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GDP GROWTH DIFFERENCES AND FINANCIAL CONTAGION: EVIDENCE FROM THE 2008-2009 SUBPRIME CRISIS

by

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ABSTRACT

Trend and panel data analyses are used to determine the role of financial variables in GDP growth differences during the last global recession. Real variables are implemented in order to absorb real shocks and give a better (less biased) estimation of the effects of those nominal (financial) shocks. Results indicate an important role of Stock Market correlations.

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1. INTRODUCTION

The purpose of this paper is to investigate the relation of cross-border financial activity with GDP growth, more notably the method of financial transmission of the American financial crisis into other economies, therefore possibly affecting economic growth in other nations. I try to describe the way financial spillovers, as described in the literature, affected economic growth as measured by productivity using empirical analysis in two different stages of Econometric regressions. Specifically, there will be focus in three channels of financial activity: stock market correlations, international bank holdings and cross-border private portfolio holdings. Real factors such as trade balance, factor of productivity and fiscal balance will account for real production variables used to reduce omitted variable bias and to represent the real the real side of each economy. Initially correlation analyses in terms of financial activity are examined to determine, at least basically, the presence of contagion as broadly defined in the literature. Once signs of contagion are discovered, fixed effects panel data regressions are used to motivate the continuation of the relation of financial activity and GDP growth differences. It is then when Two Step GMM Arellano-Bond dynamic panel data regressions are implemented to account for the dynamic nature of GDP growth and to therefore control for both endogeneity and dynamic problems of the simple panel data case. As a final step a series of comparisons are conducted in empirical results of subsets on the main database, where the objective is to compare how different perceived economies behaved during the crisis. Main results indicate a significant importance of stock market correlations as expected.

A prominent characteristic of the so called Great Recession is what many academics and researchers call contagion. Such contagion was present more than not in financial markets all over the world. More notably with those markets to which the United States had close ties in terms of commerce and business. Several financial crises in the past have exhibited such difficulties in which an economic shock in one of the trading economies affects other economies, therefore creating periods of negative growth or perhaps slow economic expansion.

Such was the case of the Mexican crisis in 1994-95, where an overvalued exchange rate, a large current account deficit, and a government induced currency devaluation (which should have served to stabilize the economic situation) has been held responsible for a loss of confidence and free fall of the exchange rate. The exchange rate instability spread to countries like Argentina and Brazil and led to an exchange rate crisis in the emerging economies of South America (Agenor and Masson 1999).

Also, the Asian crisis of 1997 was initiated as a 15 percent devaluation of the Thai baht after a series of currency attacks. Such attacks led to consequent speculation followed by more currency attacks in countries like Malaysia, Indonesia and South Korea. Such exchange rate crises resulted in direct spillovers and recessionary periods in Hong Kong, Singapore and New Zealand. Even countries as far away as Latin America felt effects of the turmoil (International Monetary Fund 1998).

Another good example of contagion is the failure of LTCM, a much respected hedge fund that sought profits in yield spreads on long term similar securities. In August and September of 1998, a debt default by Russia caused a plummet in the asset value of LTCM's holdings in a situation the International Monetary Fund called "a period of turmoil in mature markets that is virtually

without precedent in the absence of a major inflationary or economic shock" (International Monetary Fund 1998).

Under fear of an international financial meltdown, the New York Fed organized a rescue package with several influential financial institutions. Such institutions were also invested or simply linked with LTCM. LTCM's failure would not only have meant losses in the United States, but also a domino effect in financial institutions all over the world; this due in part by the significant and strong positions held by LTCM in equity markets globally (Krugman, Obstfeld and Melitz 2012).

1.1 THE 2008-2009 SUBPRIME CRISIS

The previous cases demonstrate what many researchers have defined as contagion: "an episode in which there is a significant increase in cross-market linkages after a shock occurs in one market" (Longstaff 2010) and gives a framework to understand some of the linkages in economic interactions across international markets.

In order to continue the analysis proposed in this research, one must understand and have some background on the crisis to be analyzed. Some of the main characteristics of this Subprime Crisis are related to its point of origin, the way asymmetries affected foreign markets, and the way some of the comovements have been explained throughout the recessionary exit period.

In contrast to those periods of contagion previously mentioned, the Subprime crisis was originated in a developed economy, a major player in international economic activity, and a global economic power with big trade interdependences. Another reason this crisis is different from those described previously relates to the fact that big asymmetries coming from

complicated instruments were transported into more simple and available instruments, expanding the risk effects and giving rise to higher volatilities.

Prior to the crisis, the American economy had seen several periods of substantial economic growth, especially in the real estate industry, where credit easing by the Federal Reserve along with government incentives boosted the real estate market. The development of the real estate market gave rise to price increases in the sector, which were also justified by the characteristics exposed by the American population. On the other hand such, expansions in the real estate sector gave the incentive for and creation of new financial instruments. Of notable importance to the development of the crisis were Asset Backed Securities (ABS) and Collateralized Debt Obligations (CDO). ABS and CDOs consisted of investment-based securities backed by mortgages and other real estate related debt. Such new subprime instruments made mortgages cheaper and more accessible. "The subprime mortgage segment share in new business then rose from 6% in 2001 to 15% in 2008" (Ackermann 2008). The investors' demand for such new forms of financing kept the real estate growth buoyant. Firms from the international sector started becoming part of the growing bubble as globalization and securitization made it possible for international players to participate.

Once the Federal Reserve started tightening the fed funds rate in mid-2004 from 1% to 5.25%, the rise in housing prices was slowed as well as the unusual trend of risk seeking investors. The monetary policy move also put upward pressure on mortgage interest rates, which in turn created negative pressure on disposable income and an increase in mortgage default rates.

ABS and CDOs were then distributed around the globe, and companies abroad were highly invested in the American real estate market. Hence the risk from ABS was spread but also the

uncertainty and the possible effects of an inconvenient outcome. Therefore, while the crisis was originated in the American market, it quickly spread to those companies with positions in such securities and gave rise to uncertainty not only in American companies but companies and institutions abroad.

By the beginning of August 2007, BNP Paribas, a major French bank disclosed financial distress caused by their subprime holdings. Credit markets in the main financial markets went into panic with interbank interest rates rising above central bank target rates around the world. Shortly later, central banks in the biggest economies started to act as lenders of last resort as several financial institutions started showing trouble themselves.

By 2008 the American financial trembled as the markets suffered periods of damaging volatility after the collapse, forced merger, or bailouts of Bear Stearns, Fannie Mae, AIG, Freddie Mac, Lehman Brothers, Merrill Lynch, Wachovia and many other banks throughout the country. Bond spreads rose as much as 100 basis points once credit default swaps were created from the great amount of liquidity and financial guarantees in the financial markets (Longstaff 2010).

1.2 INITIAL MOTIVATION

In order to provide motivation in to the topic of study, an initial positive relation was found between stock market correlations and GDP growth correlations; the following figure illustrates such relationship through a scatter plot of the mentioned variables. A positive relation indicates a visible expected comovement between country independent economic growth and stock market correlations with the American stock market. Such relation is the one to be studied throughout this paper and the figure serves as proper motivation for the study.
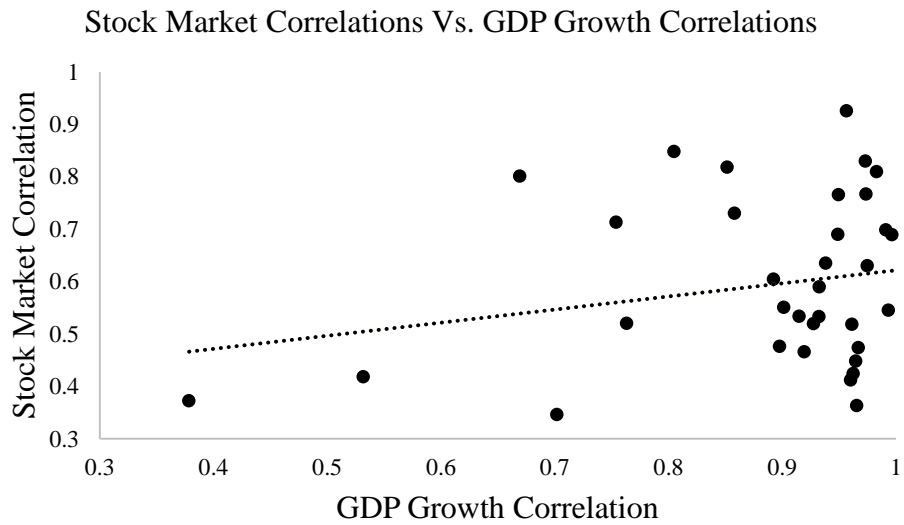
Stock Market Correlations Vs. GDP Growth Correlations

Figure 1:Stock Market Correlations Vs. GDP Growth Correlations

2. LITERATURE REVIEW

The main purpose of the paper, as stated before is to create motivation for further exploration into the linkages between financial contagion and GDP growth differences, with such goals in mind, this paper develops a unique model for two main reasons; it uses empirical methods suitable to senior level undergraduate economics students, and delivers concise results at significant levels. Another difference between this paper and other literature is based on the actual linkage between contagion and production. Given that contagion is a relatively new phenomena present in the now globalized economy, much of the research has focused in the understanding and estimation of financial contagion within the financial markets. However, this paper motivates results that aim to apply such previous signs of contagion described in previous literature to national productive behavior.

Dornbusch et al. (2000) refers to contagion as "the spread of market disturbances", a process of very strong correlations in exchange rates, stock prices, sovereign spreads, and capital flows. Academia has divided the sources of contagion into two different types. The first category emphasizing effects due to cross boundary shocks created by the normal interdependence of several economies; some examples of research that expose this kind of behavior are Masson (1998) and Allen and Gale (2000). That is, once a local shock affects a particular economy, it can be distributed over several other territories as these economies may have real and financial linkages that induce similar market behavior. Comovements of this type are normally not categorized as contagion. However, had they occurred during a period of turmoil, and had the effect enhanced given the market linkages between the economies, they may be expressed as contagion.

The second type of contagion involves a financial crisis and it occurs when investors'

behavior affects trends in equity prices and as such, no fundamental global macro-economic

shock causes the spillover; therefore, the spillover occurs even when there are no shocks to

fundamental variables. Investor behavior does not exasperate the crisis. This type of contagion is

said to be caused by "irrational" behavior (Dornbusch, Park and Claessens 2000).

Forbes and Rigobon (2002) expand the available definitios of contagion by specifying that

contagion only occurs where market correlation is significantly higher after the crisis, therefore

contagious crises are those where market comovements are high once the crisis has taken effect.

That is, markets that are highly correlated but remain correlated post crisis at the same level do

not experience contagion. It is only when such correlation/comovement is higher than in

"normal" levels that the shock can be defined as contagious.

The subprime crises can, therefore, be included within the second type of contagion; where

foreign positions in domestic investments gave international exposure of risk and volatility to an

American market that was exposing unusual behaviors. Moreover, even though there was a

macroeconomic shock in the American economy, it was local in nature and not significantly

visible in other countries in the region nor trading partners.

Pristker (2000) intended to explain financial contagion by defining the several factors that

may interfere or affect such transmissions of market instability and building explanatory models .

In his results, Pristker does not credit irrationality as the reason of propagation effects being

unexplained, but suggests that market imperfections and information asymetries cause price

movements in one country to result as contagion; which can be sometimes excessive relative to

full-information fundamentals.The factors that Pristker develops and explains in his paper are:

the economy, in which a real sector "where goods and services are produced by firms and produced by consumers", financial linkages, where there is to be found linkages in the banking and financial sectors, along with non-bank financial participants; financial markets, where assets in the real sector are represented by cashflows in financial transactions, banks (whose role is to be depository and lending institutions for the local economy), and shadow banks (that participate in financial market transactions). During the development of this paper, each of those sectors are accounted for in the way of constructed dependent variables. Therefore giving a viable framework to develop results.

According to Forbes and Rigobon (2001), other more advanced methods to test for contagion include for different approaches which allow for evidence in the transmission of shocks and test for such effects (GARCH models, cointegration, and probit models).

The simplest method to measure for contagion is that of correlations, according to common ground on the subjet, a high jump in correlation across markets given by periods of volatility in one of the markets has been studied and analyzed. Such approach attempts to control for common sources of comovements in returns before assesing changes in the information transfer process across periods. These cross-market correlations are the simplest. They test the measure of correlation in returns between two markets during a stable period and then compare them to correlations during periods of instability. Calvo and Reinhart (1996) use this method to test for contagion in the case of the Mexican crisis in 1994 and find an increase in the correlation of stock prices and bond returns across Asian and Latin American countries.

The second forementioned approach to test for contagion uses an ARCH or GARCH framework to estimate the variance-covariance transmission mechanism across countries. Hamao

et al. (1990) follow a similar approach and find that similar spillovers are substantial during the 1987 crash and that the contagion experience is not the same across different countries. They also conclude that contagion does not occur evenly across countries and is fairly stable through time. A third approach to describing contagion focuses on long run relationships instead of the immediate short run impacts of volatile behaviors. They use GARCH methods but test for changes in the co-integrating vector between stock markets instead of in the variance-covariance matrix.

The fourth method discards the methods mentioned before and tries to find an explanatory model that uses simplifying assumptions and exogenous events to identify an econometric model and measures the propagation mechanism. Baig and Goldfajn (1998) use a set of dummy variables of daily news to construct a model to capture the impact of own-country and cross-border news on the markets during the Asian crisis of 1997. They control for country news and other macroeconomic variables and find that there is contagion in the currency and equity markets.

The analysis generated for the subprime crisis in terms of contagion has been extensive. Longstaff (2010) conducts an empirical investigation into the pricing of subprime asset-backed collaterilized debt obligations (CDOs) and their contagion effects on other markets. Longstaff identifies two key elements: an event window for the distress event, and a vector of contagion which he then uses to test for changes in linkages across markets associated with the distress event. He applies a vector autoregression (VAR) to estimate the relation between CDO returns and returns in other financial markets.

Hwang, et al (2010) investigate the spillover effects of the recent subprime crisis in 38 countries. They find significant spillover effects in both emerging markets and developed market countries.

3. METHODOLOGY AND DATA

The empirical research is to be conducted at three different stages to first motivate signs of contagion during the subprime crisis, then to simply estimate the relation of financial contagion into real economic growth, and finally to use a more robust (more consistent, less unbiased) methodology to encompass dynamic features of the data and take care of endogeneity, serial correlation, and multicollinearity concerns.

3.1 CORRELATION AND TREND ANALYSIS

Since the purpose of the paper is to try to find trends of spillovers or contagion into GDP growth differences from the U.S Subprime crisis, we will focus on a pool of 36 countries: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Denmark, Finland, Germany, Greece, Hong Kong, Indonesia, Ireland, Italy, Japan, Korea (South), Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Singapore, South Africa, Spain, Sweden, Switzerland, Thailand, the United Kingdom, Venezuela and the United States (Hwang , et al. 2010) to broadly but yet concisely use a pool of countries significant of each region. Since Hwang et. al conducts contagion effects analysis of the U.S. subprime crisis on international stock markets with these pool of countries, this paper uses the same countries as Hwang et. al with the exception of Taiwan and France. Initially, a series of correlation tests and trend analyses are conducted on the three main financial variables to be analyzed throughout the first stage of the empirical analysis. Such variables are:

1. Stock Market Correlations: The primary financial variable employed is the stock market indices from the MSCI global equity index. The data consists therefore of the respective

MSCI equity index in each country. The data is retrieved at weekly values from a Bloomberg terminal, then correlations are ran using Microsoft Excel between $MSCI_{i,t}$ and $MXUS$ for the values corresponding to each week.

2. International Bank Claims: Immediate borrower basis of U.S. based borrowing as a counter party location is extracted from the Bank of International Settlements (BIS) database. Of the 35 countries analyzed (except U.S), 21 were presented by the current BIS database. Therefore, foreign claims by nationality of each country are to be analyzed during the periods mentioned on American assets. International bank claims are used as an indicator of the behavior of foreign economies in the holding of claims in American borrowing, therefore characterizing the behavior of the credit markets during the subprime crisis. The data is extracted on an annual basis.

3. Cross-Border Portfolio Holdings: Annual Cross-Border portfolio holdings were extracted from the U.S. Department of Treasury resource center. Foreign Portfolio holdings of U.S. Securities are used to represent the inflow and outflow of foreign portfolio investment in American financial assets, where stock market investments are represented.

The correlation is to be analyzed primarily in the stock market correlations variable, which represents the segment of the market in which most of the economic literature focuses on. The analysis will be conducted then in two different periods, a tranquil and a turmoil period (Hwang , et al. 2010). The tranquil period is defined from Quarter 2, 2004 to Quarter 4, 2007. The turmoil period is defined from Quarter 1, 2007 to Quarter 4, 2009. The tranquil and turmoil periods are chosen quiet loosely and were divided more with a practical mindset than based on observations in the change in financial activity throughout the whole period. The emphasis is on practicality

given the type of regressions developed later in the model, in which the number of periods is important for statistical purposes.

3.2 PANEL DATA ANALYSIS

Given that the main dataset is determined by a cross section, econometric regressions will be conducted to initially motivate a basis of understanding for the model. Hence a series of basic fixed effects panel data regressions will be conducted in the dataset. Having the suspicion that individual and time invariant country characteristics may impact or bias the estimators for the independent variables, the fixed effects methodology is used. Such time invariant characteristics are unique for the individual country and are assumed to not be correlated with the other explanatory variables in the model (Torres-Reyna n.d.). Moreover, fixed effects are used whenever there is interest in analyzing the impact of a variable over time, as in this case. The model is to include a series of real variables in order to account for the relation of real production on GDP differences, this in an effort to isolate financial effects into GDP differences and then draw better conclusions. An emphasis of using real variables is that of using such real variables as an effort to reduce omitted variable bias. The real variables are also helpful in the development of understanding the dynamics of the model.

The model therefore can be reproduced as:

$$Y_{i,t} = \beta_0 + \beta_1 SM_{i,t} + \beta_2 BH_{i,t} + \beta_3 PH_{i,t} + \beta_4 TB_{i,t} + \beta_5 FP_{i,t} + \beta_6 FB_{i,t} + U_{i,t} \tag{1}$$

$$U_{i,t} = U_i + V_{i,t} \tag{2}$$

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$Y_{i,t}$ is composed of the differences in real GDP growth compared to the previous year, that is, $Y_{U.S,t} - Y_{i,t}$. The GDP growth data was extracted from the World Bank database, the GDP growth is calculated yearly and it uses GDP as a measure of output. $SM_{i,t}$, $BH_{i,t}$, and $PH_{i,t}$ represent stock market correlation, bank holdings and portfolio holdings as specified in the previous sections. $TB_{i,t}$ represents the trade balance between the U.S and the country. The trade balance is intended to account for output transmissions across the economies where it could represent a deficit where the U.S. is said to have more imports than exports from that country or a surplus in the opposite case. The trade balance is to be extracted from the U.S. Census Bureau, the trade balance data has an annual frequency and is present for all the countries analyzed. $FP_{i,t}$ represents a proxy for the difference in productivity in both nations. Such proxy is calculated by $FP_{u,s} - FP_{i,t}$ where FP is GDP per capita. The GDP per capita data were extracted from the World Bank Database and was extracted annually with data for all the countries observed. This proxy for productivity also relates to the production ability of the country. Such ability therefore affects GDP growth, where there could be a correlation difference in both growths given different factors of productivity. $FB_{i,t}$ is the cash surplus (deficit) of the government for each country. It represents the fiscal situation of the country as it relates to possible investment crowding out. Budget balanced was extracted from the World Bank Database in an annual basis.

By convention, (2) represents the structure of the residual term in the regression. U_i represents the time invariant characteristics not explained by the other variables in the model but yet accounted for by the method of fixed effects estimation. $V_{i,t}$ represents the error term, which is assumed to have zero mean, constant variance, and is uncorrelated across time and individuals (Brañas-Garza, Bucheli and Garcia-Muñoz n.d.).

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3.3 DYNAMIC PANEL DATA REGRESSION

Even though *(1)* is simple and concise, there is major flaw to the precision of the model. Such flaw is related to the direction of GDP growth and its relationship with its own lagged values. Therefore, GDP was defined in *(1)* as a static variable, yet several problems arise concerning the actual relationship of GDP growth differences with their own lags. That is, given that such growth differences are certainly dependent on normal real and nominal economic factors of productivity in the private, public, and trading sectors, past realizations of GDP growth differences may be used to significantly forecast the future value of such differences in growth. Moreover, the variables in the right hand side of *(1)* are assumed to be independent of the error term, that is, $E(X_{i,t}V_{it})=0$. However, (*) the error term contains fixed effects individual to each country ($U_{i,t}$) that may be correlated with the variables in question . Another complication implicates that the dataset has a far larger individual dimension than time dimension as it is known that using dummy variables as in the case of fixed effects which includes a lagged variable of the dependent variable "results in biased estimates when the time dimension of the panel is small" (Judson and Owen 1996) .

Extensive research has been done in the area of dynamic panel data estimation, yet it comes to attention the approach exposed by Arellano and Bond (1991), where the development of an estimator using the Generalized Method of Moments (GMM) gave more consistency and less biasedness when used to predict panel data regressions with a lagged variable values of the dependent variable as an explanatory variable. To cope with (*), the difference GMM uses first and second differences to essentially eliminate the fixed effects from the regression; therefore eliminating the issue of endogeneity with the fixed effects in the error term. Such motivation

gives rise to the use of the Arellano-Bond Dynamic Panel Data estimator. The estimation then becomes:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 SM_{i,t} + \beta_3 BH_{i,t} + \beta_4 PH_{i,t} + \beta_5 TB_{i,t} + \beta_6 FP_{i,t} + \beta_7 FB_{i,t} + U_{i,t} \qquad (3)$$

Where all the explanatory variables are as described before and $Y_{i,t-1}$ represents the lagged value of GDP growth differences between the U.S. and country i.

Arellano and Bond propose therefore to difference equation *(3)* as follows:

$$(Y_{i,t} - Y_{i,t-1}) = \propto (Y_{i,t-1} - Y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (U_{i,t} - U_{i,t-1}) \qquad (4)$$

Where $Y_{i,t-1}$-$Y_{i,t-2}$ represents the lagged differenced value of $Y_{i,t}$. β' represents a coefficient vector for the explanatory variables and $X_{i,t}$-$X_{i,t-1}$ represents a vector of the differenced explanatory variables as explained in *(1)*. Moreover, the error term $U_{i,t}$-$U_{i,t-1}$ indicates the elimination of the time invariant fixed effects.

The econometric package STATA will be used to conduct all of the econometric analysis, where xtreg with fixed effects and a robust standard error will be used. The dynamic panel data estimation will be generated through the command xtabond with a second step and GMM standard errors.

4. RESULTS

4.1 CORRELATION AND TREND ANALYSIS

After conducting all the proper calculations and plotting them into line graphs, the results showed strong signs of an increase in market co-movements during the turmoil period. The following graphs show such results:

Arithmetic Mean of Stock Market Correlation with U.S.
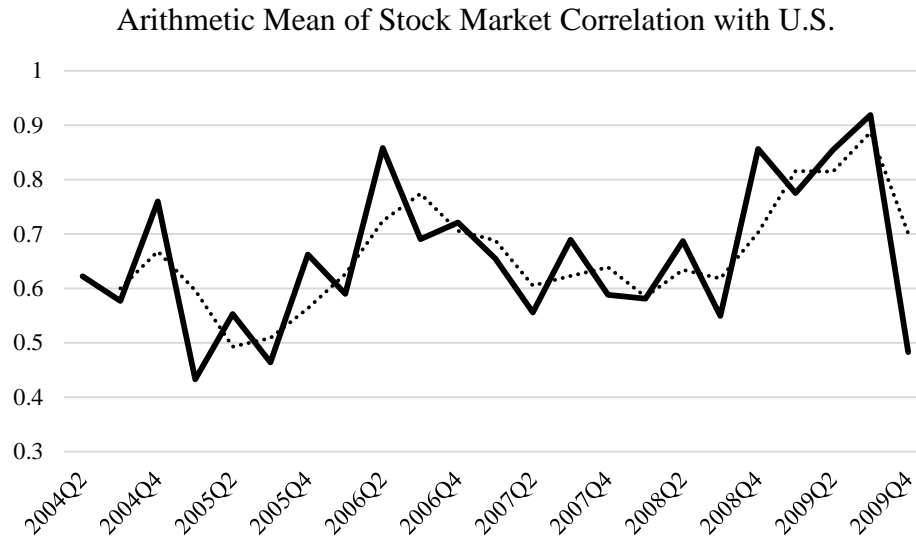
Figure 2: Arithmetic Mean of Stock Market Correlation with U.S.

Given the data in the MSCI country equity market indices, an arithmetic mean of the stock market correlation per year shows a significant increase in co-movements starting at the beginning of 2008Q2.

The graph shows that during the tranquil period, the correlation coefficient was rather steady and its average for the whole tranquil period was .630031, however, the average correlation increased significantly to 0.682638 during the turmoil period. The graph shows a notable

increase during the first period of turmoil. This was an expected result given by investor behavior characteristics also visible in the exchange rate markets, where investors tend to exaggerate their position on the instrument right after the event occurs and eventually stabilizes.

The following scatterplot is also illustration of increased high correlation during the turmoil period, particularly on years 2008 and 2009.
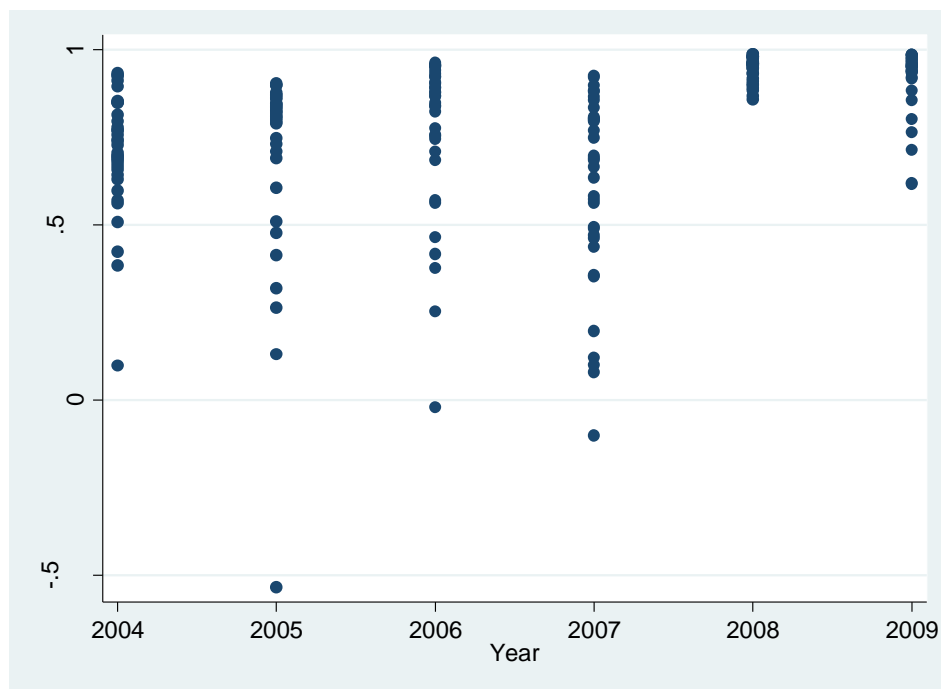
Figure 3: Stock Market Correlations Scatterplot

Arithmetic Mean of International Bank Claims of U.S.
Assets (in millions)

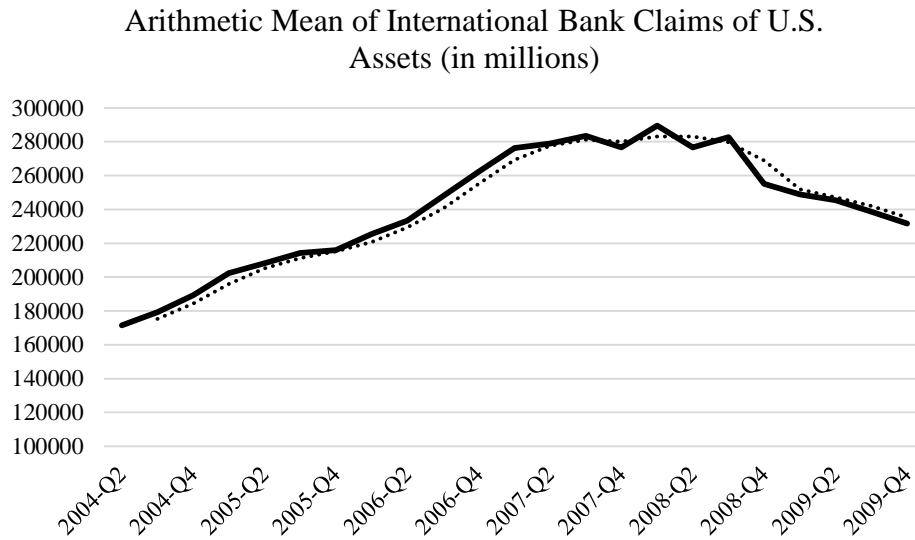*Figure 4: Arithmetic Mean of International Bank Claims of U.S. Assets*

In a related way, banks followed somewhat a similar yet inverted pattern to the stock markets,

where bank holdings of American assets showed a decreasing pattern post turmoil period. More

notably in 2008-Q3.

Arithmetic Average of Private Portfolio Holdings of U.S.
Assets
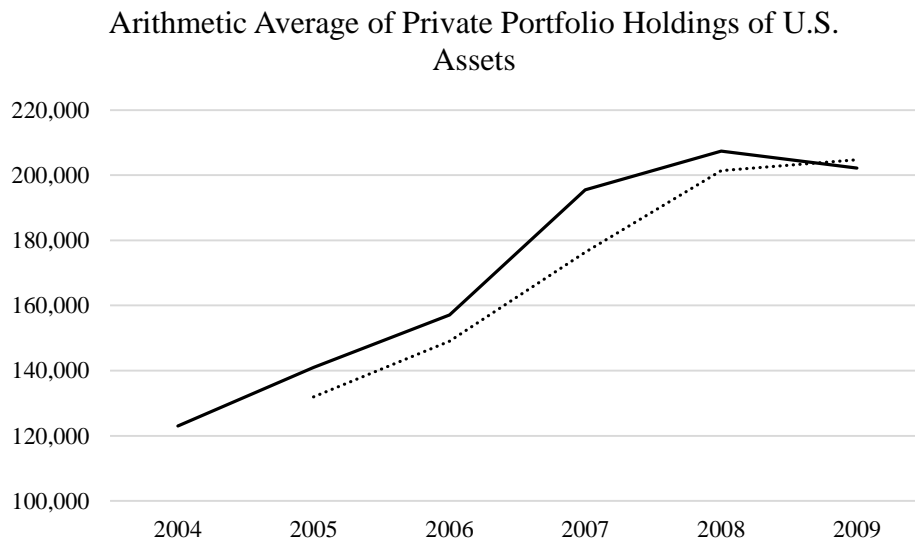
Figure 5: Arithmetic Average of Private Portfolio Holdings of U.S. Assets

Even though it seems that the arithmetic average of Private Portfolio Holdings of U.S. assets is increasing, a scatter plot of the annual growth of private portfolio holdings indicates that individually portfolio holdings were clustering towards null or negative growth. Indication of a disruption in investment or American securities.
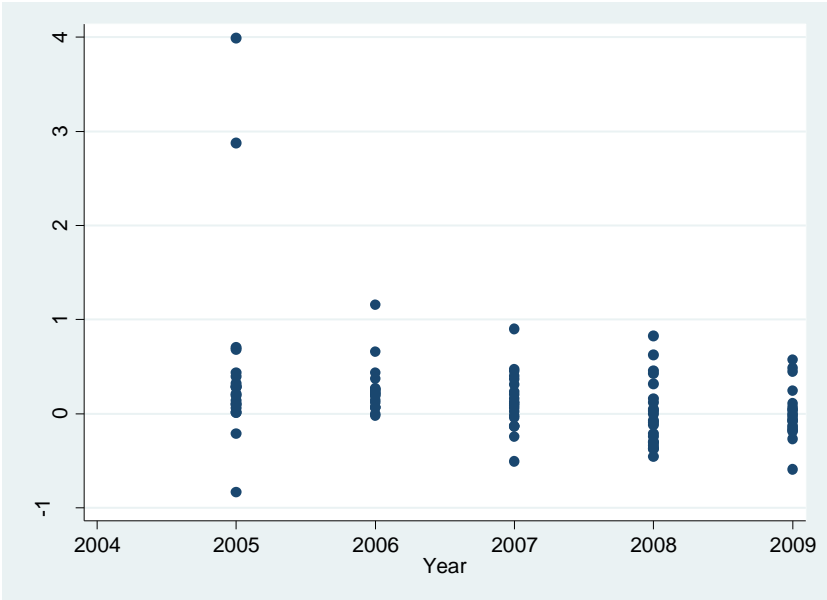

Figure 6: Private Portfolio Holdings of U.S. Assets Annual Growth Scatterplot

4.2 PANEL DATA ANALYSIS

4.2.1 TRANQUIL VS. TURMOIL

Table 1: TRANQUIL VS. TURMOIL

VARIABLES	COEFFICIENTS	
	Tranquil	Turmoil
$SM_{i,t}$	0.646681	-2.540238**
	(1.044)	(1.196)
$BH_{i,t}$	0.000014***	0.000000
	(0.000)	(0.000)
$PH_{i,t}$	-0.000026**	0.000014*
	(0.000)	(0.000)
$FP_{i,t}$	0.000048	-0.000355
	(0.000)	(0.000)
$TB_{i,t}$	-0.000000	0.000000
	(0.000)	(0.000)
$FB_{i,t}$	0.000000	0.000000***
	(0.000)	(0.000)
Constant	0.151758	5.091823
	(3.943)	(7.851)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A first instance of econometric analysis realizes the differences between the Tranquil and Turmoil periods using fixed effects panel data with standard errors clustered around the country panel identification. Initial estimation identifies an increasing significance in stock market correlations to the 99% probability, where an increase in stock market correlation causes a decrease in GDP growth difference. For instance, Italy exposes an arithmetic average in stock market correlation of -.996 during the turmoil period, if that correlation increased by .5 (i.e. stock market correlation of -.496) the GDP growth difference of Italy with the U.S. would decrease by 1.27 percentage points. The analysis realized by this initial empirical analysis is bias and inconsistent, such reasons have been explained in the methodology; however, it creates a good

starting point and it leads to the conclusion that the initial hypothesis that stock market correlations expose signs of contagion that were transmitted into GDP growth differences. Other notable characteristics of this model are that cross-equity bank holdings and portfolio holdings are significant during the tranquil period in the nominal side, while stock market correlations, portfolio holdings and fiscal health are significant during the turmoil side. Stock market correlations being the both the most significant and the variable that exposes more importance in the effects to GDP growth differences.

It is also important to mention that even though desirable, it is not possible to conduct Arellano Bond regressions with this data sample, this is caused by the time variable being of size three. Given that stock market correlations are collinear, a two-step GMM estimation is necessary, increasing the minimum number of time variables to four per both periods (tranquil and turmoil).

4.2.2 FIXED EFFECTS VS. ARELLANO BOND DYNAMIC PANEL DATA

Before estimating the dynamic panel data regression, it is important to determine whether the data contained in the data set is nonstationary and contains a trend. For such purposes, a Fisher-type unit root test (Augmented Dickie-Fuller Test for panel data was conducted in terms of $Y_{i,t,}$ $SM_{i,t,}$ $BH_{i,t,}$ and $PH_{i,t}$. Such tests exhibited that $Y_{i,t}$ has at least one panel which is stationary (Inverse chi-squared(70) of 42.7067 and a P-value of .9959), $SM_{i,t}$ demonstrated that all panels contain unit roots (Inverse Chi-Squared(70) of 103.1450 and a P-value of .0061), $BH_{i,t}$ showed that all panels contain unit roots (Inverse Chi-Squared(42) of 63.0766 and P-value of 0.0193), and $PH_{i,t}$ demonstrated that at least on panel is stationary (Inverse Chi-Squared(70) of 57.8629

and P-value of .8496). Therefore Yi,t, and $PH_{i,t}$ have autoregressive roots of one (Stock and Watson 2010). Concerns about whether the data follows a unit root is overcome by the second step differencing in the model. Where (4) differences each data point from its second lag to its first.

The following step consisted in conducting both panel and dynamic panel regressions including all of the time periods. As said before, a two-step GMM estimation, as needed in this case, requires a time variable of at least four periods. Therefore the estimation was initially conducted by using the second lag of the explanatory variables as instruments and regressing the GDP growth difference against its own first lag. A second difference approach was necessary given collinearity between the first set of lags and the error term.

Table 2: FIXED EFFECTS VS. ARELLANO BOND DYNAMIC PANEL DATA

VARIABLES	COEFFICIENTS	
	Fixed Effects PD	Arellano-Bond DPD
$Y_{i,t-1}$		0.896223***
		(0.063)
$SM_{i,t}$	-1.491912**	-1.156091***
	(0.647)	(0.267)
$BH_{i,t}$	0.000002	0.000001
	(0.000)	(0.000)
$PH_{i,t}$	0.000005	0.000000
	(0.000)	(0.000)
$FP_{i,t}$	-0.000537**	0.000425***
	(0.000)	(0.000)
$TB_{i,t}$	0.000000	-0.000000*
	(0.000)	(0.000)
$FB_{i,t}$	0.000000	0.000000***
	(0.000)	(0.000)
Constant	8.730933**	-5.443800**
	(3.898)	(2.727)

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

It is convenient to begin the analysis by looking at the fixed effects estimation, where the results are in accordance to those exhibited in the previous section, at least in direction. The value of those coefficients that are significant $SM_{i,t}$ and $FP_{i,t}$ are lower as expected from the Tranquil Vs. Turmoil analysis given the comprehensive time frame that allows for effects of bank holdings in the model. More significantly, stock market correlations seem to continue to show both a significant and important role in the model.

Before discussing dynamic panel data results, it is imperative to describe post-estimation tests required to describe the validity of the model. Therefore, Sargan and AR tests were conducted for the model in order to describe matters of instrument validity (from collinearity of the

explanatory variables' lags with the error term) and autocorrelation of the variables with their own lags, respectively. The test for zero autocorrelation indicated that the second order lag had a Z value of .1821 with a probability that the second order lags of the explanatory variables are not auto correlated at the 91% confidence level. Sargan tests indicating that the second order explanatory variables' lags are not correlated with the error term exposed a chi-squared on nine instruments of 8.5956 and a probability of the instruments not being correlated with the error term of 52.4%. These two tests therefore give the model validity and discussion can be conducted on the economic interpretation of the estimators.

The GDP growth difference lag tested significant and relevant, as a trailing lower difference in GDP growth difference is estimated to increase future GDP growth differences. That is, in the case of Japan, for instance, which showed a GDP growth difference of .68% during 2008; an increase in such growth difference of 1% has an estimated effect of growth difference increase of approximately .9%. Stock market correlation continues to play an important role even in this more sophisticated regression, where assumptions of high stock market correlations represent a concise transmission to GDP growth differences.

4.2.3 STOCK MARKET CORRELATIONS AND THEIR LAGS

A third regression is conducted in the main database trying to find a description of the effects of stock market correlation's lags on GDP growth differences as well as the explanatory power of lagged GDP growth differences into current GDP growth differences. The following table illustrates the results.

Results indicate an important impact of once again the first lag of GDP growth differences, the significance is however reduced, as expected, by the presence of a second lag of GDP growth differences. The second lag even though statistically insignificant at the 90% confidence level, is significant at the 80% confidence level.

Stock market correlation had a different outcome, as it tested significant at all three lag levels. This leads to the conclusion that stock market correlation affects GDP growth differences not only by its current time frame but by a combination of the previous stock market correlations. A result that is important once looking at cross-border stock markets and its translation to GDP growth difference between the countries. The later lags of stock market correlation, once more as in the case of GDP growth differences, were less statistically significant but yet relevant for purposes of practical interpretation. Bank holdings tested significant, yet its mean marginal effect is irrelevant for the purposes of the overall analysis of the regression.

Table 3: STOCK MARKET CORRELATIONS AND THEIR LAGS

VARIABLES	COEFFICIENTS Arellano-Bond DPD
$Y_{i,t-1}$	0.821646***
	(0.149)
$Y_{i,t-2}$	-0.261115
	(0.190)
$SM_{i,t}$	-2.781525***
	(1.024)
$SM_{i,t-1}$	-2.623066**
	(1.148)
$SM_{i,t-2}$	-2.554924*
	(1.321)
$BH_{i,t}$	-0.000004**
	(0.000)
$PH_{i,t}$	0.000002
	(0.000)
$FP_{i,t}$	0.000308
	(0.000)
$TB_{i,t}$	0.000000
	(0.000)
$FB_{i,t}$	0.000000
	(0.000)
Constant	2.322476
	(5.710)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. CONCLUSION

Even when much of the contagion and spillover research has been conducted in the financial field alone, explaining only contagion effects within the financial industries themselves, this paper tried to find a spillover effect into GDP growth differences from three main financial variables. The first set of analyses relied on simple correlation and trend analysis in an effort to identify contagion within the financial variables and the possibility of such contagion being transmitted into GDP growth. Preliminary results showed much of what the media covered during the subprime crisis, that is, a spillover effect in the financial variables from the United States into the rest of the world. Trend analyses showed very visible signs of increase in comovements, especially during the first year of the turmoil period. Average stock market correlations increased and cross-equity bank holdings and private portfolio holdings of U.S. securities decreased.

During the second stage of analyses the focus turned to the main effects to be determined, namely, GDP growth differences were analyzed in terms of the financial variables discussed with real variables. Both fixed effects and dynamic panel data showed important signs of transmission of financial contagion into real GDP growth, the only nominal effect to be found significant and relevant was stock market correlation. An increase in stock market correlation estimates a decrease in GDP growth differences.

The results went in accordance to what was expected and followed much of the research previously generated in terms of contagion and the effects of stock market activity and GDP growth. It has been found that stock market development and growth is important and beneficial

to economic growth. Where stock market and bank development have performed an important role in the process of economic growth (Beck and Levine 2002). Financial integration has also been found to be a significant player in economic growth, where the effect of financial integration on growth for emerging economies is not only significant but also important (Friedrich, Schnabel and Zettelmeyer 2010). This paper therefore continues the analysis by estimating that countries with similar stock market movements tend to affect the difference in GDP growth for such economies. There is not inference analyzed that explains causality but the relation is both significant and relevant; that is, during a financial shock, stock market correlations can be used to understand the pattern of movement for the GDP growth differences in the countries affected. Causes for the phenomena include sudden movements of investments out of highly correlated stock markets given a liquidity shock, industrial and production symmetries, and diversification channels where investors move to given a shock in the present markets.

To further enhance the topic it would be convenient to use more advanced models and reach into more detailed data sources. A next step to follow would be to use a VAR framework to better analyze the market situations. In terms of data, several other sources are available either at a prize or require membership, situation that limited both the reach and global significance of the data. The bank holdings data were unbalanced and perhaps had a significant impact in the estimation process, where the other variables were strongly balanced. Also, the time variable had an important impact in the method of estimation. Where a time variable of three years for each tranquil and turmoil periods is not appropriate to statistically analyze the data dynamically.

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