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The Determinants of Derivatives Activities in U.S. Commercial Banks
M. Kabir Hassan and Ahmad Khasawneh

Abstract: This paper aims to test the extent to which the tax regulatory and market discipline hypotheses determine derivative activities of U.S. commercial banks for the period starting 1992 through 2008. We employ Mansfield's (1961) logistic diffusion model and we consider derivative activities as real financial innovation following a time trend diffusion curve. The model is modified to include regulator, non-regulatory/bank-specific factors and macroeconomic factors. The results reveal that derivative activities are real financial innovations that are increasing over time. Another major finding is that the regulatory tax hypothesis is not a major factor in determining derivative activities by U.S. commercial banks. The results also suggest that derivatives activities do not follow business cycle and economic conditions. However, derivatives are prevalently used where economies of scale is a viable outcome since they require highly specialized and qualified staff and are more likely available to large banks. The substitution effect is dominant between derivatives and loan ratio factor. Diminishing credibility of the bank will reduce derivatives activities. While derivatives are more likely to be an innovation, they are also determined by other factors such as technology and learning.

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1. Introduction

The last two decades have witnessed an extraordinary increase in the use of derivative activities in the U.S banking industry. In 2008, the notional value of total assets items was \$12.31 trillion, compared to \$201.08 trillion in derivative items for the U.S. banking system. Derivative activities grew from \$10.2 trillion in 1992 to \$201.08 trillion in 2008, a compound growth rate of 1917%.¹ The significant growth in derivative activities by commercial banks has been a direct response to the increased domestic and international interest rate risk, credit risk, and foreign exchange risk exposures they have faced. Banks engage in derivatives activities for two major reasons; first, to earn additional fee income to compensate for declining margins or spreads on their traditional lending business. Secondly, they seek to avoid regulatory costs or taxes since reserve requirements and deposit insurance premiums are not levied on derivatives activities.

Derivatives activities have both risk reducing as well as risk increasing attributes, and the net impact on risk will depend on the ability to manage the risk resulting from engaging in these activities. The use of derivatives contracts accelerated during the 1992-2008² period and accounted for much of the growth in the off-balance sheet (OBS) activities (Table 1). These contracts offer banks a way to hedge these risks without making any extensive changes on the on-balance sheet items.

Following Jagtiani et al. (1995), we employ the logistic model. Mansfield (1961) has shown that the adoption pattern of real innovations often follow a logistic time curve. Derivatives activities (swaps, options, futures, and forwards) will be considered as an innovation following the time diffusion pattern.

This study differs from Jagtiani et al (1995) in several ways. First, they consider the important changes in capital requirements during the period of their study by imposing dummy variables representing the occurrence of each of the capital requirement

¹ FDIC: Statistics on banking, various years, [Hwww.fdic.gov](http://www.fdic.gov)H.

² Refer to figure (1).

changes. We will measure the capital requirement factor in line with the analysis of Jacques and Nigro (1997) and Nachane and Ghosh (2007) by introducing the concept of regulatory pressure in regard to banks' capital adequacy ratios (CARs). Second, the period of their analysis was limited to 1984 through 1991, and we study a more recent time span of March 1992 to December 2008, which includes the most recent regulatory pressure effects. Third, in addition to the capital requirement factor and bank specific features, we will add macroeconomic conditions as a determinant of derivative activities. Moreover, bank-level panel data are constructed and panel estimation techniques are used. One of the main benefits of panel data is that they enable us to identify and measure effects that are simply not determined in pure cross-section or pure time-series data.

2. Literature Review

The previous research in the topic of off-balance sheet (OBS) activities in the banking industry can be divided into three dimensions; the regulatory tax hypothesis, moral hazard hypothesis, and market discipline hypotheses. The regulatory tax hypothesis implies a positive relation between a bank's OBS activities and the regulatory taxes on on-balance sheet assets and liabilities. The regulatory taxes usually impose a constraint on a bank's reserve, deposit insurance premium, and capital. These constraints will encourage banks to substitute off-balance sheet activities for on-balance sheet activities.

The moral hazard hypothesis states that banks with high bankruptcy probabilities have greater moral hazard incentives and therefore have more incentive to engage in OBS activities. It proposes that both underpriced, fixed-rate deposit insurance and capital requirements provide incentives to increase financial leverage through the issuance of OBS activities that are not subject to regulation. This hypothesis argues that capital-constrained banks are projected to engage in more OBS items than less capital-constrained banks. Moreover, banks that are about to be unsuccessful will prefer to have OBS items to take advantage of accounting rules which allow them to book income from these activities immediately, whereas they cannot recognize income from the on-balance sheet items until interest is earned.

The market discipline hypothesis argues that because OBS activities are uninsured and dependent on future claims unrelated to other claims, banks with safer positions will engage in more OBS activities which will reduce risk. Bank customers will value these claims more when banks are safer, therefore, those banks which are already OBS items issuers will have an incentive to decrease their risk position and issue additional OBS items.

Pavel and Phillis (1987) examine the determinants of commercial loan sales activities. They conclude that diversification, capital, binding capital constraints, and reserve requirements all have an important impact on loan sales. Moreover, this study proposes that banks start selling loans when capital ratios are low and charge-offs are high. Avery and Berger (1988) support the moral hazard hypothesis and they suggest that standby letters of credit (SLC) have a positive impact on banks' risk exposure. Benveniste and Berger (1986, 1987) maintain that as banks approach failure, SLC issuance decreases. In addition to such of market discipline hypothesis, they also support the regulatory tax hypothesis, finding that there is a positive relation between SLCs and leverage. Pavel (1988) declared that there is no relation between loan sales and bank risk. Koppenhaver (1989) considered more OBS activities (loan commitments, SLCs and commercial letters of credit, CLCs) and studied the determinants of OBS activities employing Logit models. The results suggest that bank size, amount of reserves, and loan losses are important factors for banks to engage in OBS activities, while capital constraint factors are insignificant for banks' OBS activities decisions.

Berger and Udell (1990) and Avery and Berger (1991) conclude that there is a negative relationship between loan commitments and bank risk. Avery and Berger (1991) consider more risk measures and suggest that SLCs have a positive impact on both small and large banks' risk, a conclusion that supports the market discipline hypothesis for banks. Berger (1991) examines actual bank performance instead of stock market prices to counter for the equity effect of disciplining banks' risk-taking. The results reveal that higher capital ratios for both small and large banks are related to higher future earnings, lower probability of bankruptcy, and better bank performance. Koppenhaver and Stover (1991) claim that the existing empirical research encounters a simultaneous equation bias,

and they employ granger causality test. They find that SLCs have a positive impact on bank leverage. Hassan (1992) studied the riskiness of commercial letters of credit (CLCs) from the stockholders and bondholders point of view. His results suggest that stockholders perceive CLCs to have a risk-reducing effect while debt holders are indifferent about risk effect of CLCs activities. Hassan, Karels and Peterson (1994) used a contingent valuation model to test the market discipline hypothesis of OBS activities for bank subordinated debt. Their results support the market discipline hypothesis for most OBS activities, and suggest that debt holders and equity holders regard OBS activities to have risk reducing impact.

International research is mainly concerned with the market discipline hypothesis. Hassan, Lai, and Yu (2002) indicate that the various market measures of risk and letters of credit are negatively related in Canadian banking industry. Additionally, banks with greater portfolio risk, (equity and asset risk), high leverage and interest rate risk are less likely to issue letters of credit. Khambata and Hirche (2002) describe OBS credit risk of the top 20 European commercial banks. Their results suggest that loan commitments are the largest source of credit risk among traditional OBS instruments. Khambata and Bagdi (2003) repeat the descriptive study on OBS credit risk across the top 20 Japanese banks. The results suggest that financial derivatives were heavily used by the top four banks and that loan commitments are the largest source of credit risk among traditional OBS instruments. The notional amounts of derivative contracts make up 92 percent of total OBS activities. As compared to U.S. and European banks, Japanese banks use fewer OBS instruments as a percentage of their assets. This implies that Japanese banks are in general more conservative and risk averse than their U.S. or European counterparts.

Lieu, Yeh and Chiu (2005) implement a stochastic cost curve method by estimating and comparing cost inefficiency with or without OBS outputs of 46 Taiwanese commercial banks during the period 1998 through 2001. Their results suggest that omitting OBS outputs in estimating the cost frontier function of banks results in an underestimation of bank efficiency by approximately 5 percent. Moreover, cost efficiency and OBS usage are positively related with bank size. Banks with higher employee

productivity are more cost efficient. Their results support the existence of economies of scale in both models with and without OBS specification in Taiwan's bank system. They conclude that economies of scope between loans and OBS outputs are also practical.

Athanasios, Lyrouti and Angelidis (2004) employ total factor productivity/Malmquist indices to investigate the impact of banks' OBS activities on the productivity of decision-making units by studying 11 European countries for the period 1995-2002. Their results indicate that productivity varies according to both approaches (with and without OBS). For some countries, productivity is enhanced while in others, it is worsened.

Sinha and Chatterjee (2006) compare public and private commercial banks in India to assess their ability to generate income from off-balance-sheet activities. They employ the Data Envelopment Approach and panel data framework to test the impact of operating efficiency, capital adequacy and non-performing assets (NPA) incidence on OBS risk-taking behavior of Indian commercial banks. The results show that public sector commercial banks are lagging behind the private sector commercial banks in OBS activities. Almost all the commercial banks exhibited decreasing returns to scale, a discouraging outcome for the banking sector. Moreover the results indicate that OBS activities are positively related to operating profit ratio and negatively related to NPA ratios, which reinforces the market risk hypothesis. Nachane and Ghosh (2007) examines the determinants of OBS activities in the Indian banking sector and find that regulatory factors, banks-specific characteristics and macro-economic conditions are at work in the diffusion pattern of OBS activities.

4. Analysis of Theoretical and Empirical Models

4.1. The Logistic Diffusion Model

Mansfield (1961) uses a deterministic model to investigate (i) Why firms are slow in adopting some innovations and so quick in adopting others and (ii) What factors seem to govern the rate of imitation? His model assumes that the number of firms adopting an innovation between time t and time $t+1$, $\lambda_{ij}(t)$, depends on several factors. First is the

number of firms already using the innovation. The increase in the number of firms already using an innovation would be $\lambda_{ij}(t)$. As more information and experience accumulate, it becomes less risky to use the innovation. Moreover, competitive pressures mount and “bandwagon” effects occur. Second, the economic feasibility of using the innovation will influence $\lambda_{ij}(t)$. The higher the rate of return on investment (to compensate for risk involved) is relative to other innovations, the higher the chance of immediate adoption. Third is amount of capital outlay and source of financing the investment/project. For equally profitable innovations, $\lambda_{ij}(t)$ tends to be smaller for innovations requiring relatively large outlays. Fourth is the risk attitude of the industry. For equally profitable innovations requiring the same investment, $\lambda_{ij}(t)$ is likely to vary among industries. Below is the formal derivation of the Mansfield (1961) model.

Let n_{ij} be the total number of firms which adopted the j^{th} innovation in the i^{th} industry, $m_{ij}(t)$ be the number of these firms that introduced the innovation at time t , π_{ij} be the profitability of installing this innovation relative to alternative investments, and S_{ij} be the investment required to install the innovation as a per cent of the average total assets of the firms. $\lambda_{ij}(t)$ is the proportion of “hold-outs” (firms not using this innovation) at time t and those that introduced it by time $t+1$, i.e.,

$$\lambda_{ij}(t) = \frac{m_{ij}(t+1) - m_{ij}(t)}{n_{ij}(t) - m_{ij}(t)} \dots\dots\dots(1) \text{ And,}$$

$$\lambda_{ij}(t) = f\left(\frac{m_{ij}(t)}{n_{ij}}, \pi_{ij}, S_{ij}, \dots\right) \dots\dots\dots(2) \text{ (From the}$$

discussion above)

Assume that the number of firms that introduced an innovation can vary continuously and assume that $\lambda_{ij}(t)$ can be approximated adequately within the relevant range by Taylor’s expansion that drops third and higher order terms, then the coefficient of $\left(\frac{m_{ij}(t)}{n_{ij}}\right)$ in this expansion is zero, and we have

$$\lambda_{ij}(t) = a_{i1} + a_{i2} \frac{m_{ij}(t)}{n_{ij}} + a_{i3} \pi_{ij} + a_{i4} S_{ij} + a_{i5} \pi_{ij} \frac{m_{ij}(t)}{n_{ij}} + a_{i6} S_{ij} \frac{m_{ij}(t)}{n_{ij}} + a_{i7} \pi_{ij} S_{ij} + a_{i8} \pi_{ij}^2 + a_{i9} S_{ij}^2 + \dots \dots \dots (3)$$

Thus,

$$m_{ij}(t+1) - m_{ij}(t) = (n_{ij} - m_{ij}(t)) \left(a_{i1} + a_{i2} \frac{m_{ij}(t)}{n_{ij}} + \dots + a_{i9} S_{ij}^2 + \dots \right) \dots \dots \dots (4)$$

Assuming that time is measured in fairly small units, we can use as an approximation the corresponding differential equation

$$\frac{dm_{ij}(t)}{dt} = (n_{ij} - m_{ij}(t)) \left(\theta_{ij} + \beta_{ij} \frac{m_{ij}(t)}{n_{ij}} \right) \dots \dots \dots (5)$$

The solution of which is,

$$m_{ij}(t) = \frac{n_{ij} \left[e^{\alpha_{ij} + (\theta_{ij} + \beta_{ij})t} - \left(\frac{\theta_{ij}}{\beta_{ij}} \right) \right]}{1 + e^{\alpha_{ij} + (\theta_{ij} + \beta_{ij})t}} \dots \dots \dots (6)$$

Where α_{ij} is a constant of integration, θ_{ij} is the sum of all terms in (3) not containing

$\frac{m_{ij}(t)}{n_{ij}}$, and β_{ij} is the coefficient of $\frac{m_{ij}(t)}{n_{ij}}$

$$\beta_{ij} = a_{i2} + a_{i5} \pi_{ij} + a_{i6} S_{ij} + \dots \dots \dots (7)$$

Add another assumption, as we go backward in time, the number of firms having introduced the innovation must tend to zero, i.e.,

$$\lim_{t \rightarrow -\infty} m_{ij}(t) = 0 \dots \dots \dots (8)$$

Then,

$$P_t = \frac{m_{ij}(t)}{n_{ij}} = \left[1 + e^{(-\alpha_{ij} - \beta_{ij}t)} \right]^{-1} \dots\dots\dots(9)$$

Thus, the growth over time in the number of firms that introduced an innovation should conform to a logistic function. The logistic time curve, equation (9), predicts that the proportion of the population which has already adopted the innovation will increase at an accelerating rate until 50 percent adoption is achieved. This is attained at $t = -(\alpha/\beta)$. Thereafter, the adoption will increase at a decelerating rate and 100 percent adoption is approached asymptotically.

If equation 9 is correct, it can be shown that the rate of imitation is governed by only one parameter, β_{ij} . Assuming that the unspecified terms in (7) are uncorrelated with π_{ij} and S_{ij} and that their sum can be treated as a random error term, then it follows from equation (9)

$$\ln \left[\frac{P_{it}}{(1 - P_{it})} \right] = \alpha + \beta t \dots\dots\dots(10)$$

Where P_{it} is the ratio of nominal value of innovation (derivative items) to nominal value of total assets (on-balance sheet assets + derivative items) of bank i at time t . This definition enables us to counter for the scale on which banks introduce OBS items.

4.2. The Empirical Model

Starting from equation (10), we will add two factor vectors, the first to control for bank-specific characteristics and the second to capture the macroeconomic conditions. The choice of these factors is based on both theoretical literature and policy discussions. Accordingly, equation (11) is the modified econometric model from equation (10).

$$LGTDERV_{it} = \ln \left[\frac{P_{it}}{(1 - P_{it})} \right] = \alpha_i + \beta t + \gamma X_{it} + \delta Y_t + \varepsilon_{it} \dots\dots\dots(11)$$

where $i = 1, 2, 3, \dots, N$ denotes the number of banks and $t = 1, 2, 3, \dots, T$ denotes time periods. The dependent variable, $LGTDERV_{it}$ is the logistic transformation of P_{it} . P_{it}

is the ratio of nominal value of derivatives items to nominal value of total assets (on-balance sheet assets + derivatives items) of banks i at time t . The explanatory variables are shown below.

- i- The time trend (t) accounts for the autonomous diffusion (deterministic trend).
- ii- X_{it} is a vector of bank-specific characteristics.
- iii- Y_{it} is a vector of general macroeconomic conditions.
- iv- The intercept α is a bank-specific constant.

The bank-specific characteristics are classified into regulatory and non-regulatory variables. The non-regulatory factors are bank size, loan ratio, profitability, and net charge-off. The anticipated effect of bank size has duo effect and the net effect of these two determines the net impact of firm size on derivatives activities. On one hand, a bank has to be of a certain size to get involved in derivatives activities and get the benefit of the economies of scale. Moreover, large banks may be the only banks that have the highly qualified and specialized risk management experts. Also, sophisticated clients who engage in derivative activities believe that large banks are too big to fail. On the other hand, as bank size gets bigger, they become more risk-diversified and less likely to engage in derivative activities.

The impact of the loan ratio (amount of loans to total assets) on the usage of derivative activities is expected to be positive and significant. Angbazo (1997) shows that a higher loan ratio will increase the interest rate risk which will create an incentive for banks to hedge using derivative activities. Another reason for this positive relation is that in the process of approving loans, banks get access to their customers' investment information, which will facilitate the offer of relevant derivative risk management tools.

A positive relation is expected between profitability and derivative activities. Profitability will increase the customer valuation of a bank. Such customers have more incentives to deal with more profitable banks rather than less-profitable banks.

The net charge-off is a proxy of non-performing loans that banks assign for bad-debt loans. The predicted impact of non-performing loans is negative. As the amount of non-performing loans increases, the bank's creditworthiness decreases. This will ultimately reduce the amount of derivative activities. One may argue that as the amount of charge-off increases, the default risk that the bank has to bear increases. This may necessitate the need for use of derivatives to hedge default risk and mitigate bad loans losses. Therefore, a counter argument is such that an increase in amount charge-offs might have a positive impact on derivatives activities.

Regulatory factors, according to Jacques and Nigro (1997), are captured through capital adequacy ratio (CAR), which is the best proxy for capital requirements regulation. CAR is a measure of a bank's buffer capital, used to protect depositors and promote the stability and efficiency of financial systems.³ According to Furlong and Keeley (1989), there are two possible effects of the CAR on the diffusion pattern of derivatives items. On one hand, a high CAR increases a bank's creditworthiness, which in turn increases bank's customers' incentives to deal with bank's derivatives instruments. On the other hand, a higher CAR reduces bank's marginal gain. As bank capital increases, the incentive to assume risks increases, but the need for derivatives to hedge risk exposure may decrease. We also examine the response of banks to the 8% well capitalized total risk-based capital (RBC) standards on the capital ratio⁴. We classify the banks into two groups; low regulatory pressure, CARL and high regulatory pressure, CARH. This is because banks with CARL and CARH may react differently. CARL is the difference between the inverse of bank's actual CAR and the inverse of the stipulated CAR of 8 percent, i.e., CARL equals $(1/CAR - 1/8)$ for all banks with $RBC < 8\%$, and zero otherwise. CARH equals $(1/8 - 1/CAR)$ for all banks with a total $RBC > 8\%$ and zero otherwise. High regulatory pressure implies low creditworthiness and can be expected to

³ CAR can be expressed as $CAR = \frac{Tier I Capital + Tier II Capital}{Risk Weighted Assets}$. It is also called the capital to risk weighted assets ratio (CRAR).

⁴ Risk-Based Assessment System, Federal Deposit Insurance Corporation, FDIC. They specified three groups in terms of RBC standards, Group 1 - "Well Capitalized": Total Risk-Based Capital Ratio equal to or greater than 10 percent. Group 2 - "Adequately Capitalized": Not Well Capitalized and Total Risk-Based Capital Ratio equal to or greater than 8 percent. Group 3 - "Undercapitalized": Neither Well Capitalized nor Adequately Capitalized.

translate into lower derivatives activity. On the other hand, low regulatory pressure signifies comfortable capital position, high credit rating and active use of derivatives. Alternatively, low regulatory pressure reduces the marginal propensity to increase the risk of banks' asset portfolio (Furlong and Keeley, 1989). Therefore, banks with high capital ratios (implying low regulatory pressure) can be expected to take less derivatives risk and hence, supply a smaller volume of derivatives items.

The macroeconomic vector includes four categories; first, general economic performance measure (the real gross domestic product (GDP)). Second, price level measures (consumer price index (CPI)). Third, interest rates measures (the difference between the long and the short-term interest rate).⁵ Finally, balance of payment measures (total trade in goods, total trade in services, total trade income, total transfers, and total capital transactions).

Real GDP captures the effects caused by greater fluctuations in general economic activity. Two arguments can be made about the impact of real GDP and the usage of derivatives activities. First, the demand for derivative products reacts positively to the business cycle due to a transactions motive. Second, business risk decreases in economic boom periods, which lead to less demand for derivatives. The interest rate spread also encounters two arguments. First, large and positive interest rate spread signals a high degree of uncertainty about future interest rates and more use of derivatives to hedge. It could also signal rise in future short-term interest rates. Second, a large and positive interest rate spread gives banks' managers the incentives to engage in traditional on-balance sheet activities and take the advantage of low short-term interest rate funding and high long-term interest rate lending. Therefore, banks' managers will be less attracted to engage in derivatives activities.

The level of CPI negatively affects both derivatives and traditional banks activities. An increase in CPI reduces purchasing power and marginal propensity to save. This will reduce the bank's derivatives and traditional banks activities. All balance of payments variables, proxied by trade volume, service volume, trade income, trade

⁵ The long-term interest rate is proxied as the interest rate on long term government bonds. The short-term interest rate is proxied as the interest rate on Treasury bills.

transfer and capital volume, are expected to affect the usage of derivatives activities positively, as more international transactions will increase the need for derivatives activities.

5. Data Sources

The data set is drawn from the report of income and condition reported to the Federal Depository Insurance Corporation (FDIC) by all commercial banks in the U.S. during the period of March 1992 to December 2008 (52 quarters). Balanced data sets are constructed in a panel data format. Banks with discontinuous data were omitted to reduce the noise in the estimate. The number of banks is mainly based on the availability of derivatives items data. There are 67, 62, 20 and 19 banks included in the data sets for Swaps, Options, Forwards, and Futures, respectively. Therefore, the bank-quarter data varies from 3484 to 988.

Off-Balance Sheet Derivatives Variables include four items chosen from the report of income and report of condition schedule L. The four items are swaps, options, forwards and futures. derivative items are calculated as the ratio of the notional amount of each derivatives item to the total assets. A logistic transformation is then done according to equation (11). Total assets are defined as the summation of the on-balance sheet total assets and total derivative items.

The On-Balance Sheet Variables are also collected from the call reports of respective banks from the FDIC. The macroeconomic variables are collected from the International Monetary Fund's International Financial Statistics data base. The interest rate spread is the difference between the 10-year Treasury bond yield rate and the 3-month Treasury bill yield rate. The total trade, total service, total trade income, total transfers and the total capital is the value of the total exports and imports of goods, the total exports and imports of services, the sum of the total credit and debit income, the sum of the total credit and debit transfers, and the sum of the credit and debit sides of the capital account respectively.

6. Empirical Results

Tables (3–6) present the fixed effect estimates⁶ for the logistic diffusion model for swaps, options, forwards and futures derivative contracts. None of the included factors are significant in determining the use of futures by U.S. commercial banks.

- Time Diffusion Speed: There are significantly positive coefficients for the swaps, options, and forwards activities, and this implies that these three derivatives follow the financial innovation diffusion model over time and have taken precedence over OBS guarantees.
- Non-Regulatory Bank Specific Factors: Bank size has positive and significant impact on swaps and options contracts. This implies that swaps and options generate economies of scale, albeit they are complex, require specialized and highly qualified staff to manage them and are more likely to be used by large banks. There is a negative impact on forward contracts which seems to be more related to a bank's risk. The risk should decrease as bank size increase.

Loan ratios have positive and significant impact on the usage of swaps, which indicates informational economies of scope between loans and derivative activities. This implies that banks will participate more in derivative activities to reduce default risk resulting from loans. Loan ratios, however, have negative and significant impact on options and forwards which imply that they are substitutes for traditional bank activities (loans) and not used to mitigate the risk arising from lending activities.

Banks' profitability ratios are statistically insignificant for all derivatives contracts. The charge-off ratios have significant but negative impact on all derivatives activities except for forwards. The negative charge-off coefficients imply that banks with more non-performing loans are disadvantaged in adopting derivatives due to inadequate credibility.

- Regulatory Specific Factors have no significant effect in determining the use of derivatives. This is consistent with some recent trends whereby capital regulations are

⁶ Hausman test has rejected the null hypothesis in all cases; therefore, all estimates are fixed effect.

not considered as a major factor in derivatives usage decision-making. However, the significantly positive coefficients for forwards and options contracts for the low regulatory pressure banks mean that the better the bank's capital position and credit rating, the higher the usage of forward contracts. The significantly negative coefficient for swaps and futures contracts for the high regulatory pressure banks alludes to poor capital position, poor credit rating and low fewer derivative activities.

- Macroeconomic Factors have no significant impact on derivative activities. The coefficients of real GDP are statistically insignificant for all derivative activities except for options contracts where it is significantly negative. This suggests that the use derivative is not dictated by economic growth and business cycle. The interest rate spread has a statistically insignificant impact on derivative activities except for the forward contracts. This suggests that banks do not value the uncertainty about future interest rates when they consider derivative contracts decisions. The significantly negative impact of the interest rate spread on forward contracts can be explained by the substitution effect between traditional banking activities and derivatives activities. CPI variables also have a role in determining derivative activities. There is a negative relation between CPI and both swaps and forwards. The balance of payment variables unexpectedly have no significant role in determining the use of derivatives. However, there is significantly negative impact of total trade level on options and significantly negative impact of total transfers' level on forward derivatives contracts.

7. Concluding Remarks

The results indicate that derivatives usage is not only increasing over time but it also follows the financial innovation trend in the banking industry. We conclude that regulatory factors are not a major factor in determining the volume of derivative activities. However, bank's non-regulatory and macroeconomic factors have significant influence on the use of derivative instruments.

Banks' specific factors affect the use of derivatives in different ways. The relationship between a bank's size and derivatives is positive which is consistent with the

notion of economies of scale since derivatives require highly specialized and qualified stuff and are more likely to be utilized by large banks. The substitution effect is dominant in the case of derivatives and the loan-ratio factor. Non-performing loans will decrease derivatives activities in general due to diminished bank's credibility. The results also suggest that derivatives activities do not follow the business cycle and economic conditions. Derivatives are perceived as innovations driven by other factors like technology and learning.

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Figure (1) By Products Derivative Contracts Compared with Total Asset (During the Period of 1992 - 2008)

Table (1) Aggregated Derivatives Contracts Held by U.S. Commercial Banks⁷

	12/31/1992	12/31/1996	12/31/2000	12/31/2004	12/31/2008
Total Assets	3,506.17	4,582.2	6,245.6	8,415.6	12,318.7
Total Notional Value of Derivatives	8,764.91	20,297.4	40,759.6	88,287.7	201,080.5
Notional Amount of Credit Derivatives	0.00	0.0	425.8	2,346.7	15,896.7
Banks is Guarantor	0.00	0.0	172.6	1,127.1	7,811.0
Bank is Beneficiary	0.00	0.0	253.3	1,219.6	8,085.7
Interest Rate Contracts	4,873.25	13,427.1	32,966.4	75,519.9	164,404.4
Notional Value of Interest Rate Swaps	2,122.44	7,069.5	20,920.3	54,047.9	127,036.2
Futures and Forward Contracts	1,738.10	3,201.2	5,301.7	6,520.3	13,753.6
Written Option Contracts	504.69	1,588.6	3,362.2	7,451.7	12,127.5
Purchased Option Contracts	508.02	1,567.7	3,382.2	7,500.0	11,487.1
Foreign Exchange Rate Contracts	3,789.17	6,503.7	6,287.1	9,025.4	17,522.8
Notional Value of Exchange Swaps	278.91	470.6	899.2	2,155.5	4,133.0
Commitments to Purchase Foreign Currencies and U.S. Dollar Exchange	3,015.51	5,000.6	4,614.0	5,135.6	9,226.5
Spot Foreign Exchange Rate Contracts	0.00	262.0	189.3	418.8	698.9
Written Option Contracts	245.68	529.9	398.8	867.0	2,064.0
Purchased Option Contracts	249.08	502.6	375.1	867.3	2,099.3
Contracts on other Commodities and Equities	102.48	366.6	1,080.2	1,395.7	3,256.6
Notional Value of Swaps	15.86	61.1	148.0	203.1	536.4
Futures and Forward Contracts	26.31	101.6	150.4	127.6	230.8
Written Option Contracts	30.89	106.8	383.9	558.3	1,294.8
Purchased Option Contracts	29.40	97.1	397.8	506.8	1,194.6

⁷ Sources: FDIC, Statistics on Banking, Various Issues. Hwww.fdic.gov

Table (2) Variables used in the model

Variable	Symbol	Definition
Time	Time	Deterministic trend
Size	LTA	Log(total assets)
Loan Ratio	LLR	Total loans/total assets
Bad loans	LCOFF	Charge – off
Low Regulatory Pressure	CARL	$CARL = \begin{cases} 1 / CAR_{actual} - 1 / 0.08, & \text{if } CAR_{actual} < 8\% \\ 0, & \text{if } CAR_{actual} > 8\% \end{cases}$
High Regulatory Pressure	CARH	$CARH = \begin{cases} 1 / 0.08 - 1 / CAR_{actual}, & \text{if } CAR_{actual} > 8\% \\ 0, & \text{if } CAR_{actual} < 8\% \end{cases}$
Gross Domestic Product	LGDP	Log(GDP)
Interest Rate Spread	LINR	Long-term rate – Short term rate
Consumer Price Index	LCPI	Log(CPI)
Trade Volume	LTR	Log(goods export + goods import)
Service Volume	LTS	Log(services export + services import)
Trade Income	LTIN	Log(credit income + debit income)
Trade transfer	LTTR	Log(credit transfer + debit transfer)
Capital Volume	LTCA	Log(credit capital + debit capital)

Table (3): The estimation of *Swaps* determinants model, where the explanatory variables appearing in the first column are classified into time, bank specific characteristics, regulatory variables, and macroeconomic variables. The first row represents the coefficient (COEFF.) and standard errors (S.E).

	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E
CONST	-11.1703*	4.60854	-6.11826*	.640545	-2.18807	2.46779	-6.20611*	1.95574	-4.20611*	1.75474
TIME	.0682592*	.00807569	.0898452*	.00261932	.0071982^	.00343954	.0342363*	.00489942	.02478963*	.00247856
LTA	.166791*	.031950	.168993*	.031849	.162161*	.032144	.170587*	.031828	.1714879*	.03312478
LLR	.464278*	.160520	.489893*	.161053	.468348*	.160800	.472907*	.160216	.45844576*	.1332546
LNI	.00000001	.00000002	.000000012	.00000002	.000000015	.00000002	.000000010	.00000002	.000000012	.000000012
LCOFF	-.0000001*	.00000004	-.00000013*	.00000004	-.0000001*	.00000004	-.0000001*	.00000004	-.0000001*	.00000003
CARL	-.00095678	.00161509	-.000871188	.00162585	-.00116980	.00162550	-.00097686	.00163059	-.00075987	.001514879
CARH	-.00835656	.00575033	-.00748306	.00587816	-.976292 [□]	.591465	-.00862595	.00601570	-.00775896	.005987562
LGDP	1.14637	1.05136	---	---	---	---	---	---	1.15125	1.0012368
LINR	---	---	-.011979	.025180	---	---	---	---	.0121145 [□]	.018171751
LCPI	---	---	---	---	-.860799 [□]	.514832	---	---	-.5478956 [□]	.81375425
LTR	---	---	---	---	---	---	-.278971	.438876	-.2254781	.394588876
LTS	---	---	---	---	---	---	.411992	.326292	.385429682	.33548792
LTIN	---	---	---	---	---	---	-.054735	.208811	-.06214587	.325879811
LTTR	---	---	---	---	---	---	.021274	.057007	.019875674	.065487244
LTCA	---	---	---	---	---	---	.013610	.031672	.015412560	.044785672
No. Obs.	3484		3484		3484		3484		3484	
R ²	.117852		.118039		.116466		.118100		.119215	
L.M	.608039 [.436]		.452755 [.501]		.922985 [.356]		.501295 [.479]		.445987 [.545]	
D.W	.123585 [.000,.000]		.123095 [.000,.000]		.123301 [.000,.000]		.123818 [.000,.000]		.1236548 [.000,.000]	

Note: (*), (^), (□) represent significance levels of 1%, 5%, and 10%, respectively

Table (4): The estimation for *Options* determinants model, where the explanatory variables appearing in the first column are classified into time, bank specific characteristics, regulatory variables, and macroeconomic variables. The first row represents the coefficient (COEFF.) and standard errors (S.E).

	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E
CONST	40.8767*	9.71390	-5.52269*	1.42935	-5.14757	5.22204	2.70133	4.14554	2.70133	4.14554
TIME	.065978*	.016941	-.031489*	.00557205	-.010062	.00726292	.00788569	.010363	.00788569	.010363
LTA	.358127*	.071206	.308091*	.070755	.360975*	.071874	.284628*	.070713	.284628*	.070713
LLR	-.995284*	.254729	-1.00139*	.256100	-.989828*	.254962	-1.03694*	.256218	-1.03694*	.256218
LNI	-.00000002	.00000004	-.000000012	.00000004	-.00000002	.00000004	-.00000002	.00000004	-.00000002	.00000004
LCOFF	-.0000001 [□]	.00000008	-.00000015 [□]	.00000008	-.0000001 [□]	.00000008	-.0000001 [□]	.00000008	-.0000001 [□]	.00000008
CARL	.00447682 [□]	.00271763	.00251365	.0027383	.00505021 [□]	.00273811	.00246250	.00275168	.00246250	.00275168
CARH	.00241594	.011783	-.013960	.011956	.00705593	.012052	-.013520	.012255	-.013520	.012255
LGDP	-11.2358*	-2.22168	---	---	---	---	---	---	-10.25487*	2.124587
LINR	---	---	.158561*	.053450	---	---	---	---	.147852*	.049875
LCPI	---	---	---	---	-.136138	1.07978	---	---	-.114528	1.0992
LTR	---	---	---	---	---	---	-2.10569 [^]	.921257	-1.524897 [^]	.8521465
LTS	---	---	---	---	---	---	.085650	.6931100	.07548625	.6658792
LTIN	---	---	---	---	---	---	.270175	.439930	.254789	.4125874
LTTR	---	---	---	---	---	---	.151494	.121145	.1558796	.132547
LTCA	---	---	---	---	---	---	-.012122	.067299	-.021458	.085479
No. Obs.	3224		3224		3224		3224		3224	
R ²	.110484		.103014		.110388		.101919		.100254	
L.M	21.6187 [.000]		13.6084 [.000]		21.0843 [.000]		8.36481 [.000]		7.25698 [.000]	
D.W	.112869 [.000,.000]		.112381 [.000,.000]		.112816 [.000,.000]		.111241 [.000,.000]		.111158 [.000,.000]	

Note: (*), ([^]), ([□]) represent significance levels of 1%, 5%, and 10%, respectively

Table (5): The estimation for *Forwards* determinants model, where the explanatory variables appearing in the first column are classified into time, bank specific characteristics, regulatory variables, and macroeconomic variables. The first row represents the coefficient (COEFF.) and standard errors (S.E).

	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E
CONST	3.46283*	.696573	7.53414*	1.66284	38.5244*	10.1471	23.8968*	7.87760	23.8968*	7.87760
TIME	.0449490*	.00523209	-.026450*	.010036	.050619*	.013836	.062776*	.020524	.062776*	.020524
LTA	-.0044949*	.035018	-.478177*	.035029	-.663893*	.031636	-.661730*	.031576	-.661730*	.031576
LLR	-.0085547*	.00121634	-.00863993*	.00121286	-.012000*	.0012377	-.012162*	.00123451	-.012162*	.00123451
LNI	-.00000010	.00000031	-.000000084	.000000315	-.000000044	.000000033	-.000000039	.000000034	-.000000039	.000000034
LCOFF	.000000001	.000000004	.0000000011	.000000004	.000000005	.000000004	.000000004	.000000004	.000000004	.000000004
CARL	.141680^	.071948	.114077	.072653	.065828	.078229	.066761	.077803	.066761	.077803
CARH	-.027685*	.00951055	-.025589*	.00948567	-.022738^	.010066	-.024085*	.010063	-.024085*	.010063
LGDP	.027032	.059934	---	---	---	---	---	---	.012548	.0612584
LINR	---	---	-.634076*	.062500	---	---	---	---	-.521487	.0578954
LCPI	---	---	---	---	-6.92576*	2.19439	---	---	-5.89745	1.98547
LTR	---	---	---	---	---	---	-2.50211	1.84735	-1.87452	1.98754
LTS	---	---	---	---	---	---	-.803190	1.40437	-.778540	1.54287
LTIN	---	---	---	---	---	---	.341231	.912903	.4215478	1.012548
LTTR	---	---	---	---	---	---	-.420133*	.246697	-.445879*	.2021548
LTCA	---	---	---	---	---	---	-.181648	.136797	-.201548	.154872
No. Obs.	1040		1040		1040		1040		1040	
R ²	.242825		.242230		.166709		.166644		.164785	
L.M	15.9999 [.000]		16.9176 [.000]		2.47371 [.116]		2.60037 [.000]		2.714 [.000]	
D.W	.114805 [.000,.000]		.114883 [.000,.000]		.120018 [.000,.000]		.121171 [.000,.000]		.124785 [.000,.000]	

Note: (*), (^), (°) represent significance levels of 1%, 5%, and 10%, respectively

Table (6): The estimation for *Futures* determinants model, where the explanatory variables appearing in the first column are classified into time, bank specific characteristics, regulatory variables, and macroeconomic variables. The first row represents the coefficient (COEFF.) and standard errors (S.E).

	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E	COEFF.	S.E
CONST	5.01199	13.2301	-3.90915^	1.78720	7.44210	7.19740	1.52700	5.48932	1.52700	5.48932
TIME	.017279	.023218	.0058992	.00767113	.019417 [□]	.010319	.021697	.013759	.021697	.013759
LTA	-.015418	.090409	-.053310	.089589	-.034235	.091838	-.054542	.089376	-.054542	.089376
LLR	.216681	.425315	.330942	.427344	.259726	.426809	.285020	.428557	.285020	.428557
LNI	.000000006	.00000003	.00000002	.000000037	.000000013	.000000037	.00000002	.000000037	.00000002	.000000037
LCOFF	-.0000001^	.00000006	-.0000001^	.000000067	-.0000001^	.000000068	-.0000001^	.000000068	-.0000001^	.000000068
CARL	.013273	.033871	.016217	.033833	.011495	.033990	.014084	.033985	.014084	.033985
CARH	-.0013688	.015141	.00263787	.015045	-.00293674	.015849	-.00090429	.015531	-.00090429	.015531
LGDP	-1.89702	3.04164	---	---	---	---	---	---	-1.745865	3.12587
LINR	---	---	-.036434	.070257	---	---	---	---	-.033254	.068975
LCPI	---	---	---	---	-2.08417	1.48667	---	---	-2.14587	1.49879
LTR	---	---	---	---	---	---	.343624	1.23237	.548723	1.22548
LTS	---	---	---	---	---	---	-.935693	.912038	-.854793	.874162
LTIN	---	---	---	---	---	---	-.404106	.593044	-.501256	.6214587
LTTR	---	---	---	---	---	---	-.063350	.159067	-.054879	.166587
LTCA	---	---	---	---	---	---	-.010221	.088214	-.021487	.1002874
No. Obs.	988		988		988		988		988	
R ²	.00358380		.011790		.010354		.0016288		.0011258	
L.M	4.46847 [.035]		3.93199 [.047]		4.09445 [.024]		4.90374 [.027]		5.012548[.021]	
D.W	.314503 [.000,.000]		.307556 [.000,.000]		.311392 [.000,.000]		.307626 [.000,.000]		.310051[.000,.000]	

Note: (*), (^), (□) represent significance levels of 1%, 5%, and 10%, respectively.