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Essays on Market Linkages in NAFTA and Latin American Countries: Studies of Cointegration and Contagion

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ESSAYS ON MARKET LINKAGES IN NAFTA AND LATIN AMERICAN COUNTRIES:

STUDIES OF COINTEGRATION AND CONTAGION

A Dissertation

by

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ABSTRACT

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The globalization of securities in recent years has led to an increase in market linkages. These linkages are strong among countries that have entered into bilateral and multilateral trade agreements. I investigate the linkages of stock markets in NAFTA countries by exploring their cointegrating relationship, and I explore market linkages in Latin America by showing evidence of financial contagion between Brazil and her Latin American neighbors.

In the first essay, I employ a vector error correction model to examine the linkages between price stock indexes of NAFTA countries that have been segregated into tiers based on market capitalization. In each set of NAFTA countries (US – MEX; US – CAN; MEX – CAN), the returns of the tiered indexes reflect a long-run relationship within the same tier. Using a rolling vector error correction approach, I find a shift in the long run equilibrium during the most recent global financial crisis. The cointegrating parameter that ties the tiers together is greater in the absolute during the crisis period compared to the pre- and post-crisis periods. Despite showing that the stock indexes of the three NAFTA countries exhibit a cointegrating relationship, tests do not confirm that the relationship is the result of the NAFTA accord.

In the second essay, I investigate market linkages by exploring the possibility of financial contagion from Brazil to five Latin American countries following the presidential election of Dilma Rousseff in 2014. I employ a GARCH-DCC framework to estimate the variance-covariance transmission mechanism. By means of both the Kolmogorov-Smirnov test and a Markov Switching Dynamic Regression (MSDR), I find an increase in conditional correlations between Brazil and five Latin American countries, suggesting a shift in the long run relationship and the evidence of financial contagion.

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CHAPTER I

INTRODUCTION

Sources of Market Linkages

According to the World Bank, an explosion of regional trade agreements (RTA) has occurred in the past twenty years, increasing from 50 in 1990 to more than 280 in 2017.[1] Consequently, the proliferation of RTAs has led to greater linkages between various goods and equity markets. In addition to regional trade agreements, the mere globalization of securities has introduced increased linkages between various goods and equity markets (Hamao, Masulis, & Ng, 1990; Meric, Leal, Ratner, & Meric, 2001; Okada, 2013; Phylaktis & Ravazzolo, 2002).[2]

Consequently, academicians and practitioners alike have investigated the possible effects of these tightening relationships. Accordingly, empirical research on financial market integration has increased, and it has identified multiple channels through which welfare benefits are gained. Some of these studies examining increased welfare gains as a result of free trade agreements conclude that RTAs are associated with growth spillover of 13.6 to 15.3 percent (Rigg et al., 2009). By removing tariffs, these agreements lower prices of imports, increase services competition, and reduce cross-border costs and delays (Kondonassis, Malliaris, & Paraskevopoulos, 2008; Lederman, Maloney, Maloney, & Serven, 2005). Other studies show

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[1] Information accessed online at http://www.worldbank.org/en/topic/regional-integration/brief/regional-trade-agreements, on May 26, 2018.

[2] For an excellent review of literature related to globalization and capital flows, see Moshirian (2008).

that market integration leads to economic growth and risk-sharing benefits (Lewis, 2000; Rangvid, Santa-Clara, & Schmeling, 2016), as well as the development of local stock markets (Levine & Zervos, 1998).

While some of these studies have examined the long-run relationship between the stock markets of various major countries, such as US, Japan, England, and Germany (Masih & Masih, 2002), many have focused on the potential cointegration of markets within a particular region or markets that are related through trade agreements, such as the countries of the North American Free Trade Agreement (NAFTA) (Aggarwal & Kyaw, 2005; De Hoyos & Iacovone, 2013; Bradley T. Ewing, Payne, & Sowell, 1999; Lahrech & Sylwester, 2013) or Gulf Cooperation Council (GCC) (Alotaibi & Mishra, 2017). As a result of these studies, I have a better understanding of how the strength of market linkages might change based upon how developed the country or market is (Al Nasser & Hajilee, 2016), as well as its relationship to a local economic crisis (Climent & Meneu, 2003; In, Kim, Yoon, & Viney, 2001).

Given the economic and financial importance of market linkages and RTAs, I explore two special types of linkages within two of the largest regional markets. First, I explore the possibility that the three stock markets in North America are cointegrated, and secondly, I investigate the possibility of contagion from Brazil to its Latin American neighbors.

Types for Market Linkages

Cointegration of Stock Markets among NAFTA Countries

Several early studies did not technically address cointegration, but rather, focused on aspects of the markets in the NAFTA region becoming simply more integrated (Braun & Traichal, 1999; Kessler, 1999; Robertson, 2000). Other studies, however, attempted to investigate more directly the cointegrating nature among NAFTA equity markets. Atteberry and

Swanson (1997) were the first to explore market linkages within the region. Using Vector autoregression (VAR) and error correction methodologies, the authors investigated the daily prices and returns for the NAFTA stock markets from January 1, 1985 to December 31, 1994. Over the entire period, the authors find significant bidirectional causality and significant linkages. To be sure, the 1987 market crash in the United States affected the neighboring economies. While the authors were able to show evidence of increased integration after the passage of NAFTA, their study did not show evidence of a long-term cointegrating one.

Two years later Bradley T. Ewing et al. (1999) used monthly returns from November 1987 through March 1997 to investigate cointegration between the NAFTA markets. Contra Atteberry and Swanson (1997), the authors find no evidence of contagion from the 1987 US stock market crash. Rather, they find that the markets are segmented and show no evidence of cointegration. In 2001, the authors reinvestigated the nature of the relationship among the NAFTA stock markets (Bradley T. Ewing, Payne, & Sowell, 2001). They changed the data from monthly returns to daily stock prices, and their date range was June 2, 1992 – October 28, 1999. They show a difference in conditional volatility transmission between NAFTA and Pre-NAFTA periods. Nevertheless, they still find no evidence of cointegration.

In contrast to the earlier studies, several later studies find some evidence of a cointegrating relationship, especially as the data gets further away from the date of the passage of NAFTA in 1994. For example, Darrat and Zhong (2001), in an early study on cointegration, use weekly data from 1989 to 1999, divide the data into two periods: pre-NAFTA and post-NAFTA. While they find no evidence of cointegration in the pre-NAFTA period, they do find evidence in the post-NAFTA period, lending credence to the idea that the countries are becoming more tightly linked. Similarly, Gilmore and McManus (2004) use a Vector Error Correction Model

(VECM) on weekly and monthly data in the post-NAFTA era (1993 – 2002) and find evidence of cointegration. Aggarwal and Kyaw (2005) use daily, weekly, and monthly data from 1988 – 2001) and find that correlation coefficients increase after the passage of NAFTA. More importantly, the authors find evidence of a cointegrating relationship among the stock markets of the three NAFTA countries, but only in the post-NAFTA period. Darrat and Zhong (2005) arrive at the same conclusion.

In a later study on the benefits of diversification in trading blocs like NAFTA, Phengpis and Swanson (2006) use both VAR models and rolling cointegration to investigate the connection between NAFTA markets in pre- and post-NAFTA periods. In addition to using new techniques for testing, their data set covers a longer period of time (January 6, 1988 – December 31, 2003). Using a 10-year window for the rolling regression, interestingly, they find no evidence of cointegration, especially during the post-NAFTA period. Using a 5-year window, evidence for cointegration is weak and short-lived. Collectively, the study shows little evidence of a long-run relationship. One additional work shows that the NAFTA market linkages are tightening, and even at times moving together, but the authors still argue that the comovements fall short of a cointegrating relationship. Ciner (2006), for example, shows that the comovements are the result of the global boom in information technology stocks, and hence, was temporary in nature.

Thus, the results of numerous studies on the cointegrating nature of NAFTA have not been consistent. To be sure, the lack of unanimity among researchers, with the most recent studies not fully supporting positions theory anticipates should occur (i.e., global markets are becoming increasingly integrated) suggests that a fresh investigation of the data is warranted.

Contagion from Brazil to Latin American Neighbors

After the Asian financial crisis in 1997, economists began to use a new term—contagion—to refer to the spread of financial shocks from one country or region to another. Before 1997, Claessens and Forbes (2001) note that the term normally referred to the spread of a medical disease. With the unexplained spread of the currency crisis in Thailand in July of 1997 through East Asia, as well as Russian and Brazil, economists begin treating the crisis like a disease that can be transmitted via both direct and indirect channels. Consequently, a new generation of econometric models sought to address this type of market linkage—linkages that encourage a particular degree of co-movement in crisis periods relative to that of tranquil times.

While researchers at times use the term differently, they appear more generally to use the term contagion to refer to the spread of market disturbances (usually negative disturbances) from one country or region to another (Claessens, Dornbusch, & Park, 2001). K. J. Forbes and Rigobon (2002) seem to support this use of the term when they define contagion as a significant increase in cross-market linkages after a shock (K. Forbes & Rigobon, 2001). Thus, if no significant shift occurs, then there is no contagion.

Following Masson (1999b), later writers began to divide studies on contagion into two categories based upon transmissional source of the financial crisis: whether or not the spread of the crisis can be explained by macreconomic or other fundamentals (Boffelli & Urga, 2016; Calvo & Reinhart, 1996). Because the markets are “fundamentally” linked, some researchers do not consider this form of co-movement contagion, because they reflect normal interdependence (Claessens et al., 2001). Others argue, however, that if a significant shift occurs in the cross-market linkages after the shock, even among regions that are fundamentally linked, it may still be defined as a contagion (K. J. Forbes & Rigobon, 2002).

In their groundbreaking work on the topic, K. J. Forbes and Rigobon (2002) further bifurcate the discussion of contagion between crisis-contingent or non-crisis contingent theories. Non-crisis contingent theories do not mean that the initial shock did not result from some crisis moment in a particular market. Rather, the term suggests that the propagation of the crisis to other regions occurred through normal fundamental channels and did not generate a "shift contagion." In contrast, crisis contingent theories assume that a significant shift had to occur. Moreover, these shifts may result from various mechanisms, such as liquidity, multiple equilibria, and political economy (Claessens et al., 2001; Claessens & Forbes, 2001; Masson, 1999a). Even when one assumes that the shock emanates from multiple sources, researchers still hold that much of the increase in volatility and co-movement across countries remains unexplained (Baig & Goldfajn, 1999; Connolly & Wang, 2003; Kodres & Pritsker, 2002).

Regardless of the category, the degree of financial market integration plays an integral factor in explaining the spread of the crisis. If a country, like Brazil, is well integrated into the world market, and, the country is tightly integrated within the region, then the financial markets are instrumental in making economic variables and stock market returns move together (Claessens et al., 2001).

Several papers have investigated the spread of contagion among Latin American countries. One of the earliest attempts explored the fundamental links between changes in the U.S. interest rates and movements in capital flows to Latin America (Calvo & Reinhart, 1996). In this study, the authors investigate the correlation of asset prices and find evidence of contagion. Indeed, numerous studies have shown evidence of increased correlation among asset prices of different instruments in Latin America following various crises. Frankel and Schmukler (1996), for example, find evidence of contagion following the Mexican crisis in 1994 through correlation of asset prices of closed-end country funds. K. Forbes and Rigobon (2001) also find increase in correlations following the Mexican peso crisis. In a later study, Agénor, Aizenman, and Hoffmaister (2008) argue that the Mexican peso crisis caused a liquidity crunch in Argentina, and they show evidence of contagion in the lending spreads and output fluctuations among Argentine banks.

Current Study on Market Linkages

This dissertation aims to extend the research on market linkages in two areas. First, I investigate the possibility of cointegration between stock markets in a similar region (NAFTA) by exploring the links between common market segments. Because markets are becoming more integrated, investors constantly seek for additional investment channels for diversifying risk. I investigate if different pricing tiers based on market capitalization might offer this kind of diversification. Thus, I analyze the conditions required for the existence of a long run relationship between these price tiers and returns and I find them to be positive. By means of a vector error correction model, I further provide evidence of a long run relationship between NAFTA countries within a common pricing tier. Finally, using a rolling regression technique, I obtain a panel of long run parameters and show that during the time of the most recent global financial crisis, this parameter was unstable.

In a second essay, I seek to contribute to the existing literature on contagion by exploring the conditional correlations between Brazil and five Latin American countries between December 31, 2011 and October 16, 2015. I contend that the election of President Dilma Rousseff in October 2014 initiated another crisis period for Brazil, and represented an additional shock for investors in neighboring countries to comprehend. By means of a GARCH-DCC model, I estimate the time varying conditional correlations. Furthermore, by employing the

Kolmogorov-Smirnov test, I show that the empirical distributions of the pre-crisis period and the crisis period are statistically different. Indeed, the crisis period shows a significant increase in the conditional correlations, thus providing evidence of contagion from Brazil to the neighboring Latin American countries.

CHAPTER II

LONG-RUN EQUILIBRIUM SHIFTS OF NATIONAL STOCK MARKET PRICES FOR NAFTA COUNTRIES DURING THE 2008 FINANCIAL CRISIS

Introduction

The globalization of securities has introduced increased linkages between various goods and equity markets (Moshirian, 2008; Okada, 2013; Phylaktis & Ravazzolo, 2002). Consequently, academicians and practitioners alike have investigated the possible effects of these tightening relationships. While some of these studies have examined the long-run relationship between the stock markets of various major countries, such as the US, Japan, England, and Germany (Masih & Masih, 2002), many have focused on the potential cointegration of markets within a particular region, such as the countries of the North American Free Trade Agreement (NAFTA) (Aggarwal & Kyaw, 2005; De Hoyos & Iacovone, 2013; Bradley T. Ewing et al., 1999; Lahrech & Sylwester, 2013) or Gulf Cooperation Council (GCC) (Alotaibi & Mishra, 2017). As a result, I have a better understanding of how the strength of market linkages might change based upon how developed the country or market is (Al Nasser & Hajilee, 2016), as well as its relationship to a local economic crisis (Climent & Meneu, 2003; In et al., 2001).

Previous studies on linkages between the equity markets have used various economic methods to evaluate market relationships, such as contemporaneous correlations, lead-lag and

Granger-causal relations, and volatility transmission across national stock markets (Phengpis & Swanson, 2006). Moreover, researchers have centered their studies on both stock prices and stock returns for identifying this relationship. Identifying these relationships plays an important role for various stakeholders. Investors are interested in market diversification in order to reduce risk. If national equity markets are cointegrated, then the benefits of diversification are limited (Byers & Peel, 1993; De la Torre, Gozzi, & Schmukler, 2007). Managers, on the other hand, might find the financial integration increases market efficiency through the flow of information and adjustments (Darrat & Zhong, 2005). Additionally, managers may be interested in how integrated markets affect expected returns and the cost of capital. As foreign investors participate in the local market, the source of systematic risk shifts to the world stock market, thus affecting expected returns and stock market prices (Chari & Henry, 2004). Moreover, a reduction in risk should also result in a reduction in the cost of capital (Bekaert & Harvey, 2000). Finally, these increased relationships may also be of significant interest to policy makers and economic planners who discover that integration can foster development through more efficient allocation of capital (Umutlu, Akdeniz, & Altay-Salih, 2010) and a lower probability of asymmetric shocks (Yu, Fung, & Tam, 2010). Policy makers may utilize regulatory policy to restrict foreign equity investments in order to limit exposure to adverse volatility effects. Such actions, however, may limit the ability of firms to raise capital for projects, thus stifling economic growth.

In this essay, I study the long term relationship of the equity markets between the three countries that participate in NAFTA during the period from January 2005 through December 2016. In contrast to previous studies, I examine this relationship via stock returns that have been stratified by tiers based upon market capitalization. This approach follows a recent study of the long-run relationship in the housing market in which the authors evaluated long-run equilibrium shifts in price tiers (Damianov & Escobari, 2016). Each index tracks the appreciation and depreciation rates of the stock prices in segments over time.

While I employ a variety of econometric methods, my major results flow from two techniques in particular. I estimate a vector error correction model, which allows us to evaluate both long-run and short-run dynamics. Through this test, I am able to discern the strength of a linkages between the tiers of the various countries. More importantly, however, I can use these results to gain insight on how the short-term dynamics influence the long-term relationship. Afterwards, I utilize a rolling regression approach to allow the cointegrating parameters to vary over time. Using this procedure, I create a panel of estimated cointegrating parameters, which allows us test the stability of the relationship before, during, and after the global financial crisis of 2008.

Thus, I believe that this study fills three major gaps in the research regarding cointegration among NAFTA countries. First, previous research on cointegration among NAFTA countries reached conflicting results. Early studies showed no cointegration (Atteberry & Swanson, 1997; Bradley T. Ewing et al., 1999; Bradley T. Ewing et al., 2001), while later studies were split. In later studies, the researchers divided the samples between pre- and post-NAFTA periods. Following this method, some found for cointegration among the countries in the post-NAFTA period (Aggarwal & Kyaw, 2005; Darrat & Zhong, 2001; Gilmore & McManus, 2004), and others found evidence of no cointegration in the same period (Ciner, 2006; Phengpis & Swanson, 2006). Consequently, I believe that there is a gap to be explored here.

Secondly, I believe my decision to investigate cointegration among NAFTA countries by means of stratifying the markets based on market capitalization yields important information previously left unexplored in previous studies. Lastly, previous studies on cointegration have not investigated parameter stability of long run links. I believe that these three gaps allow me to explore and address meaningful gaps in the literature.

As a result of my analysis, I ascertain five meaningful insights. First, not dissimilar from previous studies of the returns on indexes for national stock markets, I find that the log of the price indexes for each country in each tier is non-stationary in levels but is stationary in first differences (i.e., they are integrated of order one).

Secondly, I show that for various pairs of NAFTA countries (e.g., US – MEX; US – CAN; and MEX – CAN) the stock returns of one country appreciate faster than the returns of its counterpart prior to the global financial crisis of 2008. After the crisis, however, the same countries depreciate faster than their counterparts. These comparisons are made within a particular market tier. For instance, I examine $\text{LOWTIER}^{\text{Mexico}}$ with $\text{LOWTIER}^{\text{USA}}$. Using cointegration tests, I quantify the extent of this phenomenon for each pair of countries. I find that each pair in each tier is bound by a long-run relationship. Consequently, the stock returns for each country in the pair are driven by the same factors that drive the long-run relationship to be cointegrated. Stated differently, if markets are segmented, then each market's assets are priced according to factors particular to that domestic market. If the market is integrated, then the market's assets are priced and experience returns according to international factors (Taylor & Tonks, 1989). Cointegration in this context implies that each national stock price series contains valuable information on the common stochastic trends which bind each pair of countries' returns together. Therefore, one might be able to use this information to predict another country's stock returns, which would be evidence against the market efficiency hypothesis (Granger, 1986). Nevertheless, others argue that predictability does not imply inefficiency (Masih & Masih, 2002). To be sure, violation of the market efficiency hypothesis assumes that one could use the information to earn risk-adjusted excess returns.

Thirdly, I show that in various instances the short-run dynamics between country pairs exhibits strong correlation with the long-run equilibrium parameters. Consequently, the research suggests that lagged short-term dynamics influences the long-run equilibrium of stock returns within a common priced tier.

Fourthly, I show that for each of the three-country pairs in both high and low tiers, the cointegrating parameter (β) is statistically significant. In four out of the six pairings, furthermore, the cointegrating parameter is negative. For example, the index of returns for stocks in the United States in the low tier are consistently above the index values for Mexico in the low tier. Moreover, the value of the cointegrating parameter is larger than negative one in the absolute. The negative cointegrating parameter suggests that for every dollar of price appreciation in the United States in the lower tier, the stock prices of Mexico in the low tier will appreciate at a greater amount in the long run. To my knowledge, I am the first to study the short run and long run dynamics of the time series of segmented prices during the most recent recession period.

Finally, I utilize a rolling regression approach to allow the cointegrating parameters to vary over time. Using this procedure, I create a panel of estimated cointegrating parameters, which lets us test the stability of the relationship before, during, and after the global financial crisis of 2008. Consequently, I estimate the cointegrating factor (β) for a window of 72 months for six groups (three country pairs in two tiers). This technique allows us to obtain a panel of betas for every set of countries in each tier in which the price tiers are cointegrated. Using this panel, I find a statistically significant shift in the long run equilibrium. The tests show that for each country pair, the cointegrating parameter increases in absolute value reaching its peak at the height of the recession and afterwards decreasing. Therefore, the lower priced stocks in each tier are relatively more volatile compared to the higher priced stocks of the comparable country in the same tier.

Data

In this study, I examine stock price indexes for the three NAFTA countries (USA, Mexico, and Canada). Just as the Zillow Home Value Index (ZHVI) and the Case-Shiller index (CSI) capture changes in home prices over time by separating the prices into tiers (high tier, middle tier, and low tier), I attempt to acquire similar pricing information by dividing stock prices into tiers based upon market capitalization. As Damianov and Escobari (2016) used the price tiers in home prices to evaluate long run shifts in home prices, I aim to imitate this technique to gain information about the cointegrating relationship between the economies of the NAFTA countries.

Various studies support the use of segregating firms based on market capitalization or size. In his groundbreaking article on the size effect, Banz (1981) observed that smaller firms tend to have higher returns than larger firms, which later studies seem to support (Fama & French, 1995; Reinganum, 1983). Financial theory suggests that firm size (i.e., market capitalization) is a proxy for risk, and that smaller firms tend to have greater risk than larger firms. Indeed, in their study on the earnings during the recession of 1981-82, Fama and French (1992) show that the small firms are exposed to cyclical risk factors in a fundamentally different way than for large firms, perhaps because of their access to credit markets.[3] In this regard, smaller firms have a higher return due to their liquidity risk (Liu, 2006) or informational

[3] In a subsequent paper, Fama and French (2012) argue against the existence of a size effect.

uncertainty (Zhang, 2006). Consequently, market forces exert downward pressure on the prices of stocks for small firms which lead to higher returns for investors.

For the US stock indexes, I use the S&P 500 Largecap index to capture high market capitalized companies. To qualify for this index, a company must have a minimum market value of $5.3 billion. For the low tier companies, I use the S&P Smallcap 600 index, which is comprised of 600 companies. The mean market capitalization for the S&P Smallcap 600 is about $1.2 billion, with market values ranging between $450 million to $2.1 billion. I access these indexes through Compustat via the Wharton Research Data Services (WRDS). The sample includes US high tier data from January 1988 to December 2016, and the low tier data covers the period January 1989 through December 2016.

For Mexico stock prices, I obtained data directly from S&P Dow Jones Indices LLC. The main benchmark on the Mexican stock market, called the Bolsa de Valores de Mexico (BMV) is called IPC, which stands for *índice de precios y cotizaciones*. The S&P/BMV IPC seeks to measure the performance of the largest and most liquid stocks in the Mexican market. This index captures the high tier stock prices for Mexico. For the low tier stocks, I used the S&P/BMV/IPC Smallcap index. The sample for both tiers covered the period from December 2004 through December 2016.

For Canada, I obtained information on the Toronto Stock Exchange (TSX) through TMX Group Inc. For the high tier stock, I use S&P/TSX 60 Largecap, and for the low tier, I use S&P/TSX Smallcap. While the high tier index covers the period from January 1988 through December 2016, the low tier data covers only the period from May 1999 through December 2016.

The indexes for USA and for Mexico are based on the US dollar. The Canadian indexes are based on the Canadian dollar. I use the monthly average exchange rates from the Federal Reserve Board to convert the Canadian dollars to the US dollar equivalent. Therefore, all three indexes are based on a common currency.[4]

In order for unit root and vector error correction tests to have the same sample, I limit the data to the period from January 2005 to December 2016. I convert all data to this same base year, and convert all prices to reruns by taking the natural log of the daily price relatives. Table 2.1 reports the summary statistics for the three NAFTA countries in both the low tier and high tier indexes.

I have 144 monthly returns for three countries in two tiers. Thus, I have 864 tiered index observations for my initial statistics. The standard deviations are reported in columns 3 and 8, and the relative standard deviations are reported in columns 4 and 9. Each of these statistics shows that the LOWTIER returns are more volatile than the HIGHTIER returns. This finding lends further credence to the size effect suggested by previous research (Banz, 1981; Basu, 1997; Liu, 2006; Reinganum, 1983; Zhang, 2006), as well as my decision to segment the returns based on market capitalization. Moreover, the summary statistics also suggest that stock returns in Mexico indexes are more volatile than the returns of the United States and Canada in the same tiers.

[4] Researchers have used different methods to deal with indexes that are not in a common currency. Some have left them in their local currency, while others have converted them to a common currency using exchange rate values (G. Chen, Firth, & Rui, 2002; Koch & Koch, 1991; Yu et al., 2010). According to Hamao et al. (1990), results are largely unchanged by converting to common currency. Ratanapakorn and Sharma (2002) also re-indexed each series so that the base year equaled 100 for each series. This practice did not seem common. Lastly, Byers and Peel (1993) stated that they “deflated each series by the appropriate exchange rate.” By this statement, it was not clear if the authors merely used the exchange rate, which reflects prices between countries, or if they used some inflationary adjustment prior to converting to a common currency.

Defining the Existence of Long Run Equilibrium

In my study, I have two series of data (Low and High) for each of the three NAFTA countries, thus giving us six series in all. I call the series of index returns for the small capitalized firms LowTier and the series of index returns for large capitalized firms HighTier. In this study, I do not investigate the relationship between the high and low tiers of a single country, such as LowTier$^{\text{Mexico}}$ and HighTier$^{\text{Mexico}}$. Rather, I examine the relationship between NAFTA countries within a common tier, such as Mexico$^{\text{LowTier}}$ and USA$^{\text{LowTier}}$.

Therefore, for any NAFTA country (NC) during month (t), I have NC_t^{Tier}. If I combine the price tiers of any two different NAFTA countries in the following manner,

$$NC1_t^{Tier} + \beta NC2_t^{Tier} = d_t^{Tier}, \tag{1}$$

where NC1 and NC2 represent the log of prices for any two NAFTA countries, I say that a long run equilibrium exists if the difference $d_t^{Tier}$is stationary for a given constant β. If a long run equilibrium exists, then $d_t^{Tier} = I(0)$, and $NC1_t^{Tier} = -\beta NC2_t^{Tier}$. Figure 2.1, for example, shows the graphs of the log of prices for Mexico and USA in the low tier (i.e., Mexico$^{\text{LowTier}}$ and USA$^{\text{LowTier}}$). While the graph is not determinative, it at least suggests that a long run relationship exists between the two series.

Investors across firms and countries possess a myriad of preferences with respect to risk and future price changes. Moreover, firms across the region react differently to various investment opportunities. Because of the varied preferences of investors and reactions by firms, shocks to the stock returns occur, which temporarily cause the returns to deviate from the long run equilibrium. These short run deviations from the long run equilibrium are present when $d_t^{Tier} \neq I(0)$. Because the differenced series is stationary, any deviations are necessarily temporary and are corrected in subsequent time periods. To be sure, if NAFTA has strengthened the market linkages within the region, then the markets should digest the information being communicated in the prices more quickly and consequently return to its long run equilibrium values. By stating that a long run equilibrium exists, I mean that the log of the prices of the countries in each tier are cointegrated with a vector $[1, \beta]$. The same conclusion is true for high tier returns of each country. If the long run relationship exists, then the tiered returns between countries are integrated of order one, $I(1)$, and d_t^{Tier} is integrated of order zero, $I(0)$.

I test cointegration between countries within a tier by restricting β in Eq. 1 to be equal to negative one. A necessary condition for cointegration is that the variables in the system must be integrated of the same order. I employ two types of unit root tests in order to determine whether or not the variables are stationary. First, I use the generalized least squares Augmented Dickey-Fuller (ADF) type test (Dickey & Fuller, 1979), which has the null hypothesis that a unit root exists. The ADF test attempts to account for any temporarily dependent or heterogeneously distributed errors by including lagged sequences of first differences of the variable in its set of regressors. For this reason, I employ the Akaike Information Criterion (AIC) to determine the appropriate number of lags.

Despite the popularity and ease of using the ADF test, subsequent studies suggest that the test lacks power and too frequently accepts the null hypothesis (DeJong, Nankervis, Savin, & Whiteman, 1992). Consequently, I also use a test proposed by Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) that takes as its null hypothesis that the series is stationary (Kwiatkowski, Phillips, Schmidt, & Shin, 1992). The primary statistic is based on a partial sum of the residuals from the regression, producing an LM statistic:

$$LM = \frac{1}{T^2} \sum_{t=1}^{T} \frac{S_t^2}{\widehat{\sigma_\epsilon^2}} \quad where\ S_t = \sum_{i=1}^{t} e_i, t = 1,2,\ldots,T. \tag{2}$$

In this context, e_i is the residual term from the regression of y_t on an intercept; $\widehat{\sigma_\epsilon^2}$ is a consistent long run variance estimate of y_t; and T represents the sample size. The KPSS statistic has a nonstandard distribution and critical values. If the KPSS statistic is large, then the null of stationarity is rejected.

I test each series in the log of levels ($NC_t^{LowTier}$ and $NC_t^{HighTier}$) and in differences in the log of prices ($\Delta NC_t^{LowTier}$ and $\Delta NC_t^{HighTier}$). I compute these statistics for each series in the sample. Table 2.2 presents the results for the unit root tests. The first and fifth columns in the top panel show according to the ADF test, all three countries are non-stationary in levels in the low and high tiers. Similarly, the first and fifth columns in the lower panel show that according to the KPSS test all three variables are non-stationary in levels. Columns three and seven show the unit root results for each series in differences. Both tests show that the variables are stationary in differences in the low tier. The ADF test suggests that the returns in first differences for Mexico are not stationary in the high tier. However, the ADF is known to have less power and too frequently accepts the null. Hence, the KPSS test I believe accurately reflects that it is stationary at the 1% level. Combining these results, I find that all series are I(1) in levels and I(0) in first differences.

Estimating Long Run Equilibrium

Because variables are not stationary (i.e., they are integrated of order 1), I test for the existence of a long run relationship between them.

Tests for Cointegration

Early studies on cointegration showed that a long run relationship could be ascertained through a two-step procedure (R. F. Engle & Granger, 1987). However, subsequent studies suggest a far superior procedure using a maximum likelihood estimator (ML) (Johansen, 1988;

Johansen & Juselius, 1990). This technique not only avoids the possibility of carrying over errors from the first step of estimation to later steps, it also allows greater flexibility for testing hypotheses. For this reason, I employ methods proposed by Johansen (1988) and Johansen and Juselius (1990). The ML estimator of the parameters of a cointegrating relationship is

$$\Delta y_t = \alpha\xi' y_{t-1} + \sum_{t-1}^{p-1} \Gamma_{\mathrm{i}} \Delta y_{t-1} + \epsilon_t \tag{3}$$

where y is a $(K\ x\ 1)$ vector of I(1) variables, α and ξ are $(K\ x\ r)$ parameter matrices with rank $r < K, \Gamma_1, \ldots., \Gamma_{p-1}$, and ϵ_t is a $(K\ x\ 1)$ vector of normally distributed errors that is serially uncorrelated but has contemporaneous covariance matrix Ω. From this ML estimator, Johansen derives two likelihood-ratio (LR) tests for inference on r—the number of cointegrating equations. The two LR tests are known as the trace statistic and the maximum eigenvalue statistic.

The null hypothesis of the trace statistic is that there are no more than r cointegrating relations. Thus, the remaining eigenvalues are zero. The alternative hypothesis to the trace statistic is the maximum eigenvalue statistics, which has as its null that there are exactly r cointegrating equations. In Table 2.3, I present tests for the existence of cointegrating relationships between different countries based upon pricing tiers. The trace and maximum eigenvalue statistics provide no conclusive answer regarding cointegration. For example, I report the maximum eigenvalue statistic in columns 1 and 2 of Panel B. For each country pair (USA-MEX, USA-CAN, and CAN-MEX), I can reject the null hypothesis that there are no cointegrating equations in both tiers (column 1) Panel B). However, the critical values for the maximum eigenvalue test do not correspondingly support that there is at least one cointegrating factor (column 2). In columns 3 and 4, I similarly do not find support for a cointegrating relationship between any country pair in either tier via the trace statistic.

In contrast to the Johansen tests, a third method for determining the number of cointegrating equations involves minimizing an information criterion, such as the Schwarz Bayesian information criterion (SBIC) or the Hannan Quinn information criterion (HQIC) (Aznar & Salvador, 2002; Gonzalo & Pitarakis, 1998). The final column in Panel A shows that there are at least two cointegrating equations among the three NAFTA countries in both tiers, suggesting that the price tiers in the three countries are integrated. Similarly, in Panel B, the Hannan-Quinn statistic reported in column 8 shows that all three country pairs are cointegrated.

Because the Johansen methods and the Hannan-Quinn criterion supply inconsistent statistics, I explore further whether or not the lack of cointegration might stem from regime or trend shifts, shifts for which the Johansen methods do not account. Research shows that the power of the Johansen test falls drastically when a structural break exists in the data, which affects unit root and cointegration tests (Perron, 1989; Perron & Vogelsang, 1992; Život & Andrews, 1992). These breaks can contribute to a loss of power in standard residual-based testing (Gregory & Hansen, 1996b). Consequently, Gregory and Hansen (1996b) proposed cointegration tests that account for a break in the cointegrating relationship (Gregory & Hansen, 1996a). Table 2.4 presents three test statistics for the three country pairs in both price tiers: the ADF-type test, the Z_a type test, and the Z_t type test. All three tests are significant at the 1% level, providing additional evidence of a cointegrating relationship. Columns 2, 5, and 7 reflect the estimated date of the shifts.[5]

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[5] While it is not the focus of this essay, I check for cointegration across tiers within a country. That is, in the main essay, I vary countries while keeping tiers constant. For additional consideration, I vary tiers while keeping countries constant. For example, I test for cointegration between $USA^{HighTier}$ $USA^{LowTier}$. For all three countries, I

Tests for Vector Error Correction

While I recognize that Eq. 1 theoretically represents the long run equilibrium, I also anticipate that true data generating process is far more complex than such a simple equation. As a result, I estimate a more robust and flexible vector-error correction model not dissimilar from the model proposed by Damianov and Escobari (2016). The following equations shows the model:

$$\Delta NC1_t^{Tier} = a_1 + \gamma_1\left(NC1_{t-1}^{Tier} + \beta NC2_{t-1}^{Tier}\right) + \sum_{j=1}^{k} a_{11}(j)\Delta NC1_{t-j}^{Tier} + \sum_{j=1}^{k} a_{12}(j)\Delta NC2_{t-j}^{Tier} + \epsilon_{NC_1 t} \tag{4}$$

$$\Delta NC2_t^{Tier} = a_2 + \gamma_2\left(NC1_{t-1}^{Tier} + \beta NC2_{t-1}^{Tier}\right) + \sum_{j=1}^{k} a_{21}(j)\Delta NC1_{t-j}^{Tier} + \sum_{j=1}^{k} a_{22}(j)\Delta NC2_{t-j}^{Tier} + \epsilon_{NC_2 t} \tag{5}$$

In this model, NC1 and NC2 represent any two NAFTA countries under comparison. The term in parentheses signifies the long run equilibrium, which is equivalent to the difference formula in Eq. 1. The left-hand side of equations 4 and 5 captures the short run dynamics. When variations from the long run equilibrium occur in the short run, they must be "corrected." The speed of this correction is captured by the parameters γ_1 and γ_2. If the deviations from equilibrium are positive (i.e., $d_t^{Tier} > 0$), then β is negative and the price index in NAFTA country 1 is relatively larger than the price index of NAFTA country 2 within the same tier. As a result, it is not unreasonable to anticipate that NC1 will decrease in the short run (i.e.,

find that the results mirror the results from the main study. According to the minimized Hannan Quinn information criterion, all three NAFTA countries show cointegration between their high and low tiers.

$\Delta NC1_t^{Tier} < 0)$ and NC2 will increase (i.e., $\Delta NC2_t^{Tier} > 0$). In this situation, therefore, I expect $\gamma_1$to be negative and $\gamma_2$to be positive.

An important component in the model is its capacity to provide information about short run dynamics. Consider the parameters on the lags of the right-hand part of the equation: a_{11} and a_{22}. If an increase (or decrease) in this lag term is associated with a corresponding increase (or decrease) in the current period, then the parameters would capture momentum effects. And although each parameter technically derives from its own particular equation, its presence within the system of equations within the model allows us to test for the strength of momentum within a particular country.

Table 2.5 presents the maximum likelihood estimation of Equations 4 and 5 for each set of NAFTA countries within both tiers. I used the AIC to determine the optimal lag length. According to the model, a vector of $[1, \beta]$ depicts the long run equilibrium. Column 9 presents the calculated β for each NAFTA pair. The results show considerable variation in the values of the cointegrating statistic. For each NAFTA country in both tiers, the $\beta's$ are all statistically significant.

Four of the six estimates of the cointegrating paramter are signed negative and two are positive. Not only is the parameter for Mexico – USA in the high tier signed positive, it is extremely large. This variation from the other estimates may be related to the regime shifts identified in the cointegration tests in Table 2.4. If the VECM were able to account for the shift, the value of the estimate might not appear as an outlier. Indeed, Table 2.6 reflects the value of the cointegrating factor when the parameter is allowed to vary over time. In each instance, the value of the parameter is negative and greater than one in the absolute.

The statistically significant β in Table 2.5 suggests a long run relationship between two countries within the pricing tiers. For Mexico – USA, for example, $Mexico_t^{Low} = 3.072 \cdot USA_t^{Low}$. Thus, a one point increase in the prices of stocks in the low tier of the USA are associated with 3.072 increase in the stock prices in Mexico within the low tier, suggesting returns for USA stocks in the low tier are appreciating slower than low tier stocks in Mexico. Perhaps this finding reflects the volatility of the Mexico stocks. With greater volatility comes increased risk, which potentially leads to greater returns.

Table 2.5 also shows that there is considerable evidence for momentum in both tiers. Only Mexico in the high tier in the Mexico – Canada pairing and USA in the high tier in the USA – Mexico pairing failed to have a statistically significant result. This finding suggests that the immediate past returns for any country in any tier have a significant impact on the current short-term returns.

Stability of Long Run Equilibrium

In Eqs. 4 and 5, the estimate of β is assumed to be time invariant. In light of the global financial crisis around 2007- 08 however, this assumption may be too strong. While any two NAFTA markets may be cointegrated within the tiers, one might suspect that the markets might respond to the shocks differently during the time of the crisis—the long run equilibrium might shift. For this reason, I investigate the stability of the long run equilibrium ($NC1_t^{Tier} + \beta NC2_t^{Tier}$) by using a rolling regression approach. To execute a rolling vector error correction model, I allow β to change over time.

First, I establish a window of months over which I estimate Eqs. 4 and 5. For my study, I chose 72 months. This size was big enough to get a solid estimate, but also small enough that I could roll it forward another 72 times. For my first estimate, therefore, I evaluate observations

$[1, w]$.Subsequent estimates move from $[2, w + 1]$ until I reach the final month: $[2, w + 1]$, $[3, w + 2]$, … $[N - w + 1, N]$. From this procedure, I ascertain a series of (β_t) that captures the dynamics of the cointegrating equation. I repeat this process for each of the six NAFTA pairs, allowing us to obtain a panel of estimates: β_{it}.[6]

Using this panel, I analyze how the financial crisis affected the long run equilibrium between countries within a particular price tier. The model I estimate is:

$$\beta_{it} = \delta \cdot \mathbb{I}_{|\tau_i - t| \leq \theta} + \mu_i + \eta_{it} \qquad (6)$$

where $\mathbb{I}$ is an indicator function that captures the period of the financial crisis from its formation to its end. The statistic τ_i represents the time at which the crisis for a particular grouping of NAFTA countries (i) reached its height, and θ denotes a positive integer that captures the time distance away from this period. For the purposes of this essay, I calculated the time at which the crisis "bubble" burst as the date at which the lower series in a grouping reached its maximum. The statistic of greatest interest is δ, which captures any shift in the long run equilibrium (β_{it}). Two final variables capture time invariant specific effects to the NAFTA groupings (μ_i) and any remaining stochastic error (η_{it}). Because I do not know the actual length of the crisis for each grouping, I use different window sizes (i.e., θ) equal to 3 months, 6 months, and 12 months.[7]

Figure 2.2 presents the graph of the returns for high tier indexes of Mexico and the United States. From the graph, one can easily detect an ordered relationship, with the returns for stocks in Mexico being on the top and the returns for the stocks in the USA being on bottom. The

[6] In the context of stability Darrat and Zong (2005) used an alternative test to assess the stability of the cointegrating vectors. They constructed a likelihood ratio (LR) statistic, which evaluated the likelihood of the value received from each recursive sub-sample with the likelihood value computed under restrictions (Hansen & Johansen, 1993).

[7] According to the National Bureau of Economic Research (NBER), the recession began in December 2007 and ended in June 2009. The recession affects stocks in different tiers differently. For this reason, my use of the windows operates as a robustness check.

question under discussion is whether or not the long run relationship between the two return series, which was previously identified in the VECM, is stable. To be sure, I explore this question via Equ. 6. Table 2.6 presents the results of this analysis.

I explore the possible parameter instability from various time and econometric perspectives. Table 2.6 shows the three "window" options for θ (3 months, 6 months, and 12 months). Moreover, the table also presents the estimates for β prior to the height of the crisis (β_{Pre}), at the height of the crisis (β_{Dur}), and the difference between the two ($\beta_{Dur} - \beta_{Pre}$). Lastly, I analyzed the parameter using both a pooled and fixed effects regression. Column 4, for example, with a $\theta = 6$, indicates that a one percentage increase (decrease) in the lower series of any two NAFTA countries was associated with a corresponding 1.609 % increase (decrease) in the upper series of the group during the period prior to the financial crisis. This elasticity increases to 1.90 during the 12 months around the height of the global financial crisis. From Figure 2.2 one can see an example with USA and Mexico, with returns for the USA on bottom and Mexico having the returns shown on top. This finding suggests that the rate of appreciation (or depreciation) of Mexico was greater than the rate of appreciation (or depreciation) of the United States during the crisis. Stated more generally, the returns of NAFTA countries on the upper portion of the graph appreciate (or depreciate) at a higher rate than those whose returns are below and cointegrated with them.

The results show that the estimates for β are significant at the 1% level for both periods before and during the crisis. More importantly, the final row of Table 2.6 explores the difference between the two periods. Columns 1 and 2 show that for $\theta = 3$, the difference between β_{Pre} and β_{Dur} is statistically significant at the 5% level. Columns 4, 5, and 6, on the other hand, show that for $\theta = 6$ and $\theta = 12$ the difference between β_{Pre} and β_{Dur} is statistically significant at the 1%

level The results presented in Table 6 indicate support for the conclusion that β shifted during the crisis. Indeed, the first column indicates that the appreciation (or depreciation) rate of the log of price is $.380$ smaller in the years leading to the crisis than it was at the height of the crisis.

As a robustness check, I rerun all of the same statistical tests on the non-transformed variables; I test prices. As before, all of the unit root tests, cointegration tests, and the vector error correction models show significant results. The summary statistics for the prices show that that prices in the lower tier are more volatile than the prices in the upper tier, and the prices of Mexico are considerably more volatile than those in the USA or Canada.

Similarly, the unit root tests (Table 2.8) show that the price indexes are non-stationary in levels and stationary in first differences, and the cointegrating tests (Tables 2.9 and 2.10) support the conclusion that the price indexes are cointegrated.

The VECM in prices, with results presented in Table 2.11, show long run equilibrium estimates of β are significant for four of the six country pairings. However, the evidence for momentum is largely non-existent.

I regenerate a new panel of estimates for β_{it} via a rolling regression technique. Lastly, I analyze Eq. 6 based on this new panel, which reflects prices rather than returns. The results are reported in Table 2.12. Column 4, for example, with a $\theta = 6$, indicates that a one point increase (decrease) in the lower series of any two NAFTA countries was associated with a corresponding $.615$ point increase (decrease) in the upper series of the group during the period prior to the financial crisis. At the height of the crisis, this number increases to 1.282. For the three month window size, the difference between β_{Pre} and β_{Dur} is statistically significant at either the 5% or 10% level. In light of these robustness tests, therefore, I can say with considerable confidence that the long run parameter shifted during the time of the crisis.

Finally, I attempt to determine whether or not the long run relationship among the tiered returns of the three countries was the result of the regional trade agreement—is there a NAFTA effect? In order to investigate this question, I perform the same tests on a non-NAFTA country and compare them with the returns from the USA, Mexico, and Canada. I chose Japan as my non-NAFTA country. Table 2.13 shows the results of the cointegration tests between Japan and each NAFA country. In agreement with the statistics from tables 2.3 and 2.9, the results show that the returns of Japan in each tier are cointegrated with the returns from each NAFTA country. In other words, the results suggest that while the returns from the three NAFTA countries may show evidence of tightening market linkages, they may not be necessarily due to a NAFTA effect.

Conclusion

In this essay, I investigate the interrelationships between the stock markets of three North American Countries (Mexico, North American, and Canada) which have been stratified into tiers based on market capitalization. In particular, I examine the long run relationship during the period of 2005 through 2016, thus covering the global financial crisis of 2007. An understanding this relationship between markets provides important information about the economic significance of NAFTA and for investors and managers who depend on stock market behavior.

In this essay, I investigate not only if the stock markets of the three North American countries are cointegrated, I examine whether or not NAFTA was the cause of that long run relationship. More broadly, I asked if RTA's potentially lead to economically and financially linked economies. The results of this analysis suggest that the stock markets of the United States, Mexico, and Canada not only are linked, but that they are also linked within tiers based upon market capitalization. The study also suggests the existence of structural breaks in the data, which might account for previous researchers not finding a cointegrating relationship among the stock markets of the three North American countries. In addition, the study shows that I cannot reject that the NAFTA accord is the cause of the long run relationship.

My results come with some caveats. The cointegration may result from increased correlations resulting from the financial crisis which dominates the period under investigation. And even though the results are robust, the current study controls may not capture the full impact of factors not considered. Still, my robustness tests find that the markets are cointegrated not only between countries, but also within countries. And, the robustness tests show that the cointegration not only stems from series based on returns, but also to series based on stock prices.

These findings are significant for investors, who are seeking to diversify risk. If the stock markets are linked, and if they are linked within tiers, then one cannot diversify the risk of a stock by investing in a similarly-sized stock from a neighboring country's stock market. Company managers, likewise, may use this information when making investment decisions tied to the cost of capital. If the potential investment lies within a cointegrated market, then the systematic risk shifts to the world market, which affects expected returns.

It is difficult to predict the long term effect of the agreement meant to replace NAFTA – United States – Mexico – Canada Agreement (USMCA). Although some individual markets, such as the automotive market between US and Mexico and the dairy market between US and Canada, experienced some significant changes, most of the changes in the new agreement appear more cosmetic. In fact, the changes appear to reflect that fact that the United States is more important to the economies of Mexico and Canada than each of the other countries are to the United States. Because the changes to NAFTA are minimal, it is doubtful that they will significantly affect the long term stock market relationship of those countries. Indeed, as the world becomes increasingly linked, I anticipate that those markets will reflect the same tightening reality.

From a methodological standpoint, one might question whether or not segregating stocks based on market capitalization is appropriate. The results from this analysis suggest that it not only is appropriate, but that it provides significant information about risk. Additional research may consider extending this research by exploring volatilities based on company size and market capitalization.

Finally, I used a rolling vector error correction technique to evaluate the stability of the long run relationship. I find that during the time of the most recent global financial crisis, the cointegrating parameter was unstable. While the finding in and of itself does not violate the efficient market hypothesis, it does nevertheless present an alert investor to possible arbitrage opportunities in crisis situations. In this essay, I do not explore reasons for this instability, but rather, I leave that for another researcher or time.

Figure 2.1: Mexico - USA (Low Tier)

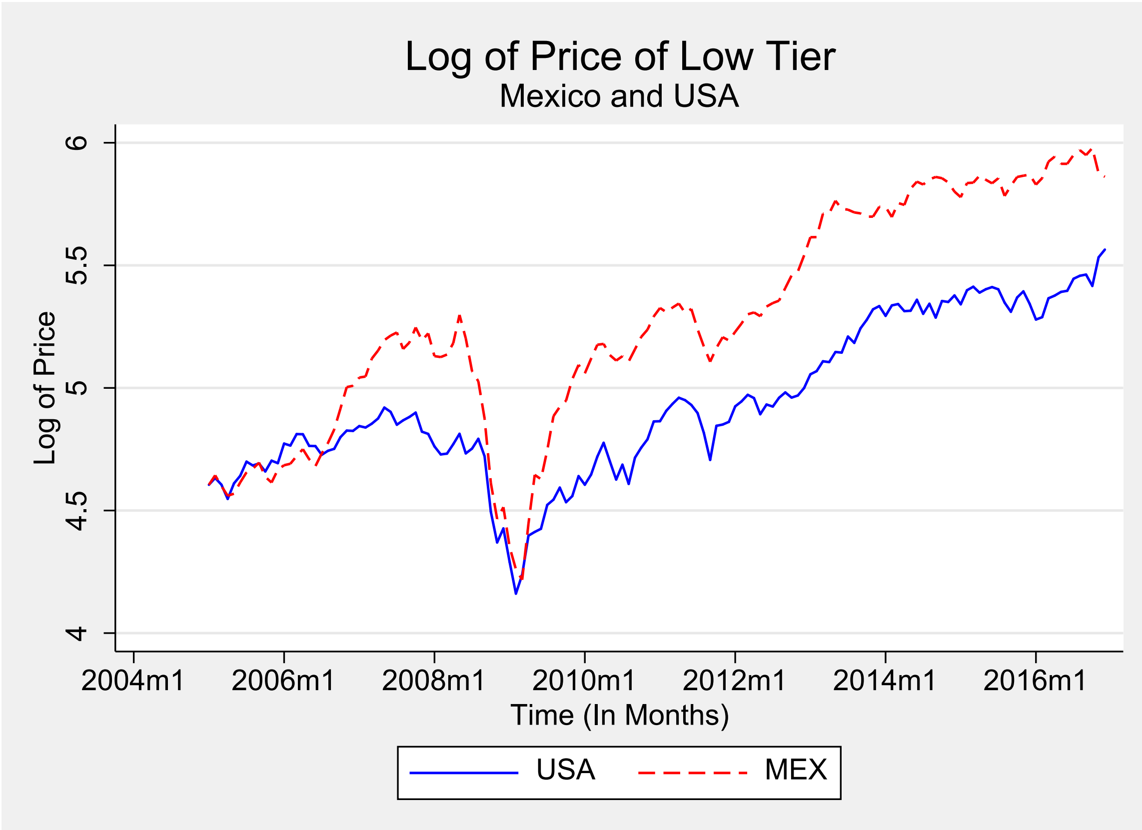


Table 2.1: Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		LOWTIER					HIGHTIER				
Country	Obs.	Mean	S.D.	RSD	Min	Max	Mean	S.D.	RSD	Min	Max
United States	144	4.938	0.317	6.411	4.161	5.564	4.797	0.253	5.281	4.131	5.245
Mexico	144	5.272	0.460	8.725	4.218	5.979	5.557	0.388	6.982	4.554	6.020
Canada	144	4.662	0.234	5.011	3.959	5.048	5.064	0.177	3.486	4.554	5.359

Notes: The sample contains monthly observations of the log of prices from 2005m1 through 2016m12 from price indexes of three countries: USA, Mexico, and Canada. There are 144 times-series observations of LOWTIER and HIGHTIER for each of the three countries. The base period for this essay is 2005m1. All series are in a common currency: the US dollar.

Table 2.2: Unit Root Tests (Log of Prices)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LowTier				HighTier			
	Levels		Differences		Levels		Differences	
VARIABLES	τ_{df}	Lags	τ_{df}	Lags	τ_{df}	Lags	τ_{df}	Lags
United States	-1.399	6	-4.202***	3	-1.506	6	-4.010***	3
Mexico	-2.430	1	-3.707***	3	-1.292	6	-2.179	13
Canada	-2.503	1	-4.070***	3	-2.172	1	-4.311***	3
	KPSS	Lags	KPSS	Lags	KPSS	Lags	KPSS	Lags
United States	0.569***	3	0.053	3	0.626***	3	0.0686	3
Mexico	0.213**	3	0.050	3	0.334***	3	0.0558	3
Canada	0.175**	3	0.044	3	0.211**	3	0.0425	3

Notes: The symbol τ_{df} is the test-statistic of the modified Dickey-Fuller Generalized Least Squares. Critical values vary. The null hypothesis is "the series is non-stationary." KPSS is the Kwiatkowski-Phillips-Schmidt-Shin test for mean stationarity. For KPSS test, the critical values are .216 (1%); .146 (5%); and .119 (10%). The null hypothesis for the KPSS test is "the series is stationary. The Akaike Information Criterion (AIC) was used to determine the optimal lag length.

Table 2.3: Cointegration Tests (Johansen and Hannan-Quinn) (Log of Prices)

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Maximum Eigenvalue			Trace Statistic			Minimum Hannan-Quinn			
	r=0	r=1	r=2	r=0	r<=1	r<=2	r=0	r=1	r=2	Eq.
USA – Mex - Can										
Low Tier	30.58	21.22	15.96	67.75	37.18	15.96	-8.718	-8.824	-8.908	2
High Tier	30.00	24.08	15.26	69.34	39.34	15.26	-10.77	-10.87	-10.98	2

Panel B

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Maximum Eigenvalue		Trace Statistic		Minimum Hannan-Quinn			
	r=0	r=1	r=0	r<=1	r=0	r=1	r=2	#Eq.
USA – MEX								
Low Tier	29.68	15.61	45.29	15.61	-5.875	-6.021	-6.111	1
High Tier	25.14	17.87	43.01	17.87	-6.883	-6.996	-7.102	1
USA – CAN								
Low Tier	26.68	19.75	46.43	19.75	-5.591	-5.714	-5.835	1
High Tier	24.30	13.67	37.97	13.67	-7.200	-7.307	-7.383	1
CAN – MEX								
Low Tier	21.94	17.75	36.69	17.75	-5.466	-5.556	-5.661	1
High Tier	31.66	20.33	52.00	20.33	-6.578	-6.738	-6.862	1

Notes: Critical values for the maximum eigenvalue for r = 0 are 14.07 (5%) and 18.63 (1%); and r = 1 are 3.76 (5%) and 6.65 (1%). Critical values for the trace statistic for r = 0 are 15.41 (5%) and 20.04 (1%). For $r \leq 1$ are 3.76 (5%) and 6.65 (1%).

Table 2.4: Cointegration with Regime Shifts (Log of Prices)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ADF-type test			Z_t -type test		Z_a -type test	
USA – Mex- Can	t-stat	Break	Lag	Z_t-stat	Break	Z_a-stat	Break
Low Tier	-12.88	2011m10	0	-12.93	2011m10	-154.7	2011m10
High Tier	-9.649	2007m6	1	-13.56	2010m10	-161.2	2010m10
USA - MEX							
Low Tier	-11.16	2008m.11	0	-11.77	2011m7	-141.3	2011m7
High Tier	-9.562	2010m9	1	-13.68	2010m10	-162.5	2010m10
USA - CAN							
Low Tier	-13.98	2011m7	0	-14.03	2011m7	-166.2	2011m7
High Tier	-10.38	2014m7	0	-10.42	2014m7	-123.9	2014m7
CAN - MEX							
Low Tier	-12.22	2011m10	0	-12.26	2011m10	-147.1	2011m10
High Tier	-10.62	2007m2	1	-13.90	2007m1	-164.6	2007m1

Notes: Optimal lag for the ADF-type test chosen by the Akaike criterion. All specifications model a change in regime and trend. Critical values for ADF-type test are -6.02 (1%), -5.50 (5%), and -5.24 (10%). Critical values for the Z_a-type test and Z_t-test are different for the different countries. All statistics are significant at the 1% level except for USA – CAN (High Tier), which is significant at 5%.

Table 2.5: Vector Error Correction Model (Log of Prices)

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mexico - USA	Change in Mexico				Change in USA				
	a_1	γ_1	a_{11}	a_{12}	a_2	γ_2	a_{22}	a_{21}	β
Low Tier	-0.030	0.129**	-0.536***	0.325***	0.009	0.429***	-0.139*	0.130	-3.072***
	0.367	0.0538	0.087	0.109	0.340	0.0498	0.0804	0.101	0.279
High Tier	-0.016	-0.123***	-0.517***	0.533***	0.015	-0.125***	-0.0068	0.0120	6.728***
	0.317	0.0196	0.082	0.120	0.256	0.0158	0.0660	0.0969	0.892
Panel B									
Canada – USA	Change in Canada				Change in USA				
Low Tier	0.023	0.101	-0.550***	0.312**	-.005	0.474***	-0.247***	0.164	-2.738***
	0.469	0.081	0.0943	0.145	0.350	0.0603	0.070	0.109	0.234
High Tier	-0.018	0.129	-0.508***	0.300**	0.0034	0.662***	-0.398***	0.234*	-1.888***
	0.320	0.115	0.113	0.147	0.264	0.095	0.093	0.122	0.142
Panel C									
Mexico - Canada	Change in Mexico				Change in Canada				
Low Tier	-0.031	-0.488***	-0.206**	0.188***	0.026	-0.577***	0.489***	-0.347***	0.517***
	0.329	0.0742	0.0842	0.063	0.417	0.094	0.107	0.080	0.159
High Tier	-0.003	0.586***	-0.144	-0.122	-0.008	-0.205*	-0.240**	-0.157	-1.463***
	0.328	0.112	0.106	0.112	0.321	0.110	0.103	0.109	0.132

Note: The figures in the second row are the standard errors. The symbol *** indicates significance at 1%; the symbol ** signifies significance at 5%; the symbol * signifies significance at 10%.

Table 2.6: Long Run Equilibrium (Log of Prices)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	$\theta = 3$		$\theta = 6$		$\theta = 12$	
	Pooled	FE	Pooled	FE	Pooled	FE
β_{pre}	-1.627***	-1.627***	-1.609***	-1.609***	-1.536***	-1.550***
	(0.0552)	(0.0359)	(0.0579)	(0.0377)	(0.0636)	(0.0412)
$H_0: \beta_{pre} = 0$	[0]	[0]	[0]	[0]	[0]	[0]
$H_0: \beta_{pre} = -1$	[0]	[0]	[0]	[0]	[0]	[0]
β_{Dur}	-2.006***	-2.006***	-1.900***	-1.900***	-1.915***	-1.887***
	(0.180)	(0.117)	(0.127)	(0.0828)	(0.0919)	(0.0595)
$H_0: \beta_{Dur} = 0$	[0]	[0]	[0]	[0]	[0]	[0]
$H_0: \beta_{Dur} = -1$	[0]	[0]	[0]	[0]	[0]	[0]
$\beta_{Dur} - \beta_{Pre}$	-0.380**	-0.380**	-0.291	-0.291***	-0.379***	-0.337***
	(0.188)	(0.188)	(0.140)	(0.0910)	(0.112)	(0.0724)
$H_0: \beta_{Dur} - \beta_{Pre} = 0$	[0.045]	[0.045]	[0.038]	[0.002]	[0.001]	[0]
Obs	420	420	420	420	420	420

Note: Figures in parentheses are standard errors. Figures in brackets are p-values. The symbol *** indicates significance at 1%; the symbol ** signifies significance at 5%; the symbol * signifies

Figure 2.2: Mexico - USA (High Tier)

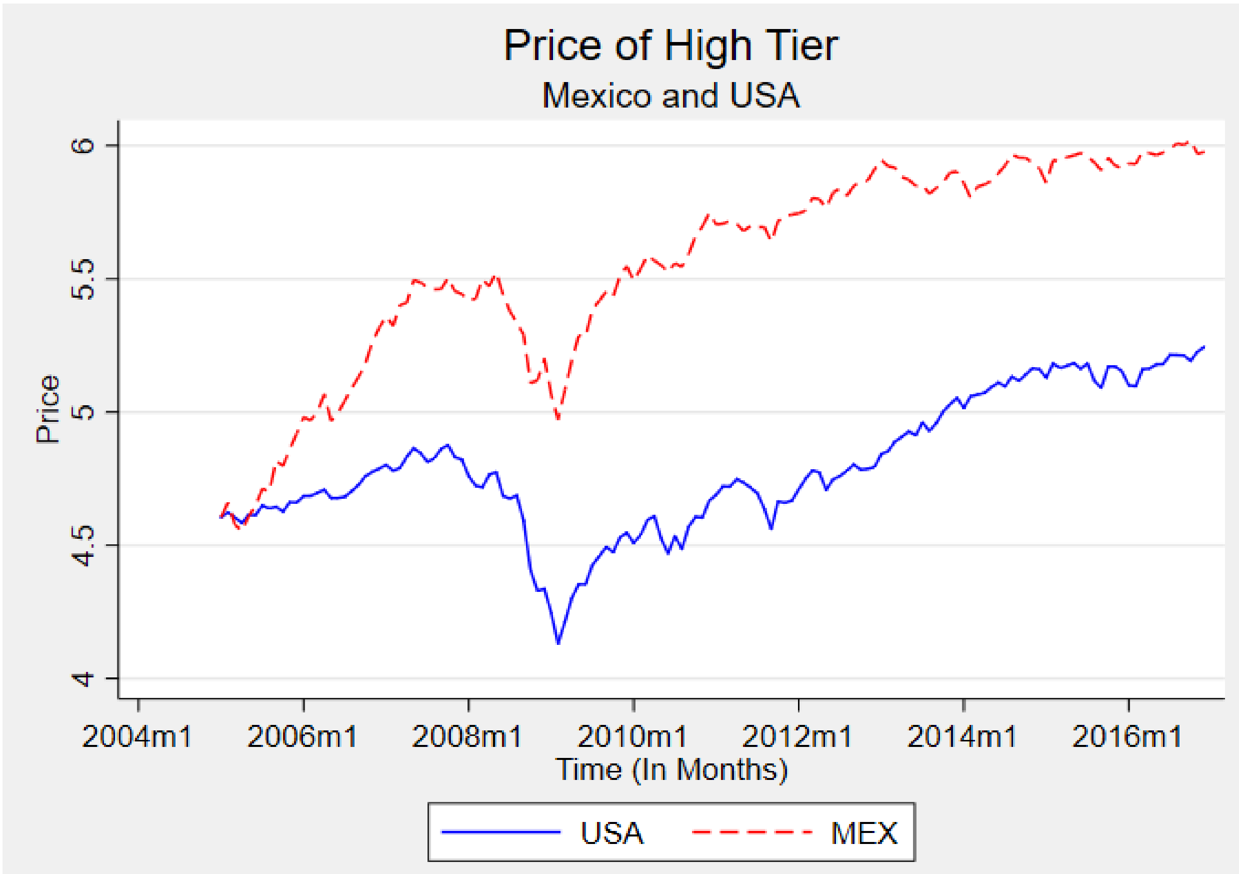


Table 2.7: Summary Statistics (Prices)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		LowTier					HighTier				
Country	Obs.	Mean	S.D.	RSD	Min	Max	Mean	S.D.	RSD	Min	Max
United States	144	470.8	151.4	32.17	206.0	838	1477	375.2	25.41	735.1	2239
Mexico	144	215.5	94.40	43.71	68.02	395.8	280.8	92.40	32.90	96.38	417.4
Canada	144	564.8	119.1	21.08	272.5	810	664.1	108.2	16.29	393.2	879

Notes: The sample contains monthly observations from 2005m1 through 2016m12 from price indexes of three countries: USA, Mexico, and Canada. There are 144 times-series observations of LowTier and HighTier for each of the three countries. The base period for this essay is 2005m1. All series are in a common currency: the US dollar.

Table 2.8: Unit Root Tests (Prices)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LowTier				HighTier			
	Levels		Differences		Levels		Differences	
VARIABLES	τ_{df}	Lags	τ_{df}	Lags	τ_{df}	Lags	τ_{df}	Lags
United States	-1.174	6	-6.509***	12	-1.434	1	-2.825**	4
Mexico	-1.936	1	-3.442***	4	-2.029	1	-3.078**	3
Canada	-2.537*	1	-4.182***	10	-1.782	1	-3.575***	2
	KPSS	Lags	KPSS	Lags	KPSS	Lags	KPSS	Lags
United States	0.705***	3	0.0559	3	0.721***	3	0.0769	3
Mexico	0.506***	3	0.0653	3	0.184**	3	0.0380	4
Canada	0.184**	3	0.0455	3	0.213**	3	0.0390	3

Notes: The symbol τ_{df} is the test-statistic of the modified Dickey-Fuller Generalized Least Squares. Critical values are -3.480 (1%); -2.811 (5%); -2.531 (10%). The null hypothesis is "the series is non-stationary." KPSS is the Kwiatkowski-Phillips-Schmidt-Shin test for mean stationarity. For KPSS test, the critical values are .216 (1%); .146 (5%); and .119 (10%). The null hypothesis for the KPSS test is "the series is stationary. In both sets of tests, the Akaike Information Criterion (AIC) was used to determine the optimal number of lags.

Table 2.9: Cointegration Tests (Johansen and Hannan-Quinn) (Prices)

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Maximum Eigenvalue			Trace Statistic			Minimum Hannan-Quinn			
	r=0	r=1	r=2	r=0	r<=1	r<=2	r=0	r=1	r=2	Eq.
USA – Mex - Can										
Low Tier	22.66	19.56	13.31	55.52	32.87	13.31	21.17	21.12	21.05	2
High Tier	41.56	24.81	13.97	80.34	38.78	13.97	20.13	19.94	19.83	2

Panel B

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Maximum Eigenvalue		Trace Statistic		Minimum Hannan-Quinn			
	r=0	r=1	r=0	r<=1	r=0	r=1	r=2	#Eq.
USA – MEX								
Low Tier	21.35	13.48	34.83	13.48	14.63	14.55	14.47	1
High Tier	36.06	16.84	52.90	16.84	13.69	13.50	13.40	1
USA – CAN								
Low Tier	22.23	14.41	36.64	14.41	13.53	13.44	13.36	1
High Tier	24.33	12.81	37.14	12.81	12.48	12.38	12.31	1
CAN – MEX								
Low Tier	21.92	12.95	34.88	12.95	14.42	14.33	14.26	1
High Tier	36.89	23.55	60.29	23.55	14.70	14.50	14.35	1

Notes: Critical values for the maximum eigenvalue for r = 0 are 14.07 (5%) and 18.63 (1%); and r = 1 are 3.76 (5%) and 6.65 (1%). Critical values for the trace statistic for r = 0 are 15.41 (5%) and 20.04 (1%). For $r \leq 1$ are 3.76 (5%) and 6.65 (1%).

Table 2.10: Cointegration with Regime Shifts (Prices)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	ADF-type test			Z_t -type test		Z_a -type test	
USA – Mex- Can	t-stat	Break	Lag	Z_t-stat	Break	Z_a- stat	Break
Low Tier	-13.34	2001m1	0	-13.39	2012m1	-159.8	2012m1
High Tier	-13.23	2012m12	0	-13.27	2012m12	-158.4	2012m12
USA - MEX							
Low Tier	-12.60	2012m.3	0	-12.64	2012m3	-151.6	2012m3
High Tier	-13.06	2010m10	0	-13.10	2010m10	-156.5	2010m10
USA - CAN							
Low Tier	-5.77	2015m2	3	-14.63	2015m2	-171.8	2015m2
High Tier	-10.25	2011m7	0	-10.29	2011m7	-122.2	2011m7
CAN - MEX							
Low Tier	-13.11	2012m1	0	-13.15	2012m1	-157.2	2012m1
High Tier	-13.59	2007m1	0	-13.64	2007m1	-162.1	2007m1

Notes: Optimal lag for the ADF-type test chosen by the Akaike criterion. All specifications model a change in regime and trend. Critical values for ADF-type test are -6.02 (1%), -5.50 (5%), and -5.24 (10%). Critical values for the Z_a-type test and Z_t-test are different for the different countries. All statistics are significant at the 1% level except for USA – CAN (High Tier), which is significant at 5%.

Table 2.11: Vector Error Correction Model (Prices)

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MEX - USA	Change in Mexico				Change in USA				
	a_1	γ_1	a_{11}	a_{12}	a_2	γ_2	a_{22}	a_{21}	β
Low Tier	1.460	0.002	0.149	-.014	-0.053	0.052**	0.061	-0.127	-1.982***
	0.930	0.033	.0987	.149	0.593	0.021	0.063	0.095	0.190
High Tier	0.789	-0.011	0.008	0.081	1.128*	0.007	-0.023	0.051	-1.276
	1.499	0.015	0.100	0.265	5.906	0.0644	0.441	0.100	0.960

Panel B									
USA – Canada	Change in USA				Change in Canada				
Low Tier	0.884	-0.004	-0.098	0.019	-0.193	-0.017***	0.063	0.173*	3.589***
	0.504	0.007	0.096	0.099	0.472	0.007	0.090	0.092	1.362
High Tier	0.438	-0.017	0.054	-0.015	-0.107	-0.069***	0.322***	0.060	0.076
	0.341	0.015	0.063	0.107	0.541	0.0233	0.0996	0.170	0.256
Panel C									
Mexico - Canada	Change in Mexico				Change in Canada				
Low Tier	1.331	-0.004	0.100	0.193	-0.689	-0.008***	0.087	0.140	8.089**
	0.827	0.005	0.094	0.148	0.511	0.003	0.058	0.092	3.209
High Tier	0.745	0.005*	-0.074	0.293**	-0.774	0.005***	0.007	0.344***	-16.58***
	1.014	0.003	0.096	0.149	0.619	0.002	0.059	0.091	4.846

Note: The figures in the second row are the standard errors. The symbol *** indicates significance at 1%; the symbol ** signifies significance at 5%; the symbol * signifies significance at 10%. $\Delta NC1_t^{Tier} = a_1 + \gamma_1\left(NC1_{t-1}^{Tier} + \beta NC2_{t-1}^{Tier}\right) + \sum_{j=1}^{k} a_{11}(j)\Delta NC1_{t-j}^{Tier} + \sum_{j=1}^{k} a_{12}(j)\Delta NC2_{t-j}^{Tier}$; and $\Delta NC2_t^{Tier} = a_2 + \gamma_2\left(NC1_{t-1}^{Tier} + \beta NC2_{t-1}^{Tier}\right) + \sum_{j=1}^{k} a_{21}(j)\Delta NC1_{t-j}^{Tier} + \sum_{j=1}^{k} a_{22}(j)\Delta NC2_{t-j}^{Tier}$.

Table 2.12: Long Run Equilibrium (Prices)

	(1)	(2)	(3)	(4)	(5)	(6)
	$\theta = 3$		$\theta = 6$		$\theta = 12$	
VARIABLES	OLS3	FE3	OLS6	FE6	OLS12	FE12
β_{pre}	-0.628***	-0.618***	-0.643***	-0.615***	-0.792***	-0.720***
	(0.174)	(0.164)	(0.182)	(0.171)	(0.199)	(0.187)
$H_0: \beta_{pre} = 0$	[0]	[0]	[0]	[0]	[0]	[0]
$H_0: \beta_{pre} = -1$	[0.034]	[0.020]	[0.050]	[0.025]	[0.297]	[0.137]
β_{Dur}	-1.739***	-1.869***	-1.113**	-1.282***	-0.502	-0.685**
	0.617	0.579	(0.444)	(0.418)	(0.317)	(0.301)
$H_0: \beta_{Dur} = 0$	[0.005]	[0.001]	[0.013]	[0.002]	[0.113]	[0.023]
$H_0: \beta_{Dur} = -1$	[0.231]	[0.134]	[0.799]	[0.500]	[0.117]	[0.296]
$\beta_{Dur} - \beta_{Pre}$	-1.111*	-1.251**	-0.470	-0.667	0.290	0.0352
	(0.641)	(0.602)	(0.480)	(0.452)	(0.374)	(0.356)
$H_0: \beta_{Dur} - \beta_{Pre} = 0$	[0.084]	[0.038]	[0.328]	[0.141]	[0.438]	[0.921]
Obs	432	432	432	432	432	432

Note: Figures in parentheses are standard errors. Figures in brackets are p-values. The symbol *** indicates significance at 1%; the symbol ** signifies significance at 5%; the symbol * signifies significance at 10%.

Table 2.13: Cointegration Tests (Japan) (Log of Prices)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Maximum Eigenvalue		Trace Statistic		Minimum Hannan Quinn			
	r=0	r=1	r=0	r<=1	r=0	r=1	r=2	#Eq.
USA – JAP								
Low Tier	30.94	21.90	52.84	21.90	-5.763	-5.918	-6.053	1
High Tier	24.55	17.97	42.53	17.97	-6.371	-6.480	-6.587	1
JAP – CAN								
Low Tier	23.88	15.21	39.09	15.21	-5.635	-5.738	-5.825	1
High Tier	20.00	14.61	34.60	14.61	-5.989	-6.065	-6.147	1
JAP – MEX								
Low Tier	23.23	18.96	42.18	18.96	-5.332	-5.431	-5.545	1
High Tier	25.02	14.54	39.57	14.54	-5.997	-6.109	-6.191	1

Notes: Critical values for the maximum eigenvalue for r = 0 are 14.07 (5%) and 18.63 (1%); and r = 1 are 3.76 (5%) and 6.65 (1%). Critical values for the trace statistic for r = 0 are 15.41 (5%) and 20.04 (1%). For $r \leq 1$ are 3.76 (5%) and 6.65 (1%).

CHAPTER III

REGIONAL VOLATILITY SPILLOVERS IN LATIN AMERICAN STOCK MARKETS FOLLOWING POLITICAL INSTABILITY

Introduction

According to the World Bank, an explosion of regional trade agreements (RTA) has occurred in the past twenty years, increasing from 50 in 1990 to more than 280 in 2017.[8] Consequently, the proliferation of RTAs has led to greater linkages between various goods and equity markets. Accordingly, empirical research on financial market integration has increased, and it has identified multiple channels through which welfare benefits are gained. Some of these studies have examined increased welfare gains as a result of free trade agreements and have concluded that RTAs are associated with growth spillover of 13.6 to 15.3 percent (Rigg et al., 2009). By removing tariffs, these agreements lower prices of imports, increase services competition, and reduce cross-border costs and delays (Kondonassis et al., 2008; Lederman et al., 2005). Other studies show that market integration leads to economic growth and risk-sharing benefits (Lewis, 2000; Rangvid et al., 2016), as well as the development of local stock markets (Levine & Zervos, 1998).

[8] Information accessed online at http://www.worldbank.org/en/topic/regional-integration/brief/regional-trade-agreements, on May 26, 2018.

Despite the many benefits, research has also shown that increased market integration does not always improve economic performance, primarily as a result of reduced trade (Spolaore & Wacziarg, 2005). Increased market integration leads to cross-country correlations (Longin & Solnik, 1995), which provides alternative contagion channels, especially during crises. When the effect of crises are measured in terms of stock returns, for example, trade links and neighborhood effects are the primary contagion channels (Hashimoto & Ito, 2002; Hernández & Valdés, 2001). As a result of these studies, therefore, I have a better understanding of how market linkages may increase or decrease economic growth and activity, as well as provide mechanisms through which the negative effects of financial crises can flow.

Numerous studies have examined volatility spillovers from one market to another, often utilizing the GARCH framework (R. Engle, 2002). An extension of this type of research considers whether or not the volatility spillover is a contagion. Part of the challenge for studies on contagion center on the lack of agreement concerning a precise definition of the term. Broadly, contagion refers to the spread of market disturbances from one country to another (Claessens et al., 2001). K. J. Forbes and Rigobon (2002) offer a more precise definition as a significant increase in cross-market linkages after a shock (K. Forbes & Rigobon, 2001). Thus, if no significant shift occurs, then there is no contagion. K. Forbes and Rigobon (2001) further distinguish between what they call non-crisis contingent contagions and crisis contingent contagions. Non-crisis contingent does not mean that the increase in market linkages do not arise out of some kind of crisis. Rather, the authors explain that the increase in correlations can be easily explained through macro-fundamental links between the economies, such as trade links, devaluations, (Corsetti, Pesenti, Roubini, & Tille, 2000), and financial links (Masson, 1999b).

Crisis contingent contagions, on the other hand, refer to increased linkages that cannot be easily explained (Connolly & Wang, 2003; Kodres & Pritsker, 2002). In addition, these crisis contingent contagions may arise from multiple equilibria, such as investor expectations (Masson, 1999b), memory of past crises (Mullainathan, 2002), and current political factors (Drazen, 2000). In this essay, I explore Drazen's (2000) theory that political factors may play a crucial role in the spread of financial contagion.

Previous studies approach political factors and instability from two main perspectives. First, some researchers use the phrase to connote executive instability (Alesina & Perotti, 1996), such as fundamental changes in constitutional governments, or the collapse of the current government, or even *coups d'etat*. Other studies, however, employ the phrase political instability to indicate social unrest and political violence (Ades & Chua, 1997). Regardless of the category of political unrest, research shows a significant relationship between political instability and economics. Some studies show that political instability affects investment decisions (Campos & Nugent, 2003; Lothian, 1991), economic growth (Alesina & Perotti, 1996; Gurgul & Lach, 2013), and asset markets in emerging markets (Diamonte, Liew, & Stevens, 1996; Fielding, 2003). Additional studies show a link between political instability and foreign direct investment (Brada, Kutan, & Yigit, 2006) and overall stock market behavior (Bailey & Chung, 1995; Kutan & Perez, 2002).

During the first decade of the twenty-first century, Latin American economies as a whole experienced remarkable economic growth. However, during the US sub-prime crisis in the summer of 2007, many of the Latin American economies began to show signs of slowing down, not unlike many of the nations of Central and Eastern Europe. To be sure, the impact of the crisis on most Latin American economies suggest that Latin American markets are closely linked to world markets.

Not only is the larger Latin American region integrated into the world economy, but previous studies have shown how Brazil in particular is tightly linked to the world and regional economies. For example, there is considerable evidence that Brazil experienced contagion effects during the Mexico peso crisis 1994 (Calvo, 1999), Asian crisis of 1997 (K. Forbes & Rigobon, 2000), and the Russian crisis of 1998 (Kaminsky & Reinhart, 2000). Moreover, Brazil is also linked to the region through various RTAs. Brazil is a member, for example, of the Latin American Integration Association (LAIA), which includes Argentina, Bolivia, Chile, Colombia, Cuba, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela. It is a member nation in Southern Common Market (MERCOSUR) with Argentina, Paraguay, and Uruguay. In addition, Brazil entered a bilateral trade agreement with Argentina 2016.

Not only is Brazil is tightly connected to the world and regional markets, increasing the possibility of contagion from Brazil to its neighboring Latin American countries, it has also been mired in significant political unrest over the past decade. Former president Dilma Rousseff was indicted and impeached in 2016 (Watts & Bowater, 2016); Petrobras, Brazil's state-controlled oil company, agreed to pay $2.95 billion to settle a lawsuit over corruption (Bray & Reed, 2018). In 2017, another former president, Lula da Silva, was found guilty of corruption and ordered to spend time in prison (Prengaman & Langlois, 2018). Finally, the current president, Michel Temer, was also charged with obstruction of justice and racketeering for his role in accepting bribes from the world's largest meatpacker, JBS (Brito & Boadle, 2017). Because Brazil is tightly linked with world and regional markets, and because Brazil has been mired in political instability, which has been shown to lead to financial contagion, this essay seeks to examine the impact of cross-country volatility spillovers—the presence of contagion—from Brazil to its Latin American neighbors following the election of its president in October 2014.

Previous studies on contagion and Latin American have focused on Latin American countries and their relation with the world economy. Hence, studies have investigated how the devaluation of the Russian ruble in 1998 affected various Latin American countries, including Brazil (K. Forbes & Rigobon, 2000; Gelos & Sahay, 2001). Additional studies focused on the possibility of contagion in Latin America following the East Asian crisis (G. Chen et al., 2002; Edwards & Susmel, 2003; Kaminsky & Reinhart, 2000). Finally, a number of studies have focused on co-movements of Latin American economies with the United States following the crash of 1987 (Meric et al., 2001) and the global financial crisis of 2007 (Baur, 2012; Bekaert, Ehrmann, Fratzscher, & Mehl, 2014; Kenourgios & Dimitriou, 2015). Additionally, various studies explore the increasing link between bond and stock markets (Panchenko & Wu, 2009) and American Depository Receipts (ADRs) in Latin America as an emerging market (Hunter, 2006). As a result of these studies, I have a better understanding of how Latin American markets are integrated with other emerging markets, as well as the world market. Because of either the non-existence or limited number of studies on contagion in Latin America that incorporate events since the most recent global financial crisis or studies on contagion that include shocks from political instability, I believe that there exists a research gap that can be explored.

Studies on linkages between the equity Latin American markets have used various economic methods to evaluate market relationships, such as feedback analysis (Johnson & Soenen, 2003) and Bayesian dynamic latent factor model (P. Chen, 2017). Additionally, some have sought to evaluate the degree of integration by using Asset Pricing Models (Alotaibi & Mishra, 2017; Errunza, Losq, & Padmanabhan, 1992), while others have focused on ARCH and

GARCH volatility models (Alotaibi & Mishra, 2015; Lahrech & Sylwester, 2013; Mellado & Escobari, 2015). Moreover, researchers have centered their investigations on a multiplicity of factors, such as stock market and bond market returns, foreign direct investment, and the difference between country funds (Frankel & Schmukler, 1996). Identifying these relationships play an important role for various stakeholders: investors, managers, and policy makers.

Investors are interested in market diversification in order to reduce risk. If national equity markets are cointegrated, then the benefits of diversification are limited (Byers & Peel, 1993; De la Torre et al., 2007). Managers, on the other hand, might find the financial integration increases market efficiency through the flow of information and adjustments (Darrat & Zhong, 2005). Additionally, managers may be interested in how integrated markets affect expected returns and the cost of capital. As foreign investors participate in the local market, the source of systematic risk shifts to the world stock market, thus affecting expected returns and stock market prices (Chari & Henry, 2004). Moreover, a reduction in risk should also result in a reduction in the cost of capital (Bekaert & Harvey, 2000). Finally, these increased relationships may also be of significant interest to policy makers and economic planners who discover that integration can foster development through more efficient allocation of capital (Umutlu et al., 2010) and a lower probability of asymmetric shocks (Yu et al., 2010). Policy makers may utilize regulatory policy to restrict foreign equity investments in order to limit exposure to adverse volatility effects. Such actions, however, may limit the ability of firms to raise capital for projects, thus stifling economic growth. In this paper, I investigate the possibility of contagion from Brazil to five major Latin American Stock markets during the period from January 2012 to October 2015. In contrast to previous studies of Latin American markets which tend to focus on the effects of major financial crises in the world (US financial crisis, Asian crisis, Russian crisis) on Latin

America, I examine the effects of regional shocks emanating from within Latin America and Brazil in particular. Secondly, whereas previous studies have focused on financial shocks that begin within the financial sector, like a stock market crash, my investigation explores how possible shocks from political instability might lead to increased correlations among linked markets.

In this essay, I employ a GARCH framework to estimate the variance-covariance transmission mechanism. After isolating the conditional correlations, I use the Kolmogorov-Smirnov test to evaluate whether or not correlations have increased from the pre-crisis to the crisis period (Conover, 1999). Using this procedure, I am able to evaluate the equality of distributions for the different periods. In addition, I use Markov Switching models to examine if the volatility clustering may be characterized by the presence of regimes alternating between low and high levels of volatility.

As a result of my analysis, I ascertain four meaningful insights. First, not dissimilar from previous studies of stock market returns between countries, I find that returns for each country fail to satisfy the Gaussian distribution assumption of normality. Indeed, I add the kernel distribution and normal distribution to the histograms, which show the distributions to be leptokurtic.

Secondly, I show evidence of significant time-varying volatility. I find each series in the panel fails the assumption of homoscedasticity, and thus, I anticipate an ARCH model will best fit the data.

Thirdly, I utilize a nonparametric test of the equality of continuous, one dimensional probability distributions in order to compare the correlations of two samples. Using this procedure, I find a shock to the returns following an election in 2014 resulted in a significant increase in the conditional correlations, lending evidence of contagion among the countries. The returns between the different Latin American countries were already positively correlated for the entire period, but the statistical technique shows that the shock to the returns following an election resulted in a statistically and economically significant increase in the conditional correlations. To my knowledge, I am the first to utilize this statistical procedure to demonstrate contagion effects for this region during this time period.

Lastly, I find political instability to be a viable mechanism for transmitting cross-country volatility shocks to financial markets. Much of the research on volatility spillovers shows that contagion is often spread through investor attitudes toward liquidity and information asymmetry (Claessens et al., 2001). However, an increasing number of researchers are beginning to recognize that contagion may spread through multiple equilibria simultaneously. In his study on European devaluations, Drazen (2000) finds that political factors might be one of many factors that play a role in causing contagion. To be sure, numerous studies find significant links between political instability and economic performance (Alesina & Perotti, 1996; Campos & Nugent, 2002, 2003; Fielding, 2003). More specifically, researchers observe links between political risk and instability with volatility in asset markets (Schwert, 1989). I find strong evidence of an increase in conditional correlations among Latin American countries following the election of Brazilian President Dilma Rousseff in October 2014.

Data

In this study, I use daily price indexes provided by Morgan Stanley Capital International accessed through *Datastream International*. All of the data are market value-weighted and expressed in US dollars. I examine the stock market indexes for five Latin American countries: Argentina, Chile, Colombia, Mexico, and Peru. In addition, I utilize indexes from Brazil, which proxy regional activity, and I use the S&P 500 from the United States, which represents one global market.

I use Brazil as a regional market since it is the largest stock market in terms of market capitalization and the number of companies listed in its domestic market. Table 3.1 shows the key market indicators. In 2011, there were 1,103 listed companies in the stock markets of the six Latin American countries, with their total market capitalization reaching US$2,234.68 billion. By 2016, the number of listed companies reached 1,067 and the total market capitalization around US$1570.36, of which Brazil accounted for roughly 48 percent. I focus on Brazil, therefore, because Brazil accounts for nearly half of the total market capitalization of the six Latin American countries; it accounts for 33% of the number of listed companies, and accounts for 78% of all of the listed stocks in the six countries.

Following the conventional approach, I calculate stock returns as the first difference of the natural log of each stock-price index. I express the returns as percentages. For missing data, due to unavailability, national holidays, bank holidays, or for other reasons, the stock prices were assumed to stay the same as those of the previous trading day.

In Table 3.2, I present the descriptive statistics of the stock-index returns in the six Latin American markets and the United States. According to the National Bureau of Economic Research (NBER), the ending date for the most recent financial crisis was December 30, 2011. In order to avoid any lingering effects from this financial crisis, I chose a starting day after this date. Thus, each series begins on December 31, 2011. Moreover, the descriptive statistics are divided into two panels. Panel A represents the pre-crisis period, which ends with the day before the election of Dilma Rousseff, Brazil's president, on October 26, 2014. Panel B covers the period from the first day of Rousseff's term (October 27, 2014) until the time Brazil's Audit court found that she illegally borrowed billions to offset 2014 budget shortfall, opening the door to impeachment by the administration's opponents.

During the pre-crisis period, most of the series are negatively skewed, with Argentina and Mexico having values quite large. These figures indicate a long left fat tail and supports the conjecture of asymmetric information. After the election of President Rousseff, however, only Colombia shows evidence of being negatively skewed. In addition, all of the series in both panels have kurtosis values greater than three, indicating that they are all leptokurtic. Stated differently, I find that returns for each country fail to satisfy the Gaussian distribution assumption of normality. In Figure 3.1, I add the kernel distribution and normal distribution to the histograms, which show the distributions to be leptokurtic.

The standard deviations in Panel B are larger for each country than the values in Panel A, indicating that volatility increased after the election of President Rousseff. Moreover, tests for heteroscedasticity show strong evidence of ARCH effects. Figure 3.2 shows the daily returns for each series. The values of these series change rapidly from period to period, showing further evidence of volatility. Moreover, small changes are followed by further small changes and large changes are followed by further large changes, indicating "clustering."

Evidence for Contagion

In the current study of contagion in Latin American countries, I am dealing with markets that are linked regionally, as well as through bilateral and multilateral trade agreements. Moreover, various countries in Central and South America have experienced multiple periods of recession during last ten years. Brazil, for example, experienced six months of recession in 2008 – 2009, and thirty-six months of recession between 2014 – 2016. Chile, Mexico, and Peru each experienced nine months of recession during the most recent global financial crisis. And

Venezuela’s economy has all but disappeared. In the presence of such an economic climate, it is not difficult to imagine investors reacting to multiple equilibria (Masson, 1999b), such as investor expectations (Masson, 1999a) and memory of past crises (Mullainathan, 2002), and the political unrest present in the region (Drazen, 2000). To be sure, numerous studies find significant links between political instability and economic performance (Alesina & Perotti, 1996; Campos & Nugent, 2002, 2003; Fielding, 2003; Schwert, 1989).

Table 3.3 offers the first impression of contagion transmission. The table reports the unconditional correlations between the countries under investigation. The table has two major panels, which provide information on the correlations before and after the crisis. In addition, each panel has two sections. The upper triangular cells report Spearman’s rank correlations, and the lower-triangular cells report Pearson’s correlation coefficients. I observe that for both the Pearson and Spearman correlations, the values are positive and substantially larger in magnitude after the crisis. All of the values are significant at the 1 percent level. While the reported statistics do not take into account the dynamics of the correlations over time, they nevertheless provide preliminary evidence that the correlations have increased after the crisis. I formally test the dynamic relationship in the following section.

Testing for Contagion

Earlier studies have long recognized that asset returns possess various characteristics that render some linear structural and time series models incapable of explaining important features (Campbell, Lo, & MacKinlay, 1997). For example, asset returns often exhibit asymmetric volatility, which result in negative shocks producing a larger impact than positive shocks of the same magnitude (Campbell & Hentschel, 1992). Moreover, asset returns tend to show signs of volatility clustering. Thus, large returns of either sign are usually followed by large returns and small returns of either sign are followed by small returns (Brooks, 2014). Other studies, in addition, find that correlations across markets are not constant over time (Berben & Jansen, 2005; Longin & Solnik, 1995).

Generalized Autoregressive Conditional Heteroscedasticity (GARCH) Model

Because linear models are largely incapable of explaining and capturing these characteristics, I employ the multivariate GARCH (Generalized Autoregressive Conditional Heteroscedasticity) methods developed by Engle (2002), which are capable of estimating dynamic conditional correlations (DCC) . I employ a GARCH-DCC model to examine the conditional correlations between Brazil and five other Latin American countries after the election of its president, Dilma Rousseff, in October 2014. I believe that this election instigated another crisis point in the Brazilian economy, which affected multiple equilibria in the neighboring countries.

In their analysis of contagion in the Asian market, Chiang, Jeon, and Li (2007) note three advantages for using Engle's (2002) GARCH-DCC model. First, the DCC model estimates correlation coefficients of the standardized residuals and accounts for heteroskedasticiy directly. Thus, the DCC model is able to address the primary problems of heterskedasticity raised in previous studies (K. Forbes & Rigobon, 2000; K. J. Forbes & Rigobon, 2002). Secondly, the DCC model allows for the inclusion of additional explanatory variables in the mean equation. For my study, I use the U.S. S&P 500 stock returns as an exogenous global factor, rather than using the source of the contagion (e.g., stock returns in Brazil) as an independent variable (Dungey, Fry, Gonzalez-Hermosillo, & Martin, 2005). Lastly, the DCC model has the advantage over other multivariate GARCH models, such as Engle and Kroner's (1995) VEC, in that it allows the inclusion of returns from multiple markets without the need to estimate too many coefficients. Consequently, the information from the estimation allows us to analyze the correlation behavior even in the presence of regime shifts.

I model the return equation as:

$$r_t = \mu + \phi r_{t-1} + \gamma r_{t-1}^{S\&P} + \epsilon_t, \tag{1}$$

where r_t is the vector of returns for each country, $\gamma r_{t-1}^{S\&P}$ is the lagged return of the U.S. S&P 500 stock return, and $\epsilon_t|\Omega_{t-1} \sim N(0, H_t)$. I also include the autoregressive term of the country (ϕr_{t-1}) in order to capture any momentum effects, as well as account for autocorrelation. My primary interest lies in the dynamics of the variance-covariance matrix, H_t, which has the following specification:

$$H_t = D_t R_t D_t \tag{2}$$

where D_t is the diagonal matrix of conditional standard deviations computed by univariate GARCH models, which takes the form

$$\begin{pmatrix} h_{11,t}^{\frac{1}{2}} & 0 & \dots & 0 \\ 0 & h_{22,t}^{\frac{1}{2}} & \dots & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & h_{mm,t}^{\frac{1}{2}} \end{pmatrix} \tag{3}$$

My primary concern is with R_t, which is the time-dependent conditional correlation matrix of the innovations ϵ_t. I can represent R_t as

$$\begin{pmatrix} 1 & \rho_{12,t} & \dots & \rho_{1m,t} \\ \rho_{21,t} & 1 & \dots & \rho_{2m,t} \\ \dots & \dots & \dots & \dots \\ \rho_{m1,t} & \rho_{m2,t} & \dots & 1 \end{pmatrix} \tag{4}$$

The estimation procedure for the Engle (2002) model consists of two steps. In the first step, I fit six (i.e., Argentina, Brazil, Chile, Colombia, Mexico, and Peru) univariate GARCH models to obtain conditional standard deviations $h_{ii,t}$, which populates matrix D_t. In the second step, I compute the standardized residuals as $\zeta_t = D_t^{-\frac{1}{2}}\epsilon_t$, after which I can calculate the parameters of dynamic conditional correlation. In this case, R_t takes the form:

$$R_t = diag\left(q_{11,t}^{-\frac{1}{2}}, q_{22,t}^{-\frac{1}{2}}, \ldots, q_{mm,t}^{-\frac{1}{2}}\right) Q_t diag\left(q_{11,t}^{-\frac{1}{2}}, q_{22,t}^{-\frac{1}{2}}, \ldots, q_{mm,t}^{-\frac{1}{2}}\right) \tag{5}$$

Engle (2002) assumes that the elements of Q_t follow a univariate GARCH model, where the evolution of the correlations in the DCC model is given by

$$Q_t = (1 - \lambda_1 - \lambda_2)\bar{Q} + \lambda_1 \frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}\left(\frac{\epsilon_{t-1}}{\sqrt{h_{t-1}}}\right)' + \lambda_2 Q_{t-1} \tag{6}$$

where λ_1 and λ_2 are nonnegative, time invariant parameters. In order to ensure that the process is stationary, $\lambda_1 + \lambda_2 \leq 1$.

Assuming a Gaussian distribution, I estimate the model in two steps using the log-likelihood function,

$$LogL1(\theta_1) = -\frac{1}{2}\sum_{t-1}^{T}[\log\{diag(D_t)\} + D_t^{-\frac{1}{2}}\epsilon_t^2] \tag{7}$$

where θ_1 is the first set of parameters, which comprises all of the univariate GARCH parameters. The second step uses the following log-likelihood function:

$$LogL2(\theta_2|\theta_1) = -\frac{1}{2}\sum_{t-1}^{T}\left\{\log|R_t| + + \left(D_t^{-\frac{1}{2}}\epsilon_t^2\right)' R_t^{-1}\left(D_t^{-\frac{1}{2}}\epsilon_t^2\right)\right\} \tag{8}$$

I maximize this second log-likelihood function conditional on the first set of parameters, θ_1, which provides us the parameters of θ_2, which are the parameters of the dynamic correlations from equation 6.

Table 3.4 reports the estimation results for the five Latin American countries in the sample. From Panel A, I observe that the coefficient ϕ, which captures the effect of the lag on returns for each country, is significant for each country except for Peru. With the exception of

Mexico, moreover, the coefficient is positive for each country, which I interpret as evidence of momentum. Similarly, I observe that the coefficient γ capturing the effect of the S&P 500 index on the stock returns is statistically significant for Chile, Colombia, and Mexico, which indicates that the U.S. stock market significantly affects the return dynamics in the local markets.

Panel B shows the variance equations for each country in the sample. The table shows that the lagged shock-squared terms (a) are statistically significant across all countries, indicating that the volatilities are indeed time-varying. The highly significant coefficients on the lagged conditional volatility (b) provides additional support for my GARCH specification. In addition, the sum of λ_1 and λ_2 are less than one, yet they still show significant levels of volatility persistence.

Kolmogorov-Smirnov Test

After fitting the GARCH-DCC model, I obtain the dynamic correlations. Figure 3.3 shows the correlations between Brazil and each of the five Latin American countries. The vertical line highlights the date at which President Rousseff was elected. Even before her election, the countries exhibited positive correlations. With the election of President Rousseff, however, Figure 3.3, shows a marked increase for each country. Nevertheless, the graph is not a formal test of an increase in correlations.

To formally test the correlation distributions, I employ the Kolmogorov-Smirnov test (KS). Various studies have recognized its usefulness in identifying shift contagion as identified by K. J. Forbes and Rigobon (2002) (Boako & Alagidede, 2017; Jin, 2018; Reboredo, Rivera-Castro, & Ugolini, 2016). Conover (1999) shows that the KS statistic has good power for evaluating alternative hypotheses, especially those involving clustering in the data (Gibbons & Chakraborti, 2011). Figure 3.2, indeed, showed strong evidence of this type of clustering. I divide the sample into two periods using a dummy variable, crisis, taking the value of 1 for the pre-crisis period (December 31, 2011 – October 26, 2014) and a value of 2 for the crisis period (October 27, 2014 – October 16, 2015).

The Kolmogorov-Smirnov test is used to evaluate whether the distributions in the two crisis groups are equal by comparing their cumulative distribution functions (CDFs). The test computes a statistic D_n:

$$D_n = \max_x |F_n^1(x) - F_n^2(x)| \tag{7}$$

where F^1 and F^2 are two distributions. The test evaluates three hypotheses. In the first line, the null hypothesis is that the distribution of the first group is stochastically dominated by the distribution of the second group. The second line tests whether the distribution of the second group is stochastically dominated by the distribution of the first. Finally, the combined test evaluates the equality of the two distributions.

Table 3.5 reports the results from the test. The KS statistic for the first line strongly rejects the null hypothesis that the correlations of the pre-crisis period dominate the correlations of the crisis period. Secondly, the KS statistic fails to reject the null that the correlations of the crisis period dominate the correlations of the pre-crisis period. In other words, the first and second lines of the KS test provide significant evidence that an increase in correlations occurred in the Latin American countries following the election of Dilma Rousseff. Finally, the null hypothesis that the distributions are equal is strongly rejected in the third line. Thus, I find strong evidence that the distribution of the correlation coefficients during the crisis period dominate the correlations during the pre-crisis period.

In order to compare the correlations graphically, I obtain the kernel distribution of the pairwise correlations during the two subsamples, before and during the crisis. Figure 3.4 shows the plot of the distributions. For each country pair, I can see that the crisis period is more right-tailed and higher than the pre-crisis period. This finding suggests a general higher correlation with Brazil during the crisis period.

Markov Switching

To further analyze the time dynamics of the conditional correlations fit by the GARCH-DCC model, I employ a Markov regime-switching model (Goldfeld & Quandt, 1973; Quandt, 1972), which Hamilton (1989) extended to AR processes. If there are two regimes for the conditional correlations, the probability of moving from state *i* to state *j* in one time period, according to a Markov chain, is given by the following equation:

$$P(s_t = j, s_{t-1} = i) = p_{ij} \tag{8}$$

I run a Markov-switching dynamic regression (MSDR) on the dynamic correlations, where the constant term is state dependent:

$$\rho_{ijt} = \mu_s + \epsilon_t \tag{9}$$

where ρ_t is the pairwise conditional correlation (DCC) between Brazil and one of the five Latin American countries.

Table 3.6 shows the two state-dependent constants, which represent the average conditional correlation in each state. Thus, the table shows that the correlations between Mexico and Brazil are higher in both states than all of the other countries. Likewise, the correlations between Colombia and Brazil are lowest in both states. The average correlation in state 1 is .421 and the average correlation in state 2 is .464.

Additionally, the results of the regression indicate that each state is highly persistent. The value of p_{11} for Mexico in column four suggests that the correlation will stay in state 1 tomorrow given that it is in state 1 today is equal to 98%. Similarly, the probability of the correlation in state

2 given that it is in state 2 today for Mexico is 99.3%. Thus, the table suggests that the correlations move between two states (state 1 and state 2), where state 1 is identified with the lower correlation state and state 2 is the higher correlation state.

Figure 3.5 shows the correlation pattern moves between the two states from 2012 to 2015. The graph has a vertical line at October 21, 2014, marking the election of the Brazilian president, Dilma Rousseff. Most interesting for my research, Figure 3.5 shows that state 2 dominates during the period following the election, providing further evidence of an increase in correlations following the election. While the MSDR by itself is not determinative that a contagion has occurred, it does lend further evidence of an increase in correlation over the period. And when considered in conjunction with Figure 3.3 and the results from the KS test, there is strong evidence that a contagion from Brazil to its Latin American neighbors occurred.

Robustness Check

As a robustness check, I employ a second model where the mean equation includes a term for regional factors. Thus, I model the return equation as:

$$r_t = \mu + \phi r_{t-1} + \gamma_1 r_{t-1}^{Brazil} + \gamma_2 r_{t-1}^{S\&P} + \epsilon_t, \tag{10}$$

where r_t is the vector of returns for each country, $\gamma_1 r_{t-1}^{Brazil}$is the lagged returns of Brazil, $\gamma_2 r_{t-1}^{S\&P}$ is the lagged return of the U.S. S&P 500 stock return, and $\epsilon_t|\Omega_{t-1} \sim N(0, H_t)$. I also include the autoregressive term of the country (ϕr_{t-1}) in order to capture any momentum effects, as well as account for autocorrelation. In this regression, the coefficient γ_1 captures any regional effects from Brazil on the returns for each country.

Table 3.7 reports the estimation results for the five Latin American countries in the sample. From Panel A, I observe that the coefficient ϕ, which captures the effect of the lag on returns for each country, is significant for each country except for Peru. With the exception of

Mexico, moreover, the coefficient is positive for each country, which I interpret as evidence of momentum. Similarly, I observe that the coefficient γ_2 which captures the effect of the S&P 500 index on the stock returns is statistically significant for Chile, Colombia, and Mexico, which indicates that the U.S. stock market significantly affects the return dynamics in the local markets. Lastly, I observe that the coefficient γ_1 which captures the effect of regional factors on each country's returns was also significant for two countries, Chile and Colombia.

Panel B shows the variance equations for each country in the sample. The table shows that the lagged shock-squared terms (a) are statistically significant across all countries, indicating that the volatilities are indeed time-varying. The highly significant coefficients on the lagged conditional volatility (b) provides additional support for my GARCH specification. In addition, the sum of λ_1 and λ_2 are less than one, yet they still show significant levels of volatility persistence. Overall, the results from the robustness model agree with the results from the main model. The same coefficients are significant, although the significance level is not as high as the significance level for the main model.

Conclusion

In this essay, I investigate the theory that political factors may play a crucial role in the spread of financial contagion. In particular, I examine the interrelationship between political unrest tied to the election of Dilma Rousseff in Brazil in 2014 and the possibility of financial contagion spreading from Brazil to its Latin American neighbors: Argentina, Chile, Colombia, Mexico, and Peru. An understanding of this relationship between markets provides important information about the economic importance of political unrest for investor and economic policy makers, especially in regions that are linked through regional trade agreements.

I investigate not only if the daily stock indexes show evidence of financial contagion from Brazil to five Latin American countries, but more significantly, I examine whether or not the increase in cross-country correlations are tied directly to the political unrest stemming from Dilma Rousseff's election as Brazil's president in October 2014. The results of this study suggest that the stock markets of Brazil and the Latin American countries share some fundamental link so that financial contagion following President Rousseff's election flowed to the other countries. The unconditional correlations increased; the conditional correlations increased; and both the Kolmogorov-Smirnov test and Markov switching model provide evidence that the increase in correlations is connected with the date of Rousseff's election.

My results come with some obvious caveats. The increase in correlations may result from unobserved and unidentified factors during the period under investigation. And even though the results are robust, the current study controls may not capture the full impact of factors not considered. Still, my robustness test finds that when the model accounts for regional factors, the markets continue to evidence increased correlations and the timing of the increase continues to correspond to the election of President Rousseff.

These results may prove useful for investors who seek to diversify risk. Even though this study does not investigate a formal cointegrating relationship, the results of the analysis nonetheless show that the stock markets between Brazil and the five Latin American countries experience some degree of financial linkage. Consequently, one cannot necessarily diversify the risk of a stock by investing in a neighboring country's stock market. The implications for the results are pertinent to both policy makers and investors in the Latin American stock markets. Since the study suggests that there are two regimes in the stock markets, then a policy recommendation suggests risk-averse investors in those markets demand higher compensation when the markets switch from the lower volatility state to the higher volatility state. In terms of the relative high-to-low volatility ratio, Colombia has a ratio of 1.17 showing the strongest sensitivity to switches in regimes, followed by Argentina at 1.13. Consequently, this recommendation applies particularly to Colombia, whose volatility seems especially sensitive to regime switches. Chile, on the other hand, may request the lowest regime change compensation since it has the lowest sensitivity.

More importantly, however, the results of this study provides significant information to economic planners, not only in the countries under investigation, but in other countries that are linked via regional trade agreements. In an attempt to limit exposure to adverse volatility effects, policy makers may utilize regulatory policy to restrict foreign equity investments during times of political unrest. Such actions may limit volatility from a particular region, but the economic effect may still stifle growth as firms struggle to raise capital for projects.

Methodologically, this study provides additional evidence that the GARCH-DCC is a powerful tool for analyzing financial contagion. The results from this analysis suggest that it not only is appropriate to use the GARCH-DCC model, but that when the GARCH model is used in conjunction with the KS test and a Markov switching regression, it provides significant information about risk and financial contagion.

Table 3.1: Key Market Indicators

Number of Listed Domestic Companies						
Year	2011	2012	2013	2014	2015	2016
Argentina	99	101	97	95	93	93
Brazil	366	353	352	351	345	338
Chile	229	225	227	230	223	214
Colombia	79	76	72	70	69	68
Mexico	128	131	138	141	136	137
Peru	202	214	212	211	212	217
Market Capitalization of Listed Companies (% of GDP)						
Argentina	8.22	6.27	9.62	11.43	9.60	11.66
Brazil	46.97	49.79	41.27	34.36	27.20	42.23
Chile	107.15	117.30	95.25	89.37	78.49	86.01
Colombia	60.01	70.90	53.31	38.80	29.49	36.75
Mexico	34.90	44.25	41.68	36.99	34.91	33.51
Peru	47.67	53.27	40.24	39.21	29.89	42.19
Market Capitalization of Listed Companies (billion US$)						
Argentina	43.58	34.25	53.10	60.14	56.13	63.60
Brazil	1228.94	1227.45	1020.46	843.89	490.53	758.56
Chile	270.29	313.33	265.15	233.25	190.35	212.48
Colombia	201.30	262.10	202.69	146.75	85.96	103.82
Mexico	408.69	525.06	526.02	480.25	402.25	350.81
Peru	81.88	102.62	80.98	78.84	56.56	81.09
Stocks Traded, total value (billion US$)						
Argentina	2.45	1.46	2.24	3.52	2.70	4.36
Brazil	824.92	831.64	739.68	644.17	419.98	561.08
Chile	51.27	46.49	41.23	27.13	19.67	23.97
Colombia	25.95	32.20	20.41	17.22	11.59	14.17
Mexico	99.79	119.69	163.69	128.04	103.65	111.90
Peru	5.18	5.28	3.17	3.23	1.45	2.70
GDP Growth (annual %)						
Argentina	6.00	-1.03	2.41	-2.51	2.65	-2.25
Brazil	3.97	1.92	3.00	0.50	-3.77	-3.59
Chile	4.04	4.02	1.36	2.27	2.65	2.29
Colombia	6.11	5.32	4.05	1.91	2.25	1.59
Mexico	6.59	4.04	4.87	4.39	3.05	1.96
Peru	6.33	6.14	5.85	2.35	3.25	3.88

Notes: All of the data for the table came from the World Development Indicators of the World Federation Exchange Database. Market capitalization (also known as market value) is the share price times the number of shares outstanding (including their several classes) for listed domestic companies. Investment funds, unit trusts, and companies whose only business goal is to hold shares of other listed companies are excluded. Data are end of year values. Listed domestic companies, including foreign companies which are exclusively listed, are those which have shares listed on an exchange at the end of the year. Investment funds, unit trusts, and companies whose only business goal is to hold shares of other listed companies, such as holding companies and investment companies, regardless of their legal status, are excluded. A company with several classes of shares is counted once. Only companies admitted to listing on the exchange are included. The value of shares traded is the total number of shares traded, both domestic and foreign, multiplied by their respective matching prices. Figures are single counted (only one side of the transaction is considered). Companies admitted to listing and admitted to trading are included in the data. Data are end of year values converted to U.S. dollars using corresponding year-end foreign exchange rates.

Table 3.2: Descriptive Statistics

	Argentina	Brazil	Chile	Colombia	Mexico	Peru	S&P
Panel A: Before the Crisis							
Descriptive Statistics							
Mean	-0.077	-0.006	-0.045	-0.016	0.026	-0.008	0.066
Std. Dev.	2.422	1.640	1.013	1.024	1.137	1.203	0.732
Min	-16.26	-5.325	-5.209	-4.183	-8.075	-4.947	-2.533
Max	9.979	8.079	5.068	3.349	3.346	5.339	2.509
Test for Heteroscedasticity							
ARCH	107.7	83.48	23.71	42.90	19.49	21.60	22.02
P-value	0	0	0.0003	0	0.0016	0.0006	0.0005
Test for Normality							
Skewness	-1.078	0.167	0.061	-0.253	-0.402	-0.007	-0.257
Kurtosis	10.51	3.960	4.904	4.491	6.599	4.549	4.179
Test for Autocorrelation							
LB	19.68	40.37	37.90	30.08	24.59	24.44	16.61
P-value	0.478	0.004	0.009	0.069	0.218	0.224	0.678
Panel B: After the Crisis							
Descriptive Statistics							
Mean	-0.0997	-0.205	-0.0677	-0.272	-0.0712	-0.0687	0.0116
Std. Dev.	2.110	2.229	1.131	1.845	1.286	1.501	0.939
Min	-6.666	-6.362	-4.607	-7.480	-3.612	-5.030	-4.021
Max	5.959	6.727	4.590	5.364	4.256	7.291	3.829
Test for Heteroscedasticity							
ARCH	12.29	10.73	19.42	31.58	9.751	26.94	56.68
P-value	0.031	0.057	0.002	0	0.083	0	0
Test for Normality							
Skewness	0.0354	0.194	0.0259	-0.0164	0.187	0.336	-0.263
Kurtosis	3.591	3.174	4.711	4.549	4.023	5.441	5.593
Test for Autocorrelation							
LB	62.34	12.07	21.66	54.50	26.33	13.59	15.75
P-value	0	0.914	0.359	0	0.155	0.851	0.732

Notes: Observations for all series in the whole sample period are 989. The observations for the pre-crisis and post-crisis sub-periods are 734 and 255 respectively. All returns are the first differences of the natural log of stock indices times 100. The ARCH statistics are computed at 5 lags and the LB statistics are computed at 20 lags.

Figure 3.1: Histogram of Daily Returns

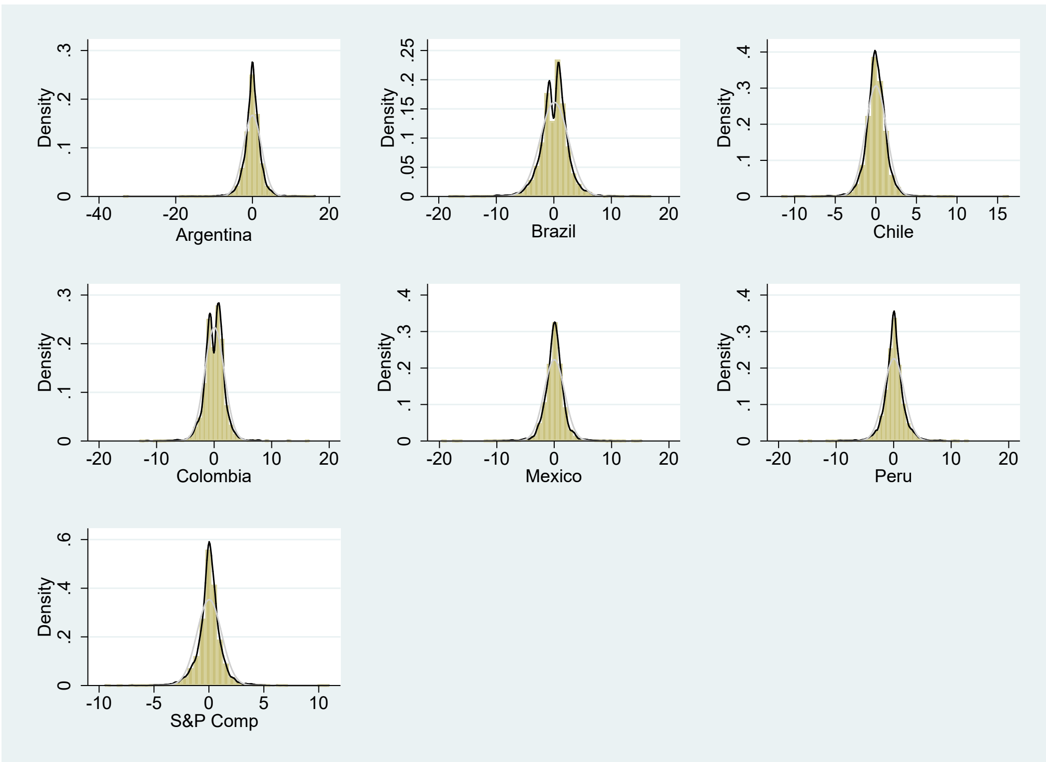


Figure 3.2 : Daily returns over time

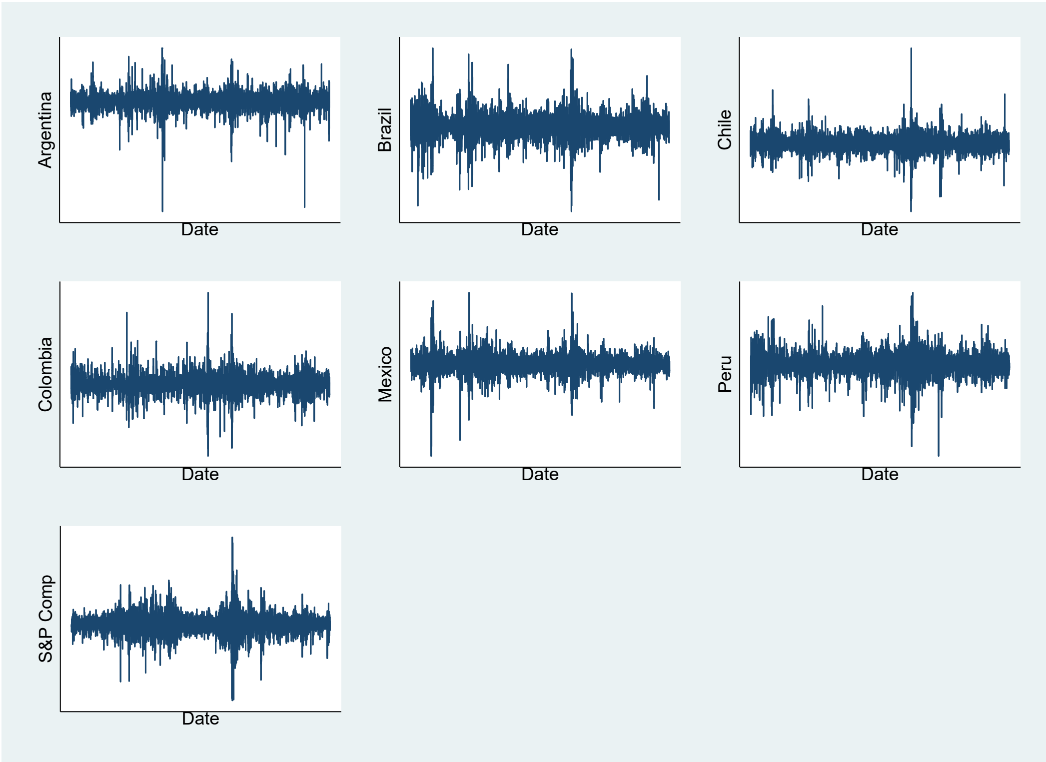


Table 3.3 Unconditional Correlations

Panel A: Before the Crisis							
	Argentina	Brazil	Chile	Colombia	Mexico	Peru	S&P
Argentina	1	0.312*	0.308*	0.209*	0.306*	0.349*	0.447*
Brazil	0.263*	1	0.483*	0.388*	0.507*	0.420*	0.369*
Chile	0.299*	0.507*	1	0.420*	0.539*	0.425*	0.398*
Colombia	0.218*	0.417*	0.444*	1	0.405*	0.322*	0.312*
Mexico	0.269*	0.516*	0.572*	0.436*	1	0.413*	0.528*
Peru	0.289*	0.431*	0.429*	0.359*	0.434*	1	0.487*
S&P 500	0.401*	0.388*	0.420*	0.380*	0.558*	0.505*	1
Panel B: After the Crisis							
	Argentina	Brazil	Chile	Colombia	Mexico	Peru	S&P 500
Argentina	1	0.405*	0.358*	0.338*	0.438*	0.379*	0.497*
Brazil	0.452*	1	0.610*	0.557*	0.671*	0.517*	0.475*
Chile	0.420*	0.610*	1	0.640*	0.684*	0.493*	0.384*
Colombia	0.409*	0.555*	0.682*	1	0.601*	0.393*	0.311*
Mexico	0.469*	0.638*	0.704*	0.652*	1	0.505*	0.504*
Peru	0.463*	0.549*	0.589*	0.513*	0.573*	1	0.524*
S&P 500	0.546*	0.481*	0.467*	0.430*	0.571*	0.604*	1

Lower-triangular cells report Pearson's correlation coefficients, upper-triangular cells are Spearman’s rank correlation

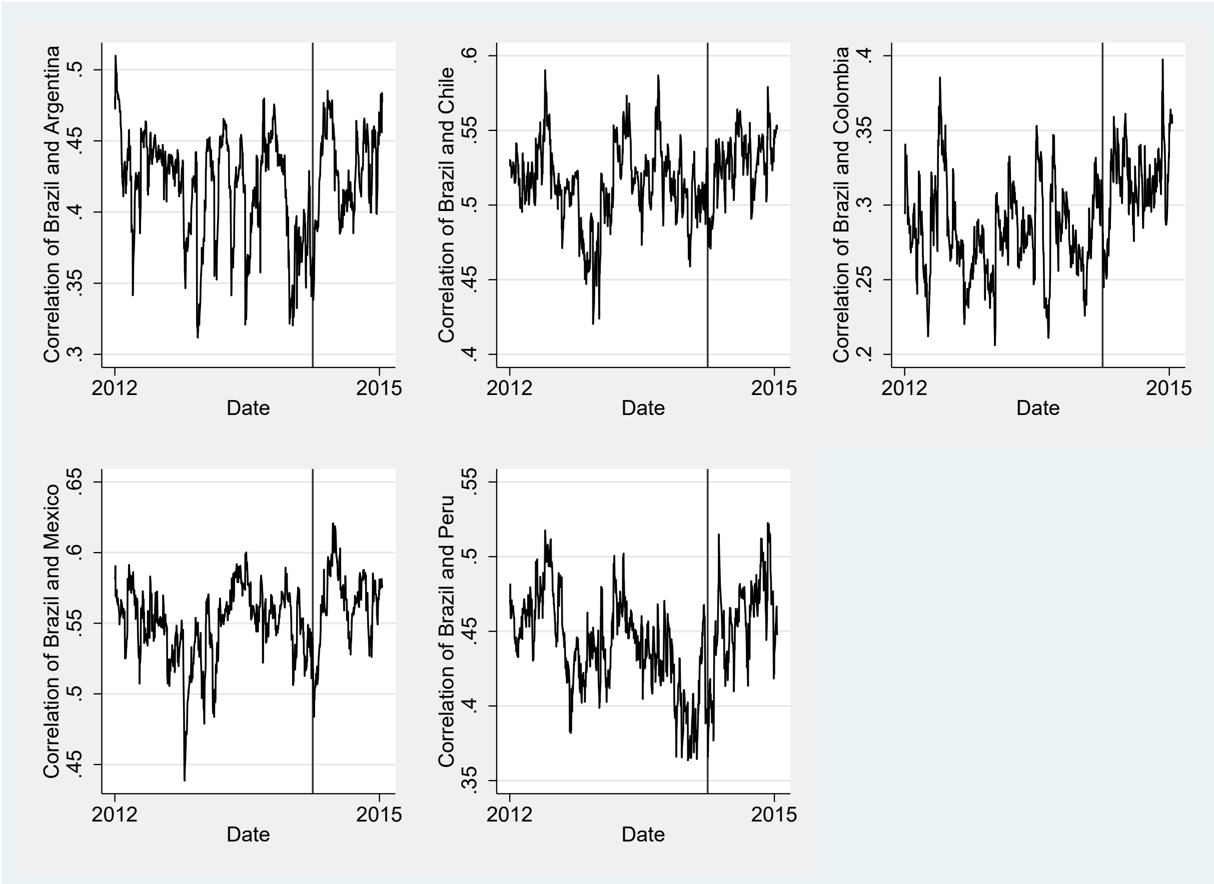
* $p<0.01$

Table 3.4: GARCH-DCC Estimation

	(1)	(2)	(3)	(4)	(5)
Countries:	Argentina	Chile	Colombia	Mex	Peru
Panel A. Mean Equations					
μ	0.035	0.010	-0.008	0.068**	0.049
	(0.067)	(0.029)	(0.033)	(0.032)	(0.037)
ϕ	0.131***	0.083***	0.127***	-0.059**	0.037
	(0.037)	(0.027)	(0.029)	(0.027)	(0.031)
γ	-0.119	0.157***	0.132***	0.255***	0.081
	(0.094)	(0.039)	(0.047)	(0.047)	(0.054)
Panel B. Variance Equations:					
c	2.277***	0.009**	0.050***	0.025**	0.032**
	(0.552)	(0.004)	(0.017)	(0.010)	(0.015)
a	0.235***	0.032***	0.088***	0.043***	0.041***
	(0.048)	(0.007)	(0.017)	(0.010)	(0.009)
b	0.334***	0.960***	0.878***	0.938***	0.940***
	(0.126)	(0.008)	(0.024)	(0.015)	(0.016)
Panel C: Multivariate DCC					
λ_1	0.012***				
	(0.003)				
λ_2	0.939***				
	(0.025)				

Notes: The figures in parentheses are standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. For each country, the return equations are: $r_t = \mu + \phi r_{t-1} + \gamma r_{t-1}^{S\&P} + \epsilon_t$, and $\epsilon_t | \Omega_{t-1} \sim N(0, H_t)$. The variance equations: $h_t = c + a(\epsilon_{t-1})^2 + bh_{t-1}$.

Figure 3.3: Dynamic Correlations with Brazil



Note: The vertical line marks the election of President Rousseff on October 27, 2014.

Table 3.5: Kolmogorov-Smirnov Test for Contagion

Countries:	(1) Argentina	(2) Chile	(3) Colombia	(4) Mexico	(5) Peru
Pre-Crisis	0.216	0.370	0.555	0.327	0.307
	[0]	[0]	[0]	[0]	[0]
Crisis	-0.011	-0.019	0	0	0
	[1]	[0.870]	[1]	[1]	[1]
Combined	0.216	0.370	0.555	0.327	0.307
	[0]	[0]	[0]	[0]	[0]

Figure 3.4: Kernel Density Plots of the Correlation Distributions

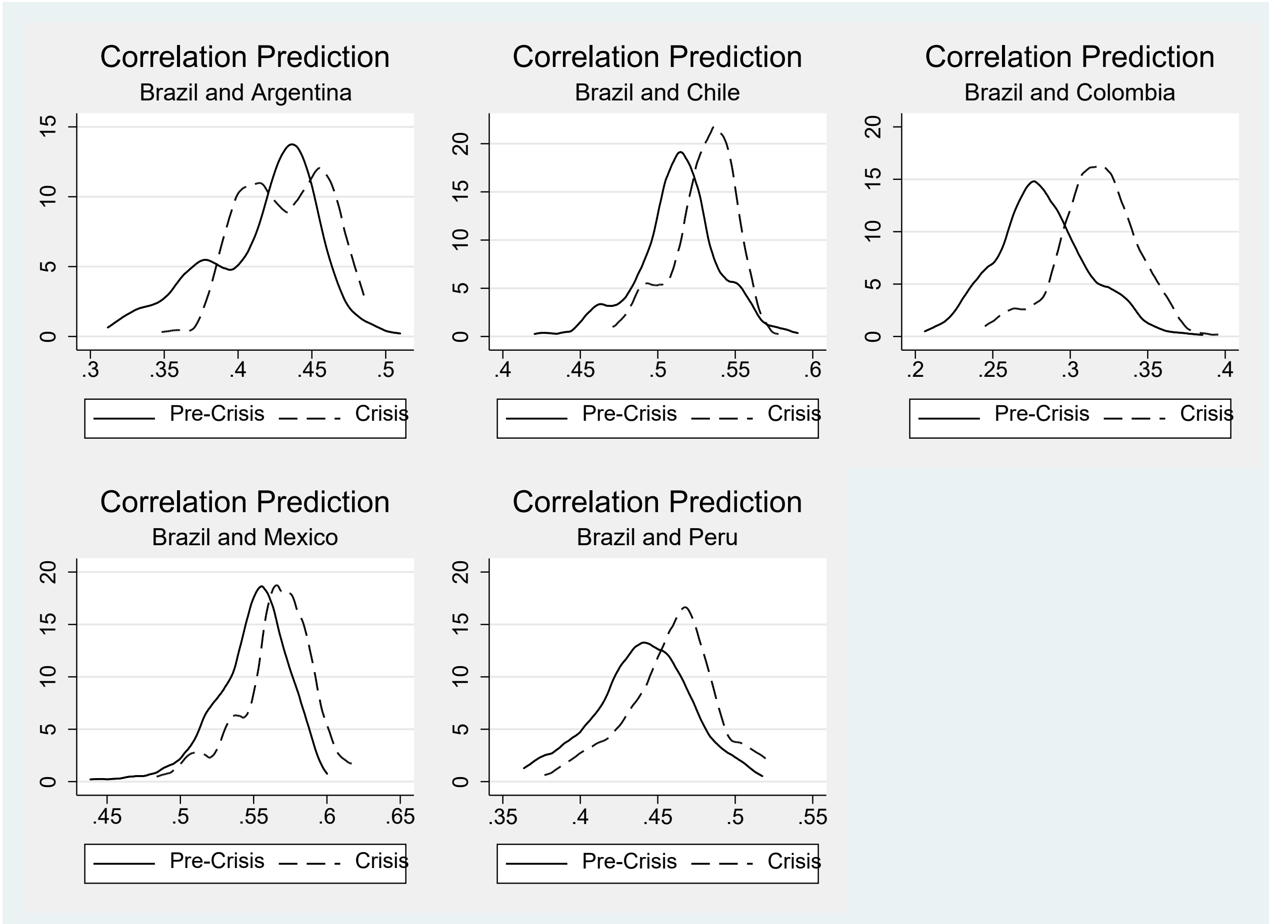


Table 3.6: Markov-Switching Dynamic Regression

	(1)	(2)	(3)	(4)	(5)
Country	Argentina	Chile	Colombia	Mexico	Peru
State1	0.387***	0.496***	0.272***	0.525***	0.424***
State2	0.439***	0.531***	0.319***	0.564***	0.468***
p_{11}	0.969	0.981	0.981	0.980	0.984
p_{12}	0.031	0.019	0.019	0.020	0.016
p_{21}	0.016	0.011	0.021	0.007	0.014
p_{22}	0.984	0.990	0.979	0.993	0.986

Notes: The figures in parentheses are standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.

Figure 3.5: Filtered state probabilities for Brazil and Mexico

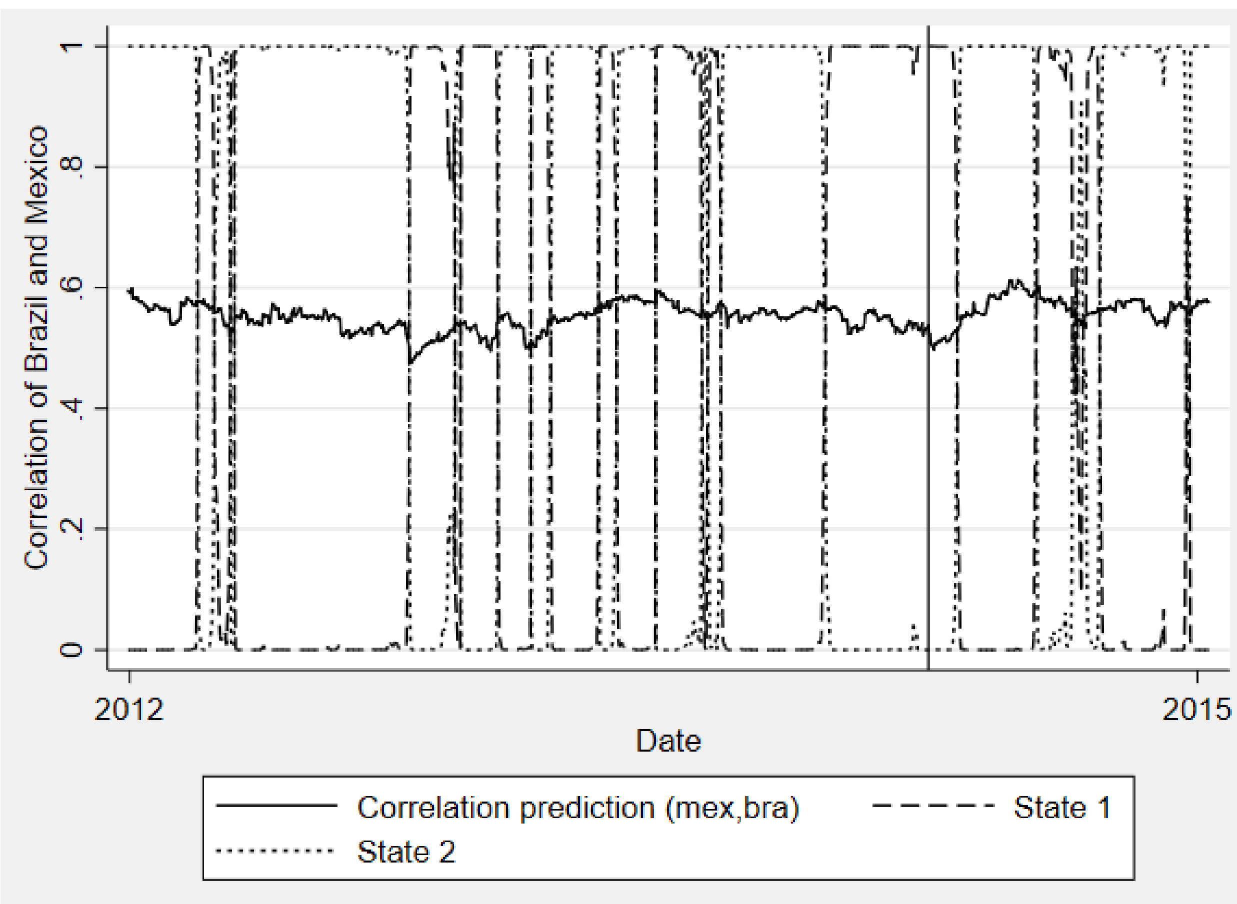


Table 3.7: GARCH-DCC Estimation (with Regional Effect)

	(1)	(2)	(3)	(4)	(5)
Countries:	Argentina	Chile	Colombia	Mexico	Peru
Panel A. Mean Equations					
μ	0.035	0.011	-0.006	0.069**	0.049
	(0.067)	(0.029)	(0.033)	(0.032)	(0.037)
ϕ	0.130***	0.069**	0.111***	-0.060**	0.042
	(0.037)	(0.029)	(0.031)	(0.029)	(0.032)
γ_1	0.021	0.032*	0.046**	0.016	0.003
	(0.037)	(0.017)	(0.022)	(0.018)	(0.021)
γ_2	-0.134	0.137***	0.100**	0.242***	0.076
	(0.098)	(0.041)	(0.049)	(0.047)	(0.056)
Panel B. Variance Equations:					
c	2.264***	0.009**	0.052***	0.025**	0.032**
	(0.550)	(0.004)	(0.018)	(0.010)	(0.015)
a	0.236***	0.032***	0.091***	0.043***	0.041***
	(0.048)	(0.007)	(0.018)	(0.010)	(0.009)
b	0.336***	0.960***	0.875***	0.938***	0.940***
	(0.126)	(0.008)	(0.025)	(0.015)	(0.016)
Panel C: Multivariate DCC					
λ_1	0.011***				
	(0.003)				
λ_2	0.939***				
	(0.025)				

Notes: The figures in parentheses are standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%. For each country, the return equations are: $r_t = \mu + \phi r_{t-1} + \gamma_1 r_{t-1}^{Brazil} + \gamma_2 r_{t-1}^{S\&P} + \epsilon_t$, and $\epsilon_t|\Omega_{t-1} \sim N(0, H_t)$. The variance equations: $h_t = c + a(\epsilon_{t-1})^2 + bh_{t-1}$.

CHAPTER IV

SUMMARY

Economists generally acknowledge that the increase in regional trade agreements (RTA) and overall globalization have resulted in greater linkages between various markets, including national stock markets. As the relationship between stock markets increases, the likelihood of their stock prices and returns being correlated also increases. Indeed, one may suspect that the stock markets share a long run relationship. Since the United States, Canada, and Mexico entered into a regional trade agreement (North America Free Trade Agreement) in 1993, their economies have become more tightly integrated, including their stock markets. The overarching question with respect to their stock markets centers on the degree of their integration: Are the markets cointegrated?

In Chapter Two, therefore, I investigate the interrelationships between the stock markets of three North American Countries (Mexico, North American, and Canada). In order to gain greater insight into the degree of possible integration, I stratify each country's stock markets into tiers based on market capitalization. In particular, I examine the long run relationship during the period of 2005 through 2016, thus covering the global financial crisis of 2007.

Using cointegration and vector error correction tests, I not only find that the three markets are cointegrated, but more importantly, they are integrated within common tiers based on market capitalization. Stated differently, the returns of the largest companies of each country are cointegrated, and the returns of the smaller companies are cointegrated. I also whether or not the NAFTA accord was the cause of that long run relationship. Even though a similar cointegrating relationship exists with a non-NAFTA stock market (Tokyo), I cannot fully reject that the NAFTA accord is the cause of the long run relationship.

Because the initial results of the analysis indicate that the stock markets of the NAFTA countries are cointegrated, I test the stability of the cointegrating parameter via a rolling vector error correction technique. I find that during the time of the most recent global financial crisis, the cointegrating parameter was unstable. The analysis consistently shows that the elasticity of returns increases during the financial crisis and this elasticity is significantly different from the period prior to the financial crisis and after the crisis. The results are robust whether the length of the time before the height of the crisis changes from three months to one year.

From an economically positive perspective, RTAs, not only reduce tariffs, lowering prices on imports and reducing cross-border costs, they may also result in the stock markets of the countries becoming cointegrated, as the results suggest for the United States, Canada, and Mexico. Negatively, however, these increased market linkages may result in volatility spillovers during times of crisis. In Chapter Three, I investigate financial contagion during period from January 2012 through October 16, 2015.

In Chapter Three, I not only investigate financial contagion, I examine the theory that political factors may play a crucial role in the spread of financial contagion. In particular, I examine the interrelationship between political unrest tied to the election of Dilma Rousseff in Brazil in 2014 and the possibility of financial contagion spreading from Brazil to its Latin American neighbors: Argentina, Chile, Colombia, Mexico, and Peru.

The results of this study suggest that the stock markets of Brazil and the Latin American countries share some fundamental link so that financial contagion following President Rousseff's election flowed to the other countries. The unconditional correlations increased; the conditional correlations increased; and both the Kolmogorov-Smirnov test and Markov switching model provide evidence that the increase in correlations is connected with the date of Rousseff's election.

My results come with some obvious caveats. The increase in correlations may result from unobserved and unidentified factors during the period under investigation. And even though the results are robust, the current study controls may not capture the full impact of factors not considered. Still, my robustness test finds that when the model accounts for regional factors, the markets continue to evidence increased correlations and the timing of the increase continues to correspond to the election of President Rousseff.

More importantly, however, the results of this study provides significant information to economic planners, not only in the countries under investigation, but in other countries that are linked via regional trade agreements. In an attempt to limit exposure to adverse volatility effects, policy makers may utilize regulatory policy to restrict foreign equity investments during times of political unrest. Such actions may limit volatility from a particular region, but the economic effect may still stifle growth as firms struggle to raise capital for projects.

Methodologically, this study provides additional evidence that the GARCH-DCC is a powerful tool for analyzing financial contagion. The results from this analysis suggest that it not only is appropriate to use the GARCH-DCC model, but that when the GARCH model is used in conjunction with the KS test and a Markov switching model it provides significant information about risk and financial contagion.

Collectively, these two essays investigate potential effects of RTAs. Positively, they may result in the stock markets of the countries becoming cointegrated, which provides important information to investors and corporate managers. In the same way, RTAs may increase the likelihood of financial contagion, which likewise, imparts vital information to investors, managers, and economic policy makers.

During the time that I am writing Chapters Two and Three, various events with economic significance continue to take place in the regions I am investigating. The United States, Canada, and Mexico are examining the possibility of updating (or replacing) NAFTA with the United States – Mexico – Canada Agreement (USMCA). It is impossible to state with confidence what the economic and financial effect of this agreement will be on the stock markets of the respective countries. The analysis of this study suggests, however, that the effects will be minimal. That is, RTAs have increased market linkages. The results of this analysis find the markets are already cointegrated, so that an updated RTA should not alter that reality. If anything, I anticipate the degree of cointegration to strengthen over time.

In other world news, Brazil just (October 29, 2018) elected Jair Bolsonaro as its new president over leftist Fernando Haddad. In many regards, the election mirrors the political polarization that was evident in the 2016 presidential election in the United States. Any time there is a new leader, the possibility of political unrest, and consequently, financial contagion, increases. In this instance, however, I am not convinced that the economic situation will be identical to the election in 2014. Brazil has been mired in political unrest for several years, largely from the left. Former president Lula da Silva attempted to run for president this year, but was disqualified while serving a term in prison for political corruption. His hand-picked successor, Dilma Rousseff likewise was impeached from office over corruption. With Bolsonaro winning the election by roughly 10% and representing a new political direction, I anticipate more excitement than instability. Nevertheless, the polarization of politics certainly makes the possibility real.

REFERENCES

Ades, A., & Chua, H. B. (1997). Thy Neighbor's Curse: Regional Instability and Economic Growth. *Journal of Economic Growth, 2*(3), 279-304.

Agénor, P. R., Aizenman, J., & Hoffmaister, A. W. (2008). External shocks, bank lending spreads, and output fluctuations. *Review of International Economics, 16*(1), 1-20.

Aggarwal, R., & Kyaw, N. A. (2005). Equity market integration in the NAFTA region: Evidence from unit root and cointegration tests. *International Review of Financial Analysis, 14*(4), 393-406.

Al Nasser, O. M., & Hajilee, M. (2016). Integration of emerging stock markets with global stock markets. *Research in International Business and Finance, 36*, 1-12.

Alesina, A., & Perotti, R. (1996). Income distribution, political instability, and investment. *European Economic Review, 40*(6), 1203-1228.

Alotaibi, A. R., & Mishra, A. V. (2015). Global and regional volatility spillovers to GCC stock markets. *Economic Modelling, 45*, 38-49.

Alotaibi, A. R., & Mishra, A. V. (2017). Time varying international financial integration for GCC stock markets. *The Quarterly Review of Economics and Finance, 63*, 66-78.

Atteberry, W. L., & Swanson, P. E. (1997). Equity market integration: The case of North America. *North American Journal of Economics & Finance, 8*(1), 23.

Aznar, A., & Salvador, M. (2002). Selecting the rank of the cointegration space and the form of the intercept using an information criterion. *Econometric Theory, 18*(4), 926-947.

Baig, T., & Goldfajn, I. (1999). Financial market contagion in the Asian crisis. *IMF Staff Papers, 46*(2), 167-195.

Bailey, W., & Chung, Y. P. (1995). Exchange rate fluctuations, political risk, and stock returns: Some evidence from an emerging market. *Journal of Financial and Quantitative Analysis, 30*(4), 541-561.

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics, 9*(1), 3-18.

Basu, S. (1997). Why institutional credit agencies are reluctant to lend to the rural poor: A theoretical analysis of the Indian rural credit market. *World Development, 25*(2), 267-280.

Baur, D. G. (2012). Financial contagion and the real economy. *Journal of Banking & Finance, 36*(10), 2680-2692.

Bekaert, G., Ehrmann, M., Fratzscher, M., & Mehl, A. (2014). The global crisis and equity market contagion. *The Journal of Finance, 69*(6), 2597-2649.

Bekaert, G., & Harvey, C. R. (2000). Foreign speculators and emerging equity markets. *The Journal of Finance, 55*(2), 565-613.

Berben, R.-P., & Jansen, W. J. (2005). Comovement in international equity markets: A sectoral view. *Journal of International Money and Finance, 24*(5), 832-857.

Boako, G., & Alagidede, P. (2017). Examining evidence of 'shift-contagion'in African stock markets: A CoVaR-copula approach. *Review of Development Finance, 7*(2), 142-156.

Boffelli, S., & Urga, G. (2016). *Financial Econometrics Using Stata*: Stata Press Publication.

Brada, J. C., Kutan, A. M., & Yigit, T. M. (2006). The effects of transition and political instability on foreign direct investment inflows: Central Europe and the Balkans 1. *Economics of Transition, 14*(4), 649-680.

Braun, G. P., & Traichal, P. A. (1999). Competitiveness and the convergence of international business practice: North American evidence after NAFTA. *Global Finance Journal, 10*(1), 107-122.

Bray, C., & Reed, S. (2018, January 3, 2018). Petrobras of Brazil to Pay $2.95 Billion over Corruption Scandal. *New York Times*. Retrieved from https://www.nytimes.com/2018/01/03/business/dealbook/brazil-petrobras-corruption-scandal.html

Brito, R., & Boadle, A. (2017, September 14, 2017). Brazil's Temer Faces New Graft Charges over JBS Testimony. Retrieved from https://www.reuters.com/article/us-brazil-corruption-temer/brazils-temer-faces-new-graft-charges-over-jbs-testimony-idUSKCN1BP2W3

Brooks, C. (2014). *Introductory Econometrics for Finance*: Cambridge University Press.

Byers, J. D., & Peel, D. A. (1993). Some evidence on the interdependence of national stock markets and the gains from international portfolio diversification. *Applied Financial Economics, 3*(3), 239-242.

Calvo, S. (1999). *Capital flows to Latin America: Is there Evidence of Contagion Effects?* : The World Bank.

Calvo, S., & Reinhart, C. M. (1996). Capital flows to Latin America: Is There Evidence of Contagion Effect? In G. A. Calvo, M. Goldstein, & E. Hochreiter (Eds.), *Private Capital Flows To Emerging Markets After The Mexican Crisis*. Washington D.C.: Institute for International Economics.

Campbell, J. Y., & Hentschel, L. (1992). No news is good news: An asymmetric model of changing volatility in stock returns. *Journal of Financial Economics, 31*(3), 281-318.

Campbell, J. Y., Lo, A. W.-C., & MacKinlay, A. C. (1997). *The Econometrics of Financial Markets* (Vol. 2): princeton University press Princeton, NJ.

Campos, N. F., & Nugent, J. B. (2002). Who is afraid of political instability? *Journal of Development Economics, 67*(1), 157-172.

Campos, N. F., & Nugent, J. B. (2003). Aggregate investment and political instability: an econometric investigation. *Economica, 70*(279), 533-549.

Chari, A., & Henry, P. B. (2004). Risk sharing and asset prices: evidence from a natural experiment. *The Journal of Finance, 59*(3), 1295-1324.

Chen, G., Firth, M., & Rui, O. M. (2002). Stock market linkages: evidence from Latin America. *Journal of Banking & Finance, 26*(6), 1113-1141.

Chen, P. (2017). Understanding international stock market comovements: A comparison of developed and emerging markets. *International Review of Economics & Finance*.

Chiang, T. C., Jeon, B. N., & Li, H. (2007). Dynamic correlation analysis of financial contagion: Evidence from Asian markets. *Journal of International Money and Finance, 26*(7), 1206-1228.

Ciner, C. (2006). A further look at linkages between NAFTA equity markets. *The Quarterly Review of Economics and Finance, 46*(3), 338-352.

Claessens, S., Dornbusch, R., & Park, Y. C. (2001). Contagion: Why crises spread and how this can be stopped *International Financial Contagion* (pp. 19-41): Springer.

Claessens, S., & Forbes, K. (2001). International financial contagion: An overview of the issues and the book *International Financial Contagion* (pp. 3-17): Springer.

Climent, F., & Meneu, V. (2003). Has 1997 Asian crisis increased information flows between international markets. *International Review of Economics & Finance, 12*(1), 111-143.

Connolly, R. A., & Wang, F. A. (2003). International equity market comovements: Economic fundamentals or contagion? *Pacific-Basin Finance Journal, 11*(1), 23-43.

Conover, W. (1999). Practical nonparametric statics. *John Wiley & Sons, Inc., New York*, 130-133.

Corsetti, G., Pesenti, P., Roubini, N., & Tille, C. (2000). Competitive devaluations: toward a welfare-based approach. *Journal of International Economics, 51*(1), 217-241.

Damianov, D. S., & Escobari, D. (2016). Long-run equilibrium shift and short-run dynamics of US home price tiers during the housing bubble. *The Journal of Real Estate Finance and Economics, 53*(1), 1-28.

Darrat, A. F., & Zhong, M. (2001). *Equity Market Integration and Multinational Trade Agreements: The Case of NAFTA.* Paper presented at the Presentation To The 2001 Annual Meeting Of Financial Management Association International, Toronto, Canada.

Darrat, A. F., & Zhong, M. (2005). Equity market linkage and multinational trade accords: The case of NAFTA. *Journal of International Money and Finance, 24*(5), 793-817.

De Hoyos, R. E., & Iacovone, L. (2013). Economic Performance under NAFTA: A Firm-Level Analysis of the Trade-productivity Linkages. *World Development, 44*, 180-193.

De la Torre, A., Gozzi, J. C., & Schmukler, S. L. (2007). Stock market development under globalization: Whither the gains from reforms? *Journal of Banking & Finance, 31*(6), 1731-1754.

DeJong, D. N., Nankervis, J. C., Savin, N. E., & Whiteman, C. H. (1992). The power problems of unit root test in time series with autoregressive errors. *Journal of Econometrics, 53*(1-3), 323-343.

Diamonte, R. L., Liew, J. M., & Stevens, R. L. (1996). Political risk in emerging and developed markets. *Financial Analysts Journal*, 71-76.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association, 74*(366a), 427-431.

Drazen, A. (2000). Political Contagion in Currency Crises *Currency Crises* (pp. 47-67): University of Chicago Press.

Dungey, M., Fry, R., Gonzalez-Hermosillo, B., & Martin, V. L. (2005). Empirical modelling of contagion: a review of methodologies. *Quantitative Finance, 5*(1), 9-24.

Edwards, S., & Susmel, R. (2003). Interest rate volatility and contagion in emerging markets: evidence from the 1990s. *Review of Economics and Statistics, 85*(2), 328-348.

Engle, R. F. (2002). Dynamic conditional correlation: A simple class of multivariate generalized autoregressive conditional heteroskedasticity models. *Journal of Business & Economic Statistics, 20*(3), 339-350.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.

Engle, R. F., & Kroner, K. F. (1995). Multivariate simultaneous generalized ARCH. *Econometric Theory, 11*(1), 122-150.

Errunza, V., Losq, E., & Padmanabhan, P. (1992). Tests of integration, mild segmentation and segmentation hypotheses. *Journal of Banking & Finance, 16*(5), 949-972.

Ewing, B. T., Payne, J. E., & Sowell, C. (1999). NAFTA and North American stock market linkages: an empirical note. *The North American Journal of Economics and Finance, 10*(2), 443-451.

Ewing, B. T., Payne, J. E., & Sowell, C. (2001). Transmission of conditional stock return volatility across North American markets: evidence from pre-and post-NAFTA. *The International Trade Journal, 15*(4), 409-427.

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance, 47*(2), 427-465.

Fama, E. F., & French, K. R. (1995). Size and book-to-market factors in earnings and returns. *The Journal of Finance, 50*(1), 131-155.

Fama, E. F., & French, K. R. (2012). Size, value, and momentum in international stock returns. *Journal of Financial Economics, 105*(3), 457-472.

Fielding, D. (2003). Modelling political instability and economic performance: Israeli investment during the Intifada. *Economica, 70*(277), 159-186.

Forbes, K. J., & Rigobon, R. (2000). *Contagion in Latin America: Definitions, Measurement, and Policy Implications* (Working Paper 7885). Retrieved from www.nber.org/papers/w7885

Forbes, K. J., & Rigobon, R. (2001). Measuring contagion: conceptual and empirical issues *International Financial Contagion* (pp. 43-66): Springer.

Forbes, K. J., & Rigobon, R. (2002). No contagion, only interdependence: measuring stock market comovements. *The Journal of Finance, 57*(5), 2223-2261.

Frankel, J., & Schmukler, S. (1996). Crisis, contagion, and country funds: Effects on East Asia and Latin America. *Pacific Basin Working Paper Series*, 232-266.

Gelos, R. G., & Sahay, R. (2001). Financial market spillovers in transition economies. *Economics of Transition, 9*(1), 53-86.

Gibbons, J. D., & Chakraborti, S. (2011). Nonparametric statistical inference *International Encyclopedia of Statistical Science* (pp. 977-979): Springer.

Gilmore, C. G., & McManus, G. M. (2004). The impact of NAFTA on the integration of the Canadian, Mexican, and US equity markets *North American Economic And Financial Integration* (pp. 137-151): Emerald Group Publishing Limited.

Goldfeld, S. M., & Quandt, R. E. (1973). A Markov model for switching regressions. *Journal of Econometrics, 1*(1), 3-15.

Gonzalo, J., & Pitarakis, J.-Y. (1998). Specification via model selection in vector error correction models. *Economics Letters, 60*(3), 321-328.

Granger, C. W. J. (1986). Developments in the Study of Cointegrated Economic Variables. *Oxford Bulletin of Economics and Statistics, 48*(3), 213-228.

Gregory, A. W., & Hansen, B. E. (1996a). Practitioners corner: tests for cointegration in models with regime and trend shifts. *Oxford Bulletin of Economics and Statistics, 58*(3), 555-560.

Gregory, A. W., & Hansen, B. E. (1996b). Residual-based tests for cointegration in models with regime shifts. *Journal of Econometrics, 70*(1), 99-126.

Gurgul, H., & Lach, Ł. (2013). Political instability and economic growth: Evidence from two decades of transition in CEE. *Communist and Post-Communist Studies, 46*(2), 189-202.

Hamao, Y., Masulis, R. W., & Ng, V. (1990). Correlations in price changes and volatility across international stock markets. *The Review of Financial Studies, 3*(2), 281-307.

Hamilton, J. D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle. *Econometrica: journal of the Econometric Society*, 357-384.

Hansen, H., & Johansen, S. (1993). Recursive estimation in cointegrated VAR-models. 1-25.

Hashimoto, Y., & Ito, T. (2002). *High Frequency Contagion of Currency Crises in Asia*: National Bureau of Economic Research.

Hernández, L. F., & Valdés, R. O. (2001). What drives contagion: trade, neighborhood, or financial links? *International Review of Financial Analysis, 10*(3), 203-218.

Hunter, D. M. (2006). The evolution of stock market integration in the post-liberalization period–A look at Latin America. *Journal of International Money and Finance, 25*(5), 795-826.

In, F., Kim, S., Yoon, J. H., & Viney, C. (2001). Dynamic interdependence and volatility transmission of Asian stock markets: Evidence from the Asian crisis. *International Review of Financial Analysis, 10*(1), 87-96.

Jin, X. (2018). Downside and upside risk spillovers from China to Asian stock markets: A CoVaR-copula approach. *Finance Research Letters, 25*, 202-212.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*(2), 231-254.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169-210.

Johnson, R., & Soenen, L. (2003). Economic integration and stock market comovement in the Americas. *Journal of Multinational Financial Management, 13*(1), 85-100.

Kaminsky, G. L., & Reinhart, C. M. (2000). On crises, contagion, and confusion. *Journal of International Economics, 51*(1), 145-168.

Kenourgios, D., & Dimitriou, D. (2015). Contagion of the global financial crisis and the real economy: A regional analysis. *Economic Modelling, 44*, 283-293.

Kessler, J. A. (1999). The North American Free Trade Agreement, emerging apparel production networks and industrial upgrading: the Southern California/Mexico connection. *Review of International Political Economy, 6*(4), 565-608.

Koch, P. D., & Koch, T. W. (1991). Evolution in dynamic linkages across daily national stock indexes. *Journal of International Money and Finance, 10*(2), 231-251.

Kodres, L. E., & Pritsker, M. (2002). A rational expectations model of financial contagion. *Journal of Finance, 57*(2), 769-799.

Kondonassis, A. J., Malliaris, A. G., & Paraskevopoulos, C. (2008). NAFTA: Past, Present and Future. *The Journal of Economic Asymmetries, 5*(1), 13-23.

Kutan, A. M., & Perez, S. M. (2002). Does organized crime affect stock market development? Evidence from Colombia. *The Emerging Markets Group, Working Paper 4, 2*.

Kwiatkowski, D., Phillips, P. C., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are I that economic time series have a unit root? *Journal of Econometrics, 54*(1-3), 159-178.

Lahrech, A., & Sylwester, K. (2013). The impact of NAFTA on North American stock market linkages. *The North American Journal of Economics and Finance, 25*, 94-108.

Lederman, D., Maloney, W. F., Maloney, W. F., & Serven, L. (2005). *Lessons from NAFTA for Latin America and the Caribbean*: Stanford University Press.

Levine, R., & Zervos, S. (1998). Capital control liberalization and stock market development. *World Development, 26*(7), 1169-1183.

Lewis, K. K. (2000). Why do stocks and consumption imply such different gains from international risk sharing? *Journal of International Economics, 52*(1), 1-35.

Liu, W. (2006). A liquidity-augmented capital asset pricing model. *Journal of Financial Economics, 82*(3), 631-671.

Longin, F., & Solnik, B. (1995). Is the correlation in international equity returns constant: 1960–1990? *Journal of International Money and Finance, 14*(1), 3-26.

Lothian, J. R. (1991). Political factors in international economics: an overview. *Journal of International Money and Finance, 10*, S4-S15.

Masih, A. M. M., & Masih, R. (2002). Propagative causal price transmission among international stock markets: evidence from the pre- and postglobalization period. *Global Finance Journal, 13*(1), 63-91.

Masson, P. (1999a). Contagion: Monsoonal Effects, Spillovers, and Jumps between Multiple Equilibria. In P. R. Agenor, M. Miller, D. Vines, & A. Webber (Eds.), *The Asian Financial Crisis: Causes, Contagion, and Consequences.* (pp. 98-142). Cambridge: Cambridge University Press.

Masson, P. (1999b). Contagion:: Macroeconomic Models with Multiple Equilibria. *Journal of International Money and Finance, 18*(4), 587-602.

Mellado, C., & Escobari, D. (2015). Virtual integration of financial markets: a dynamic correlation analysis of the creation of the Latin American Integrated Market. *Applied Economics, 47*(19), 1956-1971.

Meric, G., Leal, R. P. C., Ratner, M., & Meric, I. (2001). Co-movements of U.S. and Latin American equity markets before and after the 1987 crash. *International Review of Financial Analysis, 10*(3), 219.

Moshirian, F. (2008). Globalisation, growth and institutions. *Journal of Banking & Finance, 32*(4), 472-479.

Mullainathan, S. (2002). A memory-based model of bounded rationality. *The Quarterly Journal of Economics, 117*(3), 735-774.

Okada, K. (2013). The interaction effects of financial openness and institutions on international capital flows. *Journal of Macroeconomics, 35*, 131-143.

Panchenko, V., & Wu, E. (2009). Time-varying market integration and stock and bond return concordance in emerging markets. *Journal of Banking & Finance, 33*(6), 1014-1021.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica: journal of the Econometric Society*, 1361-1401.

Perron, P., & Vogelsang, T. J. (1992). Nonstationarity and level shifts with an application to purchasing power parity. *Journal of Business & Economic Statistics, 10*(3), 301-320.

Phengpis, C., & Swanson, P. E. (2006). Portfolio diversification effects of trading blocs: The case of NAFTA. *Journal of Multinational Financial Management, 16*(3), 315-331.

Phylaktis, K., & Ravazzolo, F. (2002). Measuring financial and economic integration with equity prices in emerging markets. *Journal of International Money and Finance, 21*(6), 879-903.

Prengaman, P., & Langlois, J. (2018, April 8, 2018). Brazil's Ex-President 'Lula' da Silva Jailed for Graft. *Associated Press*. Retrieved from https://www.usatoday.com/story/news/world/2018/04/07/brazils-ex-president-lula-da-silva-jailed-graft/496973002/

Quandt, R. E. (1972). A new approach to estimating switching regressions. *Journal of the American Statistical Association, 67*(338), 306-310.

Rangvid, J., Santa-Clara, P., & Schmeling, M. (2016). Capital market integration and consumption risk sharing over the long run. *Journal of International Economics, 103*, 27-43.

Ratanapakorn, O., & Sharma, S. C. (2002). Interrelationships among regional stock indices. *Review of Financial Economics, 11*(2), 91-108.

Reboredo, J. C., Rivera-Castro, M. A., & Ugolini, A. (2016). Downside and upside risk spillovers between exchange rates and stock prices. *Journal of Banking & Finance, 62*, 76-96.

Reinganum, M. R. (1983). The Anomalous Stock-Market Behavior of Small Firms in January - Empirical Tests for Tax-Loss Selling Effects. *Journal of Financial Economics, 12*(1), 89-104.

Rigg, J., Bebbington, A., Gough, K. V., Bryceson, D. F., Agergaard, J., Fold, N., & Tacoli, C. (2009). The World Development Report 2009 'reshapes economic geography': geographical reflections. *Transactions of the Institute of British Geographers, 34*(2), 128-136.

Robertson, R. (2000). Wage shocks and North American labor-market integration. *American Economic Review, 90*(4), 742-764.

Schwert, G. W. (1989). Why does stock market volatility change over time? *The Journal of Finance, 44*(5), 1115-1153.

Spolaore, E., & Wacziarg, R. (2005). Borders and growth. *Journal of Economic Growth, 10*(4), 331-386.

Taylor, M. P., & Tonks, I. (1989). The internationalisation of stock markets and the abolition of UK exchange control. *The review of Economics and Statistics*, 332-336.

Umutlu, M., Akdeniz, L., & Altay-Salih, A. (2010). The degree of financial liberalization and aggregated stock-return volatility in emerging markets. *Journal of Banking & Finance, 34*(3), 509-521.

Watts, J., & Bowater, D. (2016, September 1, 2016). Brazil's Dilma Rousseff Impeached by Senate in Crushing Defeat. *The Guardian*. Retrieved from https://www.theguardian.com/world/2016/aug/31/dilma-rousseff-impeached-president-brazilian-senate-michel-temer

Yu, I.-W., Fung, K.-P., & Tam, C.-S. (2010). Assessing financial market integration in Asia – Equity markets. *Journal of Banking & Finance, 34*(12), 2874-2885.

Zhang, X. F. (2006). Information uncertainty and stock returns. *The Journal of Finance, 61*(1), 105-137.

Život, E., & Andrews, D. (1992). Further evidence on the Great Crash, the oil price shock, and the unit root hypothesis. *Journal of Business and Economic Statistics, 10*(3), 251-270.

BIOGRAPHICAL SKETCH

John K. Tarwater earned the degree of Doctor of Philosophy in Business Administration with a concentration in Finance at the University of Texas Rio Grande Valley in 2018. In 2002, he received a Doctor of Philosophy in Theological Studies with a concentration in Ethics from Southeastern Baptist Theological Seminary in Wake Forest, North Carolina. Additionally, Tarwater received a Master's degree in Teaching with a concentration in Curriculum Development from Carson – Newman College in Jefferson City, Tennessee in 1998 and a Master's in Theological Studies from Duke University in Durham, North Carolina in 1993. He received his Bachelor of Science degree in Business and Mathematics from Carson – Newman College in 1991. He continues to maintain his license as a Certified Public Accountant with the state of Texas.

Since receiving his first doctoral degree, Dr. Tarwater has taught and served in administration at various colleges and universities. He directed two graduate programs, and he served as the Vice President of Administration and Chief Financial Officer for another four-year college.

Currently, Dr. Tarwater teaches classes in finance and business ethics at Cedarville University in Cedarville, Ohio. He is married to Sheila M. Tarwater, and they are the proud parents of five boys and five girls. Dr. Tarwater's dissertation, *Essays on Market Linkages in NAFTA and Latin American Countries: Studies in Cointegration and Contagion*, was supervised by Dr. Diego Escobari. He may be reached at: jtarwater@cedarville.edu.