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HAVE LIBERALISATION AND NAFTA HAD A POSITIVE IMPACT ON MEXICO'S OUTPUT GROWTH?

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This paper analyses the role of real exports, and foreign direct investment in explaining real growth in an era of economic liberalisation. The econometric approach is based on time series analysis using VARs, Granger causality, impulse response functions and variance decomposition. The empirical results reveal that exports Granger cause output growth in Mexico, which is a possible confirmation of the Export-led growth paradigm. However, no effect from FDI on GDP is found. The inclusion of NAFTA's potential impact confirms the positive effect of exports and reveals that GDP and exports Granger cause FDI. The evidence suggests that export promotion and liberalisation in Mexico had the potential to attract greater flows of foreign capital and induce economic growth.

JEL classification codes: C32, F13, F21, O1
Key words: foreign direct investment, exports, output, NAFTA, Mexico

I. Introduction

The role of exports and foreign direct investment (FDI) in explaining economic growth in developing nations is an issue that continues to be of considerable theoretical and empirical interest. Since the early 1980s, and particularly since the signing of the North American Free Trade Agreement (NAFTA) in 1994, Mexico

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experienced large inflows of FDI and export production. From 1985, the Mexican government has pursued active policies that continue to remove barriers to investment from multinational corporations with the hope that FDI will promote economic growth.

The purpose of this paper is to investigate if exports and FDI have been decisive in explaining economic growth in Mexico (from 1980 to 2002). We also investigate if NAFTA has made a difference in the way exports, FDI and GDP interact. A dynamic analysis through impulse-response functions is presented to analyse how the variables respond to shocks in the innovations. This could be helpful to determine if policy changes are likely to create a positive response in the long-run. The questions we seek to answer are: is there a meaningful causal relationship among exports, FDI and GDP? What is the nature of such relationship? Are there any co-integrating vectors that suggest a long-run relationship? Has NAFTA improved the effect of exports and FDI on growth? And what is the response of GDP, FDI and exports to shocks?

Following the introduction, Section II contains a brief review of the Mexican economy. Section III discusses the literature review while Section IV contains the empirical methodology. Section V presents the results and the last section concludes.

II. The Mexican economy

Like other countries in Latin America, for many years Mexico's policy of industrialisation relied on protectionism as a way to build a domestic industry that could generate higher growth rates. During the 1940 to 1982 period, the average growth rate of GDP was around 5.9%. The strategy known as Import Substitution Industrialisation (ISI) also required large public spending to finance domestic production at least in the first stages of development. 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. Public activities were diverse, ranging from selling basic products such as milk and sugar, to investing in the media and paper industry. In these years, average GDP growth was more or less the same as in the 1960s (6.4% per year). During the ISI, expansionary policy through public spending was one of the main instruments used to stimulate growth and this led to excessive public spending without equivalent tax revenues.

With oil prices falling in 1982, Mexico experienced a period of economic recession. For the first time, output growth fell below population growth. Mexico

had to rely on external debt to continue ISI's strategy.[1] Additionally serious obstacles to growth persisted such as the neglect of agriculture, the lack of investment policy and tax reforms, all of them leading to reconsider ISI's viability (Moreno-Brid and Ross, 2004). 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 (to 80%). The fiscal deficit reached its highest level in 1987: more than 20 billion dollars (in real terms).

Mexico started a series of structural reforms in its commercial and economic policy. In 1986, it joined the General Agreement on Tariffs and Trade (GATT), which immediately reduced average tariffs and relaxed restrictions on foreign investment (see Kehoe 1995). In 1989, the administration of President Carlos Salinas (1988-1994) intensified the process of economic liberalisation as a mechanism to attract international inflows of capital. Many public enterprises were privatised and private investment was allowed into sectors previously considered strategic such as communications and financial services, but the extraction of petroleum and natural gas remained as national property.

FDI growth rate was stable during the 1980s and 1990s. Then, the law that inhibited the flow of FDI was reformed in 1993 (the New Law of Foreign Investment[2]), and that established the basis to foster a more competitive environment for foreign and domestic investment. The reforms had a positive effect, foreign inflows increased 17 per cent between 1993 and 1997, despite of the fact that in 1994, a sequence of political and social problems and the announcement by the Bank of Mexico that international reserves could no longer maintain an over-valued peso led to massive foreign capital outflows.

A feature of FDI in Mexico is that the US is by far the largest source of FDI in Mexico, accounting for 67 per cent of all inflows since 1994. Financial services have received the largest amount of US-FDI into Mexico. In 2001, Citigroup purchased Banamex for $12.5 billion dollars, accounting for over half of all Mexico's FDI inflows in that year (ECLAC, 2001). In terms of FDI distribution around 80 per cent of FDI goes to the industrial sector, especially to manufactures (electronics and the automobile industry). Table 1 shows that FDI concentrates in the industrial and services sector (on average both account for more than 70% of total foreign investment). The reduction and subsequent elimination of trade tariffs, devaluation

[1] During Echeverria's and Lopez Portillo's presidencies (1970-1982) the average growth rate of external debt was 28.7% per year.

[2] Published the 27th of December, 1993 in *El Diario Oficial de la Federación*.

and a favourable law on foreign investment appeared to be the most important determinants that improved the operating conditions of foreign corporations in Mexico.

Table 1. FDI's distribution by economic sector

Definition/ year	1980	1985	1990	1995[a/]	1996	1997	1998	1999	2000	2001	2002	2003	2004
Billion dollars, real terms	8	8.8	16.4	34.4	36.3	30.5	41.9	29.1	43.3	49.6	75.7	57.7	43.8
Percentage distribution	100	100	100	100	100	100	100	100	100	100	100	100	100
Agriculture & livestock	0.1	0	1.6	0.1	0.4	0.1	0.3	0.6	0.5	0.2	0.4	0.1	0.1
Extraction	5.3	1	2.5	0.9	1.1	1.1	0.6	1.7	0.9	0	1.1	0.5	0.8
Industry[b/]	79.2	67.4	32	58.7	61.7	61	61.8	68.1	57.4	21.2	41.2	48	59.6
Retailing	7.3	6.3	4.6	12.1	9.6	15.4	12.4	10.3	13.6	7.9	7.8	8.7	5.5
Services	8.1	25.2	59.2	28.2	27.2	22.5	24.9	19.3	27.6	70.7	49.6	42.7	34.1

Notes: [a/] From this year on the flows account for amounts reported to the FINC that were materialised and for imports by maquiladoras [b/] Includes manufactures, construction, electricity and water. Data were deflated by an implicit price index, 1993=100. Source: INEGI.

In what concerns exports, during protectionism there was an attempt to stimulate export production of durable goods but the impact of those policies was negligible. The current account maintained a deficit for most of the period, except for the years following devaluation: in 1983 (surplus of $5.8 billion dollars); in 1987 (surplus of $4.2 billion dollars); and in 1994 (the current account did not register a surplus but its deficit declined from $30 to $1.5 billion dollars).

During the period of an outward oriented strategy, not only have exports increased, but its distribution has changed in favour of manufactures and against oil exports (see Table 2). Within manufactures the distribution has changed in favour of automobile products, machinery and equipment. For example, in 2005 two industries with around 41 per cent of total exports were automotive products, machinery and equipment. According to the *International Trade Statistics 2006* published by the World Trade Organization (WTO), Mexico achieved the 6th position in the world export of automotive products, machinery and equipment and the 10th position in the export of office machines and telecommunications. Furthermore, according to the WTO, in 2005 Mexico was among the world's top 10 leading exporters and importers of manufactures.

Table 2. Export goods and distribution by economic sector

Definition/ year	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Billion dollars, real terms	11.8	20.6	36.1	69.7	82.8	96.2	108.7	121.7	138.1	134.4	133.4	130	132.8
Percentage distribution	*100*	*100*	*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	9.2	11.3	12.6
Agriculture & livestock	8.5	5.3	5.3	5	3.7	3.5	3.2	2.9	2.5	2.5	2.6	3.1	3
Extraction	2.8	1.9	1.5	0.7	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.3	0.5
Manufactures	30.8	37.6	68.4	83.7	83.7	85.8	90.3	89.5	87.3	89.2	87.9	85.4	83.9
Maquiladoras	14	19	34.1	39.1	38.5	40.9	45.2	46.8	47.7	48.5	55.1	55.1	55.1

Notes: Data were deflated by an export index price, 1993=100. Source: Bank of Mexico.

However, most of the automobile and electronic industry is integrated by foreign investment[3] under the in-bond industry regime (Maquiladora), which promotes investment allowing temporal imported inputs. Although FDI represents an inflow of foreign exchange, it also affects the current account as most of their inputs are temporal imports. Moreno-Bid (1999) stresses the negative consequences of higher income elasticity of imports since liberalisation was introduced and how this has hindered economic growth since 1982. We evaluate here if foreign investment and openness are beneficial for the country even if this strategy is conditioned to allow large amounts of imports and schemes with low value added such as maquiladoras.

III. Literature review

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 determinant of overall growth. At the heart of the ELG model are the beliefs that the export sector generates positive externalities on other sectors in the economy

[3] For example, the automobile industry belongs to multinational corporations such as Volkswagen, Chrysler and General Motors. Meanwhile, the electronics industry is to a great extent integrated by Maquiladoras. This type of activity dominated the export market from 1990 to 2000. Between 2002 and 2005, their average exports share represents around 55.2% in the manufacturing sector and 51.7 per cent of total exports.

through efficient management and production techniques (Feder 1982, Balassa 1978, Ram 1987). It also increases productivity through economics of scale (Helpman and Krugman 1985, Sprout and Weaver 1993). In turn, it alleviates foreign exchange constraints and improves access to international markets (see Esfahani 1991). The endogenous growth theory extends the analysis by emphasising the role of exports on technological innovations and dynamic learning (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 (Barrell and Pain 1997). The effect of FDI on economic growth appears to have become 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 the technological progress of recipient countries through the generation of productivity spillovers (see Blomstrom and Persson 1983, Blomstrom 1986, OECD 1991, Borensztein et al. 1995 and Lim 2001).

Empirical work from the ELG, FDI and growth literature revealed mixed results when studied in isolation. This is mainly due to the omission of a relevant mechanism through which a liberalised economy may promote growth. Liberalisation in particular is expected to increase not only international trade but also FDI. If a complementary relationship exists between FDI and exports, then foreign investment may increase the volume of exports and international trade in general (see Goldberg and Klein 1997, and Blomstrom and Globerman 2000).

The result of the empirical evidence on the relationship between exports, FDI and output growth in Mexico is rather mixed. Sharma and Dhakal (1994) employed Granger causality tests on 30 countries including Mexico and found that in eleven out of the thirty countries, exports did prima facie cause output growth. In five countries, there was a feedback causal relationship between exports and growth. Using VAR and Granger causality tests on data from 1975 to 1997 from four countries including Mexico, Cuadros et al. (2000) found a short-run relationship going from exports to output, and a short-run and positive long-run relationship from FDI to output in Mexico. This evidence seems to confirm the complementary relationship between FDI and exports. Using data from 1983 to 1997, Cuadros (2000) examined the relationship between openness and economic growth in Mexico and found no Granger causality between exports and output growth. However, a causal relationship between imports and output growth was revealed, which suggests that openness stimulated output growth through imports. On the other hand, an empirical investigation by Pacheco-Lopez (2005) showed the existence of linkages (bidirectional Granger causality) between exports, imports and FDI in Mexico. Some authors

have tried to overcome the mixed results due to differences in levels of analysis and data frequency. For example Dussel et al. (2003) analysed at the macro, mezzo and micro level how FDI affects and is affected by the host economy. In the case of Mexico, the evidence suggests that FDI has an overall positive effect (at macro and micro levels) on exports, output, wages and employment. For the period 1970 to 2001 (in an OLS regression) they found that the main determinants of FDI were the output-elasticity of investment, labour costs and country risk; the former two, with negative effects. According to their results, market size and cheap labour are still important determinants of FDI and trade openness in Mexico.

Given the different empirical findings which might not be unconnected with data frequencies and methodologies, in this research we employed higher data frequency using quarterly information from 1980 to 2001. Additionally we provide empirical evidence from a different perspective about whether NAFTA was a key determinant to increase exports and FDI effects on output growth. We verify whether output growth was preconditioned to improve NAFTA's effect on exports and FDI. The reason is that much stress has been put on the openness policy only, and not on the endogenous or domestic conditions in Mexico. Therefore the study's goal was achieved by using up-to-date research techniques such as vector autogressive (VAR) estimations which investigate how the variables relate to each other without assuming the causal relationship a priori.

IV. Empirical strategy

The Granger causality test (Granger 1969) is often used to find the nature of the causal relationship among the variables. This technique is not a proper measure of causality but an investigation of whether past information of x improves the forecast of y. This link is obtained by estimating an unrestricted VAR which is a useful mechanism to determine the interactions between different variables. It does not impose *a priori* restrictions on the causal relationship between the variables, such as:

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

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

where x_t and y_t are stationary time series, p is the lag length and ε_{1t} and ε_{2t} are uncorrelated white noises. In equation (1) causality implies that y_t Granger causes

x_t if we reject the null hypothesis that $b_j = 0$. With more variables, Granger causality can be derived by applying either an F-test or Chi-square test of joint significance (Wald test) to the coefficients in the VARs. This method tells us if changes in y_t are to cause changes in x_t, then changes in y_t must precede changes in x_t. The same reasoning applies to measure Granger causality from x_t to y_t.

An important condition for VARs is mathematical stability, which guarantees that regardless of any shock, the system returns to its long-run equilibrium. Regression analysis on time series data assumes that the series are stationary. Stationarity can be tested by checking if the time series have unit roots. In addition, when series are non- stationary, we have to test for co-integration to determine if there is a long run relationship among the variables. If the series are cointegrated, an Error Correction Mechanism (ECM) should be included in the system of equations to capture short-term deviations from their long-term equilibrium path. However, if the series are I(1) but not cointegrated, then estimations in first differences (which are stationary, even if series in levels are not) provide valid results. The general to specific approach (Hendry 1974) was employed to choose the number of lags. The system also has to satisfy diagnostic tests on the residuals, such as the Jarque-Bera (JB) statistic for normality test, Lagrange Multiplier (LM) test for serial correlation and White test for heteroskedasticity.

Additionally to cointegration tests, we also use impulse-response functions. The impulse response functions are important tools to indicate which endogenous variables respond more strongly to certain external shocks. We used the Cholesky decomposition to make the innovations uncorrelated. In this way, each function describes the response of the endogenous variable to a unit change in the innovations over time (see Hamilton 1994). The method requires an ordering of the variables so all the effect of a common component is attributed to the first variable in the system.

Finally, we also perform a variance decomposition analysis, which provides useful information about the relative importance of each shock in affecting the variables in the system. The variance of the n-step ahead forecast error is decomposed into percentages attributable to each shock. This allows separating the different proportions of the variance due to shocks in the sequence of innovations.

The data series employed were real GDP, FDI[4] (taken as its four-year moving average to smooth quarterly fluctuations) and real exports. All the series are presented

[4] Since 1994 the National Registry of Foreign Investment (RNIE in Spanish) registers the amount of foreign investment that was not only notified but also materialised among other concepts. So there is a slight difference between the FDI series before and after 1994.

in quarterly frequency starting from 1980:1 to 2002:4. GDP and FDI were deflated with an implicit price index and exports were deflated with an export price index (where 1993 = 100) and then converted to natural logarithms. The sources of information are Banco de Información Económica from the Instituto Nacional de Estadística, Geografía e Informática (INEGI) and the Bank of Mexico.

V. Estimation results

With regards to stationarity, the Augmented Dickey-Fuller (ADF) and Phillips and Perron (P-P) tests failed to reject the null hypotheses in levels. Hence, variables in levels exhibit a unit root, and so are nonstationary. The same tests applied in first differences showed that LGDP, LFDI and LEX are stationary because the coefficients are significant. The following table contains the results of both tests in levels and first differences.

Table 3. Unit root tests for stationarity, period 1980:1 to 2002:4

Constant & trend	In levels		In first differences	
	ADF	P-P	ADF	P-P
LGDP	-1.66	-2.03	-7.79***	-7.86***
	(0.76)	(0.56)	(0.00)	(0.00)
LFDI	-2.61	-2.93	-6.70***	-8.81***
	(0.28)	(0.16)	(0.00)	(0.00)
LEX	-1.6	-1.75	-5.96***	-9.37***
	(0.78)	(0.72)	(0.00)	(0.00)

Notes: LGDP, log of Gross Domestic Product; LFDI, log of Foreign Direct Investment and LEX, log of exports. Test critical values: -4.06 (at 1%) and -3.45 (at 5%). *** 1% significance.

A VAR containing six lags was chosen as the best system to test for co-integration.[5] The results of the Johansen Cointegration test (Table 4) indicate that it is not possible to reject the null hypothesis of no co-integrating vectors; the rank of the long-run vector is zero. Under these circumstances, Granger causality can be tested with VARs in first differences, with no need of an error correction mechanism.

[5] The results of these diagnostic tests are available upon request.

Table 4. Johansen's cointegration test results, period 1980:1 to 2002:4

Hypothesized no. of cointegrating equations	Eigenvalue	Trace statistic	95% critical value	99% critical value	Max-eigenvalue statistic	95% critical value	99% critical value
None	0.171	27.536	29.68	35.65	16.117	20.97	25.52
At most 1	0.078	11.424	15.41	20.04	6.966	14.07	18.63
At most 2*	0.051	4.458	3.76	6.65	4.458	3.76	6.65

Notes: Trend assumption: linear deterministic trend, 1-5 lags. * Denotes rejection of the hypothesis at 5 % level of significance. Trace and max-eigenvalue tests indicate no cointegration at both 1 % and 5 % levels of significance.

Therefore, the system to estimate contains three endogenous variables:

$$\mathrm{DLGDP}_t = \pi_{10} + \sum_{i=1}^{p} \pi_{1i}\mathrm{DLGDP}_{t-i} + \sum_{i=1}^{p} \pi_{1i}\mathrm{DLEX}_{t-i} + \sum_{i=1}^{p} \pi_{1i}\mathrm{DLFDI}_{t-i} + \varepsilon_{1t}, \quad (3)$$

$$\mathrm{DLFDI}_t = \pi_{20} + \sum_{i=1}^{p} \pi_{2i}\mathrm{DLGDP}_{t-i} + \sum_{i=1}^{p} \pi_{2i}\mathrm{DLEX}_{t-i} + \sum_{i=1}^{p} \pi_{2i}\mathrm{DLFDI}_{t-i} + \varepsilon_{2t}, \quad (4)$$

$$\mathrm{DLEX}_t = \pi_{30} + \sum_{i=1}^{p} \pi_{3i}\mathrm{DLGDP}_{t-i} + \sum_{i=1}^{p} \pi_{3i}\mathrm{DLEX}_{t-i} + \sum_{i=1}^{p} \pi_{3i}\mathrm{DLFDI}_{t-i} + \varepsilon_{3t}, \quad (5)$$

where DLGDP_t is the first difference of the log of GDP, DLFDI_t is the first difference of the log of FDI and DLEX_t is the first difference of the log of exports; π are autoregressive coefficients; ε_t are disturbance terms and p is lag length. Schematically, we try to determine the direction and the statistical significance of the relationship between the variables:

$$\mathrm{DLGDP} \leftrightarrow \mathrm{DLFDI} \leftrightarrow \mathrm{DLEX} \leftrightarrow \mathrm{DLGDP} \quad (6)$$

Following the general to specific procedure to choose the lag length, the VAR with the best properties contains eight lags.[6] The lag structure was also suggested by the Likelihood Ratio (LR) criterion (at 5% level), which was equal to 5.843.[7]

[6] The diagnostic tests on the residuals showed that they are free from serial correlation (the LM statistic was 12.39 with probability 0.192 up to 8 lags), they are free from heteroskedasticity (the Chi-square statistic for the White heteroskedasticity test was 306.844 with probability 0.213) and are normally distributed (the Jarque-Bera statistic was 11.485 with probability 0.074).

[7] 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, diagnostic tests showed the presence of serial correlation and heteroskedasticity in the residuals so it was rejected.

A. Results of Granger causality

According to the test results, we reject the null hypothesis that exports do not Granger cause GDP (see Table 5). From 1980 to 2002, only exports were statistically significant which implies that export changes play an important role in explaining economic expansion in Mexico. The evidence seems to support the ELG hypothesis. We could say that structural changes that occurred due to trade liberalisation were conducive to improve the positive effect of exports on growth. Our results are consistent with those obtained by Cuadros et al. (2000) for the period 1975 to 1997 and Thornton (1996) for the period 1985 to 1992 with the same methodology.

On the other hand, despite our expectations, we found that FDI does not Granger cause neither GDP nor exports. This could be connected to the performance of FDI in Mexico, the reason being that this sort of investment tends to have low linkages with the domestic industry so there is less chance to find a significant effect (Dussel 2000). In regard to its impact on exports, it was only after 1993 that FDI in Mexico experienced a significant increase. This happened mainly due to favourable macroeconomic conditions and reforms to the law of Foreign Investment. These conditions made it possible to attract a large number of foreign companies that are export oriented but this only occurred in the 1990s.

Table 5. Granger causality test: Wald tests of joint significance, (8 lags)

Null hypothesis	F-stat & probability value	Chi-square stat & probability value
DLFDI does not Granger cause DLGDP	1.36	10.85
	(0.24)	(0.21)
DLEX does not Granger cause DLGDP	1.97*	15.65**
	(0.07)	(0.05)
DLGDP does not Granger cause DLFDI	0.30	2.41
	(0.96)	(0.97)
DLEX does not Granger cause DLFDI	1.07	8.55
	(0.40)	(0.38)
DLGDP does not Granger cause DLEX	0.82	6.56
	(0.59)	(0.58)
DLFDI does not Granger cause DLEX	0.59	4.76
	(0.78)	(0.79)

Notes: asterisks indicate the rejection of the null hypothesis at the 5 % (**) and 10 % (*) levels of significance.

The estimations also show that past changes in neither GDP nor in FDI Granger cause changes in exports. Considering that a large share of exports is done by foreign companies, this lack of causality from FDI was not expected. In part the poor performance of FDI, as an explanatory variable, could be attributed to its composition. For example, most of the FDI in industrial activities is under the "Maquiladora" program. Maquiladoras require a process where manufactures are produced by assembling temporal imported-components and then exported as final goods. Other programs designed to attract foreign investment relied on this concept of temporal imports to produce export goods. In 2000, 83% of total exports were registered under temporal import programs, the rest was mainly crude oil exports (Dussel et al. 2003). This situation also explains the close relationship between FDI and imports, the reason being that a large proportion of inputs come from abroad. In this sense, Moreno-Bid (1999) asserts that growth in the period 1950-1996 was hindered by the rise in the income elasticity of imports, making the balance of payments constraint more binding. This could be the rationale to why output growth does not seem to be positively affected by FDI.

Some authors interpret the new development strategy as detrimental for economic growth. For example Guerrero de Lizardi (2003) found in the periods 1982-2000 and 1987-2000 (when liberalisation was introduced) that the income elasticity of imports was 2.38 times higher than the period 1940-1981. In other words, openness not only increased the income elasticity of imports in absolute terms, but it also increased it more than proportionally to the elasticity of exports.

Our estimations also indicate that neither past changes in GDP nor in exports Granger cause FDI. This is not surprising if we consider that the flow of FDI to developing countries such as Mexico depend strongly on the economic conditions of the country where they come from more than the countries where they locate. However it is also possible that specific conditions in the host country could exert an important influence as well (Borensztein et al. 1995). However, in our sample the results did not indicate such positive relationship.

In an attempt to observe how the results would change if crude oil exports were included in total exports, we estimated a VAR in first differences with six lags[8] and tested Granger causality (no cointegration was found). Again, the results confirmed that exports Granger cause output growth at the 1% level of significance (the Chi-

[8] The system was mathematically stable and passed residual tests, the chi-square of White heteroskedasticity was equal to 224.5 (0.331) and the LM statistic of serial correlation was equal to 14.50 (0.105) up to 7 lags.

square was 28.99). In other words, the ELG hypothesis is consistent whether or not we include oil exports. We also found that exports Granger cause FDI (the Chi-square was 13.75 with probability 0.032). It seems that oil exports are still an important source of foreign exchange in Mexico and increasing amounts of oil exports could be interpreted by foreign investors as important financial resources that can sustain economic growth. The rest of the Granger causality relationships remained the same.

Granger causality before and after NAFTA

Due to the poor interaction between FDI and exports and GDP, we considered whether or not NAFTA had exerted a significant influence on the relationship between the variables. According to NAFTA's legal text, the agreement implied gradual reductions and elimination of trade tariffs through different periods extending to 2008 (Annex 302.2). The agreement also obliged countries to give regional investors no less favourable treatment than its own investors (Art.1102) and eliminated performance requirements (Art. 1106). However, a regional content of not less than 60% was established (Art. 401). Not only NAFTA liberalised more export goods but also eliminated restrictions that could be disincentives to foreign investment. It also obliged third countries' investment to increase value added if they wanted to use Mexico as an export platform. In certain way, it was logical that policy makers expected the new conditions would impact on export production and foreign investment and subsequently on GDP.

To investigate how NAFTA may have improved the interrelationship between the variables, 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, after NAFTA. We followed the same procedure employed for the selection of the lag structure and concluded we needed 4 lags. Table 6 contains a summary of the null hypotheses, Chi-square statistics and probabilities. In the second and third column we compare the results before and after NAFTA. The last rows contain the diagnostic tests.

The results show some interesting aspects about the influence of NAFTA. For example, the lack of statistical significance of exports on output before 1994 disappears once the trade agreement starts operating. A large number of goods that previously had to pay tariffs between 20 to 12% became tariff free. Moreover, when NAFTA is included in the model we see a positive impact from GDP and exports on FDI. The results provide evidence that trade liberalisation and the elimination of restrictions on foreign investment in the 1990s were favourable to improve foreign

Table 6. Summary of Granger causality tests before and after NAFTA, (4 lags)

Null hypothesis	Before NAFTA	After NAFTA
	1980:1 to 1993:4	1994:1 to 2002:4
	Chi-square (prob)	Chi-square (prob)
DLFDI does not Granger cause DLGDP	5.13	4.19
	(0.27)	(0.38)
DLEX does not Granger cause DLGDP	0.69	23.75***
	(0.95)	(0.00)
DLGDP does not Granger cause DLFDI	5.18	11.52**
	(0.27)	(0.02)
DLEX does not Granger cause DLFDI	2.25	16.33***
	(0.69)	(0.00)
DLGDP does not Granger cause DLEX	1.28	3.46
	(0.86)	(0.48)
DLFDI does not Granger cause DLEX	4.53	6.52
	(0.34)	(0.16)
Diagnostic tests		
LM test F(6,51)	8.71	13.52
	(0.46)	(0.14)
Normality (J-B stat)	5.36	9.64
	(0.50)	(0.14)
White test Chi-square	159.79	132.08
	(0.17)	(0.75)
Stability condition	Satisfied	Satisfied

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

flows. 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 base induced positive changes in FDI. Using both periods, the results confirm that neither output nor FDI explain export growth.

In summary NAFTA improved the causality effect of exports and GDP on FDI and confirmed the positive effect of exports on GDP. However it is worth mentioning that when crude oil exports were considered in the sample, exports was statistically significant as an explanatory variable of output growth even before NAFTA (the Chi square was 14.217 at 5% level of significance). The reason is that for most part

of the 1980s, crude oil was the most important export good and the most important source of foreign exchange, therefore oil exports effects on output growth are evident regardless of NAFTA.[9]

B. Analysis of impulse-response functions

The original unrestricted VAR(8) for the entire period (1980-2002) was used to calculate the impulse-response functions. The ordering of the variables was DLGDP, DLFDI and DLEX but changes in the ordering did not alter the results considerably. In a first attempt to obtain the impulse-response functions, the calculations showed large standard errors, therefore most of the estimations were statistically insignificant. As has been noted by Hamilton (1994, p. 351), "because so many parameters are estimated in a vector autoregression, the standard errors for inferences can be large". Authors such as Runkle (1987, p. 438) 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". One way to solve this problem was to restrict the system to contain only coefficients that were statistically significant. The point was to reduce the sum of squared residuals that affects the standard errors. The procedure required the elimination of those coefficients with probabilities higher than 10% and the re-estimation of the VAR (deleted variables were specified as zero in the companion matrix). The stability of the system was confirmed and diagnostic tests on the restricted system were performed. We followed the procedure regarding the Cholesky decomposition and designed a program to calculate the impulse-response functions and variance decomposition. The simulation was done for a horizon of 35 periods. The estimations showed that high standard errors persist despite the elimination of insignificant coefficients from the unrestricted VAR and reduction of the sum of squared residuals. For this reason, the results should be taken with caution.

Since all the variables are endogenous, any shock in one equation's innovation is transmitted to the rest of the system. Figure 1 shows the responses of DLGDP (difference of output), DLFDI (difference of FDI) and DLEX (difference of exports) to a unit shock in DLGDP. According to these results, in the first period a shock in

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[9] Additionally, it was found that output growth Granger caused exports before 1994 (it was statistically significant at 1% level), in this period there was a feedback relationship between exports and output. The estimated VARs before and after NAFTA contained 6 and 4 lags respectively, both systems were mathematically stable and passed diagnostic tests on the residuals (results are available upon request).

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 convergence to zero is not the same for every variable, neither in time nor intensity. For example, a shock in DLFDI has a strong positive effect on DLEX during the first four periods. The response of DLGDP tends to be also intense at the beginning but this is relatively smaller and becomes negative shortly afterwards.

The response to a shock in DLEX is diverse (see Figure 1), however in general DLGDP reacts positively after the initial shock and throughout the entire period. Also, the Granger causality tests statistically support the positive link between these two variables. The response of DLFDI to a shock in DLEX is also positive for most of the period. So also exports have stronger impact on FDI, however its response is more intense than DLGDP's response.

C. Analysis of variance decomposition

For the calculation of the variance decomposition we used the restricted system for a horizon of 35 periods. Figure 2 presents the percentages that explain each variables' variances. In other words, it presents the proportions of the forecast error variance of each variable.

Each variable explains most of its own forecast error variance, especially during the first periods. In the case of DLGDP, in the first period the total variance was 0.00054, of which 82.7 per cent of it was explained by a shock in its own innovation, 0.57 per cent by a shock in DLEX and 16.6 per cent by a shock in DLFDI. This trend does not persist for long though, as eventually most of DLGDP's variance is explained by shocks in DLEX. This result is congruent with the findings in Granger causality tests.

As would be expected, the case of DLFDI stresses the previous findings about the negligible influence from DLEX and DLGDP. About 98 per cent of its forecast error variance is due to a shock in its own innovation (see Figure 2). This proportion remains almost the same for the whole horizon. In the same way, although at the beginning DLEX explains 100 per cent of its error variance, eventually DLFDI explains 20 per cent of this variation. DLGDP explains less than 0.4 per cent.

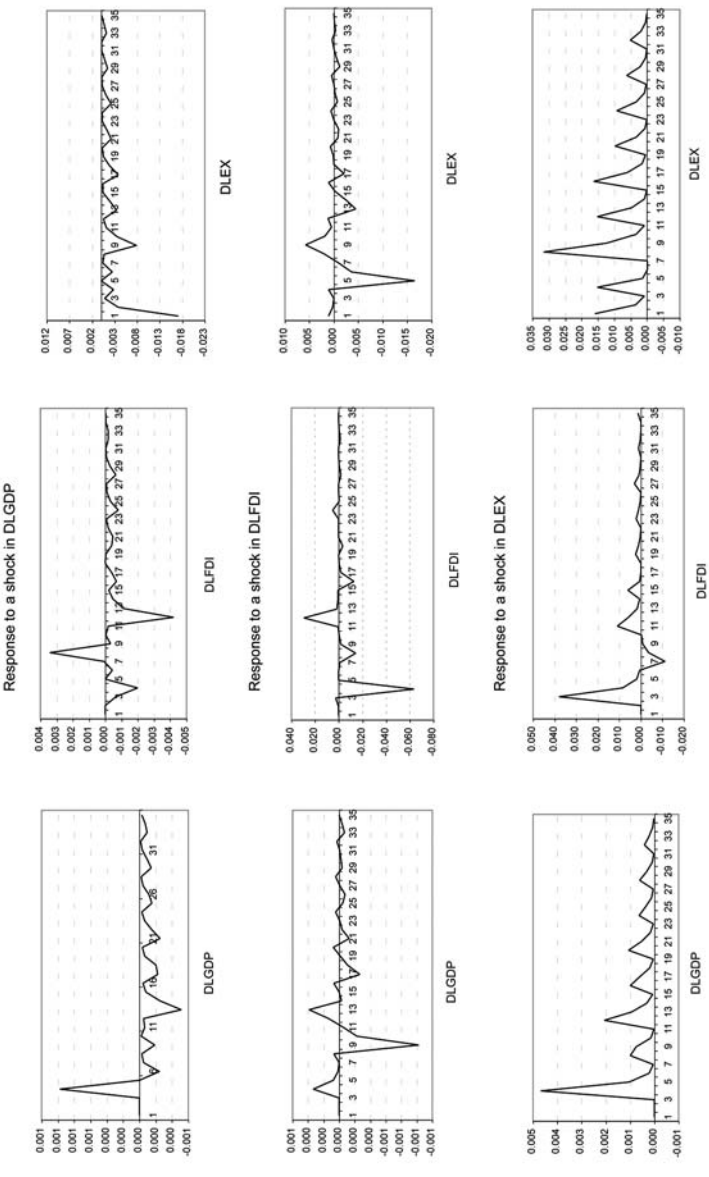
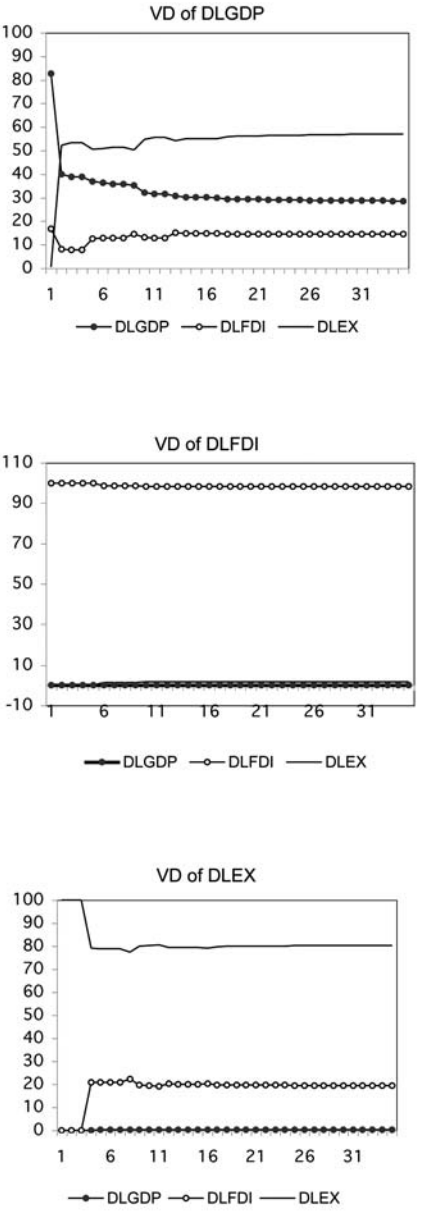


Figure 1. Graphic display of the impulse response functions

Figure 2. Variance decomposition (VD)



VI. Conclusions

Using a multivariate framework we examined whether exports and FDI have been decisive in explaining economic growth in Mexico. Granger causality tests showed that the explanation of output changes improves with the inclusion of past changes in exports. This further strengthens previous empirical evidence that the ELG paradigm applies in the Mexican situation. Trade liberalisation through its positive effect on exports has improved economic growth. Additionally, no Granger causality was found from FDI to GDP and exports. Liberalisation appeared to generate a significant effect on export growth with positive externalities to the economy. Although during the protectionism period GDP per capita in Mexico was higher than during liberalisation, this is not in conflict with our findings if we consider that growth during protectionism was based on heavy public spending and resources of crude oil exports. The subsequent fiscal deficit and massive external debt were symptoms that growth was not sustainable.

When NAFTA is accommodated in the model, both exports and GDP improve the explanation of FDI growth in Mexico. This result gives support to the hypothesis that an open economy tends to attract more foreign capital, not only because it offers a free trade market, but also because it provides investors with economic stability.

There is a negligible effect of FDI on the variables independent of the sample size. A tentative explanation is that a large proportion of FDI during the 1980s and 1990s concentrated in low capital intensive activities (Maquiladoras), creating few spillovers to the economy. Dussel et al (2003) have already pointed out that most of the inputs from the firms which make use of temporal imported goods, make it difficult to create linkages with the national industry. The results are also congruent with Dominguez and Brown (2004) who using information from 413 firms (from 1994 to 2001) find that the spillover effects cannot be generalised to the whole industry. They only capture statistically significant spillovers from FDI in industries with high technological intensity. This suggests that a positive effect from FDI will more likely occur only in sectors or industries where the gap between foreign and domestic firms is relatively low. Moreover previous findings using the balance of payments constraint model show that liberalisation has increased income elasticity of imports since the mid 1980s. This could be attributed to foreign companies having one of the highest demands for imports. It has limited the foreign exchange availability and sustainability of economic growth in Mexico. In part, it explains why we could not capture any significant effect from FDI to growth.

Impulse-response functions offered additional evidence that the response of changes in GDP to a shock in the variation of exports is more intense and positively signed than its response to a shock in the variation of FDI. Variations in FDI respond strongly and positively to shocks in the innovations to variations in exports. This indicates that a policy which promotes exports production and facilitates an open environment has the potential to improve FDI and output growth. Except for the first period, the analysis of variance decomposition showed that most of GDP variance is explained (around 55%) by a shock in exports. Again this supports the ELG hypothesis.

Our findings have some policy implications; first that liberalisation indeed can be used as a mechanism to increase exports and its effect on output growth. Second, liberalisation can also improve inflows of foreign direct investment. The rise in export production has been explicative of output growth in these years and therefore the structural change from a paternalist to a liberalised economy has paid off. However, the results also indicate that the reforms have not been enough to increase backward and forward linkages to the domestic industry as a way to grow at the same pace as imports and exports did. The policy to curtail foreign companies that relied heavily on import materials as well as the lack of financial support for national providers are holding back the economic growth in Mexico.

The consequences of these results imply that in an open economy, export production should be promoted in order to increase economic growth and increase self-sustainability. A growing GDP and macroeconomic stability tend to attract foreign investment. But a successful public policy should be able to balance the promotion of FDI under temporal import schemes and the stimulus of domestic production of exports. The negligible impact of FDI suggests that it would be more beneficial for the economy to raise incentives for national producers and reduce incentives for foreign firms with high import demand. In this way, the economic policy would try to reduce the balance of payment constraints that hinder economic growth.

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