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Economic Performance and Stock Market Activity in Mexico

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Abstract

We evaluate the association between stock market performance and the aggregate economy for the long-run and for the short-run. To that end, we perform cointegration and common cycle tests considering various stock market indicators, real GDP, consumption, investment and industrial production for the Mexican economy. We identify the existence of common trends but not common cycles. Specifically, stock market activity and real variables exhibit a positive and significant relationship in the long-run; however, they appear to respond distinctly to transitory shocks. The results suggest that stock market variables do not exhibit a significant cyclical component.

JEL Classification: C32, E20, G20
Keywords: GDP, Stock Market, Efficient Market Hypothesis.

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Introduction

Economic growth is perhaps the most studied subject in the economics literature. For decades, the theme has been analyzed under various perspectives and schools of thought. While we find consensus with respect to some of the factors that contribute to development, investment in physical and human capital for instance, the controversy on the significance of others remains. In this document we tackle one of these controversial issues: financial markets, and in particular the stock market. The debate on the importance of these markets has been intense. Some authors have suggested that the financial system is an essential component of the growth engine. They argue that a more efficient allocation of investment funds promotes productivity. Others are more skeptical and doubt that financial markets are conducive to development. Along the first line of thought we may mention Goldsmith (1969) and McKinnon (1973), who identify a close relationship between the real economy and stock market activity: well-developed capital markets are associated with strong economic performance. In contrast, Lucas (1988) suggests that financial markets have no particular function in promoting economic growth and, in fact, the causality between growth and the evolution of financial markets goes from the first to the latter. Levine (1997) provides a nice discussion on the issue.

While the debate will surely continue, one fact remains uncontested: analysis of the association between stock markets and the real economy for developing countries is scarce. Relatively few documents on this topic appear in the literature. Among them we find Caporale *et al*. (2004) who conduct a study for Argentina, Chile, Greece, Korea, Malaysia, the Philippines and Portugal. The authors conclude that efficient financial intermediation improves economic performance. Similar findings are described in Enisan and Olufisayo (2006) for seven African economies during the period 1980-2004. For the particular case of Mexico, which is the country of interest in this paper, we were able to identify only two studies explicitly examining the interaction of financial markets with the real economy: Ron Delgado (2001) and Mejia (2003). The first analyzes the long-run relationship between financial variables and industrial production. The author shows that financial performance influences real economic activity significantly. The second considers a short-run horizon and finds a countercyclical behavior of financial variables with respect to the aggregate economy.

The purpose of this document is to contribute to the literature by complementing these two studies. We do so by conducting an analysis of the relationship between stock market behavior and the performance of the aggregate economy for the long-run and the short-run. In contrast with previous studies, we use econometric techniques designed to control for the stochastic nature of the variables. In particular, we consider cointegration tests to evaluate the existence of common trends and common cycle test to determine if the variables share transitory movements. Finding cointegraton would imply that financial markets and the aggregate economy exhibit co-movements over long horizons. The existence of a common cycle would suggest that the Mexican stock market and the country's economy show similar responses to transitory shocks.

Note that the results will essentially depend on the statistical properties of the variables included in the exercise. For those representing the real economy of Mexico, we find numerous studies describing their properties. We know that real GDP, consumption, investment, and industrial production are non-stationary variables integrated of order 1[1]. For the case of financial variables, however, there is much less evidence. As such, we will need to establish their statistical properties. In general there are two broad possibilities. First, if the dynamics of the series adhere to the efficient market hypothesis (EMH), then common trends may exist but not necessarily common cycles. That is, validation of the EMH would imply that the stock market series are non-stationary processes and hence sharing common trends with macroeconomic variables is a possibility. The existence of common cycles, however, will depend on whether stock prices exhibit a significant cycle. If they do, then common cycles may be found, otherwise common cycles cannot be identified. Alternatively, if the EMH does not hold, that is the stock market series are stationary processes, then no cointegration tests can be performed. It is worth mentioning that, although Ron-Delgado (2001) finds that Mexican financial variables are I(1) series, we choose to conduct our own tests. We do so recognizing that the tests used in said document do not control for the numerous structural breaks characteristic of the Mexican economy.

A note on the EMH is also worth including. While the debate on whether the EMH holds for developed economies (particularly the US), is intense, for the case of developing countries the controversy is barely noticeable. For Mexico there is really no critical mass discussing the issue. It is true that various documents have included Mexico in analyzing the behavior of stock market variables, but only a few have explicitly focused on the Mexican stock exchange. As such, the econometric estimation we perform in this paper should be taken as the first to take into account the specifics of the Mexican economy.

The rest of the document is organized as follows: in section I we present the variables and a brief graphical analysis. Section II carries out the empirical exercise. Section III concludes.

Section I. The Real Economy and the Stock Market in Mexico

To illustrate the behavior of the Mexican Stock Exchange (BMV) we consider three different indicators: stock prices index (IPC), value of stocks (Value), and level of operations (Operations). In addition, we construct two measures of market activity by dividing value and operations by the gross domestic product (GDP). These indicators are commonly used in the literature as a proxy for stock market performance.[2] Value and level of operations are expressed in constant terms. The source for the stock market variables is the Central Bank of Mexico (Banco de Mexico). Real GDP, consumption, and investment are

[1] See for instance Garces (2006), Herrera (2003) and Castillo-Ponce (2003).
[2] Ron Delgado (2001) for example.

measured in constant terms and the sample period covers from 1993 to the first quarter of 2011. Additionally, we include industrial production in real terms as a measure of economic activity. The frequency of this variable is monthly, as are the stock market variables, and will be used to estimate specifications for the stock market variables that were divided by GDP. The source for real variables is the National Institute of Statistics and Geography (INEGI).

Graph 1 illustrates the stock market variables. Graph 2 shows the IPC with real GDP, consumption, and investment. From Graph 1 it is evident that the various stock market indicators follow a similar dynamic. All of them exhibit the slowdown of 2001 and the collapse of 2009. Also, these variables have episodes in which their behavior changes significantly, that is, they exhibit structural breaks. From Graph 2 we gather that GDP, consumption, and investment follow similar patterns. A positive association between stock market activity and the real economy in the long-run is also apparent. The mid-1990's and the most recent economic crises are evident. The close association between these variables is even more apparent in Graph 3, which shows the annual growth rates. Four episodes of economic slowdown are clearly identified: 1994-1995, 1999, early 2000's and 2009. From this graph one can say that these variables share a common cycle. As was the case with the stock market variables, real variables also present various structural breaks, a change in the dynamic of the series is evident during the 1994-1995 and 2008 economic crises. Given this fact, the econometric exercise should be implemented using methodologies that allow for structural breaks.

Section II. Empirical Exercise

The empirical strategy consists of testing for the stochastic nature of the variables and then conducting cointegration and common cycle tests. The first task is carried-out by implementing unit root tests, then, cointegration tests are estimated. The common cycle tests are preformed conditioned on the existence of cointegration. That is, if cointegration is found, the Vahid and Engle (1993) methodology is applied. In the absence of contegration no test is performed. We recognized that cointegration is amply known in the profession, so we spare the reader from its description. Nonetheless, we briefly illustrate the common cycle methodology as suggested by Vahid and Engle (1993). The narrative below follows closely the technical discussion in Issler and Vahid (2001).

Consider the decomposition of a time series y_t as follows:

$$y_t = C(1)\sum_{s=0}^{\infty} u_{t-s} + C^*(L)u_t \quad (1)$$

The first term on the right of (1) represents the trend component, the second the cyclical stationary element. It is said that the variables in y_t share common trends if there exists *r* linearly independent vectors stacked in a $r \times n$ matrix, α', with $\alpha' = C(1) = 0$. Similarly, the variables in y_t share common cycles if there exist s linearly independent vectors, $s \leq n - r$, stacked in a $s \times n$ matrix $\tilde{\alpha}'$ with $\tilde{\alpha}' = C*(L) = 0$.

While many methodologies are available for identifying cointegration, we choose Johansen (1991) since *r* can be obtained directly; for *s* we consider the common cycles test proposed in Vahid and Engle (1993). The same requires the estimation of the squared canonical correlations in the system, λ^2, and then a test to determine if the smallest correlations are zero, $\lambda_i^2 = 0 \quad \forall\, i = 1...s$. As such, the null hypothesis is the existence of common cycles. The test statistic is given by $C(p,s) = -(T - p - 1)\sum_{i=1}^{s} \log(1 - \lambda_i^2)$ and it is distributed χ^2 with $s^2 + snp + sr - sn$ degrees of freedom, where *s* refers to the number of common cycles, *n* is the number of variables, *r* is the number of cointegrating vectors and *p* represents the optimal lag structure.

As indicated before, expression (1) is the common trend-cycle representation of a time series. Taking this expression to the specific case of stock prices, we may think of it as the expression found in Fama and French (1988), where stock prices are illustrated as the sum of a random walk component and a stationary component:

$$p(t) = q(t) + z(t) \qquad (4)$$

With $q(t) = q(t-1) + \mu + \eta(t)$ as the random walk component with drift and $z(t)$ representing the stationary element.

Unit Root Tests

We first verify the stochastic nature of the series by conducting unit root tests. We consider two methodologies, KPSS and Harvey et al. (2011). It is argued that KPSS provides a more reliable estimate since the null hypothesis is stationarity. Harvey et al. is designed to account for the evident structural breaks in the series. The results presented in Table 1 are conclusive: all the series are integrated of order 1. These findings are consistent with those of many other authors including Noriega and Rodriguez-Perez (2011), Garces (2006), and Castillo (2003) for the real variables, and Ron-Delgado (2001) for the stock market variables.

Cointegration Tests

We now proceed to test for the presence of common trends. We consider bi-variate systems containing one variable as a proxy for stock market activity and one to capture the behavior of the aggregate economy. We estimate three

different cointegration methodologies: the Engle and Granger residuals test (EG), the cointegration test suggested by Johansen, and the Hatemi-J (2008) routine for testing for cointegration under the presence of structural breaks. The Johansen methodology allows for determining the number of cointegrating vectors, *r,* and the other two tests are included for robustness. The results are presented in Table 2. The EG statistics suggest the existence of cointegration in all cases except for the investment-value system. Johansen's trace and eigenvalue tests identify cointegration in the GDP-Stock, GDP-Operations, Consumption-Stock, and Investment-Stock systems. The Hatemi-J test, which controls for structural breaks, finds cointegration for all cases except Consumption-Operations, Investment-Value, and Industrial Production-ValueGDP under the Za and Zt statistics; the ADF criterion identifies cointegration for GDP-Stock Consumption-Value, Investment-Stock, Investment-Operations, and Industrial Production-OperationsGDP. Reasonably, we can take the Hatemi-J results as the most reliable and adequate test. If so, then we can determine that there exists a common trend between GDP and the three stock market variables, between Consumption and stock and value, between Investment and stock and operations, and between industrial production and operations as a proportion of GDP.
The normalized cointegrating vectors are also presented in Table 2. A positive relationship between GDP and the stock market variables is clear. The magnitude of the coefficients is relatively small, in the [0.148, 0.188] interval. Since we considered the logarithms of the variables and normalized with respect to GDP, these coefficients can be interpreted as log-run elasticities. Hence, a one percentage change in the stock market indicator is associated with a percentage change in GDP anywhere from 0.148 to 0.188. For consumption and investment the qualitative association with financial variables goes in the same direction, an increase (decrease) in stock market activity corresponds to an improvement (deterioration) of the real variables. The relationship between industrial production and the value of stock market operations is very similar to what is found for the aggregate measures. In sum, we may assert that, while no causal relation is established, stock market activity and the aggregate economy share a common trend in the long run.[1]

Common Cycle Tests

Our final estimation identifies common movements in the short run, that is, the existence of a common cycle. We consider the systems for which cointegration was identified, namely GDP-Stock, GDP-Value, GDP-Operations, Consumption-Stock, Consumption-Value, Investment-Stock, Investment-Operations, and Industrial Production-Operations. Test results are presented in Table 3.

[1] Evidently, we are not suggesting any causal relationship between the variables, we could have normalized with respect to the stock market variable and the qualitative results would had remained.

In all cases, with the exception of GDP-Operations, and Investment-Operations, the *p* value suggest the existence of one common cycle. However, none of the *t* statistics for the coefficients are significant. This is an unexpected result. We would have anticipated seeing significant short-run coefficients for the systems for which there is evidence of a common cycle. In fact, taking these statistics at face value we would have to say that there is a common cycle and the normalized co-movement vector with respect to the real variable is (1, 0), but this is not of much interest.

A more appealing interpretation of the results is that one of the variables in the system does not exhibit a significant transitory component. That is, the variables contain a stationary element but it is not “very large”. Given that there is ample evidence of a significant cyclical component on GDP, consumption, investment and industrial production, we can firmly eliminate them as candidates, which left us with the stock market variables. Thus, with the evidence from the common cycle tests, we can establish that the variables used in this exercise as a proxy for stock market activity behave as a random walk with no significant cycle, as suggested by many authors dating back to Beveridge and Nelson (1981). In their seminal paper they propose that financial variables such as the ones we have considered here contain all relevant information and their prices reflect this fact. In other word, the behavior of financial variables is consistent with the EMH.

As we indicated in the introduction, the topic of whether financial variables contain a significant stationary component has been the center of intense debate. For the case of Mexico, however, only a handful of articles have examined the stock market variables explicitly. In addition to Ron Delgado (2001) and Mejia (2003), Chen *et al.* (2002) find that the stock market index of the BMV is a series integrated of order 1, but their unit root tests did not consider structural breaks in the series, nor did the authors estimate the magnitude and significance of the transitory component in the variable. With an improvement on the unit root testing, Chaudhuri and Wu (2003) test for the random walk hypothesis including structural breaks. Their results weakly reject the null of a random walk and no testing on the magnitude of the stationary component of the series is conducted; similar results are found in Li and Chen (2010). [1] Overall, we can confidently say that there is some evidence that stock market variables in Mexico are series integrated of order 1, but no evidence other than what we provide here is available suggesting the magnitude of the transitory component on these series.

A final note, we should emphasize that the purpose of this paper is to establish the relationship between stock market variables and the aggregate economy for the long-run and for the short-run. The result pertaining to the nature of stock market variables and their association with the EMH, while important, is not the main focus of this analysis. Clearly, a more thorough and robust examination of the stochastic properties of these variables is called for.

[1] Evidence of a random walk for the stock market index of the BMV is also provided in Fernandez-Serrano and Sosvilla-Rivero (2003) among others.

Conclusion

The importance of financial markets as an input in the production process has been discussed for decades. While some argue that they are an essential component, others remain skeptical. For the most part, this discussion centers on developed economies. In the case of developing economies the evidence on this topic is scarce. In this document we conduct an analysis of the long-run and short-run relationship between variables of the Mexican stock exchange and the aggregate economy. We find that stock market indicators, including the price index, share a common trend with real GDP, consumption and investment: improvements (declines) in stock market activity are associated with increases (decreases) in economic activity. We also determined that these variables do not share a common cycle. That is, our results suggest that stock market indicators contain a significant random walk component but not an insignificant stationary element. Clearly, our results are merely suggestive and more robust analyses should be carried out to fully identify the stochastic nature of these indicators.

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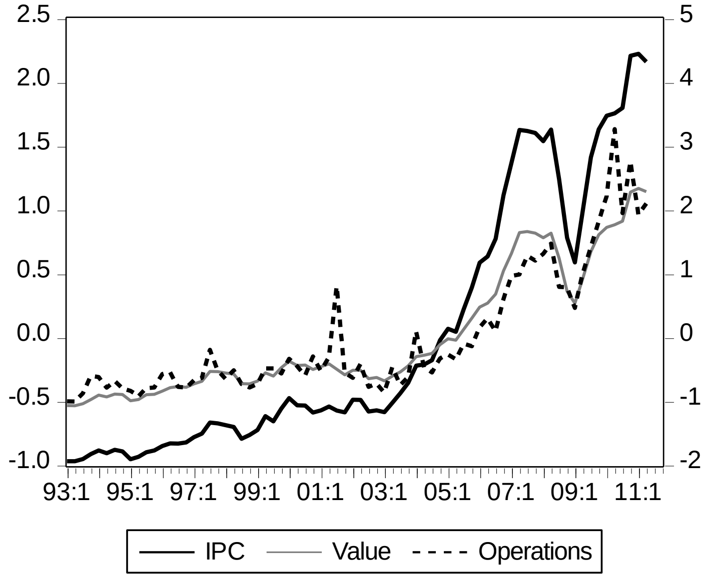
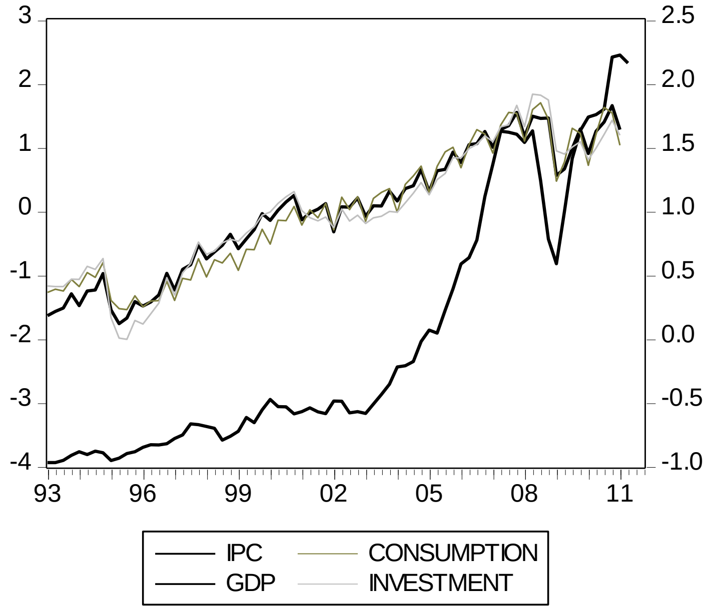
Graphs

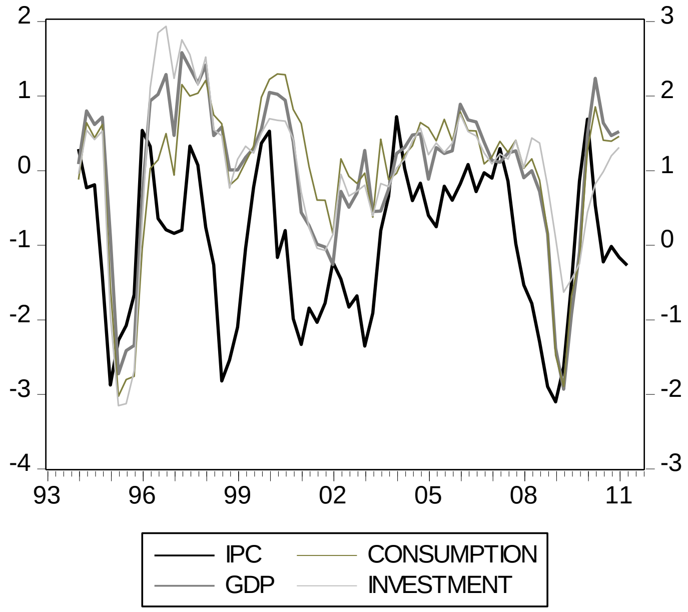
Graph 1. *Stock Market Indicators*



Graph 2. *Stock Market Performance and Real Activity in Levels*



Graph 3. *Stock Market Performance and Real Activity in Growth Rates*



Tables

Table 1. *Unit Root Tests*

	KPSS		Harvey et al.	
Series	Level	First Diff.	MDF1	MDF2
GDP	1.099*	0.185	-2.716**	-2.978**
Consumption	0.704*	0.031	-2.481**	-3.115**
Investment	0.757*	0.142	-2.934**	-3.492**
Stock	1.134*	0.041	-2.549**	-3.26**
Value	1.097*	0.056	-2.254**	-2.701**
Value/GDP	1.049*	0.065	-2.469**	-3.121**
Operations	1.030*	0.043	-2.992**	-3.732**
Operations/GDP	0.943*	0.031	-3.038**	-3.953**
Ind. Prod.	1.032*	0.099	-3.084**	-3.875**

* Reject the null of stationarity

** Do not reject the null of a unit root

Table 2. *Cointegration Tests*

Systems	EG Residuals	Johansen Trace	Johansen Eigenvalue	Hatemi ADF	Hatemi Zt	Hatemi Za	Normalized Cointegrating Vector
GDP, Stock	0.234[a]	0.090[+]	0.089[+]	-5.747***	-7.772*	-66.782***	1, -0.148 (0.005)
GDP, Value	0.274[a]	0.406	0.365	-5.405	-6.953*	-59.154***	1, -0.188 (0.008)
GDP, Operations	0.493[b]	0.055[+]	0.091[+]	-4.885	-6.600*	-54.991***	1, -0.159 (0.012)
Consumption, Stock	0.316[a]	0.087[+]	0.091[+]	-5.216	-6.931*	-62.147***	1, -0.058 (0.016)
Consumption, Value	0.489[b]	0.063[+]	0.257	-5.832***	-7.351*	-61.853***	1, -0.233 (0.084)
Consumption, Operations	0.369[a]	0.251	0.194	-5.137	-5.748	-36.507	
Investment, Stock	0.297[a]	0.081[+]	0.095[+]	-6.517**	-8.249*	-65.349***	1, -0.062 (0.037)
Investment, Operations	0.353[a]	0.052[+]	0.164	-5.935***	-8.627*	-69.423***	1, -0.456 (0.095)
Investment, Value	0.642	0.328	0.314	-4.542	-6.427*	-47.318	
Ind. Prod, ValueGDP	0.299[a]	0.298	0.246	-5.296	-4.225	-30.008	
Ind. Prod, OperGDP	0.507[b]	0.263	0.263	-6.148**	-7.110*	-60.032***	1, -0.159 (0.018)

a Do not reject the null of stationarity at 10%
b Do not reject the null of stationarity at 1%
+ Reject the null of no cointegration
* Reject the null of no cointegration at 1%
** Reject the null of no cointegration at 5%
*** Reject the null of no cointegration at 10%

Table 3. *Common Cycle Tests*

System	p values $s=1$	p values $s=2$	Coefficient	t stat
GDP, Stock	0.608*	0.000	0.640	1.507
GDP, Value	0.647*	0.000	0.634	1.621
GDP, Operations	0.030	0.000	-0.970	-0.656
Consumption, Stock	0.237*	0.000	0.176	1.041
Consumption, Value	0.428*	0.000	0.381	1.432
Investment, Stock	0.572*	0.000	0.492	1.395
Investment, Operations	0.037	0.000	-0.329	-0.948
Ind. Prod., OperGDP	0.806*	0.000	-0.193	-0.937

* Do not reject the null of the existance of one common cycle