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Are 1997 Asian Twin Crises Contagious?

Chu-Sheng Tai

Abstract

Until recently, currency and banking crises (twin crises) have been largely treated as separate phenomena, but the recent experiences of several Southeast Asian countries indicate that both banking and currency crises can occur jointly. However, most of empirical literature has focused on the determinants of each type of crisis in isolation and little empirical work to date has systematically investigated the association of the twin crises. In particular, no study has tested if there is a pure contagion effect between the twin crises. This paper tries to fill this gap by examining the pure contagion effect both *within* a country and *across* countries using data from Japan and Thailand. The empirical results indicate that within a country there is a positive feedback relation between Thai banking sector and its currency market, indicating a within-country bi-directional contagion-in-mean effect between the twin crises. Across countries there are unidirectional relations between Thai banking sector and Japanese currency market and between Japanese banking sector and Thai currency market, suggesting a unidirectional cross-country contagion-in-mean effect between the twin crises. As for contagion-in-volatility, it is not significant, implying that there is no incremental increase in volatility during the 1997 Asian crisis. Finally, the global banking industry risk is significantly priced.

I. Introduction

Because banking and currency crises (the *twin* crises) have often been extremely costly in terms of reduced income and increased unemployment to their own countries as well as others, the joint occurrence of twin crises associated with the recent 1997 Asian financial turmoil has drawn renewed attention to the interrelationship between these two phenomena. There are several theoretical reasons to explain why there is a link between the twin crises. However, most of empirical literature has focused on the determinants of each type of crisis in isolation and little empirical work to date has systematically investigated the association of the twin crises with a few exceptions (e.g., Kaminsky and Reinhart, 1999; Glick and Hutchison, 2000). Kaminsky and Reinhart (1999) find that problems in the banking sector typically precede a currency crisis, which in turn deepens the banking crisis. In other words, banking and currency crises can generate a vicious circle by amplifying each other. Similarly, Glick and Hutchison (2000) conclude that the linkage between the onset of currency and bank crises in emerging markets is strong, indicating that currency crises feed into the onset of banking problems and vice versa. However, none of the above-mentioned two studies explicitly tests whether there is a “pure” contagion effect between the twin crises. Masson (1999) argues that there are three main channels that financial markets turbulence can spread from one country to another: monsoonal effects, spillovers and pure contagion effects. ‘Monsoonal’ effects, or ‘contagions from common causes’ tend to occur when affected countries have similar economic fundamentals or face common external shocks. The second type of financial market inter-linkages arises from spillover effects, which may be due to trade linkages or financial interdependence. The first two channels of financial crises can be categorized as fundamentals-driven crises since the affected countries share some macroeconomic fundamentals, which implies that the transmission of financial crises is due to the interdependence among those countries and not necessarily due to

contagion. The third transmission channel is the pure contagion effect. Contagion here refers to the cases where crisis in one country/market triggers a crisis elsewhere for reasons unexplained by macroeconomic fundamentals. For instance, a crisis in one country may lead creditors and investors to pull out from other countries over which they have a poor understanding resulting from information asymmetries. The linkages between the twin crises studied by Kaminsky and Reinhart (1999) and Glick and Hutchison (2000) are considered to be fundamentals-driven crises, which are due to the interdependence and not necessarily due to contagion. Consequently, it will be interesting to see if there are any pure contagion effects between banking and currency crises. Forbes and Rigobon (2002) recently test contagion using national stock market data, and conclude that there is no contagion during the 1997 Asian crisis, 1994 Mexican devaluation, and 1987 U.S. market crash.¹ However, they also point out that their empirical results will be biased if the assumptions of no omitted variables (i.e. no exogenous global shocks) and endogeneity (i.e. no feedback from one market to another market) do not hold in their model. As a result, it deserves another look whether there is really no contagion during the 1997 Asian crisis if possible exogenous global shocks and feedback effects are controlled. To achieve that, the current paper makes the following contributions in contagion literature. First, I define 'contagion' as significant spillovers of country- or market-specific idiosyncratic shocks during the crisis after economic fundamental or systematic risk has been accounted for. In testing for contagion, its existence depends on the economic fundamentals used. Unfortunately, there is disagreement on the definitions of the fundamentals. To control for the economic fundamentals, most empirical studies tend to choose those fundamentals arbitrarily, such as by using macroeconomic variables, dummies for important events, and time trends. The problem with these control variables is that contagion is not well defined without reference to a theory. To overcome this problem, I rely on an inter-temporal capital asset pricing model (ICAPM), which provides me a theoretical basis in selecting the economic fundamentals. The economic fundamentals under ICAPM are the global banking industry and world market risks, so the evidence of contagion is based on testing whether idiosyncratic risks - the part that cannot be explained by the global banking industry and world market risks, are significant in describing the dynamics of conditional means and volatilities of banking sector and currency returns during the 1997 Asian crisis period. Second, in addition to the contributions in overcoming the drawback of arbitrarily choosing economic fundamentals in testing contagion effects in previous studies, the methodology used in this paper is also unique. In particular, I utilize an asymmetric Multivariate General Autoregressive Conditional Heteroscedastic in Mean (MGARCH-M) approach to model the conditional mean spillovers during the crisis period, in addition to capturing the time dependencies in the second moments of asset returns, a stylized property found in most financial time-series. Finally, this paper tests contagion between twin crises not only *within* a country, but also *across* countries. In other words, I can examine whether there is contagion not only between a country's banking sector and its currency market, but also between a country's banking sector (currency market) and another country's currency market (banking sector).

The remainder of the paper is organized as follows. Section II presents the theoretical

¹Forbes and Rigobon (2002) define contagion as a significant increase in cross-market linkages after a shock to one country or group of countries, and find that there was virtually no increase in unconditional correlation coefficients during the 1997 Asian crisis and thus conclude that there was no contagion but interdependence. However, they also point out that their definition of contagion is not universally accepted, and therefore it warrants another examination of whether contagion did occur during 1997 Asian crisis.

asset pricing model used to control for systematic risks, and the econometric methodology employed to estimate the model. Several test hypotheses are presented in Section III. Section IV describes the data and empirical results are reported in Section V. Some conclusions are offered in the final section.

II. The Model and Methodology

In this paper, I consider a two-factor model where the two factors are global market and industry risks. In particular, I test the following model:

$$R_{i,t} = \beta_i + \lambda_{mkt,t-1} Cov_{t-1}(R_{i,t}, R_{mkt,t}) + \lambda_{ind,t-1} Cov_{t-1}(R_{i,t}, R_{ind,t}) + \varepsilon_{i,t} \quad \forall i \quad (1)$$

where $R_{i,t}$ is the gross return of asset i at time t , “ mkt ” denotes global market risk and “ ind ” is the global industry risk.

The conditional ICAPM in equation (1) has to hold for every asset. However, the model does not impose any restrictions on the dynamics of the conditional second moments. Several multivariate GARCH (MGARCH) models have been proposed to model the conditional second moments. Among popular MGARCH models, the BEKK model is better suited for the purpose of this paper because it not only guarantees that the covariance matrices in the system are positive definite, but also allows the conditional variances and covariances of different markets to influence each other, which is very important for testing contagion in this paper. As a result, a BEKK structure with asymmetric volatility effects is selected over the other MGARCH specifications to model the conditional second moments of banking sector returns and to test contagion effects among them. Specifically, the dynamic process for the conditional variance-covariance matrix of asset returns is specified as:

$$\begin{aligned} H_t = & C' C + A' \cdot H_{t-1} \cdot A + B' \cdot \varepsilon_{t-1} \varepsilon_{t-1}' \cdot B + D' \cdot \eta_{t-1} \eta_{t-1}' \cdot D \\ & + G' \cdot \psi_{t-1} \psi_{t-1}' \cdot G + K' \cdot \xi_{t-1} \xi_{t-1}' \cdot K + L' \cdot \mu_{t-1} \mu_{t-1}' \cdot L + M' \cdot \nu_{t-1} \nu_{t-1}' \cdot M + N' \cdot \theta_{t-1} \theta_{t-1}' \cdot N \quad (2) \\ & + P' \cdot \varsigma_{t-1} \varsigma_{t-1}' \cdot P + Q' \cdot \tau_{t-1} \tau_{t-1}' \cdot Q + S' \cdot \upsilon_{t-1} \upsilon_{t-1}' \cdot S + V' \cdot \zeta_{t-1} \zeta_{t-1}' \cdot V + Y' \cdot \rho_{t-1} \rho_{t-1}' \cdot Y \end{aligned}$$

where H_t is 6×6 time-varying variance-covariance matrix of asset returns; C is restricted to be a 6×6 upper triangular matrix and A , B , D , G , K , L , M , N , P , Q , S , V , and Y are diagonal matrices. The 6×1 vector, η_{t-1} , captures the asymmetric impact that the vector of past negative shocks has on the conditional covariance matrix in a manner similar to that of Glosten et al. (1993). The effects of past shocks of other markets on a market's conditional variance or conditional covariances (volatility spillovers) are captured by the vectors ψ_{t-1} , ξ_{t-1} , μ_{t-1} , ν_{t-1} , and θ_{t-1} .

Several papers in the literature show that volatility spillovers between markets are asymmetric in the sense that negative innovations in a market increase volatilities in other markets more than do positive innovations in that market. Consequently, it will be interesting to see whether such asymmetric volatility spillovers do occur during the crisis. The vectors ς_{t-1} , τ_{t-1} , υ_{t-1} , ζ_{t-1} , and ρ_{t-1} capture this asymmetry. The difference between the first set of innovation vectors (ψ_{t-1} , ξ_{t-1} , μ_{t-1} , ν_{t-1} , θ_{t-1}) and the second set of innovation vectors (ς_{t-1} , τ_{t-1} ,

$v_{t-1}, \zeta_{t-1}, \rho_{t-1}$) is that the first set captures overall volatility spillovers during the *entire* sample period, while the second set captures the asymmetric volatility spillovers during the *crisis* period. By including vectors $\varsigma_{t-1}, \tau_{t-1}, v_{t-1}, \zeta_{t-1}$, and θ_{t-1} , I can then test the incremental influences of volatility shocks on the banking sectors and currency markets, which is a true test of contagion-in-volatility.

The parameterization of the conditional covariance matrix can therefore be viewed as an extension of the diagonal BEKK representation of Engle and Kroner (1995) that allows for past shocks from other markets to influence conditional variances and covariances, for asymmetries in the impacts of these shocks. This representation of the conditional covariance matrix differs from the most general BEKK form in that conditional variances are not permitted to depend on cross-products of lagged shocks, lagged conditional variances of other markets, and lagged conditional covariances with other markets. Similarly, conditional covariances are not influenced by lagged squared shocks and lagged conditional variances in other markets. The parameterization presented here facilitates testing of the null hypothesis of no volatility spillover effects against the alternative that conditional variances depend on other markets only through their past squared shocks. Even with this diagonal BEKK parameterization, it still requires the estimation of 78 parameters in the conditional covariance matrix.

Under the assumption of conditional normality, the log-likelihood to be maximized can be written as:

$$\ln L(\varpi) = -\frac{TN}{2} \ln 2\pi - \frac{1}{2} \sum_{t=1}^T \ln |H_t(\varpi)| - \frac{1}{2} \sum_{t=1}^T \varepsilon_t(\varpi)' H_t(\varpi)^{-1} \varepsilon_t(\varpi) \quad (3)$$

where ϖ is the vector of unknown parameters in the model. Since the normality assumption is often violated in financial time series, I use quasi-maximum likelihood estimation (QML) proposed by Bollerslev and Wooldridge (1992) which allows inference in the presence of departures from conditional normality. Under standard regularity conditions, the QML estimator is consistent and asymptotically normal and statistical inferences can be carried out by computing robust Wald statistics. The QML estimates can be obtained by maximizing equation (3), and calculating a robust estimate of the covariance of the parameter estimates using the matrix of second derivatives and the average of the period-by-period outer products of the gradient. Optimization is performed using the Broyden, Fletcher, Goldfarb, and Shanno (BFGS) algorithm.

III. Hypothesis Testing

A. Testing time-varying risk premium

The conditional ICAPM with a constant (positive) price of risk is usually rejected by the data. These rejections could be driven by the fact that in some periods realized return is a bad proxy for expected return, even if realized return is a reasonable proxy over longer periods of time. The increased flexibility provided by a time-varying price of risk allows the conditional ICAPM to better accommodate such periods and, as a consequence, the model is not rejected. This time-varying price of risk is economically appealing in the sense that investors use all available information to form their expectations about future economic performance, and when

the information changes over time, they will adjust their expectations and thus their expected risk premia when holding different risky assets. However, this does not come without a cost. In some periods the estimated price of risk is inevitably negative and in addition it is probably a very noise estimate of the true price of risk and hence it is not surprising if the estimate occasionally is negative. An estimated negative price of market risk is equivalent to a negative expected return on the world market portfolio. In other words, in periods when the price of market risk is negative, the world market portfolio is not conditionally efficient. This is evidence against the theoretical model developed, for example, by Merton (1980) only if we believe that expected return sometimes is negative in equilibrium. The competing interpretation is that estimated negative expected returns simply reflect that the econometric model adopts to negative realized returns. A typical suggestion in the literature is to impose the additional restriction $\lambda_{mkt,t-1} > 0$ during the estimation. However, this auxiliary restriction appears to assume the difficulty away rather than solve it. For example, De Santis and Gerard (1997) argue that the rejection of one of their asset pricing tests is a consequence of the positivity restriction or the rejection is indeed driven by the inability of their model to accommodate negative expected returns. As a result, in this paper I allow time-varying price of both world market and global industry risks, but do not impose positivity restriction on $\lambda_{mkt,t-1}$. Specifically, both $\lambda_{mkt,t-1}$ and $\lambda_{ind,t-1}$ are modeled as linear functions of the predetermined information variables, and are parameterized as follows.

$$\lambda_{mkt,t-1} = \varphi'_{mkt} Z_{t-1} \quad (4)$$

$$\lambda_{ind,t-1} = \varphi'_{ind} Z_{t-1} \quad (5)$$

where Z_{t-1} is a vector of information variables observed at the end of time $t-1$ and φ 's are time-invariant vectors of weights. Given the dynamics of prices of risks, I can then test the whether the world prices of market and industry risks are significantly priced and change over time by testing whether the information variables in Z_{t-1} are significant in addition to significant GARCH parameters.

B. Testing Contagion in Mean²

To test whether a country's (or a market's) past idiosyncratic shocks have significant impact on the other markets' condition returns (contagion-in-mean) during the Asian crisis, I incorporate past market-specific innovations into equation (1). Specifically, the equation (1) can be modified as:

$$R_{i,t} = \beta_i + \lambda_{mkt,t-1} Cov_{t-1}(R_{i,t}, R_{mkt,t}) + \lambda_{ind,t-1} Cov_{t-1}(R_{i,t}; R_{ind,t}) + \sum_{i,j} \phi_{ij} \varepsilon_{j,t-1} + CD \left(\sum_{i,j} \omega_{ij} \varepsilon_{j,t-1} \right) + \varepsilon_{i,t}; \forall i, j \quad (6)$$

where “CD” is a dummy variable, which is equal to one during the crisis and zero otherwise. In testing the contagion-in-mean effects, I allow the past market-specific innovations to affect banking sector and currency returns in the *entire* sample period, and then test whether there are any incremental influences of past innovations on these returns during the *crisis* period. Thus, the contagion-in-mean hypothesis can be examined by testing whether the coefficients, ω_{ij} ($i \neq j$) are individually or jointly significant after the systematic risks have been accounted for.

²Due to the space constraint, I do not present the test results for volatility spillover and contagion-in-volatility but they are available upon request.

IV. Data and Summary Statistics

According to Table 2 in Kaminsky and Reinhart (2001), Japanese banks were lending four times as much as U.S. banks to emerging Asia, and the five crisis countries – Indonesia, Malaysia, Philippines, South Korea, and Thailand listed in their Table 2 accounted for two-third of all loans to emerging markets. In addition, Japanese banks were most exposed to Thailand--which is the first country to experience a crisis. Consequently, I examine the pure contagion effects between the twin crises using data from Japan and Thailand. In particular, I use weekly returns on Thai and Japanese banking sector total return (dividend included) indices denominated in local currency and their bilateral exchange rates with respect to U.S. dollar. U.S. dollar denominated global banking industry (*BANK*) and world market total return indices (*WORLD*) are used to proxy global industry and world market risks, respectively. Weekly returns are calculated by taking the logarithmic first differences of the total return indices and bilateral exchange rates.

I select a set of information variables that have been widely used in the international asset pricing literature. They are excess dividend yield measured by the dividend yield on *WORLD* in excess of the 7-day Eurodollar interest rate (*DIV*), the change in the U.S. term premium, measured by the first difference of the yield difference between 10-year Treasury constant maturity rate and 7-day Eurodollar rate ($\Delta USTP$), the U.S. default premium, measured by the yield difference between Moody's Baa-rated and Aaa-rated U.S. corporate bonds (*USDP*), the lagged return on *WORLD*, and a constant (*CONSTANT*).

The weekly data ranges from April 6, 1990 to March 23, 2001, which is a 573-data-point series. However, I work with rates of return and use the first difference of information variables, and finally all the information variables are used with a one-week lag, relative to the return series; that leaves 571 observations expanding from April 20, 1990 to March 23, 2001. All the data are extracted from Datastream.

Table 1 presents summary statistics of the data and the correlation matrix for the returns. As can be seen, among all the return series *WORLD* has the highest weekly mean return of 0.164%, and, Japanese banking sector returns (*BJP*), on the other hand, has the lowest weekly mean return of -0.165%. Regarding the currency returns, the weekly mean return is negative for Thai bhat (-0.094%). This negative mean return is due to the significant depreciation of Thai bhat during the 1997 Asia crisis. For comparison, Table 1 also reports the same summary statistics during the 1997 Asian crisis period. As can be seen, all the weekly mean returns are negative except *WORLD*, implying both Thai and Japanese banking sectors and their currency markets and global banking industry were negatively affected by the crisis. In addition, almost all the pair-wise unconditional correlation coefficients are significantly higher during the crisis period than those for the entire sample period, indicating a strong market comovements between banking and currency markets during the crisis. Based on these increases in market comovements, it will be interesting to examine if these increases during the crisis are due to interdependence or contagion.

Table 1 also reports Bera-Jarque and Ljung-Box statistics. Bera-Jarque test rejects normality for all return series for any standard level of confidence. The Ljung-Box test statistics for raw returns (*LB*(16)) are significant at the 1% level only for Thai banking sector and

currency market. However, for squared returns, $LB^2(16)$ is significant at the 1% level in all cases, indicating strong nonlinear dependencies in the sample. This is consistent with the volatility clustering observed in most stock markets, suggesting that the use of a conditional heteroscedasticity model is advisable.

Table 1: Summary statistics of banking sector, currency, and factor returns

Returns	<i>BTH</i>	<i>BJP</i>	<i>CTH</i>	<i>CJP</i>	<i>BANK</i>	<i>WORLD</i>
Full sample						
Mean (%)	0.08	-0.17	-0.09	0.04	0.13	0.16
Std. Dev. (%)	6.54	3.66	1.69	1.70	2.37	1.86
Minimum (%)	-26.78	-14.84	-19.36	-5.96	-8.93	-9.01
Maximum (%)	37.16	13.12	9.83	14.60	10.37	7.71
<i>BJP</i>	0.19					
<i>CTH</i>	0.19	0.14				
<i>CJP</i>	0.09	0.14	0.17			
<i>BANK</i>	0.35	0.65	0.15	0.26		
<i>WORLD</i>	0.35	0.46	0.13	0.24	0.84	
Crisis period						
Mean (%)	-1.20	-0.86	-0.60	-0.02	-0.07	0.11
Std. Dev. (%)	10.76	4.83	4.41	2.68	3.10	2.24
Minimum (%)	-20.99	-13.84	-19.35	-4.43	-8.51	-5.31
Maximum (%)	27.42	12.45	9.83	14.60	10.37	7.71
<i>BJP</i>	0.28					
<i>CTH</i>	0.21	0.26				
<i>CJP</i>	0.25	0.32	0.25			
<i>BANK</i>	0.61	0.63	0.28	0.18		
<i>WORLD</i>	0.61	0.53	0.26	0.01	0.94	1.00
<i>B – J</i>	397.57**	78.83**	37459.81**	2372.68**	82.66**	164.54**
<i>LB(16)</i>	34.81**	23.18	86.45**	17.65	13.87	11.46
<i>LB²(16)</i>	302.73**	36.27**	100.68**	30.69*	139.42**	110.09**

* and ** denote statistical significance at the 5% and 1% level, respectively.

V. Empirical Results

I. The evidence of time-varying risk premia

First, considering the test results for the existence of time-varying risk premia for global industry and market risks. The results are very encouraging. For example, the joint hypothesis of zero prices of industry and market risks is strong rejected by Wald statistic ($Wald = 966.970$) with a p-value of zero. The joint hypothesis of constant prices of industry and market risks is also significantly rejected ($Wald = 957.779$). Next, the joint hypothesis of constant price of industry risk is strongly rejected by Wald test ($Wald = 35.741$), and the joint hypothesis of constant price of market risk is also rejected ($Wald = 88.268$). These test results imply that both industry and market risks are not only priced but also time varying. The information variables useful in predicting the dynamics of the risk prices include excess dividend yield (DIV), the

default premium (*USTP*), and the lagged world market return (*WORLD*) as evidenced from the hypothesis tests (#7, #9 and #10) reported in Table 3, and the statistical significance of individual parameter estimates, φ , depicted in Panel A of Table 2. The significant time-varying industry risk premium found here shed a new light on the pricing of global banking industry risk since previous studies conclude that it is not priced.

II. Evidence of mean spillover and contagion in mean

After controlling the systematic industry and market risks, I can then test contagion-in-mean effects among two national banking sectors and their currency markets. However, before that, I need to control for the overall mean spillovers in the entire sample period, so any incremental mean spillover effects can be tested during the crisis period. It can be seen from Table 4 that the hypothesis of no mean spillover (#1 - #4) is rejected at the 1% level for Thai banking sector (*BTH*) and two currency markets (*CTH* and *CJP*). To find out the sources of mean spillover for these three markets, one can check statistical significance of individual mean spillover parameter, ϕ , reported in Table 2. Table 2 indicates that the source of mean spillover for Thai banking sector (*BTH*) basically comes from its currency market (*CTH*) and Japanese banking sector (*BJP*) since $\phi_{BTH,CTH} = -0.479$ and $\phi_{BTH,BJP} = 0.091$ are statistically significant at the 1% level based on the robust standard errors. This finding indicates that the chain of causality, as stressed by Miller (1996), can run from currency crises to the onset of banking crises. Miller (1996) shows that a speculative attack on a currency can lead to a bank crisis if deposit money is used to speculate in the foreign exchange market and banks are “loaned up.” In addition, both Rojas-Suarez and Weisbrod (1995) and Obstfeld (1994) argue that a currency crisis may lead to problems in a vulnerable banking sector if policy makers respond to the pressure on the exchange rate by sharply raising interest rates. As for *CTH*, the source of mean spillover comes from *CJP* ($\phi_{CTH,CJP} = 0.086$). Similarly, the source of spillover for *CJP* is *CTH* ($\phi_{CJP,CTH} = 0.084$), suggesting a feedback relation between these two currency markets. These results can also be confirmed by the significant Wald statistics for the hypothesis tests (#6 to #8) reported in Table 4. By comparing the magnitude of the three Wald statistics, it appears that the two currency markets are responsible for generating return shocks for the other markets during the sample period.

Now, considering the test results of contagion-in-mean effects, as shown in Table 4, similar to the findings for mean spillovers, these effects are statistically significant at the 1% level in three cases: *BTH*, *CTH*, and *CJP*. For example, the joint hypothesis of no contagion in return shocks for *BTH* ($H_0: \omega_{BTH,j} = 0; \forall j = BJP, CTH, CJP$) during the crisis is strongly rejected by the Wald statistic ($Wald = 35.319$) at the 1% level. The same rejection also applies to the other two cases. To find out the sources of contagion in return shocks for *BTH*, one can again examine the individual significance of contagion-in-mean parameter, $\omega_{BTH,j}$, reported in Table 2 based on the robust standard errors. Basically, the current returns in *BTH* are affected by past return shocks in *CTH* ($\omega_{BTH,CTH} = 0.247$). For *CTH*, its current returns are affected by the past return shocks in the two banking sectors. Finally, the current returns for *CJP* are influenced by the past return shocks from Thai banking ($\omega_{CJP,BTH} = 0.038$) and currency markets

($\omega_{CJP,CTH} = -0.096$). By examining the significance of these individual contagion-in-mean parameters, several findings emerge between twin crisis during the 1997 crisis period. First, within a country there is a positive feedback relation between Thai banking sector and its currency market. Second, across countries there are unidirectional relations between Thai banking sector and Japanese currency market with return shocks running from *BTH* to *CJP*, and between Japanese banking sector and Thai currency market with return shocks running from *BJP* to *CTH*, suggesting a shock in a country's banking sector has significant impact on the other country's currency market. Finally, there is also a unidirectional relation between two currency markets with return shocks running from *CTH* to *CJP*. This feedback and unidirectional relations among two banking sectors and two currency markets during the crisis can be further confirmed by the hypothesis tests (#13 - #16) reported in Table 4. Although all the markets can be sources of contagion-in-mean effects as Wald test statistics reject all the hypotheses, both banking sector and currency market in Thailand seem to be the major sources in generating those contagion-in-mean effects because its two Wald test statistics are relatively higher than those for Japanese banking sector and currency market. The significant pure contagion effects found here imply that the link between the twin crises can not be explained beyond the common fundamentals shared by both banking sector and currency market. One possible explanation for this finding is a liquidity shortage of international investors. Whenever international investors face large losses in one crisis country (e.g. because of margin calls) they may be forced to rearrange their portfolio thereby redrawing money from other countries. The smaller the referring market is the more likely such transactions will influence market prices. Thus, contagion effects because of international liquidity shortages are likely to happen in small markets like they are present in emerging markets. Another possible explanation for contagion is that a group of countries might be perceived by market participants as very similar with respect to aspects like e.g. culture though in fact being quite heterogeneous. If one country of this group is suffering a currency crisis market participants might wrongly expect that other countries of the group are also likely to suffer a crisis and start to attack their currencies. This wrong misperception might be due to incomplete or wrong information as well as to unobservable characteristics of the referring countries. Finally, in an inefficient foreign exchange market a speculative attack might also be started by so-called herding behavior. The term "herding" in general describes the phenomenon that market participants mimic the behavior of other market participants. Such a herding behavior in foreign exchange markets can easily lead to a currency crisis.

Table 2: Quasi-Maximum Likelihood estimation of the conditional ICAPM

Panel A: Conditional mean process						
Prices of world market and industry risks						
	<i>CONSTANT</i>	<i>DIV</i>	Δ <i>USTP</i>	<i>USDP</i>	<i>WORLD</i>	
φ_{mkt}	-9.90	-2.38	33.51	59.17	-456.51	
	(4.26)*	(1.25)	(44.72)	(19.90)**	(82.37)**	
φ_{ind}	-6.23	9.87	-45.76	117.46	252.24	
	(1.06)**	(2.13)**	(34.60)	(46.20)*	(65.82)**	
Mean spillovers						
	$j = BTH$	$j = BJP$	$j = CTH$	$j = CJP$		
$\phi_{BTH,j}$	0.05	0.09	-0.48	-0.02		
	(0.02)*	(0.03)**	(0.11)**	(0.06)		
$\phi_{BJP,j}$	-0.01	-0.0	-0.08	0.01		
	(0.01)	(0.03)	(0.05)	(0.04)		
$\phi_{CTH,j}$	0.00	0.00	-0.24	0.09		
	(0.00)	(0.01)	(0.02)**	(0.02)**		
$\phi_{CJP,j}$	-0.01	0.00	0.08	0.02		
	(0.01)	(0.02)	(0.02)**	(0.03)		
Contagion in mean						
	$j = BTH$	$j = BJP$	$j = CTH$	$j = CJP$		
$\omega_{BTH,j}$	-0.03	-0.12	0.25	0.46		
	(0.04)	(0.14)	(0.09)**	(0.35)		
$\omega_{BJP,j}$	-0.01	-0.16	0.03	0.21		
	(0.02)	(0.04)**	(0.04)	(0.12)		
$\omega_{CTH,j}$	0.06	-0.05	0.06	-0.03		
	(0.02)**	(0.021)*	(0.06)	(0.06)		
Panel B: Conditional variance process						
	<i>BTH</i>	<i>BJP</i>	<i>CTH</i>	<i>CJP</i>	<i>BANK</i>	<i>WORLD</i>
a	0.95	0.96	0.81	0.94	0.96	0.97
	(0.02)**	(0.02)**	(0.02)**	(0.02)**	(0.01)**	(0.01)**
b	0.14	0.23	0.61	0.23	0.21	0.18
	(0.07)*	(0.06)**	(0.06)**	(0.06)**	(0.04)**	(0.04)**
d	1.38	1.09	-1.18	1.64	1.54	1.85
	(1.21)	(0.73)	(1.45)	(3.30)	(0.91)	(0.89)*
Volatility spillovers^a						
	$i = BTH$	$i = BJP$	$i = CTH$	$i = CJP$	$i = BANK$	$i = WORLD$
$j = BTH$		0.04	0.01	-0.02	0.01	-0.01
		(0.03)	(0.00)**	(0.01)**	(0.01)	(0.01)
$j = BJP$	0.12		-0.01	0.04	0.01	-0.00
	(0.14)		(0.01)	(0.01)**	(0.02)	(0.01)
$j = CTH$	0.36	-0.10		0.02	-0.00	0.01
	(0.46)	(0.14)		(0.05)	(0.00)	(0.01)
$j = CJP$	-0.11	-0.04	0.02		-0.01	-0.00
	(0.28)	(0.04)	(0.02)		(0.04)	(0.03)
$j = BANK$	0.04	0.03	0.01	-0.08		-0.01
	(0.09)	(0.05)	(0.01)	(0.04)		(0.02)
$j = WORLD$	0.01	-0.05	-0.04	0.02	-0.05	
	(0.16)	(0.05)	(0.02)*	(0.04)	(0.04)	

Contagion in asymmetric volatility ^a						
	<i>i = BTH</i>	<i>i = BJP</i>	<i>i = CTH</i>	<i>i = CJP</i>	<i>i = BANK</i>	<i>i = WORLD</i>
<i>j = BTH</i>		-0.11 (0.29)	-0.59 (0.56)	-0.13 (0.17)	0.04 (0.12)	0.02 (0.06)
<i>j = BJP</i>	1.09 (2.49)		1.20 (1.39)	0.13 (1.07)	0.09 (0.49)	0.08 (0.37)
<i>j = CTH</i>	-0.25 (2.27)	0.25 (0.45)		-0.01 (0.35)	-0.03 (0.09)	0.07 (0.23)
<i>j = CJP</i>	1.99 (27.55)	-0.49 (5.46)	6.83 (13.01)		-0.64 (7.99)	-0.11 (1.90)
<i>j = BANK</i>	-12.98 (14.22)	-4.86 (3.33)	-1.18 (2.51)	4.22 (2.41)		0.45 (0.42)
<i>j = WORLD</i>	14.69 (23.25)	2.01 (8.11)	-4.08 (4.75)	-5.88 (8.58)	1.68 (2.26)	

^a The reported parameter estimates for both the volatility spillover and contagion-in-asymmetric-volatility coefficients can be interpreted as follows. For example, if x_{ij} represents the volatility spillover coefficient from market j to market i , then the volatility spillover coefficient estimate from *BJP* to *BTH* is 0.121. Similarly, the volatility spillover coefficient estimate from *CTH* to *BTH* is 0.361. The reported parameter estimates for the contagion-in-asymmetric-volatility coefficients have the same interpretation as those for volatility spillover coefficients. Robust standard errors are given in parentheses. * and ** denote statistical significance at the 5% and 1% level, respectively.

Table 3: Hypothesis tests concerning prices of risks and predictability of conditioning variables

Null Hypothesis	Wald	d.f.	P-Value
1. Are the prices of industry and market and risks equal to zero? $H_0: \varphi_{ind} = \varphi_{mkt} = 0; Z_{t-1} = \{CONSTANT, DIV, \Delta USTP, USDP, WORLD\}$	966.97	10	0.00
2. Are the prices of industry and market risks constant? $H_0: \varphi_{ind} = \varphi_{mkt} = 0; Z_{t-1} = \{DIV, \Delta USTP, USDP, WORLD\}$	957.78	8	0.00
3. Is the price of industry risk equal to zero? $H_0: \varphi_{ind} = 0; Z_{t-1} = \{CONSTANT, DIV, \Delta USTP, USDP, WORLD\}$	64.03	5	0.00
4. Is the price of industry risk constant? $H_0: \varphi_{ind} = 0; Z_{t-1} = \{DIV, \Delta USTP, USDP, WORLD\}$	35.74	4	0.00
5. Is the price of market risk equal to zero? $H_0: \varphi_{mkt} = 0; Z_{t-1} = \{CONSTANT, DIV, \Delta USTP, USDP, WORLD\}$	286.53	5	0.00
6. Is the price of market risk constant? $H_0: \varphi_{mkt} = 0; Z_{t-1} = \{DIV, \Delta USTP, USDP, WORLD\}$	88.27	4	0.00
7. Is there no predictability from excess dividend yield? $H_0: \varphi_{ind,k} = \varphi_{mkt,k} = 0; \forall k = DIV$	25.67	2	0.00
8. Is there no predictability from the change in term premium? $H_0: \varphi_{ind,k} = \varphi_{mkt,k} = 0; \forall k = \Delta USTP$	2.45	2	0.29
9. Is there no predictability from the U.S. default premium? $H_0: \varphi_{ind,k} = \varphi_{mkt,k} = 0; \forall k = USDP$	23.86	2	0.00
10. Is there no predictability from the world market portfolio? $H_0: \varphi_{ind,k} = \varphi_{mkt,k} = 0; \forall k = WORLD$	30.82	2	0.00

Table 4: Hypothesis tests concerning mean spillover and contagion in mean

Null Hypothesis	Wald	d.f.	P-Value
1. Is there no mean spillover for BTH ? $H_0: \phi_{BTH,j} = 0; \forall j = BJP, CTH, CJP$	37.57	3	0.00
2. Is there no mean spillover for BJP ? $H_0: \phi_{BJP,j} = 0; \forall j = CTH, CJP, BTH$	3.25	3	0.36
3. Is there no mean spillover for CTH ? $H_0: \phi_{CTH,j} = 0; \forall j = CJP, BTH, BJP$	39.63	3	0.00
4. Is there no mean spillover for CJP ? $H_0: \phi_{CJP,j} = 0; \forall j = BTH, BJP, CTH$	16.70	3	0.00
5. Is there no mean spillover from BTH ? $H_0: \phi_{i,BTH} = 0; \forall i = BJP, CTH, CJP$	2.37	3	0.50
6. Is there no mean spillover from BJP ? $H_0: \phi_{i,BJP} = 0; \forall i = CTH, CJP, BTH$	10.54	3	0.01
7. Is there no mean spillover from CTH ? $H_0: \phi_{i,CTH} = 0; \forall i = CJP, BTH, BTH$	30.94	3	0.00
8. Is there no mean spillover from CJP ? $H_0: \phi_{i,CJP} = 0; \forall i = BTH, CTH, CTH$	31.27	3	0.00
9. Is there no contagion in return shocks for BTH ? $H_0: \omega_{BTH,j} = 0; \forall j = BJP, CTH, CJP$	35.32	3	0.00
10. Is there no contagion in return shocks for BJP ? $H_0: \omega_{BJP,j} = 0; \forall j = CTH, CJP, BTH$	3.35	3	0.34
11. Is there no contagion in return shocks for CTH ? $H_0: \omega_{CTH,j} = 0; \forall j = CJP, BTH, BJP$	23.41	3	0.00
12. Is there no contagion in return shocks for CJP ? $H_0: \omega_{CJP,j} = 0; \forall j = BTH, BJP, CTH$	31.23	3	0.00
13. Is there no contagion in return shocks from BTH ? $H_0: \omega_{i,BTH} = 0; \forall i = BJP, CTH, CJP$	22.50	3	0.00
14. Is there no contagion in return shocks from BJP ? $H_0: \omega_{i,BJP} = 0; \forall i = CTH, CJP, BTH$	15.94	3	0.00
15. Is there no contagion in return shocks from CTH ? $H_0: \omega_{i,CTH} = 0; \forall i = CJP, BTH, CTH$	21.87	3	0.00
16. Is there no contagion in return shocks from CJP ? $H_0: \omega_{i,CJP} = 0; \forall i = BTH, CTH, CTH$	14.05	3	0.00

VI. Conclusion

Until recently, currency and banking crises have been largely treated as separate phenomena, but the recent experiences of several Southeast Asian countries indicates that both banking and currency crises can occur jointly. However, most of empirical literature has focused on the determinants of each type of crisis in isolation and little empirical work to date has systematically investigated the association of the twin crises. In particular, no study has tested if

there is a pure contagion effect between the twin crises. This paper tries to fill this gap by examining the pure contagion effect both within a country and across countries using data from Japan and Thailand. The empirical results indicate that within a country there is a positive feedback relation between Thai banking sector and its currency market, indicating a within-country bi-directional contagion-in-mean effect between twin crises. Across countries there are unidirectional relations between Thai banking sector and Japanese currency market with return shocks running from Thai banking sector to Japanese currency market, and between Japanese banking sector and Thai currency market with return shocks running from Japanese banking sector to Thai currency market, suggesting a unidirectional cross-country contagion-in-mean effect between the twin crises. As for contagion-in-volatility, it is not significant, implying that there is no incremental increase in volatility during the crisis. Finally, in contrast to previous studies, the global banking industry risk is significantly priced, suggesting the importance of including the industry risk when testing asset pricing models using industry returns.

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Effects of Financial Variables and Market Risk on Investment Returns

Reza Rahgozar

Abstract

Previous studies have shown a positive correlation between the cross-section of average stock returns and financial variables. Some studies have documented that market risk does not seem to help explain the cross-section of average stock returns. Using data from Compustat, this study examines the relationship between stock returns and stock prices with financial variables considered relevant in predicting stock returns and market risk. The empirical results show that book value per share, free-cash flow, return on equity, dividends, and cash flow per share have a weak or no effect on stock returns and stock prices. Earnings from operations and its stability over time are the two more relevant factors affecting stock returns and prices.

I. Introduction

Miller and Modigliani (1961) argued that a firm's value is determined only by its basic earning power and its business risk. The firm's value depends on the income produced by its assets, not on how this income is split between dividends and retained earnings. Alternatively, Gordon (1963) and Lintner (1962) argued that a firm's value maximizes by setting a high dividend payout ratio (Bird-in-the-Hand Theory). When dividends are increased or initiated, prices tend to go up, and when dividends are cut or omitted, prices fall. Studies by Stattman (1980), Rosenberg, Reid, and Lanstein (1985) find that average returns on U.S. stocks are positively related to the ratio of the firm's book value to market value of common equity. In their study, Chan, Louis, Hamao, and Lakonishok (1991) showed that book-to-market value of equity also has a strong role in explaining the cross-section of average returns on the Japanese stock prices. Fama and French (1992) showed that market risk does not seem to help explain the cross-section of average stock returns. They conclude that whatever the underlying economic causes, two easily measureable variables (size and book-to-market equity) provided a simple and powerful characterization of the cross-section of average stock returns during the 1963-1990 period. In a later research, Pontia and Schall (1998) examined the ability of an aggregate book-to-market ratio to forecast market returns. They showed that an aggregate measure of the book-to-market ratio forecasts future market returns and the excess returns of small stocks over big stocks. In general, the Dow Jones Industrial Average (DJIA) book-to-market ratio is a stronger predictor of market returns than are previously examined variables such as interest rate spreads and dividend yields. Using data from the Japanese stock market, Garza-Gómez (2001) showed that the relationship between book value to market value of equity and risk was weak and found that two factors contributed to this result. First, market value correlated not only with risk but it also correlated with variables measuring liquidity and past performances. Second, book value of equity has a strong correlation with financial risk. Rahgozar (2008) showed that dividend and book value were relevant variables in predicting share values of Dow Jones Industrial Average firms (DJIA). Leong, Pagani, and Zaima (2009) found firms with the low price-to-earnings ratio (value stocks) and high price-to-earnings ratio (growth stocks) exhibit the highest returns. They showed that the book-to-market portfolio performances are not statistically different among various portfolios.

Using data from Compustat, this study examines the relationship between total stock returns as defined in Compustat and stock prices with several financial variables considered relevant in predicting total stock returns and prices. Total stock returns is defined as annualized rates of return reflecting price appreciation and reinvestment of monthly dividends and the compounding effect of dividends paid on reinvested dividends. Of course, for companies paying no dividends total investment returns are comprised only of stock price appreciations.

The remainder of this paper includes the following sections. Section II describes the data and methodology. Section III reports the empirical results. Conclusions and implications of the study appear in Section IV.

II. Data and Methodology

Data considered in this study is obtained from the Standard & Poor's Compustat. The sample includes all firms included in the S&P 500 Index. For statistical analysis, I have generated cross-sectional data for all variables appearing below by averaging data for each company and variables over the period 1992.1-2010.1. The average returns and financial variables considered under this study are all from the same periods. The mean and variance analysis employed test the stability of the total stock returns over time. In addition, correlation and regression analysis employed examine whether dividend is an important factor in estimating total investment returns. Furthermore, I have employed correlations and regressions analysis to test relationships between stock prices and financial variables considered relevant in predicting stock prices. The list of variables considered in this paper with their definitions appears below.

Variable definitions:

- 1YR = 1-Year Total Return (The Total Return concepts are annualized rates of return reflecting price appreciation plus reinvestment of monthly dividends and the compounding effect of dividends paid on reinvested dividends.)
- 3YR = 3-Year Total Return
- 5YR = 5-Year Total Return
- BVPS = Book Value Per Share
- CFPS = Cash Flow Per Share
- FCF = Free Cash Flow Per Share
- EPSO = Earnings Per Share From Operations
- EPS = Earnings Per Share Current 12- Month
- DPOT = Dividend Payout
- ESTA = Earnings Stability (Is based on Graham Dodd's definition, the sum of positive earnings for the last five years is assigned number 5, sum of the positive earnings for last four years assigned 4, ..., and for one year is assigned number one.)
- PE = Price to Earnings Ratio
- ROE = Return on Equity
- B = B, Beta Measure Market Risk
- P = Stock Price

III. Empirical Results

Table 1 contains means, standard deviations and coefficients of variation of stock returns of all firms in the S&P 500 over one, three, and five years. The numbers in the table support that high stock returns are associated with high risks. It shows that one-year return (1YR) is higher and more volatile than three and five-year returns. The average of one-year returns is equal to 20.87 percent with a standard deviation of 14.02 percent and a coefficient of variation of 0.67 percent. Whereas, the three and five-year returns are 14.74 and 14.11 with standard deviations of 8.53 and 7.94 percentages respectively.

Table 1
Means, Standard Deviations, and Coefficient of Variations of Total Stock
Returns of All Firms in the S&P 500 index, 1992.1 – 2010.1

	1YR	3YR	5YR
Mean	20.87	14.74	14.11
SD	14.02	8.53	7.94
CV	0.67	0.58	0.56
N	475	475	475

Note: Variables 1YR, 3YR, and 5YR, are one, three, and five-year total stock returns; SD is the standard deviation of returns and CV is the coefficient of variation. N is the number of companies having usable data out of the 500 S&P 500 index firms.

Table 2 includes correlations between one, three, and five years stock returns of all firms in the S&P 500 with financial variables and measure of market risk (B) appearing in the first row of table. The correlation numbers show that book-value per share (BVPS), dividend per share (DPS), earnings per share (EPS), earnings per share from operations (EPSO), earnings stability (ESTAB), and return on equity (ROE) all have a weak and negative relationship with the return variables. Whereas, cash flow per share (CFPS), free cash flow (FCF), price to earnings ratio (PE), and beta (B) all have small but positive correlation with stock returns. Among all variables in the table, PE (price-earnings ratio) is the only one that has a relatively higher positive correlation with one-year stock returns (0.44). It is interesting to note that while dividends are part of the total stock return calculations, they have a minor and negative correlation with total stock returns. This might imply that investors are less interested in dividend income than capital gains while investing in stocks.

Table 2
Correlations between Total Stock Returns and Listed
Financial Variables, 1992.1 – 2010.1

Returns	BVPS	CFPS	DPS	EPS	EPSO	ESTAB	FCF	PE	ROE	B
1YR	-0.05	0.03	-0.12	-0.32	-0.35	-0.48	0.05	0.44	-0.12	0.05
3YR	-0.04	0.08	-0.08	-0.12	-0.19	-0.12	0.03	0.13	-0.02	0.15
5YR	-0.04	0.10	-0.06	0.03	-0.11	-0.05	0.03	0.03	-0.02	0.05

Note: Variables 1YR, 3YR, and 5YR represent one, three, and five-year stock returns. BVPS is book value per share, CFPS is cash flow per share, DPS is dividend per share, EPS is earning per share, EPSO is earnings per share from operations, ESTAB is earnings stability, FCF is free cash flow per share, PE is price-earnings-ratio, ROE is return on equity, and B represents market risk.

To measure how the volatility of financial and market risk variables affect investment returns, Table 3 presents correlations between standard deviations of stock returns and standard deviations of listed variables. The numbers in Table 3 reveal that changes in earnings' stability (ESTAB) and price-earnings-ratio (PE) have the highest effect on the one-year stock returns. The variations of market risk measured by the standard deviation of beta (B) show no correlation with variations of one-year stock returns but it has a higher correlation with three and five-year returns. The variations of the remaining financial variables are weakly correlated with the variation of the total stock returns. The correlation numbers simply imply that investors prefer stability in earnings and lower volatility in price-earnings ratio and stock prices over other financial variables appearing in the table.

Table 3
Correlations between Standard Deviations of Total Stock Returns and Standard Deviations of Listed Variables, 1992.1 – 2010.1

SDV	BVPS	CFPS	DPS	EPS	EPSO	ESTAB	FCF	PE	ROE	B
1YR	-0.04	-0.00	-0.11	0.12	0.07	0.48	-0.04	0.42	0.11	0.00
3YR	-0.05	-0.02	-0.05	0.15	0.11	0.41	-0.05	0.26	0.11	0.43
5YR	-0.06	-0.03	-0.05	0.23	0.17	0.31	-0.06	0.15	0.14	0.28

Note: SDV is the standard deviation. Numbers in the table show the correlation between standard deviation of returns and standard deviations of listed financial variables.

To further investigate whether the variability of stock returns can be explained by the variations of the selected financial variables, regression analysis is employed. Table 4 includes the stepwise regression results.

Table 4
Stepwise Regressions Showing Relationship between Standard Deviation of Total Stock Returns and Standard Deviations of Financial Variables

Dep. Var.	C	BVPS	CFPS	DPS	EPS	EPSO	ESTAB	FCF	PE	B
Regression (1)										
SDYR1	25.39	-----	-----	-----	6.65	-3.29	27.04	-----	0.08	-----
	(9.11)	-----	-----	-----	(3.84)	(3.31)	(9.16)	-----	(6.19)	-----
	$R^2=0.30$		DW=1.67		N =436					
Regression (2)										
SDYR3	15.21	-----	-----	-----	1.75	-----	7.77	-----	0.02	0.31
	(14.11)	-----	-----	-----	(2.36)	-----	(6.83)	-----	(3.90)	(2.81)
	$R^2=0.36$		DW=2.05		N =414					
Regression (3)										
SDYR5	11.77	-----	-----	-----	2.19	-0.91	4.54	-----	-----	0.56
	(16.66)	-----	-----	-----	(4.46)	(3.06)	(5.94)	-----	-----	(5.98)
	$R^2=0.27$		DW=1.79		N =404					

Note: Variables SD1YR, SD3YR, and SD5YR represent standard deviations of one, three, and five-year total stock returns. BVPS is book value per share, CFPS is cash flow per share, DPS is dividend per share, EPS is earning per share, EPSO is earnings per share from operations, ESTAB is earnings stability, FCF is free cash flow per share, PE is price –earning-ratio, ROE is return on equity, and B represents market risk, t-statistics are in parentheses. R^2 is R-square and DW is the Durbin–Watson statistic. N is the number of companies included in the regressions.

Fama and French (1992) have shown that the book-to-market ratio of individual stocks has the ability to explain cross-sectional variations in stock returns of nonfinancial firms for the period of 1963-1990. The regression results in Table 4 show that cross-section variations of total stock returns and book-value per share (BVPS) have an insignificant relationship. However, results indicate the volatilities of earnings-per-share (EPS) and earnings stability (ESTAB) have a strong significant effect on the variation of stock returns (regressions #1, 2, and 3). Price-earnings ratio (PE) also has a significant and positive effect on the one-and three-year investment returns. Fama and French (1992) showed that market risk does not help to explain the cross-section of the average stock returns. Contrary to the Fama and French findings, the results in Table 4 show that variations in market risk (B) have a strong effect on the cross-section of average total of three-and five-year returns (regression 2 and 3) without having any effect on the short turn return. The weak relationship between dividend per share (DPS) and total stock returns shown above implies that dividend is a less important factor when calculating total stock returns.

The remaining portion of this study attempts to identify the most relevant financial variables that purely affect stock prices and not total returns.

Stock Price Analysis

It is of interest to many investors to identify which financial variables are more relevant to observe while making investment decisions. Table 5 Panel A, shows the relationship between stock prices and selected financial variables using correlation analysis. Panel B presents correlation between the standard deviation of stock prices and the standard deviation of the listed financial variables.

Table 5
Correlations between Stock Prices and Listed Variables
Over 1992.1 – 2010.1

Panel A: Correlations between Stock Prices and Listed Variables										
BVPS	CFP	DPS	EPS	EPSO	ESTAB	FCF	PE	ROE	B	
-0.00	-0.02	0.27	0.22	0.66	-0.01	-0.02	-0.00	-0.47	0.01	
Panel B: Correlations between Standard Deviations of Stock Prices and Listed Variables										
BVPS	CFP	DPS	EPS	EPSO	ESTAB	FCF	PE	ROE	B	
-0.00	0.02	0.14	0.85	0.88	0.07	0.2	0.01	0.67	0.06	

Note: Average stock prices of all companies included in the S&P 500 index and their standard deviations with financial variables and their standard deviations.

As is apparent from Table 5 (Panel A & B), earnings per share from operation (EPSO) and its volatility measured by standard deviation has the highest positive correlation with stock prices. The correlation between variations of earnings per share (EPS) and stock prices as shown in Panel B is high. The return on equity (ROE) has negative correlation with stock prices (Panel A) but volatility return on equity and stock prices are positively correlated. The remaining variables, including market risk volatility seem have small and negligible correlation with stock prices and its volatility.

It is interesting to note that the return on equity (ROE) has a negative effect on stock prices while correlation between variations of price and ROE are positive. One possible explanation for the negative correlation is that average equity returns for companies included in this study have been low without having a sustainable growth rate. Companies with high and stable returns on equities normally have higher earnings growth rates because a sustainable earnings growth rate is the return on equity times the retention rate. Earnings of firms with a high and stable return on equity are expected to grow at a higher rate than one with a lower return on equity (assuming dividend payout policies are same). Companies with the high and sustainable return on equity provide a higher growth in stock prices.

To further explore the relationship between stock prices and financial variables using regression analysis, Table 6 presents stepwise regression results. In regression (1), the dependent variable is stock prices and in regression (2), an endogenous variable is the standard deviation of stock prices. The test results in regression (1) show that dividend per share (DPS), earnings per share (EPS), and earnings stability (ESTAB) have a significant negative effect and earnings from operations have a positive effect on stock price level.

In regression (2), volatility of variables DPS, EPSO, ESTAB, and B have a positive and significant relationship with stock price variations. Among all financial variables appearing in the Table 6, free-cash flow, book value per share, cash flow per share, price-earnings per share, and return on equity show an insignificant relationship with stock prices. The effect of dividend per share on stock prices was changing from positive to negative. The earnings from operations, earnings stability, and earnings per share were the three most relevant variables having the strongest effect on stock prices and its volatility. This finding is in accordance with Miller and Modigliani (1961) that earnings are the most relevant factor in valuations of firm value and thus Stock price.

Table 6
Stepwise Regressions between Stock Price and Its Variations
and Listed Financial Variables

Dep. Var.	C	BVPS	CFPS	DPS	EPS	EPSO	ESTAB	FCF	PE	ROE	B
Regression (1)											
P	30.13	----	----	-29.99	-83.36	38.16	-6.57	----	----	----	----
	(4.71)	----	----	(3.30)	(19.88)	(31.79)	(4.30)	----	----	----	----
	R ² =0.70		DW=2.11		N =500						
Regression (2)											
SDP	----	----	----	4.26	----	4.81	9.86	----	----	----	0.35
	----	----	----	(2.43)	----	(39.29)	(12.60)	----	----	----	(1.93)
	R ² =0.74		DW=1.96		N =500						

Note: P is stock price, SDP is standard deviation of stock prices, BVPS is book value per share, CFPS is cash flow per share, DPS is dividend per share, EPS is earning per share, EPSO is earnings per share from operations, ESTAB is earnings stability, FCF is free cash flow per share, PE is price-earning-ratio, ROE is return on equity, and B represent market risk, t-statistics are in

parentheses. R^2 is R-square and DW is the Durbin–Watson statistics. N is the number of companies included in the regressions.

IV. Conclusion

This study examines financial variables and market risk that affect total stock returns and stock prices. The sample includes data for all companies in the Standard & Poor 500 Index. The mean and variance analysis reconfirms that short-term stock returns are more volatile and riskier than longer-term stock returns. The empirical results show that book value per share, free-cash flow, return on equity, and cash flow per share has a weak or no effect on the total aggregated S&P 500 Index companies' stock returns and stock prices. Moreover, regression results show that dividend per share has an insignificant and negative effect on the total stock returns. Such results go along with the Miller and Modigliani (1961) arguments that dividend payments are irrelevant to corporate values.

Rosenberg, Barr, Reid, and Lanstein (1985) documented positive relations between average return and book-to-market of equity for U.S. stocks. The empirical results of this study do not support a strong relationship between total stock returns and stock prices with book-value per share. Furthermore, regression results showed that market risk and its variations are important factors in explaining changes in total stock returns and stock prices. The findings are not in accordance with Fama and French (1992) that have shown market risk does not seem to help explain the cross-section of average stock returns during the 1963-1990 periods. Differences in such findings might be the result of different periods of study and/or sample selections.

Among all variables considered in this study, earnings per share and earnings stability showed the strongest and most significant effect on total investment return. This result implies that besides paying attention to company earnings, investors' also consider the stability of earnings while making investment decisions. Regarding stock prices, earnings per share from operations is the more relevant variable to consider while investing in stocks. Other financial variables have a weak and inconsistent effect on the price and price variations.

The question of what factor influence stock prices the most has been of interest to many investors and studies. It is very important, for example, to know whether dividend-paying firms' stock prices outperform non-dividend paying firms and whether factors such as earnings and its stability, cash flows, return on equity should be taken into consideration while making investment dictions. The major contribution of this study is to reinstate that the earnings and its stability are important variables to be considered while investing on stocks. Other variables like cash flows, dividends, return on equity, etc are one way or other derived from the earnings.

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Does it pay to Invest in Debt Free Firms during Recessions?

Tarek Zaher and Mahfuzul Haque

Abstract

This study examines the impact of leverage on equity returns of large cap firms during recessionary periods. We examine whether large cap firms that carry no debt on their balance sheet are rewarded during recessions. We compare the performance of portfolios of debt free firms to comparable portfolios of leveraged firms during the period of the last recession, December 2007-June 2009. The results of the study indicate that investments in portfolios of large cap debt free firms tend to generate higher returns than investments in their leveraged peers. These results imply that investors tend to reward firms that resist the urge to borrow heavily and operate with a debt free balance sheet during recessions and to penalize firms that have high levels of debt

I. Introduction

The National Bureau of Economic Research (NBER), which determines when recessions in the United States officially “begin” and “end”, has recognized 32 recessionary periods since 1857. On average, these recessions lasted 17 months. NBER declared Dec 2007-June 2009 as the dates for the latest recession. The trend has been toward fewer and shorter recessions since the end of World War II, however this does not hold true for the latest great recession; instead it was about average from a longer term perspective. Moreover, some economists, money managers, Market observers, and investors are concerned about a second dip of recession in the near future. Previous evidence suggests that each recession is different, and the current one has introduced extreme levels of volatility in equity markets overall. It also had a major impact on businesses around the world. Some large multinational firms had to shut down brands, businesses and branches and many small firms had to close altogether. As the world is emerging from the current recession, many firms have to raise large amounts of debt to stay alive. Companies with plenty of liquid assets, on the other hand, had kept away from the temptation of borrowing and were able to keep their heads above water through the crisis.

Institutional investors and portfolio managers usually maintain a strategic asset allocation based on long-term performance expectations. However they sometimes try to capitalize on shorter term anomalies through tactical shifts in asset mixes. Timing these shifts is difficult, so investors are keenly interested to understand any patterns in performance that appear to persist over time and can be exploited for tactical purposes. A number of studies have examined the performance patterns of stocks of different capitalization ranges as the U.S. economy enters and passes through recessionary periods. Some of these studies have noted small-cap stocks historically have tended to outperform larger stocks in the later stages of the recession and well into the recovery period. Typically, small-cap stocks are highly leveraged (more debt) and tend to have more volatile performance histories. Higher leverage becomes a drag as interest rates increase, and provided a lift as rates dropped. Companies with greater dependence on debt tend to suffer as credit tightens during recessionary periods, but benefit as credit loosens during expansion.

As in any investment decision, careful attention to market conditions and risk are critical to the investor's overall success, especially during volatile times when share prices are likely to remain erratic. Many investors try to play it safe and invest in large capitalization stocks that tend to be less volatile during recessions and some investors concentrate on firms with strong balance sheet, few debts and a healthy cash-flow. It is these companies that are better placed to survive a recession and prosper when the recovery finally arrives. Given the scale of the credit crunch in the last great recession, it is obvious that any company that has significant debts on its books is at a disadvantage to one that has no debt. In the aftermath of the global financial crisis debt remains a problem for highly leveraged firms. Typically, indebted companies may no longer be able to refinance their debts at such favorable terms, which will push up their costs. And there is also the fear that credit lines could be cancelled altogether. Companies that have no debt on their books, on the other hand, are in a more defensive position and they may also be better placed to profit from any future recovery. Hence investments in debt free companies during recessions are expected to reward investors.

The capital structure literature indicates that limited work has been undertaken in examining the impact of leverage on stock returns, largely due to the overwhelming influence of the work of Miller and Modigliani, (MM, 1958). MM argued that equity returns should not increase with leverage. However, the empirical evidence on the relationship between financial leverage and stock returns is contradictory and mixed. Some studies suggest that there is a positive relationship between leverage and stock returns. (Bhandari, 1988) provides evidence that common stock returns increase with leverage. Other studies provide evidence that there is a negative relationship between leverage and stock returns. (Fama & French, 1992) found that leverage based on book values is associated with lower average returns, whereas leverage based on market values is associated with higher returns. (Korteweg, 2004) also reports a negative relation between stock returns and leverage. (Penman et al, 2007) find that leverage is negatively related to returns. (Zaher, 2010) provides evidence that Investors tend to reward firms that resist the urge to borrow and operate with debt free balance sheet and penalize firms that have high levels of debt. The results of the study indicate that investments in portfolios of debt free firms tend to generate higher returns than investments in their peers of portfolios of leveraged firms over long and short periods. The results of the study raises again the question about the optimal level of debt a firm should have and whether investors should invest in low debt or high leveraged firms, especially during periods of economic downturns or financial crises.

In this study we focus on the impact of leverage on equity returns of large cap firms during recessionary periods. We examine whether large cap firms that carry no debt on their balance sheet are rewarded during recessions. In particular, we compare the performance of portfolios of large cap debt-free firms to comparable portfolios of leveraged firms. The results of this study indicate that investments in portfolios of large cap debt free firms tend to generate higher returns than investments in their leveraged peers during recessions. These results imply that investors tend to reward firms that resist the urge to borrow heavily and operate with a debt free balance sheet during recessions and to penalize firms that have high levels of debt.

The remainder of the paper is organized as follows: section 2 describes the data and sample selection. In section 3, the research methodology utilized in the study is explained. The empirical

results of the study are presented in section 4 and section 5 presents the summary and conclusions.

II. Data and samples selection

The initial sample of firms used in this study consists of all large capitalizations firms that are listed on the American exchanges during the period of the last recession, December 2007 through June 2009. Two samples of firms are constructed from the initial sample, a debt free firm sample and a leveraged firm sample. Debt free firms are firms with a zero total debt and a zero debt to equity ratio. Leveraged firm are firms with a debt to equity that is equal or greater than 15%. The firms that will enter the debt free sample were selected first. The requirement for each firm to enter the sample is to have a zero total debt, and have stock returns series available for the period of the study. The firms in the debt- free sample were sorted by sector and capitalization. The leveraged firm sample was then constructed by matching the debt free firms with leveraged firms from the same sector and with comparable market capitalization. Of the twelve sectors only six sectors contained large cap firms with no debt on their balance sheet during the period of the study. These are technology, services, industrial goods, healthcare consumer goods and basic materials.

Descriptive statistics (monthly mean return, average standard deviation, and average coefficient of variation) and two performance measures, Jensen's alpha and the annualized information ratio are then computed for the portfolios of debt free firms and leveraged firms in each of sectors and the combined portfolios of all sectors. The screening of sectors and firms within each sector is based on yahoo finance. The monthly return data for individual firms and market indexes are extracted from the CRSP data base. The return on the three month Treasury bill is obtained from online Federal Reserve data.

III. Research Method

Two alternative measures of performance are used in this study to compare the performance of debt free firms and leveraged firms, the Jensen's alpha, α_p ; and the Sharp information ratio, S_p . Jensen's alpha depends on beta as a measure of the risk of the portfolio. We estimate the Jensen's alpha α_p from the estimated equation for:

$$r_{pt} = \alpha_p + \beta_p r_{mt} + \varepsilon_{pt} \quad (1)$$

Where r_{pt} is the excess return (i.e., the observed return minus the risk free rate) on the portfolio p in month t , r_{mt} is the excess return on the benchmark or market portfolio in month t , β_p is portfolio p 's beta, and ε_{pt} is the residual term during period t . The latter error term is normally distributed $(0, \sigma_e)$.

The second measure of investment performance is the Sharp information ratio. This statistic measures the portfolio's average return in excess of a benchmark portfolio divided by the standard deviation of this excess return. The information ratio is calculated as

$$IR_j = (R_j - R_b) / \sigma_{ER} \quad (2)$$

where:

IR_j = the information ratio for portfolio j

R_j = the average return for portfolio j during the specified time period

R_b = the average return on the benchmark or market portfolio during the period

ΣER = the standard deviation of the excess return during the period

(Goodwin, 1998) shows that if excess portfolio returns are estimated with historical data using the same single factor model used to estimate Jensen's alpha, the IR simplifies to

$$IR_j = \alpha_j / \sigma_e \quad (3)$$

Where σ_e is the standard error of the error term in the regression in equation 1.

To convert the information ratio that is based on a periodic returns measured T times per year to an annualized information ratio the following formula is used:

$$\text{Annualized IR} = (T)\alpha_j / (T^{0.5})\sigma_e = (T^{0.5})IR \quad (4)$$

(Grinold and Khan, 2000) suggest that a reasonable information ratio should fall between 0.50 and 1.0. Annualized Information ratio of 0.5 indicates good performance and an IR of 1.0 indicates exceptional performance.

IV. Results

Table 1 provides listing of all large cap firms that have zero level of debt during the period of the study. The table reports the names and market capitalization for the firms that passed the screening process within each of the sectors and have a market cap of \$5 billion or more and has no debt on their balance sheet... The market cap for the 19 firms in the technology sector ranged between \$5.1 billion and \$317.5 billion. Seven firms with zero debt were identified in the services sector with a market cap between \$6.5 billion and \$85.2 billion. The market caps for the two debt free firms identified in the industrial goods sector are \$5.5 billion and \$ 9.3 billion, while the market cap for the debt free firms that survived the screening process in the healthcare sector are \$10.6 billion and \$13.5 billion. Three firms passed the screening process in the consumer goods sector and three firms in the basic materials sector. The range of the market cap for the debt free firms in the consumer goods and basic materials sectors is \$6.1 billion to 6.4 billion and \$5 billion to \$7.6 respectively.

Table 2 contains the leveraged firms that matched the zero debt firms in the first sample and passed the screening process. These are the firms that has a market cap of \$ 5 billion or greater and has a debt ratio equal to or greater than 15%. The table reports market capitalization, total debt, and debt to equity ratio of these firms. The market cap for the 26 matching leveraged firms in the technology sector ranged between 5.2 billion and 20.3 \$billion, and the debt ratio is between 0.151 and 0.975. The market cap for the 14 leveraged firms in the services sector ranged between \$27.8 billion and \$83.6 billion and the debt ratio is between 0.153 and 0 .440. The market cap for the 11 matching leveraged firms in the industrial goods sector is between \$5.6 billion and \$ 22.2 billion and the debt ratio is between 0.27 and 0.60. Three matching firms were identified in the healthcare sector with a market cap between \$10.3 billion and \$13.1 billion, and debt ratio between 0.15 and 0.48, and eight matching leveraged firms were identified in the consumer goods sector with a market cap between \$6.3billion and \$6.6 billion, and a debt ratio

between 0.15 and 0.54. In the basic materials sector, eleven leveraged firms were identified with a market cap between \$5.6 billion and 22.2 billion, and a debt ratio between 0.186 and 0.606.

Table 3 provides the descriptive statistics (monthly mean return, average standard deviation and average coefficient of variation) of the portfolios of leveraged firms and debt free firms in each of the sectors and the Z-scores from the Wilcoxon test for the period of the last recession, December 2007-June 2009. The mean monthly return is positive for the zero debt firms and negative for leveraged firms in the technology sector. The average standard deviation and the coefficient of variation are larger for the leveraged firms than the zero debt firms, indicating higher risk associated with the leveraged firms. The descriptive statistics in the services sector are similar to those in the technology sector. The mean monthly return is positive for the zero debt firms and negative for the leveraged firms, and the standard deviation and coefficient of variation are larger for the leveraged firms. The mean monthly returns for the firms in the industrial goods sector are negative for both groups of firms, and the standard deviation and coefficient of variation are approximately equal in both groups. The mean monthly return in the healthcare sector is positive for the zero debt firms, while the standard deviation and coefficient of variation are larger in the zero debt firms' sample. The consumer goods sector are showing negative mean monthly return for both groups of firms, but the standard deviation and coefficient of variation are larger for the zero debt firms. In the basic material sector, the mean monthly returns is positive for the zero debt firms and it is negative for the leveraged firms while the standard deviation and coefficient of variations are comparable. The overall mean monthly returns are positive is positive for the whole sample of debt firms and negative for the leveraged firms. The Z- scores test for difference in means indicate that the mean monthly return of debt free firms is significantly different from that of the leveraged firms. The Z-score is 2.65 and is significant at the 5% level. The Z-Score of the average standard deviation of monthly return is 2.13 and is also significant at the 5% level. The average coefficient of variation for the two groups is significant at the 10% level (Z-score is 1.73, indicating that in terms of total variability of monthly return, rather than market-related variability, the leveraged firms have higher volatility).

Table 4 reports the estimated beta from the regressions, the performance measures (Jensen's alpha and Sharp IR) and the Z scores for difference in means over the period of the last recession (December 2007-June 2009). The Jensen alpha was computed from equation (1) using NASDAQ equally weighted index from the CRSP as a benchmark. Sharp IR is calculated by dividing the estimated alpha from the regression in equation (1) by the regression standard error. This statistics is then annualized by multiplying the monthly IR by the square root of 12.

The alpha estimates in table 4 are positive and statistically significant for the debt free portfolios of all individual sectors except the portfolio from the consumer goods sector. The alpha is also positive and significant for the combined all sectors debt free portfolio.

The alpha estimates for the leveraged portfolios are mixed in sign and are statistically significant for any of the sectors and the combined portfolio of all sectors. The size of alpha is larger for the debt free firm portfolios for all sectors and the combined portfolio. These results indicate that portfolios of debt free firms outperform their leveraged peers during the period of the last recession...

The above conclusion is also supported by the results from the estimated annualized sharp information ratio. The annualized IR for the combined debt free portfolio is 1.17 and ranges between 0.321 and 0.99 for all the individual sector portfolios. It is only low for the consumer goods portfolio. These estimated annualized IR suggest very good to exceptional performance for all debt free groups of portfolios. The only exception is the consumer goods portfolio. The estimated annualized IR for the leveraged firms portfolios are below 0.5 for all sectors and for the combined portfolio. These results suggest that the leveraged firm's portfolios underperform the matching debt free portfolios. The results of the Wilcoxon two-sample test also confirm these findings. The Z-score for the Jensen's alpha is 2.17 and the Z score for the annualized Sharp IR is 2.13. Both Z-scores are significant at the 5% level. However, the Z score for the difference in beta means is not statistically significant, indicating that there is no difference in systematic risk between the debt free and leveraged portfolios. The later finding indicate that a portfolio of debt-free securities constructed from the six sectors examined in this study will outperform a comparable portfolio of leveraged firms.

The findings in this study support those of (Dimitrov and Jain, 2005), (Korteweg, 2004), (Penman et al, 2007), (Zaher 2010) who provided evidence that there is a negative relationship between leverage and stock returns, and contradicts the study by (Bhandari, 1988) who argues that stock returns increase with leverage.

V. Conclusion

This study attempts to find out whether investors reward firms that carry no debt and penalize firms that carry large amount of debt during the recent economic downturn. It compares the performance of portfolios of debt free firms to comparable portfolios of leveraged firms during the period of the last recession, December 2007-June 2009. A portfolio of large-capitalization firms who carry no debt on their balance sheet were matched with conventional firms of the same size and from the same sector. Tests of differences in the performance are conducted for each sector and the combined portfolios. The results of the study suggest that investments in portfolios of debt free firms tend to generate higher returns than investments in their peers of portfolios of leveraged firms during recessions. The evidence presented here has clear implications for investment performance. Investors would be better off if they concentrate their portion of equity investments in debt free firms rather than leveraged firms during recessions. During market downturns, debt free firms will not have the additional burden of debt, and may be able to recover much quicker than companies with levels of debt and therefore would outperform their peers of leveraged firms.

Appendix

Table 1
List of firms with Zero Debt
During Great Recession
December 2007-June 2009

Ticker	Company Name	Market Cap (\$ billions)	Total Debt
<u>Technology</u>			
AAPL	Apple Inc.	317.5	0
TXN	Texas Instruments	31.7	0
CTSH	Cognizant Technology	22.6	0
CTXS	Citrix Systems, I	15.7	0
ATVI	Activision Blizza	13.5	0
CHKP	Check Point Software	18.2	0
MRVL	Marvell Technology	17.6	0
ADSK	Autodesk, Inc.	14.9	0
FFIV	F5 Networks, Inc.	19.9	0
RHT	Red Hat, Inc. Comp.	8.9	0
ERTS	Electronic Arts I	8.0	0
GRMN	Garmin Ltd.	6.4	0
AKAM	Akamai Technology	6.1	0
INFA	Informatica Corp.	6.0	0
NTES	NetEase.com, Inc.	5.9	0
RVBD	Riverbed Technology	5.6	0
DOX	Amdocs Limited Co	5.4	0
PLCM	Polycom, Inc.	5.2	0
DLB	Dolby Laboratories	5.1	0
<u>Services</u>			
AMZN	Amazon.com, Inc	85.2	0
CHRW	C.H. Robinson	12.8	0
BBBY	Bed Bath & Beyond	12.7	0
PAYX	Paychex, Inc.	11.1	0
RUK	Reed Elsevier NV	10.9	0
EXPD	Expeditors Intern	10.7	0
CTRP	Ctrip.com	6.5	0

Table 1 continued
List of firms with Zero Debt

Ticker	Company Name	Market Cap (\$ billions)	Total Debt
<u>Industrial goods</u>			
FAST	Fastenal Company	9.3	0
FLIR	FLIR Systems, Inc	5.5	0
<u>Healthcare</u>			
ISRG	Intuitive Surgical	13.5	0
FRX	Forest Laboratories	10.6	0
<u>Consumer goods</u>			
LULU	lululemon athletic	6.1	0
FOSL	Fossil	6.3	0
HANS	Hansen Natural	6.4	0
<u>Basic Material</u>			
IAG	Iamgold Corporation	7.6	0
KMR	Kinder Morgan Man	3.7	0
CEF	Central Fund of C	5.0	0

Table 1 reports names and market capitalization cap (in \$billions) for the firms that has zero total debt during the period of the great recession December 2007 through June 2009.

Table 2
List of leveraged firms
During Great Recession
December 2007-June 2009

Ticker	Company Name	Mkt Cap (\$billions)	Total Debt	Debt ratio
Technology				
TLk	P.T. Telekomunika	17.6	2.31	0.15
NXPI	NXP Semiconductor	6.7	4.63	0.69
Auo	AU Optronics Corp	7.1	6.53	0.92
FLEX	Flextronics Inter	5.2	2.22	0.43
CSC	Computer Sciences	6.0	2.58	0.43
MU	Micron Technology	9.2	1.74	0.19
VIP	VimpelCom Ltd	18.2	5.66	0.31
MBT	Mobile TeleSystem	19.1	7.46	0.39
HRS	Harris Corp.	5.9	2.07	0.35
KLAC	KLA-Tencor Corp.	6.6	0.75	0.18
TKC	Turkcell Iletisim	12.5	1.81	0.15
STM	STMicroelectronic	9.6	1.75	0.18
ASX	Advanced Semicond	7.4	2.49	0.34
SNDK	SanDisk Corp.	10.6	1.74	0.16
CA	CA Inc.	11.5	1.55	0.16
ALU	Alcatel-Lucent	12.8	6.25	0.49
SYMC	Symantec Corp.	14.0	2.58	0.19
TEL	TE Connectivity L	15.9	2.75	0.17
TU	TELUS Corporation	16.8	7.19	0.43
A	Agilent Technolog	16.5	2.41	0.20
APH	Amphenol Corp.	9.2	1.95	0.21
UMC	United Microelect	6.7	1.75	0.26
IRM	Iron Mountain Inc	6.6	3.01	0.46
FTR	Frontier Comm	8.5	8.27	0.98
AMT	American Tower	20.3	5.57	0.27
CCI	Crown Castle Inte	11.7	6.73	0.57

Table 2 continued
List of leveraged firms

<u>Ticker</u>	<u>Company Name</u>	<u>Mkt Cap</u> (<u>\$billions</u>)	<u>Total Debt</u>	<u>Debt ratio</u>
Services				
MCD	McDonald's Corp.	83.6	12.77	0.15
DIS	Walt Disney Comp.	74.4	12.79	0.17
HD	Home Depot	55.4	10.76	0.19
CVS	CVS Caremark Corp	51.4	9.78	0.19
UNP	Union Pacific Corp	49.6	9.20	0.19
NWSA	News Corporation	45.3	15.49	0.34
TWX	Time Warner Inc.	37.7	16.56	0.44
CNI	Canadian National	34.8	6.06	0.17
TGT	Target Corp.	32.7	15.78	0.48
LOW	Lowe's Companies	30.5	6.57	0.22
CUK	Carnival Plc ADS	30.5	9.31	0.31
LVS	Las Vegas Sands	30.4	10.10	0.33
CCL	Carnival Corp.	29.0	9.31	0.32
CSX	CSX Corporation	27.8	8.14	0.29
Industrial goods				
TYC	Tyco International	22.2	4.13	0.19
WM	Waste Management	17.6	9.16	0.52
RTN	Raytheon Company	17.3	3.61	0.21
ETN	Eaton Corporation	16.2	3.45	0.21
SWK	Stanley Black & D	11.7	3.60	0.31
RSG	Republic Services	11.4	6.82	0.60
KUB	Kubota Corporation	11.0	4.53	0.41
LUK	Leucadia National	8.1	2.09	0.26
BUCY	Bucyrus Internati	7.5	1.55	0.21
X	United States Steel	6.2	3.74	0.61
ERJ	Embraer S.A. Comm	5.6	2.05	0.37
Healthcare				
BSX	Boston Scientific	10.3	4.92	0.48
CI	CIGNA Corporation	13.1	3.23	0.25
HUM	Humana	13.1	1.96	0.15

Table 2 continued
List of leveraged firms

Ticker	Company Name	Mkt Cap	Total Debt	Debt ratio
		(\$billions)		
Consumer goods				
FBR	Fibria Celulose S	6.9	6.13	0.89
TRW	TRW Automotive	6.7	1.76	0.26
TSN	Tyson Foods	6.7	2.40	0.36
BLL	Ball Corporation	6.4	3.52	0.55
MKC	McCormick &	6.4	0.97	0.15
HAS	Hasbro	6.0	1.43	0.24
CCK	Crown Holdings	6.0	3.47	0.58
ST	Sensata Technolog	6.3	1.93	0.31
Basic Material				
TYC	Tyco Internationa	22.2	4.13	0.19
WM	Waste Management	17.6	9.16	0.52
RTN	Raytheon Company	17.3	3.61	0.21
ETN	Eaton Corporation	16.2	3.45	0.21
SWK	Stanley Black & D	11.7	3.60	0.31
RSG	Republic Services	11.4	6.82	0.60
KUB	Kubota Corporatio	11.0	4.53	0.41
LUK	Leucadia National	8.1	2.09	0.26
BUCY	Bucyrus Internati	7.5	1.55	0.21
X	United States Ste	6.2	3.74	0.61
ERJ	Embraer S.A. Comm	5.6	2.05	0.37

Table 2 reports market capitalization (\$ billions), total debt (\$ billions), and debt to equity ratio for leveraged firms during the period of the great recession December 2007 through June 2009.

Table-3 Descriptive Statistics of Debt Free portfolios and Leveraged Portfolios during recession of December 2007-June 2009

	Debt Free firms	Leveraged firms
Panel A: Technology Sector		
Mean Monthly Return %	0.01	-0.02
Average Standard Deviation	0.13	0.27
Average Coefficient of Variation	11.72	-15.88
Average Debt to Ratio	0	0.39
Sample Size	19	26
Panel B: Services		
Mean Monthly Return %	0.01	- 0.01
Average Standard Deviation	0.01	0.11
Average Coefficient of Variation	2.04	-10.36
Average Debt Ratio	0	0.27
Sample Size	7	14
Panel C: Industrial Goods Sector		
Mean Monthly Return %	-0.01	-0.01
Average Standard Deviation	0.01	0.11
Average Coefficient of Variation	-19.86	-17.06
Average Debt Ratio	0	0.36
Sample Size	2	11
Panel D: Health Care Sector		
Mean Monthly Return %	0.00	-0.02
Average Standard Deviation	0.14	0.09
Average Coefficient of Variation	46.18	-5.32
Average Debt Ratio	0	0.30
Sample Size	3	3

Continued Table-3: Descriptive Statistics of Debt Free portfolios and Leveraged Portfolios during recession of December 2007-June 2009

	Debt Free firms	Leveraged firms
Panel F: Consumer Goods Sector		
Mean Monthly Return %	-0.01	-0.01
Average Standard Deviation	0.25	0.32
Average Coefficient of Variation	-30.48	-35.22
Average Debt Ratio	0	0.35
Sample Size	3	8
Panel G: Basic Materials Sector		
Mean Monthly Return %	0.01	-0.01
Average Standard Deviation	0.09	0.27
Average Coefficient of Variation	10.55	-19.83
Average Debt Ratio	0.36	0.35
Sample Size	3	11
Panel J: All Sectors		
Mean Monthly Return %	0.02	-0.09
Average Standard Deviation	0.11	0.19
Average Coefficient of Variation	40.44	-0.46
Average Debt Ratio	0	-0.34
Sample Size	37	73

Table 3 provides the descriptive statistics (mean monthly return, average standard deviation, and average coefficient of variation, average debt to equity ratio, and sample size) of the portfolios of leveraged firms and debt free firms. The Z scores for the difference in means of monthly return, average standard deviation and average coefficient of variation are 2.65*, 2.13*, and 1.73** respectively.

* Significant at the 5% level

** Significant at the 10% level

Table-4 Performance of portfolios of Debt Free Firms & portfolios of Leveraged Firms during the December 2007-June 2009 Recession

	Debt Free firms	Leveraged firms
Panel A: Technology Sector		
Beta	1.1	1.2
Jensen α	0.02*	-0.03
Sharp IR	0.86	-0.23
Panel B: Services Sector		
Beta	1.4	1.8
Jensen α	0.02*	0.01
Sharp IR	0.74	0.26
Panel C: Industrial goods Sector		
Beta	1.0	1.4
Jensen α	0.01**	0.01
Sharp IR	0.64	0.33
Panel D: Health Care Sector		
Beta	1.5	2.5
Jensen α	0.01*	0.00
Sharp IR	0.98	0.43
Panel E: Consumer goods Sector		
Beta	0.7	1.1
Jensen α	0.00	-0.01
Sharp IR	0.32	0.27

Continued Table-4: Performance of Portfolios of Debt Free Firms & Matching Portfolios of Leveraged Firms December 2007- June 2009

	Debt Free firms	Leveraged firms
Panel F: Basic Material Sector		
Beta	0.7	1.0
Jensen α	0.02*	-0.03
Sharp IR	0.87	0.34
Panel G: All Sectors		
Beta	1.2	1.6
Jensen α	0.02*	0.01
Sharp IR	1.17	0.38

Table 4 provides a comparison of portfolio performance using the Jensen's alpha and Sharp information ratio across all the sectors... Jensen alpha was computed from equation (1) using NASDAQ equally weighted index from the CRSP as a benchmark. The information ratio was annualized by multiplying the monthly IR calculated from equation (3) by the square root of 12 as shown in equation (4). The Z scores for Estimated Beta, Jensen alpha and the annualized sharp information ratio are 0.1830, 2.176, * and 2.13*

* Significant at the 5% level

** Significant at the 10% level

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Repealing Classified Boards: What Is the Motivation?

Sharon K. Lee

Abstract

Given the recent growing concerns of corporate shareholders about governance of public firms, there is a significant increase in the number of firms that have eliminated classified boards. The majority of S&P 500 firms have repealed their classified board over the past decade. Early literature [McWilliams, 1990, Lee (Bojanic) and Officer, 1994] suggest insignificant wealth effects on announcement of relatively less restrictive takeover barriers, such as a classified board. With the sensitive environment of lower confidence over the last ten years, investors appear more concerned with management entrenchment problems which could lead to poorly performing firms. This is one motivation for the significant increase in eliminations of classified board provisions. Another related motivation for eliminating the classified board is the requirement of higher levels of independence on corporate boards. This study updates the evidence on the motivation of firms eliminating the classified board in two different years of study: 2004 and 2009 in an attempt to determine reasons behind eliminating an antitakeover provision once viewed as benign.

I. Introduction and Background

Many takeover barriers that were constructed since the merger mania of the 1980's are being eliminated by shareholders in recent years. With the pressure from shareholders for stricter corporate governance any mechanism that may protect management is not desirable. Takeover barriers may entrench management from outside action, whether that was the original intent of the barrier or not. A classified, or staggered board divides the board into (usually three) groups so that only a fraction of all directors are elected every year. One argument supporting the presence of a classified board has focused upon the stability and consistency that this provision provides for a monitoring body.

In the March 23, 2012 Harvard Law School Forum on Corporate Governance and Financial Regulation, it is reported that the Harvard Shareholder Rights Project (SRP) urged several institutional investors to send proposals to declassify boards to 80 companies in the S & P 500 that still have a staggered or classified board. The report states that 42 of the 80 companies agreed to include management proposals in their proxy statements to declassify their board. Furthermore, the SRP praised these 42 companies for "their responsiveness to shareholder concerns." (Lipton and Mirvis, 2012). Lipton and Mirvis state that there is no evidence that declassifying boards enhances firm performance but instead may leave a corporation more vulnerable to unwanted takeover bids. A researcher at *The Conference Board* reports that shareholder concerns over classified boards are still growing and that "shareholders are determined to question the rationale for not having all corporate directors face a confidence vote on an annual basis" [Aguilar, 2012].

Across all indices (i.e., S & P 500, Mid-Cap, and Small-Cap) the number of companies with classified boards has declined over the last several years. By the end of 2008, just 50% of the S & P 1,500 companies maintain a classified board. This is the first time that a majority of

public companies do not have a classified board. The most significant drop has been in the largest companies, the S & P 500 companies. Only 36% of S & P 500 companies maintain a classified board at the end of 2008 compared to 56% in 2004. Larger companies tend to be more high-profile and therefore attract more investor scrutiny than the smaller-cap firms. With higher investor scrutiny, there is pressure from shareholders to eliminate any mechanism that decreases the likelihood of ousting poorly performing management. For Mid-Cap firms, 57% had classified board provisions in 2008 compared to 67% in 2004. Likewise, classified board provisions have dropped to 56 % for small-cap firms in 2008, compared to 62% in 2004. The drop in the classified board provision is also consistent with the (required) increase in board member independence. In 2008, shareholder proposals to declassify boards received the highest average support for any type of shareholder proposal (RiskMetrics, 2009). This study attempts to offer more evidence on the possible motivation of eliminating the classified board provision.

Over the last two decades numerous studies have examined the possible benefits and costs of takeover barriers. McWilliams (1990), using a sample of 325 firms proposing 763 antitakeover amendments finds insignificant shareholder wealth effects on announcement of the barrier. The sample included classified board provisions along with fair price and supermajority amendments. Lee (Bojanic) and Officer (1994), using a sample of 765 firms constructing 890 barriers find insignificant wealth effects of the amendments (including classified boards) but significant negative reactions on announcement of poison pill plans. Two competing hypotheses of takeover barriers have been posed: the managerial entrenchment hypothesis and the shareholder interest hypothesis. Consistent with agency theory, the management entrenchment hypothesis (Jensen and Meckling, 1976) states that managers construct takeover barriers to protect their job positions with the firm. According to the shareholder interests hypothesis, target company shareholders accept takeover barriers as a way for managers to extract a higher bid price. It appears that the early literature on the possible effects of specifically classified boards does not lend support for either hypothesis. However in this changing environment and the growing concern of shareholders for transparency prompting stricter corporate governance, it appears that shareholders believe that eliminating classified boards will benefit the shareholders. This is evidenced by the growing number of firms that now have boards with annual elections.

The requirement for increased board independence, since the 2002 Sarbanes-Oxley (SOX) Act, could be another motivating factor in the elimination of classified boards. To meet new independent board level requirements, we have seen an increase in the number of independent board members. The average board independence levels have been steadily rising, to 78% in 2008, up from 74% in 2007 and 72% in 2003. In 2008, 98% of the S & P 1,500 companies have a board of directors that has a majority of independent members, up from 83% just five years earlier (RiskMetrics, 2009). A recent study of S & P 500 firms (Lee and Carlson, 2007) shows that firms with the most independent boards perform significantly better than firms with less independent boards. With the elimination of a classified or staggered board, more board seat members can be removed from the board, allowing for more independent members.

Will the evidence show that firms are motivated to eliminate their classified board in order to oust management from underperforming companies or do these firms have relatively low independence levels on the board and need to make way for independent members? The largest drop in corporations with classified boards has been over the five year period 2004 to

2009. In an attempt to isolate possible changes in the motivation for eliminated boards, the sample of firms eliminating the classified board is divided into a 2004 sample and 2009 sample. Furthermore, the two samples are identified as S & P 500, mid-cap, or small-cap firms in order to further isolate reasons for the declassification.

II. Hypotheses

This study examines firms that eliminated their classified board provision in two different time periods, 2004 and 2009 in an attempt to capture possibly different motivations in different time periods. In the corporate environment of 2003/2004, the recent corporate failures and fraud were still fresh in the minds of investors and poorly performing firms would be under additional pressure to increase transparency and accountability to shareholders. Therefore we may find that the firms declassifying in 2004 had significant poor firm performance compared to other firms in their respective industries. Shareholders of poorly-performing firms may wish to have the ability to get rid of management with more ease when the board is not staggered. Years later in 2009, we may observe that this is not the motivating factor among firms declassifying their boards. Many firms have simply followed the trend answering to the general voice of the investor market for increased accountability. Two sets of hypotheses follows:

Null Hypothesis: Mean of Board Independence Level of 2004 sample of declassifying firms is not significantly different from the mean of board independence level of declassifying firms in the 2009 sample.

Alternative Hypothesis: Mean of Board Independence Level of 2004 sample of declassifying firms is significantly different from the mean of board independence level of declassifying firms in the 2009 sample.

Null Hypothesis: Mean of Industry-Adjusted ROA's for the 2004 sample of firms declassifying their board is not significantly different from the mean of Industry-Adjusted ROA's for the 2009 sample.

Alternative Hypothesis: Mean of Industry-Adjusted ROA's for the 2004 sample of firms declassifying their board is significantly less than the mean of the industry-adjusted ROA's for the 2009 sample

Another motivating factor may be the requirements for increased board independence. In order to refresh some of the board seats with independent members, some firms have eliminated the classified board that prevented election of a majority of seats at any one time. Lee (2008) finds that increased board independence is not a significant factor affecting firm performance for small-cap firms whereas Lee and Carlson (2007) find a significant positive relationship between increased independence levels and firm performance in large-cap firms (i.e., S & P 500). So for the larger firms, there may be two reasons for increasing independence levels; one is to meet new requirements and the other is to boost firm performance through the reduction of agency costs. For smaller firms, there appears to be less concern about agency costs (Lee, 2008). This may be the reason the trend to declassify boards has been less pronounced with mid-cap and small-cap firms.

As noted earlier, with stricter requirements from the 2002 SOX Act, many public companies needed to form more independent boards. By declassifying boards, higher board independence levels can be more easily achieved. This may have been more of a factor in the earlier sample year of 2004 rather than 2009. For the second set of hypotheses, any differences in the mean of the industry-adjusted ROA's are examined, comparing these means of declassified firms of 2004 vs. 2009. The most significant increase in eliminations of classified board provisions has been in the large-cap firms that are under the most investor scrutiny. To further test the two sets of hypotheses, the sample of firms in each year of study will be subdivided into large-cap, mid-cap, and small-cap firms. This may help isolate possible motivations for the declassification.

After years of declassifying actions, the majority of firms in the S & P 1,500 do not have a classified board provision and there continues to be proposals for more firms to eliminate the provision. What was the motivation for the elimination? Was the firm performing poorly in the period prior to the elimination of the classified board? If so, perhaps the motivation was to prevent further entrenchment of bad management. On the other hand, was the independence of the board significantly below the average for S & P 500 firms? If yes, then elimination of the classified board would expedite the process of increasing board independence.

III. Data and Methodology

For the S & P 500 companies, those firms which have eliminated the classified board provision in 2004 and 2009 are identified from Investor Responsibility Research Center (IRRC) publications (2005 and 2010), and the Georgeson Annual Reviews (2004 and 2009). As shown in Table I, descriptive statistics of these companies include the following variables in the year before the classified board was eliminated: 1) Independence levels of the board, 2) Board size, 3) Return on assets, 4) Average return on assets of the respective industry, and 5) Total Assets (as a proxy for firm size). The firm performance is calculated using an industry-adjusted return on assets (ROA) as used in many corporate governance studies examining the effect of specific variables on firm performance (Eisenberg, Sundgren, and Wells, 1999; Yermack, 1996; Lee and Carlson, 2007; Lee, 2008). In other words, [Firm ROA – Industry Average ROA] is used as a relative firm performance measure, and will be referred to as an industry-adjusted ROA in this study. ROA, industry-adjusted ROA, and total assets (\$) are collected from *Compustat*.

The data is analyzed to determine any relationships between firms declassifying their board of directors and their respective board independence and firm performance levels. To test for significant differences in variable means of both board independence and firm performance between those firms declassifying boards vs. the means for that firm size category (i.e., S & P 500, Mid-cap, Small-cap) or industry respectively, t-tests between means are performed. Initially, t-tests are performed to determine if several variable means, including board independence levels and industry-adjusted ROA of the firms declassifying in 2004 are different from those of declassifying firms in 2009 (Table I). For board independence levels and industry-adjusted ROA's, t-tests are performed (Tables II and III) to test for significant differences, either from the mean or from zero, respectively. To further examine possible differences between variable means comparing 2004 to the 2009 sample, t-tests are performed to test for any

significant differences, dividing the 2004 and 2009 sample into S & P 500, mid-cap, and small-cap to attempt to isolate any motivations for the declassification (Table IV).

IV. Results

In 2004, thirty-five (35) firms declassified their board and forty-one (41) firms in 2009. As shown in Table I, two (2) variables, Industry-Adjusted ROA and Total Assets were significantly different between samples of firms declassifying the board of directors in 2004 vs. those firms declassifying in 2009. At the 5% level of significance, the total assets of firms declassifying their board in 2004 were significantly larger than those that declassified in 2009. In addition, declassifying firms in 2004 had mean industry-adjusted ROA's significantly less than those firms declassifying in 2009 at the 10% level. In 2004, it appears that larger firms (i.e., higher total assets) that were not performing as well (i.e., significantly negative industry-adjusted ROA) as the average firm in their respective industry were declassifying their boards. This suggests that in the early years after the enactment of SOX, larger poorly-performing firms were quicker to declassify, and that in 2009, firm performance may not be the driving factor to declassify. However, there is stronger evidence of this when the sample is divided into S & P 500, mid-cap, and small cap subsamples, and the direct test of means between 2004 and 2009 is made in Table IV.

TABLE I
Descriptive Statistics of Entire Sample
Includes T-Tests between Means
Divided by Firms Declassifying the Board of Directors
2004 vs. 2009

Variable	Declassifying 2004 N = 35	Declassifying 2009 N = 41
Mean (Standard Deviation)		
Board Independence %	76.27 (12.37)	77.67 (10.52)
Industry-Adjusted Return On Assets (ROA) **	-1.25 (4.75)	1.15 (10.03)
Board Size	11.26 (2.33)	10.98 (2.26)
Total Assets (\$ millions) *	51364.76 (127166.16)	12984.85 (15366.92)

* Significant difference in Means between the two samples at the 5% level of significance.

** Significant difference in Means between the two samples at the 10% level of significance.

Two variables, industry-adjusted ROA and Total Assets are significantly different between samples of declassifying firms in 2004 vs. those declassifying in 2009.

A. Board Independence and Firm Performance

Table II shows the breakdown of both samples by size of the firms, specifically, S & P 500, mid-cap, and small-cap firms. Consistent with Table I, the results in Table II show that thirty-one firms (or 89%) of the firms declassifying in 2004 were in the S & P 500, whereas just 58% of the declassifying firms in 2009 were large-cap firms.

TABLE II
Board Independence as of End of 2003 or End of 2008
Firms Declassifying Boards in 2004 and 2009
Testing for Differences from Mean Board Independence of All Firms in the Same Time
Period, Further Divided by Large-Cap, Mid-Cap, and Small-Cap Firms

	2004	2009
	Declassification S & P 500 n=31 Mid--Cap n=3 Small-Cap n=1	Declassification S & P 500 n=24 Mid-Cap n =9 Small-Cap n=8
<hr/>		
Board Independence %:		
S & P 500 Firms	77.03 (72.0) t=2.24 *	80.04 (81.0) t=.60
Mid-Cap Firms	70.78 (68.0) t=.36	69.57 (78.0) t=-1.84 **
Small-Cap Firms	69.0 (66.0) n/a (n=1)	79.7 (75.0) t=1.87 ***

() Means for all Large-cap, Mid-cap, and Small-cap firms respectively.

* For these Large-Cap firms, there was a significant difference (at the 3% level) between means of the firms declassifying boards in 2004 and the average independence level of 72% for all S & P 500 firms at year-end 2003.

** For these Mid-Cap firms, there was a significant difference (10% level) between means of the firms declassifying boards in 2009 and the average independence level of 78% for all Mid-cap firms at year-end 2008.

***For these Small-Cap firms, there was a significant difference (10% level) between means of the firms declassifying boards in 2009 and the average independence level of 75% for all Small-cap firms at year-end 2008. In 2004, there is only one small-cap firm and therefore no conclusion can be made about the influence of board independence on board declassification for 2004 small-cap firms.

As mentioned earlier, the large-cap firms are under greater scrutiny and therefore more pressure to remove any type of management protection devices. The classified board provision alone has not been a restrictive antitakeover barrier but when combined with other provisions such as poison pill plans, can make it very difficult for outsiders to get rid of underperforming management. There has been less activist pressure on mid-cap and small-cap firms to declassify boards. However, over the past several years, an increasing trend to declassify boards has been observed in mid-cap and small-cap firms, but at a much slower pace than that of the larger S & P 500 firms.

In Table II, board independence percentages of each sample are tested for significant difference between means of the sample and all firms in that respective category (i.e., large-, mid-, or small-cap). In the 2004 sample, large-cap (S & P 500) firms have board independence levels significantly different (at the 3% level) from the mean of all S & P 500 firms at year-end 2003. Specifically, large firms in 2004 that declassified their board had an average independence level of 77% vs. 72% for all S & P 500 firms. So, it does not appear that the need for more board independence is a motivating factor for large firms in the 2004 sample. In that same year, there was no significant difference in board independence levels in the mid-cap and small-cap firms.

TABLE III
Firm Performance Measure (Industry-Adjusted ROA)
As of end of 2003 or End of 2008
Testing for Differences from Zero Within the Same Time Period
Firms Declassifying Boards in 2004 and 2009
Further Divided by Large-Cap, Mid-Cap, and Small-Cap Firms

	2004	2009
	Declassification S & P 500 n=31 Mid--Cap n=3 Small-Cap n=1	Declassification S & P 500 n=24 Mid-Cap n =9 Small-Cap n=8
ROA (Industry-Adjusted):		
S & P 500 Firms	-0.58 t=.40	1.16 t=.60
Mid-Cap Firms	-2.63 t=.37	5.14* t=.08
Small-Cap Firms	-10.63 n/a (n=1)	-3.36 t=.33

* For these Mid-Cap firms, there was a significant difference (8% level) between the means of the industry-adjusted ROA of the firms declassifying boards in 2009 and zero for all Mid-cap firms at year-end 2008. Mid-Cap firms declassifying the board of directors in 2009 performed significantly better than the average firm in their respective industries. In 2004, there was only one small-cap firm and so no conclusion can be made about the influence of firm performance on board declassification.

In Table II, in the 2009 sample there appears to be significant board independence level differences in both the mid-cap and the small-cap group in opposite directions. However, given the small sample sizes in both the mid-cap and small-cap firms and the level of significance at 10%, it is difficult to draw a conclusion. It appears that the mid-cap firms declassifying boards had significantly lower board independence than other mid-cap firms. Declassifying mid-cap firms have a mean board independence level of 69.6% vs. and the average independence level of 78% for all mid-cap firms at year-end 2008. This implies that declassification of the board may be “making room” for moving some independent directors onto the board, and may then be a motivating factor.

Table III provides data on the comparison of firm performance of declassifying firms vs. other firms in the same industry, once again divided by size of the firms. Though negative, it does not appear that large declassifying firms (i.e., S & P 500 firms) do not perform significantly different from firms not declassifying in that time period. However, it appears that mid-cap firms performed significantly better than the average firm in their respective industries. The industry-adjusted ROA for mid-cap firms in the 2009 sample was + 5.1433%, significant at the 8% level. Most likely, these mid-cap firms did not receive pressure to declassify the board due to poor performance but perhaps are motivated by the lower than average independence levels on the board. By declassifying the board, more seats can be filled in any one year by new, independent directors. In the other direction, the small-cap firms that are declassifying boards in 2009 have significantly greater independence levels than all small-cap firms, 79.7% compared to 75%. As noted earlier, there are small sample sizes for both the mid-cap and small-cap firms, and therefore any conclusions from testing of these two subsamples is tenuous.

B. Comparison of 2004 vs. 2009 By Firm Size

To directly compare the differences in the variables between the 2004 and 2009 sample, divided by size of the firms, additional t-tests were conducted. In Table IV these results are provided.

TABLE IV
Mean Variable Comparison between 2004 and 2009 Samples
Divided by S & P 500, Mid-Cap, and Small-Cap

Variable	2004	2009	t - value
Mean			Significance Level
(Standard Deviation)			
<u>S & P 500</u>	N =31	N=24	
Board Independence %	77.0 (12.51)	80.0 (8.84)	-1.04 0.27
Industry-Adjusted Return On Assets (ROA)	-577 (3.78)	1.16 (10.76)	-0.84 .032*
Board Size	11.06 (1.83)	11.08 (1.84)	-1.04 0.27
Total Assets (\$ millions)	57562.05 (134085.6)	18113.17 (18220.2)	1.62 0.01*
<u>Mid-Cap Firms</u>	N=3	N=9	
Board Independence %	70.78 (13.21)	69.57 (13.78)	0.14 0.48
Industry-Adjusted Return On Assets (ROA)	-2.63 (3.95)	5.14 (7.69)	-0.16 0.35
Board Size	12.67 (6.11)	10.04 (2.29)	1.17 0.05*
Total Assets (\$ millions)	4354.9 (3407.13)	6332.94 (5242.71)	-0.60 0.52

No Small-Cap comparison due to sample size N=1 for 2004.

* Significant difference in means between the two samples at the 5% level of significance.

In comparing the means of the variables by firm size, it appears that within the S & P 500 firms declassifying their boards, the significantly larger firms declassified in the early years after the SOX act. In 2009, the significantly smaller S & P 500 firms declassified. This is consistent with the fact that the majority of S & P 500 firms no longer have a classified board. It is very interesting that the S & P 500 firms that declassified in 2004 performed significantly worse than S & P 500 firms that declassified in 2009. It is very plausible that these large, poorly performing firms were pressured to declassify their boards. It also appears that the need to make room for a higher board independence level was not a motivation for declassifying. The difference in means of board independence is not significant between the two periods for S & P 500 firms.

The results for the mid-cap firms in Table IV show that only board size is significantly different for those firms declassifying in 2004 vs. 2009 for that firm size. Specifically it may be that the mid-cap firms with larger boards were among the first to declassify their board. As mentioned earlier, due to the small sample size of mid-cap firms, these results are not strong. However, by separating the entire sample into S & P 500, mid-cap, and small-cap firms, we see very clearly that the “largest of the large” firms in the S & P 500 were performing significantly worse than the average firm in their respective industries.

V. Conclusion

It appears that the initial motivation to declassify boards for the large-cap firms was the pressure from shareholders to eliminate protective barriers for underperforming management. The pressure on large firms to become more accountable was great in the early years near the 2002 Sarbanes-Oxley Act. Eighty-nine percent of the declassifying firms in 2004 were in the S & P 500. Also, when comparing the 2004 firms to the 2009 firms, the industry-adjusted ROA's were significantly lower in the 2004 sample. In examining the S & P 500 firms alone, it also appears that the largest of the S & P declassified in 2004 vs. 2009, and that the motivation for declassifying in 2004 may have been to decrease agency costs. Eliminating the classified board is another way to make management more accountable for their actions; perhaps more important with firms performing poorly. Several years later, it appears the motivation to declassify may be an attempt to increase board independence levels, as seen in the mid-cap firms (2009 sample). Board independence levels were significantly lower than other firms in their respective industries for mid-size firms. As noted earlier in this paper, today activist groups are urging all public corporations to declassify their boards, not just the underperforming firms as in 2004.

This study expands the literature on the motivation of eliminating a classified board provision and sheds light on its diminishing popularity. The classified board, once a very common takeover barrier that appeared somewhat benign in its shareholder wealth effects, is no longer desired by shareholders, especially in the large firms. Now mid- and small-cap firms are following the example of the larger firms in eliminating the staggered board. By further separating the two sample years by size of the firms, we found different motivations for different size firms. This study provides more evidence on the possible motivation of shareholders in board declassification. This trend is continuing and it will be interesting to examine if the elimination of the classified board is indeed good for increasing shareholder wealth.

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Do Exchange Rates Follow Random Walks? Evidence from the Currency Market in New York

Ingyu Chiou and John R. Willems

Abstract

This paper employs non-parametric methods to study the efficiency of four major exchange rates (\$/British pound, \$/euro, \$/Swiss franc, and \$/yen), using daily data over the period 1999-2011. Our major findings are as follows. First, each exchange rate is not normally distributed. Second, each exchange rate does not follow a random walk in the runs up and down test. Third, each exchange rate does not follow a random walk in the runs above and below a central point test. We suggest that different time zones of two currencies in an exchange rate, government interventions, and exchange rate overshooting or undershooting may result in market inefficiency. If the transaction cost is small and the foreign exchange market is not weak-form efficient, investors may be able to explore profitable opportunities. Overall, our new evidence suggests that these four exchange rates do not follow a random walk. This result is not consistent with the literature.

I. Introduction

The foreign exchange market plays an important role in currency conversion, hedging, arbitrage, and speculation. Because the cash flows of multinational companies are normally denominated in various currencies, these companies use the foreign exchange market to manage currency risk. When exchange rates change, the performance of these companies can be greatly affected. An efficient foreign exchange market can benefit all participants by facilitating the transactions between buyers and sellers, generating continuous prices, and producing fair prices. Naturally, market participants are concerned with the efficiency of the foreign exchange market.

As suggested by Fama (1970), the efficient market hypothesis (EMH) states that if there is no friction, securities prices in efficient markets fully reflect available information. This hypothesis implies that successive prices (or, price changes) are independent. He further classifies efficient markets into three forms in terms of the information set. First, if future prices do not depend on historical prices (i.e., the information set), then the market is weak-form efficient. Second, when securities prices fully incorporate all publicly available information (a larger information set), the market is semi-strong form efficient. Third, when the information set contains public and private information (an even larger information set), which is fully reflected in securities prices, the market is strong-form efficient.

Since market efficiency influences many different sub-fields of finance and can determine whether or not a market is well developed, the efficient market hypothesis (EMH) is a critical element of finance theory. Many scholars and practitioners have tested different forms of efficiency and tried to draw conclusions and implications from test results. Because it is more complicated to test the semi-strong form and strong form market efficiency, most existing papers investigate the weak-form efficiency, using stock price data. With some exceptions, the stock markets in developed countries (e.g., the U.S.) tend to be weak-form efficient, but the stock

markets in many non-developed markets (e.g., emerging-market countries) are not. If financial markets are not efficient, it implies that there may exist arbitrage opportunities for investors.

This paper is different from most of previous studies on market efficiency in five important aspects. First, while most previous papers research the topic using stock price data, we employ the exchange rate data. The foreign exchange market is different from the stock market in that the former is less regulated and is not used for raising funds. Second, unlike many previous studies that use weekly or monthly data, we use the daily data. Third, we use non-parametric methods to examine the market efficiency of exchange rates to solve the problem of non-normal distributions of the data. Fourth, we focus on the four major exchange rates, whose currencies are the most traded, according to the Bank of International Settlements (BIS) surveys in various years. Finally, as compared with Liu and He (1991), our paper uses more recent data, including a new exchange rate (\$/euro) that became available in 1999.

After examining the four daily exchange rates (\$/British pound, \$/euro, \$/Swiss franc, and \$/yen) over the period 1999-2011, our major findings are as follows. First, each of the four exchange rates is not normally distributed. Second, each exchange rate does not follow a random walk in the runs up and down test. Third, each exchange rate does not follow a random walk in the runs above and below a central point test. We suggest that different time zones of two financial markets, government interventions, and exchange rate overshooting or undershooting may play a role in market inefficiency.

The remainder of this paper is organized as follows. Section II briefly discusses the related literature. In Section III, we describe the data and methodology. Section IV presents and discusses empirical results. We summarize and conclude in Section V.

II. Literature Review

The efficient-market hypothesis (EMH) maintains that financial markets are informationally efficient with securities prices fully reflecting all available information. As a result, investors cannot consistently outperform the overall market on a risk-adjusted basis.

Although the concept of market efficiency already existed some four hundred years ago, Fama (1965) is the first to formally define what an efficient market is. Also, Samuelson (1965) is, among the first, to provide the formal mathematical model for efficient markets by focusing on the concept of a Martingale, which is a stochastic process that shows the conditional expectation of the next price is the current price.

Because market efficiency is a very important topic in finance and economics, many papers have studied this topic in different ways, in terms of the type of market (stock vs. non-stock), status of market (developed vs. non-developed), data frequency (weekly vs. non-weekly), data type (individual stocks vs. market indexes), methodology, and so on. Here, we'll briefly review three lines of research.

The first line of research focuses on the market efficiency of developed markets. Fama (1965) finds that the first-order autocorrelations of daily returns are positive for 23 of the 30

Dow Jones Industrial Average (DJIA) stocks in the U.S. and the autocorrelation coefficient is more than two standard errors from zero for 11 of the same 30 stocks. Lo and MacKinlay (1988) group NYSE-listed stocks into different sizes of portfolios and find that weekly returns on these portfolios show reliable positive autocorrelation over the period 1962-1985. In particular, the autocorrelation is stronger for portfolios of small stocks. By reviewing 280 papers studying western European markets, Hawawini and Michel (1984) conclude that the stock prices in these markets follow a random walk. Groenewold (1997) finds that the stock markets in Australia and New Zealand are weak-form efficient over the period 1975-1992. In general, most empirical studies on developed markets show that future prices do not depend on the past prices, supporting the weak-form efficiency of the EMH.

The second line of research focuses on the market efficiency of non-developed markets. Butler and Malaikah (1992) examine weak-form efficiency in the publicly traded stocks of Saudi Arabia over the period 1985-1989. All 35 Saudi stocks show a significant departure from the random walk with an average lag-one autocorrelation coefficient of -0.471 . This coefficient is opposite in sign and is huge in magnitude relative to autocorrelations reported in the studies of other stock markets. Omet and Khasawneh (2002) find that over the period 1992-2000, the market index of the Jordanian stock market is not consistent with the efficient market hypothesis. In contrast, Ojah and Karemera (1999) find evidence that equity price indices (1987-1997) in major Latin American emerging equity markets (Argentina, Brazil, Chile and Mexico) follow a random walk, and that they are, in general, weak-form efficient.

The third line of research focuses on the market efficiency of non-stock markets. Using six daily exchange rates over the period 1973-1975, Cornell and Dietrich (1978) indicate that the foreign exchange market is efficient because of low return autocorrelations. Belaire-Franch and Opong (2005) examine ten pairs of exchange rates, all relative to the euro, using the parametric variance ratio tests developed by Lo and MacKinlay (1988) and the non-parametric variance ratio tests based on ranks and signs developed by Wright (2000). They conclude that most Euro exchange rates are weak-form efficient. Rashid (2006) uses Lo and MacKinlay's variance ratio tests to investigate five pairs of weekly exchange rates, all relative to the Pakistani Rupee, and finds that most of these exchange rates follow random walks. In contrast, by applying the same parametric variance-ratio tests to five pairs of weekly exchange rate series over the period 1974-1989, Liu and He (1991) provide evidence rejecting the random walk hypothesis.

In sum, the findings of market efficiency research in most developed stock markets tend to support the weak-form efficiency because of a low degree of dependence between returns. In contrast, the findings of similar research in many non-developed stock markets are mixed. The problem of thin trading normally makes emerging markets not as efficient as developed markets. Also, although papers typically find the foreign exchange market to be weak-form efficient in most exchange rates, many studies do reject the random walk hypothesis in some exchange rates.

III. Data and Methodology

We compiled the daily exchange rates (\$/British pound, \$/euro, \$/Swiss franc, and \$/yen) in New York at noon from the Federal Reserve of the U.S. over the period January 1999-December 2011. Thus, for each time series we collect 3270 data points.

We first analyzed data for normality to determine whether serial correlations methods would be appropriate, using the following three tests: Kolmogorov-Smirnov (KS), Kolmogorov-Smirnov test with the Lilliefors Correction (KSLC), and Shapiro-Wilk (SW). The null hypothesis is that the exchange rate is normally distributed and the alternative hypothesis is that the exchange rate is not normally distributed. Table 1 presents the normality test results for each exchange rate and for each test. As we can see, for each exchange, the null hypothesis is rejected. These rejections indicate that each of the four exchange rates is not from a normal distribution and that autocorrelation methods are not appropriate for testing these exchange rate series.

Table 1 Normality test results for the four exchange rates

FX Rate	KS	KSLC	SW
\$/£	7.62	0.13	0.94
\$/€	4.69	0.08	0.96
\$/SF	3.46	0.06	0.97
\$/¥	9.60	0.17	0.88

SF = Swiss franc

KS = Kolmogorov-Smirnov; KSLC = Kolmogorov-Smirnov test with the Lilliefors Correction; and SW = Shapiro-Wilk

The KS (KSLC, or SW) column shows the test statistics for each of the four exchange rates

N = 3270 daily observations; time period = January 1999 to December 2011

Note: The p-values of all test statistics are equivalent to 0

When the time series data are not normally distributed, non-parametric tests for randomness are recommended. The null hypothesis is that the exchange rate is from a random sequence and the alternative hypothesis is that the exchange rate is not from a random sequence. We employ two popular non-parametric tests of randomness with brief explanations as follows.

A. Runs Up and Down Tests

For numerical observations, we also looked at the difference between two consecutive observations $X_{i+1} - X_i$. If an observation was equal to its preceding observation we ignored it and reduced the value of n by 1. When the number of observation is large, say, $n > 25$, the distribution of runs, R , is normally distributed with

$$\mu_r = \frac{2n - 1}{3}$$

$$\sigma_r = \sqrt{\frac{16n - 29}{90}}$$

The two sided significance level is based upon

$$z = \frac{R - \mu_r}{\sigma_r}$$

B. Runs Above and Below a Central Point Tests

For each data point in a sequence, the difference, $D_i = X_i - \text{CentralPoint}$, is calculated. The first central point we used is the median of the data. The second central point we utilized is the mean of the data. If $D_i \geq 0$, the difference is considered positive and it is considered negative otherwise. n_+ is the number of positive signs, n_- is the number of negative signs, and R is the number of runs or sign changes plus 1. For n_+ or n_- greater than 20, the sampling distribution for the number of runs is approximately normal with

$$\mu_r = \frac{2n_+n_-}{n_+ + n_-} + 1$$

$$\sigma_r = \sqrt{\frac{2n_+n_-(2n_+n_- - n_+ - n_-)}{(n_+ + n_-)^2(n_+ + n_- - 1)}}$$

The two sided significance level is based upon

$$z = \frac{R - \mu_r}{\sigma_r}$$

IV. Empirical Findings and Interpretations

Table 2 shows the results of the runs up and down test for each of the four exchange rates. As we can see, the null hypothesis is rejected for each exchange rate. The actual number of runs is significantly less than expected. These rejections indicate that each exchange rate does not follow a random walk or is not weak-form efficient.

Table 2 Results of the runs up and down test for the random walk hypothesis (RWH)

FX Rate	Actual runs	Expected runs	Z statistic	p value
\$/£	1666	2162.33	-20.67	0.00
\$/€	1672	2160.33	-20.35	0.00
\$/SF	1672	2166.33	-20.57	0.00
\$/¥	1667	2165.00	-20.73	0.00

SF = Swiss franc

N = 3270 daily observations; time period = January 1999 to December 2011

Null hypothesis: the exchange rate follows a random walk

Alternative hypothesis: the exchange rate does not follow a random walk

Table 3 shows the results of the runs above and below median tests (in Panel A) and the results of the runs above and below mean tests (in Panel B) for each of the four exchange rates. As we can see, the actual number of runs is significantly less than expected and the null hypothesis is rejected for each exchange rate and for each of the two methods. These rejections indicate that each of the four exchange rates does not follow a random walk or is not weak-form efficient.

Table 3 Results of the runs above and below median (Panel A) and results of the runs above and below mean (Panel B) tests for the random walk hypothesis (RWH)**Panel A**

FX Rate	Median	Total N	Actual runs	Z statistic	p value
\$/£	1.62	3270	74	-54.64	0.00
\$/€	1.24	3270	32	-56.11	0.00
\$/SF	0.80	3270	62	-55.06	0.00
\$/¥	0.01	3270	68	-54.85	0.00

Panel B

FX Rate	Mean	Total N	Actual runs	Z statistic	p value
\$/£	1.68	3270	17	-56.61	0.00
\$/€	1.21	3270	52	-55.36	0.00
\$/SF	0.80	3270	74	-54.64	0.00
\$/¥	0.01	3270	72	-54.45	0.00

SF = Swiss franc

N = 3270 daily observations; time period = January 1999 to December 2011

Null hypothesis: the exchange rate follows a random walk

Alternative hypothesis: the exchange rate does not follow a random walk

Our findings in Tables 2 and 3 are not consistent with those of Cornell and Dietrich (1978), who find that the foreign exchange market is weak-form efficient. However, Liu and He (1991) show that the exchange rates do not follow a random walk. There are three possible explanations. First, government interventions in the foreign exchange market often lead to distortions in the exchange rates. Second, the overshooting or undershooting phenomenon, suggested by Liu and He (1991), may make the currency market less efficient. Third, when two countries are in two different time zones, the exchange rate between two currencies of these countries may not reflect the information from these two countries immediately. For example, the yen-dollar exchange rate in New York may not incorporate the information from Japan in a timely fashion. If the foreign exchange market is not weak-form efficient, investors may be able to formulate a profitable trading strategy to explore the inefficiencies.

V. Summary and Conclusions

This paper studies the behavior of the four daily exchange rates (\$/£, \$/€, \$/Swiss franc, and \$/¥) over the period 1999-2011. These exchange rates include the most traded currencies worldwide.

Our major findings are as follows. First, each of the four exchange rates is not normally distributed. Second, each exchange rate does not follow a random walk in the runs up and down test. Third, each exchange rate does not follow a random walk in the runs above and below a central point test. We suggest that two currencies in different time zones, government interventions, and exchange rate overshooting or undershooting may play a role in market inefficiency. If the transaction cost is small and the foreign exchange market is not weak-form efficient, investors may be able to explore profitable opportunities.

Overall, this paper extends the existing literature in market efficiency by examining the exchange rates that are traded the most worldwide. Our new evidence suggests that these major exchange rates do not follow a random walk. This finding is not consistent with what the literature suggests.

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Portfolio Allocation Using Free Cash Flows and Other Methods

Thomas M. Krueger and Mark A. Wrolstad

Abstract

There are many ways to allocate money invested in shares of common stock within one's portfolio. The traditional and best known allocation methods are price-weighting, market capitalization-weighting, and equal-weighting. Of these three traditional allocation methods, we find that equally-weighted portfolios performed the best. More recently, attention has been focused on "fundamental weightings" which use financial statement items such as sales, total assets, net income, leverage, EBIT, and free cash flows to weight stock portfolio investments. Using a well-known set of stocks, this research provides insight into the relative advantages of using some of these alternative portfolio allocation methods. This study found that using free cash flows to weight portfolios was the only technique that outperformed equally-weighted portfolios and provided the investor with positive, statistically significant returns. It was also found that when using free cash flows to weight the portfolios, levels of free cash flows were more important than trends.

I. Introduction/Literature Review

This study explores some of the almost infinite number of methods that can be used to allocate funds invested in a stock portfolio. After briefly considering the traditional methods of valuation-weighting, price-weighting, and equal-weighting, we explore a number of promising fundamental factors that have been mentioned in the literature.

In their study of small firms, Hackel, Livnat, and Rai (1994) investigate the benefits of selecting stocks on the basis of operating and free cash flows, low financial leverage, and low free cash flow multiples (defined as price/free cash flows). They found that these stocks performed better than value-weighted, similar beta, and similar book/market value equities over a fourteen-year period. In subsequent research, they again found superior investment results for portfolios consisting of stocks with consistent free cash flows, low financial leverage, and those that were sold at low free cash flow multiples based upon a more recent four-year period (Hackel, Livnat, and Rai, 2000). Testing the robustness of this result in Finland, Jokipii and Vahamaa (2006) reached a similar conclusion.

In their research on fundamental indexation, Krueger and Wrolstad (2010) found that equal weighted portfolios outperformed the other two traditional weighting schemes of price-weighting and market capitalization-weighting. They also found that both net income and free cash flow-weighted portfolios outperformed other fundamental factors considered. Their "fundamental factor" portfolio allocation research was based upon two variables from the income statement, balance sheet, and statement of cash flows. When analyzing financial performance for portfolios allocated by the income statement's firm sales and net income, they found that the sales revenue and net income trends were more important than their actual levels. The highest average return for the two variables occurred when investment was based upon the year-to-year net income trend over the 2001 to 2010 period. From the balance sheet, they looked at financial leverage and firm size as measured by total assets. Use of both of

Thomas M. Krueger, DBA, is CBA Director or Research, Chair of the Accounting and Finance Department, and Professor of Finance at Texas A&M – Kingsville. Mark A. Wrolstad, Ph.D. is Professor of Finance and Chair of the Finance Department at Winona State University. They can be contacted at thomas.krueger@tamuk.edu and mwrolstad@winona.edu, respectively.

these factors resulted in negative portfolio returns over the investment period. Overall, the two highest performing portfolios in their study were the ones where investment was allocated on the basis of the net income and free cash flows variables.

The popular press has also noted the value of using free cash flow in structuring portfolios. In a relatively recent article, the Dow Theory Forecasts authors concluded that “since 1992, the factor with the highest returns is price/free-cash-flow (P/FCF)” (Dow Theory Forecasts, 2005). They found that a P/FCF strategy outperforms the average stock in nearly 80% of the three-month holding periods studied. In their study, not only did stocks with low P/FCF ratios outperform other portfolios studied, but those with highest P/FCF ratios tended to underperform. Another of their conclusions was that P/FCF ratios work well for all stocks but they worked best for small-capitalization stocks.

Similar to other research relying on a priori assumptions about probabilities and data attributes, relying on previous research we make the assumption that having an above average FCF will lead to superior investment performance ((Hill, 1976), (Honohan, 1980), (Jin, Xu, and Zhou, 2008), (Mao and Sarndal, 1966)). The unique contribution of this research is the use of a fixed group of stocks that are weighted using different schemes to optimize the overall portfolio performance. The results of this research may be of particular interest to mutual fund managers that have to balance the desire to focus their investments on a goal like social responsibility or an industry with relatively few publically held companies, yet still achieve a competitive rate of return for their investors.

II. Research Methodology

Stocks issued by firms in the Dow Jones Industrial Average (DJIA) were chosen to be the sample because they comprise a well-known, stable category of companies for which complete data is available. Twenty-three of the thirty stocks in the DJIA were a component of the index for the entire 2000 to 2010 sample period. Portfolio allocations were updated on an annual basis as information from the prior year was used to form portfolios for the subsequent year.

This study uses two methods of incorporating fundamental firm information into the investment process. The primary method, and the one just mentioned, is to base portfolio allocation upon a firm’s financial statement values during the prior year. More is invested in firms with higher financial statement values while firms with negative values are shorted. This will be referred to as the “Levels” method. The second allocation method bases allocation on the change in financial statement values from the preceding year. The change in the fundamental firm variable from “Year 1” to “Year 2” is the basis of portfolio allocation at the end of “Year 2” generating performance in “Year 3.” This allocation approach will be referred to as the “Trends” method. For instance, the change from 1999 to 2000 is used to allocate wealth in 2001. The following year the change from 2000 to 2001 is used in the allocation of portfolio wealth for 2002. The same “trends” process is used throughout the remainder of the sample period. There are many reasons why the “Levels” and “Trends” findings may be different. For instance, a DJIA firm may consistently have high sales, resulting in a high allocation within the “Levels” portfolio and have no allocation in the trends portfolio due to its

sales stability. Funds are allocated to the seven new members of the DJIA on the first day of the year in which they joined the DJIA. Removed companies are eliminated from the sample on the same day. This revision was necessary because we had only annual Morningstar data available for this analysis. The procedure has a minimal effect upon the results since it only impacts seven of three hundred observations, or less than three percent of all observations.

For the free cash flow allocation method, we also examine the simultaneous response of stock prices. In the process, we evaluate whether stock prices adjust to insights regarding free cash flows arising from press releases, quarterly reports, and the like. Since we are using annual data, we are effectively assessing the financial advantage of allocating wealth with perfect foresight regarding simultaneous free cash flow production. Given the consistent strength of this fundamental variable, we expanded the investigation and studied how well portfolios formed on the basis of free cash flows perform across bull and bear stock market conditions, in sequential sub-periods, and contemporaneous sub-periods.

Our null hypothesis is that the specified allocation method does not provide a return that is different from zero. Given the time period studied, with the stock market recessions following the 9/11 terrorist attack and 2007/2008 financial crisis, identification of an allocation technique that resulted in a statistically-significant positive rate of return would be highly regarded and an allocation method that resulted in a statistically-significant negative returns should obviously be avoided. Given that our sample is the market portfolio, we study market-excess returns without additional adjustment for risk, which is consistent with DeBondt and Thaler's (1985) study of domestic stock prices and Jordan's (2012) study of foreign stock prices. The alternative hypothesis is that the specified allocation scheme has an impact on investor wealth, and ideally generates a positive excess rate of return. Statistical significance is measured using Student's t-statistics because of the small sample size and lack of evidence that returns are normally distributed.

III. Results

Market Performance Using Traditional Portfolio Allocation Methods

Table I exhibits the performance of the traditional allocation methods during the period studied. Our values for the DJIA performance differ slightly from the published DJIA performance because we are using annual data and the firms which are added to the Dow during a given year are assumed to be in the portfolio for the entire year. The "Dow with Dividends" column uses price-weighting for the allocation and incorporates dividends into the stock returns. The capitalization-weighting column is based on a market value (i.e., shares outstanding multiplied by share price at end of prior year) allocation. We are essentially applying the technique used in computation of the S&P 500 Index performance to the DJIA.

Table I. Return and Risk Measures of Traditional Allocation Methods				
Sample Period: 2001-2010				
	Price-weighted			
	Without Dividends	With Dividends	Capitalization -weighted	Equally-weighted
Average Return	-0.21%	2.64%	0.46%	4.50%
Median Return	2.47%	5.84%	4.52%	6.95%
Geometric Return	-1.63%	1.12%	-0.80%	2.50%
Standard Deviation	17.10%	17.84%	16.02%	20.63%
Coefficient of Variation	N/A	6.76	34.83	4.58
Value of \$1000	\$849	\$1118	\$923	\$1280
<i>t</i> -statistic	0.52	0.32	0.46	0.25

*** = 0.01; ** = 0.05; * = 0.10

Comparison of the traditional allocation methods in Table I lead to the conclusion that the equal-weighted portfolio performs better than the other allocation methods. The reason for the superior performance is at least partially caused by the fact that the equal-weighted portfolio is unaffected by share price. It is not biased by the capitalization-weightings' shortcoming of overweighting over-priced companies while underweighting underpriced shares. As an investment scheme, the equal-weighted portfolio had the best risk/return performance of the three traditional methods with an average annual return of 4.50 percent. Although the equal-weighted portfolio has the highest standard deviation, its coefficient of variation (CV) is only 4.58. Neither the equal-weighted, nor the other two allocation methods provide a return which is significantly different from the null assumption of no effect on performance.

Performance Based Upon Cash Flow-Weighted Portfolios

The two fundamental cash flow weighting factors considered are cash flows from operations and free cash flows. Performances of portfolios allocated by cash flow levels and cash flow trends are presented in Table II. Results for operating cash flows are presented in the first two columns, which reveal that whether using levels or trends to allocate invested funds, operating cash flows provide results similar to each other and to the findings for the traditional allocation methods presented in Table I.

By comparison, using free cash flows to allocate the investment portfolio leads to high rates of return, high monetary gains, and statistical significance. An additional finding is that returns arising from portfolio allocation based upon free cash flow levels are higher than those from free cash flow trends. The geometric mean returns are 18.3 percent when free cash flow levels and 14.7 percent when cash flow trends are employed, which are exhibited in the third row of Table II. The high geometric mean results in the \$1,000 initial investment at the end of 2000

Table II. Return, Risk, and Predictive Power of Cash Flow Statement Levels and Trends

Portfolio wealth is allocated on the basis of prior level of operating cash flow and free cash flow, plus trends in these variable from the year before to the year prior to investment.

Sample Period: 2001-2010

	Operating Cash Flows		Free Cash Flows	
	Levels	Trends	Levels	Trends
Average Return	2.8%	4.1%	31.2%	19.3%
Median Return	3.5%	2.5%	14.7%	10.7%
Geometric Return	0.1%	2.2%	18.3%	14.7%
Standard Deviation	23.5%	20.4%	74.1%	34.5%
Coefficient of Variation	8.39	4.98	2.38	1.79
Value of \$1000	\$1,009	\$1,245	\$5,354	\$3,949
<i>t</i> -statistic	0.35	0.27	0.09*	0.05**

*** = 0.01; ** = 0.05; * = 0.10

reaching \$5,354 by the end of 2010, a \$4,354 gain! The cash flow trends-based allocation also provides a remarkable gain of \$2,949.

There is a significant amount of variance in the performance of free cash flow based portfolios with the standard deviation of the levels-based portfolio reaching 74.1 percent. However, its return stream is sufficiently positive to result in a finding of statistical significance at the 0.10 level of significance. By contrast, the 34.5% standard deviation of the returns of the free cash flow trends-based portfolio is half that of the levels-based portfolio. The coefficients of variation, which measure risk per unit of return, show that the free cash flow-based allocation approach has the lowest observed values of 2.38 and 1.79. With a 0.047 *t*-statistic for the trends-based portfolio, we are able to conclude that the relatively high returns of this portfolio are statistically different from zero at the 0.05 level!

Strength of Free Cash Flow-Weighted Portfolios during Bull and Bull Markets

Given the statistical significance arising from using free cash flows for portfolio allocation, additional study was made of portfolio returns based upon free cash flows. The first extension is to determine if free cash flows not only provide a positive rate of return but also beat the best market surrogate. Since a key finding in Table I was the superior performance of equal-weighted portfolios, the equal-weighted portfolio is used as the market surrogate. Table III also reports excess returns that could have been achieved if the investor consistently and accurately predicted whether the market would perform well and be considered a “bull market” year or would perform poorly and be considered a “bear market” year. During the period studied, there were four bear market years (2001, 2002, 2005, and 2008) and six bull market years.

Table III. Analysis of Free Cash Flow Across Market Conditions

Market-Excess Returns Versus an Equal-weighted Benchmark

2001-2010

Portfolio Allocation Weighting Scheme:	Free Cash Flow During the Prior Year (i.e., the Level)			Change in the Free Cash Flow During the Prior Year from the Previous Year (i.e., the Trend)		
	Bear Market	Bull Markets	All Markets	Bear Markets	Bull Markets	All Markets
Economy:						
N	4	6	10	4	6	10
Median	6.8%	16.3%	0.2%	14.3%	1.7%	1.8%
Geometric Mean	7.1%	20.2%	14.8%	27.1%	0.9%	10.6%
Standard Deviation	21.5%	86.7%	64.4%	47.3%	14.4%	33.4%
Value of \$1000 investment	\$1315	\$3030	\$3984	\$2607	\$1054	\$2747
<i>t</i> -statistic	0.23	0.12	0.08*	0.09*	0.39	0.09*

*** = 0.01; ** = 0.05; * = 0.10

Market-excess returns would equal zero if the performance of free cash flow based portfolios did not vary from that of the market portfolio. As shown in Table III, the average, median and geometric mean excess returns are always positive. These return measures reach their highest median at 16.3 percent, when free cash flow levels are used during bull markets. Besides being consistently positive, the one other noticeable pattern is that free cash flow trend-based allocation provides higher returns during bear markets. It is not the level of free cash flows but change in this fundamental variable that appears to dictates performance during bear markets.

The fifth row of Table III presents the marginal dollar gains from investing in free cash flow-based portfolios. Although the highest incremental gain (i.e., \$3030 - \$1,000, or \$2030) arises from using free cash flow levels over bull markets, there are more bull markets. On a per year basis, the bear market use of free cash flow trends adds approximately \$402 during each of the four bear market years, which is 27.1 percent on a compounded basis. It is also important to note that the "All Markets" gain exceeds the gain on both the bull and bear markets portfolios in both levels and trends portfolios, due to a compounding of positive returns in bear and bull markets. The excess performance of free cash flows in both markets eliminates the need to consistently and accurately predict the existence of a bear or bull market over the coming year.

Returns in excess of the equal-weighted market portfolio, over the entire sample period, using either free cash flow levels or trends are significant at the 0.10 level, as shown in the right column of the bottom line of Table III. The only other significant portfolio is the trend-based free cash flow allocation during bear markets, which is also significant at the 0.10 level. Even this low level of significance is quite remarkable given that there are only four bear-market

observations. Apparently, the high 27.1 percent geometric return is sufficient offset the high 47.3 percent standard deviation.

Sub-period Portfolio Performance

If free cash flows are truly a valuable tool for portfolio allocation, they should be an effective allocation device regardless of the sample period. Table IV divides the ten-year sample period into two sequential five-year sub-periods. In the process we are able to assess whether free cash flow’s effectiveness has changed from one five-year period to the next. The returns presented in Table IV are market-excess returns using the equal-weighting allocation method because this method of weighting DJIA members was the best choice across the traditional allocation models, which were exhibited in Table I. Statistics for the entire 2001-2010 period are included for comparison purposes.

Table IV. Free Cash Flows Based Portfolio Performance during Two Sub-periods						
Returns are market-excess values after adjustment for the equally-weighted sample portfolio’s performance						
2001-2010						
Portfolio Allocation Weighting Scheme:	Free Cash Flow During the Prior Year (i.e., the Level)			Change in the Free Cash Flow During the Prior Year from the Previous Year (i.e., the Trend)		
Time Period:	2001-2005	2006-2010	2001-2010	2001-2005	2006-2010	2001-2010
Median	-0.3%	10.0%	0.2%	10.0%	18.6%	1.8%
Geometric Mean	2.7%	20.3%	14.8%	22.0%	0.5%	10.6%
Standard Deviation	22.5%	44.4%	64.4%	45.0%	4.6%	33.4%
Value of \$1000 investment	\$1143	\$2521	\$3984	\$2541	\$1053	\$2747
<i>t</i> -statistic	0.32	0.08*	0.08*	0.06*	0.39	0.09*

*** = 0.01; ** = 0.05; * = 0.10

Particular attention should be paid to the second row of Table IV, which reports that none of the geometric means are negative. Hence, portfolio allocation using free cash flows appears to have consistently provided an improvement over the returns earned on the equal-weighted portfolio. Over the first-five year period, from 2001-2005, the trend in free cash flow provided the optimal portfolio formation technique. The 22.0 percent return found in Table IV’s fourth column is the largest single sub-period geometric mean return, and almost significant at the 0.05 level despite being based on only five observations.

Over the more recent period from 2006 to 2010, use of free cash flow levels resulted in the highest geometric mean return. The 20.3 percent annual gain earned investors \$1521(or \$304 annually) in excess of the equal-allocation scheme. Free cash flow levels-based performance was significant at the 0.10 level of significance. Relative to cash flow trends, during the half of

the entire decade with a dramatic fall and rise in stock prices, high cash flow levels apparently led to stronger performance during the subsequent year.

Concurrent Allocation Using Free Cash Flows

Free cash flows are predictive in nature because they can be used in subsequent financing of profitable projects. Stock price is assumed to be based upon future discounted dividend cash flows. Therefore, there may well be a concurrent relationship between these two variables. Following this line of reasoning, one would expect stocks issued by firms with higher cash flows in a given year to earn a positive market-excess return during the same period. Table V presents

Table V. Concurrent Return, Risk, and Descriptive Accuracy of Free Cash Flow Measures		
Portfolio wealth is allocated on the basis of current level and trend in free cash flow		
Returns are market-excess values after adjustment for the equally-weighted sample portfolio's performance		
Sample Period: 2000-2010		
	Levels	Trends
Average Return	6.1%	8.4%
Median Return	2.0%	9.0%
Geometric Return	5.1%	3.1%
Standard Deviation	14.9%	24.8%
Coefficient of Variation	2.44	2.95
Value of \$1000 investment	\$1725	\$1783
<i>t</i> -statistic	0.01*	0.14

*** = 0.01; ** = 0.05; * = 0.10

information on the simultaneous performance of stock prices and free cash flows. This portion of the study covers eleven years, one more year because a year is not lost in the process of identifying cash flow levels or trends over the prior year.

The first column of Table V reports the market-excess returns arising from weighting shares by their free cash flow level in the same year. For instance, the allocation of shares in 2000 is based upon the free cash flow performance of firms in that year. The change in free cash flow from 1999 to 2000 is used to allocate funds prior to 2000. If there is no relationship between the current year free cash flow and the stock price, the portfolio returns would mirror the return of the market and the excess would be close to zero. Findings presented in the second column are based upon a portfolio where the change in free cash flow from the prior year is used to allocate portfolio wealth. The implication of a lack of statistical significance in the second

column of Table V is that free cash flows unlock money for future investment which is not fully captured by current stock price changes.

Review of the data presented in Table V demonstrates that there is a relationship between free cash flow levels in a given year and concurrent stock price performance. Using either free cash flow levels or trends in portfolio allocation provides an average return that is more than six percent higher per year than the equal-weighted portfolio. Annual geometric mean returns are higher by at least three percent. The implication of this result is that if investors are able to invest in the beginning of each year with perfect knowledge of free cash flows during each year, they would be able to earn an extra \$1725 (\$2725 - \$1000) using free cash flow levels. With free cash flow trends, portfolio returns are \$1783 (\$2783 - \$1000) greater. Results reported in Table V are most comparable to the free cash flow data found in Table II. Although Table II's values are higher, such a result is not unexpected because funds may only be available for fraction of the current year reported in Table V. The free cash flow level allocation provides a return that is statistically significant at the 0.10 level of significance, which with the limited degrees of freedom is quite noteworthy.

IV. Conclusion

There are virtually an unlimited number of techniques by which one can diversify their portfolio. Popular means are exemplified by the Dow Jones Industrial Average's price-weighting, Standard & Poor's 500 capitalization-weighting, and MSCI World equally-weighted indexes. The advantages of equally-weighted indexes are that they do not rely upon current market price and that they provide the highest rate of return among the traditional methods of portfolio allocation employed in this study. An alternative to these traditional index-weighting schemes is the use of key firm fundamentals, increasing the weighting of firms with high measures on specified characteristics. We examined the investment value of basing allocations on the level and trend of two promising cash flow statement accounts.

Allocation of funds across firms in the Dow Jones Industrial Average (DJIA) on the basis of free cash flows were found to provide returns that were significantly greater than zero and superior to the equal-weighting of DJIA stocks. Although the sample size is small, the ability of free cash flow trends to be significant predictors of excess return was significant during bear markets. Though the preference varied, either the levels or trends free cash flow allocation method was significant in each five-year sub-period. Finally, there appears to be a simultaneous relationship between free cash flows and stock performance. Such a finding is consistent with the importance of free cash flows documented throughout this report. Future research, using alternative portfolios and time periods, will be able to ascertain the robustness of these results.

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Surplus Sensitivity and Immunization of Property and Liability Insurers

Jin Park, B. Paul Choi, Dohan Song, and Sukho Lee

Abstract

The P/L insurers were exposed to a great amount of risk from changes in interest or inflation rates because the over 83 percent of insurers assets are invested in bonds and stocks, of which values are inflation or interest rate sensitive. In addition, the insurer's liability is not free from interest rate risk, too. This study is designed to examine IRR exposures of P/L insurers and to identify how surplus immunization strategy should be designed given the IRR exposures. Using insurers predominantly underwriting private passenger auto lines of business, this study finds that sample insurers were not actively practice surplus immunization management. For P/L insurers investigated in this study, surplus immunization was not only sub-optimal, but also infeasible.

I. Introduction

For property and liability (P/L) insurers as financial institutions, the investment income is an important factor in insurance pricing along with other underwriting and cost factors, especially during the economic downturn. In 2010, the P/L insurance industry as a whole reported net underwriting losses of \$10.4 billion, but it earned net investment income of \$47.2 billion, not including realized capital gains of \$5.7 billion, resulting net after-tax income of \$34.7 billion (Insurance Information Institute, 2011). The reported investment income was primarily resulted from the industry's investment in bonds and stocks, for the amounts of \$873.7 billion and \$226.1 billion, respectively. As these two investment categories accounted for about 83.6 percent of the industry's aggregate total assets, the P/L insurers were exposed to a great amount of risk from changes in interest or inflation rates.

The P/L insurers' liabilities are exposed to interest rate risk (IRR). The P/L insurers allot loss reserves to pay for future payments related to currently open claims and claims that are incurred but not yet reported (IBNR). Loss reserves are subject to claim inflation (Hodes & Feldblum, 1996 and Gorvett & D'Arcy, 2000), which is highly positively correlated with interest rate. That is, the nominal value of future loss payments increases as unexpected inflation occurs, causing an increase in insurer's liabilities under the common assumption that inflation increases with interest rates. As the result, the market value of the P/L insurers' liabilities changes as interest rate changes. Therefore, if the market value of assets decreases more than that of liabilities when interest rate changes, the insurer's economic (market) value of surplus decreases by the difference. However, this high correlation between interest and inflation does not hold during stagflation.

The most commonly used IRR measures in the empirical and analytical literature are maturity gaps and duration measures. A duration measure is sensitive to a number of assumptions, including (1) parallel shifts of the term structures of interest rates, (2) small changes in interest rates, and (3) invariant future cash flows. Gorvett and D'Arcy (2000) cite that a parallel shift of the term structure of interest rates explains 80 percent of historical interest

Jin Park, Ph.D. is an assistant professor of Insurance and Risk Management at the Scott College of Business, Indiana State University, Terre Haute, IN 47809. B Paul Choi, Ph.D., CPCU, is an associate professor at School of Business, Howard University, Washington D.C., 20059. Dohan Song, Ph.D. is affiliated with Nonghyup Economic Research Institute, Seoul, Korea. Sukho Lee, Ph.D. is affiliated with Korea Institute of Finance, Seoul, Korea, and is a visiting scholar at Delaware State University. Authors can be contacted at jin.park@indstate.edu, bchoi@howard.edu, dsong2@gmail.com, and slee@kif.re.kr, respectively, and Jin Park is the corresponding author.

rate movement. In addition, the duration measures may not be meaningful when interest rate volatility is high (Fabozzi, 1995). If one or more of these assumptions are violated, these duration measures become less accurate measures of IRR. The assumption of invariant future cash flows presents the most problems in applying them to a P/L insurer's liabilities, because a P/L insurer's liabilities are subject to claim inflation. That is, the expected future claim payments vary with a change in inflation, specifically claim inflation (Gorvett & D'Arcy, 2000). In addition, insurers may exercise call or put options depending on circumstances, which violates the assumption of invariant future cash flow. In such a case, effective duration, which takes into account of variable future cash flows as interest rates change, is appropriate. Only a handful of studies measure effective duration of P/L lines of business (i.e., Gorvett and D'Arcy, 2000). Convexity, the change in duration with respect to an interest rate change, is also an important supplemental measure for IRR, especially when interest rate changes are large.

This study is designed to examine IRR exposures of P/L insurers and to identify how surplus immunization strategy should be designed given the IRR exposures. In doing so, this study is different from extant studies in two aspects. First, this study operationalizes measurement of total IRR of P/L insurers using duration and convexity. Exploring IRR of both assets and liabilities, or surplus as a whole, can lead to an increased awareness of risk and management of IRR. Most extant studies demonstrate how IRR may adversely affect the insurer's surplus using a hypothetical insurer (e.g., CAS Financial Analysis Committee, 1989 and Tzeng, Wang, & Soo, 2000). Most studies using empirical data for real insurers exclude IRR of insurers' assets. In many other cases, extant studies do not include all liability components in the IRR measures. The focus mostly lies on loss reserves, loss adjustment expenses reserves, and unearned premiums reserves. Second, the measurement of IRR will take into account of differences in individual insurers (rather than the industry's aggregate figures) by analyzing an insurer's own loss development factors (LDFs) of line of business for all lines of business to project loss payments. Extant studies investigating IRR include a few selected lines of business, instead of all lines of business. For example, Feldblum (1989) analyzed IRR of general liability only, while Gorvett & D'Arcy (2000) focused on IRR of private passenger auto liability and general liability. Thus, so far, private passenger auto liability, general liability, and workers compensation are the most studied lines of business.

II. Measurement of Duration and Convexity

Modified duration is a useful measure of the sensitivity of a bond's price to interest rate changes, and it is calculated as the Macaulay duration divided by one plus the current yield. A convexity measure of a security, the change in duration with respect to changes in interest rates, is the approximate change in the price of the security that is not explained by duration (Fabozzi, 1995).³

A. Interest rate sensitivity of liabilities

An estimation of future cash flows is a key to measuring the duration and convexity. Thus, to measure duration and convexity of P/L insurers' liabilities, we first need to estimate

³ Formulas to find the modified duration and convexity of a security are presented in many finance textbooks.

payout patterns adjusted for inflation for each line of business. A “loss-development triangle method” with data from Schedule P in the statutory NAIC Annual Statement is used to estimate claim payout patterns. After the payout patterns are estimated and the duration and convexity of liabilities are measured for various liability components, interest rate risk of an insurer’s liability, IRR_L , is calculated as follows:

$$IRR_L = w_{LR}(-MD_{LR}(\Delta i) + \frac{1}{2}MC_{LR}(\Delta i)^2) + w_{UP}(-MD_{UP}(\Delta i) + \frac{1}{2}MC_{UP}(\Delta i)^2) + w_{OL}(-0.5(\Delta i)) \quad (1)$$

where MD and MC are duration and convexity, respectively, and the subscripts LR , UP , and OL denote loss and loss adjustment expense reserves, unearned premiums, and other liabilities of an insurer, respectively. The w_i ’s are weights for the corresponding liabilities, and other liabilities are assumed to have a duration of 0.5, which means the cash flow happens in the middle of a year.

B. Interest rate sensitivity of assets

Schedule D in the NAIC Annual Statement provides comprehensive bond and stock portfolio information. P/L insurers are required to report the composition of their bond portfolio by types of bonds and by quality and maturity of bonds. Duration and convexity of the bond portfolio are calculated under the assumption that cash flows occur in the middle of the year.

The price sensitivity of stock price due to changes in both the real rate of interest and the rate of inflation is calculated followed by Leibowitz, et al. (1989). The inflation and interest rate flow-through parameters that are necessary to calculate the total interest rate sensitivity of stock portfolio are estimated using Maximum likelihood estimates of ARCH(2) models, which are obtained using quarterly dividend growth rates from the 1st quarter of 1980 to the 4th quarter of 1999. To ensure the conditional variance of the error term is positive and finite, the intercept term in an ARCH model should be positive, while all other coefficients of the ARCH model should be nonnegative. In addition, the sum of all coefficients of the ARCH model, except the intercept, should be equal to or greater than zero, but less than one, $0 \leq \sum_{i=1}^q \alpha_i < 1$ (Greene, 2000). These constraints are all satisfied with the models specified, and the Jarque-Bera normality test fails to reject the null hypothesis that errors of an ARCH(2) model is normally distributed. With these estimates, the interest rate sensitivity of stock price is estimated as 8.3, which means when the inflation rate increases by 100 basis points (or one percent), the value of the P/L insurer’s stock portfolio decreases by 8.3 percent. The traditional duration measure was estimated to be over 11 percent. (Results are available upon request).

In this study, the price sensitivity of stock is dichotomized into its sensitivity to the real rate of interest and its sensitivity to the inflation rate, and the equation can be easily extended to measure the total price sensitivity of stock portfolio to interest rates by simply replacing the price of a stock with the value of entire stock portfolio. Therefore, once duration and convexity of stock and bond portfolios are measured, IRR of assets of an insurer, IRR_A , is measured as follows:

$$IRR_A = w_B(-MD_B(\Delta i) + \frac{1}{2}MC_B(\Delta i)^2) + w_S\left(\frac{dP_S}{P_S}\right) + w_{OA}(-0.5(\Delta i)) \quad (2)$$

where the subscripts B and S denote the Bond portfolio and Stock portfolio of an insurer, respectively. The w_i 's are weights for the corresponding portfolios. For example, w_{OA} is the weight for other assets excluding cash and the duration for other assets, like other liabilities, is assumed to be 0.5.

C. Interest rate sensitivity of surplus

The measurement of interest rate risk of a P/C insurer's surplus is meaningful only when all related balance sheet items are aggregated and the net positions are identified. Given the IRR_A and IRR_L , total interest rate sensitivity of surplus (IRR_S) is calculated as follows:

$$IRR_S = IRR_A \left(\frac{\text{Assets}}{\text{Surplus}} \right) - IRR_L \left(\frac{\text{Liabilities}}{\text{Surplus}} \right) \quad (3)$$

III. Sample and Data

The sample of P/L insurers used in this study consists of P/L insurers that predominantly wrote private passenger auto lines of insurance. The sample consists of insurers whose net premiums written (NPW) for the combination of private passenger auto liability and physical damage insurance were more than 70 percent of total NPW as reported in the NAIC Annual Statement. Due to the data availability to the authors at the time of the analysis, the data used in this paper is limited to Year 1999, which limits the generalizability of this study's findings. However, using a single year of data does not weaken the validity and rationale of this study.

The number of insurers meeting selection criterion described above was 386. Of these, 159 insurers were eliminated due to a lack of loss payout data from Schedule P in the NAIC Annual Statement. An additional 16 insurers were eliminated because they reported negative loss reserves, cash or other assets. The number of sample insurers for analyzing IRR of insurers becomes 211 insurers.

Equations (1) through (3) shown in the previous section are estimated using various parts in the NAIC Annual Statement. IRR_A is measured using data primarily from Schedule D in the NAIC Annual Statement, and IRR_L is mainly based on LDFs estimated using data from Schedule P – Part 2 in the Annual Statement. IRR_S is measured as a value weighted average, IRR_A and IRR_L . All interest rate sensitivity measures are based on a parallel shift in the yield curve by 100 basis points (one percent), and insurers are assumed to maintain their stock portfolio and hold bonds until their maturity.

IV. Estimation results

A. Interest rate sensitivity of liabilities

Table 1 in the next page presents the duration and convexity of loss reserves for selected lines of the sample insurers. Duration of loss reserves ranges from 0.56 for short-tail lines of

business as a whole to 5.38 for Product liability (Occurrence) insurance. In general, personal lines of business have lower durations than commercial lines of business, which is expected. Duration of unearned premium reserves for all lines of business is 0.9. Measured as a value weighted average of liabilities, duration of total liabilities including other liabilities is 1.19, meaning when interest rate changes by one hundred basis points (one percent), the present value of liabilities changes by 1.19 percent.

Table 1. Modified Duration and Convexity of P/L Insurer's Liabilities

	N	Modified Duration		Modified Convexity	
		Mean	S.D.	Mean	S.D.
Loss and LAE Reserves					
Homeowners/Farmowners	121	1.43	0.81	3.36	3.82
Private Passenger Auto Liability	211	1.48	0.50	3.29	2.09
Commercial Auto Liability	114	1.85	0.83	4.72	4.09
Workers Compensation	66	4.05	2.88	19.59	17.10
Commercial Multiperil	54	3.10	2.14	14.84	18.24
Medical Malpractice - Occurrence	10	4.67	0.88	22.97	5.59
Medical Malpractice - Claims Made	1	0.79	NA	1.09	NA
Special Liability	21	3.48	3.58	17.25	27.66
Other Liability - Occurrence	109	3.24	2.95	17.23	15.94
Other Liability - Claims Made	29	3.47	2.67	18.45	22.00
International	1	5.26	NA	31.22	NA
Reinsurance – NP Assumed Property ^a	16	3.09	1.45	14.10	8.73
Reinsurance – NP Assumed Liability ^a	33	5.14	1.47	27.69	11.10
Reinsurance – NP Assumed Fin. Lines ^a	2	3.03	0.27	13.67	1.34
Product Liability – Occurrence	23	5.38	2.76	33.12	27.58
Product Liability - Claims Made	5	2.28	0.18	5.82	2.07
Short-Tail Lines of Business (Aggregated)	211	0.56	0.13	0.48	0.19
Loss and LAE Reserves – Total	211	1.56	0.59	4.00	3.00
Unearned Premium Reserves – Total	211	0.92	0.42	2.04	1.78
Reserves – Total	211	1.32	0.56	3.30	2.71
Total Liabilities ^b	211	1.19	0.48	2.78	2.23

Note: ^a NP – Non-Proportional

^b Other liabilities other than reserves are assumed to have modified duration and convexity of 0.5 and zero respectively.

The measures of convexity range from 3.29 for PPAL to 33.12 for Product liability (Occurrence); that is, if the interest rate instantaneously changes by one percent in any direction, the present values of loss reserves for PPAL and Product liability (Occurrence) increase by 0.0329 and 0.3312 percent, respectively. Therefore, if duration and convexity are considered together, the present value of PPAL loss reserves would decrease by 1.4471 percent (-1.48 + 0.0329) as the interest rate increases by one percent, and the present value would increase by

1.5129 percent ($1.48 + 0.0329$) as the interest rate decreases by one percent. By the same token, an increase in the interest rate of one percent decreases the present value of total liabilities by 1.1622 percent ($-1.19 + 0.0278$), while a decrease in the interest rate of one percent increases it by 1.2178 percent ($1.19 + 0.0278$). The differences in the percentage value changes between increase and decrease in the interest rate are the direct result of the convex shape of the general price-yield relationship for a financial security (Saunders & Cornett, 2006). For a given change in the interest rate, the percentage value increase is greater than the percentage value decrease (Fabozzi, 1999).

B. Interest rate sensitivity of assets

Comparisons of duration and convexity for insurers' bond portfolios are shown in Tables 2 and 3, by four types of issuer and two types of investment class. A yield curve for Treasury securities with different term-to-maturities was used to discount investment grade Government Bonds, while arithmetic average yield rates of AAA to BBB-rated bond yields were used to discount other investment grade bonds. For non-investment grade bonds, a term structure of average yield rates of BB+ to C-rated bonds was employed, while a constant default risk premium of 0.42 percent was added to the yield curve of Treasury securities to discount non-investment grade Government Bonds.

Table 2. Comparison of Modified Durations of P/L Insurers' Bond Portfolio

	Sample Insurers			Industry Excluding Other Auto Insurers			
	N	Mean	Std. Dev.	N	Mean	N	Mean
Government Bonds							
Investment Grade	195	4.99	2.72	711	5.03	1,326	4.61**
Non-Investment Grade	3	6.82	1.25	41	6.23	16	5.33
All Government Bonds	195	4.98	2.72	711	5.05	1,327	4.61**
Tax-Exempt Bonds							
Investment Grade	189	7.13	2.38	656	7.71***	1,093	6.96
Non-Investment Grade	20	6.29	3.30	68	5.54	43	5.17*
All Tax-Exempt Bonds	189	7.13	2.38	658	7.69***	1,094	6.95 [†]
Public Utility Bonds							
Investment Grade	115	4.60	2.51	449	4.82	491	4.68
Non-Investment Grade	10	4.98	2.45	70	4.58	51	4.56
All Public Utility Bonds	115	4.59	2.46	453	4.81***	499	4.68 [†]
Industrial Bonds							
Investment Grade	173	5.04	1.73	642	5.28*	914	5.05 [†]
Non-Investment Grade	75	4.10	1.59	286	4.51 [†] ***	253	4.42 [†] **
All Industrial Bonds	175	4.99	1.67	643	5.26	926	5.01
Total Bonds	211	5.82	2.13	747	5.87	1,542	4.97 [†] ***

Note: Investment grade bonds include the NAIC bond classes 1 and 2. The NAIC bond classes from 3 to 6 and undefined classes are categorized as non-investment grade bonds.

[†] A variance ratio test (F-test) rejects the null hypothesis that sample variances between groups are equal.

***, **, and * indicate statistical significance at 1%, 5%, and 10% levels, respectively.

Table 2 displays durations for all bond portfolios, and Tax-Exempt Bonds have the largest durations for all groups of insurers, while Public Utility Bonds generally have the

smallest durations. In addition, between the sample insurers and the other auto insurers, the sample insurers on average have statistically significantly smaller durations for investment grade Tax-Exempt Bonds (7.13 versus 7.71), all Public Utility Bonds (4.59 versus 4.81), and non-investment grade Industrial Bonds (4.10 versus 4.51). The duration for total bond portfolios of the sample insurers is not statistically different from that of the other auto insurers (5.82 versus 5.87), but it is statistically significantly different from the duration of the industry (5.82 versus 4.97).

Table 3. Comparison of Modified Convexities of P/L Insurers' Bond Portfolio

	Sample Insurers			Industry Excluding Other Auto Insurers			
	N	Mean	Std. Dev.	N	Mean	N	Mean
Government Bonds							
Investment Grade	195	29.24	29.28	711	30.11 [†]	1,326	26.45*
Non-Investment Grade	3	39.35	15.88	41	38.36	16	29.45
All Government Bonds	195	29.18	29.18	711	30.31	1,327	26.42
Tax-Exempt Bonds							
Investment Grade	189	45.16	25.11	656	51.63 ^{†***}	1,093	44.23 [†]
Non-Investment Grade	20	37.84	35.84	68	32.19	43	25.82*
All Tax-Exempt Bonds	189	45.14	25.11	658	51.46 ^{†***}	1,094	44.19 [†]
Public Utility Bonds							
Investment Grade	115	22.49	24.72	449	23.86 [†]	491	23.49
Non-Investment Grade	10	24.10	16.75	70	18.80	51	18.85
All Public Utility Bonds	115	22.20	24.02	453	23.67 ^{†**}	499	23.19 [†]
Industrial Bonds							
Investment Grade	173	25.91	16.79	642	28.56 ^{†**}	914	26.63 [†]
Non-Investment Grade	75	15.56	12.45	286	19.84 ^{†**}	253	19.63 ^{†**}
All Industrial Bonds	175	25.24	16.26	643	28.30	926	26.23
Total Bonds	211	34.00	20.39	747	34.99	1,542	28.74 ^{†***}

Note: Investment grade bonds include the NAIC bond classes 1 and 2. The NAIC bond classes from 3 to 6 and undefined classes are categorized as non-investment grade bonds.

[†] A variance ratio test (F-test) rejects the null hypothesis that sample variances between groups are equal. ^{***}, ^{**}, and ^{*} indicate statistical significance at 1%, 5%, and 10% levels, respectively.

For convexity as shown in Table 3, the statistical results are similar to duration. In addition, none of the bond portfolios for any group of insurers on average has negative convexity. When the interest rates decrease, the positive convexity will further increase the value of the bond portfolios. In contrary, when the interest rates increase, the positive convexity will mitigate the decrease in the value of the bond portfolios. For example, the value of the sample insurers' total bond portfolios decreases by 5.48 percent ($-5.82 + 0.34$), when the interest rates increase by one hundred basis points, whereas the value increases by 6.16 percent ($5.82 + 0.34$) for the same one hundred basis points decrease.

The investigation of duration suggests that P/L insurers in general did not employ a surplus immunization strategy. As discussed earlier, the duration for total reserves including unearned premium reserves is 1.32 for the sample insurers, and the duration for total bond portfolios is 5.82. Albeit not weighted by their values, a simple comparison of these durations suggests that the sample insurers were substantially exposed to interest rate risk, especially for an increase in interest rates.

C. Interest rate sensitivity of surplus

The measurement of interest rate risk of a P/L insurer's surplus is meaningful only when all related balance sheet items are aggregated and the net positions are identified. Table 4 reports on the increase (decrease) of major balance sheet items with respect to an interest rate decrease (increase) of one percent. An increase in the interest rates of one percent results in an average 4.72 percent decrease in the insurer's asset value, while the value of an insurer's liabilities decreases by 1.18 percent at the same time. That is, on average P/L insurers specializing in private passenger automobile insurance will experience a decrease in their surplus of 9.73 percent when the interest rate increases by one percent.

Table 4. Total Interest Rate Sensitivity and Dollar Sensitivity

	When $\Delta i = -1$ percent		When $\Delta i = 1$ percent	
	Mean	Std. Dev.	Mean	Std. Dev.
Total Interest Rate Sensitivity of				
Assets	4.93	1.98	-4.72	1.87
Bonds ^a	6.03	2.24	-5.69	2.04
Stocks	8.30	0.00	-8.30	0.00
Other Assets ^b	0.50	0.00	-0.50	0.00
Liabilities	1.20	0.49	-1.18	0.47
Loss & LAE Reserves	1.58	0.60	-1.54	0.57
Unearned Premiums Reserves	0.93	0.43	-0.91	0.41
Other Liabilities	0.50	0.00	-0.50	0.00
Surplus	10.23	5.21	-9.73	4.85
Dollar Sensitivity of Total Assets	6,615.3	42,935.5	-6,392.8	41,886.2
Dollar Sensitivity of Total Liabilities	611.6	3,337.6	-598.1	3,266.0
Dollar Sensitivity of Surplus	6,003.7	39,838.6	-5,794.7	38,868.4

Note: Dollar sensitivity is a measure of a change in dollar value (in thousands) with respect to changes in the interest rate.

^a Mortgage backed securities and other option embedded bonds are not differentiated from non-option embedded bonds.

^b Other assets do not include cash on hand.

On the other hand, when the interest rates decrease by the same amount, changes in the absolute values of assets, liabilities and surplus are greater than when the interest rate increases because of the convex relationship between yield and price of a financial security. The one

percent decrease in the interest rate increases the values of assets and liabilities by 4.93 percent and 1.20 percent, resulting in a net increase in surplus of 10.23 percent. Therefore, it is clear from the Table 4 that the P/L insurers studied on average “borrow short and lend long” as other financial institutions such as banks and life insurers. Therefore, insurers’ downside risk is interest rate increases because the increases in the interest rates decrease insurers’ asset value more than their liability value, resulting in a net decrease in surplus value, which is a typical IRR position taken by most financial institutions (Zaglauer and Bauer, 2008).

Dollar sensitivity, a product of total interest rate sensitivity and value of a balance sheet item, shows a change in the value of a balance sheet item with respect to a change in the interest rate. For example, a one percent increase in the interest rate decreases the value of assets by \$6.4 million, while the value of liabilities also decreases by a mere \$0.6 million, resulting in a net decrease of \$5.8 million in surplus. When interest rate decreases by one percent, the gain from the change is about \$6.0 million in surplus.

One of many implications from this sort of line of study is to find a strategy to immunize surplus (or equity) from interest (or inflation) rate changes. Surplus immunization is achieved if the value of surplus is unaffected when interest or inflation rates change. Thus, to immunize an insurer's surplus against the change, the insurer has to maintain their asset and liability sensitivity such that a change in the dollar value of assets is equal to a change in the dollar value of liabilities when interest or inflation rates change.

Let \overline{IRR}_A be the total sensitivity of assets required to immunize surplus given total sensitivity of liabilities (IRR_L), and \overline{IRR}_L be the total sensitivity of liabilities required to immunize surplus given total sensitivity of assets (IRR_A). Table 5 shows that the sample insurers’ \overline{IRR}_A and \overline{IRR}_L are on average 0.65 and 10.15. That is, in order to achieve surplus immunization given liability sensitivity of 1.15, insurers have to restructure their investment portfolio so the sensitivity of the portfolio becomes 0.65. In contrast, if asset sensitivity of 4.69 is given, insurers have to adjust their liability, so their liability sensitivity becomes 10.15. However, surplus immunization by adjusting liability sensitivity seems to be infeasible, because insurers cannot liberally adjust their liabilities, which are mainly reserves.

Table 5. Insurer’s Asset and Liability Sensitivity – Surplus Immunization

	Mean	Std Dev
Measured Total Sensitivity of Assets (IRR_A)	4.69	1.86
Measured Total Sensitivity of Liabilities (IRR_L)	1.15	0.42
Total Sensitivity of Assets Required to Immunize Surplus (\overline{IRR}_A)	0.65	0.34
Total Sensitivity of Liabilities Required to Immunize Surplus (\overline{IRR}_L)	10.15	10.83

Note: IRR_A and IRR_L measures do not consider the existence of option embedded bonds.

Surplus immunization management seems to be sub-optimal to taking IRR for the sample insurers. Given liability sensitivity, achieving asset sensitivity of 0.65 implies greater weight in the insurer’s investment portfolio for cash and short-term investment, which will

substantially reduce investment income. The reduction in investment income increases the insurance price, which may not be an easy task in rate regulated states, especially in a timely manner. Even without rate regulation, the high insurance price will eventually jeopardize insurers' survivability in this competitive industry.

However, insurers longing for surplus immunization should consider using financial derivatives, because financial derivatives can transform the duration of balance sheet items without significant additional capital (Simons, 1995). Cowley and Cummins (2005) discuss the importance of securitization and argue that securitization allows insurers to achieve liquidity goal and provides an alternative source of financing by spreading risk more broadly. The findings of Lee and Stock (2000) also suggest that use of option embedded securities, not necessarily derivatives, reduces surplus sensitivity, when interest rate changes are large. Additionally, Tzeng, Wang and Soo (2000) suggest that a linear programming can be utilized to derive an optimal asset allocation subject to zero surplus duration.

V. Conclusion

This study is mainly motivated by the fact that there is a lack of research on interest rate risk of the property/liability (P/L) insurance industry. Unexpected changes in interest (or inflation) rates may severely jeopardize insurers' survivability and surplus position. Unless they properly manage their assets and liabilities, the potential impact of changes in interest rates on P/L insurer's investment revenue, profitability, and surplus may be so large that insurers may become insolvent. The proper management of assets and liabilities is not possible without properly understanding the IRR that the insurers are exposed to (Santomero & Babbel, 1997 and Brewer et al., 2007).

The result of the investigation of the sample insurers' surplus sensitivity shows that the sample insurers in general did not actively practice surplus immunization management. Given the asset and liability sensitivities, the sample insurers might not be able to practice surplus immunization management. To have their surplus immunized, the insurers had to adjust their asset portfolios, so total sensitivity of assets had to be 0.65 on average. In other words, the insurers must forgo most of their investment income, forcing them to increase their insurance prices. The increase in the prices would probably result in a loss of business to their competitors who did not immunize their surplus. Another means to achieve surplus immunization was to have liability sensitivity of 10.15, which was a more difficult task because an apparent means to achieve the target liability sensitivity was through adjusting their payout pattern. Therefore, at least for P/L insurers investigated in this study, surplus immunization was not only sub-optimal, but also infeasible.

The implication of this study is that regulators should be concerned with interest rate sensitivities of insurer's assets, liabilities, and surplus as a whole. On average, a one percent change in interest rates decreases the value of surplus by 9.73 percent, or \$5.8 million for insurers specializing in private passenger auto insurance. However, caution is warranted in generalizing the findings of this study because (1) the data used in the study is limited to a single year and (2) the sample insurers are predominantly in private passenger auto insurance lines of business. In addition, the sample period used in the study did not have the same

economic conditions as recent years. Therefore, analyzing insurer's IRR exposures over time including the recent financial crisis will test the findings of this study and improves generalizability of empirical findings.

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