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Cointegration Relationships between Markets under Different Currency Systems: Post 2007 Financial Crisis

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Abstract

In this study, we examine the cointegration relationships between the US stock market and those of 76 international markets (with 22 developed, 24 emerging, and 29 frontier markets) in the post 2007 Financial Crisis period. Overall, we find that international stock markets are not cointegrated with the US stock market. Over the long run, international portfolio diversification is an effective way to manage country risk. Stock markets in countries with free-floating exchange rate system seem to be more integrated with the US stock market. In other words, US investors may enjoy greater benefits from portfolio diversification by investing in countries whose currencies are not free-floating. However, during a crisis, stock markets becomes more cointegrated as observed by the spike in the recursive cointegration graphs. A financial crisis in one country can have an impact on the stock market of another country. The observed contagion effect makes international portfolio diversification strategy less effective during a crisis.

I. Introduction

It has been widely recognized that international portfolio diversification offers potential benefits that goes beyond wholly domestic investments albeit conditional in some cases (Chiou, 2008; De Roon, Nijman and Werker, 2001; Harvey, 1995; Lessard, 1976; Levy and Sarnat, 1970; Li, Sarkar and Wang, 2003; and Solnik 1974). Despite the perceived association of higher return and higher risks (Bartman and Dufey, 2001), as emerging markets gradually become more accessible, they appear to be promising investment targets to both the US and global investors (Butler and Joaquin, 2002; Zonouzi, Mansourfar and Azar, 2014). This may explain the remarkable increase in portfolio investment inflow to emerging equity markets from merely US$6.2 billion in 1990 to US$217 billion in 2014 (Arouri, Jawadi and Nguyen, 2009; Koepke, Brandt and Mohammed, 2015). In addition, the literature also suggests emerging equity markets display very low correlation of returns with assets in developed markets, which further motivates investors in the developed markets such as the U.S. to pursue internationally (Naranjo and Porter, 2007).

The primary success factor of international diversification strategy stems from the correlations between constituent stock markets in the portfolio. As globalization-driven interdependence among countries ushered the growing interconnectedness and integration of the international financial markets in the past several decades, it is arguably that the emerging and developed financial markets remain gently correlated. In fact a rising level of co-movement and cointegration across developed and emerging markets has been documented, and catching the attention among scholars (Ratanapakorn and Sharma, 2002, Su and Yip, 2014; Zonouzi, Mansourfar and Azar, 2014). Nonetheless, DeSantis and Gerard (1997) shows that international portfolio diversification is still beneficial to investors.

Another issue in international portfolio diversification is stability of correlations. Longin and Solnik (1995) argues that international correlation increases when global factors dominate

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domestic factors, and they tend to affect all markets. As a result, these may be considered as global systematic risks because they cannot be easily diversified away by forming an international portfolio. According to their findings, a negative shock, such as the 1974 oil crisis, and 1987 stock market crash, or a positive shock like the end of the 1991 Gulf War, will lead not only to an increase in volatility but also subsequently an increase in correlation in international financial markets. However, given that they did not find any asymmetry in reaction since a positive shock would also lead to an increase in correlation, their findings suggest that this contagious effect may arise from positive events as well. On the other hand, the correlations between emerging and developed equity markets moved in a rising trend in a volatile economic environment, as found in two sub-periods, 1988-1993 and 1994-1995, studied by Saunders and Walter (2002). It suggests that major economic crisis promotes financial market volatility and contagiousness. Because low correlations between markets is critical in reducing the contagion effect of financial crisis, the higher the correlation during bear and/or volatile time will potentially further reduce or even offset the benefits of international portfolio diversification.

Further investigation results in cointegration relationships between the US and emerging stock markets seem inconsistent and contradictory (Su and Yip, 2014). On one hand, Ghosh, Saidi, and Johnson (1999), Sheng and Tu (2000), and Darrat and Zhong (2002) provide evidences that the US stock market and emerging stock markets are indeed cointegrated in the long run and point to the overemphasizing of the long-term benefits of internationally diversified portfolio. On the other hand, studies by Chan, Gup and Pan (1992); DeFusco, Geppert, and Tsetsekos (1996); Choudhry (1997) and Soydemir (2000), and Su and Yip (2014) found the exact opposite patterns. None of the studies was able to detect or verify any long-term cointegration relation between the US and emerging stock markets, which implies that there is simply no long-term correlation between them. In other words, cointegration does not exist, and long investment horizon is still considered as a key factor to US investors' success in international portfolio diversification strategy.

Perhaps the contradicting results can be better explained in Yang, Kolari and Sutanto (2004). This study explores the long-term stability patterns between the US and emerging stock markets from 1981 to 2001. The findings propose that the degree of cointegration depends on the overall economic environment. Specifically, major economic crisis, such as the Asian Economic Crisis of 1997-1998, is to be responsible for the heightened degree of cointegration during that time. Su and Yip (2014) reported consistent results when examining the impacts of the financial crisis in 2007 on cointegration. The strong contagion effect observed by Saunders and Walter (2002) during a bear market seems to put into question that the perceived advantages and rationale behind international portfolio diversification.

From the theoretical perspective, Goldstein and Pauzner (2004) proposes a model depicting how contagion of financial crises happened due to diversified investment portfolio across countries where two of them share the same group of investors. Despite their independent economic fundamentals, it is highly probable that the effects of a financial crisis in one country can be felt in other countries due to the sharing of common investors. Against the backdrop of intense globalization and rapidly growing acceptance of exchange traded country funds, globally well-diversified investment portfolios are still favored by experienced and ambitious investors. As long as this phenomenon prevails, one may find it logical to assume that a financial crisis will be mutually spread between emerging and developed economies regardless of the differences in their economic structures.

II. Contributions of the Study

The purpose of this paper is to examine how the currency system affects the cointegration relationship between US and the emerging stock markets. Our contributions can be considered in threefold. Firstly, to study the impact of currency systems on cointegration relationship, we will apply the recursive cointegration procedure by Yang, Kolari and Sutanto (2004) to the monthly stock returns measured both in US dollars and in local currencies. Since the cointegration relationship derived from returns measured in local currencies are free of the impact of currency market, it represents the real nature of the cointegration relationship between underlying economics. A comparison between the cointegration relationships derived from before- and after-currency adjusted returns will provide evidence on whether the currency system plays a role in global portfolio diversification.

Secondly, including both developed, emerging and frontier markets in this study allows us to investigate how different currency systems affect international investing. Generally speaking, developed countries tend to adopt floating-rate currency system while emerging countries are more inclined to use fixed-rate or managed currency system.

Thirdly, we examine the influence of major economic event post 2007 financial crisis on the cointegration relationships between markets under different currency systems.

III. Data and Methodology

A. Data

The daily stock index prices of 69 countries are obtained from Morgan Stanley Capital International, Inc. (MSCI) for the sampling period from October 27, 2010 through October 27, 2015. The 69 market indices include the US, 22 developed market indices (Australia, Austria, Belgium, Canada, Denmark, Hong Kong, Finland, France, Germany, Ireland, Israel, Italy, Japan, New Zealand, Netherlands, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and United Kingdom), 18 emerging market indices (Chile, China, Colombia, Czech Republic, Egypt, Greece, India, Indonesia, Malaysia, Mexico, Peru, Philippines, Poland, Taiwan, Thailand, Turkey, Qatar, and United Arab) and 29 frontier market indices (Argentina, Bahrain, Bangladesh, Bosnia, Botswana, Bulgaria, Croatia, Estonia, Ghana, Jamaica, Jordan, Kazakhstan, Kenya, Kuwait, Lebanon, Lithuania, Mauritius, Morocco, Nigeria, Oman, Romania, Pakistan, Saudi Arabia, Slovenia, Serbia, Sri Lanka, Trinidad, Ukraine, and Vietnam).

The MSCI "Total Return Indices with Net dividends" series are used in this study. This index measures the price performance of markets with dividends reinvested after the deduction of withholding taxes. For each market index, two prices indices are collected. First, market indices measured in local currencies (LC), which present the market movements in each domestic stock market without the currency effect. Second, market indices measured in US dollars presenting the market movements adjusted by the currency effect. This price series is more relevant for US investors who are interested in diversifying their stock portfolios.

B. Methodology

Unit Root Tests

We have to ascertain if these series are nonstationary with unit roots using the augmented Dickey-Fuller (ADF) test procedure before we are able to test whether two index series are cointegrated. If the market index series, $x_{i,t}$, follows an AR(p) process, the ADF regression model (Corbae and Ouliaris, 1988) is applied, and the model as given in equation (1).

$$\Delta x_{i,t} = a_{i,0} + a_{i,1}t + a_{i,2}x_{i,t-1} + \sum_{i=1}^{p-1} b_{i,1}\Delta x_{i,t-i} + v_{i,t} \tag{1}$$

Under the null hypothesis which state that $a_{i,2} = 0$, i.e., the variable has a unit root. As such, an insignificant ADF t-statistics suggests that one cannot reject the hypothesis of the existence of a unit root.

Cointegration Analysis

We next use Johansen's (1988) maximum-likelihood estimator (MLE) approach to test the hypothesis that there exists a long-run relationship between the US and a foreign stock market indexes. Assuming that two market indices follow a Vector Autoregressive process (VAR(*k*)) with a constant term as shown in equation (2), the cointegration model and the hypothesis of *c* cointegration vectors take the form of equation (3).

$$H_1 : \Delta \mathrm{X}_t = \Pi \mathrm{X}_{t-1} + \sum_{j=1}^{k-1} \Gamma_j \Delta \mathrm{X}_{t-j} + \mu + \upsilon_t \tag{2}$$

where $\mathrm{X}_t = \left(\mathrm{X}_{US,t} \;\; \mathrm{X}_{FOR,t}\right)$

$$\mathrm{Z}_{0t} = \Pi \mathrm{Z}_{1t} + \Gamma \mathrm{Z}_{2t} + \varepsilon_t \tag{3}$$

where $\mathrm{Z}_{0t} = \Delta \mathrm{X}_t$

$$\mathrm{Z}_{1t} = \mathrm{X}_{t-1}$$

$$\mathrm{Z}_{2t} = (\Delta \mathrm{X}'_{t-1}, \ldots\ldots, \Delta \mathrm{X}'_{t-k+1}, 1)'$$

$$\Gamma = (\Gamma_1, \ldots\ldots, \Gamma_{k-1}, \mu)$$

$$\Pi = \alpha\beta'$$

$$H_2 : \Pi = \alpha\beta'$$

To obtain the MLE results, regressions of Z_{0t} and Z_{1t} on Z_{2t} are adopted and the following "R-representation" residuals by Hansen and Johansen (1993, 1999) are produced:

$$R_{0t} = Z_{0t} - A_{0t}Z_{2t} \tag{4}$$

$$R_{1t} = Z_{1t} - A_{1t}Z_{2t} \tag{5}$$

A trace test (Johansen 1991) statistic, testing the hypothesis that there are at most *c* cointegration vectors, is given as:

$$-2\ln(Q; H_2 \mid H_1) = -T\sum_{l=c+1}^{2} \ln(1-\lambda_l) = \lambda_{trace}$$

where $\lambda_{c+1}, \ldots, \lambda_3$ are the $2 - c$ smallest square canonical correlations on the residuals from equations (4) and (5).

The Johansen (1991) trace statistic is applied to each pair of market indices to test the hypothesis that there are at most c cointegration vectors. The TC_{trace} is then calculated as the Trace test normalized by the 5% critical values. That is, $TC_{trace} = \lambda_{trace}/C_{(5\%)}$ where $C_{(5\%)}$ is the 5% trace test critical value. The null hypothesis of $r \leq 1$ (or $r = 0$, i.e., no cointegration exists) will be rejected if $TC_{trace} > 1$.

Recursive Cointegration Analysis

A recursive cointegration analysis is employed to examine the stability of the cointegration relationships over time. Following the procedure outlined by Yang, Kolari, and Sutanto (2004) and Dimpfl (2014), we investigate the constancy of the cointegration rank through time using a rolling-window framework. The procedure is described as the following:

Step 1: Estimate the model using equation (3) over the full sample period.
Step 2: Re-estimate the model with equations (4) and (5) using the data from the initial 500 days as our initial estimation period. That is, our first sample includes observations from the 1st to the 500th observation. The trace statistics is obtained and scaled by the corresponding critical value. That is,
$TC_{trace} = \lambda_{trace}/C_{(5\%)}$ where $C_{(5\%)}$ is the 5% trace test critical value. The null hypothesis of $r \leq 1$ (or $r = 0$, no cointegration exists) will be rejected if $TC_{trace} > 1$.
Step 3: Create a rolling window of 500 observations by adding the succeeding 5 observations and removing the first 5 observations (that is, a sample including observation $t+5$ to $t+505$). The scaled trace statistic is then re-estimated using this new sample. This procedure is repeated until the last sample observation is included in the regression. This procedure will give us a sequence of scaled trace test statistics.
Step 4: Apply Step 1 to Step 3 to both market price indices, measured in local currency as well as in US dollars. The trace statistics calculated based on market price indices measured in local currency is denoted as TC^{LC}_{trace} while the one measured in US dollars is denoted as $TC^{\$}_{trace}$. To compare whether the currency effect facilitates the cointegration of global stock markets, a ratio between these two trace statistics is calculated as $TC^{\$}_{trace} / TC^{LC}_{trace}$. If the $TC^{\$}_{trace}$ is greater than the TC^{LC}_{trace} (or $TC^{\$}_{trace} / TC^{LC}_{trace} > 1$), it suggests that the currency effect enhances the cointegration relationship between foreign and US stock markets.

IV. Empirical Results

All sampling firms are grouped into four sub-samples according to their classifications of exchange rate arrangements provided by IMF in 2015. These four subsamples are: 1) Free Floating System, 2) Floating System, 3) Other Managed Arrangement and Crawl-Like Arrangement System and 4) Other Exchange Rate Arrangement Systems. Appendix A reports the reclassification of exchange rate arrangement by IMF for each country during the sampling period. Table I reports the descriptive statistics for the full sample.

Table I. Summary Statistics for Daily Stock Returns

Panel A. Free Floating System										
		US				LC				
Market	N	Mean	SD	Min	*Max*	Mean	SD	Min	*Max*	
Panel A.1 Developed Markets										
Australia	1304	0.01%	1.28%	-6.60%	6.45%	0.03%	0.91%	-4.22%	3.76%	Free floating
Austria	1304	-0.01%	1.71%	-8.56%	9.42%	0.00%	1.46%	-6.98%	6.93%	Free floating
Belgium	1304	0.05%	1.32%	-6.33%	6.15%	0.06%	1.14%	-5.08%	5.84%	Free floating
Canada	1304	0.00%	1.07%	-6.00%	5.52%	0.02%	0.83%	-3.96%	4.27%	Free floating
Finland	1304	0.02%	1.61%	-7.18%	8.02%	0.04%	1.40%	-6.24%	6.16%	Free floating
France	1304	0.02%	1.52%	-7.06%	8.44%	0.04%	1.28%	-5.40%	5.96%	Free floating
Germany	1304	0.03%	1.51%	-6.74%	7.68%	0.04%	1.28%	-5.83%	5.34%	Free floating
Ireland	1304	0.07%	1.58%	-6.87%	6.97%	0.08%	1.43%	-5.32%	5.97%	Free floating
Italy	1304	0.01%	1.84%	-8.24%	8.61%	0.03%	1.61%	-6.42%	6.38%	Free floating
Japan	1304	0.03%	1.20%	-8.20%	7.39%	0.06%	1.26%	-9.12%	6.60%	Free floating
Netherlands	1304	0.04%	1.33%	-6.00%	6.48%	0.05%	1.11%	-4.64%	4.36%	Free floating
Norway	1304	0.01%	1.57%	-7.68%	6.07%	0.03%	1.16%	-5.66%	4.76%	Free floating
Portugal	1304	-0.04%	1.56%	-6.81%	5.06%	-0.03%	1.35%	-6.41%	4.23%	Free floating
Spain	1304	0.01%	1.77%	-6.81%	8.12%	0.02%	1.51%	-6.09%	6.43%	Free floating
Sweden	1304	0.03%	1.59%	-8.37%	8.51%	0.04%	1.21%	-6.73%	6.11%	Free floating
UK	1304	0.03%	1.14%	-6.25%	5.02%	0.03%	0.96%	-4.67%	4.00%	Free floating
Panel A.2 Emerging Markets										
Chile	1304	-0.04%	1.23%	-8.70%	6.95%	-0.02%	0.94%	-6.67%	6.08%	Free floating
Greece	1304	-0.09%	3.11%	-21.60%	18.73%	-0.08%	2.99%	-21.05%	17.58%	Free floating
Mexico	1304	0.01%	1.28%	-7.76%	5.61%	0.03%	0.90%	-5.57%	4.16%	Free floating
Poland	1304	-0.01%	1.66%	-10.61%	7.44%	0.01%	1.13%	-7.22%	5.05%	Free floating
Panel A.3 Frontier Markets										
Estonia	1304	0.00%	1.36%	-6.54%	9.61%	0.02%	1.18%	-6.51%	9.21%	Free floating
Slovenia	1304	-0.01%	1.20%	-6.28%	5.22%	0.01%	1.03%	-6.49%	4.66%	Free floating

Panel B. Floating System

		US				LC				
Market	N	Mean	SD	Min	*Max*	Mean	SD	Min	*Max*	
Panel B.1 Developed Markets										
Israel	1304	0.01%	1.19%	-7.38%	6.67%	0.01%	1.09%	-8.26%	5.42%	Floating
New Zealand	1304	0.04%	1.12%	-5.40%	4.86%	0.05%	0.81%	-3.90%	3.06%	Floating
Panel B.2 Emerging Markets										
Colombia	1304	-0.04%	1.28%	-7.15%	5.45%	-0.01%	0.97%	-4.58%	4.76%	Floating
India	1304	0.00%	1.34%	-7.21%	6.00%	0.03%	1.03%	-6.07%	3.81%	Floating
Indonesia	1304	0.00%	1.56%	-9.33%	7.58%	0.03%	1.39%	-10.43%	6.28%	Floating
Peru	1304	-0.03%	1.51%	-15.21%	7.56%	-0.03%	1.51%	-15.21%	7.56%	Floating
Philippines	1304	0.05%	1.24%	-7.62%	6.62%	0.05%	1.12%	-6.90%	6.54%	Floating
Taiwan	1304	0.02%	1.14%	-5.50%	5.28%	0.02%	1.02%	-5.48%	4.95%	Floating
Thailand	1304	0.02%	1.37%	-6.46%	7.32%	0.03%	1.22%	-6.18%	6.93%	Floating
Turkey	1304	-0.02%	1.92%	-10.86%	9.14%	0.03%	1.51%	-10.20%	6.99%	Floating
Panel B.3 Frontier Markets										
Ghana	1304	0.00%	1.30%	-10.67%	9.36%	0.08%	1.01%	-9.97%	9.40%	Floating
Kenya	1304	0.04%	1.01%	-6.59%	4.90%	0.06%	0.89%	-4.94%	4.95%	Floating
Mauritius	1304	0.01%	0.68%	-3.64%	4.00%	0.02%	0.53%	-3.64%	3.62%	Floating
Romania	1304	0.04%	1.41%	-9.44%	8.40%	0.05%	1.14%	-9.25%	6.87%	Floating
Serbia	1304	-0.02%	1.47%	-9.38%	12.82%	0.00%	1.25%	-8.71%	11.38%	Floating
Ukraine	1304	-0.09%	2.73%	-29.39%	23.73%	-0.03%	2.18%	-14.42%	23.70%	Floating

Panel C. Other managed and Crawl-like arrangement System

		US				LC				
Market	N	Mean	SD	Min	*Max*	Mean	SD	Min	*Max*	
Panel C.1 Developed Markets										
Switzerland	1304	0.04%	1.04%	-4.69%	4.67%	0.04%	0.98%	-8.74%	4.88%	Crawl-like
Panel C.2 Emerging Markets										
China 50	1304	0.02%	1.35%	-6.30%	6.78%	0.02%	1.34%	-6.34%	6.72%	Crawl-like
Czech Republic	1304	-0.02%	1.37%	-6.64%	6.68%	0.00%	1.06%	-6.37%	4.76%	Other managed arrangement
Malaysia	1304	0.00%	0.90%	-4.35%	5.95%	0.02%	0.61%	-2.88%	3.96%	Other managed arrangement
Panel C.3 Frontier Markets										
Argentina	1304	0.01%	2.20%	-12.71%	11.89%	0.01%	2.20%	-12.71%	11.89%	Crawl-like
Croatia	1304	-0.01%	0.91%	-3.63%	7.61%	0.01%	0.66%	-3.91%	7.35%	Crawl-like
Jamaica	1304	0.03%	1.76%	-7.72%	9.67%	0.06%	1.75%	-7.37%	9.67%	Crawl-like
Nigeria	1304	0.02%	1.28%	-7.64%	8.89%	0.04%	1.16%	-5.42%	8.89%	Other managed arrangement
Pakistan	1304	0.05%	1.04%	-6.24%	4.65%	0.07%	1.00%	-4.45%	4.71%	Other managed arrangement

Panel D. Other Systems										
		US				LC				
Market	N	Mean	SD	Min	*Max*	Mean	SD	Min	*Max*	
Panel D.1 Developed Markets										
Denmark	1304	0.05%	1.28%	-7.64%	6.30%	0.07%	1.12%	-7.61%	5.34%	Conventional peg
Hong Kong	1304	0.03%	1.06%	-5.13%	5.98%	0.03%	1.06%	-5.11%	5.97%	Currency board
Singapore	1304	0.01%	1.00%	-4.85%	5.26%	0.01%	0.81%	-4.22%	3.06%	Stabilized arrangement
Panel D.2 Emerging Markets										
Egypt	1304	0.01%	1.55%	-10.28%	11.03%	0.03%	1.53%	-9.93%	11.14%	Stabilized arrangement
Qatar	1304	0.05%	0.95%	-6.71%	10.34%	0.05%	0.95%	-6.71%	10.34%	Conventional peg
United Arab	1304	0.06%	1.49%	-8.91%	11.12%	0.06%	1.49%	-8.91%	11.12%	Conventional peg
Panel D.3 Frontier Markets										
Bahrain	1304	-0.05%	1.11%	-8.32%	8.15%	-0.05%	1.11%	-8.32%	8.15%	Conventional peg
Bangladesh	1304	-0.01%	1.76%	-15.44%	16.70%	-0.01%	1.75%	-15.24%	16.63%	Stabilized arrangement
Bosnia	1304	0.00%	1.30%	-5.31%	6.29%	0.01%	1.14%	-5.84%	6.87%	Currency board
Botswana	1304	0.01%	0.96%	-8.57%	6.56%	0.05%	0.78%	-8.51%	5.77%	Crawling peg
Bulgaria	1304	-0.03%	1.52%	-6.52%	5.47%	-0.02%	1.39%	-6.62%	6.36%	Currency board
Jordan	1304	-0.02%	1.06%	-7.30%	9.67%	-0.02%	1.06%	-7.28%	9.76%	Conventional peg
Kazakhstan	1304	-0.02%	1.79%	-9.94%	8.39%	-0.02%	1.79%	-9.94%	8.39%	Stabilized arrangement
Kuwait	1304	-0.02%	0.87%	-5.25%	8.90%	-0.01%	0.86%	-5.11%	8.90%	Conventional peg
Lebanon	1304	-0.02%	0.81%	-5.47%	4.83%	-0.02%	0.81%	-5.47%	4.83%	Stabilized arrangement
Lithuania	1304	0.01%	0.95%	-5.27%	5.52%	0.03%	0.74%	-5.24%	5.88%	Currency board
Morocco	1304	-0.03%	0.95%	-3.34%	4.59%	-0.02%	0.84%	-3.39%	4.62%	Conventional peg
Oman	1304	0.01%	0.89%	-9.63%	11.48%	0.01%	0.89%	-9.61%	11.48%	Conventional peg
Saudi Arabia	1304	0.03%	1.14%	-11.54%	10.90%	0.03%	1.14%	-11.53%	10.92%	Conventional peg
Sri Lanka	1304	-0.01%	0.97%	-7.01%	3.79%	0.01%	0.93%	-6.90%	3.70%	Stabilized arrangement
Trinidad	1304	0.05%	0.46%	-3.77%	3.34%	0.05%	0.42%	-3.69%	3.34%	Stabilized arrangement
Vietnam	1304	0.00%	1.34%	-6.50%	4.64%	0.01%	1.32%	-5.95%	4.67%	Stabilized arrangement

A. Empirical Results for Full Sample

Countries with Free Floating System (Panel A of Table II)

With few exceptions, most of the stock markets, as measured in their local currencies, are not cointegrated with US stock market during the period-examined (10/27/2010 to 10/27/2015). Only three stock markets, Germany, Spain, and Greece, report significant TC^{LC}_{trace} ratio. When measured in US dollars, the stock markets, which are cointegrated with the US stock market, are Belgium, Finland, and Greece.

It is interesting to note that after taking into consideration the currency effect, the US dollar denominated stock price indices of Germany and Spain become non-cointegrated with the US market, suggesting that the currency effect actually drive the German and Spain stock market from integration with the US stock market.

Countries with Floating System (Panel B of Table II)

Similar to results in Panel A, majority of the stock markets in this sample are not cointegrated with US stock market during the sample period. Only three stock markets measured in local currency, New Zealand, India, and Romania, report significant TC^{LC}_{trace} ratio. However, only India stock market is cointegrated with US stock market when reported in US dollar term.

Countries with Other Managed and Crawl-Like Arrangement (Panel C of Table II)

With the exception of Switzerland, all of the stock markets in this sample, as measured in local currency, are not cointegrated with US stock market. However, when measured in US dollar, none of the stock markets is cointegrated with US stock market.

Countries with Other Currency System (Panel D of Table II)

Most of the countries in this sample are considered to be frontier markets. Therefore, it is not surprising to see that most of the stock markets in this sample are not cointegrated with US stock market. Only 3 out of 16 frontier stock markets, namely, Bangladesh, Botswana, and Trinidad, as measured in local currency, reports significant TC^{LC}_{trace} ratio. Only Trinidad stock market remains cointegrated with the US stock market when exchange rate is taken into consideration.

Effect of Exchange Rate Arrangement

Overall, most of the stock markets, regardless of whether they are classified as developed, emerging or frontier markets, do not cointegrate with the US stock market. When exchange rate is taken into account, as measured in US dollar term, even fewer markets are cointegrated with the US market.

Although there are fewer stock markets reporting significant cointegration with the US stock market, there is evidence that a free-floating currency system does enhance the global integration of national stock markets. This is shown by the fact that $TC^{\$}_{trace}$ is higher TC^{LC}_{trace} (that is, $TC^{\$}_{trace} / TC^{LC}_{trace} > 1$) for 14 out of the 22 (64%) stock markets reported in Panel A. Specifically, there are 10 out of 16 developed markets, 3 out of 4 emerging markets and 1 out of 2 frontier markets fall into this category.

A floating system (“managed” floating system) does improve the degree of integration of these markets with US market, but the effect is not as strong as a free-floating system. For example, only 8 out of 16 (50%) report a higher $TC^{\$}_{trace}$ ratio as compared to the TC^{LC}_{trace} . Specifically, there are 1 out of 2 developed markets, 4 out of 8 emerging markets and 3 out of 6 frontier markets.

A managed or/and crawl-like arrangement system seems to help bringing China, Czech Republic, Malaysia, Russia, Croatia, and Pakistan stock markets more integrated with US market. However, it has adverse effect on the Swiss stock market.

A number of countries listed under other exchange rate system have their currencies pegged to the US dollar. Therefore, we expect minimal difference between their stock market return measured in local currency and those measured in US dollar. This is evident that most of the $TC^{\$}_{trace} / TC^{LC}_{trace}$ are very close to 1.

Our results seem to suggest that when exchange rate is taken into consideration, stock markets in countries with free-floating system are more cointegrated with the US stock market. In other words, the freer movement of money under the free-floating system seem to increase the cointegration of these markets with the US market.

Table II. Bivariate Cointegration Test between US and Each of the Equity Markets

The US and foreign stock markets are assumed to follow a Vector Autoregressive Process (VAR(k)). The AIC is used to select the optimal lag k. Augmented Dickey-Fuller (ADF) tests for stock market indices are reported for the whole sample period applicable to each market. The ADF without trend regression is given as:

$$\Delta \boldsymbol{x}_{i,t} = \boldsymbol{a}_{i,0} + \boldsymbol{a}_{i,2}\boldsymbol{x}_{i,t-1} + \sum_{i=1}^{p-1} \boldsymbol{b}_{i,1}\Delta \boldsymbol{x}_{i,t-i} + \boldsymbol{v}_{i,t}$$

The ADF test is reported for AR(k). The null hypothesis states that the stock index follows a unit root, i.e., $a_{i,2} = 0$. An insignificant ADF t-statistic indicates that one cannot reject the hypothesis of the existence of a unit root. The Johansen (1991) trace statistic, testing the hypothesis that there are at most c cointegration vectors, H: $c = 0$, is applied to each of the bivariate markets for the available sample period. Given no linear trend is found, a constant is restricted in the cointegration vector. Finally, a TC_{trace} ratio is calculated as the Trace test normalized by the 5% critical values.

Panel A. Free Floating System												
		US$				LC					$TC^{\$}_{trace}$/	
Market		$\text{VAR}^{\$}(k)$	$\text{ADF}^{\$}(k)$	$TC^{\$}_{trace}$		$\text{VAR}^{LC}(k)$	$\text{ADF}^{LC}(k)$	TC^{LC}_{trace}			TC^{LC}_{trace}	
Panel A.1 Developed Markets												
Australia	1	3	2.42	0.64		3	-0.86	0.76		Free floating	0.84	
Austria	2	3	-1.92	0.88		3	-2.26	0.88		Free floating	1.00	+
Belgium	3	5	-0.53	1.24	*	3	0.03	0.41		Free floating	2.15	+
Canada	4	3	-2.59	0.95		5	-1.30	0.56		Free floating	1.70	+
Finland	13	5	-1.10	1.11	*	3	-0.55	0.76		Free floating	1.46	+
France	14	3	-1.61	0.69		3	-0.73	0.81		Free floating	0.85	
Germany	15	3	-1.56	0.57		1	-0.90	1.07	*	Free floating	0.53	
Ireland	17	3	-1.01	0.80		3	-0.33	0.44		Free floating	1.82	+
Italy	19	3	-2.06	0.81		3	-1.25	0.89		Free floating	0.91	
Japan	20	3	-1.25	0.51		5	-0.27	0.51		Free floating	1.00	+
Netherlands	22	3	-1.04	0.74		3	-0.23	0.57		Free floating	1.21	+
Norway	26	3	-2.16	0.69		3	-1.58	0.53		Free floating	1.30	+
Portugal	29	3	-1.63	0.92		1	-1.86	0.74		Free floating	1.24	+
Spain	31	3	-1.93	0.80		3	-1.26	1.02	*	Free floating	0.67	
Sweden	32	5	-1.75	0.74		3	-0.73	0.76		Free floating	0.97	
UK	34	3	-1.77	0.58		3	-1.54	0.55		Free floating	1.05	+
Panel A.2 Emerging Markets												
Chile	4	3	-1.21	0.96		3	-2.28	0.77		Free floating	1.25	+
Greece	18	3	-2.26	1.08	*	3	-2.34	1.11	*	Free floating	0.97	
Mexico	24	1	-2.52	0.50		3	-1.64	0.39		Free floating	1.28	+
Poland	27	3	-2.15	0.61		3	-2.31	0.51		Free floating	1.20	+
Panel A.3 Frontier Markets												
Estonia	9	3	-1.52	0.50		3	1.59	0.39		Free floating	1.28	+
Slovenia	34	1	-1.89	0.60		3	-1.40	0.88		Free floating	0.68	

[a] * indicate the statistic is significant at 5% level, respectively.

Panel B. Floating System												
		US$				LC					$TC^{\$}_{trace}$/	
Market		VAR$^{\$}(k)$	ADF$^{\$}(k)$	$TC^{\$}_{trace}$		VAR$^{LC}(k)$	ADF$^{LC}(k)$	TC^{LC}_{trace}			TC^{LC}_{trace}	
Panel B.1 Developed Markets												
Israel	18	5	-1.15	0.86		3	-0.86	0.82		Floating	1.05	+
New Zealand	23	3	-1.69	0.47		3	-0.79	1.23	*	Floating	0.38	
Panel B.2 Emerging Markets												
Colombia	8	5	-0.27	0.94		5	-1.74	0.63		Floating	1.49	+
India	20	5	-2.18	1.08	*	2	-0.52	1.18	*	Floating	0.92	
Indonesia	21	6	-2.29	0.59		3	-1.90	0.57		Floating	1.04	+
Peru	25	5	-2.21	0.87		5	-2.20	0.87		Floating	1.00	+
Philippines	26	5	-0.97	0.72		5	-0.57	0.86		Floating	0.84	
Taiwan	33	8	-1.79	0.60		8	-1.11	0.67			0.90	
Thailand	34	3	-2.26	0.40		3	-2.00	0.42		Floating	0.95	
Turkey	35	5	-2.68	0.94		5	-1.56	0.92		Floating	1.02	+
Panel B.3 Frontier Markets												
Ghana	16	7	-1.34	0.46		5	-1.27	0.45		Floating	1.02	+
Kenya	20	5	-0.79	0.44		3	-0.61	0.60		Floating	0.73	
Mauritius	25	6	-1.53	0.43		5	-1.22	0.46		Floating	0.93	
Romania	31	3	-1.26	0.60		3	-0.30	1.15	*	Floating	0.52	
Serbia	33	5	-1.02	0.45		3	-1.69	0.36		Floating	1.25	+
Ukraine	38	5	-0.83	0.61		5	-1.05	0.53		Floating	1.15	+

[a] * indicate the statistic is significant at 5% level, respectively.

[b] Israel was reclassified from “Free Floating” to “Floating”, effective May 13, 2013. New Zealand was reclassified from “Free Floating” to “Floating”, effective November 1, 2012. Indonesia was reclassified from “Stabilized Arrangement” to “Floating”, effective February 14, 2011; from “Floating” to “Crawl-Like Arrangement”, effective June 1, 2012; from “Crawl-Like Arrangement” to “Floating”, effective August 19, 2013. Peru was reclassified from “Crawl-Like Arrangement” to “Floating”, effective April 1, 2011. Turkey was reclassified from “Free floating” to “Floating”, effective August 2009. Mauritius was reclassified from “Free floating” to “Floating” in 2010 (double check). Ukraine was reclassified from “Other Management Arrangement” to “Stabilized Arrangement”, effective 2010 (double check); from “Stabilized Arrangement” to “Floating”, effective February 7, 2014.

Panel C. Other managed and Crawl-like arrangement System											
		US$			LC					$TC^{\$}_{trace}$/ TC^{LC}_{trace}	
Market		$VAR^{\$}(k)$	$ADF^{\$}(k)$	$TC^{\$}_{trace}$	$VAR^{LC}(k)$	$ADF^{LC}(k)$	TC^{LC}_{trac}				
Panel C.1 Developed Markets											
Switzerland	33	3	-1.15	0.47	5	-0.74	1.26	*	Crawl-like	0.37	
Panel C.2 Emerging Markets											
China 50	5	3	-1.92	0.73	3	-1.92	0.72		Crawl-like	1.01	+
Czech Republic	9	3	-1.70	0.47	3	-2.32	0.37		Other managed arrangement	1.27	+
Malaysia	23	6	-1.35	0.92	9	-1.49	0.57		Other managed arrangement	1.61	+
Russia	31	3	-1.42	0.75	3	-1.42	0.75		Other managed arrangement	1.00	+
Panel C.3 Frontier Markets											
Argentina	1	3	-1.65	0.73	3	-1.56	0.74		Crawl-like	0.99	
Croatia	8	5	-1.10	0.47	5	-2.38	0.35		Crawl-like	1.34	+
Jamaica	17	3	-1.16	0.36	3	-0.21	0.55		Crawl-like	0.65	
Nigeria	27	3	-1.27	0.39	3	-1.46	0.49		Other managed arrangement	0.80	
Pakistan	30	3	-1.34	1.35	3	-1.16	0.88		Other managed arrangement	1.53	+
Tunisia											

[a] * indicate the statistic is significant at 5% level, respectively.

[b] Switzerland was reclassified from “Free Floating” to “Other Managed“, effective September 6, 2011; “Other Managed Arrangement” to “Stabilized Arrangement”, effective January 1, 2012; from “Stabilized” to “Other Managed”, effective January 14, 2013; ”Other Managed” to “Crawl-Like Arrangement”, effective May 29, 2013. China was reclassified from “Stabilized Arrangement” to “Crawl-Like Arrangement” in 2010 (double check). Czech Republic was reclassified from “Free Floating” to “Other managed Arrangement”, effective 11/7/2013. Argentina was reclassified from “Floating” to “Crawl-Like Arrangement” in 2010 (double check). Croatia was reclassified from “Stabilized Arrangement” to “Crawl-Like Arrangement” in 2010 (double check). Jamaica was reclassified from “Stabilized Arrangement” to “Crawl-Like Arrangement”, effective June 1, 2011. Pakistan was reclassified from “Stabilized Arrangement” to “Floating”, effective April 11, 2011; from “Floating” to “Other Managed Arrangement”, effective December 5, 2013. Tunisia was reclassified from “Stabilized Arrangement” to “Crawl-Like Arrangement”, effective September 1. 2011.

Panel D. Other Systems												
		US$				LC					$TC^{\$}_{trace}$/	
Market		$VAR^{\$}(k)$	$ADF^{\$}(k)$	$TC^{\$}_{trace}$		$VAR^{LC}(k)$	$ADF^{LC}(k)$	TC^{LC}_{trace}			TC^{LC}_{trace}	
Panel D.1 Developed Markets												
Denmark	5	3	-0.42	0.79		1	0.31	0.68		Conventional peg	1.16	+
Hong Kong	16	5	-1.09	0.75		5	-1.10	0.74		Currency board	1.01	+
Singapore	30	5	-2.15	0.63		5	-1.67	0.65		Stabilized arrangement	0.97	
Panel D.2 Emerging Markets												
Egypt	10	1	-1.45	0.89		1	-0.83	0.99		Stabilized arrangement	0.90	
Qatar	28,29	3	-1.25	0.67		3	-1.25	0.67		Conventional peg	1.00	
United Arab	36	7	-0.92	0.51		7	-0.92	0.51		Conventional peg	1.00	+
Panel D.3 Frontier Markets												
Bahrain	3	5	-0.93	0.72		5	-0.93	0.72		Conventional peg	1.00	+
Bangladesh	4	3	-2.60	0.27		3	-2.42	1.16	*	Stabilized arrangement	0.23	
Bosnia	5	5	-1.39	0.40		5	-1.66	0.43		Currency board	0.93	
Botswana	6	3	-1.30	0.95		6	-0.10	1.22	*	Crawling peg	0.78	
Bulgaria	7	5	-0.86	0.54		3	-0.93	0.42		Currency board	1.29	+
Jordan	18	5	-2.47	0.54		5	-2.47	0.51		Conventional peg	1.06	+
Kazakhstan	19	3	-1.25	0.54		3	-1.25	0.50		Stabilized arrangement	1.08	+
Kuwait	21	3	-1.65	0.49		3	-2.03	0.47		Conventional peg	1.04	+
Lebanon	23	3	-2.25	0.53		3	-2.25	0.53		Stabilized arrangement	1.00	+
Lithuania	24	3	-1.27	0.43		3	-0.54	0.79		Currency board	0.54	
Morocco	26	5	-1.20	0.64		5	-1.45	0.53		Conventional peg	1.21	+
Oman	29	3	-1.99	0.49		3	-1.75	0.49		Conventional peg	1.00	
Saudi Arabia	32	5	-1.39	0.41		5	-1.41	0.41		Conventional peg	1.00	+
Sri Lanka	35	9	-2.06	0.73		5	-1.58	0.73		Stabilized arrangement	1.00	+
Trinidad	36	5	-1.91	1.46	*	5	-2.03	1.41	*	Stabilized arrangement	1.04	+
Vietnam	39	3	-2.79	0.51		3	-2.73	0.50		Stabilized arrangement	1.02	+

[a] * indicate the statistic is significant at 5% level, respectively.

[b] Singapore was reclassified from "Other Managed Arrangement" to "Crawl-Like Arrangement", effective April 14, 2010; from "Crawl-Like Arrangement" to "Other Managed Arrangement", effective September 12, 2011; from "Other Managed Arrangement" to "Crawl-Like Arrangement", effective January 1, 2012; "Crawl-Like Arrangement" to "Stabilized Arrangement", effective January 1, 2013. Egypt was reclassified from "Crawl-Like Arrangement" to "Stabilized Arrangement", effective April 1, 2011; from "Stabilized Arrangement" to "Crawl-Like Arrangement", effective January 1, 2012; from "Crawl-Like Arrangement" to "Stabilized Arrangement", effective July 3, 2013. Bangladesh was reclassified from "Crawl-Like Arrangement" to "Other Managed Arrangement", effective December 19, 2011; from "Other Managed" to "Stabilized Arrangement", effective February 7, 2013. Kazakhstan was reclassified from "Crawl-Like Arrangement" to "Stabilized Arrangement", effective February 11, 2014. Sri Lanka was reclassified from "Crawl-Like Arrangement" to "Stabilized Arrangement", effective May 1, 2011; from "Stabilized Arrangement" to "Floating", effective February 9, 2012; from "Floating" to "Stabilized Arrangement", effective October 1, 2013.

B. Empirical Results for Recursive Cointegration Analysis

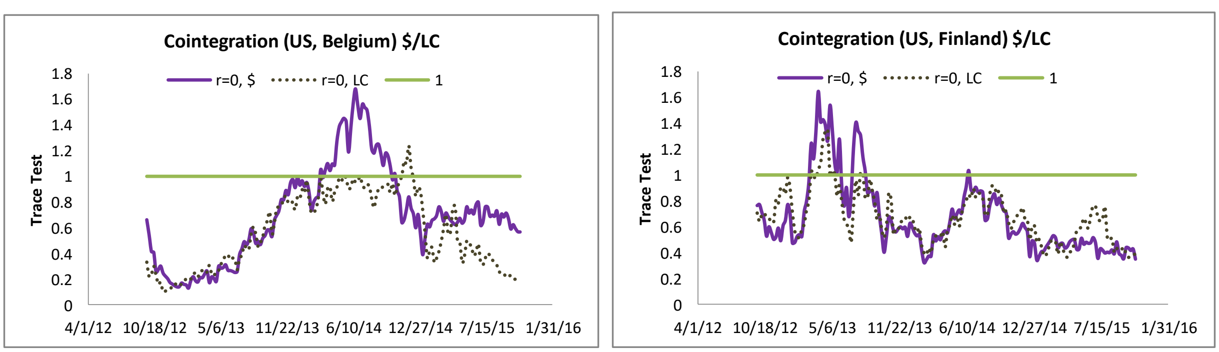
Figures I through IV plots the results of the recursive cointegration tests for the four different exchange rate regimes, namely, free-floating, floating, managed and crawl-like arrangement and others. When the trace statistic, TC_{trace}, is plotted above 1, it indicates that cointegration exists. A common feature of all these graphs is that most of the time, the stock markets are not cointegrated with the US stock market. However, there are occasional spikes that are triggered by major economic events.

Prior to 2010, Greece government was able to borrow at very low interest rate of about 5% p.a. which was only slightly higher than that of Germany. Since 2010, the beginning of the Greece Debt Crisis interest rate rose quickly to reflect the much high financial risk, the 10-year Greece government bond interest rate reached a rate of more than 25% p.a. in 2013. The crisis is clearly reflected in the cointegration graph for the Greece stock market, and this shows up as a substantial spike in 2013. The spike in 2013 shows up in the graphs for most of the European stock markets (such as Finland, Germany, Spain, Greece, Romania and Switzerland) but it is not significant for the stock markets in Asia.

By December 2014, oil prices has fallen by more than 40% since June 2014 when it was at $115/barrel. The sharp decline in oil prices can be observed from the cointegration graph for United Arab Emirates. This spike in cointegration shows up in the stock markets in developed economies such as those in Europe, Hong Kong, Singapore, and New Zealand.

During an economic crisis whether it is due to a sudden drastic drop in oil prices or severe debt crisis in member countries of European Union, the global stock markets become more cointegrated. In other words, there is a contagion effect. The effect of crisis in one country can spread to the stock market of another country.

Figure I. Countries with Free Floating System



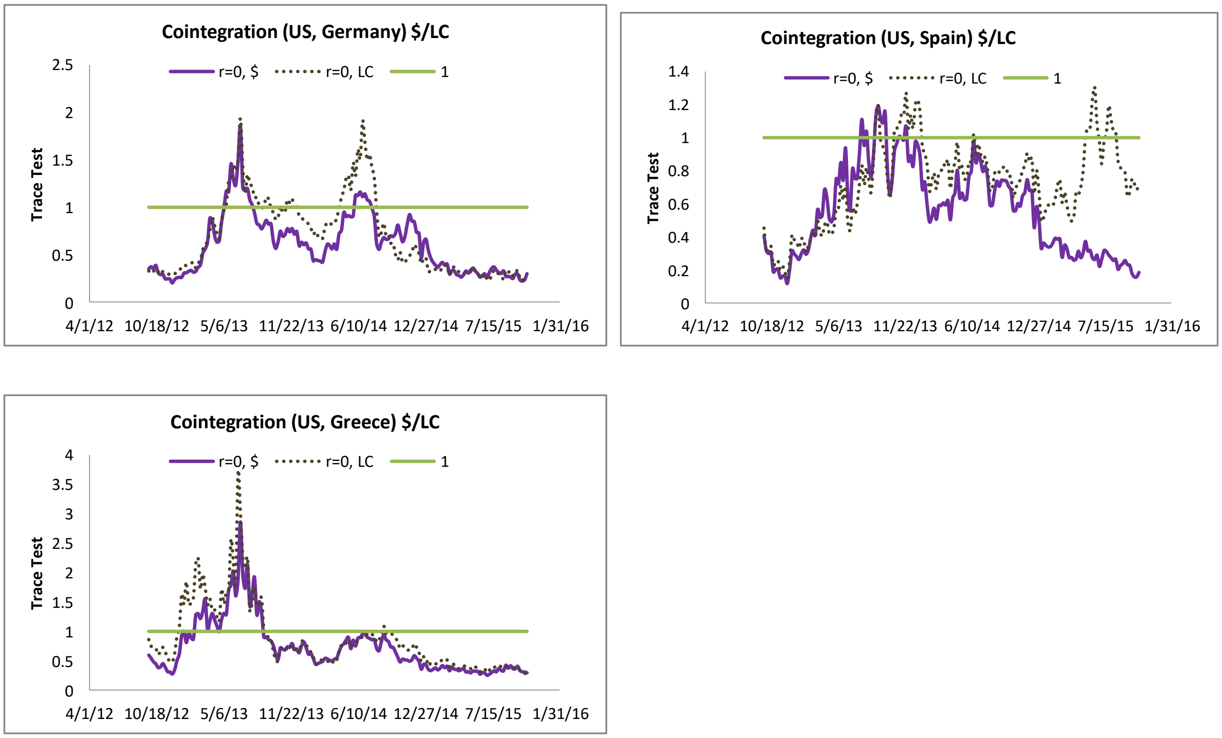


Figure II. Countries with Floating Rate System

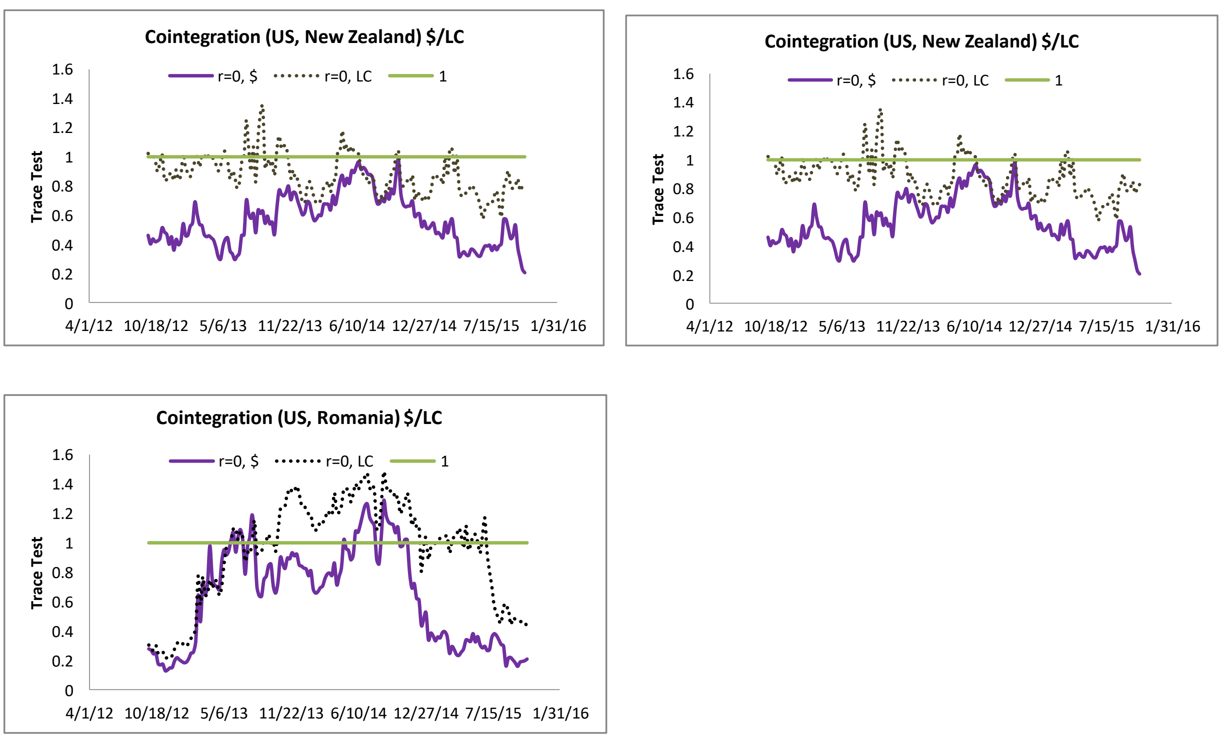


Figure III. Countries with Other Managed and Crawl-Like Arrangement System

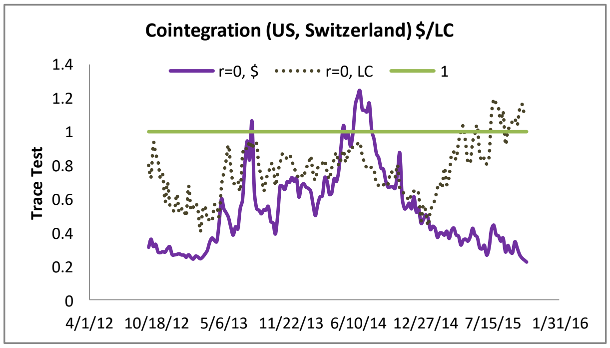
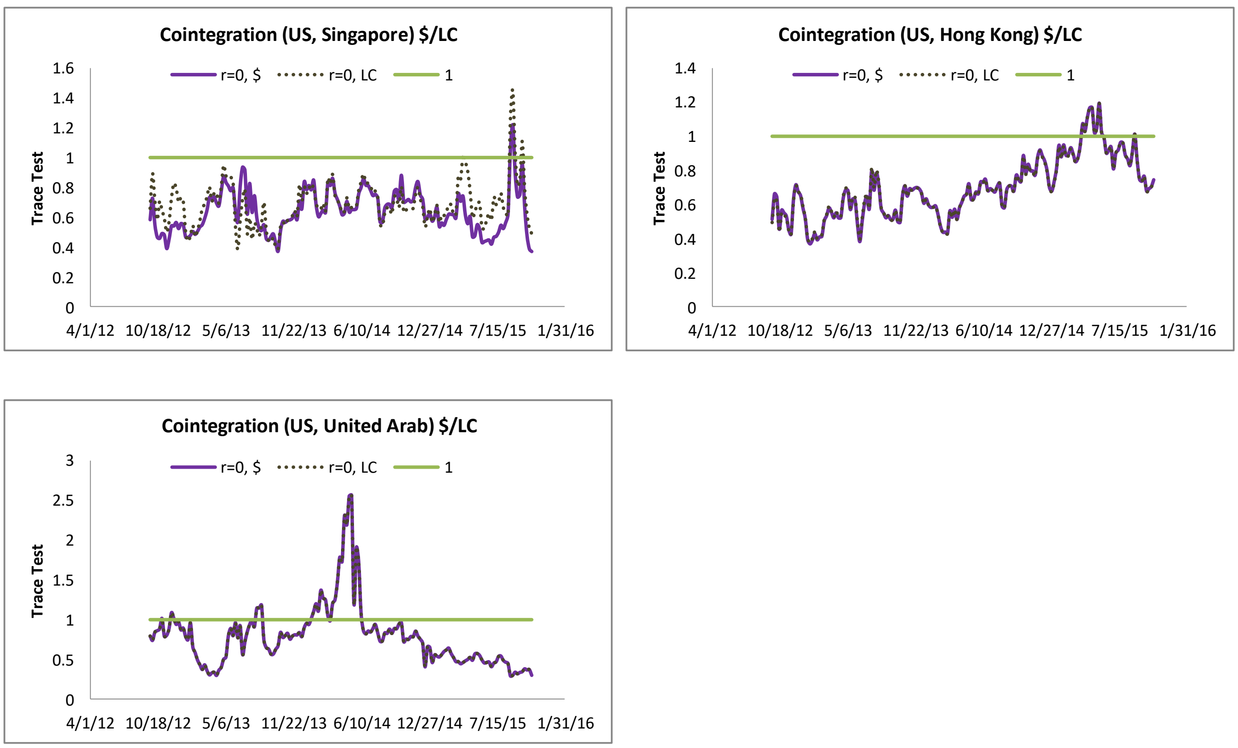


Figure IV. Countries with Other Currency System



V. Conclusions

Consistent with the results reported by Yang et al. (2004), and Su and Yip (2014), our results show that stock markets are not cointegrated with the US stock market over the period from 2010 to 2015. Stock markets in countries with free-floating exchange rate system seem to be more integrated with the US stock market. In other words, US investors may enjoy greater benefits from portfolio diversification by investing in countries whose currencies are not free-floating.

Similar to the observations made by Yang et al. (2004), Guidi and Ugur (2014), and Su and Yip (2014), our empirical results indicate that stock markets becomes more cointegrated during a crisis, as observed by the spike in the recursive cointegration graphs. A crisis in one country can have an impact on the stock market of another country. This observation suggests the portfolio diversification effect diminishes when it is needed the most. Nevertheless, although the observed contagion effect makes international portfolio diversification strategy less effective during a crisis, we believe diversification benefits still do exist. First, it is argued that even if the diversification benefit is reduced due to the increased cointegration relationship during most of the crisis periods, it still outperforms a purely domestic portfolio. For example, DeSantis and Gerard (1997) in their empirical finding state that "Although severe market declines are contagious, the expected gain from international diversification for an US investor average 2.11% per year, and have not significantly declined over the last two decades". Similarly, Guidi and Ugur (2014) report that diversification benefits still exist from September 2007 to June 2013 despite evidence of increased cointegration during most of the crisis period from September 2008 to May 2010.

Second, although over the last two decades the benefits of international portfolio diversification has declined, Driessen and Laeven (2007) argue that investors can still benefit from international diversification particularly for investors in high risk countries. As pointed by Longin and Solnik (1995) that global events may lead to an increase in market volatility, and hence an increase in correlation among international stock markets. The contagion effect caused by global events are not diversifiable. We would argue that a major benefit of international portfolio diversification is to alleviate country specific risks. Greater benefits from international diversification may be gained by investors in countries with non-free floating currency systems.

Third, as suggested in Su and Yip (2014), the contagion effect tends to be short-lived and dissipates over the long run. This suggests that even in today's integrated financial environment with evidence of dynamic cointegration, a global portfolio investment is still valuable over a long-term investment horizon. That is, over the long run, global portfolio diversification is still an effective way to manage risk.

Appendix A
Reclassification of Exchange Rate Arrangement by IMF (10/24/2010 – 10/24/2015)

	Panel A. Free Floating System
Mexico	From “Floating” to “ Free Floating”, effective 11/1/2011
Poland	From “Free Floating” “Floating”, effective 9/23/2011
	From “Floating” to “Free Floating”, effective 12/31/2011
Estonia	From “”Currency Board” to “Free floating”, effective 1/1/2011
	Panel B. Floating System
Israel	From “Floating” to “Free Floating”, Effective 8/1/2011
	From “Free Floating” to “Floating”, effective 5/13/2013
New Zealand	From “Free Floating” to “Floating”, effective 11/1/2012
Indonesia	From “Stabilized Arrangement” to “Floating”, effective 2/14/2011
	From “Floating” to “Crawl-Like Arrangement”, effective 6/1/2012
	From “Crawl-Like Arrangement” to “Floating”, effective 8/19/2013
Peru	From “Crawl-Like Arrangement” to “Floating”, effective 4/1/2011
Turkey	From “Free floating” to “Floating”, effective August 2009
Mauritius	From “Free floating” to “Floating” in 2010
Ukraine	From “Other Management Arrangement” to “Stabilized Arrangement”, effective 2010
	From “Stabilized Arrangement” to “Floating”, effective 2/7/2014.
	Panel C. Other Managed and Crawl-Like Arrangement System
Switzerland	From “Free Floating” to “Other Managed Arrangement“, effective 9/6/2011
	From “Other Managed Arrangement” to “Stabilized Arrangement”, effective 1/1/2012
	From “Stabilized Arrangement” to “Other Managed Arrangement”, effective 1/14/2013
	From ”Other Managed Arrangement” to “Crawl-Like Arrangement”, effective 5/29/2013
China	From “Stabilized Arrangement” to “Crawl-Like Arrangement” in 2010
Czech Republic	From “Free Floating” to “Other managed Arrangement”, effective 11/7/2013
Argentina	From “Floating” to “Crawl-Like Arrangement” in 2010
Croatia	From “Stabilized Arrangement” to “Crawl-Like Arrangement” in 2010
Jamaica	From “Stabilized Arrangement” to “Crawl-Like Arrangement”, effective 6/1/2011
Nigeria	
Pakistan	From “Stabilized Arrangement” to “Floating”, effective 4/11/2011
	From “Floating” to “Other Managed Arrangement”, effective 12/5/2013
Tunisia	From “Stabilized Arrangement” to “Crawl-Like Arrangement”, effective 9/1/2011
	Panel D. Other Currency System
Singapore	From “Other Managed Arrangement” to “Crawl-Like Arrangement”, effective 4/14/2010
	From “Crawl-Like Arrangement” to “Other Managed Arrangement”, effective 9/12/2011
	From “Other Managed Arrangement” to “Crawl-Like Arrangement”, effective 11/9/2011
	From “Crawl-Like Arrangement” to “Stabilized Arrangement”, effective 1/1/2013
Egypt	From “Crawl-Like Arrangement” to “Stabilized Arrangement”, effective 4/1/2011
	From “Stabilized Arrangement” to “Crawl-Like Arrangement”, effective 11/10/2011
	From “Crawl-Like Arrangement” to “Stabilized Arrangement”, effective 7/3/2013
Bangladesh	From “Crawl-Like Arrangement” to “Other Managed Arrangement”, effective 12/19/2011
Kazakhstan	From “Crawl-Like Arrangement” to “Stabilized Arrangement”, effective 2/11/2014
Sri Lanka	From “Crawl-Like Arrangement” to “Stabilized Arrangement”, effective 5/1/2011
	From “Stabilized Arrangement” to “Floating”, effective 2/9/2012
	From “Floating” to “Stabilized Arrangement”, effective 10/1/2013.

References

Chan, K.C., Gup, B.E., Pan, M. (1992). An empirical analysis of stock prices in major Asian markets and the United States. *Financial Review, 27*, 289–307.

Arouri, M.E.H., Fredj Jawadi, F., and Nguyen, D.K. (2009). *The Dynamics of Emerging Markets: Empirical Assessments and Implications*. Springer, p. 34.

Bartman, S.M. and Dufey, G. (2001). International portfolio investment: Theory, evidence, and institutional framework. *Financial Markets, Institutions & Instruments, 10, (3)*, 85-155.

Butler, K.C. and Joaquin, D.C. (2002). Are the gains from international portfolio diversification exaggerated? The influence of downside risk in bear markets, *Journal of International Money and Finance, 21, (7)*, 981-1011.

Chiou, W.P. (2008). Who benefits more from international diversification? *International Financial Markets, Institutions and Money, 18*, 466-482.

Choudhry, T. (1997). Stochastic trends in stock prices: evidence from Latin American markets, *Journal of Macroeconomics, 19*, 285–304.

Corbae, D., and Ouliaris, S. (1988). Cointegration and tests of purchasing power parity. *Review of Economics and Statistics, 70*, 508-511.

Darrat, A.F., Zhong, M. (2002), Permanent and transitory driving forces in Asian-Pacific stock markets, *Financial Review, 37*, 35–52.

De Roon, F.A., Nijman, T.E., and Werker, B.J. (2001). Testing for mean-variance spanning with short sales constraints and transaction costs: the case of emerging markets. *Journal of Finance, 56,* 721–742.

DeFusco, R.A., Geppert, J.M., Tsetsekos, G.P. (1996). Long-run diversification potential in emerging stock markets, *Financial Review, 31*, 343–363.

DeSantis, G. and Gerard, B. (1997). International asset pricing and portfolio diversification with time-varying risk. *Journal of Finance,52*, 1881-1912.

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

Dimpfl, T. (2014). A note on cointegration of international stock market indices. *International Review of Financial Analysis*, *33*, 10-16.

Driessen, J. and Laeven, L. (2007). International portfolio diversification benefits: Cross-country evidence from a local perspective. *Journal of Banking and Finance*, *31, (6)*, 1693-1712.

Ghosh, A., Saidi, R., Johnson, K.H. (1999). Who moves the Asia-Pacific stock markets—US or Japan? *Financial Review, 34*, 159–169.

Goldstein, I. and Pauzner, A. (2004). Contagion of self-fulfilling financial crises due to diversification of investment portfolios. *Journal of Economic Theory, 119, (1)*, 151-183.

Guidi, F. and Ugur, M. (2014). An analysis of South-Eastern European stock markets: Evidence on cointegration and portfolio diversification benefits. *Journal of International Financial Markets, Institutions, and Money, 30, (C)*, 119-136.

Hansen, H., Johansen, S. (1993). Recursive Estimation in Cointegrated VAR Models, Discussion Paper, Institute of Mathematical Statistics, University of Copenhagen.

Hansen, H., Johansen, S. (1999). Some tests for parameter constancy in cointegrated VAR models, *Econometrics Journal*, 2, 306–333.

Harvey, C.R. (1995). Predictable risk and returns in emerging markets. *Review of Financial Studies, 8*, 773–816.

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

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models, *Econometrica*, *59*, 1551–1580.
Koepke, R., Brandt, C. and Mohammed, S. (2015). Emerging Market Portfolio Flows: Lessons from 2014. Institute of International Finance.
Lessard, D.R. (1976). World, country, and industry relationships in equity returns implications for risk reduction through international diversification. *Financial Analysts Journal, 32m (1)*, 32-38.
Levy, H. and Sanart, M. (1970). International diversification of investment portfolios, *American Economic Review, 60, (4)*, 668-675.
Li, K., Sarkar, A., Wang, Z. (2003). Diversification benefits of emerging markets subject to portfolio constraints. *Journal of Empirical Finance, 10*, 57–80.
Longin, F. and Solnik, B. (1995). Is the correlation in international equity returns constant: 1960-1990? *Journal of International Money and Finance, 14, (1)*, 3-26.
Naranjo, A. and Porter, B. (2007). Including emerging markets in international momentum investment strategies. *Emerging Markets Review, 8, (2)*, 147-166.
Nikkinen, J. and Sahlström, P. (2004). Impact of the federal open market committee's meetings and scheduled macroeconomic news on stock market uncertainty. *International Review of Financial Analysis, 13, (1)*, 1-12.
Ratanapakorn, O. and Sharma, S.C. (2002). Interrelationships among regional stock indices. *Review of Financial Economics, 11, (2)*, 91-108.
Saunders, A. and Walter, I. (2002). Are emerging market equities a separate asset class? *Journal of Portfolio Management, 28, (3)*, 102-114.
Sheng, H., Tu, A. (2000). A study of cointegration and variance decomposition among national equity indices before and during the period of the Asian Financial Crisis. *Journal of Multinational Financial Management*, 10, 345–365.
Solnik, B.H. (1974). Why not diversify international rather than domestically? *Financial Analysts Journal, 30, (4)*, 48-54.
Soydemir, G. (2000). International transmission mechanism of stock market movements: evidence from emerging equity markets. *Journal of Forecasting, 19*, 149–176.
Su, Y. and Yip, Y. (2014). Contagion effect of 2007 Financial Crisis on Emerging and Frontier Stock Markets. Journal of Accounting and Finance, 14 (5), 2014, pp. 97-113.
Yang, J., Kolari, J.W. and Sutanto, P.W. (2004). On the stability of long-run relationships between emerging and US stock markets. *Journal of Multinational Financial Management, 14*, 233-48.
Zonouzi, S.J.M., Mansourfar, G. and Azar, F.B. (2014). Benefits of international portfolio diversification – Implication of the Middle Eastern oil-producing countries. *International Journal of Islamic and Middle Eastern Finance and Management, 7, (4)*, 457-472.

The Determinants of Dividend Policy by Information Technology (IT) Firms in the United States

Brian W. Sloboda

Abstract

This paper examines the determinants of dividend payout policy of seventy publicly traded information technology (IT) firms in the United States in 2017. More important, the standard dividend payout ratio is adjusted to include depreciation because IT firms have higher depreciation than the services sector. Thus, this higher depreciation rates may have an impact on dividend payouts by IT firms. To find out the determinants of dividend payout policy, general linear models (GLM) were estimated using for standard dividend payout and the adjusted dividend payout as the dependent variables. In the standard dividend payout regression, corporate tax and the market to book ratio have a positive relationship with the dividend payout. Operating cash flow, corporate profit, debt to equity ratio, size and sales has a negative relationship with dividend payout. Finally, the regression for the adjusted standard dividend payout showed the corporate tax, operating cash flows, profit and the market to book ratio have a positive relationship with the adjusted dividend payout. Debt to equity ratio, size, and sales has a negative relationship with adjusted dividend payout.

I. Introduction

Why do some firms pay dividends while others do not? Since the seminal contribution of Miller and Modigliani in 1961, numerous studies have been conducted to support the significance of the dividend decisions of firms. They argue that given perfect capital markets, the dividend decision does not affect the firm value and is not relevant. Such an assessment stunned many financial practitioners because the standard belief at the time suggested that a properly managed dividend policy had an impact on share prices and shareholders' wealth. In fact, the company could use this income to invest in operating assets, to acquire securities, to retire debt, and/or distributed to shareholders as cash dividends. Issues that arise if a company decides to distribute its income to shareholders include the proportion of the after-tax income would be distributed to shareholders; whether the distribution should be as cash dividends, or the cash be passed on to shareholders by buying back some of its shares.

Seneque (1978) defined dividends as "the share of the profits of a company which are received by the shareholders." However, a simple definition that has generated much debate over the years. Black (1976) wrote that "the harder we look at the dividend picture, the more it seems like a puzzle, with pieces that just do not fit together." The "dividend puzzle" is the corollary of the two questions posed by Black (1976): why firms pay dividends and why stockholders pay attention to dividends? Black (1976) also posited the factors that influence the dividend payout decision include, taxes, transaction costs, capital structure and the demand of investors for dividends, etc. After the seminal work of Black, other variables have been added to explain the policy dividend by firms, e.g., agency costs (Rozeff, 1982; Easterbook, 1984), and growth (Higgins, 1981).

The manufacturing sector in the United States was the main engine of economic growth but the information technology sector (IT) has been rapidly growing in the past few decades. The IT

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sector is capital-intensive sector and often requires huge capital asset base like manufacturing firms. The major asset of this sector is manpower as well as capital. Therefore, the funds would be comparatively more than the service sectors because of the purchase capital assets. Does this greater need of funds by IT firms hinder its ability to offer dividends to its shareholders? Hence, the broad objective of this paper was to examine empirically the determinants that impact payout dividend policy of IT firms in the United States. More specifically, the objectives were to

1. Ascertain the relationship of dividend payout and corporate profits;
2. Determine the extent of dividend payout and the amount of debt equity by the firm;
3. Assess the influence of cash flows and dividend payout;
4. Determine the impact of the relationship of the corporate tax and the dividend payout;
5. Analyze the impact sales growth and the dividend payout by the firm and;
6. Assess the market to book value and the dividend payout by the firm.

The main contribution of this paper to the literature is that earlier studies concentrated on the determinants of 'standard ratio of dividend to earnings. This paper examined the determinants of the 'standard dividend payout ratio' and the extended payout ratio in which the denominator of the ratio includes net income after taxation and depreciation. The difference between the two ratios is greater for the IT sector that usually has relatively high levels of depreciation, in comparison to the services sector. That is, depreciation may have an impact on the dividend payout ratios.

The balance of the paper is as follows. Section 2 provides the existing literature on dividends. Section 3 delves into the model specification and the discussion of the data sources used in this analysis. Section 4 presents the empirical results, and section 5 concludes and discusses the results of the paper.

II. The Existing Literature

A. Background

Several theoretical and empirical studies have been completed in the past fifty years, and the prior research has indicated mainly three outcomes: the increase (decrease) in dividend payout affect the market value of the firm or the dividend policy of the firm does not affect the firm value at all. Regrettably, these prior empirical results present mixed results. The determination whether a firm decides to issue a dividend is the main motif in corporate finance. Brealey and Myers (2016) states that dividends is one of the top ten unresolved problems in finance. The issuance of dividends by firms as well as the ‘dividend puzzle’ requires additional research to be thoroughly understood (Allen and Michaely, 2003).

The main explanation for dividends is based on the desire to communicate information to shareholders or to satisfy the demand for payouts from heterogeneous dividend clienteles (Allen and Michaely, 2003). Also, DeAngelo, DeAngelo, and Skinner (2004) have cast a doubt on signaling and clientele considerations as first-order determinants of dividend policy by reporting that dividends in the United States are increasingly concentrated among a small number of large payers. DeAngelo and DeAngelo (2006) proposed an alternative view of dividends that optimal payout policy is driven by the need to distribute the firm’s free cash flow.

Lintner (1956), Pruitt and Gitman (1991), Benartzi et al. (1997) and Baker and Powell (2000) examined the impact of past dividends on the issuance of future dividends by firms. Fama (1974) tried to depict the effect of investment decisions on dividend policy. Baker (1988), Dickens et al. (2002) and Mancinelli and Ozkan (2006) considered respectively industry classification, firm size and liquidity, capital adequacy and the ownership structure of companies as key determinants when deciding to issue dividends to shareholders. Baker et al. (2001) showed that past dividends, stability of earnings and current and expected earnings have a prominent influence on the decision to issue dividends. Furthermore, Pruitt and Gitman (1991), Rozeff (1982), Lloyd et al. (1985), Colins et al. (1996) and D'Souza (1999) considered risk as a factor to issue dividends.

B. Determinants in the Decision to Have Dividend Payout

There are several determinants when determining the dividend payout decision for IT firms. The following discussion delves into each of the determinants in the decision to have a dividend payout.

Corporate Profitability (PROFIT)

Corporate profitability is often the primary indicator of a firm's capacity in its decision to pay dividends. Amidu and Abor (2006) determined that corporate profitability and dividend payout ratios have a positive relationship. More important, Linter (1956) and Baker et al. (2001) indicate that the dividend payment pattern of a firm is influenced by the current year's earnings and previous year's dividends.

Not only does the current year's earnings have an impact on the decision to offer dividend payout, also determined that the anticipated level of future earnings would also be the determinant of dividend payment (Baker et al., 2001). Pruitt and Gitman (1991) showed that current and past years' profits are important factors in influencing dividend payments by the firm. More important, Baker and Powell (2001) concluded from their survey of NYSE-listed firms that the determinants of dividend determinants could be industry specific and anticipated level of future earnings is the major determinant whether the firm decides to offer a dividend or not.

Cash Flows (Cash)

The cash flow would be an important impetus whether the firm decides to offer a dividend payout. That is, the firm needs to have a good liquidity position because a poor liquidity position means less chance of a dividend due to shortage of cash. Amidu and Abor (2006) argues that dividend payments depend more on cash flows which reflect the firm's ability to pay dividends, than on current earnings. From their assessment, they claim that current earnings do not really reflect the firm's true intentions to pay dividends.

Corporate Tax (Tax)

Modigliani and Miller (1961) studied the imperfections of the tax system as it affects corporations directly which can impact its decision to offer dividends by the firm. More important, tax-adjusted models presume that investors require and secure higher expected returns on shares of dividend-paying stocks. Consequently, the tax-adjusted theory would place divisions of investors into dividend tax clientele. Modigliani (1982) argues that the clientele effect is responsible for the alterations in portfolio composition. Also, Masulis and Trueman (1988) conclude that as tax liability increases (decreases), the dividend payment decreases (increases) while earnings reinvestment increases (decreases).

Sales Growth (Sales)

Dividend payout levels are not totally decided after a firm's investment and financing decisions have been made; rather, the decision to have dividends decision is made in conjunction with investment and financing decisions. Sales growth serves as a proxy for past sales growth for firms. Higgins (1981) shows a direct link between growth and financing needs of a firm. Also, rapidly growing firms require external financing because working capital needs normally exceed the incremental cash flows from its new sales. In fact, Higgins (1972) argues that payout ratio is negatively related to a firm's need for funds to finance growth opportunities. Rozeff (1982), Lloyd et al. (1985), Collins et al. (1996), and Amidu and Abor (2006) show a negative relationship between historical sales growth and dividend payouts.

Market-to-Book Value (MTBV)

Market-to-book value reflects the market view of the value of equity in comparison to what shareholders have contributed to the firm since its establishment. The MTBV is used as a proxy for future growth opportunities that could influence the dividend payout ratio.

Debt to Equity Ratio (D/E)

Debt/Equity (D/E) ratio, calculated by dividing a company's total liabilities by its stockholders' equity, is a debt ratio used to measure a company's financial leverage. This ratio indicates how much debt a company is using to finance its assets relative to the value of shareholders' equity. Consequently, such risk will affect the dividend policy. Firms with high growth rates and high dividend payout ratios utilize debt financing and firms with high leverage compared to their respective industry. In some industries payout and leverage ratios are positively related while in other industries the relationship could be negative. Rozeff (1982), Lloyd et al. (1985), and Collins et al. (1986) found a statistically significant and negative relationship between firm's risk and the dividend payout ratios. From these studies, their findings suggest that firms having a higher level of risk will pay out dividends at lower rate.

In summary, the literature review summarizes that corporate profitability, cash flow, tax, sales growth, market-to-book value, and debt-to-equity ratio may impact upon the dividend payout ratio. In the previous research cited, they concentrated on the determinants of 'standard ratio of dividend to earnings. As mentioned earlier, this study also examines the determinants of the extended payout ratio in which the denominator of the extended payout ratio includes net income and depreciation. The difference between the two payout ratios is greater for the IT sector that usually has relatively high levels of depreciation, in comparison to the services sector.

III. Model Specification and Data Sources

A. Model Specification

The general model is

$$\text{Payout} = \beta_0 + \beta_1 * \text{PROFIT} + \beta_2 * \frac{\text{D}}{\text{E}} + \beta_3 * \text{CASH} + \beta_4 * \text{TAX} + \beta_5 * \text{SALES} + \beta_6 * \text{MTBV} + \beta_7 * \text{DSize} + \varepsilon_i \quad (1)$$

where Payout is the dividend payout, PROFIT is the corporate profit, $\frac{D}{E}$ is the debt to equity ratio, CASH is the operating cash flows, TAX is the corporate tax, SALES is the growth of sales between 2017 and 2016, MTBV is the market-to-book value, DSize is a dummy variable for size of the firm (1=large and 0=small) and ε_i is the stochastic error term where $\varepsilon_i \sim N(0, \sigma^2)$.

In this regression specification, the cross-section will reveal interfirm (across) variation, but this type of specification would be problematic because of the omitted variable bias problem. Consequently, this regression specification will focus on intrastate (within) variation, which will be estimated by use of the fixed effects regression. The fixed effects will be captured by the binary variables (or aka dummy variable) the size of the firm. By including the fixed effects (including a dummy variable), we are controlling for the average differences across the size of the firms in any observable or unobservable predictors. That is, the fixed effects coefficients soak up all the across group action, and the coefficient of each key predictor tells us the average, i.e., the common slope averaged across groups. What remains is the within group action (which is what we are interested in), and the problem of omitted variable bias is greatly reduced. Also, there is no dummy variable for the time variable because there is no trend in the data.

Equation (1) was estimated via the generalized linear models (GLM). In OLS, the linear models assume that the only stochastic part of the data is the normally-distributed noise around the predicted mean. However, the data for each of the variables used in this analysis do not meet the assumption of normality, so the use of OLS would not be appropriate. Consequently, GLM is a broad class of models predicting the outcome of a response as a function of some linear combination of a set of regressors. That is, models use a linear combination of variables to predict the response to predict the responses of Payout and the Adjusted Payout. More specifically, there are three components of a generalized linear model (GLM):

1. Random Component (the outcome)
2. Systematic Component (the design matrix multiplied by the parameter vector)
3. Link function (the function, g (·) that "links" the systematic component to the random component)

Nelder and Wedderburn (1972) are generally given credit for unifying a broad class (of existing) models into the GLM definitions. A brief discussion of each of the components of the GLM are presented. A random component, specifying the conditional distribution of the response variable, Y_i (for the i^{th} of *n* independently sampled observations), given the values of the explanatory variables in the model. In the initial formulation of GLMs, the distribution of Y_i was a member of an exponential family such as the Gaussian, binomial, Poisson, gamma, or inverse-Gaussian families of distributions.

For the systematic component, denote a new vector $(\eta_1, \eta_2, \ldots, \eta_n)$ such that $\eta_i = P_j \beta_j x_{ij}$, $i = 1, \ldots, n = \Sigma_j X_i\beta$. That is a linear predictor or a linear function of the regressors, $\eta_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_k X_{ik}$

Finally, for the link component, a smooth and invertible linearizing link function g(·), which transforms the expectation of the response variable, $\mu_i = E(Y_i)$, to the linear predictor: $g(\mu_i) = \eta_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_k X_{ik}$. That is, the link function essentially expresses the transformation to be applied to the dependent variable. After the GLM model is specified, the maximum likelihood estimator (MLE) is used to estimate the parameters of these models.

B. Data Sources

This paper employed a cross-sectional research design as specified in equation (1) using secondary data from the Edgar database from the Securities and Exchange Commission (SEC) of randomly selected sampled firms based on the Standard Industrial Codes (SIC) for 1987, and these IT firms are active, publicly listed firms. More specifically, the SIC codes used in this sampling are SIC Code 7371 (Computer Programming Services) and SIC Code 7372 (Prepackage Software). Based on yearly observations of publicly listed firms for 2017, seventy firms were selected using convenient random sampling technique. Table 1 summarizes the measurement of each of the variables that were discussed earlier and used in equation (1).

Table 1. Measurement of the Determinants of the Dividend Payout Decision for IT Firms

Variable	Measurement
Corporate Profitability (PROFIT)	Earnings before interest and taxes/Total assets
Cash Flow (CASH)	Log of cash flow from operating activities
Corporate Tax (TAX)	Corporate tax/Net profit before tax

Sales Growth (SALES)	(Current sales - Previous sales)/Previous sales
Market-to-Book Value (MTBV)	Common shareholders' equity / Market capitalization
Debt to Equity Ratio (D/E)	Total liabilities/Shareholders' equity
Standard Dividend Payout Ratio (PAYOUT)	Yearly dividends/Net income after tax
Adjusted Dividend Payout Ratio (ADJUSTED)	Yearly dividends/(Net income after tax + Depreciation)
Size of Firm (SIZE)	A binary variable 1= large firm and 0-small firm, as designated by the SEC

IV. Empirical Results

Summary Statistics

Table 2 presents the summary statistics for the year 2017.

Table 2. Summary Statistics (n=70)

Variable	Mean	Standard Deviation	Minimum	Maximum
Corporate Tax	0.2969	0.8982	-0.0845	4.7336
Profit	0.0295	0.4415	-0.3010	2.9234
Sales	-0.3482	0.6415	-4.0995	2.2314
Market-to-Book Value	1.3010	2.9727	-2.7784	13.0155
Debt to Equity Ratio	-0.2781	1.6838	-5.7103	5.7523
Cash	12.8405	2.9445	5.2610	18.5025
Dividend Payout	0.1740	0.8654	-1.6600	3.8020
Adjusted Dividend Payout	-1.0643	18.6355	-1.1400	54.8571

Table 2 shows that the mean of dividend payout is 0.1739 and standard deviation is 0.865 while for the adjusted dividend payout is -1.06 with a standard deviation of 18.63. The mean of debt to equity ratio is -0.278 and standard deviation is 1.688. The mean of operating cash flow share is 12.84 and standard deviation is 2.944. The mean of corporate profit is 0.029 and standard deviation is 0.4414. The mean of market to book value ratio is 1.301 and standard deviation is 2.97. The mean of cash flows is 12.84 and standard deviation is 2.94. The mean of corporate tax is 0.269 and standard deviation is 0.8981. The most noticeable results from the descriptive statistics is the minimum payment is negative and the adjusted dividend payment has a negative mean. The main reason for these negative estimates is attributed to the net income after tax which can be negative for these IT firms.

Tables 3A and 3B presents the presents the interrelationships among the variables for this study. Table 3A presents the correlations between the variables including dividend payout and excluding the adjusted dividend payout while table 3B presents the results among the variables for the adjusted dividend payout excluding the dividend payout.

Table 3A. The Correlation Matrix of Variables Including the Dividend Payout (Prob>|R| under H_o: ρ=0)

	Corporate Tax	Profit	Sales	Cash Flows	Market to Book Value	Debt to Equity Ratio	Dividend Payout
Corporate Tax	1.000						
Profit	-0.0204	1.000					
	0.867						
Sales	0.1036	0.3633*	1.000				
	0.3934	0.002					
Cash Flows	0.4089*	-0.1128	0.0978	1.000			
	0.0004	0.3524	0.4206				
Market-to-Book Value	0.0904	-0.1365	0.0868	0.4314*	1.000		
	0.4568	0.2598	0.4751	0.0002			
Debt to Equity Ratio	0.1039	-0.2691*	0.0321	0.3600*	0.2470*	1.000	
	0.3922	0.0243	0.7917	0.0022	0.0392		
Dividend Payout	-0.0422	0.025	-0.1897	-0.3022*	-0.135	-0.2683*	1.000
	0.7289	0.8374	0.1157	0.011	0.2653	0.0247	

Note: Below the correlation coefficients are the p values and the correlations designated as * are significant at a level of significance of .05.

The dividend paid shows that the relationship with corporate tax is -0.0422 which shows a negative correlation and not significant. The dividend payout shows a weak relationship between corporate profit 0.025 but not significant. Dividend paid shows the negative relationship with market to book value -0.135 and shows that the market to book value can negatively affect the dividend payout by the IT firms. However, this correlation is not significant. Dividend payout with the operating cash flows is -0.3022 which is a negative correlation and shows that operating cash flows depends varies inversely with the dividend payout of IT firms. As for the debt to equity ratio, there is a negative correlation, -0.2683 that is significant. This correlation suggests that firms having a higher level of risk will pay out dividends at lower rate.

Table 3B. The Correlation Matrix of Variables Including the Adjusted Dividend Payout (Prob>|R| under H_o: ρ=0)

	Corporate Tax	Profit	Sales	Cash Flows	Market to Book Value	Debt to Equity Ratio	Adjusted Dividend Payout
Corporate Tax	1.000						
Profit	-0.0204	1.000					
	0.867						
Sales	0.1036	0.3633*	1.000				
	0.3934	0.002					
Cash Flows	0.4089*	-0.1128	0.0978	1.000			
	0.0004	0.3524	0.4206				
Market-to-Book Value	0.0904	-0.1365	0.0868	0.4314*	1.000		
	0.4568	0.2598	0.4751	0.0002			
Debt to Equity Ratio	0.1039	- 0.2691*	0.0321	0.3600*	0.2470*	1.000	
	0.3922	0.0243	0.7917	0.0022	0.0392		
Dividend Payout	0.0212	0.1433	0.0278	0.0939	0.0432	-0.0211	1.000
	0.8615	0.2366	0.81960.	4395	0.7223	0.8326	

Note: Below the correlation estimates are the p values and the correlations designated as * are significant at a level of significance of .05.

The adjusted dividend paid shows that the relationship with corporate tax is 0.0212 which shows a weak positive correlation and not significant. The adjusted dividend payout shows a weak. positive relationship between corporate profit but not significant. The adjusted dividend paid shows a weak positive relationship with market to book value 0.0432 and shows that the market to book value would positively affect the payout by the IT firms. However, this correlation is not significant. The adjusted dividend payout with the operating cash flows is 0.0939 which is a positive correlation and shows that operating cash flows depends varies directly with the dividend payout of IT firms. As for the debt to equity ratio, there is a positive correlation that is not significant. This correlation suggests that firms having a higher level of risk will pay out dividends at a higher rate.

B. Results from the General Linear Models (GLM)

The regression results are divided into two parts. The first part of the regression analysis in table 4 shows the determinants on the standard dividend payout and the second part in table 5 explains the determinants on the adjusted dividend payout.

Table 4. Results from the General Linear Models (GLM)
Dependent Variable: Dividend Payout

Optimization Method	ML[1]	Residual df	61
		Scale parameter	0.6545
Deviance	39.9268	(1/df) Deviance	0.6545
Pearson	39.9268	(1/df) Pearson	0.6545

		AIC	2.5336
Log likelihood	-79.6750	BIC	-219.2320
Prob(log likelihood)	0.0001		

Independent Variable	**Coefficient**	**Bootstrapped Standard Errors**	**z (Test Statistic)**	**P Value**	**MEXVAL**
Binary Variable	-0.0765	0.2404	-0.3200	0.7500	104.0000
Tax	0.1120	0.0499	2.2500	0.0250	114.2500
Corporate Profit	-0.2003	0.3339	-0.6000	0.5490	107.5000
Sales	-0.2677	0.3143	-0.8500	0.3940	110.6500
Market-to-Book Value	0.0015	0.0216	0.0700	0.9460	100.8750
Debt to Equity Ratio	-0.1402	0.0626	-2.2400	0.0250	128.0000
Cash Flows	-0.2260	0.1048	-2.1600	0.0310	127.0000
Intercept	1.5302	0.8788	1.7400	0.0820	121.2500

[1]The maximum likelihood (ML) algorithm was used to estimate the robust standard errors which consisted of 200 iterations.

This regression used the GLM was used with a Gaussian distribution function and an identity link function. Also, the GLM model estimated a corresponding LR test statistic and its probability, which is analogous to the F test from ordinary least squares (OLS). The test indicates that all the variables are jointly significant at p-value of p<.001. The GLM model estimated is quite decent. The results from Table 4 explain that corporate tax and the market to book ratio have a positive relationship with the dividend payout. Operating cash flow, corporate profit, debt to equity ratio and sales has a negative relationship with dividend payout. Based on the p values, corporate tax, operating cash flows, and the debt to equity ratio were significant determinants in the dividend payout by IT firms. The results for the binary variable for firm size show that there is a negative relationship, but no significant relationship between dividend payout and size of the firm. This is surprising, but the literature does confirm this contradictory evidence (Jeong, 2008 and Avazian et al, 2006). The relationship between the firm's liquidity and dividend is negative which explains that firms with more market liquidity will pay less dividends. Amidu and Abor (2006) find similar results evidence but Belans et al (2007) shows a negative relationship. Sales growth has no significant impact on dividend payout which indicates that sales growth is not the determinant of dividend payout policies. Baker et al. (2007) also find a similar relationship; however, Belans et al. (2007), Avizan et al. (2006) determined an opposite relationship. The corporate profit or net earnings shows a negative and no significant association with the dividend payout indicates that the firms with the positive earnings pay less dividends. This evidence is opposite of the results supported by Amidu and Abor (2006) and Belans et al (2007) and these results are confirmed by Jeong (2008).

Given the importance of the variables to describe the dividend payout for IT firms, marginal explanatory value (MEXVAL) is calculated for each of the variables. From Table 4, the marginal explanatory variable (MEXVAL) of each variable is the percentage by which the standard error of the estimate (SEE) of a regression is affected if the variable is omitted from the regression and is not replaced by another variable. The MEXVAL shows the importance of each variable to the fit of the regression model rather than relying on the p-values to assess statistical significance (Almon, 2014). From these results, for the omission of any of these variables which are not replaced, the standard error of the estimate (SEE) would increase. Thus, we can conclude that each of these variables contributes significantly in the explaining of the dividend payout ratio for IT firms.

Table 5 presents the results for the adjusted dividend payout ratio for IT firms. Recall that the adjusted dividend payout ratio modifies the dividend payout ratio by including depreciation because the IT sector usually has relatively high levels of depreciation, in comparison to the services sectors.

Table 5. Results from the General Linear Models (GLM)
Dependent Variable: Adjusted Dividend Payout

Optimization	ML[1]	Residual df	61.0000
		Scale parameter	368.3134
Deviance	22467.1200	(1/df) Deviance	368.3134
Pearson	22467.1200	(1/df) Pearson	368.3134
		AIC	8.8663
Log likelihood	-301.3220	BIC	22207.9600
Prob (log likelihood)	0.0000		

Independent Variable	Coefficient	Boot Strapped Standard Errors	z (Test Statistic)	P Value	MEXVAL
Binary Variable	-7.5894	5.4428	-1.3900	0.1630	117.3750
Tax	0.2634	1.3095	0.2000	0.8410	102.5000
Corporate Profit	8.1536	10.1998	0.8000	0.4240	110.0000
Sales	-0.8306	6.4220	-0.1300	0.8970	101.6250
Market-to-Book Value	0.0908	0.4037	0.2200	0.8220	102.7500
Debt to Equity Ratio	-0.1010	1.4779	-0.0700	0.9460	100.8750
Cash Flows	0.8950	2.3518	0.3800	0.7040	104.7500
Intercept	-13.3948	20.9396	-0.6400	0.5220	108.0000

[1]The maximum likelihood (ML) algorithm was used to estimate the robust standard errors which consisted of 200 iterations.

The results from Table 5 explains that corporate tax, operating cash flows, profit and the market to book ratio have a positive relationship with the adjusted dividend payout. Debt to equity ratio and sales has a negative relationship with dividend payout. Based on the p values, none of the variables were significant in explaining the adjusted dividend payout ratio. The results for the binary variable for firm size show that there is a negative relationship, but no significant relationship between dividend payout and size of the firm. The relationship between the firm's liquidity and dividend is negative which explains that firms with more market liquidity will pay less dividends which was like the preceding regression. Sales growth has no significant impact on the adjusted dividend payout which indicates that sales growth is not the determinant of dividend payout policies. The latter was the same conclusion as in the preceding regression. The corporate profit or net earnings shows a positive and a significant association with the adjusted dividend payout indicates that the firms with the positive earnings pay more dividends. This evidence is consistent with the results supported by Amidu and Abor (2006) and Belans et al (2007) and these results were contradicted by Jeong (2008).

Then, the MEXVAL was calculated. From these results, for the omission of any of these variables which are not replaced, the standard error of the estimate (SEE) would increase. Thus, we can conclude that each of these variables contributes significantly in the explaining of the adjusted dividend payout ratio for IT firms.

V. Discussion and Conclusions

The main objective of the study was to examine the factors determining the dividend payout dynamics among the information technology (IT) firms in the United States. The findings showed that among the factors initially considered; only corporate tax, operating cash flows, and the debt to equity ratio were significant in explaining the dividend payout by IT firms while none of the variables in the adjusted dividend payout GLM were not significant. Because these variables are known in the literature to explain dividend payouts, it would be counterproductive to ignore these variables and make such conclusions. The estimates of MEXVAL in both GLM regressions indicate that these variables play an important role in determining its significance in the dividend payouts for IT firms. The dummy variable for size of the IT firm did not have any impact in either the dividend payout or the adjusted dividend payout ratios.

These findings have significant implications for the finance literature, the policy-makers, and government regulators as well as to investors. Specifically, the study extends the literature on the dividend policy by looking at the dividend policy for the IT sector in the United States. This would also assist policy-makers, government regulators, as well as investors in the development of strategies and policies for an optimal use of the dividend payouts by IT firms. Though this study has shed some light on the dividend policy by IT firms in the United States, it still suffers from some limitations that need to be addressed in the future research. Most important, the data could be expanded via a larger time span and probably more firms compared to the current study, by including more IT firms by looking at other SIC codes. Finally, the current literature includes the theories that the payout of dividends signals some private information about profitability. That is, stock prices tend to rise when a company announces an increase in dividend payouts and fall when dividends are to be decreased. Future research can examine signaling of dividend payout in the IT sector in the United States.

VI. References

Allen, F. & Michaely, R., (2003). Dividend Policy. In: Constantinides, G., Harris, M., Stulz, R. (Eds.), *Handbook of the Economics of Finance*. North-Holland, Amsterdam.

Almon, C. (2014). *The Craft of Econometric Modeling*. Ginn Press, Needham Heights Massachusetts. Also available at:
http://inforumweb.umd.edu/papers/publishedwork/books/craft1.pdf.

Amidu M & Abor J. (2006). Determinants of Dividend Payout Ratios in Ghana. *Journal of Risk Finance*, 7,136-45.

Aivazian , V. L. Booth, & Cleary, S. (2003). Do Emerging Market Firms Follow Different Dividend Policies from U.S. Firms, *The Journal of Financial Research 26*, 371-387.

Baker, H., Veit, E. & Powell, G., (2001). Factors Influencing Dividends Policy Decisions of NASDAQ Firms. *Financial Review, 36*(3), 19-37.

Baker, H. & Powell, G., (2000). Determinants of Corporate Dividends Policy: A Survey of NYSE Firms. *Financial Practice and Education, 10*(1), 29-40.

Baker, H., (1988). Relationship between Industry Classification and Dividend Policy. *Southern Business Review, 14*(1), 1-8.

Benartzi, S., Michaely, R. & Thaler, R., (1997). Do Changes in Dividends Signal the Future or the Past? *Journal of Finance, 52*(3), 1007-34.

Black, F., (1976). The Dividends Puzzle. *Journal of Portfolio Management*, 2, 5-8.

Brealey, R. A, Myers, S. C & Allen, F.S. (2016). *Principles of Corporate Finance* (12th ed). McGraw-Hill Higher Education, NY.

Collins, M.C., Saxena, A.K. & Wansley, J.W., (1996). The Role of Insiders and Dividend Policy: A Comparison of Regulated and Unregulated Firms. *Journal of Financial and Strategic Decisions, 9*(2), 1-9.

DeAngelo, H., & DeAngelo, L., (2006). The Irrelevance of the MM Dividend Irrelevance Theorem. *Journal of Financial Economics 79*, 293–316.

DeAngelo, H., DeAngelo, L., & Skinner, D.J., (2004). Are Dividends Disappearing? Dividend Concentration and the Consolidation of Earnings. *Journal of Financial Economics 72*, 425–456.

Dickens, R., Casey, K. & Newman, J., (2002). Bank Dividend Policy: Explanatory Factors. *Quarterly Journal of Business & Economics, 41*, 3-12.

D'Souza, J., (1999). Agency Cost, Market Risk, Investment Opportunities and Dividend Policy – An International Perspective. *Managerial Finance, 25*(6), 35-43.

Easterbrook, F.H., (1984). Two Agency- Cost Explanations of Dividends. *American Economic Review*, 74, 650- 659.

Fama, F., (1974). The Empirical Relationship between the Dividend and Investment Decisions of Firms. *American Economic Review, 64*(3), 304-18.

Higgins, R.C., (1981). Sustainable Growth under Inflation. *Financial Management, 10*, 36- 40.

Jeong, J. (2008). An Investigation of Dynamic Dividend Behavior in Korea, Working Paper, Korea University, Korea. Available at:
https://pdfs.semanticscholar.org/f247/ccfe6252707cfb69396ecfcc7f876bd141bb.pdf.

Lintner, J., (1956). Distribution of Incomes of Corporations among Dividends, Retained Earnings, and Taxes. *American Economic Review, 61*, 97-113.

Lloyd, W.P., Jahera, S.J. & Page, D.E., (1985). Agency Cost and Dividend Payout Ratios. *Quarterly Journal of Business and Economics, 24*(3), 19-29.

Mancinelli, M. & Ozkan, A., (2006). Ownership Structure and Dividend Policy: Evidence from Italian Firms. *European Journal of Finance, 12*(3), 265-382.

Masulis, R.W. & Trueman, B. (1988). Corporate Investment and Dividend Decisions under Differential Personal Taxation, *Journal of Financial and Quantitative Analysis, 23*, 369-86.

Miller, M.H., & Modigliani, F. (1961). Dividend Policy, Growth, and the Valuation of Shares. *Journal of Business* 34, 411–433.

Modigliani F. (1982). Debt, Dividend Policy, Inflation and Market Valuation. *Journal of Finance, 37*, 255-73.

Nelder. J. A & Wedderburn, R. W. M. (1972). Generalized Linear Models. *Journal of the Royal Statistical Society A* 135, 370-84.

Pruitt, S. & Gitman, L., (1991). The Interactions between the Investment, Financing, and Dividend Decisions of Major US Firms. *Financial Review, 26*(3), 409-30.

Rozeff, S.M., (1982). Growth, Beta and Agency Cost as Determinants of Dividend Payout Ratios. *Journal of Financial Research, 5*, 411-33.

Seneque, P. J. C., (1978). A Review of Factors Affecting the Dividend Policy of the Firm. *The Investment Analysts Journal, 12*, 8–17.

Firm Size, Profitability, and Growth: A Dynamic Panel Analysis of the U.S. Life Insurance Industry

Raja Bouzouita

Abstract

This paper analyzes the relationship between growth and firm size in the U.S. life insurance industry. Applying a dynamic panel model to a sample of life insurance companies from 1993 to 2010, I find strong support for the law of proportional effect (LPE). The results indicate that there is persistency in the growth of life insurance companies. Moreover, the findings suggest that firm specific characteristics such as age, profitability and leverage explain the size of insurance companies and macroeconomic covariates such as growth in GDP and the real interest rate are significant determinants.

I. Introduction

The issues of whether larger firms grow faster than smaller firms, and whether these larger firms have a better performance than smaller ones, have generated a large body of research in the economics and industrial organization fields. The influential law of proportionate effect (LPE) postulates independence between firm growth and size (Gibrat (1931) and Sutton (1977)). The validity of LPE has been a topic of considerable discussion among academics. The range of influence of the LPE has not been limited to the manufacturing industry. In fact, the LPE has attracted interest in the financial services industry (Goddard et al (2002), Hardwick et al (2002), Goddard et al (2004), Choi (2010), and Adams (2014)).

Companies that grow and become large have the ability to exploit economies of scale and scope. These large firms commend a sizable market share that may allow them to enhance their profitability. In turn, profitability generates internal resources to finance future growth. The empirical results of studies on the relationship between growth and size have been interpreted as part of larger structural models. Although larger companies tend to exhibit decreasing returns to scale (Cummins et al 1998), they also have the opportunity to become more efficient through growth. Without growth, companies cannot acquire the necessary business volume. However, to provide for future growth, an insurance company must generate and maintain sufficient capital to satisfy regulators. This needed capital is generated internally through higher earnings or it could be raised externally as well. Organizational structure in the life insurance industry is somewhat of an impediment to raise funds in the capital market. Many companies are organized as mutual companies and even the majority of stock companies are closely held. In addition, the cost of external capital could be high due to the inability of creditors to assess the assets of the insurer and the adequacy of its reserves.

Increasing competition in the U.S. and worldwide markets, wave of consolidations in the U.S. market, and a move toward deregulation, with the passage of the Financial Services

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Modernization Act of 1999, have shaped the life insurance market in the period covered by this study. To face these market challenges, life insurance companies are seeking to grow and maintain their market share of the financial services industry.

Though most studies on the determinants of firm size have focused on manufacturing firms, few studies analyzed the performance of the banking industry. One of the studies in the financial sector examined the growth of U.S. credit unions by Goddard, McKillop and Wilson (2002). The authors find that larger credit unions grew faster than their smaller counterparts. In the banking industry, the results are mixed. In the insurance industry, a study by Hardwick and Adams (2002) found no significant difference between the growth rates of small and large UK life insurance companies. Choi (2010) tests the LPE hypothesis for the U.S. property and liability insurance companies. Choi finds evidence that the LPE hypothesis holds for the property and liability industry. The author used a balanced data which may cause survivorship bias; however, he checks for the survivorship bias by splitting the sample into two periods. I believe that unbalanced data with the correct estimation procedure would better address the issue and would provide unbiased estimates. The latest study by Adams et al (2014) tested Gibrat's law using Swedish life insurance companies in a historical context. The data period covered goes back to the mid-twentieth century.

Because of the inherent differences between the two countries' markets in terms of regulation, organization and size, I seek to empirically investigate the growth of U.S. life insurance companies and their profitability. This article contributes to this strand of research by presenting results on a segment of the insurance industry that has not been studied before, and improves upon earlier research by considering macroeconomic variables as explanatory variables. I use an estimation procedure known as the generalized method of moments (GMM) that is appropriate for a panel data and accounts for endogeneity in some of the explanatory variables. This method was developed by Arellano and Bond (1991).

The reminder of the paper is organized as follows: Section 2 discusses the empirical model and the estimation procedure, Section 3 analyzes the results, and Section 4 concludes the paper and summarizes its findings.

II. Estimation Procedure, Empirical Model, and Sample

The theoretical basis for Gibrat's law or the law of proportional effects stipulates that growth of firms is random meaning it is independent of their size.
I estimate the following model:

$$(1) \quad S_{it} = \beta_1 S_{it-1} + \beta_2 Profitabilty_{it} + \beta_3 Age_{it} + \beta_4 Cost_{it} + \beta_5 Leverage_{it} \; \beta_6 Organization_{it} + \beta_7 Affiliation_{it} + \beta_8 GDP_t + \beta_9 RealRate_t + \varepsilon_t + \nu i + \tau i$$

Where S_{it} is the natural log of total assets of life insurer i at time t, with i= 1,..,N and t=1,...,T
Definitions of the independent variables used and their expected signs are reported in Table1.
Gibrat's Law holds if β_1 is insignificantly different from one implying that firm growth is independent of its size. Statistically significant values of $\beta_1 < 1$ would imply that smaller companies grow faster than larger ones.

Equation (1) has a lagged dependent as an explanatory variable therefore fixed effects estimation yields biased estimates especially when the time-period (T) is small compared to the number of cross sections (N). The most commonly used estimator for dynamic panels in the literature is the GMM estimator by Arellano and Bond (1991). The procedure entails an instrumental variable estimation of the differenced equation (or levels) is performed. As instruments for the lagged difference of the endogenous variable all lagged levels of the variable in question are used, starting with lag two and potentially going back to the beginning of the sample. Consistency of the GMM estimator requires a lack of second order serial correlation in the residuals of the differenced specification. The overall validity of instruments can be checked using the Sargan test of over-identifying restrictions (Arellano and Bond (1991)). One limitation of the procedure is finding appropriate instruments to endogenous regressors. A second limitation is when the time period is short compared to the number of cross sections, the estimated coefficient of the lagged dependent maybe biased.

Empirical Model:

In this paper, I hypothesize that the growth of life insurance companies depends on a number of explanatory variables that are firm specific and others that are macroeconomic in nature, and in line with previous research in the insurance industry.

Profitability. A main source of growth for any companies is profits. Generating sizable net revenues help companies expand their business. Internal funding is important for insurance companies which rarely raise external funds, especially mutual companies. The vast majority of stock life insurance companies are not publicly traded which limits their access to the wider capital market. It is expected that more profitable companies are more likely to get larger and grow faster.

Age. Defined as the difference between the year of observation and the business start date. There are two possibilities. One is that young companies could grow faster at the beginning and later, as they reach economies of scale, will grow at slower pace or may reach a plateau by facing more competition by new comers. Goddard, McKillop, and Wilson (2002) argue that the effect of age could be either positive or negative. There are low barriers to entry and high barriers to exit, as life insurance companies are prevented from exiting the market because policyholders buy life insurance coverage and annuity products for the long run. Those requirements maybe circumvented through mergers, sales, or liquidation. In addition, capital requirements to start a life insurance company are modest. This implies that young firms grow faster than older firms (Choi, 2010). On the other hand, one can argue that insurance buyers are drawn to established companies given the name recognition those companies enjoy. Several insurance companies advertise heavily through mass media and have become household brand names.

Cost. A measure of efficiency is defined as operating expenses over total direct premiums written. The effect of the cost input is related to the economies of scale. It is hypothesized that companies that have lower expenses relative to the total business revenues are more efficient, will have a competitive edge and attract more business. Greene and Segal (2004) find that the U.S. life insurance industry present significant cost inefficiencies with direct impact on growth. Their findings imply that companies that are able to exploit those cost inefficiencies by reducing their own costs will be more profitable and hence realize higher growth. Therefore, I predict a negative relation between the cost measure and the growth of insurance companies.

Leverage. This explanatory variable is used to control for risk by increasing the likelihood of insolvency (Carson and Hoyt (1995)). It is defined as the ratio of net premiums written to policyholders' surplus. Lower leverage means lower risk. Companies that are perceived to be financially strong attract more customers. Many of the products sold by life insurance companies are of long-term nature such as annuities, whole life insurance and, long term care. Therefore, the financial solvency of these companies is important to customers, investors and regulators. Hence, I predict an inverse relationship between leverage and firm growth.

Organization. There are two dominant organizational structures in the life insurance industry: mutual and stock companies. The mutual form combines the functions of owners and customers and maybe more efficient in controlling the owner-customer conflict. The expense preference hypothesis, that managers may have objectives other than profitability, predicts that mutual companies will have higher costs than stock companies due to lack of effective mechanisms to control and discipline managers (Cummins and Zi (1999)). I include a dummy variable equals to one if the company is a mutual and zero otherwise. The expense preference hypothesis predicts a negative relation between growth and organization form.

Affiliation. Insurance companies are organized as either single non-affiliated companies, or they can be part of fleet of companies under common management. Groups tend to be larger and more diversified across lines of business and geographically than single companies. Consequently, companies that are member of a group can share expertise with fellow members on complex insurance problems and may get financial, legal and other assistance if needed. I predict that companies that are part of an insurance group will be larger.

GDP. Life insurance sales are impacted by the general health of the economy more so than property and liability insurance coverage. These latter are either required by state law such as liability auto insurance or are a prerequisite to secure mortgage such homeowners' insurance. Most buy life insurance, annuity, health, and income replacement insurance on a voluntary basis often those benefits are employment based. Employers offer employee benefits at their own discretion. As the economy grows, and unemployment decreases more individuals/families will have access to benefits through their employers. Therefore, growth in the economy measured by the change in the gross domestic product will have a positive effect on the size of the U.S. life insurance industry. Studies show that changes in gross domestic product (GDP) induce growth in the insurance sector. According to Outreville (2013), most papers examining the relation between insurance and economic development focus on the demand side. Meanwhile, Cummins (1973) analyzes the effect of macroeconomic indicators on the U.S. life insurance industry. He concludes that total life insurance reserves and insurers' administrated pension reserves are correlated with gross national product (GNP) and permanent income. Webb, Grace and Skipper (2002) test the same hypothesis about the causal relationship between life insurance demand and the economy. The authors find strong evidence that insurance and banking spur capital stock productivity, which drives the level of output and investment.

Interest Rate. Insurance companies face several risks ranging from the traditional insurance risk, asset risk, legal risk, and interest rate risk. Insurance companies as financial intermediaries issue contingent claims and use premiums to invest in a variety of assets. Insurers' liabilities are measured by policy reserves and their assets are mainly comprised of bonds and stocks that are affected by changes in interest rate. The economic value of a financial asset or liability is the discounted value of its future cash flows. Thus, if interest rates increase, the economic value of future cash flows will decrease; if interest rates decrease, economic value will increase. The direction of the movement in values of both the assets and the liabilities, according to this principle, will be the same if durations of assets and liabilities are perfectly matched than there would be no effect from changes in interest rates. The problem, however, is that asset and liability values will generally not move by the same amount in response to a particular change in interest rate. If they do not move in tandem, the net worth of an insurer will change over time due to the volatility of interest rates. The liabilities of insurers also vary with interest rates due to the correlation of interest rates with inflation. If the value of policyholders' surplus decreases then the degree of leverage increases, and the cost of capital will increase. Another implication of the increase in leverage is the potential for likelihood of default. Given that insurance companies have a large portion of their assets invested in the bond market, their value will be affected by the interest rate. The last decade was marked by a major financial crisis, a higher volatility in interest rates, and unprecedented growth in asset accumulation products such as annuities and mutual funds. These factors make earnings of insurance companies more volatile as a higher proportion of insurance business is linked to equity markets. I predict a negative relationship between interest rates and life insurance growth.

Sample:

Our sample consists of 719 companies using financial data from the NAIC Tapes for a panel of life insurers. This sample represents 90 percent of industry assets and 87 percent of insurance in force. The analysis uses company data and not group data for two reasons. First, organizational structure of group companies changes due to mergers and acquisitions. Second, group companies can file either a consolidated tax return or each member of the group files an individual return. I eliminated companies with peculiar characteristics such as zero or negative surplus, zero or negative premiums written. I also eliminated companies with unusual financial ratios. These companies seem to be in either financial distress or non-operating.

The sample covers the period from 1993-2010. I use accounting measures because a large number of life insurance companies are not publicly traded. To avoid survivorship bias, the sample is not restricted to companies having complete data for the entire eighteen-year period. Some companies drop out of the sample either due to merger, bankruptcy or surrender of license and new companies join the industry.

Table I reports the definition of the variables used in the analysis, their expected direction, and summary statistics for the entire sample and separately for mutual and stock companies. Stock companies outnumber mutual companies by a ratio of 1 to 16 in 2010 for example but mutual companies tend to be larger than stock companies. There were 48 mutual companies out of 832 but those 48 companies accounted for 16% of total assets. Those mutual companies tend to have been in business longer than stock companies. Another aspect of the life insurance industry is that companies could be operating as independent companies or as a member of a group. The number of companies that operate independently is about 192 in 2010. The average return on equity is about 2.3%.

Table I Variable Definitions, Descriptive Statistics, and Expected Sign
Time Period 1993-2010, Number of Observations = 18309

Variable	Definition	Mean Total	Mutual	Stock	Min	Max	Expected Sign
Size	Log(Assets)	18.4112	20.1112	18.3111	10.0242	26.4198	+
Profitability	Net income	0.1397	0.0889	0.1397	-9.9478	17.4389	+

	over equity						
Age	Number of years in business)	38.9367	88.6379	42.7788	1	166	+/-
Cost	Total expenses over direct premiums	6.6887	3.3379	5.6269	0.0198	33.0786	-
Leverage	Liabilities over surplus	2.0267	2.1476	2.0169	0.2959	5.5189	-
Organization	Mutual =1; Stock=0	0.0811			0	1	+
Affiliation	Member =1; Single=0	0.7222			0	1	-
GDP	Growth in GDP	0.0269			-0.0278	0.0469	+
Interest Rate	3-month rate	0.0161			0.0161	0.0311	-
Observations		18309	1414	16895			

III. Estimation Results

Table II reports the results for two variations of the model estimated. Most of the coefficient of the independent variables are statistically significant and have the predicted sign. The GMM model applies the instrumental variables procedure to deal with endogeneity problems. The Sargan test of over-identification and suitability of the instruments shows that model is robust and indicates that the instruments chosen are appropriate. The test of no first order autocorrelation cannot be rejected at the 0.01 significance level. This result is not surprising given the inclusion of the lag of the dependent variable in the model. The test of no second order autocorrelation is statistically significant at conventional levels.

Table II Life Insurer Growth Determinants

$$S_{it} = \beta_1 S_{it-1} + \beta_2 Profitabilty_{it} + \beta_3 Age_{it} + \beta_4 Cost_{it} + \beta_5 Leverage_{it}$$
$$\beta_6 Organization_{it} + \beta_7 Affiliation_{it} + \beta_8 GDP_t + \beta_9 RealRate_t + e_t + \nu_i + \tau_{it}$$

	Model 1 GMM		Model 2 GMM	
Explanatory Variables	Coefficient	T Stat	Coefficient	T Stat
Lag(size)	0.2272	7.6101***	0.3461	10.6298***
Profitability	0.5289	2.1689**	1.2007	2.8102**

Age	0.0311	8.5869**	-	-
Leverage	-2.4832	-6.3897**	-1.0825	-2.8298**
Organization	-0.8942	-0.1801	-3.6796	-3.7214***
Affiliation	0.4881	2.4941**	0.8984	4.6608***
GDP	0.3286	1.8422*	-0.6391	2.6486**
RealRate	-0.8082	-2.8012**	-0.5918	-1.7209*
AR(1)	-4.10***		-4.95***	
AR(2)	-1.17		-1.39	
Sargan Test	422.07***		453.86	

The table reports the parameter estimates of the GMM model, t-statistics are based on robust estimates of standard errors. AR(1) and AR(2) are tests for first and second serial correlation respectively. The null hypothesis no serial correlation in the first order is rejected. It is expected to have first order correlation due to the presence of the lagged dependent variable in the model. The null hypothesis of no serial correlation in the second order is not rejected. The Sargan test of overriding restrictions is statistically significant.
*10% significant, **5% significant, ***1% significant.

In Model 1 that includes all independent variables, the coefficient of the lagged size variable is 0.2272 and is statistically significantly different from one. I reject the null hypothesis that β_1 is equal to one at the 0.01 significance level. Therefore, the test results support Gibrat's Law that growth is independent of company size in the life insurance industry. The results are consistent with Choi's (2010) findings for U.S. property and liability insurance companies and Hardwick and Adams (2012) for UK life insurance companies. It seems that the body of empirical evidence supports Gibrat's law in the insurance industry. Those results reinforce the findings in the financial services industry including banks and credit unions. I find that age has a positive and significant effect on growth implying that established companies have a higher growth than younger ones as reported by Adams (2014) for Swedish life insurance companies. Profitability has a positive and significant impact on company size. Large profits generated by companies are used as a source for investments in new markets and new products. Companies perceived profitable will be able to attract new customers and get larger. Within the structure conduct paradigm known in the industrial organization literature, companies that commend a sizable market share are likely to attain higher profits. The insurance industry is presumed to be an oligopoly where few companies command a large market share. Efficient firms have a lower cost and are able to capture a higher market share.

The cost variable is not statistically significant though it has the correct sign. As a robustness check, I included several variations of the cost variable with similar results. Among the tried variables are marketing expenses over direct premiums written, and total operating expenses over net premiums written. The statistical insignificance of the cost variable in this study suggest that companies in this sample are operating at the minimum efficient scale.

The coefficient of the leverage variable is negative and significant. Higher leverage is associated with an increasing risk of insolvency which would adversely affect the growth of the company. The ratio of liabilities to policyholders' surplus is a measure of capacity in the insurance industry. It measures to what extent insurance companies can assume liabilities without jeopardizing the financial solvency of the company. Policyholders' surplus is cushion against unfavorable experience.

One of the characteristics of the insurance is its group affiliation. Life insurance companies affiliated with a group tend to be larger than independent companies. This is consistent with the findings by Choi (2010) for property liability insurance companies. This result seems to suggest that group members share financial, legal, and underwriting expertise which would help all members of a group to grow faster than single unaffiliated companies. The variable organization is not statistically significant in the first specification, but the coefficient in the second specification, excluding the age variable, is statistically significant. Mutual companies tend to grow slower than stock companies. This finding can be attributed to either that mutual companies are very large and have reached an optimum size, or that stock companies have easier access to the capital markets for funding to finance growth.

As expected, I find a positive and significant association between GDP growth and the size of life insurance companies. Higher economic growth increases discretionary income, and more individuals will buy life insurance products, or increase their contributions to annuities to save for retirement. Life insurance coverage offered as part of employee benefits is usually a multiple of annual salary. Therefore, as more individuals are employed and those employed get pay raises their life insurance coverage increases.

The second macroeconomic covariate is the real interest rate. The results show that there is an inverse relation between interest rate and firm size. When interest rates are low, life insurance profitability decreases, and life insurance products become less attractive to customers who shift their investment in other financial products with potentially higher returns. Life insurance companies are forced to increase premiums to compensate for the decreased rates of return on guaranteed products. A recent study by the NAIC (2018) examining the impact of interest rates on the profitability of life insurance companies found that during the period of 2006-2016 the spread between their portfolio yield and the interest they credit on insurance policies and other products has been declining thus impacting profitability.

Table III Growth and Organizational Structure

$$S_{it} = \beta_1 S_{it-1} + \beta_2 Profitabilty_{it} + \beta_3 Age_{it} + \beta_4 Cost_{it} + \beta_5 Leverage_{it}$$
$$\beta_6 Organization_{it} + \beta_7 Affiliation_{it} + \beta_8 GDP_t + \beta_9 RealRate_t + e_t + \nu_i + \tau_{it}$$

	Mutual Companies N= 130		Stock Companies N=1474	
Explanatory Variables	Coefficient	T Stat	Coefficient	T Stat
Lag(size)	0.5149	4.9329***	0.2435	6.9521***
Profitability	-0.0051	-0.0768	0.7419	2.3487**
Age	0.0109	1.3689	0.0309	8.1519***
Cost	0.0002	0.2469	-0.0003	-1.2825
Leverage	-1.2067	-2.1783**	-2.5713	-6.5145***
Affiliation	0.2727	2.2341**	0.3231	2.0338**
GDP	0.0506	0.14975	0.4004	2.0938**
RealRate	-1.3281	-2.5771**	-0.7079	-2.2678**

AR(1)	-2.98**	-4.36***
AR(2)	-1.64	-1.46
Sargan Test	243.87***	375.76***

The table reports the parameter estimates of the GMM model, t-statistics are based on robust estimates of standard errors. AR(1) and AR(2) are tests for first and second serial correlation respectively. The null hypothesis no serial correlation in the first order is rejected. It is expected to have first order correlation due to the presence of the lagged dependent variable in the model. The null hypothesis of no serial correlation in the second order is not rejected. The Sargan test of overriding restrictions is statistically significant.
*10% significant, **5% significant, ***1% significant.

Table III reports the statistical analysis separately for mutual companies and stock companies. The results reinforce the findings on Table 2. Mutual companies' growth is not impacted by age, while stock companies results mirror the findings for the entire sample in terms of direction and magnitude of the coefficients of the control variables. For mutual companies, profitability and growth in GDP are no longer significant. This leads to the interpretation that mutual companies once they reach a certain size have no room for growth; a certain inertia hits.

IV. Conclusion

This study set out to test whether growth is independent of size in the life insurance industry. Using a GMM statistical estimation technique consistent with Choi (2010) I reject the hypothesis that growth is independent of firm size. This study contributes to existing literature by examining the growth factors with a specific emphasis on the life insurance industry and by considering macroeconomic factors which have not been included in previous insurance studies. Furthermore, the positive relation between growth and size exists in the life insurance industry regardless of ownership structure. Mutual insurance companies show a significantly stronger growth than stock companies. The empirical evidence suggests that the growth of life insurance companies is determined by several company specific variables including age, profitability, leverage, organization form, and group affiliation. The macroeconomic factors, growth in gross domestic product and the level of the real interest rate are statistically significant factors in affecting life insurance company growth. I believe that the results are statistically strong given the estimation procedure appropriate for large cross section over a relatively short time series.

V. References

Adams, M., Lars Frederick Andersen, Philip Hardwick and Magnus Lindmark. (2014). Firm Size and Growth in Sweden's Life Insurance Market Between 1855 and 1947: A Test of Gibrat's Law", *Business History*, Vol. 56 No. 6956-974.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies*, 58, 277–297.

Audretch D.B., L. Klomp, E. Santeralli and A.R. Thurik. (2004). Gibrat's Law: Are the Services Different? *Review of Industrial Organization*, 24: 301-324.

Carson, James M and Hoyt, Robert E. (1995). Life Insurer Financial Distress: Classification Models and Empirical Evidence. *The Journal of Risk of Risk and Insurance*, 62, no. 4 p.764 -775.

Choi, Byeongyong P. (2010). The U.S. Property and Liability Industry: Firm Growth, Size, and Age. *Risk Management and Insurance Review*, Vol.13, No 13, 2017-224.

Cummins, J.D., S. Tennyson, and M. Weiss. (1999) Consolidation and Efficiency in the US Life Insurance Industry, *Journal of Banking and Finance*, 23:325-357.

Cummins, J.D., Hongmin Zi. (1998) Comparison of Frontier Efficiency Methods: An Application to the U.S. Life Insurance Industry. *Journal of Productivity Analysis*, 10, 131-152.

Cummins, J.D. (1973). An Econometric Model of the Life Insurance Sector of the US Economy. *The Journal of Risk and Insurance*, Vol. 40 No.4 p.533-554.

Gibrat, R. (1931) Les Inegalites Economiques. Paris: Recueil Sirey.

Goddard, John A.; McKillop, Donald G.; and Wilson, John, O.S. (2002). The Growth of US Credit Unions, *Journal of Banking and Finance*, 26:2327-2356.

Greene, William H. and Segal, Dan. (2004). Profitability and Efficiency in the U.S. Life Insurance Industry, *Journal of Productivity Analysis*, 21, 229-247.

Hardwick, P., and M. Adams. (2002). Firm Size and Growth in the United Kingdom Life Insurance Industry, *Journal of Risk and Insurance*, 69:577-593.

Krasa, Stefan and Villamil, Anne P. (1992). A Theory of Optimal bank Size." *Oxford Economic Papers*, 44(4), pp. 725-49.

NAIC, 2018, CIPR Study on the State of the Life Insurance Industry: Implications of Insurance Trends.

Outreville, Francois J. (2013).The Relationship Between Insurance and Economic Development: 85 Empirical Papers for a Review of the Literature" *Risk Management and Insurance Review* Vol 16, Issue 1, p.71-122.

Scherer F., and David Ross. (1990). Industrial Market Structure and Economic Performance, 3rd Edition Boston: Houghton Mifflin Company.

Sutton, J. (1997). Gibrat's Legacy. *Journal of Economic Literature* 35, no 1, 40-59.

Webb, I., Grace, M.F. and Skipper, H.D. (2002) The effect of banking and insurance on the growth of capital and output, Working Paper 02, Center for Risk Management and Insurance, Robinson College of Business, Georgia State University, Atlanta

The Winner's Curse in Insurance and Underwriting Cycles

Zhiqiang Yan and Charles Pryor

Abstract

In this paper, we develop a simple economic model to explain how an entrant insurer may suffer the winner's curse in the sense that the entrant insurer's risk pool is less profitable than that of an incumbent insurer. In addition, we exploit the strategic interactions and the pricing dynamics between entrant and incumbent insurers to describe the formation of an insurance underwriting cycle. Empirical tests based on the predictions of our economic models are conducted in the homeowners and product liability insurance markets for the period 1995-2001. We find that (1) the winner's curse is present in the product liability insurance market, but not in the homeowners insurance market; and that (2) larger insurers tend to be more profitable in underwriting than their smaller competitors.

I. Introduction

The insurance underwriting cycle has attracted great attention from both academia and practitioners due to its detrimental impact on the stability of insurance markets. However, prevailing theories on the underwriting cycle mainly focus on the "hard market" stage of the cycle, while the "soft market" stage is largely ignored. In this paper, we develop a simple economic model to explain how an entrant insurer may suffer the winner's curse in the sense that the entrant insurer's risk pool is less profitable than that of an incumbent insurer, on condition that the entrant mimics the pricing structure of incumbent insurers. In addition, we exploit the tit-for-tat pricing dynamics between entrant and incumbent insurers to describe the formation of a soft market. Empirical tests based on the predictions of our model will be conducted lastly.

I.1. Winner's Curse

The term "winner's curse" is widely known in the literature of auctions. In a common value auction with incomplete information, the value of the auctioned item is roughly the same to all bidders, but none of the bidders know exactly what the value is when they bid. Each bidder independently estimates the value of the item based on his private information before bidding. The bidder who submits the highest bid wins the auctioned item. However, if, on average, bidders estimate the value of the item correctly, the winner, by submitting the highest bid, is likely to be cursed by paying too much for the auctioned item.

the property/liability insurance market (Harrington and Danzon 1994), and the life insurance settlement market (Tu 2010). In this article, we investigate whether new entrant insurers take market share at the cost of lower underwriting profitability than incumbent insurers. In other words, we'd like to know if new entrants to insurance markets suffer from the winner's curse.

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I.2. Underwriting Cycles

Property-liability insurance markets are widely believed to be cyclical, which is viewed as being detrimental to the soundness and stability of insurers in these markets. The typical description of these cycles, which are known as underwriting cycles, generally includes four stages: a soft market period, a hard market period, and two transitional periods in between. During a soft market period, price and profitability are observed to be stable or falling and insurance coverage is readily available to customers; while in a hard market period, price and profitability increase abruptly and dramatically, but less insurance coverage is available to customers. The two transitional periods are marked by the persistence of certain characteristics of soft or hard markets, while gradual changes to the next stage are on the way.

Thanks to severe hard markets in 1985-1986 across many lines of property-liability insurance, underwriting cycles caught the public's attention, which not only led many states to enact tort reforms but also spawned an extensive study of the phenomenon. In the literature, explanations for the underwriting cycle mainly fall into three categories: the arbitrage theory, the capacity-constraint theory and the cash flow underwriting. The arbitrage theory explains the presence of underwriting cycles as the result of institutional and regulatory lags, and accounting practices (Cummins and Outreville 1987). However, this theory does not allow insurers to learn from their mistakes. The capacity constraint model (Gron 1994) explains underwriting cycles as the natural outcome of shocks to insurers' capital. The capacity constraint theory is intuitively appealing, but it leaves some important issues unanswered. For example, why the insurance demand is not elastic enough to allow insurers to replenish their capital with an increase of price and decrease of coverage? The third theory views underwriting cycles as resulting from the practice of cash flow underwriting (Feldblum 1992). This theory says that insurers underwrite policies at a loss in order to generate cash flows of premiums for investment when interest rates are high. This is too simplistic in current market conditions to explain underwriting cycles, since the time value of money is a major factor in determining insurance premiums nowadays.

In the literature, people have largely ignored the interactions among market participants in interpreting underwriting cycles. In this paper, we hypothesize that strategic interactions among rational insurers, especially between new entrant insurers and incumbent insurers, can generate underwriting cycles.

II. Barriers to Entry in Insurance Markets

In standard industrial organization theories, four major elements of market structure may serve as barriers to entry: economy of scale (such as fixed costs), absolute cost advantages, product-differentiation advantages, and capital requirements. However, due to unique market characteristics, these barriers to entry are ineffective in insurance markets.

Economy of Scale. Economy of scale refers to a minimum efficient scale in a market. In industries/markets such as cable service and automobile manufacturing, a huge amount of fixed investment is required for any new entrant, which may deter potential entrants into these industries. However, this is not the case in the insurance industry, where limited fixed startup capital is needed and is unlikely to form effective barriers to entry.

Absolute Cost Advantages. If incumbent firms have developed superior production techniques, they can reduce their cost of production and maintain market price at such a level that the market is unprofitable for new entrants. These firms are said to have absolute cost advantages. In the insurance industry, the main outputs are risk sharing and risk pooling, which may be represented by expected loss. Incumbent insurers may acquire superior underwriting techniques through their experience, but this expertise is essentially embodied in human capital, which cannot be effectively protected by patents or laws. Because human capital is easily transferable, it may be fairly easy for a new entrant to have access to the same level of underwriting expertise by hiring talents from incumbents. Besides, the distribution system of independent agents and the assistance of reinsurers through reinsurance agreements may help facilitate an entrant to screen types of risks and reduce their cost of production. Consequently, absolute cost advantages also do not form effective barriers to entry in insurance markets.

Product-Differentiation Advantages. If incumbent firms have patented product innovations or have otherwise won consumer loyalty, they can enjoy product-differentiation advantages that effectively protects their market share. For example, different brands of automobiles are designed to cater to the tastes of different groups of customers, and thus this branding creates a sort of market monopoly to some extent. However, most insurance policies are indistinguishable to an average consumer, and this is especially true in personal lines of insurance which means that product differentiation is also not an effective barrier to entry in insurance markets.

Capital Requirement. Lastly, the capital requirement argument says that new entrants to a market may have trouble finding financing for their investments because of the risk to creditors. However, given the low fixed cost and the relatively low statutory capitalization requirements in the insurance industry, the capital requirement too is unlikely to be a major barrier to entry.

III. A Simple Economic Model

None of the four theoretical barriers of entry into new markets are likely to be effective in the market for insurance due to unique characteristics of the industry. It is therefore hard for incumbent insurers to bar new insurers from entering the markets. In this section, we investigate how the entrance of new insurers affects the underwriting profitability of incumbent insurers. Our framework builds on the work of Shaffer (1998).

Consider a market with N potential customers and n insurers. Customers are of two types of risk: "good" and "bad". A "good" customer files a claim with probability θ_G on average, while a "bad" customer files a claim with probability θ_B on average. We assume that each customer's type is unknown to insurers, and that $0 < \theta_G < \theta_B < 1$. However, it is common knowledge that a fraction of these N potential customers, denoted by α, are the good risk type. For simplicity, we assume that insurers charge R per unit of insurance coverage, which is fixed and exogenous, the expected loss per unit of insurance is normalized to be unity, and the discount factor is unity. Under these assumptions, an insurer earns a profit of R- θ_G on each dollar of insurance coverage sold to a good customer, and R- θ_B on each dollar of insurance coverage sold to a bad customer. To rule out the trivial equilibrium that no insurer would bother to screen potential customers, we also assume that $\theta_G < R < \theta_B$.

An insurer observes a noisy signal of each customer's type and underwrites if and only if the signal indicates that the customer is of good risk type. Signals are assumed to be independent across insurers. The signal corresponds to the true type with probability p_{gG} for good types and p_{bB} for bad ones, that is, prob(θ_G | θ_G)= p_{gG} and prob(θ_B | θ_B)= p_{bB} . Because an uninformative signal would have $p_{gG} = p_{bB} = 1/2$, We assume that $1/2< p_{gG} <1$ and $1/2< p_{bB} <1$, so that the signals are not perfect but informative.

III.1. Insurance Market with One or Two Insurers

If there is only one insurer in the market (i.e., a monopolist), all customers have to purchase insurance from the monopolist. The insurer deems $p_{gG}\, \alpha\, N + (1- p_{bB})\,(1- \alpha)\, N$ customers as good risk types and underwrites insurance to them, which yields an expected profit of $p_{gG}\, \alpha\, N\, (R- \theta_G) + (1- p_{bB})\,(1- \alpha)\, N\, (R- \theta_B)$. Hence, the insurer's expected claim rate, or the number of claims per policy sold on average, is $[p_{gG}\, \alpha\, \theta_G + (1- p_{bB})\,(1- \alpha)\, \theta_B] / [p_{gG}\, \alpha + (1- p_{bB})\,(1- \alpha)]$. Here, we assume that a rejected customer is recorded on file and will be rejected subsequently by this insurer.

Now, consider the case of two insurers with equal size (i.e., duopolists). We assume that half of the customers contact one insurer, and the remaining customers reach the other insurer for insurance. Then each insurer underwrites insurance to half as many customers as the monopoly insurer does, that is, $p_{gG}\, \alpha\, N/2 + (1- p_{bB})\,(1- \alpha)\, N/2$, and earns half of the expected profit, which is $p_{gG}\, \alpha\, N\, (R- \theta_G)/2+ (1- p_{bB})\,(1- \alpha)\, N\, (R- \theta_B)/2$.

We assume that insurers don't share information about their rejection of insurance applicants, therefore, an insurer can't distinguish whether an applicant has ever been rejected or not by the other insurer, and thus a rejected applicant will subsequently contact the other insurer. Therefore, each insurer additionally faces $(1-p_{gG})\, \alpha\, N/2 + p_{bB}\,(1- \alpha)\, N/2$ applicants, and each will additionally sell insurance policies to $p_{gG}\,(1-p_{gG})\, \alpha\, N/2 + (1- p_{bB})\, p_{bB}\,(1- \alpha)\, N/2$ applicants who previously have been rejected by the other insurer. Now, the aggregate policies sold by each insurer is $p_{gG}\,(2-p_{gG})\, \alpha\, N/2 + (1- p_{bB})\,(1+p_{bB})\,(1- \alpha)\, N/2$. It is obvious that more policies are sold in the duopolistic market than in the monopolistic market. The expected profit for each insurer is $p_{gG}\,(2-p_{gG})\, \alpha\, N\, (R- \theta_G)/2 +(1-p_{bB})\,(1+p_{bB})(1- \alpha)\, N\, (R- \theta_B)/2$, and the expected claim rate is $[p_{gG}\,(2-p_{gG})\, \alpha\, \theta_G +(1- p_{bB})(1+p_{bB})\,(1- \alpha)\, \theta_B]/ [p_{gG}\,(2-p_{gG})\, \alpha +(1- p_{bB})\,(1+p_{bB})(1- \alpha)]$.

III.2. Insurance Market with n Identical Insurers

Suppose now there are n identical insurers in the market and all potential customers randomly select an insurer to purchase insurance until one insurer accepts him or all insurers reject him. The number of potential customers faced by each insurer is given by

$(\alpha N/n)\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-\alpha)(N/n)\sum_{m=1}^{n}p_{bB}^{m-1}$ and the number of policies underwritten by each insurer is:

$$(p_{gG}\alpha N/n)\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)(N/n)\sum_{m=1}^{n}p_{bB}^{m-1}.$$

The total number of policies underwritten is: $(p_{gG}\alpha N)\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)N\sum_{m=1}^{n}p_{bB}^{m-1}$

.

Since 1- p_{gG} >0 and p_{bB} >0, it is obvious that total number of policies sold increases as the number of insurers in the market increases. That is, as more insurers are in the market, fewer potential customers are ultimately unable to obtain insurance. At the extreme, when n approaches infinity, the aggregate number of policies sold is N, that is, every applicant is insured.

The expected claim rate is given by:

$$\frac{p_{gG}\alpha\theta_G\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\theta_B\sum_{m=1}^{n}p_{bB}^{m-1}}{p_{gG}\alpha\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\sum_{m=1}^{n}p_{bB}^{m-1}}=\frac{\alpha[1-(1-p_{gG})^n]+(1-\alpha)(1-p_{bB}^n)}{\alpha\theta_G[1-(1-p_{gG})^n]+(1-\alpha)\theta_B(1-p_{bB}^n)}$$

As the number of insurers decreases from n to n-1, the change in the expected claim rate is

$$\frac{[p_{gG}\alpha\theta_G\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\theta_B\sum_{m=1}^{n}p_{bB}^{m-1}]}{[p_{gG}\alpha\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\sum_{m=1}^{n}p_{bB}^{m-1}]}$$

$$-\frac{[p_{gG}\alpha\theta_G\sum_{m=1}^{n-1}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\theta_B\sum_{m=1}^{n-1}p_{bB}^{m-1}]}{[p_{gG}\alpha\sum_{m=1}^{n-1}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\sum_{m=1}^{n-1}p_{bB}^{m-1}]}$$

$$=-\frac{\{(1-p_{gG})^n p_{bB}^n[p_{gG}-(1-p_{bB})]+(1-p_{gG})p_{bB}[p_{bB}^{n-1}-p_{gG}(1-p_{gG})^{n-1}]+(1-p_{bB})p_{bB}^n\}(1-\alpha)\alpha(\theta_B-\theta_G)}{\{\alpha[1-(1-p_{gG})^n]+(1-\alpha)(1-p_{bB}^n)\}\{(1-p_{gG})(1-\alpha)(p_{bB}^n-p_{bB})+\alpha p_{bB}[(1-p_{gG})^n-(1-p_{gG})]\}}$$

Since $0<\theta_G<\theta_B<1$, $\frac{1}{2}<p_{gG}<1$, $\frac{1}{2}<p_{bB}<1$ and $0<\alpha<1$, it is easy to show that the change in the expected claim rate is positive. In other words, the expected claim rate monotonically increases with the number of insurers in the market.

The expected profit for each insurer is $(p_{gG}\alpha N/n)(\text{R-}\theta_G)\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)(N/n)(\text{R-}\theta_B)\sum_{m=1}^{n}p_{bB}^{m-1}$, and the change in expected profit for each insurer when the number of insurers increases from n-1 to n is

$$(p_{gG}\alpha N/n)(\text{R-}\theta_G)\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)(N/n)(\text{R-}\theta_B)\sum_{m=1}^{n}p_{bB}^{m-1}$$

$$-[p_{gG}\alpha N/(n-1)](\text{R-}\theta_G)\sum_{m=1}^{n-1}(1-p_{gG})^{m-1}-(1-p_{bB})(1-\alpha)[N/(n-1)](\text{R-}\theta_B)\sum_{m=1}^{n-1}p_{bB}^{m-1}$$

. The sign of the change in expected profit per insurer depends on the parameters, and it can increase or decrease as n increases.

III.3. Entry of a New Insurer

Suppose a new insurer enters a market with n insurers. The number of uninsured good type customers in the residual market is $\alpha N-(p_{gG}\alpha N)\sum_{m=1}^{n}(1-p_{gG})^{m-1}=\alpha N(1-p_{gG})^{n}$, and the number of uninsured bad type customers is $(1-\alpha)N-(1-p_{bB})(1-\alpha)N\sum_{m=1}^{n}p_{bB}^{m-1}=(1-\alpha)N\,p_{bB}^{n}$. Assume that the new insurer uses the same screening technology, that is, prob(θ_G | θ_G)= p_{gG} and prob(θ_B | θ_B)= p_{bB}, and he sells policies if and only if he believes that a customer's type is good. The number of policies sold by the entrant is $p_{gG}\alpha N(1-p_{gG})^{n}+(1-p_{bB})(1-\alpha)N\,p_{bB}^{m-1}$and the expected profit for the new insurer is $p_{gG}\alpha N(R-\theta_G)(1-p_{gG})^{n}+(1-p_{bB})(R-\theta_B)(1-\alpha)N\,p_{bB}^{m-1}$.

Comparing the entrant with an incumbent insurer, the difference in their expected profits is

$$[p_{gG}\alpha N(R-\theta_G)(1-p_{gG})^{n}+(1-p_{bB})(R-\theta_B)(1-\alpha)N\,p_{bB}^{n}]$$

$$-[(p_{gG}\alpha N/n)(\mathrm{R}\text{-}\theta_{\mathrm{G}})\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)(N/n)(\mathrm{R}\text{-}\theta_{\mathrm{B}})\sum_{m=1}^{n}p_{bB}^{m-1}]$$

$$=(p_{gG}\alpha N/n)(\mathrm{R}\text{-}\theta_{\mathrm{G}})[n(1-p_{gG})^{n}-\sum_{m=1}^{n}(1-p_{gG})^{m-1}]+(1-p_{bB})(1-\alpha)(N/n)(\mathrm{R}\text{-}\theta_{\mathrm{B}})[np_{bB}^{n}-\sum_{m=1}^{n}p_{bB}^{m-1}]$$

Since $\frac{1}{2}<p_{gG}<1$, $\frac{1}{2}<p_{bB}<1$, it is obvious that the terms in the brackets are negative. Hence, the expected profit for a new insurer is lower than that of an incumbent insurer. In addition, the difference in the expected claim rate is

$$\frac{p_{gG}\alpha\theta_G(1-p_{gG})^{n}+(1-p_{bB})(1-\alpha)\theta_B p_{bB}^{n}}{p_{gG}\alpha(1-p_{gG})^{n}+(1-p_{bB})(1-\alpha)p_{bB}^{n}}-\frac{p_{gG}\alpha\theta_G\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\theta_B\sum_{m=1}^{n}p_{bB}^{m-1}}{p_{gG}\alpha\sum_{m=1}^{n}(1-p_{gG})^{m-1}+(1-p_{bB})(1-\alpha)\sum_{m=1}^{n}p_{bB}^{m-1}}$$

$$=\frac{\{p_{gG}(1-p_{bB})[(p_{bB}^{n}-(1-p_{gG})^{n})+\cdots+p_{bB}^{n-1}(1-p_{gG})^{n-1}(p_{bB}-(1-p_{gG}))]\}(1-\alpha)\alpha(\theta_B-\theta_G)}{[1-\alpha(1-p_{gG})^{n}-p_{bB}^{n}(1-\alpha)][p_{gG}\alpha(1-p_{gG})^{n}+(1-\alpha)p_{bB}^{n}-(1-\alpha)p_{bB}^{n+1}]}$$

Since $0<\theta_G<\theta_B<1$, $\frac{1}{2}<p_{gG}<1$, $\frac{1}{2}<p_{bB}<1$ and $0<\alpha<1$, the expression above is positive, indicating that the expected claim rate of the new insurer is higher than that of an incumbent insurer. This result is also intuitively appealing. Suppose there are n-1 insurers in the market initially. The ratio of good type to bad type customers within the residual pool is $\alpha(1-p_{gG})^{n-1}/(1-\alpha)p_{bB}^{n-1}$. However, if there are n incumbent insurers in the market, the ratio of good to bad type customers within the residual pool now becomes $\alpha(1-p_{gG})^{n}/(1-\alpha)p_{bB}^{n}$, which is less than $\alpha(1-p_{gG})^{n-1}/(1-\alpha)p_{bB}^{n-1}$ for any n, since $\frac{1-p_{gG}}{p_{bB}}<1$. That is, the risk of the residual pool continues to get worse as the number of incumbent insurers in the market increases. Therefore, a new insurer faces a worse mix of customers, and suffers a higher expected claim rate than an incumbent insurer even when using the same screening technology as the incumbent insurer. In other words, an entrant insurer suffers from the winner's curse.

Hypothesis 1*: If signals about customer type received by an entrant insurer follow the same probability distribution as they do for incumbent insurers, the entrant insurer will suffer a higher claim rate than incumbent insurers.*

III.4. Insurance Market with Heterogeneous Insurers

For simplicity, we assume now there are two insurers with heterogeneous sizes in the market. For concreteness, suppose that the size of insurer 1 is twice as large as insurer 2. All potential customers randomly contact with each firm, and if a customer is rejected by one firm, he will contact another insurer subsequently. Therefore, the number of policies that insurer 1 initially sells is $\frac{2}{3}p_{gG}\alpha N+\frac{2}{3}(1-p_{bB})(1-\alpha)N$, and the number of policies that insurer 1 subsequently sells is $\frac{1}{3}p_{gG}(1-p_{gG})\alpha N+\frac{1}{3}p_{bB}(1-p_{bB})(1-\alpha)N$, and the total number of policies sold by insurer 1 is $p_{gG}(1-\frac{1}{3}p_{gG})\alpha N+(1-p_{bB})(1-\alpha)(\frac{2}{3}+\frac{1}{3}p_{bB})N$. Therefore, the claim rate for insurer 1 is $\frac{p_{gG}(1-\frac{1}{3}p_{gG})\alpha\theta_G+(1-p_{bB})(1-\alpha)(\frac{2}{3}+\frac{1}{3}p_{bB})\theta_B}{p_{gG}(1-\frac{1}{3}p_{gG})\alpha+(1-p_{bB})(1-\alpha)(\frac{2}{3}+\frac{1}{3}p_{bB})}$. On the other hand, the total number of policies sold by insurer 2 is $p_{gG}(1-\frac{2}{3}p_{gG})\alpha N+(1-p_{bB})(1-\alpha)(\frac{1}{3}+\frac{2}{3}p_{bB})N$, and the claim rate for insurer 2 is $\frac{p_{gG}(1-\frac{2}{3}p_{gG})\alpha\theta_G+(1-p_{bB})(1-\alpha)(\frac{1}{3}+\frac{2}{3}p_{bB})\theta_B}{p_{gG}(1-\frac{2}{3}p_{gG})\alpha+(1-p_{bB})(1-\alpha)(\frac{1}{3}+\frac{2}{3}p_{bB})}$. It is obvious that the total number of policies sold in the market is the same as that in a market with two equally sized insurers, that is, $p_{gG}(2-p_{gG})\alpha N+(1-p_{bB})(1-\alpha)(1+p_{bB})N$. However, the claim rate of insurer 1 is higher than that of insurer 2, and the difference in the claim rates between insurer 1 and 2 is

$$\frac{p_{gG}(1-\frac{1}{3}p_{gG})\alpha\theta_G+(1-p_{bB})(1-\alpha)(\frac{2}{3}+\frac{1}{3}p_{bB})\theta_B}{p_{gG}(1-\frac{1}{3}p_{gG})\alpha+(1-p_{bB})(1-\alpha)(\frac{2}{3}+\frac{1}{3}p_{bB})}-\frac{p_{gG}(1-\frac{2}{3}p_{gG})\alpha\theta_G+(1-p_{bB})(1-\alpha)(\frac{1}{3}+\frac{2}{3}p_{bB})\theta_B}{p_{gG}(1-\frac{2}{3}p_{gG})\alpha+(1-p_{bB})(1-\alpha)(\frac{1}{3}+\frac{2}{3}p_{bB})}$$

$$=\frac{3\alpha p_{gG}(1-p_{bB})(1-\alpha)(p_{gG}+p_{bB}-1)(\theta_B-\theta_G)}{[2-(1-\alpha)p_{bB}^2-(1-\alpha)p_{bB}-\alpha(p_{gG}^2-3p_{gG}+2)][2(1-\alpha)p_{bB}^2-(1-\alpha)p_{bB}+\alpha(2p_{gG}^2-3p_{gG}+1)-1]}$$

Since $0 < \theta_G < \theta_B < 1$, $\frac{1}{2} < p_{gG} < 1$, $\frac{1}{2} < p_{bB} < 1$ and $0 < \alpha < 1$, the above expression is negative. Therefore, the larger insurer enjoys a lower claim rate. It reflects that the larger insurer faces less risk and it can diversify his underwriting risks more efficiently.

Hypothesis 2*: Larger insurers enjoy a lower claim rate than their smaller competitors, holding other things equal.*

IV. Data Description and Variable Development

IV.1 Data Description

Insurers' annual firm-level data are collected from the National Association of Insurance Commissioners (NAIC) Property and Casualty Database in the lines of homeowners and product liabilities for the period 1994 through 2006. To obtain an appropriate sample for this study, the following sample selection criteria are applied:

1. The firm must report to be active and file its annual statement individually;
2. The firm must report positive numbers for direct written premiums, both for the entire firm and for the line of business under study;
3. The policyholders surplus and total admitted assets must be greater than $250,000;
4. The firm must be classified either as a stock, a mutual or a reciprocal exchange;
5. The firm must survive for an additional five years after the observation.

The final data sample contains 4,130 firm-year observations in the homeowners insurance and 1,689 firm-year observations in the product liability insurance.

IV.2 Variable Development

In this section, we describe the dependent and independent variables used in the empirical analysis. A summary of the definitions of these variables are provided in Table 1.

Loss Ratio. Loss ratio is commonly used in the literature to measure an insurer's underwriting performance. Therefore, for each line of insurance, we compute the loss ratio of direct and assumed business, which is defined as the ratio of total direct and assumed losses incurred, as of year t+5, for accidents in year t to total direct and assumed premiums earned in year t. The five-year developed losses are used to reduce potential biases due to managerial loss management (Petroni 1992; Eckles and Halek 2010).

Entry. Hypothesis 1 suggests that new entrants tend to face a worse risk pool of customers and thus are more likely to have worse underwriting loss experience. Similar to Harrington and Danzon (1994), two binary indicators of new entrants are included to test for Hypothesis 1. The *line-of-business (LOB) entrant* variable indicates a recent entrant to a line of insurance business under study with experience in other lines. It equals one if the insurer did not write in the line of insurance in question but had positive net premiums written in other lines five years ago (in year t-5). The *insurance industry entrant* variable equals one if the insurer had zero net premiums written in all lines of property and liability insurance five years ago but has positive net premiums written in the line of insurance in question in year t.

Firm size. Hypothesis 2 suggests that larger insurers tend to be more profitable than their smaller competitors, everything else equal. Hence, we include the natural logarithm of total admitted assets as the measure of firm size to test this hypothesis.

Organizational characteristics. Two binary variables of insurers' organizational characteristics are included to control for idiosyncratic features of insurers. The binary variable called *mutual* equals one if the insurer is either a mutual insurer or a reciprocal exchange and zero if the insurer is a stock company. Mutual and reciprocal exchange insurers tend to be more conservative in risk-taking than stock insurers (Mayers and Smith 1990) because of managers' and policyholders/owners' aversion to financial distress and the limited ability to raise capital. However, stock insurers may be better managed because managers and stockholders/owners' interests are better aligned via stocks and stock options. The binary variable called *distribution system* equals one if the insurer is a direct writer and zero if the insurer utilizes other distribution methods such as agency or brokerage. Direct writers tend to do businesses with small to medium-sized companies, while insurers with an agency or brokerage distribution system generally specialize in large commercial accounts. However, we have no strong predictions with regard to these two binary variables of organizational characteristics.

Leverage. A firm achieves the minimum cost of capital at its optimal capital structure, which generally demands a certain level of financial leverage. Beyond this level, an increase in financial leverage can not only increase the firm's cost of capital but also raise its probability of bankruptcy. Therefore, up to some level, increased leverage could discourage firms with high bankruptcy costs from risk-taking in order to protect their tangible and intangible capital. However, for those firms with low bankruptcy costs who typically have little tangible and intangible capital, high leverage could induce more aggressive risk-taking or produce go-for-broke behavior (Harrington and Danzon 1994). Two proxies for financial leverage are included. The ratio of total liabilities to total admitted assets are included to measure overall financial leverage. However, insurers could utilize reinsurance to transfer their liabilities to reinsurers or to conceal their excessive risk-taking behavior. Thus, we include the ratio of reinsurance recoverable to total admitted assets to measure the effect of reinsurance on financial leverage.

Premium growth. Rapid growth in premiums written may result from an insurer's unintentionally low pricing due to over-optimism or inexperience in the case of new entrants. It can also be due to an insurer's intentional aggressive underwriting strategies to enter a new market or to gain market share over a short period of time. Regardless of cause, rapid growth in premiums written typically generate more volatile underwriting results and eventually lead to worse loss experience. We include the percentage growth in premiums written both at the firm level and at the level of line of business (LOB). The firm growth rate is defined as the percentage growth in the direct and assumed premiums written at the firm level, while the LOB growth rate is the percentage growth in the direct and assumed premiums written in the line of business under study.

LOB concentration. If a certain line of business accounts for a larger proportion of an insurer's underwriting risks, the insurer may have underwriting expertise in this line of business or may be more conservative in underwriting to reduce the impact of unfavorable underwriting results of this particular line on the entire firm. For each line of business, LOB concentration is defined as the ratio of premiums written in a line of business to the total premiums written.

Loss Reserve Error. As a major liability item on an insurer's statutory balance sheet, loss reserve tends to be underestimated especially by financially weak insurers (Petroni 1992) or be manipulated by insurance firm managers to maximize their compensation (Eckles and Halek 2010). Hence, we include the variable of loss reserve error to account for this phenomenon. Loss reserve error in year t is defined as the difference between the actually developed incurred losses as of year t+5 and the originally reported incurred losses in year t. A five-year development period is used since a high percentage of losses are settled during this period (Weiss 1985). If an insurer has a positive loss reserve error, it implies that the losses and loss adjustment expenses actually developed in the future are higher than initially reported by the insurer, and it is evidence of under-reserving.

Coastal States. Insurers in hurricane-prone states are likely to suffer greater underwriting losses in the homeowners insurance market. To control for this heterogeneity, we include the binary variable, *coastal states*, in the empirical analysis on the homeowners insurance market. It takes a value of 1 if an insurer is domiciled in one of the following hurricane-prone states according to the Landscape of Natural Disasters of USATODAY.com: Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Texas, Vermont, and Virginia, and 0 otherwise.

V. Estimation Procedure and Empirical Results

V.1 Estimation Procedure

We use annual firm-level data for the years 1995 through 2001 for homeowners insurance and product liability insurance to test our hypotheses, respectively. The variable of loss reserve error is only available for firms that survive through year t+5, which requires us to collect data for the years 2002 to 2006 to construct it. In addition, data for the year 1994 are collected to construct the variables of premium growth rate. The fixed effects model is chosen over the random effects model based on the Hausman specification test, and robust standard errors are estimated to control for heteroscedasticity. The econometric specification on the loss ratio is as follows:

$$\text{Loss Ratio}_{i,t} = \alpha + \beta_1 \text{Firm Size}_{i,t} + \beta_2 \text{LOB Entrant}_{i,t} + \beta_3 \text{Industry Entrant}_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t},$$

where $\boldsymbol{X}_{i,t}$ is a vector of control variables including line of business premium growth rate, firm premium growth rate, loss reserve error, the ratio of total liabilities to total admitted assets, the ratio of reinsurance recoverable to total admitted assets, line of business concentration, the binary variable of mutual, the binary variable of direct, the binary variable of coastal states for the line of homeowners insurance, and the binary variables for the years 1996 through 2001.

V.2 Empirical Results

Table 2 reports the empirical estimation for the homeowners insurance and the product liability insurance. Overall, the results are consistent with our two hypotheses that new entrants suffer from higher loss ratio and that larger insurers boast of lower underwriting losses.

Specifically, in the line of homeowners insurance, the estimated coefficient for firm size is negative and significant at the 10 percent level. This result suggests that larger insurers tend to have more favorable underwriting results than smaller insurance companies. The coefficients for new entrants are not statistically significant at the conventional levels, indicating that new entrants and incumbent insurers do not differ systematically in underwriting performance. Insurance companies with faster growth rate of premiums written in the line of homeowners insurance tend to have lower loss ratios, while insurers with higher growth rate of premiums written at firm level suffer from poorer underwriting results. This implies that the loss experience of homeowners insurance is more favorable comparing to other lines of business over the periods of 1995 to 2001. Other factors such as financial leverage and organizational characteristics appear to have no significant impact on insurers' underwriting performance.

In the line of product liability insurance, the coefficient for firm size is negative as expected but not statistically significant at the conventional levels. The results for new entrants generally support our hypothesis 1 that new entrants are less profitable in underwriting comparing to incumbent insurers. Specifically, the estimated coefficient for LOB entrant is positive as predicted but not statistically significant, whereas the coefficient for insurance industry entrant is positive and significant at the 5 percent level. This finding suggests that new entrants into the product liability insurance with limited or no underwriting experience in other lines of business, though they may gain market share over a short period of time, will suffer worse realization of claim costs comparing to incumbent insurers. In this sense, we say that these new entrants suffer winner's curse.

A positive and significant coefficient on loss reserve error indicates that insurers with more optimistic private information on future claim costs will experience worse underwriting results. Similar to the findings in the homeowners insurance, financial leverage does not appear to be of important determinants of insurers' underwriting performance. Mutuals and direct writers sustain worse underwriting results over this period, although we do not have any strong prediction related to these organizational characteristics. Another striking finding in the product liability insurance is that the loss experience in this line of business has been deteriorating over the years 1995 through 2001, which is not observed in the homeowners insurance market.

VI. Discussion: The Winner's Curse and Underwriting Cycle

Property-liability insurance markets are widely believed to be cyclical. In the literature, explanations for the underwriting cycle mainly fall into three categories: the arbitrage theory, the capacity-constraint theory and the cash flow underwriting. However, people have largely ignored the interactions among market participants in interpreting underwriting cycles. We have shown evidence of the winner's curse in the insurance markets, i.e., new entrants may gain markets relatively quickly in a short time period at the cost of worse underwriting experience. In this section, we relax the assumption of exogenous insurance price in the economic model in Section 3. We hypothesize that strategic interactions among rational insurers, especially between new entrant insurers and incumbent insurers, can generate underwriting cycles.

VI.1. Strategies of Entrants

Since barriers to entry into the insurance industry are low, it is a common phenomenon that a new insurer is established or an existing insurer ventures into new insurance markets. However, the timing of entry may heavily depend on market conditions. Specifically, when the insurance industry boosts of a higher rate of return than many other industries, we expect a large number of entrants into the insurance industry, intending to share the higher profitability in this industry. Since insurance products are quite homogeneous, at least in personal lines, product differentiation is not an effective strategy for a new entrant to gain businesses over a short period of time. Therefore, price competition is the commonly-adopted strategy for new entrants.

There are several reasons for a new entrant to do so. First, undercutting competitors is an effective method to gain business quickly and may not result in retaliation by incumbent insurers. This strategy may succeed because a new entrant is usually fairly small, and thus the effect of his price-cutting behavior may go unnoticed by most incumbent insurers. Second, an entrant usually holds a very optimistic attitude towards its new insurance businesses; otherwise it will not venture into this market. However, the optimistic attitude, which justifies the entrant's low-price strategy, may result in underestimation of the expected losses of underwriting. Third, a rational entrant may realize that the risk pool of customers it faces is worse than the population, which will result in higher expected losses than incumbent insurers. Hypothesis 2 above illustrates this point. By offering lower price, the new entrant may expect to attract customers from those incumbent insurers, which may help to improve the risk pool and thus reduce the expected losses. Lastly, if buyers are insensitive to insurer's default risk, which is likely true in short-tail personal lines of insurance such as homeowners insurance, a new entrant or a small incumbent insurer may offer a much lower price compared to sound, large incumbents. The buyers' indifference to an insurer's default risk may be due to the existence of state insurance guaranty funds. An insurer's willingness to incur default risk depends on the value of tangible and intangible capital at stake if it goes bankrupt (Harrington and Danzon 1994). Intangible capital mainly includes goodwill and the client list, which may generate above-normal profit in the future. For a new entrant or a small insurer, both their tangible and intangible capital is usually minimal, thus they have fewer solvency concerns. Therefore, these insurers can earn profit in the case of favorable claims outcomes, and go broke in case of bad outcomes from loss claims and leave the state insurance guaranty fund to hold the bag. This is the moral hazard hypothesis tested by Harrington and Danzon (1994).

VI.2. Strategy of Incumbent Insurers

Facing a few aggressive but small entrants, large incumbent insurers may still maintain their prices and not respond to the entrants' aggressive price-cutting behavior, since the loss of their market share is fairly small and their profitability won't be affected too much. Also, because of their relatively large size, any aggressive pricing behavior won't go without notice in the market, and may trigger similar price-cutting behavior by other incumbent insurers to protect their own market shares. Therefore, large incumbent insurers are hesitant to respond to the aggressive behavior of a few small entrants. However, if a large number of entrants enter the market with aggressive pricing strategies, market shares for incumbent insurers may decrease significantly. Since the loss of market share is very hard to regain, incumbent insurers will respond to the aggression of those new entrants by cutting prices. Another incentive for incumbent insurers to cut price is to keep their expected, long-run profits from renewal business. "*Renewal business is generally more profitable than new business, and insurers strive to maintain policyholder loyalty. An incumbent insurer may reduce its own rates to avoid the loss of profitable renewal business to a competitor*." (Feldblum 1993) To do so, they may have lower profitability or even incur losses for a short period of time. However, this strategy can protect their hard-won market share, prevent potential new entrants from successfully entering this market. Therefore, strategically speaking, this strategy is a rational choice between short-term losses and long-term profitability.

If a large incumbent insurer starts price cutting in response to the pricing strategy of new entrants, it may result in a self-perpetuating tit-for-tat (Funenberg and Tirole 1991) response from other insurers in the market. In other words, once a large incumbent insurer defects from his current pricing scheme in response to new entrants, it also undercuts other incumbents, which may trigger the tit-for-tat strategy where other incumbents follow suit. Therefore, an industry-wide price cut ensues and insurers' profits drop. This is the soft market condition in an underwriting cycle. Many new entrants and even small incumbent insurers can hardly maintain their businesses, due to the extended low insurance price levels and underwriting losses, and have to withdraw from the market. After a period of time when the threat of aggressive entries is mitigated, some major insurers jack up their price to increase their profitability, other incumbents follow suit to prevent a prolonged price war. At the same time, as the fight for market share among insurers eases, insurers will be more prudent in underwriting insurance business, and many people, who are regarded by insurers as high risk, may have great difficulty in obtaining insurance coverage. This is the hard market condition in an underwriting cycle.

VII. Conclusions

In this article, we set out to investigate the existence of the winner's curse in the homeowners insurance and product liability insurance markets. We build a basic economic model to examine how the entrance of new insurers affects the underwriting profitability of incumbent insurers. The model predicts that entrant insurers suffers from the winner's curse and large insurers experience better underwriting results.

Our empirical analysis uses loss ratios for homeowners insurance and product liability insurance during 1995-2001 to test the two hypotheses generated from our basic economic model. In the case of homeowners insurance, we fail to find evidence that new entrant insurers are less profitable in underwriting than incumbent insurers. However, we do find evidence that larger insurers tend to be more profitable in underwriting than their smaller competitors, which provides support to our second hypothesis.

As for product liability insurance, new entrants without any prior underwriting experience in property and liability insurance suffer worse underwriting results, whereas new entrants with expertise in underwriting other lines of insurance do not differ systematically in underwriting profitability. This finding suggests that the first type of new entrants succeed in gaining market share but at the cost of higher underwriting losses in the product liability insurance market. In this sense, we say that the first type of new entrants suffers the winner's curse. We also find weak evidence that larger insurers may enjoy more favorable realization of claim costs, but the evidence is not statistically significant.

Moreover, we discuss how the strategic interactions between new entrants and incumbent insurers not only can result in the winner's curse but also may generate underwriting cycles in the insurance market. However, a theoretical analysis of the formation of an underwriting cycle demands a multi-period dynamic economic model, and this is left for future research.

Table 1: Variable Definitions

Variable	Definition
Loss Ratio	total direct and assumed losses incurred / total direct and assumed premiums earned; line-specific

LOB Entrant	a dummy variable equals one if the insurer did not write in the line of insurance in question but had positive net premiums written in other lines five years ago; line-specific
Industry Entrant	a dummy variable equals one if the insurer did not write in the line of insurance in question and had zero net premiums written in other lines five years ago; line-specific
Firm Size	natural logarithm of total admitted assets; firm-specific
Mutual	a dummy variable equal to one if it is a mutual or reciprocal insurer
Direct	a dummy variable equal to one if the insurer is a direct writer
Leverage 1	total liabilities / total admitted assets; firm-specific
Leverage 2	reinsurance recoverable / total admitted assets; firm-specific
LOB Concentration	premiums written in a certain line / total premiums written of the insurer; line-specific
LOB Growth Rate	(premiums written in a certain line in year t / premiums written in the same line in year t-1) – 1; line-specific
Firm Growth Rate	(premiums written in year t / premiums written in year t-1) – 1; firm-specific
Loss Reserve Error	(losses as actually developed as of year t+5 - originally reported incurred losses in year t) / originally reported incurred losses in year t; line-specific
Coastal States	dummy variable equal to one if the insurer is domiciled in a hurricane-prone state; firm-specific

Table 2: Fixed-Effects Model with Robust Standard Errors

Dependent Variable: Loss Ratio

	Homeowners		Product Liability	
Independent Variables	Coeff.	t-Stat	Coeff.	t-Stat
Intercept	357.16	1.71*	10.97	0.92
Firm Size	-20.55	-1.67*	-0.46	-0.70
LOB Entrant	-17.89	-1.08	1.19	1.53
Industry Entrant	8.58	0.56	0.34	2.32**
LOB Premium Growth Rate	-3.78	-3.47***	0.00	0.00
Firm Premium Growth Rate	3.56	3.45***	0.19	0.73
Loss Reserve Error	0.41	0.78	0.03	3.69***
Liabilities / Assets	34.33	1.13	-2.08	-0.92

Reinsurance Recoverable / Assets	92.42	1.02	1.51	0.70
LOB Concentration	-13.37	-0.41	-2.55	-0.78
Mutual	3.56	1.01	0.65	2.01**
Direct	-4.02	-1.50	0.89	2.57***
Coastal States	17.07	1.15		
year1996	-1.91	-1.57	0.33	2.09**
year1997	1.57	0.86	0.41	3.57***
year1998	5.92	1.86*	0.73	2.30**
year1999	12.01	1.36	0.89	3.29***
year2000	3.83	0.91	1.06	3.74***
year2001	0.95	0.32	0.93	2.58***
R^2 (within)		81.41%		11.47%
N		4130		1689

[a]The t-statistics are calculated with White standard errors, which are corrected for cross-sectional heterogeneity.

[b]***Significant at 1% level; **significant at 5% level; *significant at 10% level.

VIII. References

Cummins, D. & Outreville, F. (1987). An International Analysis of Underwriting Cycles in Property-Liability Insurance. *Journal of Risk and Insurance 54*, 246-262.

Cummins, D. (1990). Multi-period Discounted Cash Flow Ratemaking Models in Property-Liability Insurance. *Journal of Risk and Insurance 57*, 79-109.

Cummins, D. & Danzon, P. (1997). Price, Financial Quality, and Capital Flows in Insurance Markets. *Journal of Financial Intermediation 6*, 3-38.

Doherty, N. & Garven, J. (1995). Insurance Cycles: Interest Rates and the Capacity Constraint Model. *Journal of Business 68*, NO 3, 383-404.

Eckles, D.L. & Halek, M. (2010). Insurer Reserve Error and Executive Compensation. *Journal of Risk and Insurance 77*, 329-346.

Feldblum, S. (1992). Underwriting Cycles and Insurance Solvency. Casualty Actuarial Society Discussion Paper.

Fudenberg, D. & Tirole, J. (1991). *Game Theory*. The MIT Press.

Fung, H., Lai, G., Patterson, G. & Witt, R. (2000). Underwriting Cycles in Property and Liability Insurance: An Empirical Analysis of Industry and By-Line Data. *Journal of Risk and Insurance 65*, 539-561.

Gron, A. (1994). Capacity Constraints and Cycles in Property-Casualty Insurance Markets. *Rand Journal of Economics 25*, 110-127.

Haley, J. (1993). A cointegration Analysis of the Relationship Between Underwriting Margins and Interest Rates: 1930-1989. *Journal of Risk and Insurance 60*, 480-493.

Harrington, S. & Danzon, P. (1994). Price Cutting in Liability Insurance Markets. *Journal of Business 67*, 511-538.

Harrington, S. & Niehaus, G. (2000). Volatility and Underwriting Cycles. *Handbook of Insurance*, edited by Georges Dionne, Boston: Kluwer Academic Publishers, Chapter 20.

Lai G., Witt, R., Fung, H., MacMinn, R. & Brockett, P. (2000). Great (and Not So Great) Expectations: An Endogenous Economic Explication of Insurance Cycles and Liability Crises. *Journal of Risk and Insurance 67*, 617-652

Kraus, A. & Ross, S. (1982) The Determination of Fair Profits for the Property-Liability Insurance Firm. *Journal of Finance*, Vol. XXXVII, NO 4, 1015-1028.

Mayers, D. & Smith, C.W. (1990). On the Corporate Demand for Insurance: Evidence from the Reinsurance Market. *Journal of Business 63*, 19-40.

Niehaus, G. & Terry, A. (1993). Evidence on the Time Series Properties of Insurance premiums and Causes of the Underwriting Cycle: New Support for the Capital Market Imperfection Hypothesis. *Journal of Risk and Insurance 60*, 466-479.

Petroni, K.R. (1992). Optimistic Reporting in the Property-Casualty Insurance Industry. *Journal of Accounting and Economics 15*, 485-508.

Shaffer, S. (1998). The Winner's Curse in Banking. *Journal of Financial Intermediation 7*, 359-392.

Tu, P. (2010). Winner's Curse and the Competitive Effect: Measuring Competition in the Viatical Settlement Market, MIMEO, Stanford University.

Weiss, M.A. (1985). A Multivariate Analysis of Loss Reserving Estimates in Property-Liability Insurers. *Journal of Risk and Insurance 52,* 199-221.

Winter, R. (1994). The Dynamics of Competitive Insurance Markets. *Journal of Financial Intermediation 3*, 379-415.