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ON NAFTA, EXPORTS AND ECONOMIC GROWTH IN MEXICO

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ABSTRACT

This paper applies the least squares, impulse response via vector autoregression (VAR), and causality tests to investigate the export-led growth hypothesis in Mexico within the context of the North American Free Trade Agreement (NAFTA). The results confirm the export-led growth policy and strategy employed by Mexico in fulfillment of its NAFTA objective.

1. INTRODUCTION

The North American Free Trade Agreement (NAFTA) implemented in January 1994 is an economic integration – an alliance among the United States, Canada, and Mexico to increase trade and investment in order to enhance economic growth and the standard of living among member nations. Basically, the agreement eliminated trade barriers such as tariffs, quotas, licensing schemes, and technical barriers to trade over long term periods. As Weintraub (2004) pointed out, the selling techniques for the United States focused on jobs that NAFTA would create from export expansion, and for Canada, an opportunity to increase value added on exports, whereas, for Mexico, exports would spur economic growth. Clearly, the question for Mexico is whether NAFTA is in its economic interest in the sense that Mexico is the only developing country within NAFTA and perhaps has the most to gain or lose given the success or failure of NAFTA. Thus, this paper examines whether exports led to economic growth in Mexico within the context of NAFTA.

There are a plethora of studies that have examined exports and economic growth hypothesis. A review of these studies show that Chen (2007) assessed the validity of the export-led growth and growth-driven export hypotheses in Taiwan by testing for causality applying vector error correction model (VECM) and the bounds testing approach developed by Pesaran, Shin, and Smith (2001). The results support a long-run equilibrium relationship among exports, output, terms of trade, and labor productivity and a bi-directional Granger causality between real exports and real output in Taiwan. Awokuse (2005a, 2005b) examined exports, economic growth and causality in Korea, and export-led growth and the Japanese economy, respectively. In the case of Korea, he applied both the VECM of Toda and Philips (1993) and the vector autoregression (VAR) model in line with Toda and Yamamoto (1995) as well as Dolado and Lutkepohl (1996). Again, empirical evidence supports the nexus between real exports and real GDP that is bi-directional. Also, in the case of Japan, a directed acyclic graph that captures contemporaneous and dynamic causal structure was employed together with an augmented VAR of Toda and

Yamamoto was applied by Awokuse to conclude that a bi-directional link exists between exports and GDP growth. As for the study on China, Mah (2005) asserts that the results of the error correction model (ECM) are consistent with a bi-directional causality between export expansion and economic growth. Moreover, Mamun and Nath (2005) postulate an ECM that indicates a long-run unidirectional causality from exports to growth in Bangladesh. Nnadozie (2004) buttresses this point in his application of longitudinal data that separates the combined effect of exports, labor, and capital on Nigeria's economic growth. Bahmani-Oskooee and Alse (1993) earlier ratified the bi-directional causality with respect to export growth and output growth. In contrast, Furuoka (2007), Park and Prime (1998), Shan and Sun (1998), and Dodaro (1993) examined export-led growth hypothesis in the case of Malaysia, China, Australia, and less developing countries; respectively. They concluded that the results do not support the export-led growth hypothesis. Ram (1987), however, presents a mixed result that could be attributed to the use of both time series and cross-sectional data.

The rest of the paper is outlined as follows. Sections 2, 3, 4, and 5 respectively present a brief overview of the Mexican economy, model specifications and methodology, data and empirical analysis, and conclusion.

2. OVERVIEW OF THE MEXICAN ECONOMY

The Mexican economy can be analyzed in the context of pre NAFTA and NAFTA periods. The economic development strategy of Mexico from the 1940s to the mid 1970s was based on import substitution industrialization (ISI) – a protectionist policy where the government raised import tariffs, introduced import licenses, and imposed export controls in an attempt to boost domestic industrial base (Griffiths and Sapsford, 2004). The main tenet of this industrial strategy was and still is the Maquiladora program which was launched in 1966 to stimulate the establishment of labor-intensive, in-bond export processing plants (maquiladoras) along the U. S., Canadian, and Mexican border, by providing tax free access to imported inputs and machinery, plus exemption of sales and income taxes (Moreno-Brid *et al.*, 2005). The strategy was a success to the extent that it transformed the country from an agrarian to an urban and semi-industrial society; manufacturing stimulated the growth of gross domestic product (GDP) per capita by a yearly average of 3.1 per cent. However, from the late 1970s, Mexico began to experience a downturn in economic activities that led to government expenditures financed by oil revenues and external borrowing as the main catalyst of economic growth. Following the financial crisis in the global oil market in 1980-81 and the increase in interest rates in the US, which fueled both the fiscal and monetary crisis in Mexico, President Portillo of Mexico stopped all external debt service payments in August 1982.

From 1985, the Mexican government embarked on a new economic development strategy based on export-led growth. Thus, affecting the domestic productive structure while the foreign sector has the major share of macroeconomic aggregates via the inflow of direct foreign investment (DFI). This trade liberalization policy accelerated and culminated to the signing of NAFTA in 1994 (Cardero, 2001). Despite experiencing fiscal and currency crises in 1995, Mexico continues its development path via exports as the main engine of growth as evidenced by large increase in non-oil exports or manufactures. For a detailed analysis of the economic effects of NAFTA on Mexico, see Salvatore (2007).

3. MODEL SPECIFICATIONS AND METHODOLOGY

A simple model of an open-economy is postulated to examine the export-led growth hypothesis in Mexico within the context of NAFTA. This model slightly differs in its application by employing an output or expenditure approach to GDP where real GDP is a function of consumption, investment, government spending, and exports-imports in real terms as captured in the following equation:

$$Y = f(\text{CON, I, G, X-M}) \tag{1}$$

Where; Y = real GDP, CON = real consumption, I = real gross investment, G = real government expenditures, M = real imports, and X = real exports. Hence, yielding a testable econometric equation of the form:

$$Y_t = \kappa + \alpha \text{CON}_t + \beta \text{I}_t + \gamma \text{G}_t + \delta \text{NX}_t + \text{u}_t \tag{2}$$

Where; κ is a constant, α, β, γ, and δ are elasticity coefficients, NX is net exports (X-M), while u is a stochastic term normally distributed with mean zero and a constant standard error ó, and t is time trend.

Since, exports are considered a component of output via the national income accounting identity due to the endogeneity of the export growth variable within an output growth equation (Shan and Sun); therefore, a vector autoregression (VAR) model is helpful in avoiding the simultaneity bias that could produce spurious or unreliable estimates. Hence, this study also empirically investigates the interrelationship between real output Y, and CON, I, G, and NX by employing the vector autoregression (VAR) model – a system of equations that states each endogenous variable as a function of its own past and the past of the other endogenous variables in the system (Hall *et al.*, 1990). For instance, following Greene (2003), consider a vector autoregressive (VAR) model of the form:

$$\mathbf{y}_t = \boldsymbol{\mu} + \boldsymbol{\Gamma}_1 \mathbf{y}_{t-1} + \ldots\ldots + \boldsymbol{\Gamma}_p \mathbf{y}_{t-p} + \boldsymbol{\varepsilon}_t \tag{3}$$

where $\boldsymbol{\varepsilon}_t$ is a vector of nonautocorrelated disturbances (innovations) with zero means and simultaneous covariance matrix $E[\boldsymbol{\varepsilon}_t \boldsymbol{\varepsilon}'_t] = \boldsymbol{\Omega}$. Therefore, equation (3) can be restated as

$$\boldsymbol{\Gamma}(L)\mathbf{y}_t = \boldsymbol{\mu} + \boldsymbol{\varepsilon}_t \tag{4}$$

where $\boldsymbol{\Gamma}(L)$ is a matrix of polynomials in the lag operator. Specifically, the equations are:

$$y_{mt} = \mu_m + \sum_{j=1}^{p} (\Gamma_j) m_1 y_{1,t-j} + \sum_{j=1}^{p} (\Gamma_j) m_2 y_{2,t-j} + \ldots + \sum_{j=1}^{p} (\Gamma_j)_m M y_{M,t0j} + \varepsilon_{mt} \tag{5}$$

where $(\boldsymbol{\Gamma}_j)_{lm}$ captures the (l, m) element of $\boldsymbol{\Gamma}_j$.

Finally, to capture the export-led growth hypothesis, this study thus adopts a restricted version of equation (2) where:

$$Y_t = \kappa + \delta NX_t + u_t \tag{6}$$

In order to test for the causal relationship between real GDP (Y) and real net exports (NX) two empirical techniques are applied. First, a pairwise Granger causality test utilized by Dodaro and as specified in the following equations:

$$Y_t = a_0 + a_1Y_{t-1} + a_2Y_{t-2} \tag{7}$$

$$Y_t = a_0 + a_1Y_{t-1} + a_2Y_{t-2} + a_1NX_{t-1} + a_2NX_{t-2} \tag{8}$$

$$NX_t = c_0 + a_1NX_{t-1} + a_2NX_{t-2} \tag{9}$$

$$NX_t = c_0 + a_1NX_{t-1} + a_2NX_{t-2} + a_1Y_{t-1} + a_2Y_{t-2} \tag{10}$$

Where Y is the annual growth rate of real GDP and NX is the annual growth of net exports. Equations (7) and (9) are the restricted versions, while (8) and (10) are the unrestricted versions of the causality equations. Furthermore, the **F**-statistics test is applied to verify whether the following null hypotheses can be accepted or rejected: H_0: $\theta = b_1 + b_2 = 0$, and H_0: $\lambda = d_1 + d_2 = 0$. Thus, if the first null hypothesis can be rejected, then the growth of net exports causes GDP growth if $\theta > 0$, and impedes GDP growth if $\theta < 0$. Similarly, if the second null hypothesis can be rejected, then GDP growth causes the growth of net exports if $\lambda > 0$, and hinders net export growth if $\lambda < 0$. In any case, if both null hypotheses can be rejected, then there is a feedback in the system. Conversely, no causal relationship exists if neither the first hypothesis nor the second hypothesis can be rejected.

4. DATA AND EMPIRICAL ANALYSIS

The data utilized in this study are quarterly data for Mexico from 1994Q1 to 2005Q4 and are sourced from the International Monetary Fund (IMF) International Financial Statistics (IFS). Y stands for real GDP, X is exports, and NX is net exports. Other variables include consumption (CON), gross investment (I), and government expenditures (G).

First, Table 1 presents the results of the least squares regression estimates of the Mexican economy during the NAFTA period. All the variables are significant at 1, 5, and 10 per cent levels with the expected (positive) signs. For instance, the estimated coefficient of net exports (NX) of 1.91 is statistically significant – implying a favorable export-growth (output) linkage in Mexico during the NAFTA period. Supported by a very high F-statistic, the adjusted coefficient of determination, R^2 indicates a very good fit at 99 per cent suggesting a very good relationship between the growth variable and the explanatory variables. Also, the Durbin-Watson statistic of 2.03 indicates no presence of serial correlation or first-order autocorrelation of the residuals.

Second, a vector autoregression estimates are shown in Table 2 to capture the interrelationship between economic growth, consumption, gross investment, government spending, and net exports in real terms. Thus, each variable is estimated as a function of a specified number of lags (two-period lagged model) of itself and of each of the other variables. The Akaike Information Criterion (AIC) and the Schwarz Criterion (SC) are at a minimum for two-period lagged model. Furthermore, to examine the path of dynamic responses of the variables of concern (growth and exports) to changes in each other, the model is transformed into a moving average of the residuals (innovations), whereby, an impulse response test is applied to trace the effect of a one-time shock to one of the innovations (impulses) on current and future values of the endogenous variables in Table 2, that is, if *ymt* (or its residual) in equation (5) deviates from and then returns to its equilibrium. Thus, the multiple graphs in Figure 1 depict the time path of a response to a shock equivalent to a one standard deviation (S.D.) positive innovation (residual). For example, the second graph in row one shows a positive response of output growth (Y) to net export growth (NX), while, the first graph in row two shows both positive and negative influence of net export growth (NX) to output growth (Y) over ten quarters of the NAFTA period under study.

Table 1
Least Squares Regression Results
Dependent Variable: Y

Sample: 1994Q1 2005Q4
Included observations: 48

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
C0N	0.916155	0.086163	10.63285	0.0000
I	1.351685	0.296394	4.560438	0.0000
G	0.976126	0.202439	4.821819	0.0000
NX	1.912805	0.400547	4.775479	0.0000
C	73.33253	42.45346	1.727363	0.0913
R-squared	0.997651	Mean dependent var		4807.104
Adjusted R-squared	0.997433	S.D. dependent var		2198.845
S.E. of regression	111.4051	Akaike info criterion		12.36256
Sum squared resid	533677.4	Schwarz criterion		12.55747
Log likelihood	-291.7013	F-statistic		4566.628
Durbin-Watson stat	2.030812	Prob(F-statistic)		0.000000

Table 2
Vector Autoregression Estimates

Sample (adjusted): 1994Q3 2005Q4
Included observations: 46 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	Y	*C01*	*I*	*G*	*NX*
Y(-1)	-0.688213	-0.373260	-0.132618	-0.739776	0.241001
	(0.20491)	(0.13179)	(0.05614)	(0.08924)	(0.05179)
	[-3.35859]	[-2.83234]	[-2.36240]	[-8.28974]	[4.65331]
Y(-2)	0.641278	0.474931	0.095691	0.524118	-0.157176
	(0.19512)	(0.12549)	(0.05345)	(0.08498)	(0.04932)
	[3.28660]	[3.78470]	[1.79014]	[6.16790]	[-3.18709]
C0N(-1)	0.492956	0.305317	0.038804	0.001313	0.031011
	(0.27065)	(0.17406)	(0.07415)	(0.11787)	(0.06841)
	[1.82139]	[1.75406]	[0.52335]	[0.01114]	[0.45334]
C0N(-2)	0.081187	0.061739	0.018088	0.270914	-0.086876
	(0.27213)	(0.17501)	(0.07455)	(0.11851)	(0.06878)
	[0.29835]	[0.35277]	[0.24263]	[2.28596]	[-1.26310]
I(-1)	3.263049	1.504825	1.392032	1.784413	-0.708162
	(0.65149)	(0.41900)	(0.17848)	(0.28373)	(0.16467)
	[5.00856]	[3.59149]	[7.79929]	[6.28914]	[-4.30061]
I(-2)	-1.169146	-0.518967	-0.384057	-1.449261	0.380591
	(0.77529)	(0.49862)	(0.21240)	(0.33764)	(0.19596)
	[-1.50801]	[-1.04081]	[-1.80820]	[-4.29227]	[1.94223]

table contd.

	Y	*C01*	*I*	*G*	*NX*
G(-1)	1.552338	1.275236	-0.083557	0.528516	0.106601
	(0.38449)	(0.24728)	(0.10533)	(0.16745)	(0.09718)
	[4.03739]	[5.15709]	[-0.79326]	[3.15630]	[1.09694]
G(-2)	0.724833	0.197275	0.113412	0.176741	-0.072067
	(0.37997)	(0.24437)	(0.10410)	(0.16548)	(0.09604)
	[1.90760]	[0.80727]	[1.08949]	[1.06805]	[-0.75040]
NX(-1)	2.598660	1.130482	0.206619	0.482365	0.475933
	(0.77333)	(0.49735)	(0.21186)	(0.33679)	(0.19546)
	[3.36036]	[2.27300]	[0.97526]	[1.43225]	[2.43495]
NX(-2)	0.001106	-0.119846	0.165903	-0.093027	-0.105314
	(0.74671)	(0.48023)	(0.20457)	(0.32519)	(0.18873)
	[0.00148]	[-0.24956]	[0.81100]	[-0.28607]	[-0.55801]
C	303.3971	123.4387	24.85740	78.72434	10.55083
	(62.6983)	(40.3234)	(17.1767)	(27.3055)	(15.8470)
	[4.83900]	[3.06122]	[1.44716]	[2.88310]	[0.66579]
R-squared	0.997431	0.997942	0.995368	0.972149	0.889399
Adj. R-squared	0.996697	0.997354	0.994045	0.964192	0.857799
Sum sq. resids	521164.7	215564.3	39114.93	98846.74	33293.41
S. E. equation	122.0263	78.47917	33.43007	53.14313	30.84218
F-statistic	1358.921	1696.896	752.1359	122.1698	28.14542
Log likelihood	-279.9803	-259.6758	-220.4204	-241.7429	-216.7141
Akaike AIC	12.65132	11.76851	10.06176	10.98882	9.900611
Schwarz SC	13.08860	12.20579	10.49904	11.42611	10.33790
Mean dependent	4955.674	3434.717	980.0652	555.7609	-68.00000
S. D. dependent	2123.259	1525.538	433.1988	280.8383	81.78889
Determinant resid covariance (dof adj.)		9.16E+16			
Determinant resid covariance		2.34E+16			
Log likelihood		-1193.226			
Akaike information criterion		54.27070			
Schwarz criterion		56.45712			

Finally, the pairwise Granger causality tests in Table 3 below suggest that the first null hypothesis whereby net export growth (NX) does not cause output growth (Y) can be rejected because the computed F-statistics of 6.65 is greater than the 5 % critical values for both 1 and 4 degrees of freedom, respectively. Also, the second null hypothesis asserting that output growth does not cause net export growth can be rejected as indicated by the computed F-statistics of 9.46 which is greater than the 5 % critical values for both 1 and 4 degrees of freedom, respectively. Thus, the bivariate Granger causality tests for Mexico during the period of NAFTA validates the export-led growth hypothesis in both directions.

Figure 1: Impulse Response Functions

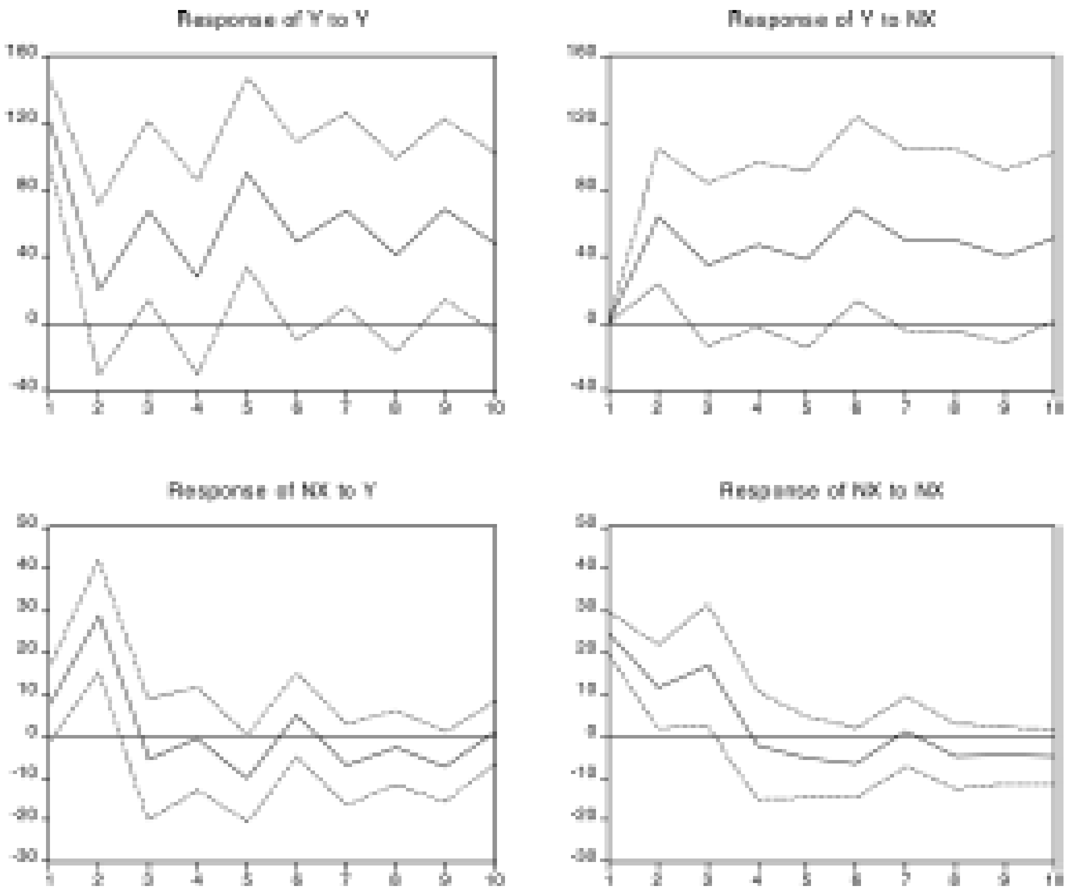

Table 3
Pairwise Granger Causality Tests

Sample: 1994Q1 2005Q4
Lags: 4

Null Hypothesis:	*Obs*	*F-Statistic*	*Probability*
NX does not Granger Cause Y	44	6.65446	0.00043
Y does not Granger Cause NX		9.46210	2.7E-05
X does not Granger Cause Y	44	2.59512	0.05311
Y does not Granger Cause X		6.41765	0.00055
X does not Granger Cause NX	44	3.05759	0.02919
NX does not Granger Cause X		2.71762	0.04528

5. CONCLUSION

The main objective of this study is to examine the relationship between economic growth and export in Mexico within the context of NAFTA. The results of the least squares regression estimates indicate that the explanatory variables are statistically significant. For example, an increase in net exports positively influences economic growth. In addition, the application of the impulse response functions from the estimated VAR equations indicate that output (growth) increases in response to an innovation (shock) in export via net exports over ten quarters, but mixed response in reverse. Finally, the causality tests utilizing net export growth as a proxy for output growth supports the contention of export-led growth hypothesis in both directions (bi-directional). Overall, the empirical results show that the Mexican government policy and strategy are consistent with its NAFTA objective of export-led growth.

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