
-.135597579-.4010258462*I	.4233301700
.1608298516e-3	.1608298516e-3
-.7885395e-4+.148422e-3*I	.1680693370e-3
-.7885395e-4-.148422e-3*I	.1680693370e-3
-.154710e-5+.729206e-4*I	.7293709919e-4
-0.0000015-.0000729*I	0.000072937

Table 7B.2 Diagnostic tests to the residuals.

	Lag order	Serial Correlation Q-Stat	Prob	Test for indendence Dimen-sion	BDS Statistic	Prob.	Normality J-B Stat
Resid01	1	0.375	0.540				
	2	0.859	0.651	2	0.003	0.7212	0.170
	3	2.174	0.537	3	0.007	0.5649	0.918
	4	6.022	0.198	4	0.002	0.8795	
	5	6.022	0.304	5	-0.003	0.8384	
	6	7.742	0.258	6	-0.003	0.8010	
Resid02	1	0.218	0.641				
	2	1.992	0.369	2	-0.012	0.084	0.747
	3	2.003	0.572	3	-0.031	0.007	0.688
	4	2.293	0.682	4	-0.027	0.043	
	5	2.345	0.800	5	-0.022	0.114	
	6	2.345	0.885	6	-0.018	0.187	
Resid03	1	0.133	0.716				
	2	0.137	0.934	2	0.015	0.064	7.749
	3	2.521	0.472	3	0.031	0.016	0.021
	4	3.153	0.533	4	0.042	0.007	
	5	10.702	0.058	5	0.033	0.047	
	6	10.836	0.094	6	0.027	0.092	
Resid04	1	0.202	0.653				
	2	0.992	0.609	2	0.032	0.001	45.862
	3	1.792	0.617	3	0.053	0.001	0.000
	4	12.338	0.015	4	0.067	0.000	
	5	12.673	0.027	5	0.065	0.001	
	6	13.410	0.037	6	0.059	0.002	
Resid05	1	0.019	0.890				
	2	0.158	0.924	2	0.006	0.448	0.118
	3	2.169	0.538	3	0.013	0.277	0.943
	4	4.394	0.355	4	0.010	0.491	
	5	5.017	0.414	5	0.023	0.111	
	6	5.694	0.458	6	0.031	0.029	
Resid06	1	0.272	0.602				
	2	0.371	0.831	2	0.024	0.0002	1.004
	3	0.433	0.933	3	0.042	0.0000	0.605
	4	3.202	0.525	4	0.051	0.0000	
	5	3.540	0.617	5	0.053	0.0001	
	6	6.564	0.363	6	0.049	0.0001	
Resid07	1	0.011	0.916				
	2	0.018	0.991	2	0.021	0.036	36.385
	3	1.365	0.714	3	0.026	0.112	0.000
	4	1.528	0.822	4	0.037	0.057	
	5	1.755	0.882	5	0.027	0.184	
	6	1.854	0.933	6	0.030	0.128	

7C. Specification of the restricted system

$$
{}_t = C + M_1 {}_t + M_2 {}_t + M_3 DLGDP_{t-i} + M_4 DLFDI_{t-i} + M_5 DLE {}_{t-i} + M_6 DLHC_{t-i} +
M_7 DLPRO_{t-i} + M_8 DLCA_{t-i} + M_9 DLIR_{t-i} + M_{10} DLTT_{t-i} + M_{11} DLWAGES_{t-i} + M_{12} DLRER_{t-i} +
M_{13} GE_{t-i} + M_{14} DLUS_{t-i} + M_{15} DLMB_{t-i} + M_{16} DLINF_{t-i} + M_{17} D(LT \quad - LGDP)_{t-i} +
M_{18} D(LGDP - LPOP)_{t-i} + M_{19} DLINFL_{t-i} + D_{86} + D_{94} + AR(p)
$$

${}_t$= Endogenous variables

${}_t$= Exogenous variables

C= Constant

t= Observation √

i= 1 … 6. Number of lags

$${}_t^{'} = [DLGDP_t, DLFDI_t, DLE \quad {}_t, DLHC_t, DLPRO_t, DLCA_t, DLIR_t]$$

$${}_t^{'} = [DLTT_t, DRWAGES_t, DLRER_t, DLGE_t, DLUS_t, DLMB_t, DLINF_t, DLT \quad {}_t, DLPOP_t, DLINFL_t, DLMB_t, D_{86}, D_{94}]$$

$$
C = \begin{pmatrix} 0 \\ 0 \\ \surd \\ \surd \\ \surd \\ \surd \\ 0 \end{pmatrix}
\quad
M_1 = \begin{pmatrix}
0 & 0 & 0 & 0 & \surd & \surd & 0 \\
\surd & 0 & \surd & 0 & 0 & 0 & 0 \\
\surd & 0 & 0 & 0 & 0 & \surd & 0 \\
0 & 0 & 0 & 0 & 0 & \surd & 0 \\
\surd & 0 & 0 & \surd & 0 & 0 & 0 \\
\surd & 0 & 0 & 0 & 0 & 0 & \surd \\
\surd & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\quad
M_2 = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & \surd & \surd & 0 & 0 & 0 & 0 & \surd & 0 & 0 \\
0 & \surd & \surd & 0 & \surd & 0 & 0 & 0 & 0 & 0 \\
\surd & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\surd & 0 & \surd & \surd & 0 & 0 & \surd & 0 & \surd & 0 \\
0 & 0 & 0 & 0 & 0 & \surd & 0 & 0 & 0 & \surd
\end{pmatrix}
\quad
M_3 = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \surd & 0 \\
0 & 0 & 0 & 0 & 0 & \surd \\
\surd & \surd & \surd & 0 & 0 & 0 \\
0 & 0 & 0 & \surd & 0 & 0
\end{pmatrix}
$$

$$
M_4 = \begin{pmatrix}
0 & 0 & 0 & 0 & \surd & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
\surd & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \surd & \surd \\
0 & 0 & 0 & 0 & \surd & \surd \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\quad
M_5 = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \surd & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\quad
M_6 = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & \surd \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\quad
M_7 = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & \surd \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & \surd & \surd & 0 & 0 \\
\surd & \surd & \surd & \surd & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \surd & \surd \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
$$

$$
M_8 = \begin{pmatrix}
0 & 0 & \surd & \surd & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
\surd & \surd & 0 & 0 & 0 & 0 \\
\surd & \surd & 0 & \surd & \surd & 0 \\
0 & 0 & \surd & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\quad
M_9 = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 \\
\surd & \surd & 0 & \surd & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & \surd & \surd & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\quad
M_{10} = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \surd \\
0 & 0 & 0 & 0 & 0 & 0 \\
\surd & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
\surd & \surd & 0 & \surd & \surd & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\quad
M_{11} = \begin{pmatrix}
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \surd \\
\surd & 0 & \surd & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
$$

$$M_{12} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & 0 & \surd & \surd & 0 \\ \surd & \surd & 0 & \surd & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & \surd & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad M_{13} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \surd & \surd & 0 \\ 0 & 0 & \surd & \surd & 0 & 0 \\ 0 & 0 & \surd & \surd & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad M_{14} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \surd & 0 & 0 & \surd \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad M_{15} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & 0 & 0 & 0 & 0 \end{pmatrix}$$

$$M_{16} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & \surd & \surd & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \surd & \surd & \surd & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & \surd & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad M_{17} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \surd & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad M_{18} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \surd & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{pmatrix} \quad M_{19} = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ \surd & 0 & 0 & 0 & 0 & 0 \\ \surd & \surd & 0 & 0 & 0 & 0 \end{pmatrix}$$

$$D_{86} = \begin{pmatrix} \surd \\ \surd \\ \surd \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \quad D_{94} = \begin{pmatrix} \surd \\ \surd \\ \surd \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \quad AR(p) = \begin{pmatrix} \surd & 0 & 0 & 0 \\ \surd & \surd & \surd & \surd \\ \surd & \surd & 0 & 0 \\ \surd & 0 & 0 & 0 \\ \surd & 0 & 0 & 0 \\ \surd & \surd & \surd & 0 \\ \surd & \surd & 0 & 0 \end{pmatrix}$$

7D Detailed results of the 3SLS estimations.

Table 7D.1 Dependent variable: DLGDP

	Coefficient	Std. Error	Prob.
DLCA	0.148	0.015	0.000
DLPRO	0.285	0.033	0.000
DLFDI(-5)	0.012	0.007	0.086
DLCA(-3)	0.058	0.018	0.001
DLCA(-4)	-0.069	0.015	0.000
DLPRO(-6)	-0.062	0.029	0.036
D_{86}	0.005	0.001	0.000
D_{94}	-0.001	0.002	0.696
AR(1)	-0.194	0.098	0.047
R-squared		0.668	
Adjusted R-squared		0.633	
S.E. of regression		0.010	

Table 7D.2 Dependent variable: DLFDI

	Coefficient	Std. Error	Prob.
DLEX	0.382	0.152	0.013
DWAGES	1.461	0.543	0.007
DLRER	0.403	0.173	0.020
DLTX-DLGDP	-0.339	0.245	0.167
DLEX(-3)	0.407	0.140	0.004
DWAGES(-6)	0.599	0.340	0.078
DLRER(-1)	-0.341	0.200	0.089
DLRER(-2)	0.776	0.213	0.000
DLRER(-4)	0.623	0.157	0.000
DLRER(-5)	0.541	0.160	0.001
DUS(-1)	4.489	1.745	0.010
DLIR(-1)	-0.071	0.083	0.395
DLIR(-2)	-0.114	0.070	0.106
DLIR(-4)	-0.192	0.077	0.013
DLINF(-1)	0.180	0.103	0.082
DLINF(-2)	0.401	0.104	0.000
DLINF(-3)	0.156	0.104	0.133
DLINF(-4)	0.552	0.114	0.000
D_{86}	-0.043	0.018	0.017
D_{94}	0.039	0.014	0.006
AR(1)	-0.126	0.100	0.210
AR(2)	-0.288	0.099	0.004
AR(3)	-0.376	0.097	0.000
AR(4)	-0.543	0.108	0.000
R-squared		0.575	
Adjusted R-squared		0.404	
S.E. of regression		0.121	

Table 7D.3 Dependent variable: DLEX

	Coefficient	Std. Error	Prob.
C	-0.068	0.024	0.005
DLGDP	0.957	0.585	0.102
DLCA	-0.116	0.193	0.546
DWAGES	-0.639	0.288	0.027
DLRER	0.122	0.090	0.175
DUS	5.100	1.264	0.000
DLFDI(-1)	-0.092	0.048	0.057
DLCA(-1)	-0.377	0.142	0.008
DLCA(-2)	-0.052	0.143	0.715
DLPRO(-3)	0.329	0.245	0.180
DLPRO(-4)	1.159	0.241	0.000
DWAGES(-1)	-0.487	0.264	0.065
DWAGES(-3)	-0.315	0.244	0.197
DLRER(-1)	0.254	0.098	0.010
DLRER(-2)	-0.197	0.108	0.068
DLRER(-4)	-0.266	0.086	0.002
DUS(-3)	-1.043	1.076	0.333
DUS(-6)	1.801	1.072	0.094

Table 7D.3 cont.

	Coefficient	Std. Error	Prob.
D_{86}	0.093	0.021	0.000
D_{94}	-0.060	0.013	0.000
AR(1)	0.064	0.111	0.567
AR(2)	-0.257	0.108	0.018
R-squared		0.493	
Adjusted R-squared		0.318	
S.E. of regression		0.067	

Table 7D.4 Dependent variable: DLHC

	Coefficient	Std. Error	Prob.
C	0.010	0.002	0.000
DLCA	0.025	0.009	0.008
DLTT	-0.015	0.005	0.005
DLFDI(-5)	0.005	0.001	0.000
DLFDI(-6)	-0.002	0.002	0.254
DLCA(-1)	0.013	0.008	0.117
DLCA(-2)	0.001	0.004	0.889
DLCA(-4)	-0.016	0.005	0.003
DLCA(-5)	-0.006	0.005	0.276
DLPRO(-1)	0.002	0.008	0.805
DLPRO(-2)	0.011	0.008	0.190
DLPRO(-3)	0.008	0.008	0.309
DLPRO(-4)	0.022	0.008	0.006
DLTT(-1)	-0.011	0.005	0.025
DLGE(-4)	0.002	0.001	0.008
DLGE(-5)	0.000	0.001	0.756
DLINF(-3)	0.000	0.002	0.987
DLINF(-4)	-0.001	0.002	0.589
DLINF(-5)	0.002	0.002	0.193
D(LGDP-DLPOP)(-5)	0.044	0.015	0.004
AR(1)	0.879	0.041	0.000
R-squared		0.891	
Adjusted R-squared		0.856	
S.E. of regression		0.002	

Table 7D.5 Dependent variable: DLPRO

	Coefficient	Std. Error	Prob.
C	-0.013	0.005	0.010
DLGDP	1.429	0.178	0.000
DLHC	1.021	0.480	0.034
DLGDP(-6)	0.358	0.155	0.021
DLFDI(-5)	-0.047	0.019	0.013
DLFDI(-6)	-0.017	0.018	0.346
DLCA(-3)	-0.115	0.049	0.021
DLGE(-3)	0.001	0.009	0.908
DLGE(-4)	0.012	0.009	0.173
AR(1)	-0.018	0.101	0.860
R-squared		0.398	
Adjusted R-squared		0.325	
S.E. of regression		0.026	

Table 7D.6 Dependent variable: DLCA

	Coefficient	Std. Error	Prob.
C	0.012	0.003	0.000
DLIR	0.022	0.021	0.292
DLTT	0.389	0.044	0.000
DLRER	0.009	0.035	0.791
DLGE	0.009	0.009	0.329
DLINF	-0.026	0.023	0.254
D(LGDP-LPOP)	0.859	0.233	0.000
DLPRO(-5)	0.094	0.110	0.397
DLPRO(-6)	-0.131	0.108	0.226
DLTT(-1)	-0.069	0.040	0.087
DLTT(-2)	-0.055	0.046	0.234
DLTT(-4)	0.147	0.039	0.000
DLTT(-5)	-0.065	0.028	0.023
DLRER(-1)	-0.144	0.056	0.010
DLRER(-2)	-0.033	0.048	0.492
DLRER(-3)	0.025	0.045	0.573
DLGE(-3)	0.000	0.009	0.961
DLGE(-4)	-0.013	0.010	0.161
D(LGDP-LPOP)(-1)	0.883	0.206	0.000
D(LGDP-LPOP)(-2)	-0.317	0.200	0.113
D(LTX-LGDP)(-3)	-0.004	0.060	0.942
DLIR(-4)	-0.003	0.018	0.860
DLIR(-5)	-0.010	0.016	0.505
DLINFL(-1)	0.004	0.022	0.868
DLINF(-1)	-0.009	0.027	0.748
DLINF(-2)	0.041	0.027	0.119
DLINF(-3)	0.060	0.029	0.038
AR(1)	-0.111	0.107	0.298
AR(2)	-0.283	0.103	0.007
AR(3)	-0.055	0.111	0.621
R-squared		0.895	
Adjusted R-squared		0.837	
S.E. of regression		0.024	

Table 7D.7 Dependent variable: DLIR

	Coefficient	Std. Error	Prob.
DLGDP	-2.151	1.001	0.032
DLMB	-0.211	0.212	0.321
DLINFL	0.718	0.109	0.000
DLGDP(-4)	-2.012	0.903	0.026
DLINFL(-1)	-0.504	0.131	0.000
DLMB(-1)	0.061	0.217	0.779
DLMB(-2)	0.297	0.213	0.163
DLINFL(-2)	0.014	0.105	0.891
AR(1)	0.121	0.100	0.226
AR(2)	-0.253	0.103	0.014
R-squared		0.456	
Adjusted R-squared		0.390	
S.E. of regression		0.151	

7E Final form multipliers

Table 7E.1 Multiplier effect of a unit change in a change technology transfer (DLTT).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	0.120	0.063	0.058	-0.003	0.168	0.486	-0.257
1	0.039	-0.032	-0.167	0.010	0.066	0.137	-0.084
2	0.001	0.008	-0.073	0.004	0.006	-0.002	-0.003
3	0.024	0.068	0.070	0.002	-0.019	0.009	-0.052
4	-0.061	0.023	0.152	-0.004	-0.107	-0.033	-0.110
5	-0.035	0.013	0.064	-0.001	-0.053	-0.073	-0.004
6	-0.006	0.050	0.027	-0.002	0.032	-0.031	0.009
7	-0.005	0.051	-0.050	-0.002	0.008	-0.008	-0.037
8	-0.001	-0.006	-0.143	-0.001	0.003	-0.003	0.125
9	0.013	-0.002	-0.037	-0.002	0.027	0.007	0.041
10	0.010	0.000	0.102	0.000	0.015	0.008	-0.022
11	0.003	0.002	-0.002	0.000	0.005	0.012	-0.007
12	0.000	0.001	-0.005	0.000	0.000	-0.001	0.000
13	0.000	0.044	0.005	0.000	0.000	-0.001	-0.001
14	-0.001	0.009	0.015	0.000	-0.002	-0.001	-0.020
15	-0.001	0.002	0.004	0.000	-0.001	0.000	-0.004
16	0.000	0.004	0.000	0.000	0.003	-0.003	0.001
17	0.000	0.006	-0.001	0.000	0.001	-0.001	0.000
18	0.000	0.004	-0.003	0.000	-0.002	0.000	0.001
19	0.000	0.000	-0.001	0.000	-0.001	0.000	0.004
20	-0.001	0.015	-0.061	0.000	-0.002	-0.001	0.003
21	0.000	-0.001	-0.001	0.000	-0.001	-0.002	0.001
22	0.000	0.000	0.001	0.000	0.000	0.000	0.000
23	0.000	-0.025	-0.001	0.000	0.000	0.000	0.000
24	0.000	-0.001	0.000	0.000	0.000	0.000	0.003

Table 7E.1 Cont.

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
25	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
26	0.000	-0.001	0.000	0.000	-0.001	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	-0.001	0.000	0.000	0.001	0.000	0.000
29	0.000	0.000	-0.001	0.000	0.001	0.000	-0.001
30	0.000	0.000	0.003	0.000	-0.001	0.000	-0.001

Table 7E.2 Multiplier effect of a unit change in a change in relative wages (DWAGES).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	0.000	1.217	-0.639	0.000	0.000	0.000	0.000
1	0.000	-0.043	-0.112	0.000	0.000	0.000	0.000
2	0.000	0.001	0.004	0.000	0.000	0.000	0.000
3	0.000	-0.260	0.000	0.000	0.000	0.000	0.000
4	0.000	-0.036	0.024	0.000	0.000	0.000	0.000
5	0.001	0.003	0.004	0.006	-0.050	0.001	-0.001
6	-0.014	-0.009	-0.012	-0.003	-0.041	-0.011	0.030
7	-0.004	0.007	0.003	-0.001	-0.006	-0.016	0.009
8	-0.001	-0.007	-0.011	-0.002	0.009	0.000	0.001
9	0.002	-0.032	-0.069	-0.001	0.008	0.002	-0.005
10	0.000	-0.022	-0.047	-0.001	0.001	-0.003	0.028
11	0.010	-0.002	0.007	0.000	0.014	0.010	-0.012
12	0.007	-0.023	0.014	0.001	0.006	0.019	-0.014
13	0.001	-0.013	0.005	0.001	0.002	0.006	-0.006
14	-0.001	0.001	0.004	0.000	0.000	-0.002	0.001
15	-0.002	0.015	0.018	0.000	-0.002	-0.004	-0.016
16	-0.002	0.007	0.005	0.000	-0.004	-0.002	-0.009
17	-0.002	0.005	0.001	0.000	0.002	-0.004	0.001
18	0.001	0.008	0.001	0.000	0.005	-0.001	0.000
19	0.001	0.004	-0.003	0.000	0.002	0.002	0.001
20	0.000	0.001	-0.004	0.000	0.000	0.001	0.004
21	0.000	0.002	0.004	0.000	0.000	0.000	0.002
22	0.000	0.001	0.006	0.000	-0.001	0.001	-0.002
23	-0.001	-0.002	0.002	0.000	-0.002	0.000	0.000
24	-0.001	0.000	-0.001	0.000	-0.002	-0.002	0.002
25	-0.001	0.002	0.000	0.000	-0.001	-0.002	0.000
26	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
27	0.000	-0.001	-0.003	0.000	0.000	0.000	0.002
28	0.000	-0.001	-0.002	0.000	0.001	0.000	0.001
29	0.000	-0.001	-0.001	0.000	0.000	0.001	0.000
30	0.000	-0.001	-0.001	0.000	0.000	0.001	0.000

Table 7E.3 Multiplier effect of a unit change in a change in the exchange rate (DLRER).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	0.003	0.451	0.124	0.000	0.005	0.012	-0.007
1	0.001	-0.016	-0.045	0.000	0.002	0.003	-0.002
2	0.000	0.001	0.000	0.000	0.000	0.000	0.000
3	0.001	0.051	0.002	0.000	0.000	0.000	-0.001
4	-0.001	-0.018	0.000	0.000	-0.003	-0.001	-0.003
5	-0.001	0.002	0.003	0.002	-0.020	-0.001	-0.001
6	-0.005	-0.002	-0.004	-0.001	-0.014	-0.005	0.011
7	-0.002	-0.001	0.000	0.000	-0.002	-0.006	0.002
8	0.000	-0.002	-0.007	0.000	-0.003	0.000	0.003
9	-0.001	-0.013	-0.028	-0.001	-0.001	0.000	0.003
10	0.000	-0.009	-0.016	0.000	0.000	-0.002	0.011
11	0.004	-0.003	0.001	0.000	0.005	0.004	-0.004
12	0.002	-0.013	-0.003	0.000	0.002	0.007	-0.005
13	0.000	-0.007	-0.003	0.000	0.000	0.001	0.001
14	0.001	0.000	0.002	0.000	0.001	0.000	-0.001
15	0.000	0.002	0.006	0.000	0.000	0.001	-0.008
16	-0.001	0.001	0.001	0.000	-0.001	0.000	-0.003
17	0.000	0.002	0.001	0.000	0.001	-0.001	0.000
18	0.000	0.004	0.002	0.000	0.002	0.000	-0.002
19	0.000	0.002	-0.001	0.000	0.001	0.001	-0.001
20	0.000	0.001	-0.001	0.000	0.000	0.000	0.001
21	0.000	0.002	0.002	0.000	0.000	0.000	0.000
22	0.000	0.001	0.002	0.000	0.000	0.001	-0.001
23	0.000	0.000	0.000	0.000	-0.001	0.000	0.000
24	0.000	0.001	0.000	0.000	-0.001	-0.001	0.001
25	0.000	0.001	0.001	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	-0.001	0.000	0.000	0.000	0.001
28	0.000	0.000	-0.001	0.000	0.000	0.000	0.001
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	-0.001	0.000	0.000	0.000	0.000	0.000

Table 7E.4 Multiplier effect of a unit change in a change in government expenditure (DLGE).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	0.003	0.002	0.002	0.000	0.005	0.011	-0.006
1	0.001	-0.001	-0.004	0.000	0.002	0.003	-0.002
2	0.000	0.000	-0.002	0.000	0.000	0.000	0.000
3	0.001	0.002	0.002	0.000	0.000	0.000	-0.001
4	-0.001	0.001	0.004	0.000	-0.003	-0.001	-0.003
5	-0.001	0.000	0.002	0.000	-0.001	-0.002	0.000
6	0.000	0.001	0.001	0.000	0.001	-0.001	0.000
7	0.000	0.002	-0.001	0.000	0.000	0.000	-0.001
8	0.000	0.000	-0.003	0.000	0.000	0.000	0.003
9	0.000	0.000	-0.001	0.000	0.001	0.000	0.001
10	0.000	0.000	0.001	0.000	0.000	0.001	0.000

Table 7E.4 Cont.

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
11	0.000	-0.001	0.000	0.000	0.000	0.001	0.000
12	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.001	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7E.5 Multiplier effect of a unit change in a change in the world economy (DLUS).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	0.000	1.948	5.100	0.000	0.000	0.000	0.000
1	0.000	-0.068	-0.179	0.000	0.000	0.000	0.000
2	0.000	0.002	0.006	0.000	0.000	0.000	0.000
3	0.000	2.076	0.000	0.000	0.000	0.000	0.000
4	0.000	-0.145	-0.190	0.000	0.000	0.000	0.000
5	0.001	0.008	0.014	0.010	-0.080	0.001	-0.002
6	-0.022	-0.015	-0.020	-0.004	-0.066	-0.017	0.047
7	-0.007	-0.081	0.004	-0.002	-0.010	-0.025	0.014
8	0.000	-0.004	-0.008	0.009	-0.088	0.002	-0.001
9	-0.026	-0.070	-0.136	-0.008	-0.071	-0.019	0.053
10	-0.009	-0.041	-0.070	-0.003	-0.011	-0.036	0.063
11	0.014	-0.016	-0.010	-0.002	0.019	0.016	-0.018
12	0.009	-0.105	-0.124	-0.002	0.008	0.030	-0.020
13	0.000	-0.069	-0.087	-0.001	0.003	-0.003	0.051
14	0.018	-0.005	0.016	0.000	0.028	0.017	-0.023
15	0.012	-0.037	0.026	0.001	0.008	0.033	-0.054
16	-0.001	-0.026	-0.001	0.001	-0.002	0.006	-0.014
17	0.000	0.008	0.012	0.000	0.009	-0.006	-0.001
18	0.001	0.031	0.037	0.000	0.006	0.000	-0.039
19	-0.003	0.013	0.004	0.001	-0.003	0.001	-0.017
20	-0.002	0.012	-0.002	0.000	0.006	-0.007	0.008
21	0.002	0.024	0.016	0.000	0.009	-0.001	-0.005
22	0.002	0.011	0.006	0.000	0.002	0.005	-0.006
23	-0.001	0.001	-0.005	0.000	-0.002	0.000	0.008
24	-0.001	0.008	0.009	0.000	-0.001	-0.003	0.006

Table 7E.5 Cont.

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
25	0.000	0.007	0.012	0.000	-0.002	0.001	-0.005
26	-0.002	-0.002	0.000	0.000	-0.005	-0.001	0.001
27	-0.002	0.000	-0.004	0.000	-0.003	-0.004	0.007
28	0.000	0.003	-0.001	0.000	0.000	-0.002	0.002
29	0.000	-0.001	-0.003	0.000	-0.001	0.000	0.000
30	0.000	-0.004	-0.007	0.000	0.000	0.000	0.004

Table 7E.6 Multiplier effect of a unit change in a change in the monetary base (DLMB).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	-0.002	-0.001	-0.001	0.000	-0.002	-0.006	-0.208
1	0.000	0.015	0.002	0.000	-0.001	-0.002	0.001
2	0.000	0.023	0.000	0.000	0.000	0.000	0.000
3	0.000	-0.002	-0.003	0.000	0.000	0.000	0.001
4	0.001	0.040	-0.002	0.000	0.002	0.001	0.001
5	0.001	-0.002	-0.004	0.000	0.002	0.004	-0.002
6	0.000	-0.002	-0.001	0.000	-0.001	0.001	-0.001
7	0.000	-0.001	0.000	0.000	-0.002	0.000	0.001
8	0.000	-0.001	0.002	0.000	-0.001	0.000	-0.001
9	-0.001	0.000	0.002	0.000	-0.003	-0.001	-0.001
10	-0.001	0.000	-0.002	0.000	-0.002	-0.001	0.001
11	0.000	0.000	-0.002	0.000	0.000	-0.001	0.001
12	0.000	0.000	-0.002	0.000	0.000	0.000	0.000
13	0.000	-0.002	-0.004	0.000	0.001	0.001	0.001
14	0.000	-0.002	-0.002	0.000	0.000	0.000	0.001
15	0.001	-0.001	0.000	0.000	0.001	0.001	0.000
16	0.000	-0.001	0.000	0.000	0.000	0.001	-0.001
17	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.001	0.000	0.000	0.000	0.000
19	0.000	0.001	0.001	0.000	0.000	0.000	-0.001
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7E.7 Multiplier effect of a unit change in a change in infrastructure (DLINF).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	-0.009	-0.005	-0.004	-0.001	-0.013	-0.033	0.018
1	-0.003	0.002	0.011	-0.001	-0.005	-0.010	0.006
2	0.000	-0.001	0.005	0.000	0.000	0.000	0.000
3	-0.002	-0.005	-0.005	0.000	0.001	-0.001	0.004
4	0.004	-0.003	-0.012	0.000	0.007	0.002	0.009
5	0.002	-0.001	-0.004	0.000	0.004	0.005	0.001
6	0.001	-0.004	-0.002	0.000	-0.002	0.002	-0.001
7	0.000	-0.004	0.003	0.000	0.000	0.001	0.002
8	0.000	0.000	0.010	0.000	0.000	0.000	-0.008
9	-0.001	0.000	0.003	0.000	-0.002	0.000	-0.003
10	-0.001	0.001	-0.003	0.000	0.000	-0.002	0.001
11	0.000	0.003	0.000	0.000	0.000	-0.002	0.000
12	0.000	0.003	0.000	0.000	0.001	0.000	-0.001
13	0.000	-0.001	-0.002	0.000	0.001	0.001	0.001
14	0.000	0.000	0.000	0.000	0.001	0.000	0.001
15	0.000	0.000	0.001	0.000	0.000	0.001	0.000
16	0.000	0.000	0.001	0.000	-0.001	0.000	-0.001
17	0.000	0.000	0.001	0.000	-0.001	0.000	0.000
18	0.000	0.000	0.001	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	-0.001	0.000	0.000	0.000	0.001
21	0.000	0.000	-0.001	0.000	0.000	0.000	0.001
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7E.8 Multiplier effect of a unit change in a change in tax revenues (DLTX).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	0.000	-0.339	0.000	0.000	0.000	0.000	0.000
1	0.000	0.012	0.031	0.000	0.000	0.000	0.000
2	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.013	0.000	0.000	0.000	0.000	0.000
5	0.000	-0.001	-0.001	-0.002	0.014	0.000	0.000
6	0.004	0.003	0.003	0.001	0.011	0.003	-0.008
7	0.001	0.001	-0.001	0.000	0.002	0.004	-0.002
8	0.000	0.002	0.003	0.000	0.000	0.000	0.000
9	0.000	0.009	0.020	0.000	0.000	0.000	0.000
10	0.000	0.006	0.013	0.000	0.000	0.002	-0.008
11	-0.003	0.001	-0.001	0.000	-0.004	-0.003	0.003
12	-0.002	0.008	0.000	0.000	-0.002	-0.005	0.004

Table 7E.8 Cont.

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
13	0.000	0.005	0.001	0.000	0.000	-0.001	0.000
14	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000
15	0.000	-0.002	-0.005	0.000	0.000	0.000	0.005
16	0.001	-0.001	-0.001	0.000	0.001	0.000	0.003
17	0.000	-0.001	-0.001	0.000	-0.001	0.001	0.000
18	0.000	-0.003	-0.001	0.000	-0.001	0.000	0.001
19	0.000	-0.001	0.001	0.000	0.000	0.000	0.000
20	0.000	0.000	0.001	0.000	0.000	0.000	-0.001
21	0.000	-0.001	-0.001	0.000	0.000	0.000	0.000
22	0.000	0.000	-0.002	0.000	0.000	0.000	0.001
23	0.000	0.000	0.000	0.000	0.001	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.001	-0.001
25	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.001	0.000	0.000	0.000	-0.001
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7E.8 Multiplier effect of a unit change in a change in population (DLPOP).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	-0.285	-0.152	-0.146	-0.027	-0.435	-1.090	0.613
1	-0.093	0.068	0.374	-0.023	-0.156	-0.327	0.200
2	-0.003	-0.020	0.170	-0.010	-0.015	0.006	0.007
3	-0.054	-0.168	-0.176	-0.006	0.041	-0.019	0.117
4	0.135	-0.086	-0.412	0.008	0.239	0.073	0.283
5	0.078	-0.033	-0.148	0.001	0.119	0.156	0.019
6	0.019	-0.121	-0.054	0.005	-0.068	0.082	-0.034
7	0.014	-0.143	0.109	0.006	-0.016	0.025	0.079
8	0.002	0.006	0.317	0.002	-0.006	0.006	-0.277
9	-0.028	0.008	0.085	0.004	-0.058	-0.015	-0.096
10	-0.028	0.042	-0.098	-0.003	0.006	-0.070	0.022
11	-0.016	0.116	-0.006	-0.004	0.007	-0.051	0.005
12	0.013	0.088	-0.003	-0.001	0.035	0.013	-0.032
13	0.012	-0.041	-0.068	0.000	0.033	0.032	0.031
14	0.011	0.002	0.009	0.001	0.023	0.013	0.033
15	0.015	0.006	0.024	0.002	0.010	0.026	-0.001
16	-0.004	-0.013	0.036	0.002	-0.023	0.006	-0.018
17	-0.011	0.008	0.034	0.001	-0.028	-0.015	-0.001
18	-0.007	0.015	0.030	-0.001	-0.008	-0.016	-0.007
19	-0.007	0.014	0.004	-0.001	-0.007	-0.011	-0.015
20	-0.005	0.004	-0.036	-0.001	-0.003	-0.010	0.018
21	0.001	0.002	-0.030	-0.001	0.008	-0.004	0.020
22	0.005	-0.001	-0.006	0.000	0.007	0.007	0.003
23	0.005	-0.015	-0.008	0.000	0.004	0.011	0.004
24	0.002	-0.016	-0.002	0.000	0.000	0.005	0.006
25	0.001	-0.002	0.011	0.000	-0.003	0.001	-0.003

Table 7E.8 Cont.

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
26	-0.001	-0.001	0.008	0.000	-0.004	0.000	-0.008
27	-0.003	-0.001	0.002	0.000	-0.004	-0.004	-0.004
28	-0.001	0.004	0.000	0.000	0.000	-0.004	-0.001
29	0.000	0.003	-0.003	0.000	0.003	-0.001	-0.001
30	0.000	0.001	-0.006	0.000	0.002	0.001	0.001

Table 7E.10 Multiplier effect of a unit change in a change in inflation (DLINFL).

Period	DLGDP	DLFDI	DLEX	DLHC	DLPRO	DLCA	DLIR
0	0.005	0.003	0.003	0.000	0.008	0.020	0.707
1	0.002	-0.052	-0.007	0.000	0.003	0.006	-0.004
2	0.000	-0.080	0.002	0.000	0.000	0.000	0.000
3	0.001	0.006	0.011	0.000	-0.001	0.000	-0.002
4	-0.003	-0.137	0.007	0.000	-0.006	-0.004	-0.003
5	-0.004	0.006	0.015	0.000	-0.006	-0.013	0.005
6	-0.001	0.005	0.004	-0.001	0.002	-0.004	0.002
7	0.000	0.002	-0.001	-0.001	0.005	0.000	-0.002
8	0.001	0.004	-0.008	0.000	0.004	0.001	0.004
9	0.002	-0.001	-0.006	-0.001	0.010	0.002	0.004
10	0.003	0.002	0.005	0.001	0.006	0.004	-0.004
11	0.001	0.000	0.006	0.000	0.000	0.004	-0.003
12	0.000	0.000	0.006	0.000	-0.001	0.000	-0.001
13	-0.001	0.006	0.012	0.000	-0.002	-0.002	-0.002
14	-0.001	0.006	0.006	0.000	-0.001	-0.001	-0.004
15	-0.002	0.002	-0.002	0.000	-0.002	-0.003	0.002
16	-0.001	0.004	-0.002	0.000	0.000	-0.003	0.003
17	0.000	0.002	-0.002	0.000	0.001	0.000	0.001
18	0.000	-0.001	-0.002	0.000	0.000	0.001	0.001
19	0.000	-0.002	-0.002	0.000	0.000	0.001	0.003
20	0.000	-0.001	0.000	0.000	0.000	0.001	0.001
21	0.000	-0.001	0.001	0.000	-0.001	0.000	-0.001
22	0.000	-0.001	0.000	0.000	-0.001	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	-0.001	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	-0.001
25	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
26	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000

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