

SENIOR THESIS PROPOSAL:

Granger-Causality Testing Stock Market Integration of Developed and Emerging Markets

As globalization expands across the world, stock markets have become increasingly linked together. Even since the early 1900's, evidence of integration is apparent. In the 1929 catastrophe, the London Stock Exchange fell two days after the US stock market crash. As technology improved, the massive outflow of information through the Internet allowed any investor to access global financial information and place stock trades within milliseconds. However, this phenomenon may not be true for all markets. This thesis seeks to investigate the level of integration and order of which market indexes of nations respond to one another. Particular attention will be paid towards emerging markets, where their behavior may differ from those of developed markets. One may hypothesize that developing nations look to developed countries in terms of market movements. Once assessed through granger-causality tests, we may prove or disprove integration between stock markets around the world and if so, which markets are affected by others. Due to the complexity of analysis, only certain markets will be assessed. This test will also only test for explanatory power, not determining co-movements, since an econometric assessment of that caliber would require additional economic variables to determine the accurate movement directions, none of which data are available in daily format. Those selected would be the best representations of their respective regions. A mere granger-causality test does not automatically imply causation. Hence, economic reasoning will first be required. Factors in possible integration and granger causality to be investigated also include market size, geographic location, time difference, and economic or cultural connections between nations. The results may provide insight on how integration will affect economies of different countries in times of boom and bust.

Theory

The main vectors of financial integration are information sharing and deregulation. Increased trade and flow of capital across countries since the 1990's spurred high growth and interaction between emerging and developed countries. Deregulation allowed financial firms have already spread around the world, creating linkages in liquidity and financial products. In addition, investors in developing countries gained greater access to investing in emerging economies. As a result, co-movements in asset prices become increasingly more linked.

Benefits of financial integration include increased investment opportunities, efficient capital allocation, and risk sharing. Integration allows investors from developed markets to gain access to investing in emerging markets, spurring growth in those developing economies.

There are times, however, when integration can cause inefficiencies. Financial contagion, the negative implication of integration, is the linkage of market disturbances through co-movements in exchange rates, stock prices, and capital flows. It is the risk inherent in the global economy as communication and technological innovation accelerate. If a stock index undergoes a fire sale, other markets around the world may respond with larger and unexplained movements, leading to global downswings. Bae et al. noted that emerging markets that were more integrated experienced the largest stock drops during the 1997 Asian financial crisis. This increased spread of risk heightens the degree of panics and shocks to the global system. There is, however, evidence that some markets are not as directionally integrated as others. A panic in the Egyptian stock index may not necessarily imply a spillover to other international markets such as the US or Asian markets, but the reverse can be true.

Fundamental causes are macroeconomic shocks that have effects on international markets through links of trade and finance. The most prevalent source, common shocks, is triggered

through economic shifts in industrial countries and changes in commodity prices. In these cases, one can expect to see capital inflows to emerging and developing markets. Should interest rates rise in one country, one can expect to see capital outflows from that country and into nations with comparatively lower rates. This outflow will subsequently lower asset prices. Currency price changes are also claimed to be a determinant in price co-movements. Competitive devaluations occur when a country hit by a crisis lowers the value of their currency to promote exports and competitiveness at the expense of other nations. Those foreign nations would thus respond in kind, sparking a currency war and co-movements in currency values.

Investor behavior is the main source of these price movements past fundamental levels. Dornbusch et al. highlight four behaviors that can explain irrational movement. Individual behavior that can be considered rational may lead to excessive co-movements on a macro-scale. The spread of liquidity may lead investors to sell off assets from multiple markets due only to a change in a single market. If one market's risk increases, an individual would sell their assets in other high-risk markets to lower their overall portfolio risk. This would lead to a subsequent decrease across markets that may not even be that integrated. The second source of contagion stemming from investor behavior is imperfect information and differences in investor expectations. If an investor does not have perfect information of a certain crisis in a market, they may incorrectly believe a similar event can happen in similar markets. This is perfectly rational and realistic behavior to the investor, but leads to co-movements that break fundamentals. Most small investors would view the cost of individual information gathering as too great. Hence, many would end up following better-informed investors, which can lead to herd-behavior and exaggerations in prices movements. The third possible explanation is the concept of multiple equilibriums. Analogous to a bank run, investors may believe that a crisis in one market may

lead to a change in another market. This expectation is ultimately self-fulfilling. Investors would then race to sell assets before assets are supposedly devalued further. Dornbusch notes that this is particularly the case for integrated emerging markets. Finally, changes in government policies can create unknown impacts on markets that can spook investors.

To test the level of integration in stock prices, we would need the granger-causality test to see which markets are “first movers” and integrated with others. It is widely known in the statistical community that correlation does not imply causality. Economist Clive Granger devised an econometric test that assumed that if event X influenced or “caused” event Y, event X would occur first followed by event Y after some time. In a nutshell, the test seeks to assess whether the initial event has predictive power on the future values of the caused event. The null hypothesis is that the explanatory variable does not granger-cause the response variable. This multivariate model requires stationary time series processes. Lag lengths of the explanatory variable are chosen through an information criterion. Finally, an F-test is performed on the fitted model to assess if the significance level is large enough to reject the null hypothesis. The model is given below:

$$Y_t = \beta_0 + \sum_{i=1}^p \beta_i Y_{t-i} + \sum_{j=1}^k \gamma_j X_{t-j} + u_t$$

The null hypothesis is that $\gamma = 0$; X does not granger cause Y. The reverse can also be tested to see if Y granger causes X. Note that this does not tell true coefficient of co-movement; the granger causality test only seeks whether a lagged X has any explanatory power in Y.

Methodology

Using the granger-test, daily closing prices of markets will be tested on one another to seek out granger causality relationships. Non-time synchronicity and cultural holidays will play a large factor in determining the level of data treatment. The treatment method is to be determined but will most likely include eliminating data where holidays and nonconsecutive trading days are present.

If we were to add a large number of markets, the matrix of results will be impossible to put on paper. For example, analyzing five markets will already require a five by five matrix involving 20 separate granger tests. Adding only one more to the existing five would increase the matrix size to 30 tests. By this reasoning, I will only select five markets that contain the available closing prices and best represent their respective markets. The regions of interest are North America, South America, Europe, Africa, and Asia. European and North American markets will be chosen from already developed nations, while emerging markets will be represented from South American, African, and Asian regions. These markets must represent their development status. For example, the NIKKEI 225 index, while representing an Asian market, cannot be chosen due to its status as a developed market. Indexes will most likely be chosen through market capitalization relative to other indexes in the region. This is still selection method is still under consideration.

Pairwise tests on the five selected indices will be performed. Results from these tests will thus allow me to gain a full picture of the orders of causality among the subjects. Of course, these tests alone will not account for most of the paper. Granger-causality does not factor the possibility of spurious correlations, so empirical explanations will be needed to explain linkages.

Outline

The first section of the paper will include an introduction to the central question in mind on integration and some historical background and the context of the problem. In the next section, I will introduce the theories of the causes and implications financial integration. Both positives and downsides will be discussed using empirical data and theory obtained by past literature. In addition, I will mention different econometric methods used in previous literature to assess financial integration. Using theory and case studies, a formal hypothesis on the order of integration and movement causality between stock index prices will be developed. This is yet to be determined. Indexes to be tested will then be chosen based on the hypothesis. In the next section, there will be a discussion on dealing with nonsynchronous trading data and subsequent presentation of treatments. I will then present the theory and model of the granger-causality test and its usage. The lag lengths will be selected and the results of the multiple granger-causality tests will be presented. Finally, I will discuss the results of the tests and explain reasons why the tests held true to my hypothesis or rejected it.

Bibliography

1. Dornbusch, Rudiger; Park, Yung Chul; Claessens, Stijn. 2000. "Contagion: understanding how it spreads". *The World Bank research observer*. -- Vol. 15, no. 2 (August 2000), pp. 177-97.

Abstract: This paper explains the vectors in which market disturbances through co-movements in asset prices can spread. Linkages through trade and finance are defined risks imposed by institutional and investor behavior is discussed. It forms the main basis of forming the hypothesis of my paper.

2. Baumöhl, Eduard, and Tomás Výrost. "Stock Market Integration: Granger Causality Testing with Respect to Nonsynchronous Trading Effects*." *Finance a Uver* 60.5 (2010): 414.

Abstract: This paper performs a Granger causality analysis on stock market indices from Asian, European, and US markets. The authors use new methods to solve the problem of time non-synchronicity. It entails removing dates with holidays and nonconsecutive trading days. This paper is the main basis for my econometric test. I extend this paper to include theory and more emerging markets.

3. Levine, Ross. "Financial development and economic growth: views and agenda." *Journal of economic literature* 35.2 (1997): 688-726.

Abstract: This paper presents evidence of a positive relationship between financial development and economic growth. Levine suggests that financial integration is paramount to global economic growth. I will use the concepts in this literature to present the benefits of integration along with formulating the theoretical relationships between emerging and developing indices in my hypothesis.

4. Malliaris AG, Urrutia JL (1992): The International Crash of October 1987: Causality Test. *Journal of Financial & Quantitative Analysis*, 27(3):353-64.

Abstract: This paper is another causality test done in several indices during the time period of the October 1987 crash. The authors found no evidence of lagged causality but noted that there was an increase in contemporaneous causality. As a result, they suggest that the crisis may have begun simultaneously in the different markets. I will use this paper as a case study and should I find no evidence of lagged causalities, may use a simultaneous model as a back up assessment.

5. Obstfeld, Maurice. *Risk-taking, global diversification, and growth*. No. w4093. National bureau of economic research, 1992.

Abstract: The authors argue that financial integration, with both its good and bad aspects, is necessary for global growth and investment. Growth depends on the availability of both low risk and high risk capital. They find that state welfare gains from global financial integration for some markets are several times their initial wealth pre-integration. I will use the evidence and theory provided by this paper to discuss the benefits and costs of integration and whether the increased risks in integration are worth its potential downsides.