A Simultaneous Dynamic Analysis of the Mexican Liberalisation: 1980 to 2002

Belem Vasquez Galan, Ph.D.[1]
El Colegio de la Frontera Norte

As many other developing countries, economic liberalisation introduced in the 1980s changed the economic structure in Mexican. In this paper we investigate how the promotion of exports and FDI impacted on the Mexican economy and analyse the impact response of the system to external variables. To do this, a macroeconomic model was estimated to determine the nature of the relationship between real Gross Domestic Product [GDP], Foreign Direct Investment [FDI], exports and other endogenous variables. Exogenous variables (such as the world economy, technology investment and population) and some policy related variables like government spending and the exchange rate were also considered. Then to investigate the time path followed by the endogenous variables to external shocks, we made use of dynamic multipliers, which required the calculation of the impact, interim and total multipliers from the *final form*. The methodology applied is based on the estimation of a dynamic simultaneous equations model (via 3SLS). The period of analysis was from 1980 to 2002 in quarterly frequency. Among the most interesting results, the estimation showed that FDI is an important determinant of GDP. The analysis of dynamic multipliers showed that there is a strong link between how well the US economy does and how well FDI and exports do in Mexico. This was observed by the acceleration of exports and FDI in response to a shock in the US economy. The strongest total multiplier effect of technological transfer occurred on capital accumulation, followed by output growth which may be an indication that technology transfer due to openness and FDI inflows is an essential part of the country's production capacity.

I. Introduction

In this paper, 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.

We want to achieve two goals, the first goal 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

[1] Dr. Vasquez is a researcher at El Colegio de la Frontera Norte, Tecnicos 277, Col. Tecnologico, Monterrey, N.L. 64700, Mexico. Email: belem@colef.mx

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 goal 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. The point is to investigate economic relationships that occur as a consequence of free interaction between economic agents. 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 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. In order 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 paper is organised as follows: in Section II we present an analysis about the trajectory of FDI and exports in Mexico. In Section III we present the theoretical framework that is pertinent to analyse the issues under concern. In Section IV we describe the econometric methods. In Section V, we present the structural model and discuss the 3SLS estimations. Based on these estimations, Section VI contains an analysis of the endogenous variables' response to a one-unit change in the exogenous variables. Finally, Section VII concludes with a discussion of some empirical results.

II. A review of foreign investment and exports in Mexico

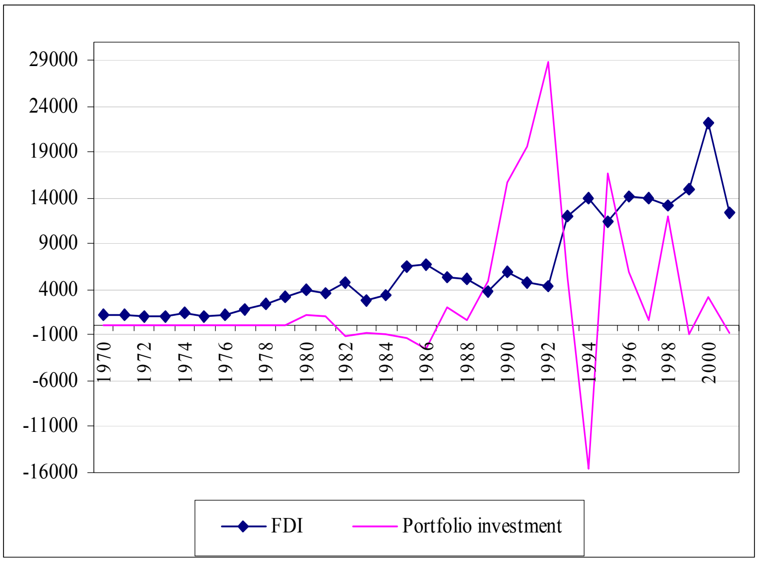
The first attempt to relax the restrictions on foreign investment occurred in 1984, when changes to administrative regulations were introduced, but the law was not modified significantly thought (Kehoe, 1995). There is empirical evidence showing that FDI reacted positively in the years following 1984. 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.

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 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 1).

FDI showed a more stable growth rate that ironically would be stimulated by devaluation in 1994. 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.

Figure 1
FDI inflows and investment in the stock market (million dollars, constant prices).



Source: Bank of Mexico and IMF.

Around 80% of FDI goes to the industrial sector, especially to the manufacturing of electronics and the automobile industry. In Table 1 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 1 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.

Regarding Mexican exports, during the period of 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 was 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 $5.85 billion dollars) and 1987 (a surplus of $4.23 billion dollars). In the year following devaluation in 1994, the current account did not register a surplus, but its deficit declined from $29.66 billion dollars to $1.57 billion 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.

III. Theoretical framework and empirical studies

We know from the Ricardian and H-O models 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 it 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 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. 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.

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 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., 1995) 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. 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 shows 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. There is also close positive relationship between FDI and the world economy due to large financial and commodity transactions between Mexico and the US. 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, 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. 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.

Recent literature has highlighted the role of both exports and FDI on economic growth. On one side, the Export-Led Growth [ELG] hypothesis states that exports are the main determinants of overall growth. At the heart of the ELG model are the beliefs that export sector generates positive externalities on other sectors in the economy through efficient management and production techniques see Feder (1982), Balassa (1978), Ram (1987); increases productivity through economic of scale, see Helpman and Krugman (1985), Sprout and Weaver (1993); alleviates foreign exchange constraints and improves access to international markets, see Esfahani (1991). The endogenous growth theory extends this analysis by emphasising the role of exports on technological innovations and dynamic learning, see Romer (1986) and Lucas (1988).

On the other hand, empirical evidence in the last few decades indicates that FDI flows have been growing at a pace far exceeding the volume of international trade, see Barrell and Pain (1997). The effect of FDI on economic growth appears to have become quite explicit with multinational enterprises acting as the primary vehicles for the international transfer of technology. It was further argued that FDI plays a central role in technological progress of recipient countries through the generation of productivity spillovers, see Blomstrom and Persson (1983), Blomstrom (1986), Borensztein *et al*. (1995) and Lim (2000).

IV Econometric procedure

System of simultaneous equations

In the standard regression model: $y = X\beta + \varepsilon$, it is assumed that the errors are uncorrelated with the exogenous variables (*X*), i.e. that the conditional expectation of ε given *X* 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:

$$\Gamma y_t + Bx_t = \varepsilon_t \qquad (1)$$

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,

$$y_t = \Pi x_t + v_t \qquad (2)$$

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

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 (1) changes to:

$$\Gamma y + Bx + \Phi y_{t-1} = \varepsilon \qquad (3)$$

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 (3) in its reduced form:

$$y = \Pi x + \Delta y_{t-1} + v \quad (4)$$

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, $|\Delta - \lambda I| = 0$.

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 structural equations estimated by 3SLS will serve 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.

To calculate the time-path followed by the endogenous variables due to changes in the exogenous variables, the procedure is the following:

- First, the estimated structural equations has to be 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 has to be built to obtain the interim and long-run multipliers.

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:

$$y = \Pi x + \Delta \Pi x_{t-1} + \Delta^2 y_{t-2} \quad (5)$$

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 ($\lim_{t \to \infty} \Delta^t = 0$)[2], then the final form of the system is equal to:

$$y = \Pi x + \Delta \Pi x_{t-1} + ... + \Delta^r \Pi x_{t-r} \quad (6)$$

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.

Finally, 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).

V. A structural approach to analyse the effects of liberalisation in Mexico

We describe the following six equations based on the theoretical grounds and empirical analysis described in Section III:

GDP= f (c, FDI, EX, CA, HC, PRO) (7)

where *FDI, EX, CA, HC, PRO* > 0

FDI= f (c, GDP, EX, HC, RWAGES, RER, INF_SA, US) (8)

where *GDP, EX, HC, RER, INF_SA, US* > 0 and *RWAGES* < 0

EX= f (c, GDP, FDI, CA, PRO, RWAGES, RER, US) (9)

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

---

[2] This will occur provided the latent roots of Δ are all less than 1 in absolute value.

$$HC = f(c, FDI, CA, PRO, TT, GE\_SA, INF\_SA, GDP/POP) \quad (10)$$

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

$$PRO = f(c, GDP, FDI, CA, HC, TT, GE\_SA) \quad (11)$$

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

$$CA = f(c, FDI, PRO, TT, RER, GE\_SA, INF\_SA, GDP/POP) \quad (12)$$

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

Description of the variables:

GDP	Gross Domestic Product. It is measured in real million dollars.
FDI	Foreign Direct Investment. It is measured as flows, in real million dollars. The series was transformed to its moving Average (4) in order to smooth its fluctuation.
EX	Exports. Export goods excluding crude oil (flows), in real million dollars.
HC	Human capital. It is measured as the number of students enrolled in secondary and technical schools.
PRO	Labour productivity. Labour productivity is measured as the monthly output produced by a worker in the manufacturing industry. In real dollars.
CA	Capital accumulation. Gross fixed capital formation, in real million dollars
TT	Technology transfer. Imports of capital goods by the private and public sector, in real million dollars.
RER	Real exchange rate. Pesos per dollar
GE_SA	Government expenditure. Public spending in social infrastructure, in real million dollars. It was seasonally adjusted
INF_SA	Infrastructure. Public spending in physical infrastructure, in real million dollars. The series was seasonally adjusted
RWAGES	Real relative wages. 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
US	World economy. It was proxied by the US's real GDP, in real million dollars[3]. The series was seasonally adjusted.
POP	Population. Residents in Mexico

[3] 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%.

Equation 7 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. All the variables are expected to have a positive effect.

Equation 8 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). 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.

Equation 7, which explains (EX) is 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.

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.

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.

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.

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). All series are in quarterly frequency (from 1980:1 to 2002:4).

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).

Before the estimations, we checked for unit roots in the variables to decide if the series had to be first differentiated or not.

Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) tests were applied to every series in the system. The results are presented in Table 2. 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 3); therefore the series are integrated of order one ~ I(1).

Table 2. 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). All the series were converted to natural logarithms to stabilise the variance. To denote a variable in logs, an L was added to the notation.

Table 3. Augmented Dickey Fuller (ADF) and Phillips-Perron (P-P) statistics
and probabilities. Series are in first differences.
Null hypothesis: there is unit root

Series	ADF		P-P	
	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)		-10.199 (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		-11.222 (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). To denote a variable in first differences a D was added to the notation.

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 (7 to 12). To select the lag structure, we followed the procedure described in Section IV. Different systems of equations were estimated with 6, 5 and 4 lags, all of them were tested for mathematical stability and residual tests. There is not a unique criterion to select the lags structure in a dynamic simultaneous model. The procedure consisted in the estimation of various systems of equations containing different number of lags, from a relative large number to only few. The selection of 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.

$$
\begin{aligned}
Y_t &= C + M_1 Y_t + M_2 X_t + M_3 DLGDP_{t-i} + M_4 DLFDI_{t-i} + M_5 DLEX_{t-i} + M_6 DLHC_{t-i} \\
&+ M_7 DLPRO_{t-i} + M_8 DLCA_{t-i} + M_9 DLGE_{t-i} + M_{10} DLINF_{t-i} + M_{11} DLTT_{t-i} + \\
&M_{12} DLWAGES_{t-i} + M_{13} DUS_{t-i} + M_{14} DLRER_{t-i} + M_{15} D(LGDP - LPOP)_{t-i} + AR(p)
\end{aligned}
$$

Where:

Y_t= Endogenous variables

X_t= Exogenous variables

C= Constant

t= Observation

i= 1 … 6. Number of lags

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

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

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

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

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

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[4].

---

[4] 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.

Hausman´s (1978) 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[5]. The fitted values from these regressions are then included in the expanded regression which contains the original regressors. The test is applied to each equation of the system. Equation DLPRO shows that there is simultaneity bias, DLGDP and DLHC cannot be considered as weakly exogenous since they are correlated with the residuals (results are available upon request). 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.

According to the order condition, all the equations are overidentified, meaning that there are more than enough variables to use as instruments in order to estimate the coefficients. 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. 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^*). The determinants of at least one sub-matrix found in each equation. The system satisfied the rank condition of identification (results are available upon request).

Diagnostic tests: stability condition and tests on the residuals

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 Table A1 in the appendix).

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.

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

Estimation results

All the estimation results are shown in the appendix, in this section we only discuss the most important findings. The estimations of equation DLGDP 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.

Regarding equation DLFDI, the estimations showed positive lagged effect from exports and mixed effects from relative wages. The lagged effect of export was statistically significant at 5% level and positively signed. 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.

The empirical findings on DLFDI 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 could be attributed to the fact that in the long run devaluation cannot sustain gains since real prices will tend to adjust.

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. 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. 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.

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.

The estimations of DLHC 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. 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. 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 effects of DLFDI were positively signed (0.0028) which indicates 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.

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. The estimations also show that there is a feedback relationship between labour productivity and output growth and vice versa, the same occurs with human capital. $DLFDI_{t-5}$ 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.

The estimations of equation DLCA indicate that most of its determinants were statistically significant which supports the hypothesis about the significant role of current technology transfer, government expenditure, GDP per capital and infrastructure to explain positive changes in capital accumulation. It is relevant to note that 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. Contrary to the expected, FDI did not appear as significant in the unrestricted system and therefore it did not appear in the restricted system.

VI. 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 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:

$$\Gamma y + A + Bx + \Phi y_{t-1} = \varepsilon \qquad (13)$$

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:

$$y = K + \Pi x + \Delta y_{t-1} + v \qquad (14)$$

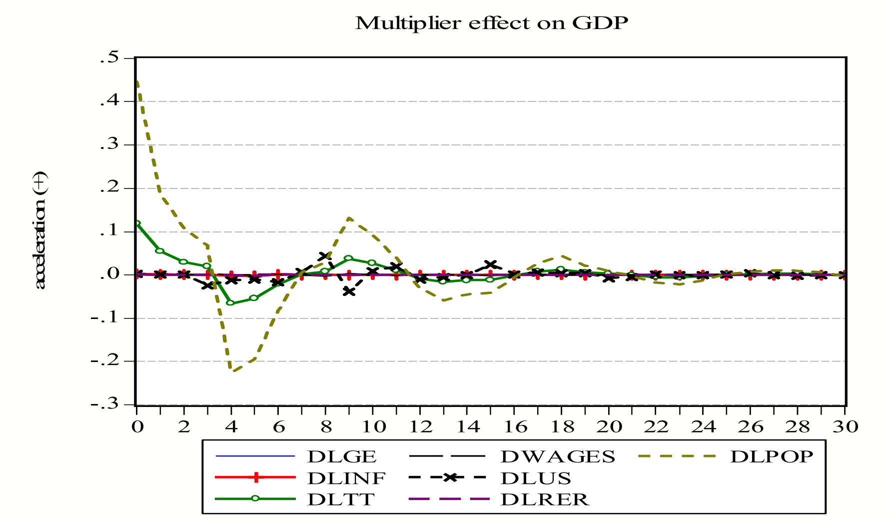
where: $K = -\Gamma^{-1}A$, $\Pi = -\Gamma^{-1}B$, $\Delta = -\Gamma^{-1}\Phi$ and $v = -\Gamma^{-1}\varepsilon$. We can ignore the vector of constant terms (K) since they are not relevant to the calculations of the multipliers.

To check the stability of the system, 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 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.

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). 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.

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 2. In it, we can see that the multiplier of population[6] 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. 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 2



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.

Regarding FDI, two interesting observations arise from its multipliers; first as we can see in Figure 3, 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. 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

[6] 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.

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 3

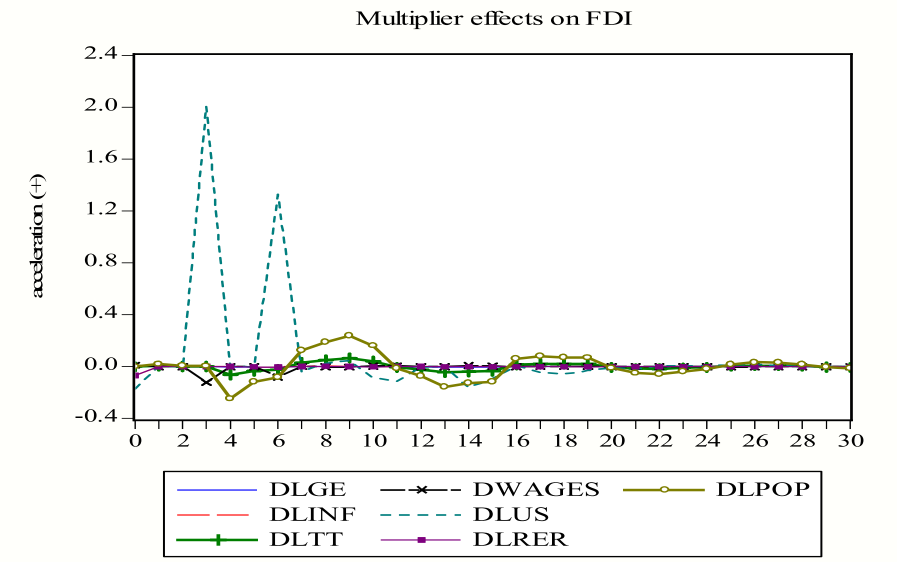
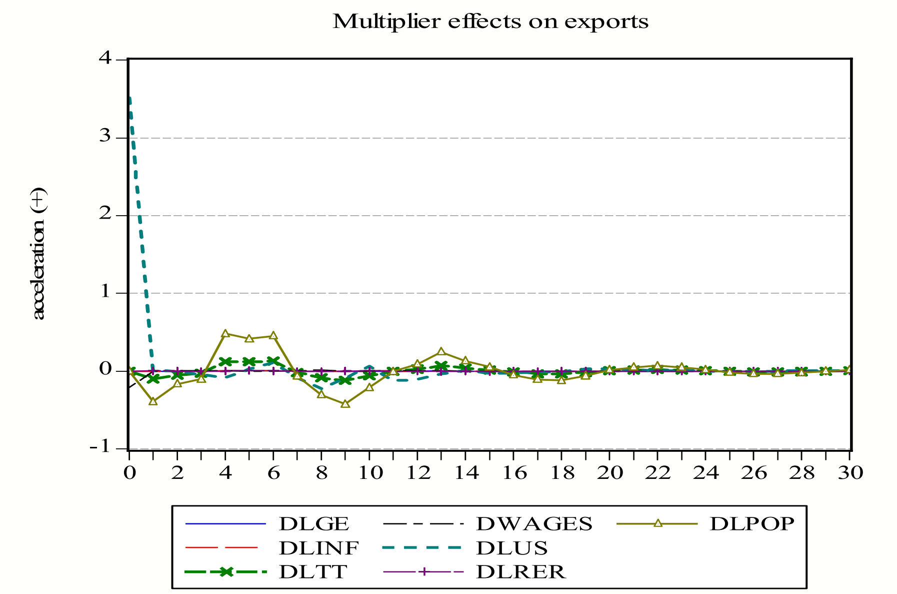


Figure 4

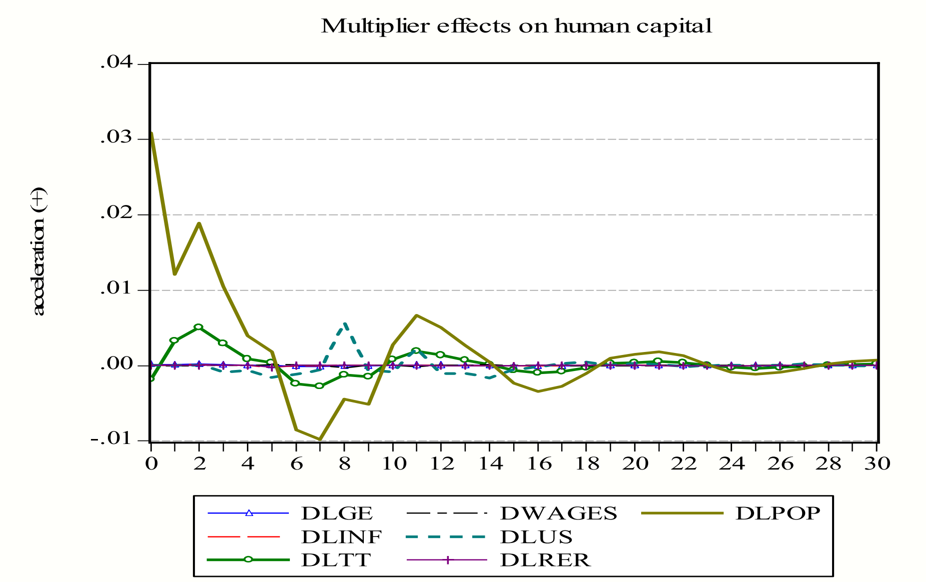


Regarding the response of exports, in Figure 4 is evident that DLUS has an immediate impact, as exports accelerate by 3.4%. This response shows the strong link between the US economy and Mexican exports. However, this response dies out quickly in the following periods. Nevertheless, the cumulative effect –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.

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.

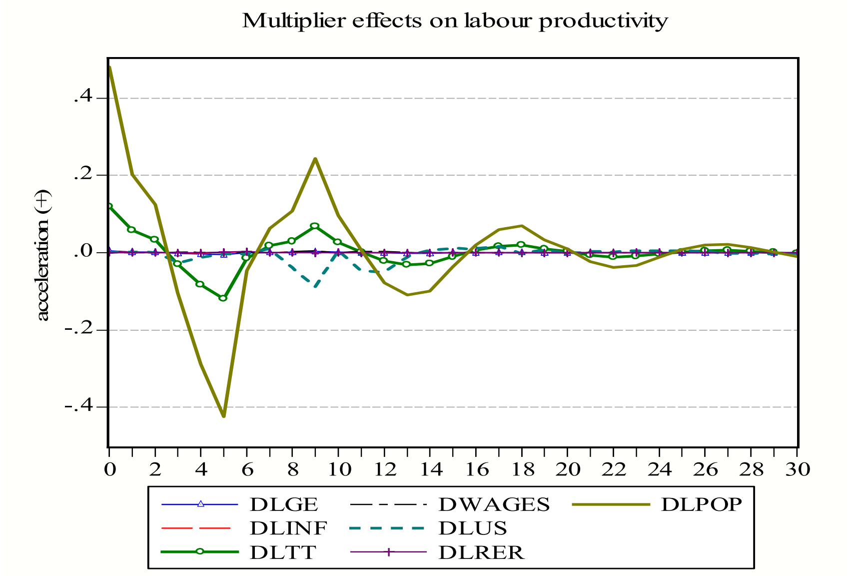
The multipliers of population and, at a lesser extent, technology transfer indicate that they generate the strongest acceleration on human capital (Figure 5). Neither government expenditure nor relative wages showed any relevant impact as expected. It seems that rises in technology transfer tend to accelerate 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 5



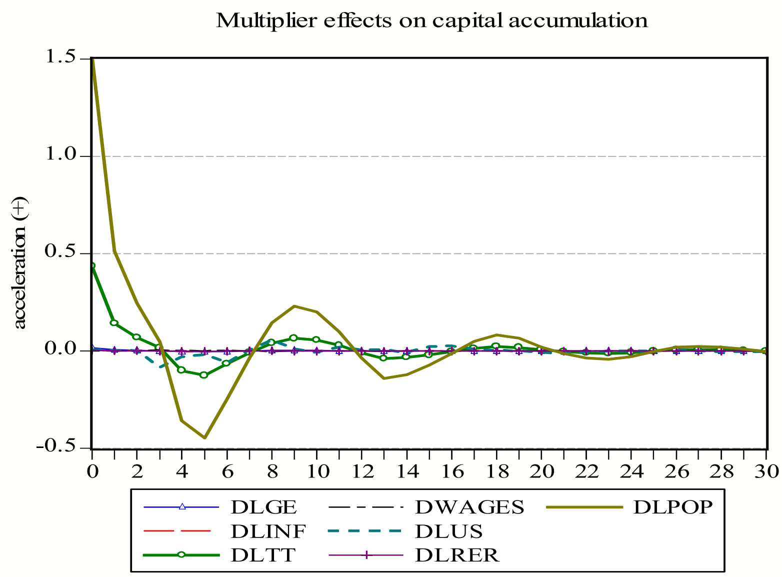
An interesting finding was the positive acceleration of DLHC due to the multiplier effect of DLUS in the 8th period. This outcome could be related to the incentives that the domestic economy obtains from higher world economic activity. Indirectly, it stimulates investment in human resources since a growing world economy stimulates FDI and exports and then they might create a potential demand for skilled labour.

Figure 6



The multiplier effects on labour productivity follow a similar pattern to human capital, but the intensity in absolute terms is stronger (see Figure 6). 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 7



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. This is consistent with the fact that most of capital accumulation depends on the acquisition of technology and rises in personal income.

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 4). 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 4. Cumulative multipliers. Long-run cumulative impact.

On endogenous	Multiplier effect of the exogenous variables						
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).

VII. Conclusions

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 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. 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 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 the majority of the cases, the shock tends to generate relatively strong acceleration or deceleration effect but eventually –after 15 periods- it adjusts 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, followed by output growth. 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 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.

Appendix

Table A1. Diagnostic tests on the residuals: serial correlation, iid and normality test.

	Serial Correlation			Independence test				Nomality
Residual	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	

Estimations of the system of equations with 3SLS.

Table A2. 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.

Table A3. 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)		

Table A4. 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)		

Table A5. 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)		

Table A6. 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)		

Table A7. Dependent variable: DLCA

Explanatory variable	Coefficient	Std. Error	Prob.
$DLFDI_t$	-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
$D(LGDP-LPOP)_t$	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
$D(LGDP-LPOP)_{t-1}$	0.8627	0.1525	0.0000
$D(LGDP-LPOP)_{t-3}$	-0.2218	0.1272	0.0819
$D(LGDP-LPOP)_{t-4}$	-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)		

References

BALASSA, B., (1978). Exports and Economic Growth. *Journal of Development Economics*, 5, 181-189.

BARRELL, R. AND PAIN, N. (1997) Foreign Direct Investment, Technological Change and Economic Growth Within Europe, *The Economic Journal* 107, pp. 1770-86.

BENDE-NABENDE, A.; FORD, J. AND SLATER, J., (2001). FDI, Regional Economic Integration and Endogenous Growth: Some Evidence from Southeast Asia. *Pacific Economic Review*, 6, 383-399.

BLOMSTROM, M. (1986) Foreign Investment and Productive Efficiency: The Case of Mexico. *The Journal of Industrial Economics*, 35 (1), pp. 97-110.

BLOMSTROM, M., KOKKO, A. AND ZEJAN, M., (1994). Host Country Competition, Labour Skills, and Technology Transfer by Multinationals. *Weltwirtschaftliches Archiv*, Band 130, p. 521-533.

BLOMSTROM, M., AND KOKKO, A., (1997). Regional Integration and Foreign Direct Investment. A Conceptual Framework and Three Cases, Policy Research Working Paper 1750. International Economics Department, The World Bank.

BLOMSTROM, M. AND PERSSON, H. (1983) Foreign Investment and Spillover Efficiency in an Underdeveloped Economy: Evidence from the Mexican Manufacturing Industry. *World Development*, 11, pp. 493-501.

BORENSZTEIN, E.; DE GREGORIO, J. AND JONG-WHA, L., (1995). How does Foreign Direct Investment Affect Economic Growth?. *NBER* Working Paper 5057.

ESFAHANI, H.S. (1991) Exports, Imports, and Economic Growth in Semi-Industrialized Countries. *Journal of Development Economics* 35, pp. 93-116.

FEDER, G., (1982). On Exports and Economic Growth. *Journal of Development Economics*, 12, 59-73.

GREENE, W., (2003). *Econometric Analysis.* Fifth Edition, Prentice Hall.

GROSSMAN, G. AND HELPMANN, E., (1991). *Innovation and Growth in the Global Economy*. Chapter 9, The MIT Press.

HELPMAN, E. AND KRUGMAN, P.R. (1985) *Market Structure and Foreign Trade* (Cambridge: MIT Press).

HENDRY, D. AND RICHARD, J.F., (1983). The Econometric Analysis of Economic Time Series. In: HENDRY, D., (1993). *Econometrics, Alchemy or Science*, 387-416.

ISCAN, T., (1997). Contributions of Exports to Growth, Mexico 1970-1990: Capital Accumulation or Labour Productivity Growth?. *Economía Mexicana Nueva Época,* VI (1), 5-31.

KAHOE, T., (1995). A Review of Mexico's Trade Policy from 1982 to 1994. *The World Economy*, 18, 135-151.

LIM, E. G. (2000) Determinants of, and the Relation Between, Foreign Direct Investment and Growth: A Summary of the Recent Literature. *IMF Working Paper*, Middle Eastern Department. November 2001. IMF. Washington DC.

LOVE, J. AND LAGE-HIDALGO, F., (2000). Analysing the Determinant of US Direct Investment in Mexico. *Applied Economics*, 32, 1259-1267.

LUCAS, R.E. (1988) On the mechanics of Economic Development. *Journal of Monetary Economics*, 22, pp. 3-42.

MADDALA, G. S., (2001). *Introduction to Econometrics*. Third Edition, Wiley.

RAM, R., (1987). Exports and Economic Growth in Developing Countries: Evidence from Time-Series and Cross-Section Data. *Economic Development and Cultural Change,* (36), 51-63.

ROMER, P., (1986). Increasing Returns and Long Run Growth. *The Journal of Political Economy*, 94 (5), 1002-1037.

ROSS, J., (1995). Mercados financieros, flujos de capital y tipo de cambio en México. *Economía Mexicana, Nueva Época*, IV (1), 5-67.

SPROUT, R. AND WEAVER, J., (1993). Exports and Economic Growth in a Simultaneous Equation Model. *The Journal of Developing Areas*, 27, 289-306.