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Export Vs. Import - Led Growth In Mexico

Joseph Kababie
University of Texas at El Paso, jkababie@miners.utep.edu

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JOSEPH KABABIE

Department of Economics and Finance

APPROVED:

Thomas Fullerton, Ph.D., Chair

Wm. Doyle Smith, Ph.D.

Charles R. Boehmer, Ph.D.

Patricia D. Witherspoon, Ph.D.
Dean of the Graduate School

Dedication

My thesis is dedicated, first and foremost, to God for all the blessings that my family and I have received; Secondly, to my parents, Ruben and Martha Kababie; thirdly, to my siblings, Leon and Paulina Kababie.

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by

JOSEPH KABABIE, B.B.A., M.B.A.

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Abstract

This study concentrates on the role of imports and the impact they have for economic growth in the country of Mexico. The investigation is conducted in a time series framework using an ordinary least square method, a vector autoregressive model, and a vector error correction model to test the trade variables of exports and imports for exogenous or endogenous induced growth. The results indicate through Granger causality tests that imports are having the significant impact for economic growth. These findings are in some ways in contradiction to previous literature that has focused on exports as being the sole engine for economic growth. This article contributes to the growing literature of endogenous growth theory with its findings of import led growth for Mexico.

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Section 1: Introduction

It is well known, that gross domestic product (GDP), is one of the key measures of economic growth. GDP is defined as the value of all goods and services produced during a specific period. GDP is made up of the following components: (1) consumption expenditures; (2) private domestic investment; (3) government purchases; and (4) net exports (GDP = C+I+G+NX). Net exports are made up of exports minus imports (NX = X-M).

When net exports rise, in isolation to the other components (C+I+G), so does GDP. When net exports fall, so does GDP. The simple mechanics of that aspect of the identity occasionally lead to misguided claims that imports cause GDP to deteriorate and hurt the economic health of a nation. The truth is, if imports are reduced to zero, GDP would not rise but rather remain constant. This is due to, the accounting principle in the balance of payments not to double-count imports, which are already, included in consumption, investment, and government purchases and therefore must be subtracted from exports. This implies that industrialized nations that import more and emerging markets that export more or vice versa, can both achieve growth in their GDP without lowering their respective economic positions. However, depending on the nation, the causal direction and magnitude of the effects of exports and imports will vary from country to country.

A large volume of empirical research confirms that trade is vital and necessary for development and growth. What seems to be left for debate is the most effective path to economic growth through trade. There are three dominant hypotheses proposed in the economic literature: (1) export-led growth (ELG); (2) growth-led exports (GLE); and (3) import-led growth (ILG) (Awokuse, 2008). Of the three hypotheses, the focus of this paper will be on the third hypothesis of import-led growth. To date, work in this area has been completed for a small

number of Asian (Thangavelu and Rajaguru, 2004) and Latin American economies (Awokuse, 2008), but not for Mexico. For that reason, the paper will examine what the data indicate for economic performance in the latter country.

During much of the post-war period, Mexico adopted an import-substitution growth policy. That approach began to be questioned during the mid 1970s. With the eventual implementation of the North American Free Trade Agreement (NAFTA), Mexico shifted gears in favor of export-led growth. There are several contributions that imports provide to growth. They include increased capital stocks, access to new technologies, and the generation of new ideas.

The paper investigates whether economic growth in Mexico is led by imports. The study is organized as follows. Section II provides a review of pertinent literature on this topic. Section III discusses the theoretical framework and data. Section IV presents the empirical analysis. Conclusions are given in section V.

Section 2: Literature Review

The economic literature has established that imports are valuable to economic growth for three primary reasons: (1) they are a source of technology transfers; (2) they promote innovation through import competition; and (3) they provide factors of production, which are used in both domestic and export sectors. Given that, it is no surprise that an expansion of imports can frequently spur an expansion of exports (Coe and Helpman, 1995; Lawrence and Weinstein, 1999; Awokuse, 2008).

Prior studies, have often examined on the role of exports as a means for economic growth, to the exclusion of the role of imports, which have led to misleading or perhaps biased conclusions in favor of the ELG and GLE hypotheses. Empirical evidence indicates this is because spurious results may occur when analyzing a system without including imports in Granger causality tests (Awokuse, 2008). It is clear that exports are a catalyst for economic growth, but this does not mean that an export-led growth strategy should take precedence over an import-led growth strategy. This is because, both imports and exports are equally important for an outer-oriented economic strategy (Thangavelu and Rajaguru, 2004).

For transitional European countries, Awokuse (2007) concludes that imports stimulate economic growth just as much as exports. Awokuse (2008) reports similar results for Latin American countries. Evidence in those indicate that for an export promotion strategy to work effectively, it must also be combined with an equally effective import promotion strategy. That is at least partially because imports facilitate export strategies by supplying critical production inputs. In many of the Latin American countries tested, imports are found to have larger effects on growth than exports.

In developing countries, per-capita income growth rates are often higher for countries that import more capital goods for the production of capital stock relative to the ratio of domestically produced capital goods for investment (Lee, 1994). Moreover, growth rates tend to decline as the ratio of imported capital goods to gross domestic product (GDP) falls (Krueger, 1983). Lawrence and Weinstein (1994) use data for Korea, Japan, and the United States to analyze growth. Imports are found to be conduits for promoting productivity and growth, while no evidence is found in support of exports as promoting productivity and growth for the two higher income countries.

Growth in the long run can be achieved by accumulating inputs that will provide positive externalities. In addition, endogenous growth models relying on imports can be used for sustained long-run economic growth (Grossmann and Helpman, 1994). Imports seemingly provide a virtuous link between trade and output growth for many regions (Thangavelu and Rajaguru, 2004).

Empirical research conducted for the ELG and GLE hypotheses point to three possible outcomes: (1) support for the ELG hypothesis; (2) support for GLE hypothesis; and (3) bi-directional causal relationships (Van den Berg and Schmidt, 1994; Xu, 1996; Riezman *et al.*, 1996; Giles and Williams, 2000). Less empirical testing has been carried out on the ILG hypothesis. This study attempts to partially fill that gap in the literature by employing trade and growth data for Mexico.

Section 3: Theoretical Framework and Data

To examine the causal relationship between trade and economic growth for Mexico, an integrated framework focusing on the roles of exports and imports is used. Three methods are utilized to carry out the investigation: (1) an estimated production function of the traditional neoclassical growth model; (2) vector autoregression (VAR) analysis with three endogenous variables to test for the ELG and ILG hypotheses; and (3) vector error correction (VEC) models for long-run and short-run relationships between exports, imports, and GDP (Awokuse, 2008).

The traditional neoclassical growth model has been augmented with exports and imports added to the aggregate production function (Balassa, 1978; Sheehey, 1992; Awokuse, 2008). To test their respective effects on growth in Mexico, the aggregate production function is expressed as:

$$Y = F\,[(K, L); X, M] \qquad (1)$$

In (1), Y is real GDP; K is a real gross capital formation proxy for capital; L is the labor force; X is real exports; and M is real imports. Following logarithmic transformation, equation (2) offers a specification that can be used for parameter estimation:

Log (2)

Equation (2) offers a useful starting point for empirical analysis, but may impose unrealistic causality assumptions.

Vector autoregressive models (VAR) are very useful in describing dynamic behavior in economic time series data given by (Lutkepohl, 1991):

$$Z_t = \mu + \alpha_{1Zt-1} + ... + \alpha_{pZt-p} + \varepsilon_t \qquad (3)$$

The equation notation for the three main variables is:

$$Y_t = \beta_1 + \beta_{11} Y_{t-1} + \beta_{12} X_{t-1} + \beta_{13} M_{t-1} \ldots + \beta_{14} Y_{t-p} + \beta_{15} X_{t-p} + \beta_{16} M_{t-p} + \varepsilon_{1t} \quad (4)$$

(5)

(6)

An error correction model (ECM) framework allows capturing both long-run and short-run dynamics (Engle and Granger, 1987). A multivariate vector error correction model (VECM) (Johansen and Juselius, 1990; Johansen, 1991) can be expressed as:

(7)

For GDP, exports, and imports, one such VECM system is given by:

$$\Delta Y_t = \mu_1 + \alpha_{11} \xi_{1t-1} + \alpha_{12} \xi_{2t-1} + \sum_{j=1}^{p-1} \phi_{1j} \Delta Y_{t-j} + \sum_{j=1}^{p-1} \theta_{1j} \Delta \mathrm{X}_{t-j} + \sum_{j=1}^{p-1} \psi_{1j} \Delta M_{t-j} + \varepsilon_{1t} \quad (8)$$

$$\Delta X_t = \mu_2 + \alpha_{21} \xi_{1t-1} + \alpha_{22} \xi_{2t-1} + \sum_{j=1}^{p-1} \phi_{2j} \Delta Y_{t-j} + \sum_{j=1}^{p-1} \theta_{2j} \Delta \mathrm{X}_{t-j} + \sum_{j=1}^{p-1} \psi_{21j} \Delta M_{t-j} + \varepsilon_{2t} \quad (9)$$

$$\Delta M_t = \mu 3 + \alpha_{31} \xi_{1t-1} + \alpha_{32} \xi_{2t-1} + \sum_{j=1}^{p-1} \phi_{3j} \Delta Y_{t-j} + \sum_{j=1}^{p-1} \theta_{3j} \Delta \mathrm{X}_{t-j} + \sum_{j=1}^{p-1} \psi_{3j} \Delta M_{t-j} + \varepsilon_{3t} \quad (10)$$

In the above VECM framework, ΔY_t, ΔX_t, and ΔM_t are influenced by long term error correction terms (ξ_{1t-1}) and short-term difference lags of variables of Y_{t-j}, X_{t-j}, and M_{t-j}.

Section 3.1: Data

The data for Mexico are from the World Development Indicators of the World Bank. The annual frequency data are for 1960-2007 measured in constant 2000 U.S. $ and include 48 observations. The exception, due to missing observations, is the labor force variable which is collected from four different sources: (1) 2007-1980 from the World Bank; (2) 1979-1974 from Laborsta, International Labour Organization (ILO); (3) 1960 and 1970 from the Instituto Nacional de Estadistica y Geografia (INEGI) decennial census; and (4) the missing observations for the years 1973-1971 and 1969-1961 are obtained by using the Stata statistical software program to interpolate separately using real GDP and population patterns applied to observations for the labor force variable. An average of both series produces the generated labor force estimates for the missing observations. All variables are transformed using natural logarithms.

Section 4: Empirical Analysis and Results

All empirical analysis and tests are conducted using the Stata statistical software program, version 10 and EViews, version 7. As a point of departure, an ordinary least squares (OLS) regression is used to give initial insight into which of the three proposed hypotheses may be occurring for Mexico: (1) export-led growth (ELG); (2) growth-led exports (GLE); or (3) import-led growth (ILG) (Awokuse, 2008). Table 1 indicates that the OLS regression suffers from autocorrelation at the first and higher orders, as the null hypothesis is strongly rejected (Breusch, 1978; Godfrey, 1978).

Table 1. Breusch-Godfrey LM Test for Autocorrelation

lags	chi2	df	Prob > chi2
1	17.058	1	0.0000
2	17.068	2	0.0002
3	17.244	3	0.0006
4	17.247	4	0.0017

Notes:
Ho: no serial correlation
Stata syntax: estat bgodfrey, lag (1,2,3,4).

To correct the effects of serial correlation at lower and higher orders, an autoregressive moving average exogenous procedure (ARMAX) is utilized (Pagan, 1974). Table 2 provides results of the nonlinear ARMAX regression. The ARMA (2,1) specification applied includes an autoregressive (AR2) term at second order and a moving average (MA1) component of first order. The AR2 and the MA1 terms are found to be significant at the 5% significance level and the Durbin-Watson statistic of 2.037 indicates that autocorrelation has been eliminated and the OLS model is now properly specified.

The independent variable of most importance to the study is imports, which is shown in this model to have a negative marginal effect. The negative marginal effect occurs, when there is

a 1 percent increase to imports causing GDP to fall by -0.0447 percent. Secondly, exports have a positive marginal effect of 0.0891 in this OLS model. The other independent variables all have positive marginal effects on GDP and are shown to be statistically significant with the exception of labor force. The results show that, under the OLS model, the hypothesis of import-led growth (ILG) for Mexico does not hold, but rather export-led growth (ELG) is occurring for Mexico. Additional testing may be helpful because the specification shown in Table 2 does not take into account potential dynamic effects affecting trade and growth.

Table 2. OLS Model With Serial Correlation Correction

Dependent Variable: gdp_ln
Method: Least Squares
Sample: 1962-2007
Included observations: 46
Convergence achieved after 17 iterations
MA Backcast: 1961

Variable	Coefficient	Std. Error	t-Statistic	Prob.
cons	14.6711	2.0509	7.1536	0.0000*
exports_ln	0.0891	0.0255	3.4956	0.0012*
imports_ln	-0.0447	0.0207	-2.1600	0.0370*
capital_ln	0.3151	0.0296	10.6528	0.0000*
laborforce_ln	0.1918	0.1183	1.6215	0.1130
AR(2)	0.9039	0.0293	30.8008	0.0000*
MA(1)	0.8837	0.0773	11.4318	0.0000*

R-squared	0.9996	Mean dependent var	26.5059
Adjusted R-squared	0.9996	S.D. dependent var	0.5283
S.E. of regression	0.0109	Akaike info criterion	-6.0649
Sum squared resid	0.0046	Schwarz criterion	-5.7866
Log likelihood	146.4924	Hannan-Quinn criter.	-5.9606
F-statistic	17685.7100	Durbin-Watson stat	2.0375

Inverted AR Roots	.95	-.95
Inverted MA Roots	-.88	

Notes:
* denotes significance of variables at the 5% significance level.

Table 3 presents results of Breush-Pagan / Cook Weisberg test for heteroskedasticity (Breush and Pagan, 1979; Cook and Weisberg, 1983). The test shows that the null hypothesis is accepted with a p-value above 0.05. The acceptance of the null hypothesis indicates that the residuals are homoskedastic. Other diagnostics shown in Table 2 exhibit levels of statistical significance.

Table 3. Breush-Pagan / Cook Weisberg Test for Heteroskedasticity

chi2(1)	=	1.11
Prob > chi2	=	0.2912

Notes:
Ho: Constant variance
Variables: fitted values of gdp_ln
Stata syntax: estat hettest

The second model deployed is a VAR model. A VAR model does take into account dynamic time series properties. To find the optimal lag length of a VAR model, several criteria are used: (1) Likelihood ratio (LR) test; (2) Final predication error (FPE) criterion; (3) Akaike information criterion (AIC); (4) Hannan and Quinn criterion (HQIC); and (5) Schwarz Bayesian criterion (SBIC). Table 4 shows that 3 of the 5 tests (FPE; HQIC; SBIC) favor of an optimal lag length of 1. The optimal lag length of 1 differs from the optimal lag length of 2 found in the Awokuse (2008) study. However, the optimal lag length of 1 does coincide with that reported for Hong Kong, Indonesia, Japan, Singapore, and Taiwan in Thangavelu and Rajaguru (2004).

Table 4. Selection-Order Criteria

Sample: 1964-2007
Included Observations: 44

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	113.137	-	-	-	5.00E-09	-19.332	-19.332	-19.332
1	440.571	654.87	25	0.000	5.5e-15*	-33.079	-32.703*	-32.0652*

2	465.569	49.997	25	0.002	5.70E-15	-33.0789	-32.327	-31.0514
3	483.916	36.694	25	0.062	8.70E-15	-32.7765	-31.6487	-29.7353
4	515.986	64.139*	25	0.000	8.10E-15	-33.0978*	-31.594	-29.0429

Notes:
Endogenous: gdp_ln exports_ln imports_ln capital_ln laborforce_ln,Exogenous: _cons.
Stata syntax: varsoc, maxlag(4) lutstats.
* denotes optimal lag length.

Table 5 and 6 presents the results of the Lagrange multiplier test for autocorrelation (Johansen, 1995) and the Eigenvalue test for stability (Lutkepohl, 1991; Hamilton, 1994). As can be seen in Table 5, the autocorrelation null hypothesis fails to be rejected. The VAR model is also shown to be stable (Table 6). Together, these tests uncover no evidence of model misspecification.

Table 5. Lagrange-Multiplier Test

lag	chi2	df	Prob > chi2
1	22.6122	25	0.6002
2	25.36	25	0.4424
3	29.6149	25	0.2390
4	14.4882	25	0.9525

Notes:
Ho: no autocorrelation at lag order.
Stata syntax: varlmar, mlag(4).

Table 6. Eigenvalue Stability Condition

Eigenvalue	Modulus
0.9733	0.9733
0.9186 + 0.1239i	0.9269
0.9186 - 0.1239i	0.9269
0.6774 + 0.2490i	0.7217
0.6774 - 0.2490i	0.7217
0.3634 + 0.5432i	0.6535
0.3634 - 0.5432i	0.6535
-0.2051 + 0.0523i	0.2117
-0.2051 - 0.0523i	0.2117

0.0354	0.0354

Notes:
All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.
i: is part of the complex number component of the eigenvalues (i^2=-1).
Stata syntax: varstable.

The VAR model coefficients are shown in Table 7. In VAR models, interpreting coefficients on their own can be very difficult. Therefore, Granger causality Wald tests based on the VAR model are conducted to examine the causality hypotheses. Table 8 provides results of various Granger causality Wald tests.

Table 7. Vector Autoregression Estimation Results

Sample: 1962-2007
Included Observations: 46

Variable	Coef.	Std. Err.	z	P>|z|
gdp_ln				
gdp_ln				
Lag 1.	1.3578	0.4457	3.05	0.002
Lag 2.	0.0435	0.4031	0.11	0.914
exports_ln				
Lag 1.	0.0658	0.0759	0.87	0.386
Lag 2.	-0.0812	0.0736	-1.1	0.270
imports_ln				
Lag 1.	0.0680	0.0595	1.14	0.254
Lag 2.	0.0265	0.0642	0.41	0.680
capital_ln				
Lag 1.	-0.2142	0.1530	-1.4	0.161
Lag 2.	-0.0965	0.1446	-0.67	0.504
laborforce~n				
Lag 1.	0.4751	0.3435	1.38	0.167
Lag 2.	-0.7401	0.3417	-2.17	0.030
cons	-0.3524	1.2199	-0.29	0.773

exports_ln				
gdp_ln				
Lag 1.	1.0352	0.8027	1.29	0.197
Lag 2.	-0.9431	0.7261	-1.3	0.194
exports_ln				
Lag 1.	1.1565	0.1368	8.46	0.000
Lag 2.	-0.4393	0.1326	-3.31	0.001
imports_ln				
Lag 1.	-0.0044	0.1073	-0.04	0.967
Lag 2.	0.0760	0.1156	0.66	0.511
capital_ln				
Lag 1.	-0.2066	0.2755	-0.75	0.453
Lag 2.	0.1884	0.2604	0.72	0.469
laborforce~n				
Lag 1.	-0.5926	0.6186	-0.96	0.338
Lag 2.	1.1673	0.6155	1.9	0.058
cons	-6.5847	2.1972	-3	0.003
imports_ln				
gdp_ln				
Lag 1.	2.8162	1.9221	1.47	0.143
Lag 2.	-0.1705	1.7386	-0.1	0.922
exports_ln				
Lag 1.	0.3923	0.3275	1.2	0.231
Lag 2.	-0.4013	0.3175	-1.26	0.206
imports_ln				
Lag 1.	1.4097	0.2568	5.49	0.000
Lag 2.	-0.0601	0.2769	-0.22	0.828
capital_ln				
Lag 1.	-1.6128	0.6597	-2.44	0.014
Lag 2.	-0.3350	0.6235	-0.54	0.591
laborforce~n				
Lag 1.	1.5950	1.4813	1.08	0.282
Lag 2.	-2.9271	1.4739	-1.99	0.047
cons	-7.5701	5.2611	-1.44	0.150

Equation	Parameters	RMSE	chi2	P>chi2
gdp_ln	11	0.9975	18688.57	0.000
exports_ln	11	0.9986	32580.63	0.000
imports_ln	11	0.9863	3322.275	0.000

capital_ln	11	0.9791	2159.648	0.000
laborforce_ln	11	0.9992	55968.27	0.000

Log likelihood= 484.257	AIC= -18.6634
FPE= 5.66e-15	HQIC= -17.8443
Det(Sigma_ml)= 4.94e-16	SBIC= -16.4769

Notes:
Stata syntax: var gdp_ln exports_ln imports_ln capital_ln laborforce_ln.

In Table 8, Exports are found not to Granger cause GDP and GDP is found not to Granger cause exports. Imports are found to Granger cause GDP and GDP is also found to Granger cause imports, implying a bi-directional causality link between these variables. The Granger causality tests indicate that the hypotheses of ELG and GLE and are not supported by the estimation results. The VAR model, does however, support the ILG hypothesis. To further investigate the various growth hypotheses being examined, a VEC model is also estimated (Awokuse, 2008; Thangavelu and Rajaguru, 2004).

Table 8. Granger Causality Wald Test

Equation	Excluded	chi2	df	Prob > chi2
gdp_ln	exports_ln	1.2445	2	0.537
gdp_ln	imports_ln	7.4245	2	0.024*
gdp_ln	capital_ln	6.9864	2	0.030*
gdp_ln	laborforce_ln	8.934	2	0.011*
gdp_ln	ALL	16.558	8	0.035
exports_ln	gdp_ln	1.7552	2	0.416
exports_ln	imports_ln	1.2759	2	0.528
exports_ln	capital_ln	0.6448	2	0.724
exports_ln	laborforce_ln	10.289	2	0.006*
exports_ln	ALL	27.837	8	0.001
imports_ln	gdp_ln	10.936	2	0.004*
imports_ln	exports_ln	1.6428	2	0.440
imports_ln	capital_ln	15.275	2	0.000*
imports_ln	laborforce_ln	10.103	2	0.006*
imports_ln	ALL	35.908	8	0.000

Notes:
Ho: endogenous variables do not Granger cause the dependent variable.
* denotes significance of variables.
Stata syntax: vargranger

A VEC model also allows for dynamic time series properties and permits examining short-run and long-run causal patterns. To avoid spurious results in the VEC model, both unit root tests and cointegration tests are applied. For the unit root tests, a null hypothesis of nonstationarity is examined (Dickey and Fuller, 1979), and a test for a null hypothesis of stationarity is also deployed (Kwiatkowski et al.,1992). The combination of both tests provides a robust technique for exposing the presence of unit roots (Awokuse, 2008). Table 9 indicates that the variables are integrated after first differencing at order one and that cointegrating relationships may exist among the variables.

Table 9. Unit Root Tests

Variable	ADF	KPSS
Levels		
GDP_ln	-3.447**	1.04**
Exports_ln	0.459	0.324**
Imports_ln	0.257	0.667**
Capital	-1.534	0.607**
Labor Force_ln	-0.646	0.671**
First Differences		
GDP_ln_diff	-4.556**	0.118
Exports_ln_diff	-3.968**	0.136*
Imports_ln_diff	-5.077**	0.0447
Capital_ln_diff	-5.671**	0.0712
Labor Force_ln_diff	-3.826**	0.453**

Notes:
** and * denote rejection of the null hypothesis of unit roots for ADF and KPSS tests at 5% and 10% significance levels.
The critical values for the ADF are -2.941 at 5% and -2.605 at 10%.
The KPSS critical values are 0.146 at 5% and 0.119 at 10%.

To establish the number of cointegrating vectors, two tests are conducted: (1) the maximal eigenvalue (λ-max) which tests the null hypothesis, that rank($\prod$) = r against the hypothesis that the rank is r + 1 and is given by:

$$\lambda\text{-max} = -\mathrm{T}\ln(1-\lambda_r) \tag{14}$$

and (2) the Trace test, based on the Likelihood ratio test, that examines the null hypothesis that the number of cointegrating vectors is less than or equal to r (Johansen and Juselius, 1990; Johansen, 1991) and is expressed as:

$$\text{Trace} = -\mathrm{T}\sum_{i=r+1}^{n}\ln(1-\lambda_i) \tag{15}$$

Table 10 presents the results of the λ-max and the Trace test using the optimal lag length of 1, chosen for the VAR model in Table 4. The results show that there are cointegrating relationships among the variables and they are integrated at order one, implying that the VEC specification is appropriate and will not produce spurious regressions. Table 11 shows that the VEC model does not suffer from autocorrelation as the null hypothesis fails to be rejected. In addition, it is indicating that the model is properly specified.

Table 10. Johansen and Juselius Cointegration Test

Cointegrating rank r	Trace statistics	C(5%)
r=0	346.532**	68.52
r ≤ 1	114.722**	47.21
r ≤ 2	21.935	29.68
r ≤ 3	2.393	15.41
r ≤ 4	0.0021	3.76
	λ-max statistics	C(5%)
r=0	231.81**	33.46
r ≤ 1	92.786**	27.07
r ≤ 2	19.542	20.97
r ≤ 3	2.391	14.07
r ≤ 4	0.0021	3.76

Notes:
** Denotes rejection of the null hypothesis of cointegration rank r at the 5% signifcance level.
The critical values (C(5%)) are taken from (Osterwald-Lenum, 1992).

Table 11. Lagrange-Multiplier Test

lag	chi2	df	Prob > chi2
1	29.6761	25	0.2367
2	25.1945	25	0.4515
3	33.8741	25	0.1106
4	12.6634	25	0.9804

Notes:
Ho: no autocorrelation at lag order.
Stata syntax veclmar, mlag(4).

Table 12 summarizes results from the VEC cointegrating equations. The cointegrating parameter magnitudes and signs differ considerably from those of the OLS regression shown in Table 2. For instance, exports exhibit a negative marginal effect on GDP. Where as imports exhibit a positive marginal effect on GDP. This is a reversal of the signs seen in the OLS model where exports had a positive marginal effect on GDP and imports had a negative marginal effect on GDP. The results of VEC cointegrating equations indicate that ELG hypothesis is not supported. The ILG hypothesis is, however, supported. It is difficult to determine causality by only interpreting coefficients in the VEC model. Granger causality Wald tests based on the VEC model are conducted to further examine the causality hypotheses (Granger, 1969).

Table 12. Vector Error-Correction Model

Dependent Variable:	gdp_ln_diff			
Sample:	1963-2007			
Included	Observations:	45		
Variable	Coef.	Std.Err.	z	P>|z|
exports_ln~f	-0.5112	0.1342	-3.81	0.000*
imports_ln~f	0.4159	0.1006	4.14	0.000*
capital_ln~f	-0.4390	0.1452	-3.02	0.003*
laborforce~f	1.0341	0.5186	1.99	0.046*
_cons	-0.0368	-	-	-

Cointegrating Equation	Equations Parameters	chi2	P>chi2
_ce1	4	33.3586	0.0000
Log likelihood=	417.4962	AIC=	-16.8221
		HQIC=	-16.2384
Det(Sigma_ml)=	6.01e-15	SBIC=	-15.2563

Notes:
Identification: beta is exactly identified and Johansen normalization restriction imposed.
Stata syntax: vec gdp_ln_diff exports_ln_diff imports_ln_diff capital_ln_diff laborforce_ln_diff.
* denotes significance of variables.

Table 13 provides results of the Granger causality Wald tests. Each column represents a VEC equation for each of the five variables in the system. The Granger causality Wald results are given as the p-values. The values in brackets represent the z-statistics for the error-correction terms for each cointegration equation. The significant z-statistics indicate long-run causality and significant p-values indicate short-run causality.

Only, the most vital variables to the study will be expounded upon: (1) GDP; (2) exports; and (3) imports. In the VEC model, exports are not found to Granger cause GDP and GDP is found not to Granger cause exports with p-values exceeding the 0.05 critical levels at 0.0958 and 0.4243. Imports are found to Granger cause GDP, but there is no bi-directional causal relationship between imports and GDP. Hence GDP is found to not Granger cause imports. The respective error-correction terms (z-statistics) of imports and GDP are significant at -5.26 and -2.78, indicating that long-run causal relationships exist between them. The results of the VEC model imply that the hypotheses of ELG and GLE do not hold for Mexico, but the ILG hypothesis is shown to be valid for Mexico. The findings are consistent with Awokuse (2008) and Thangavelu and Rajaguru (2004) and add to the growing body of international evidence in favor of the ILG development hypothesis.

Table 13. Granger Causality Test Results Based on VEC Model

Dependent	Exports	Imports	Capital	GDP	Labor Force
z-statistics	[2.33]*	[-5.26]*	[-3.27]*	[-2.78]*	[-1.62]
Independent					
Exports	–	0.1108	0.0963	0.0958	0.14
Imports	0.1667	–	0.0047*	0.0385*	0.3967
Capital	0.6458	0.0597	–	0.4254	0.7918
GDP	0.4243	0.3815	0.6335	–	0.7556
Labor Force	0.0220*	0.0033*	0.0305*	0.0329*	–

Notes:
Ho: endogenous variables do not Granger cause the dependent variable.
Values in brackets are estimated z-statistics for each cointegration equation.
All other values represent p-values.
* denotes statistical significance.

Section 5: Conclusion

In summary, two of the three empirical methods conducted in this study favored the ILG hypothesis with the only exception being the OLS model. The OLS model indicated that the ELG hypothesis is supported for Mexico, however, OLS models have significant limitations and are not known to determine the direction of causality (Awokuse, 2008). In the VAR model, using Granger causality tests, the ILG hypothesis is supported with evidence of bi-directional causality with GDP. Moreover, the VEC model also upholds the ILG hypothesis with the VEC cointegrating equations, and further supports it with VEC Granger tests. The empirical evidence for Mexico, thus, tends to support the ILG hypothesis in accordance with other similar studies (Thangavelu and Rajaguru, 2004; Awokuse, 2007; and Awokuse, 2008).

Aside from the evidence reported for other countries, the results obtained here are fairly logical. Imports bring about economic growth because (1) they are a source of technology transfers; (2) they promote innovation through import competition; and (3) they provide factors of production, which are used in both domestic and export sectors. The results of the paper lend credence to policies implemented in Mexico that continue to deregulate international commerce.

Liberalized trading regimes represent only one facet of market-oriented structural reforms. Another question yet to be answered for Mexico is whether other reform measures can bolster economic performance further. Potential topics to consider include labor code reforms and business registry practices.

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Data Appendix

Year	GDP	Exports	Imports
1960	94354817024	4617406976	11154782208
1961	99075309568	5025683968	11023779840
1962	103696596992	5337655808	11215342592
1963	112103161856	5482562560	12380507136
1964	125449592832	5860808192	14273521664
1965	133686927360	6329359360	14847919104
1966	141836664832	6938912768	16000411648
1967	150141108224	6564347392	15939359744
1968	164289314816	6893077504	16924787712
1969	169905750016	7743076864	16898599936
1970	180953841664	8074131456	18195755008
1971	187762163712	8303965184	17415174144
1972	203212750848	9461671936	20103745536
1973	219187560448	10494202880	24284225536
1974	231849639936	10471209984	28612204544
1975	245168209920	10708926464	27494103040
1976	255998377984	11488024576	25827717120
1977	264678359040	13580831744	21112207360
1978	288385433600	16672159744	25759961088
1979	316353544192	19789766656	33346646016
1980	345563267072	24183482368	45746413568
1981	375878156288	26932840448	53852356608
1982	373518008320	33007099904	33467883520
1983	357844090880	37703368704	22157424640
1984	370762907648	39871221760	26104422400
1985	380378218496	38093148160	28971890688
1986	366099136512	39804108800	26774652928
1987	372892991488	43581755392	28152502272
1988	377537167360	46093193216	38488494080
1989	393387278336	48702803968	45403860992
1990	413325328384	51286577152	54368497664
1991	430776975360	53886935040	62620344320
1992	446408392704	56572846080	74904133632
1993	455115702272	61150703616	76297003008
1994	475405942784	72034557952	92512247808
1995	445845274624	93784563712	78597152768
1996	468760952832	110882349056	96583499776

1997	500522057728	122764451840	118552231936
1998	525080297472	137721970688	138184032256
1999	545418018816	154700267520	157629186048
2000	581426413568	179887865856	191482445824
2001	580513693696	173419069440	188358049792
2002	585312698368	175920152576	191113396224
2003	593223352320	180658765824	192437272576
2004	617023340544	201437069312	213108408320
2005	636769271808	215035183104	231169228800
2006	667428519936	238313111552	260665147392
2007	688805773312	253014376448	278983507968

Units of measure: Constant 2000 US$.
Data source: World Development Indicators, the World Bank.

Year	Capital	LaborForce
1960	15230522368	11253297
1961	15369924608	11374799
1962	16223889408	11497271
1963	18068043776	11658941
1964	21727744000	11871335
1965	23352766464	12035962
1966	25410082816	12201976
1967	28325777408	12371577
1968	31039725568	12601148
1969	33238427648	12749808
1970	35845033984	12955057
1971	34864238592	13517337
1972	39449415680	14343039
1973	45354401792	15191203
1974	49105539072	15946000
1975	53749755904	16597000
1976	53516763136	17301000
1977	49681076224	18043000
1978	57795719168	18826000
1979	69290131456	19651000
1980	81371996160	21883572
1981	94578016256	22771202
1982	78696718336	23525348
1983	56441057280	24056305
1984	60068601856	24857943
1985	64785387520	25654049
1986	57141805056	26352933
1987	57071812608	27216572
1988	60370853888	28054457
1989	63842881536	28994192
1990	72221589504	29930514
1991	80161169408	30858575
1992	88849768448	32104902
1993	86603653120	33313603
1994	93870473216	34148795
1995	66645393408	34996003
1996	77571530752	35847622
1997	93889855488	37540123
1998	103542767616	38322308

1999	111524519936	38653777
2000	124191096832	39435346
2001	117189582848	39665024
2002	116441423872	40477726
2003	116871135232	40822330
2004	126232133632	42438727
2005	134375981056	43115044
2006	147320733696	44580258
2007	155572486144	44356138

Units of measure: Constant 2000 US$ for Capital.
Data sources: World Development Indicators, the World Bank for Capital.
LaborForce sources: (1) 2007-1980 from the World Bank; (2) 1979-1974 from Laborsta, International Labour Organization (ILO); and (3) 1960 and 1970 from the Instituto Nacional de Estadistica y Geografia (INEGI).

Vita

Joseph Kababie was born on November 8th, 1982 in Mexico, Distrito Federal and raised in El Paso, Texas. He graduated from Coronado High School in the spring of 2001 and spent the academic school year 1999-2000 in Yeshiva High School Chanoch Lennar in Brooklyn, New York. In July of 2005 he was awarded the degree of Bachelor of Business Administration with a concentration in International Business from the University of Texas at El Paso. In December of 2006 he was awarded the degree of Master of Business Administration from the University of Texas at El Paso. From the spring of 2008 until the completion of his thesis he worked as a graduate teaching assistant for the Economics and Finance Department at the University of Texas at El Paso.

Permanent address: 917 Broadmoor Drive
El Paso, Texas, 79912

This thesis was typed by Joseph Kababie.