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EVIDENCE ON THE RELATION BETWEEN INVENTORY CHANGES, EARNINGS AND FIRM VALUE

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ABSTRACT

Prior studies contend that an unexpected increase in inventory reflects a firm's difficulty in generating sales and results in negative earnings growth and stock returns. Using a sample with over 85,000 observations for the period of 1950-2005, we confirm the negative relation between inventory changes and firm performance but find that the relation is sensitive to the choice of sample period. Moreover, this relation is somewhat attenuated for firms in the wholesale and retail industry as well as for firms that normally carry low levels of inventory. Our findings suggest that the macroeconomic and industry-specific environments are important moderators of the relation between inventory changes and firm performance.

JEL: G34

KEYWORDS: Inventory; Working capital management

INTRODUCTION

In their survey of research on inventories, Blinder and Maccini (1991) point out that the drop in inventory accounts for 87% of the drop in Gross National Product (GNP) during an average recession in the US. Ramey and West (1997) point out a similar link between inventories and GDP for five of the G7 countries. At the firm level, Thomas and Zhang (2002) find that changes in inventory are the primary driver for the relation between accruals and future abnormal returns. Taken together, they suggest that inventories are important determinants of firm performance and value. Yet, there is very little research that has examined this issue and our understanding of the influence of inventory on firm value remains incomplete. Notable exceptions are the work of Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993). Abarbanell and Bushee (1997) examine the relation between EPS changes and several firm characteristics (including the change in inventories) from 1983 to 1990 and find that an unexpected increase in inventory (to sales) is negatively related to short-term earnings growth measured by one-year-ahead EPS change. Lev and Thiagarajan (1993) examine the relation between inventory changes and stock price returns by examining a large cross-section of firms from 1974 to 1988 and find that unexpected increases in inventory result in lower stock price returns. However, even this evidence is not complete. First, our present understanding of the role of inventory relies disproportionately on a relatively small number of studies that analyze a narrow set of metrics over a small number of years. As a result, it is not clear if the conclusions will hold out of sample. Second, prior research has not delved into potential differences between industries. In particular, inventory management is at the heart of the operations of retailers and wholesalers (in this paper we collectively refer to them as distributors). Therefore, increases or decreases in inventory levels for retailers and wholesalers may be driven by very different considerations than similar changes for firms in any other industries.

In this paper we address these two issues. First, by employing a relatively long 56-year sample period, we examine if the negative correlation between the unexpected changes in inventory and earnings growth holds for all time periods. We also test for the robustness of our conclusions using a number of alternate metrics of firm performance. Second, by further classifying firms by industry, we examine if the negative correlation holds for all the industries. Similar to Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993), we find that an unexpected increase (decrease) in inventory is followed by a fall (rise) in short term earnings during the 1970s and 1980s. However, this conclusion does not hold for other time periods. We find no significant relation during the 1950s and the 1960s and a weaker relation in the years after 2000. With respect to long term changes in earnings, we find an inverse relation between the unexpected change in inventories and long term changes in earnings for the 1950s and the 1990s but not for the other decades. We also test for the robustness of these results to the use of alternate metrics of firm performance such as return on assets and the market to book ratio. We find negative relations between inventory and the changes in the market-to-book ratio and also between inventory and the change in the return on assets. However, the significance and the magnitude of the relation remain sensitive to the choice of sample period. Finally, in our analysis of industry effects, we find some evidence that suggests that an unexpected increase in inventories is not as negative for wholesalers and retailers. However, this conclusion is also sensitive to the choice of sample period.

Our contributions from this study are twofold. First, in comparison with prior research, we examine a relatively large sample period. As a result, we are better able to assess the relation between the unexpected inventory changes and firm performance and its stability over time. Second, we examine potential problems that may arise from viewing all firms as a homogeneous group. In particular, we test for potential differences in this relation for the wholesale and retail industry. Our results provide a more complete picture of the way in which inventory management affects firm performance. The rest of the paper is organized as follows. Section 2 reviews prior research and presents our hypotheses; section 3 describes our data; section 4 presents our results, and section 5 concludes.

PRIOR WORK AND HYPOTHESES

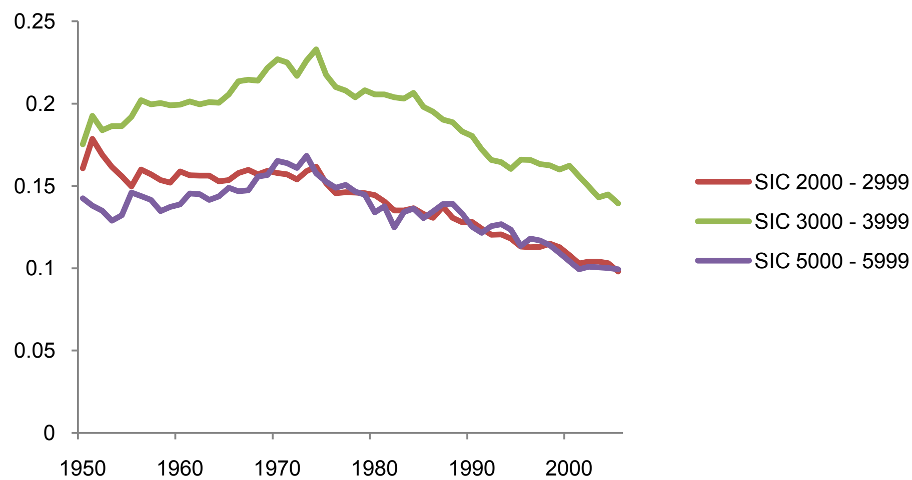
Inventory management affects firm performance in various ways. As noted by Blinder and Maccini (1991), by holding inventory, firms can improve production scheduling, minimize stock-out costs, reduce purchasing costs by buying in quantity and speculate on price movements. However, there are costs to holding inventory as well. These typically include opportunity cost, cost of space, handling cost, stock obsolescence, insurance, spoilage, pilferage and inventory damage. It is also possible that the stock market may interpret a rise in inventory as an indication of an unanticipated shortfall in sales. Therefore, the stock market could discount firms with high inventory, and so raise the capital costs of firms that carry high levels of inventory. As noted by Lai (2006), better managed firms will signal their superior quality by carrying lower inventory and so distinguishing themselves from firms that are unable to decrease inventory to similar levels. Finally, the motives of managers could also be an important determinant of inventory levels. As shown by Gaur et al (2005) inventory and gross margin are negatively correlated. Therefore, lowering inventory may improve earnings in the short run. However, this could be at the expense of the long-term growth if maintaining high inventory is the optimal strategy. Moreover, as pointed out by Stein (1988), Narayanan (1985) and Niehaus (1989), managers could overemphasize short term earnings growth as their compensation, in the form of bonuses, grants of stock and options holdings are more short-term performance related. In summary, there are several advantages to holding inventory as well as several disadvantages. The net impact of increasing or decreasing inventory on firm performance, therefore, remains an empirical matter.

The relatively sparse evidence on this topic has mostly supported a negative relation between inventory and firm performance. With respect to stock market based measures of firm performance, Lai (2006) finds that firms with less inventory are better regarded by the stock market as evinced by a higher Tobin's Q. Chen et al (2005) find that stocks of firms holding less inventory earn superior returns. However, they note that their conclusion does not hold for firms with the lowest inventory levels. Finally, Lev and Thiagarajan (1993), Abarbanell and Bushee (1998) and Bao and Bao (2004) document a negative relation between stock returns and changes in inventory. The only comprehensive study using accounting measures is by Abarbanell and Bushee (1997). They examine the relation between earnings per share (EPS) change and a series of firm characteristics from 1983 to 1990 and find that changes in inventory are negatively related to short-term earnings growth as measured by one-year-ahead EPS change. However, they do not find any relation between changes in inventory and long-term growth in earnings measured by five-year geometric mean growth in EPS. In a related study, Weiss et al (2008) find that between 1990 and 2000 inventory changes are significant predictor of future earnings.

Although the evidence largely supports a negative relation between inventory and firm performance, there are reasons to believe that it is incomplete. First, the most comprehensive studies outlined above pertain to the period from the 1970s to the 1990s. As can be seen from Figure 1, the overall inventory management policies of all listed firms seem to have changed over time. In particular, the period from the 1970s to the 1990s were characterized by declining inventory levels and it is possible that the negative relation between inventory and firm performance during that time was an artifact of the then prevailing economic environment rather than a more general relation. Second, and to a lesser extent, a more comprehensive set of metrics of firm performance could help us test for the robustness of the observed relation. In summary, our first hypothesis is as follows:

Hypothesis 1: Firm performance, as measured by earnings, return on assets and market valuation will be negatively related to changes in inventories.

Figure 1: Profile of Inventory-to-sales Ratio from 1950 to 2005



The sample consists of all firms in the primary products (SIC 2000-2999), manufacturing (SIC 3000-3999), and wholesale and retail industry. (SIC 5000-5999) in the annual Compustat database from 1950 to 2005.

Our first hypothesis implies that any change in inventory that is greater than the corresponding change in sales stems from an unplanned change in the volume of sales. However, an increase in inventory for the wholesale and retail industry could be driven by other considerations. The wholesale / retail industry has several unique features, differentiating it from other sectors. First, the interpretation of an unexpected increase in inventory to sales as bad news stems largely from the role of inventory in smoothing production. Unlike manufacturers, wholesalers and retailers do not produce any goods, and so this motive does not exist in the wholesale and retail industry. Moreover, dealing with a large number of customers on a daily basis may provide distributors with more market feedback on their products. As a result, they might better able to predict market demand, and therefore adjust inventory in anticipation of future changes in the product market. As a result, a sudden increase in inventory for a distributor is relatively more likely to be the response to a predicted change in future demand than the result of an unanticipated change in current demand. Finally, it has become increasingly common for distributors to develop collaborative partnerships with their suppliers on inventory protection in case of obsolete items and unfavorable price changes, substantially reducing their risks of holding inventory. The inventory protection mechanism is expected to offset the negative effect of the inventory increase by hedging against price risk and obsolescence risk.

Vendor-managed inventory (VMI) is one of the most widely discussed supplier/vendor programs in the wholesale and retail industry and it was popularized in the late 1980s by Wal-Mart and Procter & Gamble. As noted by Waller et al (2001), through VMI the vendor transfers financial responsibility for the inventory partly to the supplier. Thus, holding more inventory works like a call option. When prices rise, distributors benefit from the change. However, their losses are limited when prices go down. Overall, retailers and wholesalers enjoy unique benefits from holding inventory. Therefore, our second hypothesis is as follows:

Hypothesis 2: The negative general relation between an unexpected increase in inventories and firm performance will be smaller for firms in the wholesale and retail industries.

DATA AND METHODOLOGY

We collect data on firm characteristics from the Compustat database. In addition, we collect data on nominal GDP growth rate, the three month T-bill rate, and the Producer Price Index (PPI) from Federal Reserve Economic Data (FRED) made available by the Federal Reserve Bank of St. Louis. As indicated by Abarbanell and Bushee (1997) inventory data are meaningful in the context of our study only for industries that maintain a stock of raw materials or finished goods. Therefore, we only include firm-year observations from the primary products (SIC codes from 2000 to 2999), manufacturing (SIC codes from 3000 to 3999), and wholesale and retail (SIC codes from 5000 to 5999) sectors. We follow prior research in defining our sample in this fashion as it is difficult to interpret inventory holdings for other sectors – a similar industry specification for the sample has been followed by Lai (2005), Lai (2006) and Abarbanell and Bushee (1997).

We mainly follow Lev and Thiagarajan (1993) and Abarbanell and Bushee (1997) in defining our variables and the details of these are provided in Table 1. We avoid problems due to outliers by winsorizing the extreme 1% observations of the predictor variables. The final sample consists of 7,821 firms that we follow for the 56 years from 1950 to 2005. In order to explore the relation between inventory changes and firm value or earnings we run a number of ordinary least squares (OLS) regressions of the form:

$$\textit{Performance metric} = \beta_0 + \beta_1 * \textit{Inventory change} + \Sigma\, \beta_i * \textit{Control variable}_i$$

Our dependent variable is one of several performance metrics and based on earnings and firm value. Similar to Lev and Thiagarajan (1993) and Abarbanell and Bushee (1997), we measure short term changes in earnings by CEPS1 and long term changes in earnings by CEPSL. We also measure the operating performance using changes in the return on assets (ROA). Finally, we measure value changes using changes in the market-to-book ratio. We define our independent and dependent variables in Table 1.

We follow Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993) in choosing our control variables. They include the unexpected increase in accounts receivable (AR), the unexpected decrease in capital expenditures (CAPX), the unexpected decrease in the gross margin (GM), the unexpected increase in selling and administrative expenses (S&A), earning quality (EQ), and the change in the number of employees scaled by sales (LF). In each case, the expected change is proxied by the change in sales and the unexpected change is computed as the difference between the observed change and the expected change. We also control two macro-economic factors, real GDP growth rate (GDPGROW) and nominal interest rate (INTEREST). In general, high real GDP growth and low interest rate provide favorable exterior environment for firms to growth their earnings, so real GDP growth is expected to be positively related to earnings growth while interest rate is negatively related. Our primary dependent variable is the unexpected increase in inventory (INV) and is measured as the percentage change in inventory minus the percentage change in sales.

Table 1: Definition of Variables

Variables	Measurement [a]
Inventory (INV)	Δ Inventory - ΔSales
Accounts Receivable (AR)	Δ Accounts Receivable - Δ Sales
Capital Expenditure (CAPX)	Δ Industry CAPX -Δ Firm CAPX
Gross Margin(GM)	Δ Sales - Δ Gross Margin
Selling and Administrative Expense (S&A)	Δ S&A -Δ Sales
Labor Force (LF)	$\left(\frac{Sales_{t-1}}{\#\ Employes_{t-1}} - \frac{Sales_t}{\#\ Employes_t}\right) \Big/ \frac{Sales_{t-1}}{\#\ Employes(29)_{t-1}}$
One-Year –Ahead Earnings (CEPS1)	$[Adj.EPS_{t+1} - EPS_t]/P_{t-1}$ [e]
Long-Term Growth in Earnings ($CEPSL_t$)	$\prod_1^5 CEPSi^{1/5}$ e.g. $CEPS2 = [adjEPS_{t+2} - EPS_{t+1}]/P_t$
CHGEPS	$[Adj.EPS_t - EPS_{t-1}]/P_{t-1}$
CROA	$ROA_{t+1} - ROA_t$
CHGROA	$ROA_t - ROA_{t-1}$
CMtoB	$\frac{M}{B}\ ratio_t - \frac{M}{B} ratio_{t-1}$
GDPGROW	Real GDP growth rate
INTEREST	Nominal interest rate

1)The definitions of the predictor variables are based on Abarbanell and Bushee (1997). The Δ operator represents a percentage change in the variable based on a two-year expectation model; e.g. $\Delta Sales = [Sales_t - E(Sales_t)]/E(Sales_t)$ *where* $E(Sales_t) = (Sales_{t-1} + Sales_{t-2})/2$ *2) The Inventory variable is finished goods when available, total inventory otherwise. 3) Industry Capital Expenditures are calculated by aggregating firm figures for all firms with the same two-digit SIC code. 4) Adjusted EPS refers to adjustments made for stock splits and stock dividends in order to EPS numbers for different years comparable.*

RESULTS

Table 2 provides a descriptive summary of the whole sample as well as the subsample from the wholesale and retail industry. Over the entire sample period, the wholesale and retail industry accounts for 10% to 20% of the total observations. On average, wholesalers and retailers are roughly the same size as firms in other industries but have lower profitability and a higher rate of inventory turnover. Figure 1 highlights further differences between the distributors and firms in other industries. As can be seen in Figure 1, distributors tend to carry significantly less inventory than manufacturing firms and somewhat less than firms that operate in the primary products industries. Overall, Table 2 and Figure 1 suggest potential differences in inventory levels for distributors.

Table 2 Descriptive Summary

Panel A: Full Sample	1950s	1960s	1970s	1980s	1990s	2000 -
Number of firm-years	5757	17001	32438	36963	45023	23953
Inventory/Sales	17.29%	18.18%	18.42%	16.78%	14.49%	12.87%
EBITDA/Sales	12.86%	11.08%	9.94%	9.96%	10.62%	10.84%
Asset(mm$)	54.80	29.50	30.90	40.81	69.90	139.59

Panel B: Wholesale and Retail Firms	**1950s**	**1960s**	**1970s**	**1980s**	**1990s**	**2000 -**
Number of firm-years	673	2786	6654	7849	9252	4279
Inventory/Sales	13.50%	14.77%	15.46%	13.41%	11.88%	10.04%
EBITDA/Sales	6.59%	6.16%	6.26%	6.33%	6.28%	7.01%
Asset(mm$)	50.40	24.57	31.10	45.68	104.45	248.57

Overall Relation between Inventory and Firm Performance

Our first set of tests is geared towards understanding the relation between inventory and short term firm performance. We define short term firm performance in two ways. First, and similar to Abarbanell and Bushee (1997), we look at the one year forward change in the earnings per share (CEPS1). Second, we look at the change in the return on assets (CROA) over a similar period. Our primary predictor variable is the change in the inventory - to - sales ratio (INV) in the preceding year and we run regressions of the form:

$$CEPS1_{t,i} = \beta_0 + \beta_1 * CHGEPS_{t,i} + \beta_2 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (1)$$

$$CROA_{t,i} = \beta_0 + \beta_1 * CHGROA_{t,i} + \beta_2 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (2)$$

where the observations are for the firm *i* in period *t* with the subscript *j* for the control variables. Similar to Abarbanell and Bushee (1997), we control for one year lagged values of the dependent variable (CHGEPS and CHGROA). We also control for AR, CAPX, GM, S&A, EQ, LF and macro-economic factors including real GDP growth rate and nominal interest rate. Unlike Abarbanell and Bushee (1997), we do not control for the tax rate and earnings quality as there are a large number of missing observations for these variables, especially during the earlier years of our sample. However, their inclusion leaves our conclusions largely unchanged.

Table 3 reports the results of this regression. In Panel A of Table 3 we report the results pertaining to the test of earnings growth. The coefficient estimate for INV is negative and significant from 1970 to 1999. Interestingly, this covers the sample period studied by Abarbanell and Bushee (1997) and Lev and Thiagarajan (1993). Outside of this period, the significance is markedly lower from 2000 to 2005 and the estimate is insignificant during the 1950s and the 1960s. Our results indicate that the relation is sensitive to sample period selection and that the results presented by prior research are limited to the specific samples that they study.

Table 3 Panel A: Changes in Short Term Earnings

	1950-2005	50-59	60-69	70-79	80-89	90-99	2000-05
CHGEPS	-0.106	-0.264	-0.128	-0.122	-0.123	-0.134	-0.056
	(11.43)***	(3.11)***	(1.83)	(5.39)***	(7.00)***	(8.37)***	(2.98)***
INV	-0.011	-0.008	-0.004	-0.021	-0.016	-0.006	-0.007
	(8.33)***	(1.13)	(1.42)	(6.24)***	(7.77)***	(2.60)***	(1.91)*
AR	-0.008	0.022	0.003	-0.003	-0.014	-0.012	0.005
	(3.72)***	(3.59)***	(1.20)	(0.53)	(3.52)***	(3.06)***	(0.71)
CAPX	0.011	-0.001	0.001	0.010	0.009	0.012	0.015
	(16.19)***	(0.51)	(1.84)	(7.54)***	(8.51)***	(9.92)***	(6.24)***
GM	0.024	-0.026	-0.004	0.036	0.027	0.012	0.026
	(6.40)***	(1.65)	(0.53)	(2.83)***	(4.05)***	(2.08)**	(3.05)***
S&A	0.032	-0.010	-0.005	0.013	0.028	0.029	0.054
	(7.39)***	(1.41)	(0.92)	(1.09)	(3.57)***	(3.87)***	(4.53)***
EQ	0.009	-0.000	0.000	0.003	0.005	0.017	0.027
	(5.45)***	(0.09)	(0.27)	(0.90)	(1.64)	(5.34)***	(3.72)***
LF	-0.021	0.047	0.002	-0.013	-0.018	-0.018	-0.040
	(4.81)***	(2.55)**	(0.56)	(0.98)	(2.52)**	(2.45)**	(3.32)***
GDPGROW	0.002	0.001	0.002	0.002	0.004	0.000	0.011
	(8.31)***	(2.27)**	(7.48)***	(4.35)***	(6.65)***	(0.32)	(7.49)***
INTEREST	-0.004	-0.017	-0.003	-0.004	-0.001	-0.007	-0.009
	(11.17)***	(8.64)***	(7.70)***	(2.98)***	(0.91)	(3.86)***	(5.47)***
CONSTANT	0.034	0.049	0.011	0.050	0.005	0.046	0.020
	(11.98)***	(7.67)***	(4.55)***	(5.52)***	(0.63)	(4.10)***	(2.12)**
Observations	85226	1470	5412	19333	22037	25100	11874
R-squared	0.03	0.21	0.05	0.04	0.04	0.03	0.03

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 1 where the dependent variable is the one year forward change in EPS (CEPS1). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Table 3 Panel B: Changes in ROA

	1950-2005	**50-59**	**60-69**	**70-79**	**80-89**	**90-99**	**2000-05**
CHGROA	-0.223	-0.150	-0.116	-0.167	-0.255	-0.244	-0.182
	(17.76)***	(3.26)***	(4.16)***	(6.58)***	(11.54)***	(11.37)***	(5.94)***
INV	-0.009	0.001	-0.005	-0.009	-0.009	-0.008	-0.009
	(8.74)***	(0.26)	(1.78)*	(6.03)***	(4.94)***	(4.15)***	(3.16)***
AR	0.001	0.020	0.005	0.002	0.002	-0.002	-0.001
	(0.50)	(4.62)***	(1.72)*	(0.91)	(0.75)	(0.56)	(0.18)
CAPX	0.005	0.001	0.002	0.003	0.004	0.007	0.009
	(13.14)***	(0.91)	(3.18)***	(5.23)***	(6.43)***	(8.17)***	(5.41)***
GM	0.007	0.011	0.014	0.026	0.009	0.001	-0.000
	(2.55)**	(1.60)	(3.01)***	(4.88)***	(1.86)*	(0.19)	(0.02)
S&A	-0.007	0.004	0.004	0.000	-0.015	-0.015	0.011
	(2.16)**	(1.22)	(1.17)	(0.02)	(2.22)**	(2.37)**	(1.19)
EQ	-0.003	0.001	-0.001	0.000	-0.004	-0.004	-0.003
	(5.07)***	(0.49)	(0.77)	(0.11)	(3.31)***	(3.71)***	(1.41)
LF	-0.009	0.023	0.001	-0.002	-0.011	-0.004	-0.026
	(3.05)***	(2.28)**	(0.30)	(0.28)	(1.89)	(0.76)	(2.94)***
GDPGROW	0.001	0.001	0.002	-0.000	0.001	-0.001	0.001
	(8.04)***	(3.26)***	(9.39)***	(1.78)	(4.99)***	(2.65)***	(0.79)
INTEREST	-0.001	-0.014	-0.005	-0.005	-0.001	-0.004	-0.008
	(10.24)***	(10.24)***	(10.40)***	(11.04)***	(3.86)***	(4.48)***	(9.73)***
CONSTANT	0.003	0.026	0.008	0.034	0.002	0.021	0.016
	(2.82)***	(5.68)***	(2.94)***	(9.62)***	(0.49)	(3.86)***	(4.63)***
Observations	95511	2188	6159	23026	24419	27177	12542
R-squared	0.05	0.18	0.08	0.06	0.07	0.06	0.05

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 2 where the dependent variable is the one year forward change in ROA (CROA). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

It is possible that the growth in earnings is related to an expansion in the asset base. In order to get a cleaner measure of the change in the performance for a given firm, we replace EPS change with ROA change. Panel B of Table 3 reports the results for the tests using ROA as a measure of firm performance. As in Panel A, we control for one year lagged values of the dependent variable as well as AR, CAPX, GM, S&A, EQ, LF, and real GDP growth rate and nominal interest rate. As in the previous case, we exclude the tax rate and the earnings quality from the list of control variables. However, our conclusions remain qualitatively unchanged when we include them. Our conclusions are as before: INV is negatively related ROA but the relation is sensitive to the choice of the sample period.

In order to assess if the effects of a change in inventory pertain more to the longer term, we run the following tests. First, we recognize that the market to book ratio of the firm will capture all future expected changes and so will proxy for longer term changes in the performance of the firm. Our second measure of long term performance changes is based on earnings. We use the five-year geometric mean of changes in EPS as our measure of the long term changes in earnings per share (CEPSL). These two measures of firm performance are our dependent variables in the next set of tests. We estimate OLS regressions as follows:

$$CMtoB_{t,i} = \beta_0 + \beta_1 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (3)$$

$$CEPSL_{t,i} = \beta_0 + \beta_1 * CHGEPS_{t,i} + \beta_2 * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (4)$$

Table 4 Panel A: Changes in the Market to Book Ratio

	1960-2005	60-69	70-79	80-89	90-99	2000-05
INV	-0.077	0.004	-0.034	-0.075	-0.090	-0.103
	(10.63)***	(0.06)	(3.48)***	(6.56)***	(6.86)***	(5.05)***
AR	-0.044	-0.120	-0.068	-0.081	-0.025	-0.001
	(4.14)***	(2.44)**	(4.54)***	(4.63)***	(1.31)	(0.04)
CAPX	0.036	0.021	0.004	0.025	0.053	0.062
	(11.92)***	(1.37)	(1.23)	(5.37)***	(8.79)***	(6.02)***
GM	-0.111	-0.466	-0.070	-0.123	-0.114	-0.091
	(7.32)***	(2.75)***	(2.59)***	(4.86)***	(4.14)***	(2.64)***
S&A	-0.112	-0.492	-0.045	-0.059	-0.167	-0.126
	(5.48)***	(4.12)***	(1.36)	(1.72) *	(4.57)***	(2.50)**
EQ	-0.057	-0.001	-0.053	-0.069	-0.018	-0.083
	(14.17)***	(0.08)	(9.34)***	(9.62)***	(2.11)**	(6.36)***
LF	0.033	-0.112	-0.017	0.035	0.040	0.044
	(2.01)*	(1.33)	(0.61)	(1.26)	(1.41)	(1.09)
GDPGROW	0.019	0.072	0.034	0.005	0.019	0.028
	(26.87)***	(8.05)***	(32.99)***	(2.91)***	(6.33)***	(6.39)***
INTEREST	-0.001	-0.058	0.042	0.008	0.012	-0.070
	(1.36)	(2.94)***	(17.16)***	(3.61)***	(2.10)*	(12.07)***
CONSTANT	-0.039	-0.049	-0.368	-0.053	-0.128	0.174
	(4.56)***	(0.36)	(18.70)***	(2.11)**	(3.47)***	(7.51)***
Observations	88462	3091	20038	23537	26603	15193
R-squared	0.02	0.17	0.09	0.02	0.02	0.04

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 3 where the dependent variable is the change in the market to book ratio (CMtoB). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Table 4 Panel B: Changes in Long Term Earnings

	1950-2005	50-59	60-69	70-79	80-89	90-99	2000-05
CHGEPSL	-0.099	-0.057	-0.088	-0.069	-0.069	-0.127	-0.182
	(6.16)***	(2.85)***	(3.86)***	(2.30)**	(2.43)**	(4.85)***	(1.85)*
INV	-0.009	-0.005	-0.003	-0.009	-0.003	-0.008	-0.024
	(3.38)***	(2.27)**	(1.56)	(1.54)	(0.79)	(1.75)*	(1.31)
AR	0.001	0.003	0.001	-0.002	0.002	0.002	-0.015
	(0.20)	(1.55)	(0.72)	(0.18)	(0.22)	(0.22)	(0.62)
CAPX	0.002	-0.000	0.001	0.001	0.002	0.003	-0.003
	(2.00)**	(0.01)	(2.67)***	(0.26)	(1.18)	(1.24)	(0.45)
GM	-0.005	-0.002	0.003	-0.016	0.002	-0.003	-0.005
	(0.76)	(0.45)	(1.03)	(0.82)	(0.15)	(0.30)	(0.13)
S&A	0.000	0.000	0.001	0.003	-0.001	-0.009	0.011
	(0.06)	(0.02)	(0.44)	(0.18)	(0.09)	(0.68)	(0.28)
EQ	-0.019	0.001	0.001	-0.018	-0.019	-0.031	-0.014
	(7.60)***	(1.67)	(0.44)	(3.93)***	(4.12)***	(6.21)***	(0.57)
LF	0.016	0.006	-0.001	0.030	0.001	0.016	0.060
	(2.18)**	(1.26)	(0.55)	(1.52)	(0.12)	(1.23)	(1.52)
GDPGROW	-0.000	0.000	-0.000	-0.001	0.003	-0.003	0.000
	(0.16)	(0.29)	(0.41)	(1.35)	(3.58)***	(1.90)	(0.00)
INTEREST	-0.001	-0.003	-0.001	-0.005	0.006	-0.005	0.000
	(2.04)**	(3.92)***	(1.30)	(2.54)**	(5.44)***	(1.94)	(0.00)
CONSTANT	-0.012	0.010	0.009	0.024	-0.098	0.011	-0.041
	(2.96)***	(5.02)***	(5.48)***	(1.75)*	(7.50)***	(0.63)	(1.97)**
Observations	58614	1452	5217	15787	16105	18373	1680
R-squared	0.01	0.06	0.01	0.00	0.01	0.01	0.02

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 4 where the dependent variable is the five-year change in EPS (CEPSL). The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Panels A and B of Table 4 report the results of these regressions. In Panel A, we consider the relation between changes in the market to book ratio and the changes in inventory. The coefficient estimate for INV is negative and significant from 1970 to 2005, but insignificant in the 1960s. This finding is consistent with Lai (2005). Overall the relation between market valuation and inventory appears to be more robust although it does not manifest during the 1960s.

In Panel B we consider the relation between inventory changes and long term earnings growth. Consistent with Abarbanell and Bushee (1997), no evidence is found in the 1980s that INV will affect long-term EPS growth. However, we find a negative and significant relation during the 1950s and a weaker but similar relation during the 1990s. As with our previous tests, our findings indicate that the relation is sensitive to the choice of the sample period.

Our results till this point pertain to the overall relation between inventory changes and firm performance. Our findings suggest that the relation has changed over time and ignoring this change provides a misleading picture of the nature of this relation. In the following tests we explore the differences between firms that operate in the retail and wholesale industries and those that operate in other industries.

Table 5: Inventory and Firm Performance for the Retail and Wholesale Industries

Panel A: Changes in Short Term Earnings for the Retail and Wholesale Industry

	1950-2005	50-59	60-69	70-79	80-89	90-99	2000-05
CHGEPS	-0.106	-0.263	-0.128	-0.121	-0.123	-0.134	-0.056
	(11.43)***	(3.10)***	(1.83)	(5.35)***	(6.99)***	(8.37)***	(2.98)***
INV	-0.011	-0.007	-0.004	-0.024	-0.016	-0.006	-0.007
	(8.43)***	(1.02)	(1.18)	(7.48)***	(7.60)***	(2.68)***	(1.99)**
AR	-0.008	0.021	0.003	-0.004	-0.014	-0.012	0.005
	(3.75)***	(3.46)***	(1.21)	(0.76)	(3.52)***	(3.11)***	(0.71)
CAPX	0.011	-0.001	0.001	0.010	0.009	0.013	0.015
	(16.23)***	(0.50)	(1.78)	(7.53)***	(8.51)***	(10.00)***	(6.24)***
GM	0.024	-0.025	-0.004	0.040	0.027	0.012	0.026
	(6.41)***	(1.64)	(0.54)	(3.18)***	(4.05)***	(2.09)*	(3.02)***
S&A	0.032	-0.009	-0.005	0.013	0.028	0.029	0.055
	(7.37)***	(1.31)	(0.94)	(1.14)	(3.57)***	(3.83)***	(4.55)***
EQ	0.009	-0.000	0.000	0.003	0.005	0.017	0.027
	(5.45)***	(0.10)	(0.30)	(0.88)	(1.64)	(5.34)***	(3.72)***
LF	-0.021	0.046	0.002	-0.016	-0.018	-0.018	-0.040
	(4.80)***	(2.53)**	(0.56)	(1.20)	(2.52)**	(2.43)**	(3.32)***
INV×Dist	0.000	-0.023	-0.009	0.017	-0.001	0.000	0.002
	(6.61)***	(0.68)	(1.23)	(4.19)***	(0.71)	(5.50)***	(0.78)
GDPGROW	0.002	0.001	0.002	0.002	0.004	0.000	0.011
	(8.30)***	(2.28)**	(7.46)***	(4.41)***	(6.65)***	(0.30)	(7.49)***
INTEREST	-0.004	-0.017	-0.003	-0.003	-0.001	-0.007	-0.009
	(11.17)***	(8.65)***	(7.57)***	(2.89)***	(0.90)	(3.87)***	(5.47)***
CONSTANT	0.034	0.049	0.011	0.049	0.005	0.046	0.020
	(11.98)***	(7.67)***	(4.50)***	(5.42)***	(0.63)	(4.12)***	(2.12)**
Observations	85226	1470	5412	19333	22037	25100	11874
R-squared	0.03	0.21	0.05	0.04	0.04	0.04	0.03

Panel B: Changes in ROA for the Retail and Wholesale Industry

	1950-2005	1950-59	1960-69	1970-79	1980-89	1990-99	2000-05
CHGROA	-0.223	-0.150	-0.116	-0.167	-0.255	-0.244	-0.182
	(17.77)***	(3.24)***	(4.17)***	(6.56)***	(11.55)***	(11.38)***	(5.94)***
INV	-0.009	0.002	-0.004	-0.010	-0.009	-0.008	-0.009
	(8.81)***	(0.42)	(1.48)	(6.41)***	(5.16)***	(4.20)***	(3.22)***
AR	0.001	0.020	0.005	0.002	0.002	-0.002	-0.001
	(0.48)	(4.62)***	(1.72)*	(0.76)	(0.79)	(0.58)	(0.18)
CAPX	0.005	0.001	0.002	0.003	0.005	0.007	0.009
	(13.18)***	(0.93)	(3.10)***	(5.17)***	(6.51)***	(8.21)***	(5.42)***
GM	0.007	0.011	0.014	0.027	0.009	0.001	-0.000
	(2.55)**	(1.61)	(3.00)***	(5.00)***	(1.88)*	(0.19)	(0.05)
S&A	-0.007	0.004	0.004	0.001	-0.015	-0.015	0.011
	(2.17)**	(1.21)	(1.16)	(0.08)	(2.19)**	(2.40)**	(1.21)
EQ	-0.003	0.001	-0.001	0.000	-0.004	-0.004	-0.003
	(5.07)***	(0.50)	(0.74)	(0.10)	(3.30)***	(3.71)***	(1.41)
LF	-0.009	0.023	0.001	-0.002	-0.011	-0.004	-0.026
	(3.04)***	(2.22)*	(0.31)	(0.39)	(1.87)*	(0.75)	(2.95)***
INV×Dist	0.000	-0.004	-0.013	0.004	0.002	0.000	0.002
	(3.91)***	(0.95)	(1.63)	(4.10)***	(2.08)**	(11.51)***	(0.85)
GDPGROW	0.001	0.001	0.002	-0.000	0.001	-0.001	0.001
	(8.03)***	(3.26)***	(9.37)***	(1.77)*	(4.98)***	(2.67)***	(0.79)
INTEREST	-0.001	-0.014	-0.005	-0.005	-0.001	-0.004	-0.008
	(10.24)***	(10.25)***	(10.30)***	(11.00)***	(3.87)***	(4.50)***	(9.72)***
CONSTANT	0.003	0.026	0.007	0.034	0.002	0.021	0.016
	(2.83)***	(5.68)***	(2.90)***	(9.57)***	(0.51)	(3.88)***	(4.63)***
Observations	95511	2188	6159	23026	24419	27177	12542
R-squared	0.05	0.18	0.08	0.06	0.07	0.06	0.05

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. Panel A provides estimates of equation 5 where the dependent variable is the one year forward change in EPS (CEPS1). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Panel B provides estimates of equation 6 where the dependent variable is the one year forward change in ROA (CROA). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

In order to further examine the difference in the impact of inventory changes on firm performance for distributors we create an indicator variable Dist which equals one if a firm's SIC is between 5000 and 5999 and is equal to zero otherwise. We capture the specific impact of inventory changes for distributors by multiplying INV by this new variable. We then re-estimate equations 1 through 4 by introducing this interactive term in addition to the previous variables. Thus, we estimate OLS regressions for the following equations:

$$CEPS1_{t,i} = \beta_0 + \beta_1 * CHGEPS_{t,i} + \beta_2 * INV_{t,i} + \beta_3 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (5)$$

$$CROA_{t,i} = \beta_0 + \beta_1 * CHGROA_{t,i} + \beta_2 * INV_{t,i} + \beta_3 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (6)$$

$$CMtoB_{t,i} = \beta_0 + \beta_1 * INV_{t,i} + \beta_2 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (7)$$

$$CEPSL_{t,i} = \beta_0 + \beta_1 * CHGEPSL_{t,i} + \beta_2 * INV_{t,i} + \beta_3 * Dist * INV_{t,i} + \sum_j \beta_j * Control_{t,i,j} + \varepsilon_{t,i} \quad (8)$$

Table 6 Panel A: Changes in the Market to Book Ratio for the Retail and Wholesale Industry

	1950-2005	60-69	70-79	80-89	90-99	2000-05
INV	-0.077	0.002	-0.033	-0.076	-0.090	-0.109
	(10.60)***	(0.02)	(3.32)***	(6.45)***	(6.84)***	(5.26)***
AR	-0.044	-0.120	-0.068	-0.081	-0.025	-0.003
	(4.13)***	(2.45)**	(4.51)***	(4.63)***	(1.30)	(0.09)
CAPX	0.036	0.021	0.004	0.025	0.053	0.064
	(11.90)***	(1.38)	(1.27)	(5.37)***	(8.76)***	(6.10)***
GM	-0.111	-0.465	-0.071	-0.123	-0.114	-0.092
	(7.33)***	(2.76)***	(2.62)***	(4.86)***	(4.15)***	(2.69)***
S&A	-0.112	-0.491	-0.045	-0.059	-0.167	-0.124
	(5.48)***	(4.13)***	(1.37)	(1.72)	(4.57)***	(2.46)*
EQ	-0.057	-0.001	-0.053	-0.069	-0.018	-0.083
	(14.17)***	(0.09)	(9.34)***	(9.62)***	(2.11)*	(6.35)***
LF	0.033	-0.112	-0.016	0.035	0.040	0.044
	(2.01)**	(1.33)	(0.58)	(1.26)	(1.41)	(1.08)
INV×Dist	-0.000	0.033	-0.007	0.001	-0.000	0.047
	(0.44)	(0.12)	(1.62)	(0.32)	(0.28)	(2.93)***
GDPGROW	0.019	0.072	0.034	0.005	0.019	0.028
	(26.87)***	(8.03)***	(32.98)***	(2.91)***	(6.33)***	(6.40)***
INTEREST	-0.001	-0.058	0.042	0.008	0.012	-0.070
	(1.36)	(2.97)***	(17.14)***	(3.61)***	(2.11)*	(12.06)***
CONSTANT	-0.039	-0.048	-0.367	-0.053	-0.128	0.174
	(4.57)***	(0.36)	(18.68)***	(2.11)**	(3.47)***	(7.50)***
Observations	88462	3091	20038	23537	26603	15193
R-squared	0.02	0.17	0.09	0.02	0.02	0.04

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 7 where the dependent variable is the change in the market to book ratio (CMtoB). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

The results are reported in Tables 5 and 6. In Panel A of Table 5 we report the coefficient estimates from equation 5. The coefficient estimates for the interactive term are positive and indicate that the negative relation between inventory and short term earnings changes is not as strong for the wholesale and retail industry. However, the estimate is statistically significant only for the 1970s and the 1990s. As before, the relation between inventory changes and long term performance is sensitive to the choice of the sample period. In Panel B of Table 5 we report the coefficient estimates for equation 6. The conclusions from using changes in ROA as the dependent variable are similar to those using short term changes in earnings.

Table 6 Panel B: Changes in Long Term Earnings for the Retail and Wholesale Industry

	1950-2005	50-59	60-69	70-79	80-89	90-99	2000-05
CHGEPS	-0.099	-0.057	-0.088	-0.067	-0.069	-0.127	-0.183
	(6.16)***	(2.84)***	(3.86)***	(2.26)*	(2.43)*	(4.85)***	(1.85)*
INV	-0.009	-0.005	-0.002	-0.013	-0.003	-0.008	-0.025
	(3.41)***	(2.14)**	(1.11)	(2.06)**	(0.80)	(1.76)*	(1.31)
AR	0.001	0.003	0.001	-0.003	0.002	0.002	-0.015
	(0.20)	(1.44)	(0.74)	(0.34)	(0.22)	(0.22)	(0.63)
CAPX	0.003	-0.000	0.001	0.000	0.002	0.003	-0.003
	(2.01)**	(0.01)	(2.55)**	(0.05)	(1.18)	(1.25)	(0.41)
GM	-0.005	-0.002	0.003	-0.011	0.002	-0.003	-0.005
	(0.74)	(0.43)	(0.97)	(0.57)	(0.15)	(0.30)	(0.14)
S&A	0.000	0.000	0.001	0.004	-0.001	-0.009	0.012
	(0.06)	(0.11)	(0.40)	(0.22)	(0.09)	(0.69)	(0.29)
EQ	-0.019	0.001	0.001	-0.018	-0.019	-0.031	-0.014
	(7.60)***	(1.64)	(0.46)	(3.93)***	(4.12)***	(6.20)***	(0.57)
LF	0.016	0.006	-0.001	0.026	0.001	0.016	0.061
	(2.18)**	(1.24)	(0.54)	(1.37)	(0.12)	(1.24)	(1.52)
INV×Dist	0.000	-0.009	-0.011	0.020	0.000	0.000	0.011
	(1.30)	(0.81)	(1.74)	(4.22)***	(0.46)	(1.45)	(0.57)
GDPGROW	-0.000	0.000	-0.000	-0.001	0.003	-0.003	0.000
	(0.16)	(0.32)	(0.45)	(1.31)	(3.58)***	(1.90)	(0.00)
INTEREST	-0.001	-0.003	-0.000	-0.005	0.006	-0.005	0.000
	(2.04)*	(3.93)***	(1.22)	(2.47)**	(5.44)***	(1.94)	(0.00)
CONSTANT	-0.012	0.010	0.009	0.023	-0.098	0.011	-0.041
	(2.96)***	(5.01)***	(5.37)***	(1.65)*	(7.50)***	(0.63)	(1.96)*
Observations	58614	1452	5217	15787	16105	18373	1680
R-squared	0.01	0.06	0.01	0.01	0.01	0.01	0.02

*The sample consists of all firms with SIC codes from 2000 to 3999 and from 5000 to 5999 in the annual Compustat database from 1950 to 2005. The table provides estimates of equation 8 where the dependent variable is the five-year change in EPS (CEPSL). The interactive term, INVxDist captures the unique effect of the retail and wholesale industry. The second column provides estimates for the full sample while the remaining columns provide estimates for the subsamples for each decade. Figures in parentheses are robust (White) t-statistics. Significance at 10%, 5%, and 1% level are marked by *, **, and *** respectively.*

Similar to Table 4, In Table 6 we include our interactive term in our tests for the influence of inventory on long term changes in firm performance. In Panel A of Table 6, we report the results from estimating equation 7. The coefficient estimates for the interactive term are largely insignificant with the exception of the years after 2000. This is consistent with the findings of Chen et al (2007) who find that, between 1981 and 2004, inventory is negatively related to firm performance for firms in the retail and wholesale industry. In Panel B, we report results obtained from estimating equation 8. The coefficient estimates for the interactive term are largely insignificant with the exception of the decade of the 1970s. Overall, our results indicate that the relation between inventory changes and firm performance could be different for the wholesale and retail industry. However, the differences, if any, are small and the conclusions sensitive to the choice of the sample period.

Robustness Tests

As noted by Chen et al (2005), the relation between inventory changes and firm value could be different for firms that normally hold low levels of inventory. In order to test for this difference for our sample we create an indicator variable that takes on a value of one if the inventory holdings of a particular firm for a particular year is in the bottom ten percentile of its industry (as defined by two digit SIC code). We then multiply INV by this variable and similar to equations 5 – 8 test for the influence of this interactive term on our four measures of firm performance. In our unreported tests, the coefficient estimates for this interactive term are largely positive and so in agreement with the conclusions of Chen et al (2005). However, as with all reported results, the significance of these tests is also sensitive to the choice of the sample period and differs from one performance metric to another.

Our results till this point indicate that the relation between inventory changes and firm performance is a tenuous one and rather dependent on the time period in question. However, the full sample OLS regressions consistently show a statistically significant and negative relation between inventory changes in firm performance. In order to explore the robustness of this relation, we include year fixed effects in all our tests for the full sample. We also consider a random a random effects model – however, the Hausman test for each regression is strongly significant and suggests that fixed effect regressions are more appropriate than random effect ones. The results for the regressions with year fixed effects indicate that changes in inventory are statistically significant determinants of firm performance. However, the economic magnitude is even lower than in our earlier OLS tests. The interactive dummy for the wholesale and retail industry is only significant when performance is measured by ROA and its economic magnitude diminishes to the point that it is very close to zero. However, the interactive dummy for firms that carry low inventory remains significant. Overall the tests suggest that there is a negative relation between inventory changes and firm performance but the strength of the relation is sensitive to the sample period. However, this relation, in general does not appear to hold for firms that carry low inventory.

CONCLUSION

Inventory management remains one of the key components of working capital management. However, prior research on the relation between inventory changes and firm performance are limited by their focus on relatively small sample periods and the use of specific measures of firm performance. In this paper, we remedy this shortcoming through a comprehensive examination of this relation using a large sample period and a multiple measures of firm performance. We also test for differences in the nature of this relation between industries.

Our findings can be summarized as follows. Changes in inventory are negatively related to changes in firm performance. However, the strength of this relation is dependent on the time period. Moreover, the relation does not hold for the group of firms that normally hold low levels of inventory and is slightly weaker for wholesalers and retailers. One possible explanation for our finding is the changing nature of inventory management. The past five decades have seen the improvement of inventory management through JIT and VMI techniques. Although operations management researchers have helped us better understand the techniques themselves, their impact on the financial performance of the firm remains unclear. It is also possible that the changing relation between inventory and firm performance is driven by the changing nature of inventory management. Moreover, the uniqueness of the wholesale and retail industry suggests a complex relation between inventory and firm performance that depends on the external economic environment, the evolution of inventory management techniques and the details of specific industries. We look forward to future research that will help us better understand these interactions.

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EXAMINING BOARD COMPOSITION AND FIRM PERFORMANCE

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ABSTRACT

This paper investigates the relationship between key factors of board composition and firm performance. We find that listed companies in Taiwan are suffered from the divergence between stock-control rights and earnings-distribution rights, and the divergence of rights is negatively associated with firm performance, as predicted. Besides, consistent with the viewpoint of Agency Theory that the controlling interests of CEO may induce them to enhance company performance, we find that, CEO internalization is significantly positively associated with firm performance. In addition, the results of the influence of board structure document that, the more outside independent directors of a company, the better performance the company has. Our findings provide strong support for the notion that corporate ownership structure and board compositions are key factors in determining the corporate governance efficiency and play important roles in enhancing firm performance.

JEL: G34, L25

KEYWORDS: Board leadership structure, CEO duality, Independent directors, firm performance

INTRODUCTION

The management level of a company plays a determining role in how well a company performs, but the structure of a firm's leadership and various supervising mechanisms play an even more crucial role. The leadership structure of the board of directors and performance evaluation are among the most important topics in the literature of corporate governance. Although companies around the world have different cultural and legal backgrounds, making it inappropriate for localized studies to be applied to other regions, Taiwan adopted the U.S. regulations regarding external directors such that listed firms in Taiwan must have independent directors in order to facilitate the operation of the board of directors and achieve optimal corporate governance. Therefore, it is therefore safe to say that, with suitable cultural and legal adjustments, well-designed foreign managing structures and models can be adapted by other nations to achieve desirable results.

This paper is a discussion of the relationship between, on one hand, board composition and leadership structures in listed companies in Taiwan and, on the other, company performance. One related issue is whether independent directors and institutional directors can oversee companies properly and create a positive effect on company performance. Another task is to examine the unique characteristics demonstrated by the boards of directors in listed Taiwanese companies and how they are different from their counterparts in other regions. For example, how is a company's performance influenced when it is family-owned or when the shareholders through manipulation, a process also known as the "internalization" of the CEO, elect its chief executive officer (CEO)? How is a company's performance affected when power of attorney is bought as a means of gaining a seat in the board in order to gain control of the company? What separations are created between the stock-control or seat-control rights and cash-flow rights? Can the effects of this action on the company's decision-making process also affect the company's performance?

The findings of this paper serve as a reference for both the Taiwanese authority in its formulation of legal regulations regarding listed companies and the public investors and stakeholders in their decision-making. They also demonstrate how the mechanism of corporate governance in Taiwan's listed companies is different from those in other countries.

The remainder of this study is organized as follows. The next section, a literature review, is followed by an introduction to the study's methodology, along with a description of our sample and variable measures. The empirical results are then presented, and conclusions and implications are provided in the final section.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

CEO Duality

The two prominent theories about the relationship between CEO duality (i.e., when the role of CEO and chairperson are combined) and company performance inside the structure of the board of directors are the agency theory and the stewardship theory. In the agency theory, the company's owner is referred to as the "principal," whereas the manager is the "agent"; agency costs are incurred if the actions of the manager are not in the best interest of maximizing shareholders' profits but are undertaken for self-interest (Jensen and Meckling 1976). The protection of stockholder interests relies on the fact that the chairperson is not controlled by the CEO, or by creating an interest shared by the CEO and shareholders through appropriate incentives (Williamson 1985). The stewardship theory, on the other hand, defines the manager as a steward who gains a sense of achievement by being high-performing and taking actions that are beneficial to the stockholders' profits (Muth and Donaldson 1998).

Studies see these two theories and their effects on CEO duality and company performance differently. Some see that, from an agency point of view, CEO duality can lower the level of supervision of the general manager by the board, thus creating a less than desirable situation for company performance (Levy, 1981; Dayton, 1984). The manager holds the information advantage regarding the status of the company, and the principal cannot accurately assess or stay on top of the actions or level of dedication demonstrated by the manager, resulting in conditions ripe for opportunism (Williamson, 1985). Lowering opportunism requires a board of directors to represent the stakeholders by monitoring the actions of the manager, which is a relationship that is more sustainable when the chairperson and the manager are two different persons. However, when the chairperson is also the CEO; the balance within the board of directors may be compromised (Donaldson and Davis, 1991).

Other researchers have claimed that, when the chairperson is also the CEO, thereby gaining complete authority, potential conflict between management and the board is reduced, leading to a higher performance level (e.g. Anderson and Anthony, 1986; Donaldson and Davis, 1991; Davis *et al*., 1997). Still other studies on the aspect of cost-effectiveness claim that neither option is the ideal leadership structure because some companies work well one way, and others work well the other (Brickley *et al*., 1997). Using the contingency theory to explain the relationship between performance and CEO duality, either theory can be correct, with different results occurring from different circumstances (Boyd, 1995).

To summarize, there have been mixed findings on the relationship between CEO duality and company performance. Therefore, two hypotheses are established:

H1a: CEO duality is negatively related to firm performance.
H1s: CEO duality is positively related to firm performance.

CEO Internalization

In order for an individual or group to acquire decision-making or controlling rights to a publicly listed company, they must purchase the company's stocks to gain the stock-control, or voting rights. The company's ultimate controller—the one with the final say in the company's management and resource distribution—is usually the largest shareholder, the chairperson of the board, the general manager, the family members of the owner, or the management team. "CEO internalization" means the CEO is also the ultimate controller or a family member of the owner of the company (Lee, 2007).

When the CEO is internalized, he or she is a member of or appointed by the ultimate controlling family, stockholder, or group. Therefore, in the decision-making process, the CEO would consider the controller's interests above those of the managers or other shareholders. Since it is uncertain whether this interest would align with the interests of the majority of the shareholders or whether it leads to increased or decreased performance, a hypothesis is proposed:

H2: Internalization of the CEO is related to firm performance.

Board Structure

The board of directors plays a central role in the managerial policies of a large company (Fama and Jensen, 1983). The number of director seats in the board is an important element in the effectiveness of the management of the company (Dalton et al., 1999); the smaller the board, the more efficient it is because close interactions and debates are possible (Firstenberg and Malkiel, 1994). While smaller boards lead to better company performance, larger boards may have communication and coordination problems, weakening the board's control over the situation (Yermack, 1996; Eisenberg *et al*., 1998; Chiang and Lin, 2007). However, the larger the board, the greater the variety of specialists who can participate will be, making the board more capable of gaining full information about decisions (Goodstein et al. 1994).

In this study, the total number of seats of directors/supervisors in a company and the number of seats controlled by the controlling interest are used as research variables in an effort to demonstrate their influences on company performance, so the following hypothesis proposed:

H3: Board size is related to firm performance.

An independent outside director is someone who is unrelated to the company except as a director. The inside director is someone who is also a manager of the company (Clifford and Evans, 1997). However, according to the stewardship theory, internal directors should be more helpful to the board of directors since their professional knowledge, abilities, and familiarity with the CEO's decision-making quality make them better at evaluating the CEO (Wagner et al. 1998). Some studies have indicated that having a large number of outside independent directors may lower the risk that the managers will manipulate the finances and earnings management (Beasley, 1996; Klein, 2002), so a greater number of outside directors have a positive relationship with company performance (Pearce and Zahra, 1992). The following hypothesis is proposed:

H4: The proportion of outside independent directors is positively related to firm performance.

Generally speaking, institutional investors are considered able to lower agency risks through more effective monitoring of the company–especially with a large institution with outside shareholders that allows a stricter monitoring (Shleifer and Vishny, 1986; Bathala *et al*., 1994). Thus, the following hypothesis is proposed:

H5: The proportion of outside institutional directors is positively related to firm performance.

Stock-Control Rights

The stock-control right is the right to vote and the power to control the company's decision-making. The voting right comes from share ownership, whether they are direct shares or indirect shares. Indirectly held stocks are usually acquired through the pyramidal control structure or through cross-shareholding. One can control a company either through investment or through the purchase of power-of-attorney from shareholders to acquire voting rights at shareholders' meetings and, in turn, acquire a seat on the board of directors. Controlling seats (seat-control rights) by controlling stock is the ultimate controller's dominance over the company's resources. However, the earnings-distribution right is the shareholders right to demand earnings distribution and thereby to dominate the company's resources. If the interests of the stock-control rights and the earning-distribution rights are aligned, the decision-makers interests and the results for shareholders are related, and the decisions are in sync with the shareholder's profit targets, making agency costs more unlikely. However, when the interests of the stock-control rights and earnings-distribution rights (stocks/earnings) and the interests of the seat-control right and the stock-control right (seats/stocks) deviate, agency costs increase. The following hypotheses are established:

H6: Non-alignment of stock-control rights and earnings-distribution rights is negatively related to firm performance.

H7: Non-alignment of seats-control rights and stock-control rights is negatively related to firm performance.

DATA AND METHODOLOGY

This research uses samples from the *Taiwan Economics Journal* database. The sample consists of 1194 observations over a one-year period for 2008 publicly traded Taiwanese firms. Our samples are composed of 676 companies listed and in the market for trading on the Taiwan Stock Exchange (TSE) and 518 companies in the over-the-counter market for trading on the Gre Tai Securities Market in 2008 were used, with the exception of companies in the financial industry. The original sample size was 1225 companies. After 31 companies excluded because of incomplete data, 1194 companies remained to be used as a sample.

This study uses a multivariate regression analysis to examine the relationship of independent variables and firm performance. The full regression model is as follows:

$$\begin{aligned} Yj &= \beta_0 + \beta_1(DUALITY) + \beta_2(INCEO) + \beta_3(BS) + \beta_4(CS) + \beta_5(IDS) + \beta_6(OCD) \\ &+ \beta_7(OFD) + \beta_8(DSE) + \beta_9(DSS) + \beta_{10}(SIZE) + \beta_{11}(SAG) + B_{12}(LEV) + \varepsilon \end{aligned} \quad (1)$$

The sample firms are divided into those that have CEO duality and those that do not. The regression model is as follows:

$$\begin{aligned} Yj &= \beta_0 + \beta_1(INCEO) + \beta_2(BS) + B_3(CS) + B_4(IDS) + B_5(OCD) + B_6(OFD) \\ &+ B_7(DSE) + \beta_8(DSS) + \beta_9(SIZE) + \beta_{10}(SAG) + \beta_{11}(LEV) + \varepsilon \end{aligned} \quad (2)$$

The sample firms are divided into those that have CEO internalization and those that do not. The regression model is as follows:

$$\begin{aligned} Yj &= \beta_0 + \beta_1(DUALITY) + \beta_2(BS) + \beta_3(CS) + \beta_4(IDS) + \beta_5(OCD) + \beta_6(OFD) \\ &+ \beta_7(DSE) + \beta_8(DSS) + \beta_9(SIZE) + \beta_{10}(SAG) + \beta_{11}(LEV) + \varepsilon \end{aligned} \quad (3)$$

where Y is firm performance, and j = ROE, ROA.

Table 1 shows a definition of variables in this study. Return on assets (ROA), and return on equity (ROE) are the variables for evaluating company performance for this research.

Table 1 Variable Definitions

Variable Name	Variable Definitions
ROA	Return on assets: (net income/ average total asset * 100%)
ROE	Return on equity: (net income/average net worth * 100%)
DUALITY	CEO duality: The positions of chairperson and CEO of a company are held by the same individual. This is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise.
INCEO	CEO Internalization: The case in which the ultimate controller or immediate family members serve as CEO. This dummy variable is set to 1 when there is CEO internalization and 0 otherwise.
BS	Board size: The number of directors in the company.
CS	Controlling size: The number of directors controlled by the ultimate controller.
IDS	Outside independent directors' size: The number of outside independent directors on the board of directors.
OCD	Outside corporate directors: The number of non-ultimate-controller directors who control other listed companies.
OFD	Outside Foundations directors: The number of non-ultimate–controller directors who represent foundations (trust funds, hospitals, schools, etc.) under their control.
DSE	Stocks/earnings deviation: The stock-control right less the earnings-distribution right. The stock-control right, also known as voting right, is the percentage of stocks controlled by the ultimate controller. The earnings-distribution right, also called the cash-flow right, is the earnings-distribution right by the ultimate controllers.
DSS	Seats/stocks deviation: The seat-control right less the stock-control right. The seat control right is the number of directors the ultimate controller controls divided by the total number of board members, which represents the level of internalization of the board of directors.
SIZE	The natural log value of the total assets of the company.
SAG	Sales growth ratio: (current year's net sales- last year's net sales) / (last year's net sales)*100%.
LEV	Debt ratio: (total liability/total assets)*100%

EMPIRICAL RESULTS

Descriptive Statistics and Correlation Analysis

Table 2 presents the descriptive analysis of the sample companies: 30% of listed Taiwanese company chairpersons also assume the CEO position, as compared to 40-55% of Hong Kong company chairpersons (Chen et al., 2005; Lam and Lee, 2008) and 70%-80% of American chairpersons (Rechner and Dalton, 1991; Rhoades et al., 2001). In Europe, most company chairpersons do not also serve as CEOs; for example, in Britain, only 10% of companies have such a leadership configuration (Coles et al., 2001; Higgs, 2003; Kang and Zardkoohi, 2005). Thus, Taiwanese and Hong Kong's companies in Asia lie between the US and Europe in terms of the percentage of chairpersons who are also CEOs. Table 1 shows that 44% of the companies have a higher rate of CEO internalization than the rate of CEO duality, indicating that, although some companies still have a separate chairperson and CEO, the position of CEO is still controlled by the ultimate controlling interest.

The average size of boards of directors is 9.41 seats, with 5.1 (54%) seats owned by the controlling interest. Companies have an average of 1.24 (13%) outside independent directors. (Although Taiwan's law requires newly listed companies to have at least two outside independent directors, the law does not apply to companies listed before 2002.) . Companies average less than one institutional directors and foundations directors. The stocks/earnings deviation average is at 5.6%, which means that the stock-control right and the cash flow right in listed Taiwanese companies is not aligned. The range of deviation is from 0 to 74%, so non-alignment is the norm, and significant non-alignment is present in a small percentage of companies. The seats/stock deviation averages of 25% with a maximum of 87%, indicating that, among listed Taiwanese companies, the purchasing of powers of attorney from shareholders to acquire company control does happen. Internalization of the board of directors is also a common occurrence.

Table 2: Descriptive Statistics

	N	Minimum	Maximum	Mean	S.D.
ROA	1194	0-.91	0.45	0.0517	0.11791
ROE	1194	-3.13	0.75	0.0056	0.25349
DUALITY	1194	0.00	1.00	0.2923	0.45501
INCEO	1194	0.00	1.00	0.4447	0.49714
BS	1194	5.00	32.00	9.4137	2.32080
CS	1194	1.00	24.00	5.0913	2.52349
IDS	1194	0.00	5.00	1.2379	1.37284
OCD	1194	0.00	8.00	0.7437	1.17375
OFD	1194	0.00	4.00	0.0293	0.22421
DSE	1194	0.00	0.74	0.0556	0.10068
DSS	1194	-0.65	0.87	0.2499	0.22856
SIZE	1194	11.14	20.29	15.1026	1.35791
SAG	1194	-1.00	20.55	0.0380	1.04310
LEV	1194	0.01	1.12	0.3672	0.18155

*Notes: ROA: net income/ average total asset * 100%. ROE: net income/average net worth * 100%. DUALITY: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. INCEO: is a dummy variable that is set to 1 when there is CEO internalization and 0 otherwise. BS: the number of directors in the company. CS: The number of directors controlled by the ultimate controller. IDS: the number of outside independent directors on the board of directors. OCD: the number of non-ultimate-controller directors who control other listed companies. OFD: the number of non-ultimate–controller directors who represent foundations under their control. DSE: the stock-control right- the earnings-distribution right. DSS: the seat-control right - the stock-control right. SIZE: the natural log value of the total assets of the company. SAG: (current year's net sales- last year's net sales) / (last year's net sales)*100%. LEV: (total liability/total assets)*100%.*

As shown in Table 3, the ROA regression model uses ROA as a proxy to assess company performance. The analysis of the full regression model in model (1) reveals that the DUALITY status and company performance are negatively correlated, meaning that when the role of the chairperson and the CEO are assumed by the same person, it worsens company performance and results in agency costs. Therefore, this research finds that the situation of listed Taiwanese companies with CEO duality position supports the agency theory as well as H1a, which states that CEO duality is negatively related to firm performance. The findings here do not support the stewardship theory or H1b, which states that CEO duality is positively related to firm performance. INCEO and company performance showed no significant relationship. Therefore, H2, which states that CEO internalization is related to firm performance, is not supported by the results.

Within the structure of the board of directors, BS and CS do not show a significant correlation with company performance, so H3—that board size and company performance are related—is not supported. However, IDS and company performance have a positive relationship, which means that, the more numerous the supervising directors, the better the effect of monitoring the company's management level is. This finding supports H4, which states that the scale of outside independent directors is positively related to firm performance. Concerning the supervising effects of outside institutional directors, we analyzed OCD and OFD against company performance and found no significant correlations. This result does not support H5, which states that the proportion of outside institutional directors is positively related to firm performance.

The stock-control right and seats-control right represent the ultimate controlling interest's dominance over the company's resources, while earnings-distribution right is the level of the shareholders' dominance of the company's resources. Our evidence show that, within Taiwanese listed companies, DSE and DSS is common. DSE and company performance have a significantly negative relationship. This finding helps to explain that, when the decision-makers and the shareholders have different goals, agency costs are generated. This result supports H6, which states that non-alignment of stock rights and earning-distribution rights is negatively related to firm performance, as well as H7, which states that non-alignment between seats rights and stock rights is negatively related to firm performance.

Table 3: ROA Regression Model Analysis

		Model (1)	Model (2)		Model (3)	
	Expected sign	**ROA**	**Duality**	**Non-duality**	**Internalized**	**Non-internalized**
Intercept		-0.254 ***	-0.391 ***	-0.217 ***	-0.262 ***	-0.240 ***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DUALITY	-/+	-0.030 ***			-0.030 ***	-0.029 *
		(0.000)			(0.001)	(0.069)
INCEO	+/-	0.010	0.019	0.011		
		(0.182)	(0.301)	(0.182)		
BS	+/-	-0.002	-0.004	-0.001	-0.001	-0.002
		(0.408)	(0.391)	(0.597)	(0.883)	(0.398)
CS	+/-	0.001	0.006	0.000	-0.001	0.002
		(0.625)	(0.254)	(0.939)	(0.863)	(0.584)
IDS	+	0.009 ***	0.005	0.013 ***	0.006	0.013 ***
		(0.001)	(0.331)	(0.000)	(0.181)	(0.001)
OCD	+	-0.001	-0.005	0.002	-0.004	0.001
		(0.726)	(0.373)	(0.532)	(0.400)	(0.810)
OFD	+	0.011	0.028	0.010	-0.001	0.012
		(0.443)	(0.463)	(0.518)	(0.975)	(0.468)
DSE	-	-0.065 *	0.076	-0.075 **	0.006	-0.025
		(0.059)	(0.456)	(0.040)	(0.942)	(0.517)
DSS	-	-0.068 ***	-0.116 ***	-0.041 *	-0.087 ***	-0.046
		(0.001)	(0.002)	(0.081)	(0.002)	(0.110)
SIZE	+	0.027 ***	0.034 ***	0.023 ***	0.028 ***	0.026 ***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SAG	+	0.011 ***	0.007 *	0.022 ***	0.011 **	0.011 ***
		(0.000)	(0.092)	(0.000)	(0.029)	(0.004)
LEV	-	-0.204 ***	-0.199 ***	-0.198 ***	-0.167 ***	-0.227 ***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted R^2		0.182	0.180	0.177	0.141	0.206
F-value		23.187 ***	7.963 ***	17.507 ***	8.936 ***	16.595 ***
N		1194	349	845	531	663

*Notes: ROA: net income/ average total asset * 100%. ROE: net income/average net worth * 100%. DUALITY: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. INCEO: is a dummy variable that is set to 1 when there is CEO internalization and 0 otherwise. BS: the number of directors in the company. CS: The number of directors controlled by the ultimate controller. IDS: the number of outside independent directors on the board of directors. OCD: the number of non-ultimate-controller directors who control other listed companies. OFD: the number of non-ultimate–controller directors who represent foundations under their control. DSE: the stock-control right- the earnings-distribution right. DSS: the seat-control right - the stock-control right. SIZE: the natural log value of the total assets of the company. SAG: (current year's net sales- last year's net sales) / (last year's net sales)*100%. LEV: (total liability/total assets)*100%.*
****, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.*

Model (2) separates the sample companies into those with CEO duality and those without in order to perform a regression analysis. Results show that, in companies with CEO duality, the DSS and company performance have a significantly negative relationship. Since the difference between seat-control rights and stock-control rights widens, agency problems occur more easily, resulting in poor performance. Under this circumstance, the supervisory effort of the independent directors is not apparent and has no significant relationship to company performance.

In companies in which the chairperson is not also the CEO, the number of independent directors has a significantly positive relationship with company performance; thus, when the chairperson and CEO roles are played by different people, the independent directors are better able to do perform their role. The DSS and company performance also has a significantly negative relationship, which shows that, when the chairperson is not also the CEO, DSE exerts a greater negative effect on company performance.

By separating sample companies into those with CEO duality and those without, we show through analysis that the independent directors are less able to exert their supervisory capacity under CEO duality. In the opposite scenario, the independent directors' number is significantly and positively related to company performance, and when DSE occurs, the companies without CEO duality feel a greater negative effect than do those with CEO duality.

Model (3) separates companies into those with internalized CEO and those without in order to conduct a regression analysis. The analysis shows that, under CEO duality, the company performance is worse regardless of whether there is CEO internalization. Under the scenario of INCEO and DSS, company performance is more significantly and negatively affected than when the CEO is not internalized. When management is not internalized, IDS is more positively related to company performance. Thus, when there is no internalization, the outside independent directors are better able to performance their supervisory functions.

Table 4 is the ROE regression model analytical table, which uses ROE as a company performance proxy. The analysis of model (1) shows that DUALITY and company performance are negatively correlated, so, when the same person assumes the positions of chairperson and the CEO, company performance suffers and agency costs rise. Therefore, when there is CEO duality in listed Taiwanese companies, the perspective of the agency theory is supported, as is H1a, which states that CEO duality and company performance are negatively related. However, this part of the analysis does not support the perspective of the stewardship theory or H1b, which states that CEO duality and company performance are positively related. The significantly positive relationship between INCEO and company performance supports H2—that CDCEO and company performance are positively related—and explains that, when the CEO is a member of the controlling interest group, he or she will put the best interest of the group first, which raises the performance of the company, particularly the stockholders' return rate. Thus, INCEO is beneficial to aligning the interests of the company and the stockholders.

In terms of the structure of the board of directors, the relationship of the BS and CS to company performance is not significant, so it does not support H3, which states that the size of the board of directors and company performance are related. However, IDS and company performance have a significantly positive relationship; thus, the more outside independent directors there are, the better they are able to perform management level functions, increasing company performance. This finding supports H4, which states that the proportion of outside independent directors is positively related to firm performance. As for the supervisory effects of the outside institutional directors, we examined the relationship between the number of OCD and OFD and company performance and found no significant relationship and no support for H5, which states that the proportion of outside institutional directors is positively related to firm performance.

The stock-control rights and seat-control rights represent the ultimate controlling interest's dominance over the company's resources, while the earnings-distribution rights represent the shareholders' dominance of the company's resources. DSE and DSS have a significant negative relationship to company performance, which can explain why, when decision-makers and shareholders have different goals, an agency cost is generated. This result supports H6, which states that non-alignment of stock rights and earnings-distribution rights is negatively related to firm performance, as well as H7, which states that misalignment Between seats rights and stock rights is negatively related to firm performance.

Model (2) separates the sample companies into those that have CEO duality and those that do not in order to perform a regression analysis. Results show that among companies with CEO duality, INCEO and company performance have significantly positive relationships. Thus, when the CEO is a member of the controlling interest and there is CEO duality, there is also a positive effect on company performance. DSE and company performance have a significantly negative relationship, indicating that the difference between the seat-control rights and the stock-control rights widens, and agency problems occur more easily, creating poor performance under CEO duality. Under this circumstance, the supervisory effort of the independent directors is less effective and has no significant relationship to company performance. In companies where there is no CEO duality, the number of independent directors and company performance has significantly positive relationship; thus, when the chairman and CEO are two different individuals, the independent directors are better able to do perform their role. DSS and company performance also have a significantly negative relationship; thus, when the chairperson is not also the CEO and DSE arises, it exerts a greater negative effect on company performance.

Table 4: ROE Regression Model Analysis

		Model (1)	Model (2)		Model (3)	
	Expected sign	**ROE**	**Duality**	**Non-duality**	**Internalized**	**Non-internalized**
Intercept		-0.584 ***	-0.920 ***	-0.483 ***	-0.636 ***	-0.537 ***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
DUALITYY	-/+	-0.067 ***			-0.050 ***	-0.100 ***
		(0.000)			(0.006)	(0.005)
INCEO	+/-	0.035 **	0.093 **	0.025		
		(0.031)	(0.031)	(0.139)		
BS	+/-	-0.003	-0.009	-0.001	-0.008	-0.002
		(0.456)	(0.387)	(0.850)	(0.279)	(0.788)
CS	+/-	-0.001	0.012	-0.004	0.005	-0.004
		(0.891)	(0.296)	(0.531)	(0.546)	(0.621)
IDS	+	0.010 *	-0.002	0.018 ***	0.013	0.011
		(0.080)	(0.878)	(0.007)	(0.110)	(0.214)
OCD	+	-0.008	-0.009	-0.005	-0.004	-0.009
		(0.245)	(0.517)	(0.513)	(0.661)	(0.347)
OFD	+	-0.002	0.026	0.003	0.034	-0.012
		(0.934)	(0.770)	(0.930)	(0.575)	(0.747)
DSE	-	-0.218 ***	0.095	-0.230 ***	-0.056	-0.174 **
		(0.003)	(0.687)	(0.002)	(0.748)	(0.046)
DSS	-	-0.082 *	-0.148 *	-0.038	-0.120 **	-0.050
		(0.054)	(0.087)	(0.435)	(0.031)	(0.442)
SIZE	+	0.055 ***	0.076 ***	0.044 ***	0.060 ***	0.052 ***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SAG	+	0.019 ***	0.016 *	0.037 ***	0.013	0.023 **
		(0.003)	(0.072)	(0.001)	(0.160)	(0.011)
LEV	-	-0.486 ***	-0.681 ***	-0.382 ***	-0.438 ***	-0.514 ***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted R^2		0.179	0.250	0.145	0.171	0.178
F-value		22.631 ***	11.518 ***	14.053 ***	19.940 ***	14.071 ***
N		1194	349	845	531	663

*Notes: ROA: net income/ average total asset * 100%. ROE: net income/average net worth * 100%. DUALITY: is a dummy variable that is set to 1 when there is CEO duality and 0 otherwise. INCEO: is a dummy variable that is set to 1 when there is CEO internalization and 0 otherwise. BS: the number of directors in the company. CS: The number of directors controlled by the ultimate controller. IDS: the number of outside independent directors on the board of directors. OCD: the number of non-ultimate-controller directors who control other listed companies. OFD: the number of non-ultimate–controller directors who represent foundations under their control. DSE: the stock-control right- the earnings-distribution right. DSS: the seat-control right - the stock-control right. SIZE: the natural log value of the total assets of the company. SAG: (current year's net sales- last year's net sales) / (last year's net sales)*100%. LEV: (total liability/total assets)*100%.*
****, **, and * indicate significance at the 1, 5 and 10 percent levels respectively.*

When we separated sample companies into ones with CEO duality and ones without, our analytical results showed that the independent directors are less able to exert their supervisory capacity under CEO duality. When there is no CEO duality, the number of independent directors is significantly and positively correlated to company performance, and DES has a greater negative effect than it does on companies with

CEO Duality

Model (3) separates companies into those with internalized CEO and those without in order to conduct a regression analysis. The analysis shows that, in companies with CEO duality, the company performance decreases, regardless of whether there is CEO internalization. When there is INCEO and DSS, company performance is more significantly and negatively affected than when the CEO is not internalized. DSE and company performance have a significantly negative relationship under non-INCEO conditions.

As indicated by Table 3 (ROA regression model analysis) and Table 4 (ROE regression model analysis), in both the group model and the scattered model, the control variables SIZE and SAG are significantly and positively related to company performance, and LEV and company performance are significantly and negatively related. This finding indicates that, the bigger the SIZE and SAG of listed Taiwanese companies, the better the performance; and the higher the LEV, the worse the performance.

CONCLUSION

This research uses listed Taiwanese companies as sample companies. To examine the effects on firm performance of leadership structure of the boards of directors, the effects of misalignment between the stock-control rights and the seat-control rights and between the seat-control rights and the earnings-distribution rights, and related variables such as sales growth ratio, debt ratio, and company size.

Our analyses of the sample reveals that, in 30% of Taiwanese companies, the chairperson also assumes the position of CEO, a percentage lower than that of the US but higher than that in Europe. In the greater Chinese area (including Mainland China, Hong Kong, Macao, and Taiwan), the majority of companies are family-owned, and family members and friends are elected as CEOs in order to maintain exclusive management control (Yeung, 2000; Chen, 2001; Ahlstrom et al., 2004; Lien et al., 2005; Liu et al., 2006). Our research reveals that 44% of the companies have CEO internalization, rather than duality; therefore, the CEO is still controlled by the controlling interest. This finding is consistent with current research. Of the sample companies, 5.6% have a misalignment between stock-control rights and earnings-distribution rights, and a small percentage have a serious misalignment. The misalignment between seat-control rights and stock-control rights shows that the situation wherein someone acquires company control by purchasing powers of attorney from stockholders is present in Taiwan. The internalization of boards of directors is also a common occurrence.

The findings and results of this research can provide Taiwanese governing bodies with a reference for strengthening corporate governance policies. For example, the number of independent directors and company performance show a significantly positive relationship, which is consistent with the direction of today's governmental policies. However, the current requirement as to the number of independent directors in listed companies applies only to

companies established after 2002, so we recommend that this requirement be applicable to all businesses. In addition, because agency problems occur because of CEO duality because independent directors are less able to operate under CEO duality, policies should be set in place to alleviate this situation. In listed Taiwanese companies, the stock-control right and the cash flow right are often misaligned, and the occasions of severe misalignment indicate that the control. This practice and the resulting misalignment exert a negative effect on company performance and stakeholders and are worth the attention of governing bodies. These findings also serve as a valuable reference for the investing public and stakeholders during their decision-making. Since this research is an analysis of listed Taiwanese companies, it cannot provide more generalized statements about the relationship between the board leadership structure and firm performance.

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DEPOSITOR SENSITIVITY TO RISK OF ISLAMIC AND CONVENTIONAL BANKS: EVIDENCE FROM INDONESIA

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ABSTRACT

Islamic banks operate without involving interest, and therefore are believed to be less risky during financial crises than conventional banks. This advantage may not be significant if the government either partially or fully guarantees bank deposits. In the presence of deposit insurance the public can be indifferent to risk of both Islamic and conventional banks. However, insufficient studies have examined the issue of deposit insurance impact on depositor behavior and market discipline. This research conducts empirical tests on whether the risk of Islamic and conventional banks influence depositors in Indonesia, during two periods using cross-sectional analysis. This research also investigates the behavior of Indonesian depositors towards risk of both bank types during the US crisis through panel data analysis. Data from all insured domestic banks in Indonesia, from January 2002 to December 2009 are examined.

JEL: G 21

KEYWORDS: Bank Risk, Deposit Insurance, Market Discipline, Islamic Bank

INTRODUCTION

Deposit insurance may be useful in preventing bank runs (Diamond & Dybvig, 1983) and improving risk sharing (Niinimaki, 2004). However, Merton (1977) argues that deposit insurance may also encourage banks to be more risk takers. Some scholars like England (1991) further explain that the presence of high deposit insurance ceilings have made depositors almost insensitive to bank risk. Depositors are argued to be indifferent to bank's fundamentals and the associated potential risk to their deposits. They trust their government to ensure the safety of their deposits (Demirguc-Kunt, 1998a, 1998b, and 2000a). This depositors' insensitivity worsened the moral hazard consequences of deposit insurance, inducing banks to engage in high-risk activities, which in turn boosted their default rate (Grossman, 1992, Wheelok, 1992, Thies & Gerlowski, 1989, and Demirguc-Kunt & Detragiache, 2002).

Studies on banking crises have proposed solutions that might be effective in preventing reoccurrence. The capability of non government agents to control bank risk-taking, i.e. market discipline, has increasingly attracted both policy-makers and economists. Market discipline works through a mechanism, in which depositors, bond-holders, and shareholders punish risky banks by using their market power. Depositors withdraw their deposits from, or require high deposit interest from risky banks (Hosono, 2005). In some market economies, traditional government regulation and supervision have not functioned as effectively as expected. Banking activities have become increasingly complex as a result of tougher competition and advanced customer preferences. At the same time, the market's role in stimulating appropriate banks' risk taking behavior becomes more and more significant. This fact has partly accounted for the growing policy-makers emphasis on market discipline (See, e.g., Calomiris, 1999).

Nevertheless, it is unclear if such market discipline works well in emerging economies. Will depositors be sensitive to bank risk in developing countries deposits are insured by the government or a government-related institution? Another important question is whether depositors are sensitive to the risk of Islamic

Banks that do not involve fixed returns in their operation. In this research, we investigate whether depositors in Indonesia are indifferent to the risk of Islamic banks and conventional banks during the application of the blanket scheme and deposit insurance. We also investigate depositors sensitivity towards risk of both types of bank during the US crisis (2008.10 to 2009.12).

The remainder of the paper is organized as follows. In session 2, we reveal some relevant studies conducted in other economies, and briefly summarize the variables included in the first and second equation, and. In session 3, we explain the division of data and periods of observation, as well as the research methodology. In session 4, we explain the empirical results and findings. We describe the sensitivity of depositors to risk of Islamic banks and conventional banks in several periods of observation. At the end, we conclude with a brief discussion.

LITERATURE REVIEW

A question on whether a deposit insurance scheme could weaken market discipline in an economy has become a crucial issue. Many economies have adopted deposit insurance schemes and many more economies are planning to implement deposit insurance, to prevent bank runs from occurring (Laeven, 2002). There have been many studies proving that the market can control bank risk-taking behavior. The rationale behind the concern might be that deposit insurance to some extent guarantees a return to depositors in case of bank failure. Depositors would therefore be indifferent on whether banks take riskier activities.

Using different measurement approaches, variable derivations, country specifics, and so on, some studies show varied results. Peria, and Schmukler (1999 and 2001), employing data across countries and across deposit insurance schemes, find that deposit insurance does not lessen market discipline, and further suggests that market discipline exists even among small, insured depositors. This conclusion is backed up by Khorassani (2000), who finds that in the 1980s and early 1990s, US depositors remained sensitive to bank risk, despite high deposit insurance caps. Contrarily, using cross-country data, Demirgüç-Kunt and Huizinga (2004) suggest that explicit deposit insurance reduces deposit interest rates and at the same time lowers market discipline on bank risk taking. They find that deposit rates continue to reflect bank riskiness for countries with varying deposit insurance schemes. Peresetsky, Karminsky, and Golovan (2007) find that Russian depositors demand higher deposit interest rates from banks with risky financial policies, and that the risks taken by banks increase after the introduction of deposit insurance in 2005. In Japan, Murata & Hori (2006) prove that depositor sensitivity to bank risks has changed over time.

Advocates for the conclusion that deposit insurance is negatively correlated with market discipline seem to significantly dominate studies, but they provide varied explanations. When relating market discipline to the degree of deposit insurance, Ikuko and Masaru (2007) find that depositor discipline is most significant during periods of full pledge rather than during limited insurance exposure. Deposit withdrawal stimulates bank managers to conduct aggressive restructuring. They further suggest that the magnitude of depositor discipline is influenced by the degree of public confidence in the stability of the financial system and the extent of regulatory forbearance.

In Turkey, Muslumov (2005) investigates the impact of full deposit guarantee introduced in 1994 on market discipline, and finds that the deposit insurance scheme distorts the incentive structure of commercial banks, prevents the proper functioning of the market discipline mechanism and leads to excessive risk-taking. Ioannidou and Dreu (2006) show that deposit insurance causes a significant reduction in market discipline, that the effect of deposit insurance depends on the coverage rate, and that the introduction of deposit insurance affected mainly those who were already active in imposing discipline. Investigating the relationship between deposit insurance and market discipline in financial crisis perspective, Hosono (2005) shows that responsiveness magnitude of deposit interest rates to bank capital was higher before the crisis, probably reflecting the fact that the deposit guarantee was less generous before the crisis than during and after the crisis, He recommends disclosure adequacy and deposit protection limits for market discipline enhancement.

DATA AND METHODOLOGY OF THE STUDY

This study tests the existence of market discipline using reduced-form equations that are developed from prior studies done by Sinkey (1975), Wheelock (1992), Grossman (1992), Wheelock and Kumbhakar (1994), Barr, Seiford, and Siems (1995), Park (1995), Cole and Gunther (1995), Honohan (1997), Khorassani (2000), Antonio Ahumada and Carlos Budnevich (2001), Canbas, Cabuk, and Kilic (2005), and King, Nuxoll, and Yeager (2006). Particularly, in the second stage, this study will regress the total deposit on some factors assessed by depositors before depositing their fund in banks. The regressors of Equation 1 seek to control for the contribution of internal and external contributors to bank risk.

$$\begin{aligned}Fin_{i,t+k} = \gamma_{i,t} &+ \overset{(-)}{\lambda_1 CapAst_{i,t}} + \overset{(+/-)}{\lambda_2 AggAst_{i,t}} + \overset{(+/-)}{\lambda_3 TrAst_{i,t}} + \overset{(+/-)}{\lambda_4 ManAst_{i,t}} + \overset{(+/-)}{\lambda_5 ConsAst_{i,t}} + \overset{(+/-)}{\lambda_6 SecAst_{i,t}} + \\ &\overset{(+/-)}{\lambda_7 PlcBI_{i,t}} + \overset{(+/-)}{\lambda_8 PlcOB_{i,t}} + \overset{(-)}{\lambda_9 Inv\mathrm{Re}v_{i,t}} + \overset{(-)}{\lambda_{10} LogAst_{i,t}} + \overset{(-)}{\lambda_{11} Off_{i,t}} + \overset{(-)}{\lambda_{12} Bank_{i,t}} + \overset{(+/-)}{\lambda_{13} Charter_{i,t}} + \\ &\overset{(+/-)}{\lambda_{14} Perinc_{i,t}} + \overset{(+/-)}{\lambda_{15} Unem_{i,t}} + \overset{(-)}{\lambda_{16} Age_{i,t}} + \overset{(-)}{\lambda_{17} IncAst_{i,t}} + \overset{(-)}{\lambda_{18} LiqAst_{i,t}} + \overset{(+/-\_}{\lambda_{19} DepAst_{i,t}} + \varepsilon_{i,t}\end{aligned} \tag{1}$$

Where:

Fin	= A binary variable set equal to 0 for a bank being financed using one of the Bank Indonesia's financial aid scheme and 1 for otherwise
Cap/Asset	= Capital asset ratio of each bank
Agg/Ast	= The ratio of total agricultural PLS Investments of each bank to its total assets
Tra/Ast	= The ratio of total Trading PLS Investment of each bank to its total assets
Man/Ast	= The ratio of total Manufacturing PLS Investment of each bank to its total assets
Cons/Ast	= The ratio of total Construction PLS Investment of each bank to its total assets
Sec/Ast	= The ratio of total security investments of each bank to its total assets.
PlcBI/Ast	= The ratio of total placement in the Indonesian Central Bank of each bank to its total assets.
PlcOB/Ast	= The ratio of total placement in other banks of each bank to its total assets.
Inv/Rev	= The ratio of total PLS Investment revenue of each bank to its total revenue.
Logast	= The natural log of total assets of each bank divided by 100
Office	= A variable which is set equal to 1/1000 for banks with one office and equal to number of service offices divided by 1000 for banks with multiple offices.
Bank	= The ratio of the number of banks to total population in an area, multiplied by 1,000. (An area is defined as metropolitan city, if available, or a state otherwise).
Charter	= A binary variable set equal to 0 for national banks and 1 for state banks.
Perinc	= Percentage change of real personal income, in an area. (An area is defined as metropolitan city, if available, or a state otherwise).
Unem	= Change of unemployment rate, in an area. (An area is defined as metropolitan city, if available, or a state otherwise).
Age	= Age of the bank in months, divided by 1,000.
Inc/Ast	= The ratio of total net income of each bank to its total assets.
Liq/Ast	= The ratio of total liquid assets of each bank to its total assets
Dep/Ast	= The ratio of total deposits of each bank to its total assets.
Note:	Investment is a terminology used in Islamic Bank for interest-bearing loan in Conventional Bank.

It is assumed that the impact of the bank's internal and external factors included in Equation 1 on bank risk can be seen in *t+12*. This implies that depositors, who are considering depositing their money in a bank, could use the estimated coefficients obtained from Equation 1 to predict the probability of bank intervention by the central bank for periods *t+12, t+13,* or *t+14.* This probability is obtained by multiplying the regression coefficients of Equation 1 by the values from *t+12.* In the next stage, a cross-sectional data set on variable *Risk* is constructed in every month during the periods of 2003.1-2005.8 (Blanket System Application), 2006.9-2009.12 (Deposit Insurance Application), and 2008.10-2009.12 (USA crisis impact). We obtain the data from the Bank Indonesia and National Beaureau of Statistics.
Variable *Risk* in Equation 2 reflects the sensitivity of depositors to bank risk. Below is the detail of Equation 2.

$$Ldp_{i,n} = \phi_{i,n} + \phi_1 \overset{(-)}{Risk}_{i,n} + \phi_2 \overset{(+)}{Meanrisk}_{i,n} + \phi_3 \overset{(+)}{Lincprbk}_{i,n} + \phi_4 \overset{(+)}{Rdp}_{i,n} + \phi_5 \overset{(-)}{Meanrdp}_{i,n} + \phi_6 \overset{(+)}{Lnum}_{i,n} + \phi_7 \overset{(+)}{Lage}_{i,n} + \mathrm{E}_{i,n} \quad (2)$$

Ldp	Natural log of amount fund deposited in a bank *i* in period *n* (*n* equal to *t+12*)
Risk	Predicted risk of bank *i* in period *n*, derived from Equation 1.
Meanrisk	Average predicted risk across all banks in the area in the beginning of period *n*, where area is defined as metropolitan statistical area, if available, state otherwise.
Lincprbk	Natural log of the ratio of area personal income to the number of commercial banks in the area in period *n,* where area is defined as metropolitan statistical area, if available, state otherwise.
Rdp	Return rate on bank deposits in period *n,* defined as the ratio of total interest on CDs of IDR 100,000,000 or more to the quarterly average of CDs in denominations of IDR 100,000,000 or more.
Meanrdp	Average return (interest) rate paid by all banks in the area in period *n,* where area is defined as metropolitan statistical area, if available, state otherwise.
Lnum	Natural log of number of offices in period *n*. That is, the number of service office is set equal to 1 if bank *i* has no service office, 2 if bank *i* has one service office,... etc.
Lage	Natural log of age of the bank in period *n,* where age is defined as the actual age of the bank plus one.

This study employs financial data from all Indonesia domestic banks in the period of 2002.1 – 2009.12. The number of banks decreased in number, from 145 in January 2002 to 121 in December 2009. We only include banks whose data is consistently available during the observation period. There are 53 banks that meet this criterion, including 51 conventional banks and two Islamic banks. Since Islamic banks use profit-loss sharing (PLS) income/payment, instead of interest income/expense, some terminologies on their financial reports are different from those on conventional bank reports. However, the respective functions of the terminologies are similar, so that we can equivalently calculate all the variables in both banking systems. All the above data is obtained from the Bank of Indonesia and the National Beaureau of Statistics.

In the first stage of the statistical measurement, i.e. empirical measurement of the sensitivity of depositors to bank risk, bank risk needs to be defined, before the regression is run. Khorassani (2000) states that most studies assessing bank failure use official definitions and/or economic definitions of a failed bank. For the purpose of this study, the official definition of a failed bank in Indonesia may not be appropriate, since it is biased in reflecting the probability of depositors losing their money. Indonesian banking regulators have been proven inconsistent in determining whether a bank should be bailed out or closed. For instance, in November 2008, the authorities lowered minimum capital adequacy ratio (CAR) requirements from 8% to 0%, to help a small bank survive, while a year earlier a slightly bigger bank was closed under the minimum CAR requirement of 8%. In this study we define a bank as at risk if the bank receives one of three central bank's financial assistance schemes, i.e., Intraday Liquidity Fund (locally known as FPI), Short-term Fund (FPJP), and Emergency Fund (FPD).

In the first equation, we conduct a regression of some variables on the binary figure (0 or 1) that reflects the financial assistance. The variables include ratio of capital to total asset (*Capast*), ratios of loan (or PLS investment) in agriculture (*Aggast*), trading (*Tradast*), manufacture (*Manast*), and construction to total asset (*Consast*), ratio of security to total asset (*Secast*), placement in Bank Indonesia *(Plcbi)*, placement in other domestic banks *(Plcob),* the ratio of total loan/PLS Investment revenue of each bank to its total revenue (*Invrev*), natural log of total asset (*Logast*), age of bank (*Age*), number of bank office (*Off*), income per capita (*Perinc*), unemployment rate (*Unem*), the ratio of the number of banks to total population in an area (*Bank*), charter of a bank *(Char)*, ratio of deposit to total asset (*Depast*), ratio of net income to total asset (*Incast*), and ratio of liquid asset to total asset (*Liqast*). From the first equation regression, we obtain values of *Risk* (predicted risk) that are then included in the second equation regression. In the second stage, we regress the predicted risk, natural log of the ratio of national income per capita to the number of banks nationwide (*Lincprbk*), return rate on bank deposits (*Rdp*), natural log of the number of bank offices (*Lnum*), natural log of age of the bank (*Lage*), on the natural log of total bank deposit (*Ldp*), to assess the depositor sensitivity.

We conduct the above process using data from conventional banks only and data of both Islamic and conventional banks. By doing this, we expect to see the difference between depositor sensitivity to risk of Islamic banks to conventional banks. However, since there only two Islamic banks whose data are available consistently during the observed periods, the statistical analysis on sensitivity of depositors to the risk of Islamic Banks is different from the way we handle data on conventional banks. We conduct a rolling regression to the Islamic banks data in both observation periods, for the first equation. The variable *Risk*, which is the probability of the bank being financed by Bank Indonesia, is obtained by multiplying the regression coefficients by the latest available values of the right hand side variables—namely values from *t+12*. The series of *Risk* values along with other independent variables in Equation 2 are then regressed to the dependent variable, i.e., the natural log of total bank deposit (*Ldp*). The results of Equation 2 using data of Islamic Banks and using data of conventional banks are analyzed differently. The former results in one multiple regression equation, while the latter end up with series of multiple regression equations.

EMPIRICAL RESULTS AND FINDINGS

Table 1 shows the full description of the included 44 rolling regressions and the estimated coefficients of the probit model for the periods of 2002.1 through 2005.8. In general, the probit equations indicate good result across the rolling periods, which are well reflected by the average Pseudo R-square ranging from 0.353 - 0.594. Moreover, most of the resulting coefficient signs are in line with the theory. It can be seen that five independent variables have a significant contribution to the probability of banks being assisted by the central bank to survive in at least one-third of the observed rolling periods. The five independent variables include *capast, off, perinc, unem*, and *liqast*. Ratio of Capital to asset, number of bank service office, personal income, and ratio of liquid asset to total asset negatively influence the Islamic bank risk. This suggests that in that post crisis period, adequacy of capital, bank service convenience, and sufficiency of liquid asset are crucial in reducing bank risk. In addition, to the extent that economic recovery leads to higher personal real income and more opportunity for individuals to deposit their money in a bank, higher real personal income reduces the Islamic bank risk in this period.

Meanwhile, as expected, change in the unemployment rate positively influences the probability of bank failure. Positive changes in the unemployment rate may reflect a less conducive business environment, which puts more pressure on the operations of Islamic banks.

Table 1: Description of Probit Model Estimates Using 44 Rolling Periods for Islamic Banks, Periods of 2002.1 – 2004.8 (Blanket Scheme Application)

Independent Variable	**Number of Rolling Periods in Which the Variable Is Included**	**Number of Rolling Periods with Negative but Insignificant Coefficient (Prob >0.05)**		**Number of Rolling Periods with Negative and Significant Coefficient (Prob <0.05)****		**Number of Rolling Periods with Positive but Insignificant Coefficient (Prob >0.05)**		**Number of Rolling Periods with Positive and Significant Coefficient (Prob <0.05)****	
		No	Prop	No	Prop	No	Prop	No	Prop
C	44	6	0.13	5	0.11	25	0.56	9	0.20
CAPAST	44	5	0.10	38	0.85	1	0.02	1	0.02
AGGAST	44	8	0.19	2	0.05	22	0.49	12	0.27
TRAST	44	26	0.58	0	0.00	13	0.30	5	0.11
MANAST	44	23	0.53	12	0.27	8	0.19	0	0.01
CONSAST	44	10	0.23	0	0.00	21	0.48	13	0.29
SECAST	44	8	0.18	0	0.00	27	0.60	10	0.22
PLCBI	44	20	0.46	10	0.22	12	0.28	2	0.05
PLCOB	44	22	0.50	11	0.25	4	0.08	7	0.17
INVREV	44	19	0.44	10	0.23	12	0.27	3	0.06
LOGAST	44	24	0.54	12	0.27	8	0.19	0	0.00
OFF	44	10	0.23	15	0.34	19	0.43	0	0.00
BANK	44	28	0.63	10	0.22	6	0.14	1	0.02
CHAR	44	0	0.00	0	0.00	44	1.00	0	0.00
PERINC	44	28	0.65	16	0.35	0	0.00	0	0.00
UNEM	44	0	0.00	0	0.00	29	0.66	15	0.34
AGE	44	12	0.27	6	0.14	26	0.59	0	0.00
INCAST	44	20	0.46	8	0.19	11	0.26	4	0.09
LIQAST	44	8	0.19	17	0.38	18	0.41	1	0.03
DEPAST	44	32	0.73	6	0.14	6	0.14	0	0.00
Pseudo R-square (Average)			0.463		Pseudo R-square (Range)			0.353 - 0.594	

*Source: processed data ** significant at the 5 percent level This table shows the regression results of the Equation 1:*

$$Fin_{i,t+k} = \gamma_{i,t} + \lambda_1 \overset{(-)}{CapAst_{i,t}} + \lambda_2 \overset{(+/-)}{AggAst_{i,t}} + \lambda_3 \overset{(+/-)}{TrAst_{i,t}} + \lambda_4 \overset{(+/-)}{ManAst_{i,t}} + \lambda_5 \overset{(+/-)}{ConsAst_{i,t}} + \lambda_6 \overset{(+/-)}{SecAst_{i,t}} + \lambda_7 \overset{(+/-)}{PlcBI_{i,t}} + \lambda_8 \overset{(+/-)}{PlcOB_{i,t}} + \lambda_9 \overset{(-)}{Inv\mathrm{Re}v_{i,t}} + \lambda_{10} \overset{(-)}{LogAst_{i,t}} + \lambda_{11} \overset{(-)}{Off_{i,t}} +$$
$$\lambda_{12} \overset{(-)}{Bank_{i,t}} + \lambda_{13} \overset{(+/-)}{Charter_{i,t}} + \lambda_{14} \overset{(+/-)}{Perinc_{i,t}} + \lambda_{15} \overset{(+/-)}{Unem_{i,t}} + \lambda_{16} \overset{(-)}{Age_{i,t}} + \lambda_{17} \overset{(-)}{IncAst_{i,t}} + \lambda_{18} \overset{(-)}{LiqAst_{i,t}} + \lambda_{19} \overset{(+/-\_}{DepAst_{i,t}} + \varepsilon_{i,t}$$

*There are 44 regressions (rolling periods), involving 32 months-data per regression from 2 Islamic banks. Columns 3 and 5 show number of periods in which the associated variables are negative, not significantly and significantly, respectively. Columns 7 and 9 show number of periods in which the associated variables are not significantly and significantly negative, consecutively. Columns 4, 6, 8, and 10 show the proportions of the associated non significant negative, significant negative, non significant positive, and significant positive variables, respectively. ** indicates significance at the 5 percent level.*

Table 2 reveals the results of Equation 2 Regressions for Islamic Banks during the Blanket Scheme application. The regression should exclude variable *lage* as it is highly correlated with *lincprbk*. The respective SIC values of both regression equations without *lincprbk* and without *lage* are compared to select the model. Models with the higher absolute value of SIC is chosen. This model has passed the classical assumption tests, i.e. Normality, Autocorrelation, Heterocedasticity, and Multicolinearity. The model is significant at levels of 5% or better. The adjusted R-square value reveals that the six independent variables explain 55.9% of the dependent variable change. The table shows that only *meanrisk* and *lnum* coefficients are significant at the 5% level. Both have a positive influence on quantity of deposits in Islamic banks. This suggests that Islamic bank depositors are indifferent to Islamic bank risk when any level of deposit was guaranteed by the government. Risk of other banks in the Islamic bank geographic area and accessibility of Islamic bank services helped the increase deposits in Islamic banks.

Table 3 shows the results of rolling regressions and the estimated coefficients of the probit model for the periods of 2005.9 through 2009.12. The obtained probit equations indicate good result across the rolling periods, as indicated by the average Pseudo R-square ranging from 0.355 - 0.590. The majority of the coefficient signs are consistent with the theory. The independent variables of *capast, off, perinc, unem*,

Table 2: Equation 2 Model for Islamic Banks Periods of 2003.1 – 2005.8 (Blanket Scheme Application)

Variable	Coefficient	t-Statistic	
C	***5.1785	17.629	Dependent Variable: LDP
RDP	-10.162	-1.343	Number of observations: 44
MEANRDP	0.0002	1.099	
DRISK	-0.0032	-0.613	
EMEANRISK	***0.0422	5.418	
LINCPRBK	-0.0488	-0.841	
LNUM	***0.6372	3.065	
R-squared	0.6205		*** significant at 1% level
Adjusted R-squared	0.5589		** significant at 5% level
SIC	-16.250		* significant at 10% level

Source: processed data This table shows the regression results of the Equation 2:

$$Ldp_{i,n} = \varphi_{i,n} + \varphi_1 \overset{(-)}{Risk}_{i,n} + \varphi_2 \overset{(+)}{Meanrisk}_{i,n} + \varphi_3 \overset{(+)}{Lincprbk}_{i,n} +$$
$$\varphi_4 \overset{(+)}{Rdp}_{i,n} + \varphi_5 \overset{(-)}{Meanrdp}_{i,n} + \varphi_6 \overset{(+)}{Lnum}_{i,n} + \varphi_7 \overset{(+)}{Lage}_{i,n} + \mathrm{E}_{i,n}$$

*There are 44 regressions, involving 32 month-data per regression from 2 Islamic banks. Columns 1, 2 and 3 show the regressors, their coefficients and the associated t-statistics.The adjusted R-square figure indicates the determination degree of the independent variables toward the dependent variable. Meanwhile, SIC figures are used for model selection, in which a higher absolute value of SIC indicates the betterness of the chosen model. *, ** and ** indicate significance at the 10, 5 and 1 percent levels, respectively.*

and *liqast* have a significant contribution to the probability of banks being financed by the central bank to survive for at least one-third of the observed rolling periods under the deposit insurance establishment. This result imply that regardless of the deposit guarantee system, ratio of Capital to asset, number of bank service office, personal income, and ratio of liquid asset to total asset negatively influence Islamic bank risk, and change in unemployment rate positively influences probability of bank failure.

Table 4 shows the results of the Equation 2 regression for Islamic Banks during the deposit insurance application. The regression should exclude variable *lincprbk* as it is highly correlated with *lage*. Regression model excluding *lincprbk* is chosen for its higher absolute SIC value. This model has passed the classical assumption tests, i.e. Normality, Autocorrelation, Heterocedasticity, and Multicolinearity. The model is significant at significance level of 5% or better. The adjusted R-square value reveals that six independent variables explain 94.7% of the change in the dependent variable. Coefficients of *meanrisk, lage,* and *lage(-1)* are significant at 5% level. The variable *lage(-1)* is included to overcome heterocedasticity problem. This result suggests that depositors considered risk of other banks in the area and the age of the observed Islamic bank in their deposit decision, when deposits were insured at a certain level.

In Table 5 the estimated coefficients of the probit model for the periods of 2002.1 through 2004.8 are presented. The probit equations indicate good result across the rolling periods, which are well reflected by the average Pseudo R-square ranging from 0.349 - 0.593. More than 60% of the resulting coefficient signs are consistent with the theory. Most of the independent variables have a significant contribution to the probability of banks being financed by the central bank to survive in at least one-third of the observed rolling periods. The results show that only *char* and *liqast* are significant in more than one-third of the total observed months, implying that regulation on a conventional bank's operational coverage and sufficiency of liquid asset are more crucial in determining risk of a conventional bank during the application of full deposit guarantee (blanket scheme)

Table 6 shows the results of cross-sectional multiple regressions from Equation 2. From the 32 regressions, only *rdp, meanrisk* and *lnum* are significant in more than one-third of the observed periods. This implies that when deposits are fully insured, depositors considered the interest rate offered by a conventional bank and risk of other banks in the area, and bank accessibility in their deposit decision.

Table 3: Probit Model Estimates Using 52 Rolling Periods for Islamic Banks, 2005.9 – 2008.12 (Deposit Insurance Application)

Independent Variable	**Number of Rolling Periods In Which The Variable Is Included**	**Number of Rolling Periods with Negative But Insignificant Coefficient (Prob >0.05)**		**Number of Rolling Periods with Negative And Significant Coefficient (Prob <0.05)****		**Number of Rolling Periods with Positive But Insignificant Coefficient (Prob >0.05)**		**Number of Rolling Periods with Positive And Significant Coefficient (Prob<0.05)****	
		No	Prop	No	Prop	No	Prop	No	Prop
C	52	7	0.13	6	0.11	29	0.56	10	0.20
CAPAST	52	2	0.04	49	0.94	1	0.02	0	0.00
AGGAST	52	10	0.19	3	0.05	25	0.49	14	0.27
TRAST	52	30	0.58	0	0.00	16	0.30	6	0.11
MANAST	52	28	0.53	14	0.27	10	0.19	1	0.01
CONSAST	52	12	0.23	0	0.00	25	0.48	15	0.29
SECAST	52	9	0.18	0	0.00	31	0.60	11	0.22
PLCBI	52	26	0.50	11	0.22	12	0.23	3	0.05
PLCOB	52	26	0.50	13	0.25	4	0.08	9	0.17
INVREV	52	23	0.44	12	0.23	14	0.27	3	0.06
LOGAST	52	25	0.48	17	0.33	10	0.19	0	0.00
OFF	52	13	0.25	17	0.33	22	0.43	0	0.00
BANK	52	33	0.63	11	0.22	7	0.14	1	0.02
CHAR	52	0	0.00	0	0.00	52	1.00	0	0.00
PERINC	52	34	0.65	18	0.35	0	0.00	0	0.00
UNEM	52	0	0.00	0	0.00	34	0.66	18	0.34
AGE	52	14	0.27	7	0.14	31	0.59	0	0.00
INCAST	52	24	0.46	10	0.19	14	0.26	5	0.09
LIQAST	52	11	0.21	18	0.35	21	0.41	2	0.03
DEPAST	52	38	0.73	7	0.14	7	0.14	0	0.00
Pseudo R-square (Average)			0.465		Pseudo R-square (Range)				

Source: processed data. This table shows the regression results of the Equation 1:

$$Fin_{i,t+k} = \gamma_{i,t} + \lambda_1 \overset{(-)}{CapAst_{i,t}} + \lambda_2 \overset{(+/-)}{AggAst_{i,t}} + \lambda_3 \overset{(+/-)}{TrAst_{i,t}} + \lambda_4 \overset{(+/-)}{ManAst_{i,t}} + \lambda_5 \overset{(+/-)}{ConsAst_{i,t}} + \lambda_6 \overset{(+/-)}{SecAst_{i,t}} +$$
$$\lambda_7 \overset{(+/-)}{PlcBI_{i,t}} + \lambda_8 \overset{(+/-)}{PlcOB_{i,t}} + \lambda_9 \overset{(-)}{InvRev_{i,t}} + \lambda_{10} \overset{(-)}{LogAst_{i,t}} + \lambda_{11} \overset{(-)}{Off_{i,t}} + \lambda_{12} \overset{(-)}{Bank_{i,t}} + \lambda_{13} \overset{(+/-)}{Charter_{i,t}}$$
$$+ \lambda_{14} \overset{(+/-)}{Perinc_{i,t}} + \lambda_{15} \overset{(+/-)}{Unem_{i,t}} + \lambda_{16} \overset{(-)}{Age_{i,t}} + \lambda_{17} \overset{(-)}{IncAst_{i,t}} + \lambda_{18} \overset{(-)}{LiqAst_{i,t}} + \lambda_{19} \overset{(+/-\_}{DepAst_{i,t}} + \varepsilon_{i,t}$$

*There are 52 regressions (rolling periods), involving 40 months of data per regression from 2 Islamic banks. Columns 3 and 5 show the number of periods in which associated variables are negative, not significantly and significant, respectively. Columns 7 and 9 show the number of periods in which associated variables are not significant and significantly positive, respectively. Columns 4, 6, 8, and 10 show the proportions of associated non significant negative, significant negative, non significant positive, and significant positive variables, respectively. ** indicates significance at the 5 percent level.*

In this full deposit guarantee regime, depositors were indifferent to the calculated risk of a bank, as reflected by the variable *risk*. Rather, they were responsive to the signal of bank risk. The interest rate offered by conventional banks in this period was perceived as a signal of real bank risk. Banks offering higher interest rates were perceived as more in need of quick funds to alleviate liquidity problems, thereby bearing higher risk. Despite the deposits being fully pledged, depositors tried to avoid putting their money in potentially troubled banks. The reason was that the process of withdrawal from a failed bank was time consuming, which was not favorable, to the extent that depositors considered the time value of money.

Table 7 reveals the estimated coefficients of the probit model for the periods of 2002.1 through 2004.8, which indicate good result across the rolling periods. This is supported by the average Pseudo R-square ranging from 0.346 - 0.595. Most of the independent variables have significant contribution to the probability of banks being financed by the central bank to survive, at least in one-third of the observed rolling periods, and are consistent with the theory. The table shows that *capast, plcbi, bank*, *char, age, incast*, and *liqast* are variables that are significant in more than one-third of the total observed months.

Table 4: Equation 2 Model for Islamic Banks, Periods of 2006.9-2009.12 (Deposit Insurance Application)

Variable	Coefficient	t-Statistic	
C	-0.146467	-0.534221	Dependent Variable: LDP
RDP	0.06477	0.268301	Number of observations:51
MEANRDP	4.20E-06	0.135954	
RISK	-0.001466	-0.950932	
MEANRISK	***0.011618	3.576.384	
LNUM	0.06315	1.848.102	
LAGE	***1597365	2.030.157	
LAGE(-1)	***1711191	2.282.084	
R-squared	0.954197		*** significant at 1% level
Adjusted R-squared	0.946741		** significant at 5% level
SIC	-353.995		* significant at 10% level

This table shows the regression results of the Equation 2:

$$Ldp_{i,n} = \varphi_{i,n} + \varphi_1 \overset{(-)}{Risk}_{i,n} + \varphi_2 \overset{(+)}{Meanrisk}_{i,n} + \varphi_3 \overset{(+)}{Lincprbk}_{i,n} + \varphi_4 \overset{(+)}{Rdp}_{i,n} + \varphi_5 \overset{(-)}{Meanrdp}_{i,n} + \varphi_6 \overset{(+)}{Lnum}_{i,n} + \varphi_7 \overset{(+)}{Lage}_{i,n} + \mathrm{E}_{i,n}$$

*There are 51 regressions, involving 40 month-data per regression from 2 Islamic banks. Columns 1, 2 and 3 show the regressors, their coefficients and the associated t-statistics. The SIC figure is used for model selection, in which higher absolute value of SIC indicates the betterness of the chosen model. *, ** and ** indicate significance at the 10, 5 and 1 percent levels, respectively.*

Table 5: Description of Probit Model Estimates for Conventional Banks Periods of 2002.1 – 2004.8 (Blanket Scheme Application)

Independent Variable	Number of Periods in Which the Variable Is Included	Number of Periods with Negative but Insignificant Coefficient (Prob >0.05)		Number of Periods With Negative and Significant Coefficient (Prob <0.05)**		Number of Periods With Positive but Insignificant Coefficient (Prob >0.05)		Number of Periods with Positive and Significant Coefficient (Prob <0.05)**	
		No	Prop	No	Prop	No	Prop	No	Prop
C	32	10	0.31	1	0.03	20	0.63	2	0.06
CAPAST	32	17	0.53	10	0.31	5	0.16	1	0.03
AGGAST	32	18	0.56	3	0.09	10	0.31	1	0.03
TRAST	32	18	0.56	1	0.03	8	0.25	6	0.19
MANAST	32	14	0.44	1	0.03	10	0.31	6	0.19
CONSAST	32	6	0.19	0	0.00	22	0.69	4	0.13
SECAST	32	15	0.47	3	0.09	13	0.41	1	0.03
PLCBI	32	14	0.44	8	0.25	10	0.31	0	0.00
PLCOB	32	9	0.28	1	0.03	18	0.56	5	0.16
INVREV	32	8	0.25	0	0.00	19	0.59	4	0.13
LOGAST	32	5	0.16	9	0.28	17	0.53	1	0.03
OFF	32	16	0.50	2	0.06	14	0.44	0	0.00
BANK	32	1	0.03	5	0.16	26	0.81	0	0.00
CHAR	32	14	0.44	12	0.38	6	0.19	0	0.00
PERINC	32	19	0.59	6	0.19	6	0.19	1	0.03
UNEM	32	19	0.59	3	0.09	10	0.31	0	0.00
AGE	32	3	0.09	9	0.28	20	0.63	1	0.03
INCAST	32	6	0.19	9	0.28	17	0.53	0	0.00
LIQAST	32	11	0.34	12	0.38	8	0.25	0	0.00
DEPAST	32	16	0.50	5	0.16	10	0.31	0	0.00
Pseudo R-square (Average)			0.461		Pseudo R-square (Range)			0.349 - 0.593	

Source: processed data.This table shows the regression results of the Equation 1:

$$Fin_{i,t+k} = \gamma_{i,t} + \lambda_1 \overset{(-)}{CapAst}_{i,t} + \lambda_2 \overset{(+/-)}{AggAst}_{i,t} + \lambda_3 \overset{(+/-)}{TrAst}_{i,t} + \lambda_4 \overset{(+/-)}{ManAst}_{i,t} + \lambda_5 \overset{(+/-)}{ConsAst}_{i,t} + \lambda_6 \overset{(+/-)}{SecAst}_{i,t} + \lambda_7 \overset{(+/-)}{PlcBI}_{i,t} + \lambda_8 \overset{(+/-)}{PlcOB}_{i,t} + \lambda_9 \overset{(-)}{Inv\mathrm{Re}v}_{i,t} + \lambda_{10} \overset{(-)}{LogAst}_{i,t} + \lambda_{11} \overset{(-)}{Off}_{i,t} + \lambda_{12} \overset{(-)}{Bank}_{i,t} + \lambda_{13} \overset{(+/-)}{Charter}_{i,t} + \lambda_{14} \overset{(+/-)}{Perinc}_{i,t} + \lambda_{15} \overset{(+/-)}{Unem}_{i,t} + \lambda_{16} \overset{(-)}{Age}_{i,t} + \lambda_{17} \overset{(-)}{IncAst}_{i,t} + \lambda_{18} \overset{(-)}{LiqAst}_{i,t} + \lambda_{19} \overset{(+/-)}{DepAst}_{i,t} + \varepsilon_{i,t}$$

*There are 32 cross-sectional regressions done on 51 conventional banks. The columns 3 and 5 show number of periods in which the associated variables are negative, not significantly and significantly, respectively. The columns 7 and 9 show number of periods in which the associated variables are not significantly and significantly positive, consecutively. The columns 4, 6, 8, and 10 show the proportions of the associated non significant negative, significant negative, non significant positive, and significant positive variables, respectively.The ** indicates significance at the 5 percent level.*

Table 6: Equation 2 Model for Conventional Banks, 2003.1 – 2005.8 (Blanket System Application)

Independent Variable	**Number of Periods with Negative but Insignificant Coefficient (Prob >0.05)**	**Number of Periods with Negative and Significant Coefficient (Prob <0.05)****	**Number of Periods with Positive but Insignificant Coefficient (Prob >0.05)**	**Number of Periods with Positive and Significant Coefficient (Prob <0.05)****	**Average Value of The Estimated Coefficients Across Periods**
C	0	0	2	30	4.22
RDP	0	29	2	1	-2.36
MEANRDP	4	2	25	1	0.28
RISK	17	3	12	0	0.00
MEANRISK	13	12	4	3	0.00
LINCPRBK	17	2	12	1	-0.83
LNUM	2	0	15	15	2.04
LAGE	8	1	22	1	0.95

Source: processed data. This table shows the regression results of the Equation 2:

$$Ldp_{i,n} = \varphi_{i,n} + \varphi_1 \overset{(-)}{Risk}_{i,n} + \varphi_2 \overset{(+)}{Meanrisk}_{i,n} + \varphi_3 \overset{(+)}{Lincprbk}_{i,n} + \varphi_4 \overset{(+)}{Rdp}_{i,n} + \varphi_5 \overset{(-)}{Meanrdp}_{i,n} + \varphi_6 \overset{(+)}{Lnum}_{i,n} + \varphi_7 \overset{(+)}{Lage}_{i,n} + \mathrm{E}_{i,n}$$

*There are 32 cross-sectional regressions done on 51 conventional banks.The ** indicates significance at the 5 percent level. Columns 2 and 3 show number of periods in which the associated variables are negative, not significantly and significantly, respectively. Columns 4 and 5 show number of periods in which the associated variables are not significantly and significantly positive, consecutively. Column 6 shows the average vvalue of the estimated coefficients across periods. ** indicates significance at the 5 percent level.*

This suggests that capital adequacy, placement in the central bank, bank competition in an area, bank's operational coverage, management experience, profitability, and sufficiency of liquid asset were more important in determining risk of a conventional bank during the application of deposit insurance. It is interesting that the ratio of number of bank to total population in particular area gave negative impact on bank risk. This might reflect that bank competition in an area forced the banks to conduct more efficient operation, thereby resulting in more profitable and less risky banking.

Table 8 shows the results of cross-sectional multiple regressions from Equation 2 for conventional banks during the Deposit Insurance Application. The result of 52 regressions reveals that variables *rdp, meanrdp, lincprbk* and *lnum* are significant in more than one-third of the observed periods. Surprisingly, both *rd* and *meanrdp* show negative influence on deposits. The interest rate of conventional banks might indicate the real level of risk during the application of deposit insurance. The negative influence of average interest rate in an area of deposits might signal that the observed bank bore the same risk level as other banks in the area. Thus, in this period, depositors tended to observe the risk of each bank through its interest rate offering and avoid putting their money in banks offering high interest rate. On the positive side, an increase in personal real income might lead to more deposits. To analyze the impact of the USA Crisis that was blown up in September 2008, we combined the data of Islamic & Conventional Banks for the period of 2007.10-2008.9. The Equation 1 is employed to estimate variable *Risk* for t+12 (2008.10-2009.12) that is used in the Equation 2. The results can be seen on Table 9 and Table 10.

Table 9 shows the results of 14 probit cross sectional regressions done using data from 51 conventional banks and 2 Islamic banks. The table reveals the estimated coefficients of the probit model for the periods of 2002.1 through 2004.8, which indicate good results across the rolling periods. The Pseudo R-square ranging from 0.352 - 0.603 supports this conclusion. Most independent variables have significant contribution to the probability of intervention by the central bank to survive, in at least one-third of the observed rolling periods, and are consistent with the theory. The table also reveals that *capast, plcbi, off,*

Table 7: Probit Model Estimates for Conventional Banks 2005.9 – 2008.12 (Deposit Insurance Application)

Independent Variable	Number of Periods in Which the Variable Is Included	Number of Periods with Negative but Insignificant Coefficient (Prob >0.05)		Number of Periods with Negative and Significant Coefficient (Prob <0.05)**		Number of Periods with Positive but Insignificant Coefficient (Prob >0.05)		Number of Periods with Positive and Significant Coefficient (Prob <0.05)**	
		No	Prop	No	Prop	No	Prop	No	Prop
C	52	14	0.27	3	0.06	32	0.62	3	0.06
CAPAST	52	17	0.33	26	0.50	5	0.10	4	0.08
AGGAST	52	28	0.54	6	0.12	16	0.31	2	0.04
TRAST	52	28	0.54	1	0.02	13	0.25	9	0.17
MANAST	52	24	0.46	2	0.04	16	0.31	11	0.21
CONSAST	52	9	0.17	0	0.00	36	0.69	7	0.13
SECAST	52	11	0.21	14	0.27	21	0.40	6	0.12
PLCBI	52	14	0.27	22	0.42	15	0.29	1	0.02
PLCOB	52	14	0.27	1	0.02	29	0.56	7	0.13
INVREV	52	14	0.27	0	0.00	32	0.62	7	0.13
LOGAST	52	8	0.15	15	0.29	28	0.54	1	0.02
OFF	52	26	0.50	3	0.06	23	0.44	0	0.00
BANK	52	14	0.27	27	0.52	11	0.21	0	0.00
CHAR	52	12	0.23	28	0.54	11	0.21	1	0.02
PERINC	52	30	0.58	11	0.21	9	0.17	2	0.04
UNEM	52	32	0.62	5	0.10	15	0.29	0	0.00
AGE	52	3	0.06	32	0.62	16	0.31	1	0.02
INCAST	52	9	0.17	26	0.50	16	0.31	1	0.02
LIQAST	52	18	0.35	20	0.38	14	0.27	1	0.02
DEPAST	52	27	0.52	9	0.17	16	0.31	1	0.02
Pseudo R-square (Average)			0.466	Pseudo R-square (Range)				0.346-0.595	

Source: processed data. This table shows the regression results of the Equation 1:

$$Fin_{i,t+k} = \gamma_{i,t} + \lambda_1 \overset{(-)}{CapAst}_{i,t} + \lambda_2 \overset{(+/-)}{AggAst}_{i,t} + \lambda_3 \overset{(+/-)}{TrAst}_{i,t} + \lambda_4 \overset{(+/-)}{ManAst}_{i,t} + \lambda_5 \overset{(+/-)}{ConsAst}_{i,t} +$$
$$\lambda_6 \overset{(+/-)}{SecAst}_{i,t} + \lambda_7 \overset{(+/-)}{PlcBI}_{i,t} + \lambda_8 \overset{(+/-)}{PlcOB}_{i,t} + \lambda_9 \overset{(-)}{Inv\,\mathrm{Re}\,v}_{i,t} + \lambda_{10} \overset{(-)}{LogAst}_{i,t} + \lambda_{11} \overset{(-)}{Off}_{i,t} + \lambda_{12} \overset{(-)}{Bank}_{i,t}$$
$$+ \lambda_{13} \overset{(+/-)}{Charter}_{i,t} + \lambda_{14} \overset{(+/-)}{Perinc}_{i,t} + \lambda_{15} \overset{(+/-)}{Unem}_{i,t} + \lambda_{16} \overset{(-)}{Age}_{i,t} + \lambda_{17} \overset{(-)}{IncAst}_{i,t} + \lambda_{18} \overset{(-)}{LiqAst}_{i,t} +$$
$$\lambda_{19} \overset{(+/-)}{DepAst}_{i,t} + \varepsilon_{i,t}$$

*There are 52 cross-sectional regressions on 51 conventional banks.Columns 3 and 5 show number of periods in which the associated variables are negative, not significantly and significantly, respectively. Columns 7 and 9 show number of periods in which the associated variables are not significantly and significantly positive, consecutively. Columns 4, 6, 8, and 10 show the proportions of the associated non significant negative, significant negative, non significant positive, and significant positive variables, respectively. **indicates significance at the 5 % level*

bank, *char, age, incast*, and *liqast* are variables that are negatively significant in more than one-third of the total observed months. This suggests that capital adequacy, placement in the central bank, number of service office, bank competition, bank's operational coverage, management experience, profitability, and sufficiency of liquid asset moved in the opposite direction with bank risk during the USA crisis period. This is in line with the theory, except for the variable *bank*. To the extent that bank competition encourages banks to conduct more efficient operations, the more are banks in an area the lower the probability of bank failure.

Indonesian financial authorities tried to minimize the impact of the USA financial crisis on the domestic financial and banking system by raising the ceiling of deposits guaranteed, i.e. from IDR 100 millions to IDR 2,000 millions. It appears this policy has been effective in preventing bank runs. Table 10 shows that from the 14 cross-sectional multiple regressions, *rdp* is significant in more than one-third of the observed periods, and the associated coefficient tends to be negative. This is consistent with the findings of the impact of return rate on quantity of deposits using conventional banks data during both the application of blanket scheme and deposit insurance.

Table 8: Equation 2 Model for Conventional Banks 2005.9-2009.12 (Deposit Insurance Application)

Independent Variable	Number of Periods with Negative but Insignificant Coefficient (Prob >0.05)	Number of Periods with Negative and Significant Coefficient (Prob <0.05)**	Number of Periods with Positive but Insignificant Coefficient (Prob >0.05)	Number of Periods with Positive and Significant Coefficient (Prob <0.05)**	Average Value of the Estimated Coefficients Across Periods
C	1	14	11	26	2.43
RDP	6	39	5	2	-4.11
MEANRDP	7	31	13	1	-0.21
RISK	24	5	20	3	0.00
MEANRISK	16	12	14	10	0.00
LINCPRBK	13	3	17	19	0.01
LNUM	5	24	21	2	-1.01
LAGE	13	12	16	11	0.85

Source: processed data. This table shows the regression results of the Equation 2:

$$Ldp_{i,n} = \varphi_{i,n} + \varphi_1 \overset{(-)}{Risk}_{i,n} + \varphi_2 \overset{(+)}{Meanrisk}_{i,n} + \varphi_3 \overset{(+)}{Lincprbk}_{i,n} +$$
$$\varphi_4 \overset{(+)}{Rdp}_{i,n} + \varphi_5 \overset{(-)}{Meanrdp}_{i,n} + \varphi_6 \overset{(+)}{Lnum}_{i,n} + \varphi_7 \overset{(+)}{Lage}_{i,n} + \mathrm{E}_{i,n}$$

*There are 52 cross-sectional regressions done on 51 conventional banks. ** indicates significance at the 5 percent level. Columns 2 and 3 show number of periods in which the associated variables are negative, not significantly and significantly, respectively. Columns 4 and 5 show number of periods in which the associated variables are not significantly and significantly positive, consecutively. Column 6 shows the average vvalue of the estimated coefficients across periods.*

The rate of return on deposits may indicate the probability of a bank failure, while depositors may want to avoid the time-consuming fund withdrawal from a failed bank. On the positive side, the ratio of personal income to the number of banks, number of bank, and age of bank moved in the same direction as the quantity of deposits. This implies that during the USA financial crisis, depositors considered personal income, the bank's service accessibility, and experience in their deposit decision.

CONCLUSION

This study is aimed at revealing the impact of bank risk on the quantity of deposits using data from Islamic and conventional banks in Indonesia during the period of blanket scheme application (January 2002 – August 2005), and the period of explicit deposit insurance implementation (September 2005 – December 2009), as well as the period of the USA financial crisis.

This study employs 2-stage regressions. The first equation is to develop models for risk estimation. The models are used to calculate *risk* using the real data of t+12, which is included in the second equation. The regressions on Islamic bank data use rolling periods as there is a limitation on cross-sectional data availability. The regressions on Conventional and the combination of Islamic-Conventional bank data use cross-sectional regressions.

Investigation on depositor sensitivity to risk of Islamic banks revealed that in both periods of observation, the depositor was not sensitive to the calculated risk of an Islamic bank, but they were influenced by the average risk of other banks in making deposit decisions. They also considered accessibility and experience of the Islamic banks in the decision. Similar exploration done using conventional bank data in both periods showed that depositor might believe that rate of return on deposits in the taget bank and in other banks reflected the real bank risk. Moreover, the depositor considered the accessibility and credibility of a bank in their deposit decision.

Finally, during the USA financial crisis, the rate of return on deposits tended to have negative influence on the quantity of deposit. Depositors seemed to be indifferent to the calculated risk of a bank, but were aware of bank risk signaled by the level of interest rate offered by the bank.

Table 9: Description of Probit Model Estimates for Islamic & Conventional Banks 2007.10-2008.12

Independent Variable	**Number of Periods in Which the Variable Is Included**	**Number of Periods with Negative but Insignificant Coefficient (Prob >0.05)**		**Number of Periods with Negative and Significant Coefficient (Prob <0.05)****		**Number of Periods with Positive but Insignificant Coefficient (Prob >0.05)**		**Number of Periods with Positive and Significant Coefficient (Prob <0.05)****	
		No	Prop	No	Prop	No	Prop	No	Prop
C	14	2	0.14	1	0.07	8	0.57	3	0.21
CAPAST	14	3	0.21	7	0.50	4	0.29	0	0.00
AGGAST	14	6	0.43	2	0.14	5	0.36	1	0.07
TRAST	14	7	0.50	1	0.07	4	0.29	2	0.14
MANAST	14	8	0.57	2	0.14	4	0.29	0	0.00
CONSAST	14	5	0.36	2	0.14	7	0.50	0	0.00
SECAST	14	2	0.14	1	0.07	3	0.21	8	0.57
PLCBI	14	4	0.29	7	0.50	3	0.21	0	0.00
PLCOB	14	5	0.36	2	0.14	5	0.36	2	0.14
INVREV	14	4	0.29	2	0.14	6	0.43	2	0.14
LOGAST	14	6	0.43	2	0.14	6	0.43	0	0.00
OFF	14	3	0.21	6	0.43	4	0.29	1	0.07
BANK	14	3	0.21	1	0.07	5	0.36	5	0.36
CHAR	14	5	0.36	7	0.50	1	0.07	1	0.07
PERINC	14	4	0.29	3	0.21	4	0.29	3	0.21
UNEM	14	4	0.29	1	0.07	3	0.21	6	0.43
AGE	14	6	0.43	5	0.36	3	0.21	0	0.00
INCAST	14	3	0.21	6	0.43	5	0.36	0	0.00
LIQAST	14	4	0.29	5	0.36	4	0.29	1	0.07
DEPAST	14	6	0.43	3	0.21	2	0.14	3	0.21
Pseudo R-square (Average)			0.464		Pseudo R-square (Range)			0.352 - 0.603	

*Source: processed data. This table shows the regression results of the Equation 1: ** indicates significance at the 5 percent level*

$$Fin_{i,t+k} = \gamma_{i,t} + \lambda_1 \overset{(-)}{CapAst}_{i,t} + \lambda_2 \overset{(+/-)}{AggAst}_{i,t} + \lambda_3 \overset{(+/-)}{TrAst}_{i,t} + \lambda_4 \overset{(+/-)}{ManAst}_{i,t} + \lambda_5 \overset{(+/-)}{ConsAst}_{i,t} +$$
$$\lambda_6 \overset{(+/-)}{SecAst}_{i,t} + \lambda_7 \overset{(+/-)}{PlcBI}_{i,t} + \lambda_8 \overset{(+/-)}{PlcOB}_{i,t} + \lambda_9 \overset{(-)}{Inv\mathrm{Re}v}_{i,t} + \lambda_{10} \overset{(-)}{LogAst}_{i,t} + \lambda_{11} \overset{(-)}{Off}_{i,t} + \lambda_{12} \overset{(-)}{Bank}_{i,t}$$
$$+ \lambda_{13} \overset{(+/-)}{Charter}_{i,t} + \lambda_{14} \overset{(+/-)}{Perinc}_{i,t} + \lambda_{15} \overset{(+/-)}{Unem}_{i,t} + \lambda_{16} \overset{(-)}{Age}_{i,t} + \lambda_{17} \overset{(-)}{IncAst}_{i,t} + \lambda_{18} \overset{(-)}{LiqAst}_{i,t} + \lambda_{19} \overset{(+/-\_}{DepAst}_{i,t} + \varepsilon_{i,t}$$

There are 14 cross-sectional regressions done on 53 Islamic and conventional banks. Columns 3 and 5 show number of periods in which the associated variables are negative, not significantly and significantly, respectively. Columns 7 and 9 show number of periods in which the associated variables are not significantly and significantly positive, consecutively. Columns 4, 6, 8, and 10 show the proportions of the associated non significant negative, significant negative, non significant positive, and significant positive variables, respectively.

Table 10: Equation 2 Model for Islamic & Conventional Banks, Periods of 2008.10-2009.12 (USA Financial Crisis)

Independent Variable	**Number of Periods with Negative but Insignificant Coefficient (Prob >0.05)**	**Number of Periods with Negative and Significant Coefficient (Prob <0.05)****	**Number of Periods with Positive but Insignificant Coefficient (Prob >0.05)**	**Number of Periods with Positive And Significant Coefficient (Prob <0.05)****	**Average Value of the Estimated Coefficients Across Periods**
C	2	4	3	5	4.14
RDP	2	5	5	2	0.00
MEANRDP	4	2	5	3	0.06
RISK	4	3	6	1	-0.01
MEANRISK	5	2	5	2	0.00
LINCPRBK	5	0	5	4	3.82
LNUM	4	0	4	6	3.59
LAGE	4	1	4	5	3.61

Source: processed data. This table shows the regression results of the Equation 2:

$$Ldp_{i,n} = \phi_{i,n} + \phi_1 \overset{(-)}{Risk}_{i,n} + \phi_2 \overset{(+)}{Meanrisk}_{i,n} + \phi_3 \overset{(+)}{Lincprbk}_{i,n} + \phi_4 \overset{(+)}{Rdp}_{i,n} + \phi_5 \overset{(-)}{Meanrdp}_{i,n} + \phi_6 \overset{(+)}{Lnum}_{i,n} + \phi_7 \overset{(+)}{Lage}_{i,n} + \mathrm{E}_{i,n}$$

*There are 14 cross-sectional regressions done on 53 Islamic and conventional banks.The ** indicates significance at the 5 percent level. Columns 2 and 3 show number of periods in which the associated variables are negative, not significantly and significantly, respectively. Columns 4 and 5 show number of periods in which the associated variables are not significantly and significantly positive, consecutively. Column 6 shows the average vvalue of the estimated coefficients across periods. ** indicates significance at the 5 percent level*

We cannot make direct comparisons of depositor sensisitvity to the bank risk between the two banking systems, since there are very few Islamic banks in Indonesia. As there has been an increase in the number of Islamic banks in Indonesia since 2008, future research on this topic can employ cross-sectional regressions, which will overcome the limitation inherent in this paper.

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USING DEPOSIT INTEREST RATES IN SETTING LOAN INTEREST RATES: EVIDENCE FROM TURKEY

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ABSTRACT

Bank credit margins are set by two dynamics: loan interest rates and deposit interest rates. The latter is the leading funding cost for the commercial banks. Sampling the period running from the last financial quarter of 2002 to the last financial quarter of 2009, we consider all the listed commercial banks operating in Turkey. We obtain strong evidence of one-way causality between loan interest rates and deposit interest rates. In setting their loan interest rates, banks use deposit interest rates of the preceding period. The reverse is not true. Concurring with the literature, this causation implies that deposit interest rates explain the changes in the margin.

JEL: G21, M41.

KEYWORDS: Causality; Bank; Funding cost; Deposit interest rate; Loan interest rate; Size; Margin; Istanbul Stock Exchange.

INTRODUCTION

Kaymaz *et al.* (2010) shows that the larger the bank, the greater the bank credit margin (henceforth, referred to as margin). The reason for this was that the funding costs of the larger commercial banks (henceforth, referred to as banks) were significantly lower than those of the smaller banks. These funding costs are deposit interest rates. The authors make a further investigation to understand whether loan interest rates as the source for revenue streams also affect the degree of margin. They find that loan interest rates do not explain the changes in the margin.

Kaymaz *et al.* (ibid.) also finds that smaller banks have higher loan rates than larger banks. This linkage relies on the scholars' main implication once again, deposit interest rates. They explain this linkage saying that, as smaller banks have higher funding costs than those of their larger counterparts, they also have to set their loan prices higher. Otherwise, smaller banks will face losses in their financial statements. Therefore, Kaymaz *et al.* (ibid.) overall imply that the higher (smaller) the bank size, the lower (higher) the deposit interest rates will be.

The above-mentioned results that derive from factual information are both interesting and intuitive. As agents with major stakes in the economies, banks could be reasonably expected to set their loan prices as high as possible so as to maximize their interest revenues. The findings of Kaymaz *et al.* (ibid.), however, report that this may not always be the case.

This should not be surprising though. Indeed, we see that, in practice, after a certain point, banks cannot further rise their loan rates, due to the fear of losing (a) some of their clients, particularly the good ones with ability-to-pay and willingness-to-pay *and* to (b) the competition power in the market. This is particularly true for the larger banks. On the other hand, smaller banks do necessarily have to keep their loan prices high, and if they do not, their long-term survival will be literally at stake (Kaymaz *et al.*, unpublished a).

The above discussions indicate that banks consider their deposit interest rates in setting their loan prices. We aim to specifically document the predicted causality between bank deposit interest rates and loan interest rates, and hence obtain a supporting evidence that deposit interest rates explain the margin changes. The remainder of this paper is hence organized as follows. The next section provides the literature. The third section prescribes the data and the empirical specification on loan interest rate-deposit interest rate causality. The fourth section presents and discusses the test results. And eventually the fifth section concludes the paper.

LITERATURE REVIEW

Prior literature concentrate rather on asymmetrical adjustment process between the borrowing (deposits) and the lending (loans) rates (e.g. Enders and Granger (1998), Enders and Siklos (2001), De Bondt *et al.* (2005), Thompson (2006), Nguyen and Islam (2009) etc.). A considerable amount of studies dates back to the seminal paper by Stiglitz and Weiss (1981). The referred scholars examine the credit rationing in the setting of imperfect information, and present a model. They argue that the credit ration happens through either contracting the number of loans banks grant or setting the interest rates higher. They also argue that in the equilibrium to ration the credits, the monetary policy may work well to impact investment level by moving the fund supply around. However, this will happen by means of credit supply rather than interest rates.

Stiglitz and Weiss suggests that imperfect information could be the cause for excess supply. More importantly, imperfect information may alone induce information asymmetries which further induce adverse selection issue. The hypothesis postulated by Stigliz and Weiss is known as consumer reaction hypothesis in the literature (Nguyen and Islam, 2009).

Schnitzel (1986) examines the causation between deposit rates and mortgage loan rates through empirical tests. He shows that loan interest rates have been affected by deposit interest rates for the period under the regulated deposit interest rate regime. Sampling the banks operating in Barbados, Greenidge and McClean (2000) investigates the effect of regulatory covenants on the bank interest rates. The sample includes a bank acting as a leader in the industry. They consider average values to proxy loan interest rates and the highestly observed time-deposit values to proxy deposit interest rates. These time deposits span three months. The scholars show that in the case of the leader bank, deposit interest rates Granger cause loan interest rates.

De Bondt *et al.* (2005) explores term structures of interest rates along with the adjustment process in the European Union (EU) Member States. They show that retail bank interest rates self-adjust to the changes in the market interest rates with both short-term and long-term specifications. But this adjustment follows rather a slow progress. The scholars conduct a Granger causality, and document the existence of the causation running from the deposit interest rates to the loan interest rates.

Conducting a panel data analysis, Gambacorta (2008) investigates the way how banks determine their interest rates. Using two lags in the model estimations, Gambacorta samples 73 cross-sections that are the banks operating across Italy. The scholar shows that the factors such as interest rate volatility, bank efficiency, credit and interest risks as well as temporary and permanent changes in income have all significant impacts on the level of bank interest rates. In other words, banks consider all these factors in pricing their interest buffers.

Nguyen and Islam (2009) investigates the asymmetric behavior related to credit margin. Considering the period from the first quarter of 1991 to the first quarter of 2007, the scholars work on the banking market in Thailand. They document that banks respond faster to the spread changes when the spread is getting larger than to the spread changes when it is getting smaller. They find the reason for the increase (decrease) in the spread as the decrease (increase) in the deposit interest rates. Banks revise their loan rates, considering the shift in the deposit rates.

Nguyen and Islam perform a Granger causality test to detect the probable causation between the loan and deposit interest rates. Unlike Thompson (2006), they find that Granger causality runs from the deposit interest rates to the loan interest rates, therefore follows a one-way direction. The scholars argue that the reason for this asymmetry is the oligopsonistic association between banks and their influential clients. These clients are rather institutional customers that are big claimants to the banks they are interacting with.

In addition to the presented relevant literature, we are also aware of an emerging research strand regarding the lending-borrowing channel: pass-through mechanism/process. A pass-through process is purported to be a shift between the economic agents that might happen in different forms and that brings up transformation. The scholars usually tend to consider this repatriation within asymmetrical context along with different time horizons.

For instance, considering Harvey (1981) and using the firm-level banking data, Gambacorta (2008) samples Italy. He shows that pass-through between the market and the bank interest rates is asymmetrical over the short-run. The degree of capitalization, relationship lending or liquidity all affect this transformation. Furthermore, Betancourt *et al.* (2008) argues that there is a pass-through running from the policy rate changes to the market interest rate changes. Building on Frexias and Rochet (1997) and sampling Colombia for the period between 1999 and 2006, the scholars develop a micro-banking model. They show that macroeconomic drivers that set the borrowing and lending conditions are influential in the degree of this pass-through.

As mentioned in the introductory paragraphs, Kaymaz *et al.* (2010) contended that banks that are larger (smaller) in size have lower deposit interest rates and therefore higher [lower] margins. They have shown that loan interest rates do not account for why larger banks gain higher margins than those of their smaller counterparts. Instead, smaller banks set such loan interest rates that are higher than those by larger banks. Kaymaz *et al.* (ibid.) is one of the early studies in the literature that explicitly shows this.

The findings presented by Kaymaz *et al.* (ibid.) raises the issue of whether banks use deposit interest rate values in pricing their loan interest rate values. Documenting the predicted causality between bank deposit interest rates and loan interest rates, we aim to contribute to the bank margin (profitability) literature. In this respect, our study is one of its firsts. The next section prescribes the data and the empirical specification on loan interest rate-deposit interest rate causality.

DATA AND SPECIFICATION

Kaymaz *et al.* (ibid.) explores the impact of size on bank credit margins. Following the literature (e.g. Brock and Suarez (2000), Kaya (2001)), they specify margin as the difference between loan interest rates and deposit interest rates. These rates are average interest values that are obtained on quarterly basis for each sampled bank. The period running from 2002 to 2009 is considered for all the banks listed in Istanbul Stock Exchange (ISE).

Building on Kaymaz *et al*. (ibid), we consider all the listed banks that are quoted on ISE (website of ISE@www.imkb.gov.tr). We employ loan interest rates and deposit interest rates that are collected from banks' disclosed independent audit reports. Banks' interest rate data before the last quarter of 2002 are not published. Therefore, we sample the period from back-in the last quarter of 2002 to the last quarter of 2009, which makes 29 financial periods overall.

The causality analysis is not achievable without using the market values of banks' interest rates. We thereby process our data through averaging the loan and the deposit interest rate values of all the listed banks given each of the quarterly financial period. These values are presented in Table 1 on a period-by-period basis.

Table 1: Loan Interest Rates, Deposit Interest Rates (in %)

Periods	LIR	DIR
20024:1	57.38	45.69
20031:2	56.75	43.13
20032:3	48.62	37.75
20033:4	46.74	33.26
20034:5	44.95	27.16
20041:6	37.58	22.02
20042:7	34.88	21.12
20043:8	34.33	20.68
20044:9	33.24	20.13
20051:10	30.62	17.56
20052:11	28.18	16.20
20053:12	25.67	16.01
20054:13	24.07	15.85
20061:14	21.21	14.60
20062:15	22.70	14.67
20063:16	24.20	16.88
20064:17	23.18	17.71
20071:18	23.21	18.37
20072:19	23.35	17.57
20073:20	22.66	17.37
20074:21	22.10	16.60
20081:22	21.18	15.95
20082:23	21.13	16.62
20083:24	22.12	17.19
20084:25	24.12	18.55
20091:26	23.53	13.05
20092:27	21.50	12.09
20093:28	19.29	10.07
20094:29	17.54	9.30

Notes: Table 1 presents the market interest rates across the periods. The figures on the left cells are the financial periods. For instance, 20094:29 which refers to the last quarter of 2009 is the 29th period. The figures on the middle cells are loan interest rates represented by LIR. For instance, 17.54% refers to the average loan interest rate value in the market for 20094:29. The figures on the right cells are deposit interest rates represented by DIR. LIR and DIR values are in percentages. For instance, 9.30% refers to the average deposit interest rate value in the market for 20094:29. ***Source:*** *authors' own calculations using the data available at ISE.*

We perform three empirical tests. A bivariate correlation test is first made to see how, and to what extent these two margin-determining interest rates correlate to each other. Using autoregression model (VAR), Granger test is made to identify the posited causality. Two lags are included on both the interest rates. Our empirical model is hence estimated as the following:

$$LIR_t = \delta_0 + \delta_1 * LIR_{t-1} + \delta_2 * LIR_{t-2} + \psi_1 * DIR_{t-1} + \psi_2 * DIR_{t-2} + \varepsilon_t \quad (1)$$
$$DIR_t = \delta_0 + \delta_1 * DIR_{t-1} + \delta_2 * DIR_{t-2} + \psi_1 * LIR_{t-1} + \psi_2 * LIR_{t-2} + \varepsilon\varepsilon_t \quad (2)$$

where t stands for time, LIR for loan interest rates, DIR for deposit interest rates, ε_t and $\varepsilon\varepsilon_t$ for the error terms of LIR and DIR respectively.

Controlling for the cross-sectional and temporal differences, we also perform panel data analysis to see how the given interest rates statistically pertain to each other. We estimate both the fixed-effects and random-effects regression models, and show which one is the better fit for our data.

The above-mentioned empirical analyses facilitate a concurrent view on the degrees of the correlation, causation and association between the loan interest rates and deposit interest rates of the sampled banks. The next section provides and discusses the analyses results.

EMPIRICAL RESULTS & DISCUSSION

Table 2 presents the bivariate correlation test results between loan and deposit interest rates. Pearson correlation coefficient reports that loan interest rates are 95.5% correlated to deposit interest rates. This linkage is positive.

Table 2: Correlations: Loan Interest Rate─Deposit Interest Rate

		LIR	DIR
LIR	Pearson Correlation	1	.955
	Sig. (1-tailed)		.000***
	N	29	29
DIR	Pearson Correlation	.955	1
	Sig. (1-tailed)	.000***	
	N	29	29

*Notes: Table 2 presents the correlations between loan interest rate and deposit interest rate. LIR and DIR stand for loan interest rate and deposit interest rate respectively. N that refers to the number of observations is 29.*** indicates the significance at 1 percent level.*

Teasing the presented simultaneous equation (Statements 1 and 2), VAR test results are presented in Table 3, and Granger causality test results are presented in Table 4. VAR diagnostics given Table 3 show that loan interest rates positively relate to deposit interest rates.

Table 3:Vector Autoregression (VAR), Loan Interest Rate─Deposit Interest Rate

Sample: 3-29= -92.79=27 Log likelihood No. of obs

			Coef.	*Std. Err.*	*z*
LIR					
	lir	*L1.*	.432	.194	2.23
		L2.	.243	.159	1.53
	dir				
		L1	*.441*	*.192*	*2.30***
		L2	-.204	.199	-1.02
		_cons	3.228	.985	3.28
DIR					
	lir				
		L1	-.278	.196	-1.41
		L2	.222	.161	1.37
	dir				
		L1	1.207	.194	6.21
		L2	-.324	.202	-1.61
		_cons	2.768	.998	2.77

*Notes: Table 3 presents Vector Autoregression (VAR) outcomes. LIR and DIR respectively indicate loan interest rate and deposit interest rate. Number of observations is considered as 27. L1 and L2 respectively indicate first and second lags. Cons represents regression constant value. ** stands for the significance at 5 percent level.*

Amongst other results, Table 3 and 4 report that the changes in the lead values of loan interest rates are explained by the first lags of deposit interest rates at 5% significance. In particular, Table 4 clearly shows the existing causality between loan interest rates and deposit interest rates.

Table 4: Granger Causality Wald Tests, Loan Interest Rates─Deposit Interest Rates

Equation	Excluded	Chi2	df
LIR	DIR	7.51**	2
DIR	LIR	2.09	2

*Notes: Table 4 presents Granger Causality test outcomes. LIR and DIR respectively indicate loan interest rate and deposit interest rate. Number of observations is considered as 27. ** stands for the significance at 5 percent level.*

This causality is significant at 5% and its direction is one-way. We see that it is not loan rates, but deposit interest rates that Granger-cause loan interest rates. Banks use deposit interest rates of the preceding period in setting their loan interest rates in the following period. We have also performed panel data analysis to see how bank deposit interest rates relate to bank loan interest rates. The panel regression models are estimated as follows:

$$LIR_{it}= \varphi_{0i} + \varphi_i * DIR_{it} + \varepsilon_{it} \; [RE]$$
$$LIR_{it}= \varphi_0 + \varphi_i * DIR_{it} + \varepsilon_{it} \; [FE]$$

where RE and FE stand for the random-effects and fixed-effects panel regressions respectively. LIR stands for loan interest rates and DIR for deposit interest rates. As deposit interest rates have been shown to cause loan interest rates, we set the deposit interest rate as the explanatory variable and the loan interest rate as the dependent variable in these models. All the other notations and terms have obvious meanings. Notice that we need to have a combination of the cross-sections (group variable) and periods (time variable) to conduct panel analysis. Therefore, the data used in the panel regression tests are not the market-based, but the firm-intrinsic interest rate values that belong to each sampled bank.

Table 5 and 6 report that the models overall significantly predict the variance in the dependent variable, as shown by the values of " Prob>chi2 " in the random-effects case and of " Prob>F " in the fixed-effects case. Both of the referred significance values converge at 0. This can also be verified looking at the individual p-values (P>|z| in the random-effects case and P>|t| in the fixed-effects case) in the models approximating 0 each. The overall adjusted R^2 values in both the estimations indicate that the deposit interest rates explain the changes in the loan interest rates as much as over 65%. This signifies the relevance of the Granger causality test outcomes we have previously shown, and therefore provides a considerable degree of integrity to the very objective of this paper.

Table 5: Random-effects Panel Regression

Number of obs = 366			
Group variable: banks			
Number of groups = 13			
R-sq: within = 0.6949			Obs per group: min = 23
between = 0.1902			avg = 28.2
overall = 0.6505			max = 29
Wald chi2(1) = 796.02		Prob>chi2 = 0.000***	
lir	***Coef.***	***Std. Err.***	***z***
dir	1.114	.0395	28.21***
cons.	7.088	1.112	6.37***

*Notes: Table 5 presents the random-effects outcomes. Number of observations is 366 and the number of cross-sections is 13. LIR represents loan interest rate that is the dependent variable. DIR represents deposit interest rate that is the regressor. Cons represents regression constant value.*** stands for the significance at 1 percent level.*

As both the models yielded very similar results that are hard to distinguish from each other, we have also conducted the Hausman test to make sure which one is the case here. The test results are provided in Table 7. The p-value (Prob>chi2) suggests that we accept the alternative hypothesis postulating the appropriacy of the fixed-effects panel regression model. In other words, the fixed-effects model is a better fit for our data. The next section concludes this paper.

Table 6: Fixed-effects (within) Panel Regression

Number of obs = 366			
Group variable: banks			
Number of groups = 13			
R-sq: within = 0.6949			Obs per group: min = 23
between = 0.1902			avg = 28.2
overall = 0.6505			max = 29
F(1,352) = 801.63		Prob>chi2 = 0.000***	
lir	***Coef.***	***Std. Err.***	***t***
dir	.122	.0396	28.31***
cons.	6.927	.856	8.09***

*Notes: Table 6 presents the fixed-effects regression outcomes. Number of observations is 366 and the number of cross-sections is 13. LIR represents loan interest rate that is the dependent variable. DIR represents deposit interest rate that is the regressor. Cons represents regression constant value.*** stands for the significance at 1 percent level.*

Table 7: Hausman Test

	Coefficients			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
dir	1.122	1.114	.008	.004

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 5.64 Prob>chi2 = 0.0176**

*Notes: Table 7 presents Hausman test outcomes.'b' stands for the variable coefficient obtained from the fixed-effects estimation (fe). 'B' stands for the variable coefficient obtained from the random-effects estimation (re). DIR represents deposit interest rate.** stands for the significance at 5 percent level.*

CONCLUSION

Prior literature contended that banks that are larger (smaller) in size have lower deposit interest rates and therefore higher [lower] margins. Loan interest rates have been shown not to account for why larger banks gain higher margins than those of their smaller counterparts. Instead, smaller banks set such loan interest rates that are higher than those by larger banks. This raises the issue of whether banks use deposit interest rate values in pricing their loan interest rate values, which was the research objective of this paper. We aimed to contribute to the bank margin (profitability) literature through documenting the predicted causality between bank deposit interest rates and loan interest rates.

Considering all the listed banks that are quoted on ISE, we sampled the period from the last quarter of 2002 through the last quarter of 2009. Bank-specific deposit and loan interest rates were available in banks' disclosed independent audit reports over the sampling period. Through reorganizing these micro-level data, we employed quarterly-based market interest rate values.

We performed three empirical tests. A bivariate correlation test was first made to see how, and to what extent these two margin-determining interest rates correlate to each other. Pearson correlation coefficient indicated that loan interest rates are 95.5% correlated to deposit interest rates. This linkage was found to be positive and significant at 1 percent level.

Controlling for the cross-sectional and temporal differences, we performed panel data analysis to see how the given interest rates statistically pertain to each other. We estimated both the fixed-effects and random-effects regression models. We showed that the fixed-effects model is the better fit for our data. We found that the deposit interest rates robustly explain the changes in the loan interest rates as much as over 65%.

Using autoregression model (VAR), Granger test was made to identify the posited causality. Empirical documentations provide strong evidence that there is a one-way causality between deposit interest rates and loan interest rates. It is deposit interest rates from the preceding period that banks use to set loan interest rates, rather than vice versa. This causation is significant at 5 percent level, which is robust as well. Corroborating what the literature suggests, our findings hence provide further implication that deposit interest rates explain the margin changes.

This paper is not without its limitations. Due to the unavailability of the data, we could not further extend our sample window in the way to cover back the periods before the last quarter of 2002. Nonetheless, we do not think that this would significantly alter our findings since we consider quarters rather than year-ends. Employment of frequent temporal data corrected for the probable cross-sectional differences between the groups.

There is yet a plenty of work to do for the scholars. We suspected the unilateral causation between deposit interest rates and loan interest rates. The reason was that, in contrary to their peers, larger banks realize higher margins since their deposit interest rates are significantly lower. A future research may be conducted on the causation of banks' asset sizes with deposit interest rates and/or margins. As was in this study, we would expect to see a one-way causation running from asset sizes to deposit interest rates or margins in the event of the conduct of such a research.

Furthermore, a potential research may replicate our analysis, considering an economy featuring advanced capital market prospects. This replication may better comprise a wide array of territories so as to make a direct comparison between, and thereby obtain a concurrent implication about less-developed and developed countries.

With this awareness, there is a plenty of work to do for the implementers as well, including the banks alone at the foremost and the sector policy makers. Banks that are smaller in size may mobilize their funds to specific segments and thus make a difference. They can choose a particular sector to invest, build their appropriate supplier and customer networks as well as IT systems there, and specialize. After getting the know-how, smaller banks can start to grant loans to the demanding customers acting in that sector or segment. In addition to this, regulatory agents could take the necessary cautions as well as making the relevant arrangements to improve the borrowing terms of the smaller banks. These combine to alleviate the funding cost burden and promote asset growth.

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THE IMPACT OF IAS AND BASEL II REGULATIONS ON NET INTEREST MARGIN: EVIDENCE FROM ITALY

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ABSTRACT

The paper examines the impact of the costs of complying with IAS and Basel II regulations on the net interest margin and operating costs of Italian banks using bank level data for the period 2001-2007. More specifically, the paper intends to ascertain whether: a) IAS and Basel II compliance costs have increased operating costs and have been incorporated in a larger spread; b) there is the presence of scale diseconomies related to compliance costs for Italian mutual banks. An empirical analysis demonstrates that compliance costs have indeed affected operating costs and net interest margin although mutual banks do not face a higher average cost of complying with IAS and Basel II regulation, thanks to the presence of the mutual bank network which enables them to exploit economies of scale. Moreover, empirical findings show that mergers among banks can increase the impact of regulatory costs on net interest margin. These findings remain unchanged even if they are checked for individual bank characteristics represented by labor productivity, size, credit quality, loans, net fee income margin and equity. High net interest margin and operating costs tend to be associated with banks with low productivity that concentrate on traditional lending business, with high credit risk and relatively high equity.

JEL: D18; G21; G28; G33; G38

KEYWORDS: Net interest margin; compliance costs, Italian mutual banks, business processes

INTRODUCTION

There are a relatively large number of studies on the rationale behind financial regulation (Bhattacharya et al., 1998; Llewellyn, 1999). Such regulation can generate both benefits and compliance costs (Goodhart et al., 1998; Elliehausen, 1998). Beyond a certain threshold, financial regulation may introduce a perverse effect on market structure and behavior, such as lower levels of competition, greater entry barriers and increased moral hazard (Briault, 2002; Alfon and Andrews, 1999). Studies on the cost of regulation demonstrate that regulation increases operating costs, but the impact of these costs is not always constant for all firms (Hail and Leuz, 2006). Lastly, compliance costs can significantly affect the prices of financial products and services.

This paper contributes to this discussion on regulation costs by focusing on the International Accounting Standards, hereinafter IAS and the new Capital Accord, hereinafter Basel II. In fact, IAS and Basel II (Basel Committee on Banking Supervision, 2006) have been the most important innovations in financial regulation of the last decade. IAS has caused a dramatic change in bank balance sheets, and Basel II has introduced new ways to measure overall bank risk and capital absorption. Banks have been required to invest heavily in both human resources and technology systems to comply with IAS and Basel II regulations, but there are no studies, available to the public, on the impact of these regulations on bank operating costs and profitability.

This paper tackles two sets of questions: 1) Have IAS and Basel II compliance costs increased operating expenses, and have these compliance costs been translated into larger spreads? 2) Has this impact been different for banks of different size and, in particular, for mutual banks? To address these questions, regressions are used on balanced panel data, which included 431 Italian banks of which 344 are mutual banks, over the period 2001-2007. It is worth noting that in Italy, the central bank has imposed IAS on all banks, including those that are not quoted (see: D. Lgs. N. 38 of 28/2/2005). For mutual banks, the obligation to draw up the balance sheet with IAS was introduced in 2006 instead of 2005 as with other banks. Basel II has been applied to all banks from the first of January, 2008.

This research follows in the footsteps of Franks et al. (1998), Elliehausen and Lowrey (2000), Demirgüç-Kunt and Huizinga (1999) and Demirgüç-Kunt et al. (2004). In particular, this paper applies objective of the first two papers and the methodological approach of the second papers. It extends existing literature in several ways.

First, the data include Italian mutual banks, which are characterized by lower integration and greater autonomy than other cooperative banks operating abroad (Gutiérrez, 2008). Moreover, mutual banks differ from other banks not only with respect to their very small size but also in terms of their business model, according to which proximity to customers and mutual control shared among member clients both play a crucial role.

Second, the determinants of commercial bank interest margins and operating costs have been studied by many authors (Tsy and Saunders, 1981; Hanson and Rocha, 1986; Molyneux and Thornton, 1992; Angbazo, 1997; Carbò Valverde and Rodriguez, 2007), but this paper considers the specific business processes (Masini, 1988; Frankel et al., 2002; Munari, 1995) on which regulation has significant impact. The determinants of net interest margin and operating costs have been chosen on the basis of these business processes. In particular, these determinants of net interest margin and operating costs are considered as proxies of various business processes, namely, labor productivity as a proxy of human resources management processes, size as a proxy of administration and accounting processes, credit quality and loans as a proxy of credit processes, net fee income as a proxy of activity mix processes and equity as a proxy of financial management processes.

The paper is organized as follows. Section 2 considers a literature review. Section 3 explains the data and empirical strategy. Section 4 presents the empirical findings and section 5 summarizes the main conclusions.

LITERATURE REVIEW

The impact of IAS and Basel II regulations on net interest margin and operating costs is related to the broader, relatively controversial topic of bank regulation. In this regard, studies have addressed this subject by focusing on both advantages and costs of regulation (Llewellyn, 1999; Di Giorgio and Di Noia, 2001; Demirgüç-Kunt and Detragiache, 2002; Hoggarth et al. 2005).

Financial regulation becomes particularly pertinent when market imperfections can prevent the market from reaching efficient conditions (Leland and Pyle, 1977; Diamond, 1984). Although there has been some disagreement in the literature over the usefulness of external regulation (Benston, Kaufman, 1996; Benston, 2000), a glance at actual financial systems shows that some sort of regulation exists virtually universally (Barth et al., 2006), although with varying intensity. Furthermore, bank regulation can itself generate some benefits in terms of earning stability and reductions in monitoring costs of the banking counterpart. However, beyond a certain threshold, bank regulation can result in inefficacy and inflexibility (Padoa-Schioppa, 2004), and it can negatively affect the competitive strategies of individual banks (Guiso et al., 2007).

The literature usually classifies regulatory costs into three types, namely: direct external, direct internal and indirect regulatory costs. Direct external regulatory costs are all of the costs of running the regulatory agencies. Direct internal costs are the costs that firms sustain by complying with regulations (Schroeder, 1985; Elliehausen and Kurts, 1985; Elliehausen and Lowrey, 1997). These internal costs affect bank operating expenses, even if the accounting systems used by the banks do not normally separate regulatory costs from other costs. Internal regulatory costs are in fact included in the following: a) the cost of personnel and system requirements necessary to provide information to regulators or to perform internal checks on compliance and b) the business income lost or costs incurred to redefine hedging risk strategies or products and services supply to comply with regulations (Franks et al., 1998). Indirect regulatory cost type includes costs that may have a negative impact on market efficiency by reducing competition or increasing moral hazard.

The compliance costs are analyzed in the literature from both macro and micro-economic points of view, which are distinct in terms of their objective and their method of analysis. From a macro-economic perspective, research has explored how banking industry regulation affects the market structure, the cost of credit, access to credit, the degree of competition and economic growth. Generally, this body of literature employs cross-section analysis among different countries with different institutional and regulation characteristics. Jayaratne and Strahan (1996) and Dehejia and Lleras-Muney (2005) focus, for example, on the impact of regulation changes across U.S. states on financial development and economic growth. Barth et al. (2004) evaluate the relationship between regulation and firm performance and show that disclosure together with incentives for market control have greater impact than other factors on bank stability and profitability. Guiso et al. (2004) emphasize the effects of credit access in Italy under the Banking Law of 1936. Barth et al. (2003) explore the influence of regulation on performance using accountant indicators such as the return on assets and the ratio between operating expenses and total assets. Demirgüç-Kunt et al. (2004) analyze the impact of banking regulation across different countries on the cost of intermediation. Guiso et al. (2007) explore both the effects of bank regulation before 1993 and the impact of deregulation after 1993. Demirgüç–Kunt et al. (2006) and Pasiouras et al. (2006) focus on the impact of regulation on bank solidity using credit ratings. Pasiouras et al. (2007) study the influence of regulation on bank efficiency using stochastic frontier analysis instead of accountant ratios.

Studies taking a micro-economic point of view do not analyze the systemic impact of the regulation as a whole but rather explores the influence of each regulation on the operating expenses of the bank. In this area of study, surveys and case studies are generally used, whereas econometric methods are relatively rare.

Most research that adopts surveys and case studies has been undertaken in the U.S. context. Grant Thornton (1993), for example, estimates the aggregate cost of complying with 13 regulatory requirements. In this survey, each bank was asked to assess the number of employee hours spent on compliance activities; the overall estimated regulatory costs were 12.6% of non-interest expenses. Similar results were found in the survey carried out by the American Bankers Association (Elliehausen, 1998), through the questionnaire did not specify a specific regulation for consideration. Consequently, in this survey, the set of regulations differed from bank to bank. In Europe, the surveys from the Financial Services Authority and conducted by Europe Economics (2003) are noteworthy in the Anglo-Saxon context (see: Deloitte, 2006; Oxera, 2006). In these surveys, each financial intermediary in the sample was asked to report compliance costs on the basis of a set of activities linked by regulation. Note that the surveys consider different sets of financial regulation.

Franks et al. (1998) use accounting data collected from different regulatory agencies to compare the direct regulatory costs of financial services, excluding banks, in the U.S., United Kingdom and France. They show that both direct and indirect costs vary according to the size of the firm. Some authors in this strand of literature show the presence of economies of scale with regard to regulation compliance costs. In the presence of economies of scale, smaller banks should face higher regulation compliance costs than larger banks (Schroeder, 1985; Elliehausen and Lowrey, 1997; Thakor and Beltz, 1993).

Besides surveys and case studies, econometric methods can also be used for such studies, even if they are only rarely used. A useful starting point is the estimate of Cobb-Douglas cost function in which the dependent variable is the compliance cost of each bank as related to the introduction (or start-up) of a specific regulatory rule. The independent variables are represented by the following: a) output defined by cost-causing activities that a bank can carry out to comply with regulations, b) input prices and c) other variables affecting compliance costs.

Benston (1975) first used econometric methods to study the operating cost of regulation but found no statistical significance for the estimated coefficients. Mitchell et al. (2008) analyze the effect of changes in regulation of Australian financial services on the expense ratio (i.e., operating expenses to total assets), showing a steady increase in compliance costs. Elliehausen and Lowrey (2000) use an econometric method to study the cost of implementing the Truth in Savings Act in the U.S.; they show that start-up compliance costs were insensitive to the extent of changes required to implement regulation.

There are some difficulties in using econometric methods to assess regulatory costs in a micro-economic perspective because of difficulties related to data collection. In particular, data relating to the activities carried out by banks to comply with regulations are not directly observable in balance sheets and profit and loss accounts. These data can only be collected through questionnaires and surveys.

It is worth noting that in a micro-economic point of view, the focus is generally on the cost of compliance with a single or set of specific regulations, but no study has analyzed the cost of compliance with IAS and Basel II. This paper addresses this gap in the literature by applying the goal of the micro-economic perspective and the methodological approach of the macro-economic perspective. In particular, this paper does not quantify the specific cost of compliance with IAS and Basel II but rather intends to estimate the impact of IAS and Basel II regulation on the net interest margin and operating costs as a whole. Consequently, the problem of collecting data not available in usual bank accounting is overcome. However, the results of this study cannot be compared with previous studies focusing on the compliance costs of specific regulations, the reason being that it is impossible to conclude whether the cost of complying with IAS and Basel II regulations has been more or less than other regulations.

EMPIRICAL METHOD AND DATA SAMPLE

Variable Definition

Following Demirgüç-Kunt et al. (2004), the paper examined two dependent variables to assess the impact of IAS and Basel II regulations, namely, net interest margin and operating costs.

Regarding net interest margin, the research considered the ex-post net interest margin over the bank output, which is equal to the sum of customers' loans and deposits. An ex-post measure of net interest margin is used because it does not reflect differences in perceived risks (Demirkug-Kunt and Huizinga, 1999). Regarding operating costs, the paper considered the ratio between operating costs associated with all bank activity and bank output. Bank output has been considered as the denominator rather than total assets because the evaluation criteria stated by IAS may affect the value of total assets.

Net interest margin and operating costs are affected by IAS and Basel II regulations and by several internal and external factors, as shown in the following equation:

$$y_{i,t} = f\left(\mathrm{Re}\,g_{i,t} + Bank_{i,t} + \eta_t\right)$$

where $y_{i,t}$ represents either net interest margin or operating costs for bank i at time t; $Reg_{i,t}$ is a proxy of IAS and Basel II regulations; $Bank_{i,t}$ is a vector of firm-specific characteristics for bank i at time t; and η_t is a temporal dummy variable that represents external factors.

Reg is the ratio between Information and Communication Technology cash-outflow (ICT cash-out, i.e., I.C.T. expenses plus I.C.T. net investment) and bank output. Reg refers to three functional areas, namely, 1) administration and accounting, 2) credit and 3) risk and control management. These three areas have been selected because it is likely that IAS and Basel II regulations have directly affected the ICT endowment involved in those areas.

The inclusion of bank characteristics is intended to control for factors that may influence net interest margin and operating costs. These bank characteristics have been selected by taking into account banking business processes (Frankel R. et al., 2002) such as 1) human resources management processes, 2) administration and accounting processes, 3) credit processes, 4) bank activity mix processes and 5) financial management processes.

For each business process, certain factors have been chosen as proxies affecting net interest margin and operating costs. In particular, the following factors have been associated with various business processes (variable names in parentheses): 1) labor productivity is proxied by the ratio between bank output and the number of employees (Productivity); 2) size is proxied by the logarithm of total assets (Lnsize) (Demirküç-Kunt et al. 2004); 3) credit quality (Angbazo, 1997) and loans (Naceur and Goiaed, 2005) are represented by loans to bank output (Loans) and the ratio between non performing exposures to loan (Credit risk), respectively; 4) net fee income margin is represented by net fee and commission income (fee and commission income – fee and commission expenses) to bank output (Net fee income); 5) equity (Berger, 1995) is represented by the ratio of equity to bank output (Equity). Two additional factors that may affect the net interest margin and the costs, have also been included. These factors are mergers (M&A) and quotation (Quot), which are represented by dummy variables. Table 1 sums up the above control variables together with the expected sign.

Table 1: Explanatory Variables and Expected Signs

Explanatory Variables	Expected Sign with Respect to Net Interest Margin to Bank Output	Expected Sign with Respect to Operating Costs to Bank Output
IAS and Basel II regulations (Reg) = ratio of ICT cash-outflow (i.e., administration, credit, risk & management control) to bank output	> 0	> 0
Size (lnsize) = logarithm of total assets	< 0	< 0
Labor productivity (Productivity) = ratio of bank output to number of employees	< 0	< 0
Loans (Loan) = ratio of loans to bank output	> 0	> 0
Credit quality (Credit risk) = non-performing exposure to bank output	> 0	> 0
Bank activity mix process (Net fee income) = ratio of net fee and commission income to bank output	< 0	> 0
Equity (Equity) = ratio of equity to bank output	> 0	> 0
Merger and Acquisitions (M&A) = dummy variable with the value of 1 if bank underwent a merger from the year of merger	> 0	> 0
Quotation (Quot) = dummy variable with the value of 1 for banks quoted	> 0	> 0

This table shows the definition of independent variables together with their expected sign for both the dependent variables, i.e. net interest margin and operating costs divided by bank output. Bank output is the sum of customers' loans and deposits.

To isolate the effect of banks characteristics on net interest margin and operating costs, it is important to also control for external factors, such as indicators related to the macro-economic and financial sector environment, taxation and regulatory variables (Levine, 1996; Demirküç-Kunt, et al. 2004). These external factors change over time and do not depend on the bank. As the research focuses on the impact of compliance costs of IAS and Basel II regulations on net interest margin and operating costs only for Italian banks, these factors are common across all banks under analysis. Thus, in order to capture their impact, only temporal dummies (η_t) have been introduced for 2001 to 2007, with 2001 used as the base year.

Econometric Modeling

After defining all the variables, regressions of the following form are estimated:

$$y_{i,t} = \alpha_i + \beta_1 \operatorname{Re} g_{i,t} + \beta_2 \eta_t + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ represents either the net interest margin or operating cost ratio of the bank i at time t for 2001 to 2007; $Reg_{i,t}$ is a proxy of IAS and Basel 2 regulations; η_t represents dummy variables (six dummy variables); and $\varepsilon_{i,t}$ is the residual. These dummy variables account for an important source of unobserved heterogeneity due to time-specific effects, including the impact of external variables that affect the net interest margin and operating cost ratio, as discussed above.

To control for bank characteristics, model 1 has been modified by adding a vector of internal factors related to business processes (i.e., productivity, size, credit risk, loan, fee income and equity). The following model is then estimated:

$$y_{i,t} = \alpha_i + \beta_1 \operatorname{Re} g_{i,t} + \beta_2 \eta_t + \beta_3 Bank_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $Bank_{i,t}$ is a vector of firm-specific characteristics for bank i at time t.
To take into account additional factors such as M&A and quotation, model 2 can be modified as follows:

$$y_{i,t} = \alpha_i + \beta_1 \operatorname{Re} g_{i,t} + \beta_2 \eta_t + \beta_3 Bank_{i,t} + \beta_4 M\,\&\,A + \beta_5 M\,\&\,A * \operatorname{Re} g_{i,t} + \\ + \beta_6 quot + \beta_7 quot * \operatorname{Re} g_{i,t} + \varepsilon_{i,t} \quad (3)$$

where M&A is a dummy variable that assumes the value of 1 in presence of a merger; M&A*$Reg_{i,t}$ is the interaction term with respect to mergers and IAS and Basel II regulations; quot is a dummy variable that assumes the value of 1 for a quoted bank; quot* $Reg_{i,t}$ is the interaction term between quot and IAS and Basel II regulations. It is possible to evaluate whether there are differences in the influence of regulatory costs for IAS and Basel II with respect to banks that are not involved in mergers and not quoted.

To consider the specific impact of IAS and Basel II regulations on mutual banks (MB), the following model has also been considered:

$$y_{i,t} = \alpha_i + \beta_1 \operatorname{Re} g_{i,t} + \beta_2 \eta_t + \beta_3 Bank_{i,t} + \beta_4 MB + \beta_5 MB * \operatorname{Re} g_{i,t} + \varepsilon_{i,t} \quad (4)$$

where MB is a dummy variable that assumes the value of 1 for mutual banks and 0, otherwise; MB*$Reg_{i,t}$ is an interaction term between IAS and Basel II regulations and mutual banks. In this way, it is possible to assess whether there are differences between mutual banks and other types of banks with respect to the influence of compliance costs for IAS and Basel II regulations.

The estimation technique involves balanced panel data regressions. For each regression, two different estimation techniques have been used, namely, a fixed effect model and a random effect model. The null hypothesis that there is no individual heterogeneity within banks has been rejected on the basis of Breusch and Pagan's Lagrange multiplier test (1979), whereas Hausman's test supports the fixed effect model (within estimator) with respect to random effects (Wooldridge J.M., 2006, pp. 448-500). Consequently, random effect estimates are not reported, and the discussion will focus on the most robust empirical findings.

Data Sources and Descriptive Statistics

The data needed for this study were extracted from two different data sources. To measure the control variable, the data have been extracted from the Abibank dataset provided by the Italian Banking Association (ABI), which contains accounting information relating to all banks in the Italian credit system. Table 2 shows the number of observations split by year and by asset size.

Table 2: Composition of the Sample Data

Asset Size Classes (Classification Bank of Italy)	2001	2002	2003	2004	2005	2006	2007	Total
Greater size banks	4	4	4	4	4	4	4	28
Large size banks	7	7	7	7	7	7	7	49
Medium size banks	21	21	21	21	21	21	21	147
Small size banks	55	55	55	55	55	55	55	385
Sub total	87	87	87	87	87	87	87	609
Mutual banks	344	344	344	344	344	344	344	2408
Total	431	431	431	431	431	431	431	3017
% total assets with respect to the whole Italian banking system	72.31%	79.00%	75.73%	74.15%	73.64%	75.00%	72.94%	

This table shows: the number of observations, divided by year and asset size, and the dimension of the sample compared with the whole of the Italian banking system.

The sample includes 431 banks representing about 72.94% of the total assets of the Italian banking system at the end of 2007. The sample also includes banks of different size categories as defined by the Bank of Italy, wherein 344 are mutual banks. Data have been taken from the period 2001-2007. Only banks with available balance sheets for the whole period were included. To measure IAS and Basel II regulations (Reg), data have been collected from the "Annual survey on Automation in Italian credit system" carried out by the Interbank Convention Automation (CIPA) which was set up in 1968 at the initiative of the Bank of Italy and the Italian Banking Association (ABI). In this survey, the annual ICT cash-out is available for the entire Italian banking system. It also includes the breakdown of ICT cash-out by functional area. Tables 3 and 4 provide summary statistics for all dependent and independent variables for each year and for different sizes of banks.

Cross-bank differences in the net interest margin and operating cost ratio may reflect differences in efficiency and competition degree but also may be justified due to different bank activities, asset allocations or risk preferences. In particular, in the 2001-2007 period, for mutual banks and unlike other banks, one can observe less development of fee income activity and greater values for net interest margin, credit risk and equity. This is in line with the specific business model of mutual banks, which is much more oriented to retail segments and greatly stresses the relationship between customers and the bank. In addition, mutual banks located in the south of Italy are smaller in average size show greater values in terms of net interest margin, operating costs, risk credit and equity in comparison with the mutual banks located in the north of Italy. Tables 5 and 6 display the correlation among the explanatory variables with respect to net interest margin and operating costs.

Table 3: Summary Statistics of all Variables for Each Year

Years	Variables	Net Interest Margin/Bank Output	Operating Costs/Bank output	IAS and Basel 2 Regulation	Size (Mln)	Productivity (mln)	Credit risk	Loan	Net fee income	Equity
2001	Mean	0.0242	0.0232	0.0005	3,021	5.12	0.0488	0.4105	0.0055	0.1011
	Std. Dev.	0.0062	0.0063	0.0001	20,000	2.19	0.033	0.0733	0.0036	0.0595
2002	Mean	0.0218	0.0218	0.0005	3,490	5.52	0.0441	0.4169	0.005	0.094
	Std. Dev.	0.0045	0.0055	0.0001	24,800	2.25	0.0275	0.0743	0.0032	0.043
2003	Mean	0.0205	0.0207	0.0006	3,479	5.96	0.0449	0.4276	0.0051	0.0901
	Std. Dev.	0.0046	0.0058	0.0001	24,300	2.39	0.0265	0.0734	0.0037	0.0403
2004	Mean	0.0194	0.0196	0.0006	3,592	6.39	0.0461	0.4361	0.0051	0.0865
	Std. Dev.	0.0042	0.0053	0.0001	24,800	2.35	0.0286	0.0683	0.0039	0.0381
2005	Mean	0.0187	0.0193	0.0006	3,911	6.79	0.0513	0.4424	0.0049	0.0835
	Std. Dev.	0.0042	0.0048	0.0001	27,200	2.27	0.0303	0.0691	0.0032	0.0319
2006	Mean	0.0204	0.0187	0.0006	4,283	7.16	0.0523	0.4734	0.0048	0.087
	Std. Dev.	0.0047	0.0047	0.0001	29,800	4.17	0.0522	0.0779	0.003	0.038
2007	Mean	0.0213	0.0182	0.0005	4,617	7.51	0.0506	0.4764	0.0046	0.0863
	Std. Dev.	0.0052	0.0052	0.0001	32,600	2.98	0.0315	0.0752	0.0027	0.0394
Total Average	Mean	0.0215	0.0208	0,0005	2,759	5.14	0.0488	0.4378	0.0052	0.0919
	Std. Dev.	0.0057	0.0061	0,0001	17,200	11.24	0.0345	0.0766	0.0039	0.048

The table shows mean and standard deviation, year by year, of all variables. Dependent variables are represented by: 1) the ratio between net interest margin and bank output and 2) the ratio between operating costs and bank output. The independent variables are IAS and Basel II regulation (ICT cash-out, referring to administration, credit, risk & management control), size (total assets), productivity (bank output divided by number of employees), credit risk (non-performing exposure), loans, net fee income (net fee and commission income), equity. All the above variables, except for productivity, are understood to be divided by bank output which is the sum of customers' loans and deposits

The correlation matrices show: a) a positive, statistically significant relationship between net interest margin and operating costs and compliance costs for IAS and Basel II regulations; and b) expected signs and significant relationships between dependent variables and the control variables, except for the loan variable, which has an unexpected sign.

EMPIRICAL FINDINGS

Tables 7 and 8 report the results of the regressions of net interest margin and operating costs, respectively. The tables show two specifications for model 2 and three specifications for model 4, including a basic specification with a regulation variable and year effects. In the first specification of model 2, size and productivity variables have been added and in the second specification other bank characteristics have also been considered. In the first specification of model 4, the regulation variable is interacted with a dummy variable representing Italian mutual banks; in the second specification of model 4, it has been added another interaction term between the regulation variable and the dummy variable representing small banks that are not mutual banks. Finally, in the third specification of model 4, the regulation variable is interacted with mutual banks located in the northwest, northeast, middle and south of Italy.

Table 4: Summary Statistics of all Variables for Size Class. Mean over the Period 2001-2007

	Other Bank (OB)		Mutual Bank (MB)		Mutual Bank of Which		Mutual Bank of Which		Mutual Bank of Which		Mutual Bank of Which	
					North - West Italy		North - East Italy		Middle Italy		South Italy	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Net interest margin/bank output	0.0185	0.0066	0.0216	0.0049	0.0214	0.0038	0.0204	0.0043	0.0214	0.0041	0.0262	0.0052
operating costs/bank output	0.0218	0.0092	0.02	0.0048	0.0202	0.0047	0.0188	0.0041	0.0206	0.0046	0.0234	0.0051
IAS and Basel II regulation	0.0006	0.0001	0.0005	0.0001	0.0005	0.0001	0.0005	0.0001	0.0005	0.0001	0.0006	0.0001
Size (mln)	17,000	54,800	267	340	464	366	234	217	301	566	137	110
Productivity (mln)	6.36	4.04	6.3	2.46	6	1.58	6.67	6.92	5.99	1.55	5.6	3.43
Credit risk	0.0399	0.0289	0.0507	0.0356	0.0374	0.0201	0.0453	0.0364	0.0509	0.0218	0.0686	0.0401
Loan	0.4799	0.0882	0.4299	0.0694	0.4458	0.0503	0.4642	0.0492	0.4243	0.0534	0.3538	0.0587
Net fee income	0.0091	0.0068	0.0041	0.0014	0.0047	0.0014	0.0044	0.0017	0.0043	0.0012	0.0037	0.0014
Equity	0.0792	0.0722	0.0931	0.0386	0.0933	0.0302	0.098	0.037	0.0777	0.0247	0.1015	0.0505

The table reports mean and standard deviation of the variables with respect to size classification over the period 2001-2007. Dependent variables are represented by: 1) the ratio between net interest margin and bank output and 2) the ratio between operating costs and bank output. The Independent variables are: IAS and Basel II regulation (ICT cash-out, referring to administration, credit, risk & management control), size (total assets), productivity (bank output divided by number of employees), credit risk (non-performing exposure), loans, net fee income (net fee and commission income), equity. All the above variables, except for productivity, are understood to be divided by bank output which is the sum of customers' loans and deposits.

Table 5: Correlation Matrix between Net Interest Margin Ratio and the Explanatory Variables

	Net Interest Margin/Bank Output	**IAS and Basel II Regulation**	**Size**	**Productivity**	**Credit Risk**	**Loan**	**Net Fee Income**	**Equity**
Net interest margin	1							
IAS and Basel 2 regulation	0.1345*	1						
Size	-0.1652*	0.2027*	1					
Productivity	-0.4191*	-0.0982*	0.0448	1				
Credit risk	0.1943*	0.0127	-0.0494*	-0.0059	1			
Loan	-0.4238*	-0.2379*	0.0665*	0.3105*	-0.0705*	1		
Net fee income	-0.0379	0.2879*	0.1357*	-0.2168*	-0.1975*	0.1564*	1	
Equity	0.4633*	0.5051*	0.0032	-0.1100*	0.0386	-0.1476*	0.1595*	1

*Correlations are presented for the sample of all observations. The matrix shows the correlation between the dependent variable, that is the net interest margin divided by bank output, and the independent variables represented by: IAS and Basel II regulation (the ratio between ICT cash-out, referring to administration, credit, risk & management control and bank output), size (logarithm of total assets), productivity (the ratio between bank output and the number of employees), credit risk (ratio between non-performing exposure and bank output), loan (ration between loans and bank output), net fee income (the ratio between net fee and commission income and bank output), equity (the ratio between equity and bank output). *Indicates significance at 1% level.*

In the first column of tables 7 and 8 (model 1), the coefficients of the regulation variable are positive and significant, regardless of the dependent variable (i.e., net interest margin or operating costs). This suggests that compliance costs resulting from IAS and Basel II regulations not only contributed to cost increases, which seems intuitive, but these costs were also passed on to depositors and lenders by increasing net interest margin. The robustness of the above results has been checked in a number of ways, as described below.

Table 6: Correlation Matrix between Operating Cost Ratio and the Explanatory Variables

	Operating Costs	IAS and Basel II Regulation	Size	Productivity	Credit Risk	Loan	Net Fee Income	Equity
Operating costs	1							
IAS and Basel 2 regulation	0.3477*	1						
Size	-0.0261	0.2027*	1					
Productivity	-0.5582*	-0.0982*	0.0448	1				
Credit risk	0.0597*	0.0127	-0.0494*	-0.0059	1			
Loan	-0.4137*	-0.2379*	0.0665*	0.3105*	-0.0705*	1		
Net fee income	0.5360*	0.2879*	0.1357*	-0.2168*	-0.1975*	0.1564*	1	
Equity	0.3266*	0.5051*	0.0032	-0.1100*	0.0386	-0.1476*	0.1595*	1

*Correlations are presented for the sample of all observations. The matrix shows the correlation between the dependent variable, that is the operating costs divided by bank output, and the independent variables represented by: IAS and Basel II regulation (the ratio between ICT cash-out, referring to administration, credit, risk & management control and bank output), size (logarithm of total assets), productivity (the ratio between bank output and the number of employees), credit risk (ratio between non-performing exposure and bank output), loan (ration between loans and bank output), net fee income (the ratio between net fee and commission income and bank output), equity (the ratio between equity and bank output). *Indicates significance at 1% level.*

Additional controls for productivity and size (model 2a): The coefficient of productivity is negative and significant. This result indicates that banks with higher labor productivity tend to show lower net interest margin. This is also true for size, as the negative coefficient suggests that larger banks tend to show lower net interest margin and operating costs due to scale economies. This is consistent with previous empirical studies (Shaffer, 1985) as well as models that emphasize the positive role of size due to scale efficiencies.

Credit process, activity mix and leverage (model 2b); In the third column of tables 7 and 8 (model 2b), the paper checked whether the results remain valid when considering certain banks characteristics, such as credit process variables (i.e., loans and credit risk), the product mix variable (i.e., net fee income) and equity. The results do not indicate important differences with respect to either net interest margin or operating costs. There is a positive, though not significant, relationship between credit risk and the dependent variables (i.e., net interest margin and operating costs), which is consistent with previous studies (Wong, 1997). The coefficient is positive and significant with respect to the loan variable, indicating that at a higher ratio of loans to output, banks tend to have higher net interest margins, which confirms previous findings (Demirgç-Kunt and Huizinga, 1999; Naceur and Goaied, 2005).

Next, there is a positive but insignificant coefficient on the non-interest income with respect to net interest margin; however, this coefficient is significant with respect to operating costs. The sign of the coefficient for net interest margin is not as expected, which signals that higher fee-income activities increase net interest margin. This indirectly suggests traditional bank activities subsidize non-traditional bank activities. The inverse mechanism, that is traditional bank activities subsidized by non-traditional bank activities, is true abroad (Demirküç-kunt et al., 2004). Finally, there is a positive and significant coefficient for the equity variable with respect to net interest margin, but this same relationship is not significant with regard to operating costs. Well-capitalized banks tend to have higher net interest margins, which is consistent with the theory that highly capitalized banks face lower risks of bankruptcy. As such, funding costs are reduced, which increases net interest margin. However, equity is much more expensive than debt, and banks with relatively high capital ratio may attempt to cover this cost by introducing an extra spread (Saunders and Schumacher, 2000).

Table 7: Regression Results: Dependent Variable Ratio of Net Interest Margin to Bank Output.

Independent	Model 1	Model 2		Model 3	Model 4		
		a)	b)		a)	b)	c)
Reg	0.250***	0.232***	0.0943*	0.102*	0.0723*	0.0972*	0.0696*
	(0.07490)	(0.07990)	(0.05450)	(0.05570)	(0.04160)	(0.05330)	(0.03920)
Year 2002	-0.00227***	-0.00162***	-0.00163***	-0.00163***	-0.00162***	-	-0.00162***
	(0.00009)	(0.00015)	(0.00016)	(0.00016)	(0.00016)	(0.00016)	(0.00017)
Year2003	-0.00533***	-0.00395***	-0.00311***	-0.00315***	-0.00312***	-	-0.00308***
	(0.00055)	(0.00067)	(0.00050)	(0.00048)	(0.00048)	(0.00048)	(0.00042)
Year 2004	-0.00745***	-0.00542***	-0.00411***	-0.00419***	-0.00412***	-	-0.00407***
	(0.00086)	(0.00101)	(0.00073)	(0.00070)	(0.00070)	(0.00070)	(0.00061)
Year 2005	-0.00805***	-0.00552***	-0.00433***	-0.00442***	-0.00434***	-	-0.00429***
	(0.00083)	(0.00102)	(0.00077)	(0.00074)	(0.00074)	(0.00074)	(0.00065)
Year 2006	-0.00552***	-0.00260***	-0.00250***	-0.00254***	-0.00251***	-	-0.00246***
	(0.00059)	(0.00086)	(0.00077)	(0.00075)	(0.00075)	(0.00075)	(0.00068)
Year 2007	-0.00203***	0.00120*	-0.000206	-0.000154	-0.000187	-0.000217	-0.00019
	(0.00026)	(0.00065)	(0.00071)	(0.00072)	(0.00072)	(0.00072)	(0.00073)
Productivity		-0.00272**	-0.00202**	-0.00202**	-0.00200**	-0.00198**	-0.00203**
		(0.00111)	(0.00094)	(0.00093)	(0.00094)	(0.00094)	(0.00092)
Lnsize		-0.00443***	-0.00374***	-0.00363***	-0.00375***	-	-0.00373***
		(0.00096)	(0.00080)	(0.00077)	(0.00080)	(0.00080)	(0.00080)
Credit risk			0.000312	0.0000864	0.000247	0.000199	0.000216
			(0.00190)	(0.00186)	(0.00189)	(0.00188)	(0.00188)
Loan			0.0150***	0.0144***	0.0148***	0.0150***	0.0148***
			(0.00357)	(0.00342)	(0.00343)	(0.00342)	(0.00338)
Net fee income			0.158	0.184	0.171	0.177	0.172
			(0.16300)	(0.14400)	(0.15900)	(0.15400)	(0.15900)
Equity			0.0375***	0.0373***	0.0376***	0.0384***	0.0374***
			(0.00753)	(0.00737)	(0.00748)	(0.00755)	(0.00731)
M&A				-0.00750**			
				(0.00310)			
Reg*M&A				0.129**			
				(0.06080)			
Reg*quot				-0.0957			
				(0.06800)			
Reg*MB					0.0305	0.00204	
					(0.03630)	(0.04880)	
Reg*small size						-0.0503	
						(0.04480)	
Reg*MB north-west							0.0221
							(0.02810)
Reg*MB north-east							0.014
							(0.03290)
Reg*MB middle							0.0510
							(0.03000)
Reg*MB south							0.0371
							(0.05040)
_cons	0.0117***	0.0910***	0.0726***	0.0713***	0.0724***	0.0720***	0.0727***
	(0.00370)	(0.01510)	(0.01300)	(0.01270)	(0.01290)	(0.01290)	(0.01270)
Oobservations	3017	3017	3017	3017	3017	3017	3017
adj. R-sq	0.518	0.575	0.635	0.639	0.636	0.636	0.636
Within R^2	0.5195	0.5762	0.6364	0.6405	0.6373	0.6381	0.638

*This table reports regression estimates. The dependent variable is net interest margin divided by bank output. Bank output is the sum of customers' loans and deposits. Reg. stands for IAS and Basel II Regulation.; Year 2002 to 2007 are temporal dummy variables.. The control variables are: Productivity (ratio of bank output to the number of employees); Lnsize (logarithm of total assets); Credit risk (ratio of non performing exposure to bank output); Loans (ratio between loans and bank output); Net fee income (Bank activity mix process proxy by net fee and commission income divided by bank output); Equity (ratio of equity and to output). M&A is a dummy variable with value 1 for banks which merged; quotation is a dummy variable with the value of 1 for banks quoted; The fixed effect model has been used as estimation techniques. Standard errors are between brackets. *, **, ***, indicate significance levels of 10%, 5% and 1%, respectively.*

Table 8: Regression Results: Dependent Variable is the Ratio of Operating Costs to Bank Output

Independent	**Model 1**	**Model 2**		**Model 3**		**Model 4**	
		a)	b)		a)	b)	c)
Reg	0.250***	0.176***	0.141***	0.130***	0.138***	0.143***	0.140***
	(0.03640)	(0.03670)	(0.03560)	(0.03980)	(0.02900)	(0.03430)	(0.02910)
Year 2002	-0.00113***	-0.000232	-0.000154	-0.000153	-0.000153	-0.000154	-0.000152
	(0.00011)	(0.00021)	(0.00018)	(0.00018)	(0.00018)	(0.00018)	(0.00018)
Year2003	-0.00408***	-0.00174***	-0.00170***	-0.00162***	-0.00170***	-0.00170***	-0.00172***
	(0.00027)	(0.00049)	(0.00044)	(0.00046)	(0.00044)	(0.00044)	(0.00043)
Year 2004	-0.00618***	-0.00267***	-0.00264***	-0.00251***	-0.00264***	-0.00264***	-0.00267***
	(0.00041)	(0.00071)	(0.00065)	(0.00067)	(0.00065)	(0.00065)	(0.00062)
Year 2005	-0.00635***	-0.00212**	-0.00224***	-0.00210***	-0.00224***	-0.00223***	-0.00226***
	(0.00043)	(0.00082)	(0.00074)	(0.00077)	(0.00075)	(0.00074)	(0.00072)
Year 2006	-0.00615***	-0.00163*	-0.00194**	-0.00185**	-0.00194**	-0.00194**	-0.00196**
	(0.00036)	(0.00087)	(0.00083)	(0.00085)	(0.00083)	(0.00083)	(0.00082)
Year 2007	-0.00403***	0.000443	-0.000267	-0.000275	-0.000265	-0.00027	-0.000253
	(0.00020)	(0.00094)	(0.00092)	(0.00093)	(0.00093)	(0.00092)	(0.00092)
Productivity		-0.00826***	-0.00646***	-0.00643***	-0.00646***	-0.00645***	-0.00644***
		(0.00225)	(0.00190)	(0.00189)	(0.00190)	(0.00191)	(0.00190)
Lnsize		-0.00313**	-0.00221*	-0.00238**	-0.00221*	-0.00220*	-0.00222*
		(0.00126)	(0.00114)	(0.00114)	(0.00115)	(0.00114)	(0.00114)
Credit risk			0.00669**	0.00690**	0.00668**	0.00667**	0.00663**
			(0.00307)	(0.00314)	(0.00306)	(0.00305)	(0.00308)
Loan			0.00102	0.00163	0.00101	0.00103	0.000986
			(0.00319)	(0.00322)	(0.00315)	(0.00318)	(0.00312)
Net fee income			0.692***	0.651***	0.693***	0.694***	0.693***
			(0.13500)	(0.16300)	(0.13900)	(0.14000)	(0.13900)
Equity			0.00402	0.00453	0.00404	0.00417	0.00407
			(0.01150)	(0.01110)	(0.01130)	(0.01080)	(0.01150)
M&A				0.00698**			
				(0.00274)			
Reg*M&A				0.142***			
				(0.05410)			
Reg*quot				0.126*			
				(0.06660)			
Reg*MB					0.00366	0.00121	
					(0.03300)	(0.02870)	
Reg*small size						-0.0086	
						(0.04650)	
Reg*MB north-							0.018
							(0.03330)
Reg*MB north-							0.0165
							(0.02900)
Reg*MB middle							0.0000324
							(0.02770)
Reg*MB south							0.00209
							(0.04270)
_cons	0.0106***	0.124***	0.0936***	0.0955***	0.0936***	0.0935***	0.0935***
	(0.00180)	(0.02190)	(0.02120)	(0.02120)	(0.02110)	(0.02100)	(0.02110)
Number of	3017	3017	3017	3017	3017	3017	3017
adj. R-sq	0.456	0.59	0.647	0.652	0.647	0.647	0.647
Within R^2	0.457	0.5915	0.6486	0.654	0.6487	0.6487	0.6491

*The table reports the regression estimates. The dependent variable is operating costs divided by bank output. Bank output is the sum of customers' loans and deposits. Reg. stands for IAS and Basel II Regulation.; Year 2002 to 2007 are temporal dummy variables.. The control variables are: Productivity (ratio of bank output to the number of employees); Lnsize (logarithm of total assets); Credit risk (ratio of non performing exposure to bank output); Loans (ratio between loans and bank output); Net fee income (Bank activity mix process proxy by net fee and commission income divided by bank output); Equity (ratio of equity and to output). M&A is a dummy variable with value 1 for banks which merged; quotation is a dummy variable with the value of 1 for banks quoted; The fixed effect model has been used as estimation techniques. Standard errors are between brackets. *, **, ***, indicate significance levels of 10%, 5% and 1%, respectively.*

Mergers and public quotation (model 3): The coefficient of the interaction variable with mergers is positive and significant for both net interest margin and operating costs. This suggests that compliance costs for IAS and Basel II regulations are higher for firms involved in mergers. Merged banks tend to translate higher costs into net interest margin. In contrast, the coefficient of the interaction variable with quotation is negative and not significant for net interest margin, but it is positive and significant for operating costs. This suggests that for quoted banks, IAS and Basel II regulations have higher costs as compared to unquoted banks due to the fact that quoted banks must meet more severe regulations with respect to transparency. It is worth noting that this greater cost may not be translated into net interest margin.

Regulation and mutual banks (model 4): The last three columns of tables 7 and 8 are designed to test whether there is a difference in the impact of IAS and Basel II compliance costs for mutual banks as compared to other banks. The coefficient sign of the regulation variable interacted with mutual banks (MB) is positive though not significant (model 4a) both for net interest margin and operating costs. This suggests that for mutual banks, there is a certain degree of sensitivity to regulatory costs, but there is no strong evidence that there exists a cost disadvantage in complying with IAS and Basel II regulations.

This is also true for non-cooperative small banks. In fact, as can be observed from model 4b, the sign of the coefficient of the interaction variable Reg*small size banks is negative, even if not significant. The same results also appear if we consider mutual banks with regard to location. The coefficient sign of the interaction term between IAS and Basel II regulations and mutual banks is always positive, though not significant, regardless of geographic location (model 4c).

In general, the empirical evidence does not lead to the conclusion that mutual banks face a higher average cost of compliance with IAS and Basel II regulations as compared with other banks. This is not surprising if it is considered that mutual banks have generally opted for a rather standard approach to the Basel II, which is much simpler and requires less investment than other approaches. Moreover, mutual banks have been supported by local and national associations, which have centralized certain key products in order to facilitate the common management of important support services, such as regulatory compliance. Thus, mutual banks have overcome the problem of indivisibilities in regulatory compliance. Software, human skills and organizational processes generate large fixed costs and are not divisible; thus, to comply with IAS and Basel II regulations, banks must acquire all of these capabilities. With respect to mutual banks, local associations have acquired all of these capabilities, thereby exploiting the cost advantages derived from production on a larger scale. This has allowed all mutual banks to benefit from an economy of scale much like larger banks, which have taken advantage of scale economies in regulation costs, as shown in previous studies (Elliehausen, 1998; Thakor and Beltz, 1993).

CONCLUSIONS

This paper focuses on the impact of IAS and Basel II regulations on the net interest margin and operating costs of Italian banks using bank-level data for the period 2001-2007. In particular, the paper intends to verify if: a) IAS and Basel II compliance costs have increased operating costs and have been translated into a larger spread, b) there is the presence of scale diseconomies with respect to IAS and Basel II compliance costs for mutual banks as compared with other banks. To address these aims, a series of regressions on balanced panel data have been estimated in the paper. Estimations have been conducted by using: a) the accounting data of 431 Italian banks of which 344 are mutual banks and b) the annual ICT cash outflow collected from the “Annual Survey on Automation in the Italian credit system” carried out by Interbank Convention Automation.

In the paper, the dependent variables are represented by net interest margin and operating costs which are both divided by bank output defined as the sum of customers’ loans and deposits. The independent variable relating to IAS and Basel II regulations is represented by the ratio between the ICT cash-outflow and bank output. This variable specifically refers to three functional areas: 1) administration and accounting, 2) credit and 3) risk and control management.

The robustness of the findings has been checked for various bank characteristics, including labor productivity, size, credit quality, loan, net fee income and equity linked to typical business processes, such as human resource management, administration, credit processes, bank activity mix processes and financial management. Mergers and quotations have been included as additional extraordinary factors that may affect net interest margin and operating costs.

The main results of the paper are as follows: first, the compliance costs of IAS and Basel II regulations affect operating costs; they also partly affect net interest margins. Second, mutual banks as compared with other banks present a certain sensitivity with respect to IAS and Basel II compliance costs, but there is no strong evidence of the existence of cost disadvantages even if regulations are simpler to fulfill for mutual banks. Third, bank mergers can increase the impact of regulatory costs on net interest margin due to diseconomies, whereas in quoted banks, the contrary is true. Fourth, the above findings remain unchanged even when checking for individual bank characteristics. High net interest margin and operating costs tend to be associated with banks with low levels of productivity that concentrate on traditional credit business and have high levels of equity and credit risk.

The empirical findings suggest that the regulatory authority should carefully evaluate the impact of all new financial rule on the operating costs of the banks as part of these costs could be passed on to depositors and lenders. In addition, the empirical findings demonstrate the positive role played by mutual bank networks, as these networks help Italian mutual banks exploit economies of scale, but this advantage can only persist if institutions dedicated to linking mutual banks continue to improve their own efficiency and offer high-value services.

It is worth underlining that this paper does not quantify the specific cost of compliance with IAS and Basel II but rather intends to estimate the impact of IAS and Basel II regulation on the net interest margin and operating costs as a whole. Consequently, the results of this study cannot be compared with previous research quantifying the compliance costs of specific regulations. Future developments of the research should focus on the cost-causing activities that a bank may carry out in order to comply with IAS and Basel II regulations. To address this task, a questionnaire needs to be drawn up and submitted to a sample bank. After collecting the data, it will be possible to estimate a Cobb-Douglas cost function as in most studies using an econometric method. Moreover, the paper focuses exclusively on the compliance cost of regulation. Further work should be undertaken on the possible benefits of IAS and Basel II regulation. In fact, it is important to highlight that IAS have generated costs but also a greater transparency and homogeneity of valuation criteria by favoring the opportunity for comparison. On the other hand, Basel II establishes a minimum level of capital needed to cover unexpected losses and this can reduce the monitoring costs that other banks have to sustain in order to evaluate each other's creditworthiness. The Interaction between cost and benefits could improve the understanding of the impact of IAS and Basel II regulation.

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THE IMPACT OF DOLLAR-RAND VOLATILITY ON U.S. EXPORTS TO SOUTH AFRICA

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ABSTRACT

This study investigates the effects of exchange rate volatility on the top ten categories of exports by the United States to South Africa over a 20-year period from January 1990 to December 2009. The paper uses several measures of volatility to generate a measure of exchange rate volatility, which is then tested in a model of U.S. exports to South Africa. We employ sectoral trade data at the 2-digit HS level to evaluate these effects on the top ten individual commodities traded. Utilizing bounds testing cointegration, we estimate the short- and long-run impact of exchange-rate volatility on the US exports to South Africa. Our results suggest that while the effects of exchange rate volatility on exports is mixed in the short-run, in the long-run, exchange rate volatility exerts a negative effect on the U.S. exports to South Africa.

JEL : F14, F31

KEYWORDS: exchange rates, volatility, exports, ARDL bounds testing, South Africa.

INTRODUCTION

The breakdown of the Bretton Woods system and the adoption of the flexible exchange rate regime in 1973 has led to a proliferation of research on the impact of exchange rate volatility (ERV) on real exports. The interest in this research was prompted by three main developments: (a) both the real and nominal exchange rates have undergone periods of substantial volatility since 1973; (b) during the same period, international trade declined significantly among industrialized countries; and (c) macroeconomic instability in terms of output, inflation, interest rates, and employment began to surface.

Despite the sizeable number of studies conducted, no real consensus about the impact of exchange rate volatility on exports has emerged. While a large number of studies find that ERV tends to reduce the level of trade, others find either weak or insignificant or positive relationships. For example, Onafowara and Owoye (2008), Byrne, Darby, and MacDonald (2008), Choudhry (2005), Bahmanee-Oskooee (2002), Arize, *et al.* (2000), Arize (1995), Chowdhury (1993), Pozo (1992), and Bahmani-Oskooee and Ltaifa (1992), find evidence for negative effects. According to these scholars, ERV may affect exports directly through uncertainty and adjustment costs for risk-averse exporting investors. Further, it may have an indirect effect through its impact on the structure of output, investment and government policy. On the other hand, Doyle (2001), Chou (2000), McKenzie and Brooks (1997), Qian and Varangis (1994), Kroner and Lastrapes (1993), and Asseery and Peel (1991) find evidence for a positive effect for volatility on export volumes of some developed countries because exchange rate volatility makes exporting more attractive to risk-tolerant exporting firms. However, other scholars such as Aristotelous (2001), Bahmani-Oskooee and Payestch (1993), Bahmani-Oskooee (1991), and Hooper and Kohlhagen (1978) have reported no significant relationship between ERV and exports.

Reasons for contradictory results by different studies may be due to a variety of factors, among them: different methods used to measure ERV; the use of different price deflators; the differential use of sample data, for example, the use of aggregate export data versus sectoral export data; different time-frame periods; ignoring import dependency on intermediate and capital goods of the receiving country, as is the case with many developing countries; and the absence of complex econometric methods for studying these variations. As a result scholars stopped investigating the ERV-export nexus by the late 1990's. However, with better access to sectoral data and the development of more sophisticated econometric models, recent studies have begun evaluating the ERV-export connection from a sectoral perspective. The rationale behind this is that different trade sectors would be impacted differentially by ERV, and therefore may be more revealing than aggregate studies.

This study focuses on sectoral export trade from the United States to South Africa, a developing country, using three different measures of volatility that may help to uncover the nature and sensitivity of the relationship between ERV and sectoral exports. We use the bounds testing approach to cointegration to establish a long-run relationship among the explanatory variables. We also employ error-corrections models (ECM) to establish the short-run dynamics of the relationship. In addition, we use the generalized autoregressive conditional heteroskedasticity (GARCH) model to generate one of the three measures of ERV. Using this approach we investigate the effects of exchange rate volatility on the top ten categories of exports by the U.S. to South Africa over a period of 20 years using monthly data from January 1990 to December 2009. Although South Africa accounts only for a very small share of U.S. total trade, it is the largest African trading partner of the United States. On the other hand, the United States is the third largest market for South African exports.

To this end we provide a brief review of the literature in the next section. Thereafter, we lay the empirical framework of our study by specifying our model. In the section following that we discuss variable definitions and outline our data sources. Empirical results from the bounds testing approach to cointegration, and error-correction model estimates are presented in the penultimate section. The final section presents a summary and conclusion of the results obtained in this study.

LITERATURE REVIEW

In this section we present a brief overview of studies that examine the ERV-trade nexus on U.S. trade flows using sectoral data. We begin by discussing the most recent and sophisticated studies, employing cointegration techniques using GARCH and ECM models, to older, less complex studies.

Bahmani-Oskooee and Hegerty (2009) investigate the effects of exchange rate fluctuations on trade flows between the U.S. and Mexico using disaggregated, industry-level annual export and import data for 102 industries from 1962 to 2004. They analyze both the short- and long-term effects of volatility in the peso/dollar real exchange rate on Mexican-United States trade. They conclude that in the short-term increased volatility negatively affects trade flows in most industries. Long-term effects however, are significant for only one-third of the industries studied, and of this, only two-thirds are negative. They speculate that increased Mexican integration and liberalization of economic policies allow for greater adjustments in the long-term so that volatility is less of a problem in the long-term than in the short-term.

Byrne, Darby, and MacDonald (2008) analyze the impact of ERV on the volume of bilateral U.S. trade flows using homogenized and differentiated sectoral annual data over the period 1989-2001 for a cross-section of 6 EU countries and 22 industries. Their study finds that clustering all industries together provides evidence of a negative effect on trade from ERV, which confirms findings of other studies using aggregate data. However, when investigating sectoral trade differences, the effects of ERV on trade is negative and significant for differentiated goods and insignificant for homogeneous goods, confirming recent studies that sectoral differences are in fact crucial to explaining the differential impact of volatility on trade. They suggest that a greater degree of disaggregation at the industry level may provide more worthwhile results, which is what we do in this study.

Bahmani-Oskooee and Kovyryalova (2008) investigate the effect of exchange rate fluctuations on trade flows between the U.S. and the United Kingdom using disaggregrated annual export and import data for 177 commodities industries from 1971 to 2003. They analyze both the short- and long-term effects of real ERV on trade between the U.S and the UK. Their results reveal that the volatility of the real dollar–pound rate has a short-term significant effect on imports of 109 industries and on exports of 99 industries. In most cases, such effects are unfavorable. In the long run, however, the number of significant cases is somewhat reduced: only 62 import and 86 export industries are significantly and adversely affected by ERV. The industries affected involve both durable and non-durable goods, and include small as well as large industries, supporting findings by aggregate studies.

In another study, Bahmani-Oskooee and Mitra (2008), investigate the effects of ERV on trade flows between the U.S. and India, an emerging economy. Using annual data from 40 industries from 1962–2004, their results demonstrate that ERV has more short-run than long-run effects. In the short-run, 17 industries were affected on the import side and 15 on the export side. The industries affected show India's increasing ability to produce import substitutable goods. However, in the long run, only a few industries are affected because the increasing dependence on trade between India and the US cause industries to respond inelastically to ERV.

Using both the nominal and the real exchange rate between the United States dollar and the currencies of Canada and Japan, Choudhury (2005) investigates the influence of exchange rate volatility on U.S. real exports to Canada and Japan using aggregate monthly data ranging from January 1974 to December 1998. The study uses conditional variance from the GARCH (1, 1) model as a measure of exchange rate volatility, and finds significant and mostly negative effects of ERV on real exports.

As in the above studies, Sukar and Hassan (2001) investigate the relationship between U.S. trade volume and ERV using cointegration and error-correction models. Their study uses quarterly aggregate data covering the period 1975Q1 – 1993Q2 and a GARCH model to measure the exchange rate volatility. Paralleling other studies, the authors find evidence for a significantly negative relationship between U.S. export volume and ERV. However, unlike other findings, they reveal that the short-run dynamics of the ERV-trade relationship is insignificant. They argue that this result may be due to the existence of avenues for hedging against exchange risks so as to neutralize the negative impact of ERV. Other scholars argue that this short-run insignificant relationship may be because of the investigators' use of aggregate data, which ignores sectoral differences. For example, while one sector may exhibit a negative relationship, another may exhibit an equal but opposite effect so that they offset each other.

Arize (1995), using monthly series from February 1978 to June 1986 analyzes the effects of real ERV on the proportions of bilateral exports of nine categories of goods from the U.S. to seven major industrial countries. The volatility measure employed is the standard deviation of the monthly percentage change in the bilateral exchange rate between the U.S. and the importing country from *t* to *t-12*. The study reveals differential effects of ERV across different categories of exports. The study also concludes that exchange rate uncertainty has a negative effect on U.S. real exports, and that it may have a major impact on the allocation of resources to different industries depending on trade elasticities.

Lastrapes and Koray (1990) analyze the interrelationships among exchange rate volatility, international trade, and macroeconomic variables using the vector autoregression (VAR) model. The model estimates U.S. multilateral trade from 1973 to 1990 and includes a moving standard deviation measure of real ERV. While the results reveal some evidence of a statistically significant relationship between volatility and trade, the moving average representation of the model implies a rather small quantitative effect. The study concludes that ERV is influenced by the state of the economy, a factor ignored in a variety of other studies.

Klein (1990) is one of the first few scholars to analyze the effects of ERV on the proportion of disaggregated bilateral exports of nine categories of goods from the U.S. to seven major industrial countries using fixed effects framework. Using monthly series data from February 1978 to June 1986, the study reveals that in six categories of exports ERV significantly affects the volume of exports and in five of these categories the effect is positive, suggesting that real ERV may in fact increase exports by risk-taking firms.

Koray and Lastrapes (1989) examine the relationship between real ERV and bilateral imports from five countries, namely, the UK, France, Germany, Japan, and Canada, employing a VAR model. The study uses aggregate monthly data over a 17-year period from January 1959 to December 1985, and tests for different effects during both the fixed and the flexible exchange rate regimes. Results suggest that while the effects of volatility on imports is weak, permanent shocks to volatility experience a negative impact on imports. However, those effects are relatively more important during the flexible-rate than the fixed-rate period.

Finally, Cushman (1988) tests for real exchange rate volatility on U.S. bilateral trade flows using annual data from 1974-1983 to study the effects of the floating exchange rate regime on ERV. The study finds evidence for significant negative effects in only two of six U.S. export flows with one export flow showing a significant positive effect, confirming other studies of a weak risk-averse effect of ERV on exporting firms.

One major problem with most of the studies above is that the sample period includes the period prior to the end of the fixed exchange regime, so results may include the lag effects of fixed exchange rates on trade before 1973 lingering on during the transition period after the implementation of the floating exchange rate regime. The current study corrects for this potential bias by using U.S. monthly-disaggregated trade data covering a 20-year period from January 1990 to December 2009. We focus on the top ten export products in U.S.-South Africa trade to better understand how each industry is affected by ERV. The methodology used in this study incorporates many of the recent developments in the literature, namely, bounds testing approach to cointegration and error-correction models, which may uncover the nature and sensitivity of the ERV-trade nexus. In addition, GARCH models are used to generate the ERV variable used in the study.

MODEL SPECIFICATION

The objective of this study is to assess the effects of exchange rate volatility on the disaggregated U.S. sectoral exports to South Africa. Drawing on the existing empirical literature in this area, we specify that a standard long-run export demand function for commodity i may take the following form (see, for example, Ozturk and Kalyonku, 2009; Choudhry, 2005; Arize, 1998, 1996, 1995; and Asseery and Peel, 1991):

$$\ln X_{it} = \beta_0 + \beta_1 \ln Y_t + \beta_2 \ln P_{it} + \beta_3 \ln RER_t + \beta_4 \ln ERV_t + \varepsilon_t \quad (1)$$

Where X_{it} is real export volume of commodity i in period t, Y_t is the real income of South Africa in period t, P_{it} is the relative price of exports of commodity i in period t, RER_t is the real exchange rate between the U.S. dollar and the South African rand, ERV_t is a measure of exchange rate volatility, and ε_t is a white-noise disturbance term.

Economic theory posits that the real income level of the domestic country's trading partners would have a positive effect on the demand for its exports. Therefore, *a priori*, we would expect that $\beta_1 > 0$. On the other hand, if the relative price of exports rise (fall), domestic goods become less (more) competitive than foreign goods, causing the demand for exports to fall (rise). Therefore, *a priori*, one would expect that β_2, which measures the competitiveness of U.S. exports relative to South African domestic production, is negative. Similarly, if a real depreciation of the U.S. dollar, reflected by a decrease in the RER, is to increase export earnings of industry i, we would expect an estimate of β_3 to be negative. Of course, this will at the same time imply that the South African import demand for commodity i is elastic. If, however, the South African import demand for commodity i were inelastic, we would expect β_3 to be positive. The last explanatory variable is a measure of exchange rate volatility. Various measures of real ERV have been proposed in the literature. Some of these measures include (1) the averages of absolute changes, (2) the standard deviations of the series, (3) the deviations from the trend, (4) the squared residuals from the ARIMA or ARCH or GARCH processes, and (5) the moving sample standard deviation of the growth rate of the real exchange rate. Since the effects of ERV on exports have been found to be empirically and theoretically ambiguous (Bredin, *et al.* 2003), β_4 could be either positive or negative.

Equation (1) shows the long-run relationships among the dependent and independent variables in our model. Given the recent advances in time-series analysis, in estimating the long-run model outlined by equation (1), it is now a common practice to distinguish the short-run effects from the long-run effects. For this purpose, equation (1) should be specified in an error-correction modeling (ECM) format. This method had been used in many recent studies including Bahmani-Oskooee and Hegerty (2009), Bahmani-Oskooee and Wang (2008, 2009), Bahmani-Oskooee and Mitra (2008), Bahmani-Oskooee and Kovyryalova (2008), and Bahmani-Oskooee and Ardalani (2006). According to Bahmani-Oskooee and Wang (2008), such an approach is warranted given that the measure of exchange rate volatility is a stationary variable (see, for example, De Vita and Abbot, 2004; Bahmani-Oskooee & Payesteh, 1993; and Doyle, 2001), whereas the other variables in equation (1) are non-stationary. Therefore, following Pesaran, Shin, and Smith (2001) and their method of bounds testing or the Autoregressive Distributed Lag (ARDL) approach to cointegration analysis, we rewrite equation (1) as an error-correction model in equation (2) below.

$$\begin{aligned}\Delta \ln X_t = \alpha_0 &+ \sum_{i=1}^{n} \beta_i \Delta \ln X_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta \ln Y_{t-i} + \sum_{i=0}^{n} \delta_i \Delta \ln P_{t-i} + \sum_{i=0}^{n} \eta_i \Delta \ln RER_{t-i} \\ &+ \sum_{i=0}^{n} \varphi_i \Delta \ln ERV_{t-i} + \lambda_0 \ln X_{t-1} + \lambda_1 \ln Y_{t-1} + \lambda_2 \ln P_{t-1} + \lambda_3 \ln RER_{t-1} + \lambda_4 \ln ERV_{t-1} + \omega_t \end{aligned} \quad (2)$$

Where Δ is the difference operator and the other variables are as defined earlier. Pesaran, Shin, and Smith's (2001) bounds testing approach to cointegration is based on two procedural steps. The first step involves using an F-test or Wald test to test for joint significance of the no cointegration hypothesis $H_0 : \lambda_0 = \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$ against an alternative hypothesis of cointegration, $H_1 : \lambda_0 \neq 0$, $\lambda_1 \neq 0$, $\lambda_2 \neq 0$, $\lambda_3 \neq 0$, $\lambda_4 \neq 0$. This test is performed using equation (2). The advantage of this approach is that there is no need to test for unit roots, as is commonly done in cointegration analysis. Pesaran, Shin, and Smith (2001) provide two sets of critical values for a given significance level with and without time trend. One assumes that the variables are stationary at the levels or I(0), and the other assumes that the variables are stationary at the first difference or I(1). If the computed F-values exceed the upper critical bounds value, then H_0 is rejected signaling cointegration among the independent variables. If the computed F-value is below the critical bounds values, we fail to reject H_0. Finally, if the computed F-statistic falls within the boundary, the result is inconclusive. After establishing cointegration, the second step involves estimation of the long-term elasticities and the error-correction model.

DATA SOURCES AND VARIABLES

Our export data time series spans a 20-year period from January 1990 through December 2009, leading to 240 monthly observations. Monthly data on real export volume and prices are taken from the Global Trade Information Services, *World Trade Atlas Database*. Monthly data on real export volumes and prices have been converted into export volume indices and export price indices with 2005 serving as the base (=100). The study focuses on the top ten export commodities defined at the 2-digit Harmonized System (HS) codes level, and selected based on their average export value between 1990 and 2009. They are: Machinery (HS 84); Passenger Vehicles (HS 87); Aircraft and Spacecraft (HS 88); Electrical Machinery (HS 85); Optical and Medical Instruments (HS 90); Organic Chemicals (HS 29); Mineral Fuel and Oil (HS 27); Cereals (HS 10); Plastic (HS 39); and Miscellaneous Chemical Products (HS 38).

The real income variable for South Africa is proxied by the industrial production index (2005=100) of South Africa. The underlying series is obtained from the International Monetary Fund's *International Financial Statistics database* and from the Organization for Economic Cooperation and Development's online database.

The relative price ratio for U.S. exports is calculated as the ratio of the export price index of each commodity to the price level, proxied by the consumer price index (2005=100) of South Africa. The export price index for each of the export products is computed using the unit prices taken from the Global Trade Information Services, *World Trade Atlas Database*, while the consumer price index is also obtained from the International Monetary Fund's *International Financial Statistics database*.

Following Bahmani-Oskooee and Wang (2008, 2009), and Sekkat and Varoudakis (2000), the real exchange rate, RER_t, is constructed as:

$$RER_t = \left(\frac{ER_t \times P_t^{US}}{P_t^{SA}} \right) \tag{3}$$

where RER_t is the real exchange rate, ER_t is the bilateral nominal exchange rate between the United States and South Africa defined as number of rand per U.S. dollar at time t, P_t^{SA} is the consumer price index (2005=100) of South Africa at time t, and P_t^{US} is the consumer price index (2005=100) of the U.S. at time t. The monthly data on nominal exchange rates are taken from the IMF, *International Financial Statistics database*.

Finally, we use three alternative measures of exchange rate volatility in this study so we may test the sensitivity of our results. It should be noted at this juncture that there is no unique way to measure real exchange rate volatility. The first ERV measure is obtained using the estimated GARCH (1,1) model, which has also been used in recent studies by, among others, Chowdhury and Wheeler (2008), Choudhury (2005), and Gheong, Mehari, and Williams (2005). We make use of real as opposed to nominal exchange rates in our measurement. As Choudhury (2005) points out, unlike other measures of ERV that can potentially ignore information on the stochastic processes by which exchange rates are generated, ARCH-type models capture the time-varying conditional variance as a parameter generated from a time-series model of the conditional mean and variance of the growth rate, and thus are very useful in describing volatility clustering.

The GARCH (1,1) model we estimate is based on an autoregressive model of order 2 ($AR(2)$) of the first difference of the real exchange rate and it takes the following form:

$$\ln RER_t = \beta_o + \beta_1 \ln RER_{t-1} + \beta_2 \ln RER_{t-2} + e_t, \qquad \text{where} \quad e_t \sim N(0, u_t^2) \tag{4}$$

$$u_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 u_{t-1}^2 \tag{5}$$

The estimated conditional variance (u_t^2) from Equation (4) is used as our measure of ERV.

Our second measure of volatility is constructed following Bredin, Fountas, and Murphy (2003), Weliwita, Ekanayake, and Tsujii (1999), Chowdhury (1993), Lastrapes and Koray (1990), and Koray and Lastrapes (1989). Following these authors the real exchange rate volatility measure is constructed as:

$$VOL_t = \left[\frac{1}{m} \sum_{i=1}^{m} (\ln RER_{t+i-1} - \ln RER_{t+i-2})^2 \right]^{1/2} \tag{6}$$

where VOL_t is the volatility of real exchange rate, RER_t is the real exchange rate and m = 4 is the order of the moving average. According to Koray and Lastrapes (1989), this measure can capture general movements in real exchange rate volatility and exchange rate risk over time.

We also experimented with a third measure of volatility. This alternative measure of exchange rate volatility is defined as the time-varying twelve-month coefficient of variation of the real exchange rate given by:

$$CV_{t+m} = \frac{\left[\frac{1}{m} \sum_{i=1}^{m} (RER_{t+i-1} - \overline{RER})^2 \right]^{1/2}}{\overline{RER}} \tag{7}$$

where $\overline{RER}$ is the mean of the bilateral real exchange rate between months t and t+m-1.

EMPIRICAL RESULTS

Applying the ARDL approach to cointegration to monthly data from January 1990 to December 2009, we assess the exports of the U.S. to South Africa for the top ten export products. First, we estimate equation (2). Following Bahmani-Oskooee and Mitra (2008) we impose a maximum of four lags on each first differenced variable and employ Akaike's Information Criterion (AIC) to select the optimum lag length. Choosing a combination of lags that minimizes the AIC, we then test whether the variables for each industry are cointegrated. These results are shown in Table 1.

Table 1 reveals that seven of the ten industries (HS84, HS87, HS88, HS90, HS29, HS10, HS39) encompass an F-statistic above the upper bound of 3.79, implying that these industries' five variables are cointegrated. This result is consistent across industries for all three volatility measures. The other three industries (HS27, HS38, HS85) reveal an F-statistic below the lower bound of 2.62, indicating no cointegration among variables. Therefore, only those seven industries that exhibit cointegrating relationships among variables are used to analyze the effects of ERV on exports.

We first estimate Equations (4) and (5) for this period, and the results are shown in Table 2. The coefficients of α_0 , α_1, and α_2 are all positive and $\alpha_1 + \alpha_2 = 0.94 < 1$. These results ensure that conditional variance is strictly positive, thus satisfying the necessary conditions of the ARCH model in Equation (5). Our findings also demonstrate that the estimated coefficients of e_{t-1}^2 and u_{t-1}^2 are statistically significant at the 1% level, implying that significant ARCH and GARCH effects exist in the data. The predicted value of Equation (5) provides our first measure of real exchange rate volatility.

Table 1: Cointegration Test Results of Top Ten Export Commodities from the U.S. to South Africa

Industry	Volatility Measure	F	ECM	Cointegrated?
HS 84: Machinery	1	3.83**	-0.247 (5.22)	Yes
	2	4.47**	-0.338 (2.74)	Yes
	3	3.80**	-0.054 (2.25)	Yes
HS 87: Passenger Vehicles	1	6.28**	-0.412 (2.85)	Yes
	2	5.65**	-0.428 (3.19)	Yes
	3	6.13**	-0.421 (3.08)	Yes
HS 88: Aircraft and Spacecraft	1	8.54**	-0.325 (4.51)	Yes
	2	5.90**	-0.184 (1.66)	Yes
	3	7.81**	-0.249 (4.05)	Yes
HS 85: Electrical Machinery	1	2.77	-0.178 (1.97)	No
	2	2.03	-0.183 (2.08)	No
	3	2.61	-0.136 (1.59)	No
HS 90: Optical and Medical Instruments	1	9.07**	-0.563 (3.71)	Yes
	2	9.11**	-0.570 (3.79)	Yes
	3	7.67**	-0.573 (3.75)	Yes
HS 29: Organic Chemicals	1	9.05**	-0.709 (4.02)	Yes
	2	9.29**	-0.725 (4.17)	Yes
	3	8.21**	-0.776 (4.22)	Yes
HS 27: Mineral Fuel and Oil etc.	1	1.48	-0.844 (5.33)	No
	2	1.38	-0.923 (5.93)	No
	3	1.54	-0.844 (5.01)	No
HS 10: Cereals	1	4.42**	-0.512 (2.18)	Yes
	2	6.56**	-0.629 (2.87)	Yes
	3	5.05**	-0.560 (2.43)	Yes
HS 39: Plastic	1	6.59**	-0.308 (5.22)	Yes
	2	9.56**	-0.349 (2.06)	Yes
	3	7.01**	-0.527 (1.62)	Yes
HS 38: Miscellaneous Chemical Products	1	1.31	-0.464 (3.22)	No
	2	1.93	-0.411 (2.89)	No
	3	1.34	-0.483 (3.37)	No

*Note: This table summarizes the results of the bounds testing approach to cointegration. The figures in parentheses are absolute value of the t-statistic. ECM represents the error-correction term. Volatility measures 1, 2, and 3 are defined earlier in equations (4) and (5), (6), and (7), respectively. The upper bound critical value for the F-statistic with unrestricted intercept and no trend at the 5% level of significance is 3.79. The lower bound critical value is 2.62. These values are taken from Pesaran, Shin, and Smith (2001, Table CI(iii) Case III, p. 300). ** indicates the significance at the 5 percent level.*

Table 2: Estimation of Real Exchange Rate Variance as a GARCH (1, 1) Process

$$\ln RER_t = 0.00730 + 0.17667 \ln RER_{t-1} + 0.06874 \ln RER_{t-2}$$
$$(2.94) \quad (2.09)^* \qquad (0.84)$$

$$u_t^2 = 0.00013 + 0.25977\, e_{t-1}^2 + 0.68601\, u_{t-1}^2$$
$$(2.69)^{**} \; (3.45)^{**} \qquad (7.31)^{**}$$

Log L = 453.19 ***N = 237***

*Note: This table shows the results of the first measure of volatility as defined by Equations (4) and (5). The figures in parentheses are t-statistics. * and ** indicate the statistical significance at the 5% and 1% level, respectively.*

The estimated coefficients for the seven cointegrated industries are presented in Table 3. Following the studies by Bahmani-Oskooee and Hegerty (2009), Bahmani-Oskooee and Wang (2008, 2009), Bahmani-Oskooee and Mitra (2008), Bahmani-Oskooee and Kovyryalova (2008), and Bahmani-Oskooee and Ardalani (2006), we report only the short-run volatility coefficients and all the long-run coefficients.

Short-Run Effects of Exchange Rate Volatility: The short-run estimated coefficients on ERV presented on the left panel in Table 3 reveal a mixture of negative and positive signs regardless of the volatility measure employed. There is also a significance variation of the exchange rate volatility on exports among industries in the short-run. The first industry, machinery, has a negative and statistically significant coefficient regardless of the volatility measure. The reason for this may be because of South Africa's ability to import machinery from other trading partners. Passenger vehicles industry has a negative but statistically insignificant impact in the short-run in all three cases.

The next two industries, aircraft and spacecraft, and medical and optical instruments, have positive signs under all three measures of volatility. Each of the coefficients is also statistically significant in all cases. The organic chemicals industry has a positive and statistically significant coefficient under the first and third measure of volatility but has a negative and insignificant effect under the second measure. The last two industries, cereals and plastic, have mixed results. In general, the impact of ERV on exports for these seven industries is mixed in the short-run. The U.S. dominates these industries globally, and South Africa is import dependent on these products, so even though exchange rates have increased in volatility since the 1990's, demand for these goods have continued. That cereals and plastics render mixed results may be due to South Africa's strong domestic production in these industries.

Long-Run Effects of Exchange Rate Volatility: The long-run coefficient estimates are shown in the right panel of Table 3. As economic theory postulates, the real income variable renders a positive sign in all cases, regardless of the volatility measure. This coefficient is statistically significant in the majority of industries including HS84, HS87, HS88, HS90, HS29, HS10, and HS39; the coefficient for cereals (HS 10) is insignificant under volatility measures (1) and (3), while the coefficients for plastic (HS 39) and cereals are insignificant under volatility measure (2). The relative price variable displays the expected negative sign and is statistically significant at the 1% level in 19of the 21 cases, and at the 5% level for machinery (HS 85) under volatility measures (2) and (3). This result is similar to those of Bahmani-Oskooee and Mitra (2008), Bahmani-Oskooee and Kovyryalova (2008), and Bahmani-Oskooee and Ardalani (2006).

The real exchange rate coefficient has a negative sign in all cases and is statistically significant in the majority of cases, except for machinery and passenger vehicles. Finally, the estimated coefficients on ERV show a mixture of negative signs for machinery, passenger vehicles, optical and medical instruments, organic chemicals, and plastic industries and positive signs for aircraft and spacecraft, and cereal, regardless of the volatility measure used. Under volatility measure (1), five of the seven coefficients are negative and only three coefficients are statistically significant. Under volatility measures (2) and (3), five of the seven coefficients are negative and four coefficients are statistically significant at either the 5% or 1% levels. Thus, ERV has a negative effect in five of the seven industries presented in Table 3. They include machinery, passenger vehicles, optical and medical instruments, organic chemicals, and plastic. Our findings are somewhat similar to those of Bahmani-Oskooee and Hegerty (2009) and Bahmani-Oskooee and Wang (2008, 2009). In general, in the long-run, ERV appears to have a negative effect on the U.S. exports to South Africa.

SUMMARY AND CONCLUSIONS

In this paper we have examined the dynamic relationship between exports and exchange rate volatility in United States' exports to South Africa in the context of a multivariate error-correction model. Estimates of the long-run export demand functions were obtained by employing the bounds testing approach to cointegration using monthly data for the period January 1990 - December 2009.

The cointegration results clearly show that there exists a long-run equilibrium relationship between real exports and real foreign economic activity, relative prices, real exchange rate, and real exchange rate volatility, in seven of the ten commodities selected. All the specifications yielded expected signs for the coefficients. All our coefficients are statistically significant either at the 1% or 5% levels. Of the seven products analyzed in detail, five of them, namely, machinery, passenger vehicles, optical and medical instruments, organic chemicals, and plastic, have negative signs for the ERV variable indicating that ERV tends to deter exports of these products in the long-run.

Table 3: Short-Run and Long-Run Coefficient Estimates

Panel A: Volatility Measure 1: ARCH Volatility Measure as Defined in Equations (4) and (5)									
	Short-Run Coefficient Estimates					**Long-Run Coefficient Estimates**			
Industry	$\Delta \ln V_{1t}$	$\Delta \ln V_{1t-1}$	$\Delta \ln V_{1t-2}$	$\Delta \ln V_{1t-3}$	Constant	$\ln Y_t$	$\ln P_t$	$\ln RER_t$	$\ln V_{1t}$
Machinery			-0.086*		-19.506	5.901**	-1.288**	-1.307*	-0.168
			(2.21)			(3.90)	(3.43)	(2.73)	(1.31)
Passenger				-0.071	-41.366	9.837**	-1.288**	-1.307*	-0.101
Vehicles				(1.29)		(5.33)	(3.43)	(2.73)	(1.62)
Aircraft &			0.238*		40.332	7.103*	-0.752**	-1.307*	0.234
Spacecraft			(2.11)			(2.18)	(4.20)	(2.73)	(1.52)
Optical &	0.068*	0.099**			1.562	1.001*	-1.533**	-0.818**	-0.076*
Med. Inst.	(2.09)	(3.21)				(2.31)	(9.78)	(5.46)	(1.96)
Organic				0.101**	-0.538	1.098*	-0.953**	-0.043	-0.133**
Chemicals				(2.93)		(2.21)	(4.25)	(1.26)	(2.90)
Cereals			-0.469*		-15.156	6.621	-1.821**	-1.390**	0.759*
			(2.17)			(1.29)	(9.23)	(3.01)	(2.31)
Plastic				-0.055*	-6.687	2.728**	-0.961**	-0.587*	-0.038
				(2.11)		(3.88)	(3.01)	(2.14)	(1.53)
Pane B: Volatility Measure 2: Volatility Measure as Defined in Equation (6)									
	Short-Run Coefficient Estimates					**Long-Run Coefficient Estimates**			
Industry	$\Delta \ln V_{1t}$	$\Delta \ln V_{1t-1}$	$\Delta \ln V_{1t-2}$	$\Delta \ln V_{1t-3}$	Constant	$\ln Y_t$	$\ln P_t$	$\ln RER_t$	$\ln V_{1t}$
Machinery	-0.039*		-0.020*		-20.148	7.958**	-1.148*	-0.300	-1.832*
	(2.54)		(2.58)			(3.06)	(2.29)	(1.56)	(7.95)
Passenger			-0.022		-44.811	9.581**	-2.788**	-0.388	-0.038
Vehicles			(1.27)			(5.07)	(9.43)	(0.93)	(1.62)
Aircraft &			0.064*		30.844	7.771*	-0.721**	-0.941*	0.060
Spacecraft			(2.04)			(2.02)	(4.55)	(2.29)	(1.28)
Optical &		0.038*	0.046**		1.645	1.543*	-2.165**	-0.717**	-0.298**
Med. Inst.		(2.23)	(2.81)			(1.97)	(9.47)	(4.59)	(3.35)
Organic		-0.117			-2.462	1.195*	-0.482**	-0.411**	-0.374**
Chemicals		(1.58)				(2.02)	(2.99)	(2.96)	(5.45)
Cereals		-0.112			-8.859	6.732	-3.575**	-1.624*	0.442
		(1.61)				(1.43)	(9.38)	(2.23)	(1.21)
Plastic		0.054*	0.035	0.030*	-6.019	5.393	-1.149**	-2.943**	-0.137**
		(2.58)	(1.85)	(2.10)		(0.97)	(5.22)	(2.52)	(6.46)
Panel C: Volatility Measure 3: Volatility Measure as Defined in Equation (7)									
	Short-Run Coefficient Estimates					**Long-Run Coefficient Estimates**			
Industry	$\Delta \ln V_{1t}$	$\Delta \ln V_{1t-1}$	$\Delta \ln V_{1t-2}$	$\Delta \ln V_{1t-3}$	Constant	$\ln Y_t$	$\ln P_t$	$\ln RER_t$	$\ln V_{1t}$
Machinery	-0.038*		-0.020		-23.043	7.958**	-1.477*	-0.583	-1.858**
	(2.54)		(1.73)			(3.06)	(2.29)	(1.25)	(6.48)
Passenger		-0.086			-39.438	9.581**	-2.788**	-0.338	-0.038
Vehicles		(1.45)				(5.07)	(9.43)	(0.94)	(1.18)
Aircraft &	0.255*		0.301*		41.708	7.710*	-0.721**	-0.941*	0.060
Spacecraft	(2.08)		(2.44)			(2.02)	(4.55)	(1.80)	(1.27)
Optical &		0.111**			-0.124	1.543*	-2.165**	-0.717**	-0.298**
Med. Inst.		(3.39)				(1.97)	(9.47)	(4.59)	(3.35)
Organic	0.302**				1.090	0.631*	-0.482**	-0.411**	-0.374**
Chemicals	(2.78)					(2.08)	(2.99)	(2.97)	(5.45)
Cereals		0.528			-19.835	6.732	-3.375**	-1.624*	0.442
		(1.91)				(1.42)	(9.38)	(2.23)	(1.21)
Plastic				0.067	18.177	5.398*	-1.149**	-2.943**	-0.137**
				(1.86)		(2.01)	(5.22)	(2.52)	(4.59)

*Note: This table summarizes the results obtained using the ARDL model defined in Equation (2). The figures in parentheses are absolute value of t-statistic. ** and * indicate the statistical significance at the 1% and 5% levels, respectively.*

The short-run dynamics also indicate that, in general, the impact of ERV on exports in these seven industries is mixed in the short-run. These results point out to the decreasing competitiveness of U.S. exports in the global economy despite the depreciating value of the dollar over time. It underscores the degree to which a developing country such as South Africa has succeeded in finding alternative markets in Europe and especially in Asia in the last decade.

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APPLICATION OF A HIGH-ORDER ASYMPTOTIC EXPANSION SCHEME TO LONG-TERM CURRENCY OPTIONS

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ABSTRACT

Recently academic researchers and practitioners have use the asymptotic expansion method to examine a variety of financial issues under high-dimensional stochastic environments. This methodology is mathematically justified by Watanabe theory (Watanabe, 1987), and Malliavin calculus (Yoshida, 1992a,b) and essentially based on the framework initiated by Kunitomo and Takahashi (2003) and Takahashi (1995, 1999) in a financial context. In practical applications, it is desirable to investigate the accuracy and stability of the method especially with expansion to higher orders in situations where the underlying processes are highly volatile. After Takahashi (1995,1999) and Takahashi and Takehara (2007) provided explicit formulas for the expansion to the third order, Takahashi, Takehara and Toda (2009) develop general computation schemes and formulas for an arbitrary-order expansion under general diffusion-type stochastic environments. In this paper, we describe these techniques in a simple setting to illustrate thier key ideas. To demonstrate their effectiveness the techniques are applied to pricing long-term currency options.

JEL: C63, G13

KEYWORDS: Asymptotic Expansion, Malliavin Calculus, Stochastic Volatility, Libor Market Model, Currency Options

INTRODUCTION

This paper explains two alternative computation schemes proposed by Takahashi, Takehara and Toda (2009). The work is based on the asymptotic expansion approach based on Watanabe theory (Watanabe, 1987) in Malliavin calculus. The explanation is provided in a simple setting and applied to pricing long-term currency options under a cross-currency Libor market model and general stochastic volatility of spot exchange rates.

Recently, academic researchers and practitioners have used the asymptotic expansion method for a variety of financial issues. e.g. pricing or hedging complex derivatives under high-dimensional underlying stochastic environments. These methods are fully or partially based on the framework developed by Kunitomo and Takahashi (1992), Takahashi (1995,1999) in a financial literature. In theory, this method provides the expansion of underlying stochastic processes. This has a proper meaning in the limit of some ideal situations including deterministic cases (for details see Watanabe, 1987; Yoshida, 1992a; or Kunitomo and Takahashi, 2003).

In practice, however, researchers are often interested in cases far from the ideal, where the underlying processes are highly volatile as seen in recent financial markets. From the view point of accuracy and stability in practical uses, it is desirable to investigate behaviors of estimators with expansion to high orders.

In asymptotic expansion applications, the crucial step is computation of conditional expectations appearing in expansions, especially in expansion to high orders which is important in cases with long maturities or/and with highly volatile underlying variables. Takahashi, Takehara and Toda (2009) developed two alternative schemes for these computations in a general diffusion-type stochastic environment.

This paper describes the essence of their method in a much simpler setting and applies them to the evaluation of long-term currency options with maturities up to twenty years under a cross-currency Libor market model and general stochastic volatility of a spot exchange rates. It is very complex to obtain closed-form formulas in this instance. The remainder of the paper is as follows: In the following section we discuss the relevant literature. Next our methods are developed in simple setting, Section 3 applies the algorithms described in the previous section to concrete financial models, and confirms the effectiveness of the higher order expansions by numerical example. Detailed proofs, formulas and argument of the applied technique in a general setting including our complex example are found in Takahashi, Takehara and Toda (2009).

LITERATURE REVIEW

In this subsection we briefly review literature related to asymptotic expansion. The first known application of asymptotic expasion based on Watanabe theory in finance was Kunitomo and Takahashi (1992) who evaluated average options. Kunitomo and Takahashi (1992) and Takahashi (1995) derive approximation formulas for an average option by an asymptotic method. Their method is based on log-normal approximations of an average price distribution when the underlying asset price follows a geometric Brownian motion process. Yoshida (1992b) applies a formula derived by the asymptotic expansion of certain statistical estimators for small diffusion processes.

Thereafter asymptotic expansion has been applied to a broad class of problems in finance. In a general setting, the basic framework of the method was described in Kunitomo and Takahashi (2003), Takahashi (1999, 2009). Kunitomo and Takahashi (2001) generalized and applied the method to interest derivatives where the underlying model was not necessarily Markovian. Matsuoka, Takahshi and Uchida (2004) computed Greeks, the sensitivities of derivatives with respect to parameters. In Takahashi and Yoshida (2004, 2005) the method was used for the optimal portfolio problem and a new variance reduction technique for Monte Carlo simulations with the asymptotic expansion was developed. Muroi (2005) considered credit derivatives. Pricing currency options under the cross-currency Libor market model and exchange rates with sotchastic volatility and/or jumps, were examined in Takahashi and Takehara (2007, 2008a,b). Takahashi, Takehara and Toda [2009] introduced genral procedures for actual computation in the method which are applied in this paper.

AN ASYMPTOTIC EXPANSION APPROACH IN A BLACK-SCHOLES ECONOMY

In this section, we explain the concepts of this paper in a simple Black-Scholes-type economy. Let (W, P) be a one-dimensional Wiener space. Hereafter P is considered as a risk-neutral equivalent martingale measure and a risk-free interest rate is set to be zero for simplicity. Then, the underlying economy is specified with a ($\mathbf{R}_+$ -valued) single risky asset $S^{(\varepsilon)} = \{S_t^{(\varepsilon)}\}$ satisfying:

$$S_t^{(\varepsilon)} = S_0 + \varepsilon \int_0^t \sigma(S_s^{(\varepsilon)}, s) dW_s \tag{1}$$

where $\varepsilon \in (0,1]$ is a constant parameter; σ: $\mathbf{R}_+^2 \mapsto \mathbf{R}$ satisfies some regularity conditions. We will consider the following pricing problem;

$$V(0,T) = \mathbf{E}[\Phi(S_T^{(\varepsilon)})] \tag{2}$$

where Φ is a payoff function written on $S_T^{(\varepsilon)}$ (for example, $\Phi(x) = \max(x-K,0)$ for call options or $\Phi(x) = \delta_x(x)$, a delta function with mass at x for the density function) and $\mathbf{E}[\cdot]$ is an expectation operator under the probability measure P. Rigorously speaking, they are a generalized function of the Wiener function $S^{(\varepsilon)}$ and a generalized expectation for generalized functions, whose mathematically proper definitions are given in Section 2 of Takahashi, Takehara and Toda (2009).

Let $A_{kt} = \frac{\partial^k S_t^{(\varepsilon)}}{\partial \varepsilon^k}|_{\varepsilon=0}$. Here we represent A_{1t}, A_{2t} and A_{3t} explicitly by

$$A_{1t} = \int_0^t \sigma(S_s^{(0)}, s)dW_s, \tag{3}$$

$$A_{2t} = 2\int_0^t \partial\sigma(S_s^{(0)}, s)A_{1s}dW_s, \tag{4}$$

$$A_{3t} = 3\int_0^t \left(\partial^2\sigma(S_s^{(0)}, s)(A_{1s})^2 + \partial\sigma(S_s^{(0)}, s)(A_{2s})\right)dW_s \tag{5}$$

recursively and then $S_T^{(\varepsilon)}$ has its asymptotic expansion

$$S_T^{(\varepsilon)} = S_0 + \varepsilon A_{1T} + \frac{\varepsilon^2}{2!}A_{2T} + \frac{\varepsilon^3}{3!}A_{3T} + o(\varepsilon^3). \tag{6}$$

Note that $S_t^{(0)} = \lim_{\varepsilon\downarrow 0} S_t^{(\varepsilon)} = S_0$ for all t. Next, normalize $S_T^{(\varepsilon)}$ with respect to ε as $G^{(\varepsilon)} = \frac{S_T^{(\varepsilon)} - S_T^{(0)}}{\varepsilon}$ for $\varepsilon \in (0,1]$. Then,

$$G^{(\varepsilon)} = A_{1T} + \frac{\varepsilon}{2!}A_{2T} + \frac{\varepsilon^2}{3!}A_{3T} + o(\varepsilon^2) \quad \text{in } L^P \text{ for every } p > 1.$$

Here the following assumption is made: $\Sigma_T = \int_0^T \sigma^2(S_t^{(0)}, t)dt > 0.$ Note that A_{1T} follows a normal distribution with mean 0 and variance Σ_T, implying that the distribution of A_{1T} does not degenerate. It is clear that this assumption is satisfied when $\sigma(S_t^{(0)}, t) > 0$ for some $t > 0$. Then, the expectation of $\Phi(G^{(\varepsilon)})$ is expanded around $\varepsilon = 0$ up to ε^2-order in the sense of Watanabe (1987) and Yoshida (1992a) as follows. Hereafter the asymptotic expansion of $\mathbf{E}[\Phi(G^{(\varepsilon)})]$ up to the second order will be considered:

$$\begin{aligned}
\mathbf{E}[\Phi(G^{(\varepsilon)})] &= \mathbf{E}\left[\Phi(A_{1T})\right] + \varepsilon\mathbf{E}\left[\Phi^{(1)}(A_{1T})A_{2T}\right] + \varepsilon^2\left\{\mathbf{E}\left[\Phi^{(1)}(A_{1T})A_{3T}\right] + \frac{1}{2}\mathbf{E}\left[\Phi^{(2)}(A_{1T})(A_{2T})^2\right]\right\} + o(\varepsilon^2) \\
&= \mathbf{E}\left[\Phi(A_{1T})\right] + \varepsilon\mathbf{E}\left[\Phi^{(1)}(A_{1T})\mathbf{E}\left[A_{2T} \mid A_{1T}\right]\right] \\
&\quad + \varepsilon^2\left\{\mathbf{E}\left[\Phi^{(1)}(A_{1T})\mathbf{E}\left[A_{3T} \mid A_{1T}\right]\right] + \frac{1}{2}\mathbf{E}\left[\Phi^{(2)}(A_{1T})\mathbf{E}\left[(A_{2T})^2 \mid A_{1T}\right]\right]\right\} + o(\varepsilon^2) \\
&= \int_{\mathbf{R}} \Phi(x)f_{A_{1T}}(x)dx + \varepsilon\int_{\mathbf{R}} \Phi^{(1)}(x)\mathbf{E}\left[A_{2T} \mid A_{1T} = x\right]f_{A_{1T}}(x)dx \\
&\quad + \varepsilon^2\left\{\int_{\mathbf{R}} \Phi^{(1)}(x)\mathbf{E}\left[A_{3T} \mid A_{1T} = x\right]f_{A_{1T}}(x)dx + \frac{1}{2}\int_{\mathbf{R}} \Phi^{(2)}(x)\mathbf{E}\left[(A_{2T})^2 \mid A_{1T} = x\right]f_{A_{1T}}(x)dx\right\} + o(\varepsilon^2)
\end{aligned}$$

$$= \int_{\mathbf{R}} \Phi(x) f_{A_{1T}}(x)dx + \varepsilon \int_{\mathbf{R}} \Phi(x)(-1)\frac{\partial}{\partial x}\{\mathbf{E}\left[A_{2T} \middle| A_{1T} = x\right] f_{A_{1T}}(x)\}dx$$
$$+\varepsilon^2 \left(\int_{\mathbf{R}} \Phi(x)(-1)\frac{\partial}{\partial x}\{\mathbf{E}\left[A_{3T} \middle| A_{1T} = x\right] f_{A_{1T}}(x)\}dx \right.$$
$$\left. +\frac{1}{2}\int_{\mathbf{R}} \Phi(x)(-1)^2 \frac{\partial^2}{\partial x^2}\{\mathbf{E}\left[(A_{2T})^2 \middle| A_{1T} = x\right] f_{A_{1T}}(x)\}dx \right) + o(\varepsilon^2). \quad (8)$$

where $\Phi^{(m)}(x)$ is m-th order derivative of $\Phi(x)$ and $f_{A_{1T}}(x)$ is a probability density function of A_{1T} following a normal distribution; $f_{A_{1T}}(x) := \frac{1}{\sqrt{2\pi\Sigma_T}}\exp\left(-\frac{x^2}{2\Sigma_T}\right)$. In particular, letting $\Phi = \delta_x$, we have the asymptotic expansion of the density function of $G^{(\varepsilon)}$ as seen later. Then, to evaluate this expansion a computation of these conditional expectations is completed. Specifically, we present two alternative approaches.

An Approach with an Expansion into Iterated Itô Integrals

In this subsection we show an approach with further expansion of A_{2T}, A_{3T} and $(A_{2T})^2$ into iterated Itô integrals to compute the conditional expectations in (8). Recall that we have:

$$\mathbf{E}[\Phi(G^{(\varepsilon)})] = \int_{\mathbf{R}} \Phi(x) f_{A_{1T}}(x)dx + \varepsilon \int_{\mathbf{R}} \Phi(x)(-1)\frac{\partial}{\partial x}\{\mathbf{E}\left[A_{2T} \middle| A_{1T} = x\right] f_{A_{1T}}(x)\}dx$$
$$+\varepsilon^2 \left(\int_{\mathbf{R}} \Phi(x)(-1)\frac{\partial}{\partial x}\{\mathbf{E}\left[A_{3T} \middle| A_{1T} = x\right] f_{A_{1T}}(x)\}dx \right.$$
$$\left. +\frac{1}{2}\int_{\mathbf{R}} \Phi(x)(-1)^2 \frac{\partial^2}{\partial x^2}\{\mathbf{E}\left[(A_{2T})^2 \middle| A_{1T} = x\right] f_{A_{1T}}(x)\}dx \right) + o(\varepsilon^2).$$
(9)

Next, it is shown that A_{2T}, A_{3T}, $(A_{2T})^2$ can be expressed as summations of iterated Itô integrals. First, note that A_{2T} is:

$$A_{2T} = 2\int_0^T \int_0^{t_1} \partial\sigma(S_{t_1}^{(0)}, t_1)\sigma(S_{t_2}^{(0)}, t_2)dW_{t_2}dW_{t_1} \quad (10)$$

Next, by application of Itô's formula to (5) we obtain

$$A_{3T} = 6\int_0^T \int_0^{t_1} \int_0^{t_2} \partial\sigma(S_{t_1}^{(0)}, t_1)\partial\sigma(S_{t_2}^{(0)}, t_2)\sigma(S_{t_3}^{(0)}, t_3)dW_{t_3}dW_{t_2}dW_{t_1}$$
$$+6\int_0^T \int_0^{t_1} \int_0^{t_2} \partial^2\sigma(S_{t_1}^{(0)}, t_1)\sigma(S_{t_2}^{(0)}, t_2)\sigma(S_{t_3}^{(0)}, t_3)dW_{t_3}dW_{t_2}dW_{t_1} + 3\int_0^T \int_0^{t_1} \partial^2\sigma(S_{t_1}^{(0)}, t_1)\sigma^2(S_{t_2}^{(0)}, t_2)dt_2dW_{t_1}.$$
(11)

Similarly,

$$(A_{2T})^2 = 16\int_0^T \int_0^{t_1} \int_0^{t_2} \int_0^{t_3} \partial\sigma(S_{t_1}^{(0)}, t_1)\partial\sigma(S_{t_2}^{(0)}, t_2)\sigma(S_{t_3}^{(0)}, t_3)\sigma(S_{t_4}^{(0)}, t_4)dW_{t_4}dW_{t_3}dW_{t_2}dW_{t_1}$$
$$+8\int_0^T \int_0^{t_1} \int_0^{t_2} \int_0^{t_3} \partial\sigma(S_{t_1}^{(0)}, t_1)\sigma(S_{t_2}^{(0)}, t_2)\partial\sigma(S_{t_3}^{(0)}, t_3)\sigma(S_{t_4}^{(0)}, t_4)dW_{t_4}dW_{t_3}dW_{t_2}dW_{t_1}$$

$$+8\int_0^T\int_0^{t_1}\int_0^{t_2}\partial\sigma(S_{t_1}^{(0)},t_1)\partial\sigma(S_{t_2}^{(0)},t_2)\sigma^2(S_{t_3}^{(0)},t_3)dt_3dW_{t_2}dW_{t_1}$$
$$+8\int_0^T\int_0^{t_1}\int_0^{t_2}\partial\sigma(S_{t_1}^{(0)},t_1)\partial\sigma(S_{t_2}^{(0)},t_2)\sigma(S_{t_2}^{(0)},t_2)\sigma(S_{t_3}^{(0)},t_3)dW_{t_3}dt_2dW_{t_1}$$
$$+8\int_0^T\int_0^{t_1}\int_0^{t_2}\left(\partial\sigma(S_{t_1}^{(0)},t_1)\right)^2\sigma(S_{t_2}^{(0)},t_2)\sigma(S_{t_3}^{(0)},t_3)dW_{t_3}dW_{t_2}dt_1 \;+4\int_0^T\int_0^{t_1}\left(\partial\sigma(S_{t_1}^{(0)},t_1)\right)^2\sigma^2(S_{t_2}^{(0)},t_2)dt_2dt_1. \tag{12}$$

Then, by Proposition 1 in Takahashi, Takehara and Toda (2009), the conditional expectations in (9) can be computed as

$$\mathbf{E}[A_{2T}\mid A_{1T}=x]=2F_2\left(\partial\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2\right)\frac{H_2(x;\Sigma_T)}{\Sigma_T^2}=:c_2^{2,1}H_2(x;\Sigma_T) \tag{13}$$

$$\mathbf{E}[A_{3T}\mid A_{1T}=x]=\left(6F_3\left(\partial\sigma^{(0)}\sigma^{(0)},\partial\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2\right)+6F_3\left(\partial^2\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2,(\sigma^{(0)})^2\right)\right)\frac{H_3(x;\Sigma_T)}{\Sigma_T^3}$$
$$+3F_2\left(\partial\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2\right)\frac{H_1(x;\Sigma_T)}{\Sigma_T} \tag{14}$$
$$=:c_3^{3,1}H_3(x;\Sigma_T)+c_1^{3,1}H_1(x;\Sigma_T)$$

and

$$\mathbf{E}[(A_{2T})^2\mid A_{1T}=x]$$
$$=\left(16F_4\left(\partial\sigma^{(0)}\sigma^{(0)},\partial\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2,(\sigma^{(0)})^2\right)+8F_4\left(\partial\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2,\partial\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2\right)\right)\frac{H_4(x;\Sigma_T)}{\Sigma_T^4}$$
$$+\left(16F_3\left(\partial\sigma^{(0)}\sigma^{(0)},\partial\sigma^{(0)}\sigma^{(0)},(\sigma^{(0)})^2\right)+8F_3\left((\partial\sigma^{(0)})^2,(\sigma^{(0)})^2,(\sigma^{(0)})^2\right)\right)\frac{H_2(x;\Sigma_T)}{\Sigma_T^2}$$
$$+4F_3\left((\partial\sigma^{(0)})^2,(\sigma^{(0)})^2\right)H_0(x;\Sigma_T)\;=:c_4^{2,2}H_4(x;\Sigma_T)+c_2^{2,2}H_2(x;\Sigma_T)+c_0^{2,2}H_0(x;\Sigma_T) \tag{15}$$

where $H_n(x;\Sigma)$ is a n-th order Hermite polynomial defined by

$$H_n(x;\Sigma):=(-\Sigma)^n e^{x^2/2\Sigma}\frac{d^n}{dx^n}e^{-x^2/2\Sigma},$$

with notations $F_n(f_1,\cdots,f_n):=\int_0^T\int_0^{t_1}\cdots\int_0^{t_{n-1}}f_1(t_1)\cdots f_n(t_n)dt_n\cdots dt_1, n\geq 1,$

$\sigma^{(0)}=\sigma(S_t^{(0)},t)$ and $\partial^i\sigma^{(0)}=\partial^i\sigma(S_t^{(0)},t)$.

Substituting these into (9), we have the asymptotic expansion of $\mathbf{E}\left[\Phi(G^{(\varepsilon)})\right]$ up to ε^2-order. Further, letting $\Phi=\delta_x$, we have the expansion of $f_{G^{(\varepsilon)}}$, the density function of $G^{(\varepsilon)}$:

$$f_{G^{(\varepsilon)}}=f_{A_{1T}}(x)+\varepsilon(-1)\frac{\partial}{\partial x}\{\mathbf{E}\left[A_{2T}\middle|A_{1T}=x\right]f_{A_{1T}}(x)\}$$
$$+\varepsilon^2\left((-1)\frac{\partial}{\partial x}\{\mathbf{E}\left[A_{3T}\middle|A_{1T}=x\right]f_{A_{1T}}(x)\}+\frac{1}{2}(-1)^2\frac{\partial^2}{\partial x^2}\{\mathbf{E}\left[(A_{2T})^2\middle|A_{1T}=x\right]f_{A_{1T}}(x)\}\right)+o(\varepsilon^2)$$

$$= f_{A_{1T}}(x) + \varepsilon(-1)\frac{\partial}{\partial x}\{c_2^{2,1}H_2(x;\Sigma_T)f_{A_{1T}}(x)\} \tag{16}$$

$$+\varepsilon^2\left((-1)\frac{\partial}{\partial x}\{\sum_{i=1,3}c_i^{3,1}H_i(x;\Sigma_T)f_{A_{1T}}(x)\} + \frac{1}{2}(-1)^2\frac{\partial^2}{\partial x^2}\{\sum_{i=0,2,4}c_i^{2,2}H_i(x;\Sigma_T)f_{A_{1T}}(x)\}\right) + o(\varepsilon^2).$$

An Alternative Approach with a System of Ordinary Differential Equations

In this subsection, we present an alternative approach in which the conditional expectations are computed through some system of ordinary differential equations. Again the asymptotic expansion of $\mathbf{E}\left[\Phi(G^{(\varepsilon)})\right]$ up to ε^2-order is considered. Note that the expectations of A_{2T}, A_{3T} and $(A_{2T})^2$ conditional on A_{1T} are expressed by linear combinations of a finite number of Hermite polynomials as in (13), (14) and (15). Thus, by Lemma 4 in Takahashi, Takehara and Toda (2009), we have we have

$$\mathbf{E}[A_{2T} \mid A_{1T} = x] = \sum_{n=0}^{2} a_n^{2,1}H_n(x;\Sigma_T), \tag{17}$$

$$\mathbf{E}[A_{3T} \mid A_{1T} = x] = \sum_{n=0}^{3} a_n^{3,1}H_n(x;\Sigma_T), \tag{18}$$

and $$\mathbf{E}[(A_{2T})^2 \mid A_{1T} = x] = \sum_{n=0}^{4} a_n^{2,2}H_n(x;\Sigma_T), \tag{19}$$

where the coefficients are given by

$$a_n^{2,1} = \frac{1}{n!}\frac{1}{(i\Sigma)^n}\frac{\partial^n}{\partial\xi^n}\bigg|_{\xi=0}\left\{\mathbf{E}[Z_T^{<\xi>}A_{2T}]\right\}, a_n^{3,1} = \frac{1}{n!}\frac{1}{(i\Sigma)^n}\frac{\partial^n}{\partial\xi^n}\bigg|_{\xi=0}\left\{\mathbf{E}[Z_T^{<\xi>}A_{3T}]\right\},$$

$$a_n^{2,2} = \frac{1}{n!}\frac{1}{(i\Sigma)^n}\frac{\partial^n}{\partial\xi^n}\bigg|_{\xi=0}\left\{\mathbf{E}[Z_T^{<\xi>}(A_{2T})^2]\right\}, \text{and} Z_t^{<\xi>} := \exp\left(i\xi A_{1t} + \frac{\xi^2}{2}\Sigma_t\right).$$

Note that $Z^{<\xi>}$ is a martingale with $Z_0^{<\xi>} = 1$. Since these conditional expectations can be represented by linear combinations of Hermite polynomials as seen in the previous subsection, the following should hold, which can be confirmed easily with results of this subsection:

$$\begin{cases} a_2^{2,1} = c_2^{2,1}; a_1^{2,1} = a_0^{2,1} = 0; a_3^{3,1} = c_3^{3,1}; a_1^{3,1} = c_1^{3,1}; a_2^{3,1} = a_0^{2,1} = 0; (20) \\ \quad a_4^{2,2} = c_4^{2,2}; a_2^{2,2} = c_2^{2,2}; a_0^{2,2} = c_0^{2,2}; a_3^{2,2} = a_1^{2,2} = 0. \end{cases} \tag{21}$$

Then, computation of these conditional expectations is equivalent to that of the unconditional expectations $\mathbf{E}[Z_T^{<\xi>}A_{2T}]$, $\mathbf{E}[Z_T^{<\xi>}A_{3T}]$ and $\mathbf{E}[Z_T^{<\xi>}(A_{2T})^2]$. First, applying It$\hat{o}$'s formula to $\left(Z_t^{<\xi>}A_{2t}\right)$ we have

$$\mathbf{E}\left[Z_t^{<\xi>}A_{2t}\right] = \mathbf{E}\left[\int_0^t Z_s^{<\xi>}dA_{2s} + \int_0^t A_{2s}dZ_s^{<\xi>} + \left\langle A_2, Z^{<\xi>}\right\rangle_t\right]$$

$$= 2(i\xi)\int_0^t \partial\sigma(S_s^{(0)},s)\sigma(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}A_{1s}\right]ds \quad (22)$$

Then, applying It$\hat{o}$'s formula to $\left(Z_t^{<\xi>}A_{1t}\right)$ again, we also have

$$\mathbf{E}\left[Z_t^{<\xi>}A_{1t}\right]=\mathbf{E}\left[\int_0^t Z_s^{<\xi>}dA_{1s}+\int_0^t A_{1s}dZ_s^{<\xi>}+\left\langle A_1,Z^{<\xi>}\right\rangle_t\right]$$

$$=(i\xi)\int_0^t \sigma^2(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}\right]ds=(i\xi)\int_0^t \sigma^2(S_s^{(0)},s)ds \qquad (23)$$

since $\mathbf{E}\left[Z_t^{<\xi>}\right]=1$ for all t.

Similarly, the following are obtained:

$$\mathbf{E}\left[Z_t^{<\xi>}A_{3t}\right]=3(i\xi)\Bigg(\int_0^t \partial^2\sigma(S_s^{(0)},s)\sigma(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}(A_{1s})^2\right]ds$$

$$+\int_0^t \partial\sigma(S_s^{(0)},s)\sigma(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}A_{2s}\right]ds\Bigg) \qquad (24)$$

$$\mathbf{E}\left[Z_t^{<\xi>}(A_{1t})^2\right]=\int_0^t \sigma^2(S_s^{(0)},s)ds+2(i\xi)\int_0^t \sigma^2(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}A_{1s}\right]ds \qquad (25)$$

$$\mathbf{E}\left[Z_t^{<\xi>}(A_{2t})^2\right]=4\int_0^t \left(\partial\sigma(S_s^{(0)},s)\right)^2\mathbf{E}\left[Z_s^{<\xi>}(A_{1s})^2\right]ds\ +4(i\xi)\int_0^t \partial\sigma(S_s^{(0)},s)\sigma(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}A_{2s}A_{1s}\right]ds \qquad (26)$$

$$\mathbf{E}\left[Z_t^{<\xi>}A_{2t}A_{1t}\right]=2\int_0^t \partial\sigma(S_s^{(0)},s)\sigma(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}A_{1s}\right]ds \qquad (27)$$

$$+(i\xi)\int_0^t (\sigma(S_s^{(0)},s))^2\mathbf{E}\left[Z_s^{<\xi>}A_{2s}\right]ds+2(i\xi)\int_0^t \partial\sigma(S_s^{(0)},s)\sigma(S_s^{(0)},s)\mathbf{E}\left[Z_s^{<\xi>}(A_{1s})^2\right]ds.$$

Then, $\mathbf{E}[Z_T^{<\xi>}A_{2T}]$, $\mathbf{E}[Z_T^{<\xi>}A_{3T}]$ and $\mathbf{E}[Z_T^{<\xi>}(A_{2T})^2]$ can be obtained as solutions of the system of ordinary differential equations (22), (23), (24), (25), (26) and (27). In fact, since they have a grading structure that the higher-order equations depend only on the lower ones, they can be easily solved by substituting each solution into the next ordinary differential equation recursively. Moreover, since these solutions are clearly the polynomial of $(i\xi)$, we can easily implement differentiations with respect to ξ in (17), (18) and (19). It is obvious that the resulting coefficients given by these solutions are equivalent to the results in the previous subsection.

In summary, in a Black-Scholes-type economy, we consider the risky asset $S^{(\varepsilon)}$ and evaluate some quantities, expressed as an expectation of the function of the terminal price, such as prices or risk sensitivities of the securities on the asset. First we expand them around the limit to $\varepsilon=0$ so that we obtain the expansion (8) which contains some conditional expectations. Then, by approaches described in Section 2 and 3, we compute these conditional expectation. Finally, substituting computation results into (8), we obtain the asymptotic expansion of those quantities.

NUMERICAL EXAMPLES: APPLICATION TO LONG-TERM CURRENCY OPTIONS

In this section we apply our methods to pricing options on currencies under Libor Market Models(LMMs) of interest rates and stochastic volatility of the spot foreign exchange rate (Forex), which is much more complex then Black-Scholes-type case in the previous section. Due to limitation of space, only the structure of the stochastic differential equations of our model is described here. For details of the underlying model, see Takahashi and Takehara (2007). Detailed discussions in a general setting including the following examples are found in Section 3 and 4 of Takahashi, Takehara and Toda (2009).

Cross-Currency Libor Market Models

Let $(\Omega, F, \tilde{P}, \{F_t\}_{0 \le t \le T^* < \infty})$ be a complete probability space with a filtration satisfying the usual conditions. We consider the following pricing problem for the call option with maturity $T \in (0, T^*]$ and strike rate $K > 0$;

$$V^C(0;T,K) = P_d(0,T) \times \mathbf{E}^P\left[(S(T)-K)^+\right] = P_d(0,T) \times \mathbf{E}^P\left[(F_T(T)-K)^+\right] \tag{28}$$

where $V^C(0;T,K)$ denotes the value of a European call option at time 0 with maturity T and strike rate K, $S(T)$ denotes the spot exchange rate at time $t \ge 0$ and $F_T(t)$ denotes the time t value of the forex forward rate with maturity T. Similarly, for the put option we consider

$$V^P(0;T,K) = P_d(0,T) \times \mathbf{E}^P\left[(K-S(T))^+\right] = P_d(0,T) \times \mathbf{E}^P\left[(K-F_T(T))^+\right]. \tag{29}$$

It is well known that the arbitrage-free relation between the forex spot rate and the forex forward rate are given by $F_T(t) = S(t)\frac{P_f(t,T)}{P_d(t,T)}$ where $P_d(t,T)$ and $P_f(t,T)$ denote the time t values of domestic and foreign zero coupon bonds with maturity T respectively. $\mathbf{E}^P[\cdot]$ denotes an expectation operator under EMM(Equivalent Martingale Measure) P whose associated numeraire is the domestic zero coupon bond maturing at T.

For these pricing problems, a market model and stochastic volatility model are applied to modeling interest rates' and the spot exchange rate dynamics respectively. We first define domestic and foreign forward interest rates as $f_{dj}(t) = \left(\frac{P_d(t,T_j)}{P_d(t,T_{j+1})} - 1\right)\frac{1}{\tau_j}$ and $f_{fj}(t) = \left(\frac{P_f(t,T_j)}{P_f(t,T_{j+1})} - 1\right)\frac{1}{\tau_j}$ respectively, where $j = n(t), n(t)+1, \cdots, N$, $\tau_j = T_{j+1} - T_j$, and $P_d(t,T_j)$ and $P_f(t,T_j)$ denote the prices of domestic/foreign zero coupon bonds with maturity T_j at time t ($\le T_j$) respectively; $n(t) = \min\{i : t \le T_i\}$. We also define spot interest rates to the nearest fixing date denoted by $f_{d,n(t)-1}(t)$ and $f_{f,n(t)-1}(t)$ as $f_{d,n(t)-1}(t) = \left(\frac{1}{P_d(t,T_{n(t)})} - 1\right)\frac{1}{(T_{n(t)}-t)}$ and $f_{f,n(t)-1}(t) = \left(\frac{1}{P_f(t,T_{n(t)})} - 1\right)\frac{1}{(T_{n(t)}-t)}$. Finally, we set $T = T_{N+1}$ and will abbreviate $F_{T_{N+1}}(t)$ to $F_{N+1}(t)$ from here forward.

Under the framework of asymptotic expansion in the standard cross-currency libor market model, we consider the following system of stochastic differential equations(SDEs) under the domestic terminal measure P to price options. For detailed arguments on the framework of these SDEs see Takahashi and Takehara (2007).

As for the domestic and foreign interest rates we assume forward market models; for $j = n(t)-1, n(t), n(t)+1, \cdots, N$,

$$f_{dj}^{(\varepsilon)}(t) = f_{dj}(0) + \varepsilon^2 \sum_{i=j+1}^{N} \int_0^t g_{di}^{0,(\varepsilon)}(u)'\gamma_{dj}(u) f_{dj}^{(\varepsilon)}(u)du + \varepsilon \int_0^t f_{dj}^{(\varepsilon)}(u)\gamma_{dj}'(u)dW_u, \tag{30}$$

$$f_{fj}^{(\varepsilon)}(t) = f_{fj}(0) - \varepsilon^2 \sum_{i=0}^{j} \int_0^t g_{fi}^{0,(\varepsilon)}(u)' \gamma_{fj}(u) f_{fj}^{(\varepsilon)}(u) du + \varepsilon^2 \sum_{i=0}^{N} \int_0^t g_{di}^{0,(\varepsilon)}(u)' \gamma_{fj}(u) f_{fj}^{(\varepsilon)}(u) du$$
$$-\varepsilon^2 \int_0^t \sigma^{(\varepsilon)}(u) \bar{\sigma}' \gamma_{fj}(u) f_{fj}^{(\varepsilon)}(u) du + \varepsilon \int_0^t f_{fj}^{(\varepsilon)}(u) \gamma_{fj}'(u) dW_u, \quad (31)$$

where $g_{dj}^{0,(\varepsilon)}(t) := \frac{-\tau_j f_{dj}^{(\varepsilon)}(t)}{1+\tau_j f_{dj}^{(\varepsilon)}(t)} \gamma_{dj}(t), g_{fj}^{0,(\varepsilon)}(t) := \frac{-\tau_j f_{fj}^{(\varepsilon)}(t)}{1+\tau_j f_{fj}^{(\varepsilon)}(t)} \gamma_{fj}(t);$ x' denotes the transpose of x and W is a r-dimensional standard Wiener process under the domestic terminal measure P; $\gamma_{dj}(s)$, $\gamma_{fj}(s)$ are r-dimensional vector-valued functions of time-parameter s; $\bar{\sigma}$ denotes a r-dimensional constant vector satisfying $\|\bar{\sigma}\|=1$ and $\sigma^{(\varepsilon)}(t)$, the volatility of the spot exchange rate, is specified to follow a $\mathbf{R}_{++}$-valued general time-inhomogeneous Markovian process as follows:

$$\sigma^{(\varepsilon)}(t) = \sigma(0) + \int_0^t \mu(u, \sigma^{(\varepsilon)}(u)) du + \varepsilon^2 \sum_{j=1}^{N} \int_0^t g_{dj}^{0,(\varepsilon)}(u)' \omega(u, \sigma^{(\varepsilon)}(u)) du + \varepsilon \int_0^t \omega'(u, \sigma^{(\varepsilon)}(u)) dW_u, \quad (32)$$

where $\mu(s,x)$ and $\omega(s,x)$ are functions of s and x.

Finally, we consider the process of the Forex forward $F_{N+1}(t)$. Since $F_{N+1}(t) \equiv F_{T_{N+1}}(t)$ can be expressed as $F_{N+1}(t) = S(t) \frac{P_f(t,T_{N+1})}{P_d(t,T_{N+1})}$, we easily notice that it is a martingale under the domestic terminal measure. In particular, it satisfies the following stochastic differential equation

$$F_{N+1}^{(\varepsilon)}(t) = F_{N+1}(0) + \varepsilon \int_0^t \sigma_F^{(\varepsilon)}(u)' F_{N+1}^{(\varepsilon)}(u) dW_u \quad (33)$$

where $\sigma_F^{(\varepsilon)}(t) := \sum_{j=0}^{N} \left(g_{fj}^{0,(\varepsilon)}(t) - g_{dj}^{0,(\varepsilon)}(t) \right) + \sigma^{(\varepsilon)}(t).$

Numerical Examples

We here specify our model and parameters, and confirm the effectiveness of our method in this cross-currency framework. First, the processes of domestic and foreign forward interest rates and of the volatility of the spot exchange rate are specified. We suppose $r = 4$, that is the dimension of a Brownian motion is set to be four; it represents the uncertainty of domestic and foreign interest rates, the spot exchange rate, and its volatility. Note that in this framework correlations among all factors are allowed. We also suppose $S(0) = 100$.

Next, we specify a volatility process of the spot exchange rate in (32) with

$$\begin{cases} \mu(s,x) = \kappa(\theta - x), (34) \\ \omega(s,x) = \omega\sqrt{x}, \end{cases} \quad (35)$$

where θ and κ represent the level and speed of its mean-reversion respectively, and ω denotes a volatility vector on the volatility. In this section the parameters are set as follows; $\varepsilon = 1$, $\sigma(0) = \theta = 0.1$, and $\kappa = 0.1$; $\omega = \omega^* \bar{v}$ where $\omega^* = 0.3$ and $\bar{v}$ denotes a four dimensional constant vector given below.

We further suppose that initial term structures of domestic and foreign forward interest rates are flat, and their volatilities also have flat structures and are constant over time: that is, for all $j, f_{dj}(0) = f_d$, $f_{fj}(0) = f_f$, $\gamma_{dj}(t) = \gamma_d^* \bar{\gamma}_d 1_{\{t<T_j\}}(t)$ and $\gamma_{fj}(t) = \gamma_f^* \bar{\gamma}_f 1_{\{t<T_j\}}(t)$. Here, γ_d^* and γ_f^* are constant scalars, and $\bar{\gamma}_d$ and $\bar{\gamma}_f$ denote four dimensional constant vectors. Moreover, given a correlation matrix $\underline{C}$ among all four factors, the constant vectors $\bar{\gamma}_d$, $\bar{\gamma}_f$, $\bar{\sigma}$ and $\bar{v}$ can be determined to satisfy $\|\bar{\gamma}_d\| = \|\bar{\gamma}_f\| = \|\bar{\sigma}\| = \|\bar{v}\| = 1$ and $V'V = \underline{C}$ where $V := (\bar{\gamma}_d, \bar{\gamma}_f, \bar{\sigma}, \bar{v})$.

In this subsection, we consider four different cases for f_d, γ_d^*, f_f and γ_f^* as in Table 1. For correlations, the parameters are set as follows. The correlation between interest rates and the spot exchange rate are allowed while there are no correlations among the others. The correlation between domestic interest rates and the spot forex is 0.5($\bar{\gamma}_d'\bar{\sigma} = 0.5$) and the correlation between foreign interest rates and the spot forex is -0.5($\bar{\gamma}_f'\bar{\sigma} = -0.5$). It is well known that (both exact and approximate) evaluation of the long-term options is a difficult task with such complex structures of correlations.

Table 1: Initial Domestic/Foreign Forward Interest Rates and Their Volatilities

	f_d	γ_d^*	f_f	γ_f^*
case (i)	0.05	0.12	0.05	0.12
case (ii)	0.02	0.3	0.05	0.12
case (iii)	0.05	0.12	0.02	0.3
case (iv)	0.02	0.3	0.02	0.3

This table shows the initial term structures of domestic and foreign forward interest rates and those of their volatilities, which are assumed to be flat. The figures in the first and second column are the initial value of the domestic interest rates and their volatility. The figures in the third and fourth columun are thoes of foregin interest rates.

Lastly, we make an assumption that $\gamma_{dn(t)-1}(t)$ and $\gamma_{fn(t)-1}(t)$, volatilities of the domestic and foreign interest rates applied to the period from t to the next fixing date $T_{n(t)}$, are equal to be zero for arbitrary $t \in [t, T_{n(t)}]$.

In Figure 1, we compare our estimations of the values of call and put options whose maturities are from ten to twenty years by an asymptotic expansion up to the fourth order to the benchmarks estimated by 10^6 trials of Monte Carlo simulation. In the simulation, we discretized the underlying processes by a Euler-Maruyama scheme with time step 0.05 applied the Antithetic Variable Method. For the moneynesses (defined by $K / F_{N+1}(0)$) less than one, the prices of put options are shown; otherwise, the prices of call options are displayed.

As seen in this figure, in general the estimators seems more accurate as the order of the expansion increases. Especially, for the deep out of the money put options the fourth order approximation performs much better and is more stable than the lower order approximation.

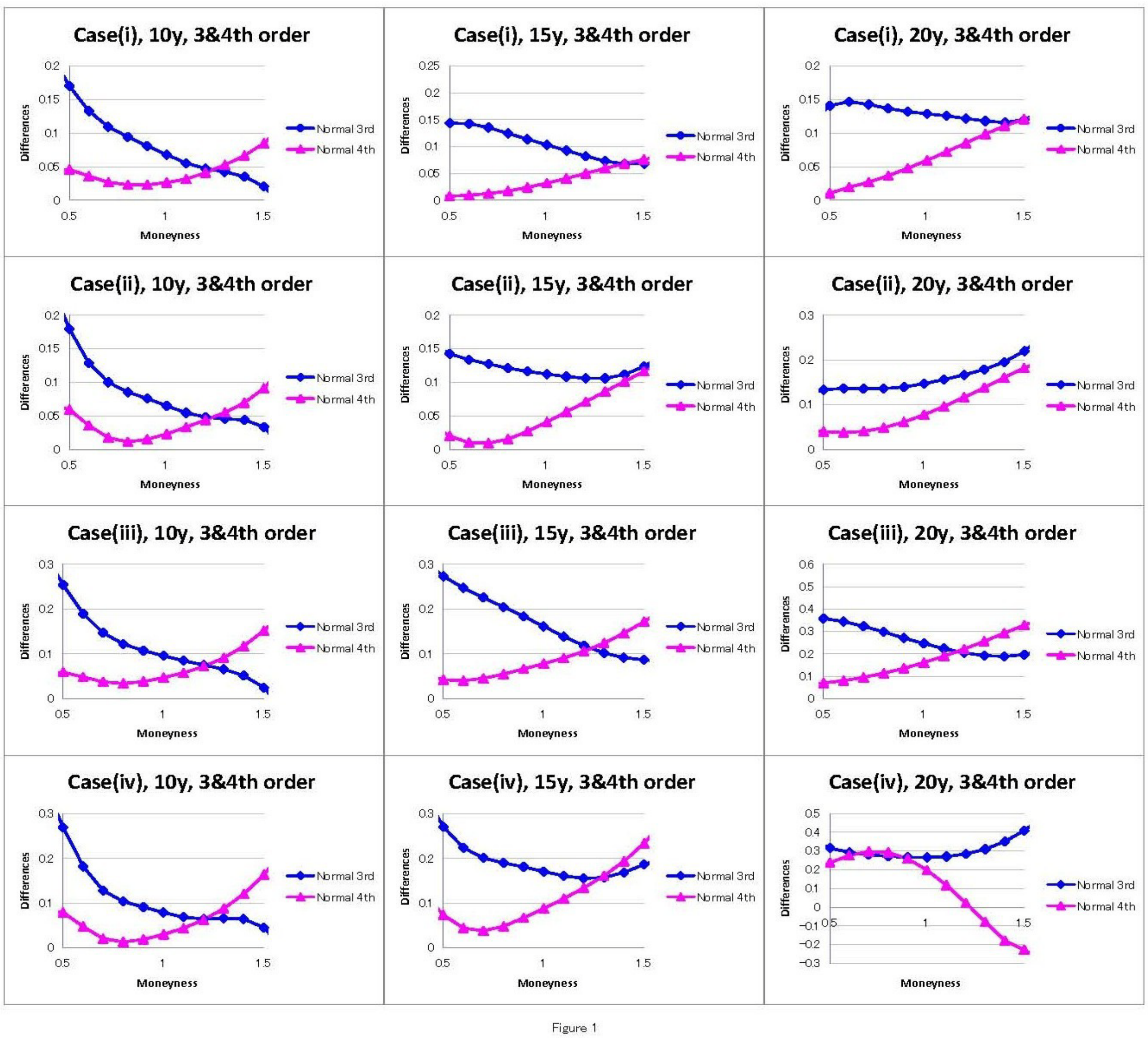
CONCLUSIONS

In this paper, we reviewed the general procedures for the explicit computation of the asymptotic expansion method. One procedure is that of conditional expectations based on the approach for iterated Ito integrals. The other is the alternative but equivalent calculation algorithm which computes the unconditional expectations directly instead of using conditional expectations.

For simplicity and space limitation, we focused on the simple case of Black-Scholes-type economy which illustrated our key ideas. Moreover, we applied the methods to option pricing in the cross currency Libor market model with a stochastic volatility of the spot exchange rate to illustrate the usefulness and accuracy of our approximation with high order expansions. In this practically important example, satisfactory results were confirmed even for options with a twenty-year maturity.

In this paper considers only path-independent European derivatives without considering jumps. Future research will develop a similar result in the presence of a jump component. Future research might also pursue an efficient method for the evaluation of multi-factor path-dependent or/and American derivatives.

Figure 1: Comparison of the Estimators by the Asymptotic Expansion and Simulations



This figure shows the differences between our estimators of option prices by the asymptotic expansion up to the third(blue lines) and fourth order(pink lines) and those by Monte Carlo simulations. The defferences are defined by (the estimate by the asymptotic expansion – that by simulation). "Moneyness" is defined by (Strike Rate / Spot Rate).

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THE ROLE OF LONG RETURNS IN SECURITY VALUATION: INTERNATIONAL EMPIRICAL EVIDENCE

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ABSTRACT

This study examines empirically the role of financial information in explaining long return windows in three major capital markets, UK, USA and France. We hypothesize that the relationship between financial information and security returns improves the longer the return window, and that this robustness depends on the country under investigation. The dataset consists of more than 40,000 USA, UK and French firm-year observations over a nine year period. Multivariate statistical regression analysis is undertaken to test the major research hypotheses. Results indicate that the importance of earnings and cash flows in all three countries over a longer period of time (more than a year and up to five years) is more robust, and that investors perceive earnings and cash flows differently. Interestingly, the importance of earnings and cash flows from one to five years , as measured by the R^2, increases the highest in the USA (almost quadruples), whereas increases the least in France. These results are not that surprising in that in Anglo-Saxon countries such as the USA and the UK the increase is greater than in a code law country such as France. This is due to the fact that in the shorter run there is a greater manipulation of financial information in Anglo-Saxon countries than in more conservative countries such as France.

JEL: G14, G15, G30

KEYWORDS: Capital markets, earnings, international, empirical.

INTRODUCTION

The value relevance of earnings in the capital markets has been among the primary empirical questions raised in several studies in the past few decades. The usefulness of earnings has also been examined recently in conjunction with cash flows (Bali et al (2009), Banker et al (2009), Bartov et al., 2001; Charitou and Clubb, 1999, Ball et al., 2000, among others). Empirical research provided evidence to support that earnings are more useful than cash flows in the capital markets. Existing evidence on the association of cash flows beyond earnings in explaining security returns in international capital markets has been inconclusive. The present study hypothesizes the value relevance of earnings and cash flows are country specific and it is affected by the security return measurement interval.

Regression analysis was undertaken to test the major hypotheses. A sample of more than 40,000 USA, UK and French firm year observations was used to test the research hypotheses. The major conclusions of the empirical results are summarized as follows. First, regarding our basic proposition which stated that earnings and cash flows are associated with stock prices in USA, UK and France, results indicate that indeed both earnings and cash flows are taken into consideration by investors in their investment decisions. Second, regarding our major hypothesis which stated that the value relevance of earnings and cash flows depends on the measurement interval and on the country under investigation, our results again support the hypothesis that investors in USA, UK and France perceive earnings and cash flows differently. Interestingly, the importance of earnings and cash flows from one to five years , as measured by the R^2, increases the highest in the USA (almost quadruples, 7% to 27.8%), whereas increases the least in France (almost triples, 11.4% for the annual and 32% for the five year interval). These results are not that surprising in that in Anglo-Saxon countries such as the USA and the UK the increase is greater than in a code law country such as France. This is due to the fact that in the shorter run there is a greater manipulation of financial information in Anglo-Saxon countries than in more conservative countries such as France (Charitou and Vlittis, 2010; Chan et al., 2006; Ali and Hwang, 2000).

In summary, evidence provided in this study supports that indeed there are substantial differences in the way investors and financial analysts perceive financial information such as earnings and cash flows in UK, France and USA over a longer return interval.

The remainder of the study is organized as follows: Section 2 reviews the related literature, motivates the paper and develops the hypothesis. Section 3 provides details on the research design and methodology, section 4 evaluates the empirical results and, finally, section 5 provides concluding remarks.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Earnings are of primary importance to managers, because managerial executive compensation contracts are usually based on earnings. Managers select financial reporting methods to maximize the value of their bonus awards through incentives created by bonus schemes. In addition, managers indulge in income smoothing, that is, taking actions to dampen fluctuations in their organization's earnings, as investors pay more for a firm with a smoother income stream (Ball et al., 2003; Dechow 1994; Barth et al. 2010).

In the past few years there has been an increased interest in the role of earnings and cash flows in explaining security returns. Since one of the major problems of most earnings-returns studies was the low explanatory power of the models, Easton, Harris and Ohlson (1992) extended this type of research by taking into consideration longer windows for the return and earnings variables. By doing that, one of the major problems associated with earnings that have to do with accruals management is mitigated to a great extent as the measurement interval increases. Easton, Harris and Ohlson (1992) used USA data to examine the association of earnings with security returns. The results of these studies provided evidence that the association of earnings with security returns improves over longer measurement intervals. Easton et. al., showed that for a five-year return interval the R^2 is equal to 33%. For the annual return interval the R^2 is only 5%. These researchers examined only the value relevance of earnings over longer return intervals. Dechow (1994) and Charitou and Clubb (1999) examined also the value relevance of cash flows over longer return intervals. They claimed that cash flows suffer more from timing and matching problems over short measurement intervals because they have no accrual adjustments and the accruals associated with cash flows are long term in nature and they do not reverse in the short-run (Vuolteenaho, 2002; Givoli et al., 2009; Dumontier, 1998).

On the other hand, the explanatory power of earnings compared to cash flows is expected to be the highest over short measurement intervals, because earnings include current and noncurrent accruals that mitigate the timing and matching problems related to the organizations operating, investing and financing cash flows. Moreover, Generally Accepted Accounting Principles trade off relevance and reliability so that accruals do not completely mitigate all short term timing and matching problems in realized cash flows. Dechow (1994) used US data. Results show that there is a relative increase in the explanatory power of cash flows compared to earnings over longer measurement intervals. More specifically, Dechow examined the value relevance of earnings and cash flows over a quarterly, annual and a four year period. The explanatory power of the earnings models as measured by the adjusted R^2 was as follows: 3.24% over the quarterly period, 16.20% over the annual period and 40.26% over the four year return interval. As far as the cash flow models are concerned, the explanatory power of these models as measured by the adjusted R^2 was as follows: 0.01% over the quarterly period, 3.18% over the annual period and 10.88% over the four year return interval. The following conclusions can be drawn from this study: a) that the explanatory power of earnings is greater in all three intervals tested, b) the explanatory power of both earnings and cash flows increases as the measurement interval increases, and c) the explanatory power of the cash flow models compared to the explanatory power of the earnings model increases at a higher rate as the measurement interval increases. It was less than 1% (R^2 of earnings model divided by the R^2 of the cash flow model) in the quarterly interval and it reached 27% in the four year interval.

In summary, these studies provide evidence that as the measurement interval increases, the value relevance of both earnings and cash flows improves. However, none of those studies used multivariate analysis to examine the value relevance of both earnings and cash flows in all those countries tested in the present study (Orpurt and Zang, 2009; Uhrig-Homburg, 2005).

The present study goes a step further to examine whether the value relevance of earnings and cash flows depends on the return interval in an international setting._ Extant evidence on the value relevance of cash flows beyond earnings in different countries over a longer measurement interval has been inconclusive (Barth et al., 2010, Bartov et al., 2001). The inconclusive results in prior studies and the limited research on this issue provide motivation for this study. The research hypothesis to be tested is:

H1: The value relevance of earnings and cash flows improves as the measurement interval increases.

This research hypothesis tests aforementioned model. In this theoretical framework, the market return variable is considered a function of an aggregate earnings (levels) variable. In this framework, the difference between the market value of equity and the book value of equity at time t is called goodwill. Within this framework the change in goodwill captures the 'measurement error' in aggregate earnings, and, for long return intervals, it is hypothesized that the variation in the earnings variable overwhelms the variation in the earnings' error variable.

Thus far, there has been limited research on the value relevance i) of cash flows over long measurement intervals, and ii) of earnings and cash flows in the USA, the UK and France. Studies by Easton et al. (1992), Dechow (1994), and Charitou and Clubb (1999) examined the value relevance of earnings over long return intervals in the US and UK but these studies failed to examine the value relevance issue for a) both earnings and cash flows and b) for common law and code law countries.

This hypothesis predicts that the value relevance of earnings and cash flows improves in all three countries as the measurement interval is increased. Over longer measurement intervals, cash flows will suffer from fewer timing and matching problems, the importance of accruals will diminish, and therefore, earnings and cash flows are expected to converge as measures of firm performance (Dechow, 1994; Easton, Harris and Ohlson, 1992). Cash flows suffer more from timing and matching problems over short measurement intervals because they have no accrual adjustments and the accruals associated with cash flows are long term in nature and they do not reverse in the short-run (Dechow, 1994). On the other hand, the explanatory power of earnings compared to cash flows is expected to be the highest over short measurement intervals, because earnings include current and noncurrent accruals that mitigate the timing and matching problems related to the organizations operating, investing and financing cash flows. Prior USA and UK studies showed that there is a relative increase in the explanatory power of earnings over longer measurement intervals (Easton, et al., 1992; Charitou and Clubb, 1999; Dechow, 1994).

RESEARCH DESIGN

All industrial firms that belong in the Manufacturing Industry (SIC 100-4299, 4400-4799), Retail Industry (SIC 5000-5999) and Service Industry (SIC 7000-8999) from the USA, UK and France over a nine year period, starting 1998, were selected. Industrial firms that had all annual information available for the computation of operating cash flows, operating earnings and security returns were included in the sample, resulting in more than 40,000 annual firm-year observations for the USA, UK and France. Consistent with prior empirical studies, observations that were regarded as outliers were excluded from the sample, i.e. observations with absolute change in earnings/market value, absolute change in cash flows/market value, earnings/market value and cash flow/market value greater than 150%. Also observations that were in excess of three absolute studentized residuals were considered outliers and were excluded from the sample. These restrictions resulted in approximate reduction of the sample size of about 2%, which is consistent with prior empirical studies. The final sample size resulted in approximately 35,000 US firm-year observations, 4,100 U.K firm-year observations and 1,100 French firm-year observations.

In order to examine whether investors in UK, USA and France take into consideration in their investment decisions the levels and changes of earnings and cash flows, independent of each other, the following univariate regression model will be used:

Univariate Model

$$RET_{it} = b_0 + b_i X_i + e_I \quad (1)$$

where:

X_i: is replaced by:

- E: Operating Earnings
- **Δ**E: Change in operating-earnings
- CFO: Operating cash flows
- **Δ**CFO: Change in operating cash flows.
- RET_{it}: stock return for firm i measured over a 12-month return interval ending three months after the fiscal-year-end.

b_0: the intercept term

b_i: slope coefficient

e_i: error term

To test whether both the levels and changes of earnings and cash flows are valued differently in the capital markets, namely in USA, UK and France, the following multivariate regression model will be used:

Long Windows Empirical Models

In order to test the research hypothesis which relates to the long return intervals, the dependent and explanatory variables of the following model will be re-estimated.

$$RET_{it} = b_0 + b_i E + b_2 CFO + e_I \quad (2)$$

where:

E: operating earnings

CFO: Cash flow from operations

Security Returns (RET_{it}): The return for security i in year t is defined as cash dividends (DIV), plus capital gains, divided by security price at the beginning of the fiscal year.

$$RET_t = (P_t - P_{t-1} + DIV_t) / P_{t-1}$$

where:

P_t = security price of the firm at the end of the fiscal year t

DIV_t = cash dividends for the year t Returns will be calculated for the 12 months ending 3 months after the fiscal year-end (Easton and Harris, 1992)

In particular, for longer measurement intervals a) the RET is the product of the annual returns over the relevant period, and b) the level of earnings and cash flows is the sum of the deflated earnings and cash flows over the relevant period.

For longer return intervals where the year T is greater than one (T>1 year), the RET is the sum of the annual returns over the relevant period:

$$RET(t,T) = \sum_{i-0}^{T=1} RET_{t-i}$$

where T=return interval; t=current period. For example, the 3-year return will be estimated as follows:

$RET(3\text{-year})=((1+RET_t) * (1+RET_{t-1})*(1+RET_{t-2}))-1.$

EMPIRICAL RESULTS

Table 1 presents descriptive statistics for all earnings, cash flows and security returns variables examined in the study for all three countries (USA, UK and France) for the recent nine year period. Results indicate the following: a) the mean security return for UK and USA is the highest (0.092 and 0.08, respectively), whereas in France is somewhat lower, 0.055, b) the mean earnings level is higher for UK (0.057) and lowest for USA.

Table 1: Descriptive statistics for all firms for the USA, UK and France

Country	Variable	Mean	Median	Standard Deviation	Minimum	Maximum
USA	E	-0.008	0.038	0.192	-1.485	1.437
	ΔE	0.007	0.051	0.187	-1.477	1.499
	CFO	0.057	0.078	0.226	-1.496	1.488
	ΔCFO	0.009	0.005	0.245	-1.479	1.499
	RET	0.08	0.005	0.562	-0.998	3.778
UK	E	0.057	0.072	0.144	-1.416	1.375
	ΔE	0.005	0.008	0.157	-1.497	1.481
	CFO	0.123	0.107	0.204	-1.397	1.479
	ΔCFO	0.002	0.007	0.245	-1.487	1.356
	RET	0.092	0.073	0.372	-0.957	1.699
FRANCE	E	0.037	0.058	0.135	-1	0.582
	ΔE	0.008	0.005	0.144	-1.114	1.092
	CFO	0.184	0.134	0.237	-0.989	1.455
	ΔCFO	0.006	0.005	0.269	-1.335	1.224
	RET	0.055	0.03	0.318	-0.82	1.16

Where: E: operating earnings, ΔE: Changes in earnings, CFO: Operating cash flows, ΔCFO: changes in Operating Cash flows; RET: annual security returns

For the French dataset the mean of earnings levels is 0.037; c) the mean of the cash flow levels is shown to be the highest for the French dataset (0.184) and lower for UK and USA (0.123 and 0.057, respectively); d) as expected the standard deviation of the levels and changes of cash flows is always higher than the level and changes of earnings in all three countries. These results are consistent with the results provided in prior empirical studies. Moreover, untabultated correlation analysis results indicate that there are no significant correlations that may possibly affect the results.

To test the hypothesis proposed in this study, both univariate and multivariate regression analysis results are provided in this section. Univariate results presented in Table 2 indicate the following. First, as far as the value relevance of earnings is concerned, as expected, the results indicate that both the levels and changes in earnings are positive and statistically significant in all three countries. Interestingly, the size of the levels of earnings and the size of the changes in earnings is approximately equal in all three countries, in spite of the fact that the French financial reporting system is much more conservative. Specifically, the coefficients of the level of earnings are 0.759, 0.767 and 0.793 for the USA, the UK, and France, respectively. The coefficients of the changes in earnings are 0.701, 0.612 and 0.669, for the US, UK and France, respectively. As far as the R^2 is concerned, results indicate that French earnings (levels and changes) are more value relevant than the earnings in the USA and the UK, even though the financial reporting system in France in more conservative. The R^2 for the level of earnings is 11.20%, 8.80% and 6.70% for France, the UK and the USA. The same ranking applies to the changes in earnings, although the R^2 is somewhat lower, indicating that the level of earnings is more value relevant than the changes in earnings.

Table 2: Univariate Regression Analysis Results for USA, UK and France

Xi E	USA	UK	FRANCE
Coefficient	0.759 *	0.767 *	0.793 *
t-statistic	50.864	20.128	12.179
P-value	0	0	0
N	35873	4178	1165
F-value	2587.17 *	405.13 *	148.33 *
R^2 Adj	6.70%	8.80%	11.20%
ΔE			
Coefficient	0.701 *	0.612 *	0.669 *
t-statistic	45.442	17.205	10.86
P-value	0	0	0
N	35873	4178	1165
F-value	2064.98	296.00 *	117.94 *
R^2 Adj	5.40%	6.60%	9.10%
CFO			
Coefficient	0.447 *	0.451 *	0.197 *
t-statistic	34.617	16.46	5.061
P-value	0	0	0
N	35873	4178	1165
F-value	1198.31 *	270.94 *	25.61 *
R^2 Adj	3.20%	6.10%	2.10%
ΔCFO			
Coefficient	0.196 *	0.202 *	0.072 **
t-statistic	16.274	8.686	2.09
P-value	0	0	0.037
N	35873	4178	1165
F-value	264.84 *	75.45 *	4.36 **
R^2 Adj	0.70%	1.80%	0.30%

*where E: operating earnings, ΔE: Changes in earnings, CFO: Operating cash flows,ΔCFO: changes in Operating Cash flows; RET: annual security returns. All Independent variables (E, ΔE, CFO, ΔCFO) are deflated by the market value of the firm at fiscal year end of the previous year. *, **, *** statistically significant at a=1%, 5% and 10%, respectively.*

As far as the value relevance of cash flows is concerned, as expected, results indicate that cash flows are value relevant in all three countries. All the coefficients of the levels and changes in cash flows are positive and statistically significant. The size of the coefficients of cash flows as well as the magnitude of the R^2 are somewhat higher in the Anglo-Saxon countries, suggesting that cash flows could be less value relevant in France. Moreover, as it was expected the size of the earnings coefficients and the magnitude of the R^2 are relatively higher than the equivalent cash flow statistics. These results are consistent with our hypotheses, expectations and consistent with prior empirical evidence. This is due to the fact that earnings are considered more value relevant in the stock markets.

Results in Table 3 provide multivariate regression results over longer-return intervals. Thus far, results were presented using annual return windows. That means that all returns, earnings and cash flow variables included in the model were measured on an annual basis, i.e., the way they are reported in the annual reports of the firms. Results in this table are presented for measurement intervals of 1, 2, 3, 4 and 5 years, for each country. For example, to test the five year model all variables included in the model, returns, earnings and cash flows were measured over a five year period., i.e. for the earnings variable the earnings of a five year period were added together. The same applies to cash flows and returns. Results in table 3 indicate the following: first, as expected, for all countries, the five-year models have the highest R^2, compared to the other one to four year models. For example, for the one year models, the R^2 is 11.4%, 10.1% and 7%, for France, the UK and the USA respectively, whereas the five year model R^2 results are 32%, 35.2% and 27.8%, for France, the UK and the USA, respectively.

Table 3: Multivariate Regressions over Longer Return Intervals (Model : Ret = a + b_1 E + b_2 CFO)

Country	Interval	Constant	E	CFO	R^2 Adj %
	Annual	0.014	0.756	0.072	11.40%
		-1.23	(11.13')*	(1.87')***	
	2 Years	0.04	1.05	0.09	20.30%
		(2.3)**	(15.6)*	(3.22)*	
	3 Years	0.09	0.82	0.12	26.50%
FRANCE		(3.5)*	(14.4)*	(4.2)*	
	4 Years	0.063	0.92	0.17	30.60%
		(1.83)***	(13.9)*	(5.76)*	
	5 Years	0.1	0.64	0.23	32.00%
		(1.89)***	(10.3)*	(6.7)*	
	Annual	0.029	0.598	0.239	10.10%
		(4.49')*	(13.68')*	(7.71)*	
	2 Years	0.11	0.73	0.06	15.20%
		(14.8)*	(24.3)*	(2.8)*	
UK	3 Years	0.16	0.72	0.12	19.40%
		(14.6)*	(23.4)*	(5.4)*	
	4 Years	0.17	0.94	0.146	24.50%
		-10.8	-26.3	-6.8	
	5 Years	8.5	1.13	0.07	35.20%
		(8.2)*	(29.5)*	(1.68)***	
	Annual	0.076	0.666	0.152	7.00%
		(25.27)*	(38.13)*	(10.28)*	
	2 Years	0.26	0.57	0.11	9.80%
		(43.6)*	(35.5)*	(7.4)*	
	3 Years	0.45	0.6	0.09	13.60%
USA		(44.8)*	(32.6)*	(5.9)*	
	4 Years	0.57	0.62	0.15	21.40%
		(44.3)*	(38.5)*	(9.4)*	
	5 Years	0.68	0.75	0.16	27.80%
		(43.7)*	(41.3)*	(9.53)*	

where E: operating earnings, CFO: operating cash flows, RET: security returns
*, **, ***: statistically significant at a= 0.01, 0.05 and 0.10 respectively. *First line is the slope coefficient, 2nd line is t-statistic)*

As it can be seen, by increasing the measurement interval from one year to five years, the explanatory power of the regression model increases about three times. From the practitioner point of view, it means that the annual earnings and cash flows explain about 11.4% of the variability of the security returns in France, but in a five-year period the same earnings and cash flows explain about 32% of the variability of stock returns. Second, again as hypothesized, in all countries, the explanatory power of the model increases when I increase the measurement interval. For example, in the UK, the R^2 is only 10.1% in the one year interval, and it goes up to 15.2%, 19.4%, 24.5% and finally to 35.2% when I increase the interval to two, three, four and five years. Third, in all models tested for all countries for all measurement intervals, the earnings variable is positive and statistically significant, as it was expected. Fourth, similar to the earnings variable, the cash flow variable is positive and statistically significant in all models tested in all three countries. Fifth, interestingly, the explanatory power of the model from one to five years increases the highest in the USA (almost quadruples, 7% to 27.8%), whereas increases the least in France (almost triples, 11.4% for the annual and 32% for the five year interval). These results are not that surprising and they are consistent with my expectation. These results are due to the fact that in the shorter run there is a greater manipulation of financial information in Anglo-Saxon countries than in more conservative countries such as France. Thus, in Anglo-Saxon countries, such as the USA and the UK, the increase in the value relevance of financial information over longer-return windows is greater than in a code law country, such as France.

CONCLUSIONS

This major objective of this study was to examine empirically the value relevance of financial information in explaining long return windows in three major capital markets, UK, USA and France. It was hypothesized that the relationship between financial information and security returns improves the longer the return interval, and that this increase in power depends on the country under investigation. The dataset consists of more than 40,000 USA, UK and French firm-year observations over a nine year period. Multivariate statistical regression analysis is undertaken to test the research hypothesis.

Consistent with the hypothesis tested and expectations, results indicate that the value relevance of earnings and cash flows depends on the measurement interval and on the country under investigation. , i.e., that investors in USA, UK and France perceive earnings and cash flows differently. Results show that the importance of earnings and cash flows from one to five years, as measured by the R^2, increases the highest in the USA, whereas increases the least in France. These results may be due to the fact that in the shorter run there is a greater manipulation of financial information in Anglo-Saxon countries than in more conservative countries such as France. The results of this study maybe limited due to the fact that there are timing and matching differences, as well accounting differences over time. Future research may take those factors into consideration, if any, in evaluating the value relevance of financial information. Nevertheless, this study encourages further research that may improve our understanding of the value relevance of financial information explaining stock prices in international capital markets. Future research may examine in more depth industry and firm specific factors, such as earnings transitoriness, default risk, and quality of financial information.

There exist practical implications as well from this study and should be of great importance to the major stakeholders such as investors, creditors, financial analysts, especially with the latest events that are taking place, and the major collapses of giant organizations worldwide such as Lehman Brothers, Bear Stearns, General Motors, among others. Regulatory bodies, investors, financial analysts and the financial press, blamed among others, the possible manipulation of financial information supplied to the investors by these organizations. The question raised, is whether this type of information is taken into consideration by investors in their investment decisions.

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