How bank business models drive interest margins:

Evidence from U.S. bank-level data

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Abstract

The two decades prior to the credit crisis witnessed a strategic shift from a traditional, relationships-oriented model (ROM) to a transactions-oriented model (TOM) of financial intermediation in developed countries. A concurrent trend has been a persistent decline in average bank interest margins. In the literature, these phenomena are often explained using a causality that runs from increased competition in traditional segments to lower margins to new activities. Using a comprehensive dataset with bank-level data on over 16,000 FDIC-insured U.S. commercial banks for a period ranging from 1992 to 2010, this paper qualifies this chain of causality. We find that a bank's business model, measured using a multi-dimensional proxy of relationship banking activity, exerts a robust, positive effect on interest margins. Relationship banks still enjoy considerable interest margins. Our results provide evidence that banks' quest for growth, not the level of competition in traditional retail segments, has transformed banks' balance sheets and has reduced interest rate margins as a by-product.

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1. Introduction

Interest margins in developed banking sectors have experienced a steady decline during the past two decades. In explanation of this phenomenon, the literature describes a causality that runs from increased competition in the retail segments to lower margins to new activities. A common argument runs as follows: heightened competition and disintermediation depressed interest margins in traditional retail markets, motivating banks in developed countries to diversify into new lines of business in order to increase their non-interest income (Allen and Santomero 2001; Lepetit *et al.* 2008; Valverde and Fernández 2007; Albertazzi and Gambacorta 2009). However, empirical research by Elsas (2005) and DeGryse and Ongena (2007) shows that heightened interbank competition *reinforces* banks' focus on traditional, relationship lending activities. These seemingly contradictory findings call into question the exact nature of the relationship between competitive conditions, bank strategy and interest margins.

This paper seeks to qualify the chain of causality running from competition to lower margins to new activities. We propose an alternative explanation for the decline in interest margins, which, in our view, better fits the empirical and narrative evidence on bank behavior in the run-up to the credit crisis. The two decades prior to the credit crisis also witnessed a strategic shift from a relationships-oriented model (ROM) to a transactions-oriented model (TOM) of financial intermediation in developed countries. Although theory suggests that this development has important repercussions for the size of net interest margins, it has largely been omitted in the empirical research on bank interest margins.

Using a comprehensive dataset with bank-level data on over 16,000 FDIC-insured U.S. commercial banks for a period ranging from 1992 to 2010, this paper tests whether a bank's business model is empirically important in explaining the size of bank interest margins in the United States. In addition to a number of univariate proxies commonly used in the literature, we utilize factor analysis to measure the variable of interest, i.e. relative adherence to ROM, using five different dimensions. In doing so, we provide a more detailed and accurate description of the chain of causality leading to lower interest margins in developed banking industries than the one that is available now. The key difference with the traditional explanation is that banks' quest for growth, not the level of competition in traditional retail segments, has transformed banks' balance sheets and has reduced interest rate margins as a by-product.

There are several reasons why we think our empirical agenda is important. First, earlier research on the impact of competitive conditions on bank interest margins has proven inconclusive (see section 2). This implies that there is room for an alternative or complementary explanation. Second, most sample periods of recent studies in the field end in 2001 (Valverde and Fernández 2007 and Hawtrey and Liang 2008) and thus do not cover the period in which the strategic shift towards transaction banking has been most prominent.[1] While the shift from relationship towards transaction banking has figured prominently in debates on the causes of the credit crisis (Buiter 2008), its implications for interest rate margins have not been researched previously. Our sample covers the period 1992 – 2010, and promises to yield interesting results in this respect. Finally, a better

[1] The only exception is a small-scale study by Liebeg and Schwaiger (2009) looking at the determinants of interest margins of small, local banks in Austria, with a sample ranging to 2005.

understanding of the different banking models and their impact on bank earnings profiles can contribute to the policy debate sparked by the credit crisis.

This paper is structured as follows. Section 2 provides an overview of the relevant literature. Section 3 describes our methodology and dataset and lists the hypotheses for testing. Section 4 provides descriptive statistics and our preliminary findings. Section 5 reports the results. Section 6 concludes.

2. The impact of bank business models on interest margins

Central in empirical research in the field of interest margins is the model developed by Ho and Saunders (1981). Combining the at that time concurrent hedging and expected utility approaches, Ho and Saunders (henceforth HS) model banks as risk-averse 'dealers' in deposits and loans. The demand and supply functions of bank loans and deposits follow stochastic processes, causing deposit supplies to arrive at different times than loan demands. Banks demand a positive spread as the price for providing immediacy of service in face of this transactions uncertainty. The bank sets loan and deposit rates, at which it extends new loans and accepts deposits:

$$R_D = r - a \quad (1)$$

$$R_L = r + b \quad (2)$$

The net interest margin or spread is equal to the sum of these two mark-ups or the difference between the rate earned on loans minus the rate paid on deposits:

$$s = R_L - R_D = (a + b) \quad (3)$$

where:

R_D is the rate set on deposits,
R_L is the rate set on loans,
r is the expected risk-free or market interest rate,
a and b are risk premia charged to compensate for the transaction risk involved in financial intermediation.

According to HS, the optimal mark-ups and thus the interest margin of a bank are a function of the competitive conditions and a risk-adjustment term:

$$s = (a + b) = \frac{\alpha}{\beta} + \frac{1}{2} R \sigma_I^2 Q \quad (4)$$

The first term or α/β is the ratio of the intercept (α) and slope (β) of the symmetric deposit and loan arrival functions and measures the bank's risk-neutral spread given its monopoly power or the elasticity of supply and demand. The size of the risk-adjustment term depends on three factors: (i) R, bank's management's coefficient of risk aversion; (ii) σ_I^2, interest rate volatility; and (iii) Q, transaction size. Increased competition or lower market power (α/β) lowers net interest margin s. Degree of risk aversion (R) determines the size of the risk premium charged. If risk appetite increases (i.e. R decreases), the risk premium charged is smaller and net interest margins decrease (compare Saunders and Schumacher 2000).

Over the years, authors have made several extensions to this model. Allen (1988) incorporates loan heterogeneity in the model. Angbazo (1997) and Maudos and De Guevara (2004) formally include respectively credit risk and operating costs. Empirical research in the field has attested to the positive relationship between bank interest margins and interest rate risk, measured using rate volatility (e.g. Angbazo 1997; Saunders and Schumacher 2000; Valverde and Fernández 2007). Also credit risk is found to influence margins positively, suggesting that banks add a default risk premium to loan rates (HS; Angbazo 1997; Maudos and De Guevara 2004; Hawtrey and Liang 2008). Management's degree of risk aversion as well as transaction size have proven more difficult to quantify and have at times been excluded from empirical testing. Since HS's seminal paper, empirical research on interest margins has reported a significant impact of additional factors such as capital structure, operating costs and managerial efficiency. Section 3 describes the different determinants of bank interest margins and their measurement in more detail.

HS posit that competitive conditions influence the size of bank interest margins, such that higher market power leads to higher margins. In the past two decades, the interest margins of banks in many developed banking industries, including the United States, have been declining steadily. In explanation of deteriorating or low margins, studies in the field show a strong focus on market structure (Demirgüç-Kunt and Huizinga 1999; Maudos and De Guevara 2004; Gischer and Jüttner 2003; Berger *et al.* 2004; De Guevara *et al.* 2005; Lepetit *et al.* 2008), following for example the traditional structure-conduct-performance (SCP) hypothesis or similar paradigms.[2]

One often-used argument is the following: increased competition and disintermediation lowered margins in traditional retail markets, and in response banks in developed countries branched into non-traditional activities in order to increase their non-interest income. Thus, for example Allen and Santomero (2001, p. 274) recount: "As traditional businesses began to dry up, the management of those institutions was forced to become entrepreneurial and develop new businesses in order to survive." Lepetit *et al.* (2008, p. 2325) state that: "Commercial banks suffered from a sharp decline in interest margins and profitability on traditional intermediation activities. Banks reacted to this new environment by diversifying into new activities." See Valverde and Fernández (2007, p. 2058) and Albertazzi and Gambacorta (2009, p. 395) for further illustrations of this line of reasoning. Common to these quotes is a causality that runs from competition to lower margins to new activities.

The empirical evidence, however, is hazy at best. Authors in the field generally agree that market structure, often measured using an index of market concentration or market power such as the Herfindahl index or Lerner index, affects margins positively. Demirgüç-Kunt *et al.* (2003) find that the generally positive relationship between concentration and bank margins breaks down when controlling for institutional development. Valverde and Fernández (2007) also suspect that the relationship between concentration and interest margins may be influenced by third variables and find that market concentration can even

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[2] There is a long string of literature looking into the relationship between market structure and bank profitability. Bikker and Bos (2005) provide an overview of the different approaches to analyzing the relationship between competition, efficiency and profitability in the banking industry.

affect margins negatively. Demirgüç-Kunt and Huizinga (1999) and Gischer and Jüttner (2003) find evidence that banks in countries with a more competitive banking sector have smaller margins. Yet in contrast, Maudos and De Guevara (2004) attribute the fall of margins in the European banking system to a relaxation of competitive conditions rather than heightened competition. The heterogeneity of the available evidence calls into question the exact nature of the relationship between competitive conditions and margins.

We put forward an alternative or more complete explanation. In the past two decades, many banks moved from a traditional, relationships-oriented model of financial intermediation (ROM) towards a transactions-oriented model of financial intermediation (TOM). This shift in business model is obviously closely related to the structure of the markets in which banks operate and also affects banks' market power, but not in the way in which this relationship is usually modeled in the literature on bank interest margins.

Because of their ability to invest in customer-specific information – often 'soft' in nature –, relationship banks can produce differentiated products, create local market power and establish information monopolies (e.g. Rajan 1992; Boot 2000; Elyasiani and Goldberg 2004). These locally focused banks have the potential to earn high margins: paying a low interest rate to a loyal base of core depositors, they can charge high interest rates to an information-problematic class of borrowers, which otherwise would have difficulty obtaining funding from the capital markets, and over which they have market power due to information-based switching costs. In contrast, transaction banking focuses on the efficient use of 'hard' information and the commoditization of financial services. Transaction banks take advantage of economies of scale in the production, marketing, securitization and servicing of 'transaction loans'. These banks operate with low unit costs, but are likely to earn low interest margins as they are essentially selling financial commodity products in highly competitive markets. As a result, spreads for transaction banks are likely to be smaller (DeYoung *et al.* 2004, DeYoung and Rice 2004b and DeYoung 2010).

Authors such as Allen and Santomero (2001), Lepetit *et al.* (2007) and Albertazzi and Gambacorta (2009) assume that increased competition in the traditional, retail segments motivated banks to move from a traditional, relationships-oriented model towards a transactions-oriented model of financial intermediation. However, this is not obvious from the literature. Boot and Thakor (2000) predict that increased interbank competition (as opposed to competition driven by capital markets or disintermediation) renders relationship lending *more* attractive for banks since it provides better insulation against price competition (see also Elsas 2005). This is affirmed by the empirical findings of Elsas (2005) and DeGryse and Ongena (2007), who find that fiercer interbank competition reinforces banks' focus on relationship lending activities.[3] Indeed, DeYoung (2010) suggests that there exists a strategic equilibrium, with large, transaction banks on one side and smaller, relationship banks on the other side.

Rather, it seems that deregulation and technological advances left banks with a strategic choice between ROM and TOM. The former is a profitable strategy, with the opportunity to

[3] Using product-level data on an important Belgian bank, DeGryse and Ongena (2007) find that bank branches facing stiff local competition shift their orientation towards relationship banking. Elsas (2005), analyzing data on German Hausbanks, also finds that for low and intermediate levels of local market concentration, competition increases the likelihood of relationship lending.

exploit local market power and achieve considerable interest margins. Yet the opportunity for growth in this strategy is inherently limited, both because transportation and monitoring costs increase with geographical distance to the borrower (e.g. DeGryse and Ongena 2005) and because smaller banks have a competitive advantage in processing the soft information used in relationship lending (e.g. Berger and Udell 2002 and Stein 2002). Large banks, given the scale of their operations, were better equipped to react to the strategic opportunity posed by the new technologies such as credit scoring and securitization. Slow growth in the traditional deposit and loan segments constrained these banks in their quest to maximize return on equity (ROE). Wholesale funding and securitization enabled them to free themselves from these constraints as they accessed the international markets, and opened up a quick route to expansion and higher ROE. Huang and Ratnovski (2010) call this one of the "bright sides" of wholesale funding. Although the move towards TOM entailed a move into more competitive market segments with lower interest margins, the scalability of their operations and the opportunity to supplement their interest income fee income from loan origination, securitization and loan servicing, allowed transaction banks to earn higher returns on equity than traditional banks (DeYoung *et al.* 2004 and DeYoung and Rice 2004b).

The contribution of the present paper is to incorporate the shift from traditional intermediation services to transaction banking in an empirical model of margins. The shift towards transaction banking blurs the conventional relationship between market structure, competition and interest margins as investigated in empirical studies of bank interest margins. The balance sheets of today's banks are an assortment of ROM elements (loans and deposits) and TOM elements (securities and money-market funding). Banks conducting business in the international money and capital markets hold little market power. As a result, near-competitive conditions hold, and TOM-margins will either be thin or reflect (excessive) risk-taking. For the ROM-share of the balance sheet, however, different conditions hold and banks may be able to exploit market power due to local presence or information monopolies. A bank's overall net interest margin will reflect the composition of the balance sheet and specifically the allocation across ROM- and TOM-activities.

The strategic repositioning from ROM towards TOM can thus provide an explanation for the negative relationship between concentration ratios and interest margins that is occasionally found in the literature (e.g. Maudos and De Guevara 2004). When transaction banking and bank consolidation are two contemporaneous trends, a larger concentration ratio is likely to coincide with lower interest margins. It is therefore important to disentangle the TOM-effect by including a variable measuring the shift to transaction banking into an empirical model of interest margins.

In conclusion, in an era of rapidly changing banking models, an empirical model of interest margins should take bank balance sheet composition into account as a relevant driver of margins. If the strategic shift amongst banks in the past two decades proves to be an important driver of spreads, our results provide a more accurate explanation for the decline in interest margins that occurred in many developed banking sectors than the one that is available now.[4] The following section puts forward our model for testing and lists the associated hypotheses.

[4] Note that our alternative explanation of the reduction in bank interest margins does not exclude the possibility that bank retail markets have become more competitive over the years. As such, it can

3. Data and methodology

This paper uses bank-level data from the call reports (also: Thrift Financial Reports) published on a quarterly basis by the Federal Deposit Insurance Corporation (FDIC). Our panel dataset contains quarterly balance sheet and income statement data on every FDIC-insured commercial bank for a period ranging from 1992 to 2010. The cross-section includes more than 16,000 banks (unbalanced sample). The number of bank-quarter observations is 385,971; the number of bank-year observations is 161,239. We use annual series in our analyses and use the quarterly series to test the robustness of our findings.

We prefer using annual series over quarterly series because of two reasons. First of all, statements of condition and income were only filed on a quarterly basis from 2001 onwards. Before that year, reports were filed on an end-of-year basis only. Including the years 1992 – 2000 thus requires a conversion of the end-of-year income data to approximate average quarterly income in these years. Since the 1990s were a period characterized by industry deregulation and increased transaction banking activity, we prefer analyzing the entire sample period 1992 – 2010 using the annual data, utilizing the quarterly data for robustness testing. Secondly, the quarterly statements of income are filed on a year-to-date basis. For several variables of interest, the analysis of consecutive quarters therefore requires a year-to-date conversion that isolates quarterly income.

The length and size of our sample poses some challenges in terms of data handling. The following describes the main decisions made in this respect. First of all, we follow Demsetz (1999), Kashap and Stein (2000), Maudos and De Guevara (2004) and Claeys and Van der Vennet (2008) in conducting our analysis on the bank-level (as opposed to the holding company level) and use unconsolidated data. We consider the bank an appropriate decision-making unit as regards the distribution of activities between ROM and TOM. Second, to eliminate the distorting effect of bank mergers and acquisitions for the continuity of our time series, we follow Kashap and Stein (2000), Campello (2002) and Cebenoyan and Strahan (2004) and eliminate all bank-quarters, in which mergers or acquisitions took place, from our sample. Thus, we removed all bank-quarter (bank-year) observations, in which asset growth was above 100 percent or below 100 percent as well as those in which total loan growth was above 50 percent or below 50 percent (Cebenoyan and Strahan 2004). Further, we lose some data due to obviously incorrect data. For instance, we dropped those observations from the sample, for which balance sheet ratios either exceeded 1 or were negative.[5] Finally, the ratios of securities plus other assets to total loans, operating costs to gross income and loans to employees have some very large positive and negative outliers. To make sure that these outliers do not drive our results, we have Winsorized these variables at the 0.5% level (i.e. at the 0.5th and 99.5th percentile) (Cebenoyan and Strahan 2004). These corrections leave us with a total sample of 139,362 observations using annual series (or 313,219 using quarterly series).

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coexist with the traditional explanation. It is also undeniable that in recent decades non-interest income has become a more important source of revenues for banks. Our point is, however, that, irrespective of any changes in the intensity of competition in traditional retail banking, any move from the relationship to the transaction banking model will serve to reduce interest rate margins.

[5] Thus, we removed some observations on the basis of the equity-to-liabilities, deposits-to-liabilities and loans-to-assets ratios. Also, we excluded observations where the ratio of operating expenses to average assets was either negative or exceeded 1. We also excluded those observations where total assets and total liabilities reported by a particular bank differed with more than $50,000.

The macro-level variables included in our analysis have three different sources. Quarterly and annual GDP statistics are obtained from the OECD National Accounts. Data on inflation or the rate of change of the consumer price index (CPI) is taken from the OECD Economic Outlook. Finally, daily (quarterly, annual) rates on Treasury bills with different maturities are obtained from the Federal Reserve Bank.

Following more recent iterations of the HS model (including those of Angbazo 1997, Maudos and De Guevara 2004 and Hawtrey and Liang 2008), we test an extended empirical specification, incorporating the effects of such factors as credit risk, operating costs, managerial efficiency and scale on bank interest margins. We add one additional variable to capture the extent to which banks are operating according to either a relationships-oriented or a transactions-oriented model (*relbank*). This leads to the following specification:

$$\begin{aligned} margin_{i,t} = \ & \alpha + \beta_1 * relbank_{i,t} + \beta_2 * capstruc_{i,t} + \beta_3 * dgdp_t + \beta_4 * inflation_t \\ & + \beta_5 * i\text{-}level_t + \beta_6 * i\text{-}vol_t + \beta_7 * credrisk_{i,t} + \beta_8 * opex_{i,t} + \beta_9 * c5_t \\ & + \beta_{10} * implint_{i,t} + \beta_{11} * oppcost_{i,t} + \beta_{12} * riskexp_{i,t} + \beta_{13} * maneff_{i,t} \\ & + \beta_{14} * scale_{i,t} + \varepsilon \end{aligned} \quad (5)$$

In this equation i denotes bank i and t denotes year t. The dependent variable, net interest margin (*margin*), is defined as net interest income as a percentage of average total assets or (interest income – interest expense)/average total assets (see also Angbazo 1997, Demirgüç-Kunt and Huizinga 1999, Maudos and De Guevara 2004 and Hawtrey and Liang 2008).

To measure the effect of a bank's business model on interest margins, we use six different indicators. There are several bank-level measures of relationship banking found in the literature. Asset-based measures include small business loans (with original dollar amounts of <$1M or <$500K) as a percentage of total assets (Goldberg and White 1998 and Elyasiani and Goldberg 2004); the ratio of commercial and industrial loans to total assets (Goldberg and White 1998); and the ratio of commercial and industrial loans plus construction loans, agricultural loans and leases to total assets (Peek and Rosengren 1995 and Goldberg and White 1998). These studies indicate that these are loans typically made by local banks, characterized by informational opacity and not easily securitized. More recent research by Berger and Udell (2006) nuances this view, stressing that lending technology used rather than client group served determines whether a loan should be classified as a relationship loan.[6] According to Berger and Udell, asset-based lending technologies (including factoring, fixed-asset lending and leasing) are based on hard information about the quality of the underlying asset and are correctly classified as transactions lending technologies, alongside credit scoring and financial statement lending.

Taking this into account, we construct two assets-based measures of relative relationship banking activity. The first is based on the amount of corporate loans on a bank's balance sheet, excluding those loans that are secured by real estate, land, or other means.

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[6] Not all loans made to groups of clients for which problems of information asymmetry are acute (such as small businesses) can as such be classified as relationship loans. One way to mitigate problems of information asymmetry in the absence of hard information about a client's soundness and profitability is to engage in asset-based lending. In this case, the collateral provides insurance against the risk stemming from the problem of information asymmetry and effectively substitutes for investments in soft or proprietary information about the borrower as used in relationship lending.

Construction, land development and other land loans reported to the FDIC are secured by real estate or land and therefore fit Berger and Udell's definition of transaction loans, as do leases. However, commercial and industrial loans and farm loans are generally unsecured. We therefore use the ratio of commercial and industrial loans plus farm loans to total assets as a first measure of relationship banking activity (*corploass*). Secondly, from 2003 onwards, the June call reports include a statement of small business lending, allowing us to perform an additional regression on 47,653 bank-quarter observations. Drawing upon this schedule, we use the ratio of small business loans (with original amounts of $1M or less) to total assets (*sbloass*) as an alternative assets-based dimension of relationship banking activity.

Another, liabilities-based, measure of relative relationship banking activity found in the literature is the core deposits to total liabilities ratio. Berlin and Mester (1999) were the first to link deposit-funding to relationship lending. They show that banks funded more heavily with core deposits, like savings or demand deposits, are able to provide more inter-temporal loan rate smoothing in response to exogenous credit shocks, a feature often attributed to relationship lending (e.g. Allen and Gale 1997; Boot 2000). Song and Thakor (2008) expand this notion and establish that banks want to match the highest value-added liabilities (core or retail deposits) with the highest value-added loans (relationship loans). In doing so, banks minimize the fragility imposed by withdrawal risk and maximize the value added in relationship lending. We use the ratio of core deposits to total liabilities as a third measure of bank business model (*depliab*).

Fourth, we include the ratio of interest income to total income (i.e. interest income plus non-interest income) (*intincrel*). Non-interest income includes income from trading and securitization, investment banking and advisory fees, brokerage commissions, venture capital, and fiduciary income, and gains on non-hedging derivatives. DeYoung (2007) and Brunnermeier *et al.* (2011) suggest that a higher ratio of non-interest income to total income is as such related to an increase in non-traditional (or transaction banking) activities (whilst interest income derives from more traditional banking activities).

Fifth, we include the natural logarithm of the number of domestic offices divided by total loan volume (*branchnet*) as a measure of local presence. We posit that a higher ratio of domestic offices to loan volume is indicative of a stronger branch network, which is a feature of a traditional, relationship banking strategy, rather than an arm's length or transaction banking model.

Finally, the literature suggests that the implementation of ROM versus TOM is related to bank size. Whereas large banks may have a competitive advantage in making 'hard'-information based transaction loans, small banks have a competitive advantage in lending technologies that are based on relationship lending and 'soft' information and are best managed in small, closely-held organization with few managerial layers. Recent research by Berger and Black (2010) and De La Torre *et al.* (2010) affirms the relative advantages in the different lending technologies related to asset size, but dispels the notion that this means that large banks are per definition better at catering to large, transparent organizations, and small banks to small and opaque borrowers, for the reasons described by Berger and Udell (2006). We explore the role of bank size by analyzing subsamples based on asset size (*assetclass*). Following DeYoung (2007), we divide banks in the sample in four asset classes: (i) large banks, with more than $20B of assets; (ii) medium banks, with assets between $10B and $20B; (iii) large community banks, with assets between $500M and $2B; and (iv) small community banks, with assets of $500M or less (compare DeYoung *et al.* 2004; Stiroh 2006; DeYoung 2010). We use 2007 as our base year and track the banks in the different classes over time.

There is a certain measurement error in making inferences about a bank's business model from any single one of the relationship banking measures described above. Using multiple measures of a construct tends to reduce the effect of measurement error in any individual indicator on the accuracy of results (Kline 2005). In addition to analyzing the impact of these univariate proxies of a bank's business model, we therefore perform a factor analysis. Factor analysis allows latent variables or phenomena of theoretical interest, which cannot be observed directly – in our case adherence to ROM –, to be assessed by a set of measures which are observable: reflective indicators (see e.g. Diamantopoulos *et al.* 2008). We present the results of this analysis in the next section. In our tests of specification (8), we thus include a number of univariate proxies of relationship banking activity. In addition, we include two composite measures of a bank's business model, which use five different dimensions. We expect a significant, positive relationship between all these variables, indicative of bank's business model, and a bank's net interest margin.

We will briefly comment on the other, control variables in equation (8). As is common to more recent iterations of the HS model, we include the core capital-to-assets ratio (*capstruc*) to capture the effect of bank capital structure or solvency on margins, and expect a positive effect (e.g. Angbazo 1997; Demirgüç-Kunt and Huizinga 1999; Valverde and Fernández 2007). We incorporate both economic growth (*dgdp*) and inflation (*inflation*) in our model to control for the macroeconomic environment.

Further, we include both interest rate level and interest rate volatility in our regression (*i-short* and *i-vol*). In line with the research by Borio and Zhu (2008) and Maddaloni and Peydró (2010), the coefficient for interest rate level captures the effect of monetary policy on bank risk-taking and, ultimately, interest margins. Interest rate volatility is the conventional proxy for interest rate risk; in the original HS framework, this is expected to bear a positive sign. In line with HS, Saunders and Schumacher (2000), Maudos and De Guevara (2004) and Hawtrey and Liang (2008), we use the annual (or quarterly, where appropriate) standard deviation of daily interest rates on 3-month Treasury bills to proxy interest rate risk. To test the sensitivity of interest rates to longer-term volatility and add to the robustness of our results, we repeat our regression analysis using the rates on 1-year and 3-year Treasury bills.[7]

There are several measures of credit risk found in the literature. We follow HS and Angbazo (1997) and use net loan charge-offs/average total assets (*credrisk*), expecting a positive sign. We check whether the results obtained using this measure hold when using alternative proxies of credit risk, such as the loans-to-assets ratio (e.g. Maudos and De Guevara 2004) and loan loss allowance as a percentage of total assets (e.g. Angbazo 1997).

Next, Maudos and De Guevara (2004), Valverde and Fernández (2007) and Hawtrey and Liang (2008) find a positive relationship between operating costs and interest margins and agree that banks pass operating costs fully onto customers. We include operating costs (*opex*, measured using operating expenses divided by average assets) in our specification and expect a positive effect on interest margins. As a proxy for market structure, we use the

[7] Angbazo (1997), Maudos and De Guevara (2004) and Hawtrey and Liang (2008) also include an interaction term between interest rate and credit risk. We run one additional regression to test the significance of such an interaction effect.

fraction of assets held by the five largest banks in the sample (*c5*) and, alternatively, the fraction of assets held by the three largest banks (*c3*). As mentioned, traditionally, higher market concentration is expected to lead to higher margins, but when bank consolidation and transaction banking are two simultaneous trends in banking, this could yield a negative coefficient.

HS posit that banks are likely to include implicit interest payments to depositors (e.g. through service charge remissions and other types of depositor subsidy) and their opportunity cost of holding required reserves as an additional interest expense in their mark-up. This is affirmed by empirical findings of HS, Saunders and Schumacher (2000), Maudos and De Guevara (2004) and Hawtrey and Liang (2008). Only Demirgüç-Kunt and Huizinga (1999) find a negative coefficient for non-interest bearing reserves. We include both implicit interest payments, defined as operating expenses minus non-interest income divided by average assets (*implint*), and opportunity costs or non-interest-bearing reserves divided by total assets (*oppcost*) (see HS, Angbazo 1997, Saunders and Schumacher 2000 and Maudos and De Guevara 2004).

Authors have found it difficult to find the right specification for managerial efficiency (or quality) and management risk aversion. Following Maudos and De Guevara (2004) and Hawtrey and Liang (2008), we use the ratio of operating costs to gross income (*maneff*) as a proxy for managerial efficiency. We check the robustness of the results obtained using this measure by using, alternatively, the loans-to-employees ratio. Managerial efficiency could either have a positive effect on margins through improved profitability (Angbazo 1997 and Maudos and De Guevara 2004), or management could pass the efficiency gains onto the customer, which would mean that higher efficiency would reduce margins, resulting in a negative relationship (Gischer and Jüttner 2003 and Hawtrey and Liang 2004). Given the empirical findings regarding banks and operating costs, we expect the latter.

Since there is no direct measure of bank management risk aversion, we follow Hawtrey and Liang (2008) and use securities plus other assets divided by total loan volume. This is a measure of risk exposure rather than risk aversion (*riskexp*). In the conventional rationale, risk averse bank managers will impose an extra bank margin to compensate for a higher risk exposure (HS; Maudos and De Guevara 2004; Hawtrey and Liang 2008). Following this rationale, the coefficient for *riskexp* is expected to be positive. If, however bank management is not quite as risk-averse, but increasingly risk-taking, we expect a negative relationship. In this case, *riskexp* can be interpreted as a banks' deliberate engagement in transaction banking activities, which we expect to affect margins negatively.

Lastly, we follow Maudos and De Guevara (2004) and Hawtrey and Liang (2008) in using the natural logarithm of the volume of loans to proxy transaction size (*scale*). HS expect transaction size to influence margins positively, but Maudos and De Guevara (2004) and Hawtrey and Liang (2008) find a negative relationship between transaction size and interest margins, arguing that the cost-reductions associated with scale efficiencies outweigh a premium for increased credit risk.

Finally, a recent string of literature suggests that banks have become increasingly risk-taking in the past decade (e.g. Rajan 2006; Borio and Zhu 2008; Maddaloni and Peydró 2010). Adrian and Shin (2008) suggest that in times of rising asset prices, banks expand their balance sheets, raising leverage and their share of money-market funding to fuel their growth. We posit that the shift towards transaction banking was in large part motivated by aspirations to balance sheet expansion. Thus, we run an additional regression with the change in the core deposits/liabilities ratio (*ddepliab*) as dependent and asset growth as independent variable, including *dgdp*, *infl* and *i-short* as control variables. We hypothesize a significant, negative relationship between asset growth and changes in the deposits/liabilities ratio. The relevant specification is as follows:

$$ddepliab_{i,t} = \alpha + \beta_1 * assetgrowth_{i,t} + \beta_2 * dgdp_t + \beta_3 * inflation_t + \beta_4 * i\text{-}short_t + \varepsilon \quad (6)$$

The next section provides descriptive statistics and our preliminary findings.

4. Preliminary findings

Tables 1 and 2 provide a few descriptive statistics for our sample of U.S. commercial banks. Table 1 displays mean values of various financial ratios for banks of different asset sizes over the period 1992 – 2010. We include credit card loans (a classical financial commodity product) as a business line that is characterized by easy securitization and economies of scale. In contrast, we include the ratio of small business loans and commercial and industrial loans with original amounts of less than $1 million, typical relationship loans, to total loans. Large banks typically provide more credit card services, whereas small banks have a higher share of small business loans. Turning to the liabilities-side of the balance sheet, table 1 shows small banks to have a larger share of deposit funding than large banks. Also, retail or core deposits make up a larger share of their deposits base. Further, large banks make considerably more use of federal funds purchased overnight from other banks. Since financial commodities are sold in highly competitive markets where margins are low, we expect banks using money-market funding to fund transaction loans to have lower interest margins than those operating in relationship banking segments, where it is possible to exploit local market power. This is in line with table 1, which shows that the interest margins of large banks as a percentage of total assets are on average about 0.5% lower than those of community banks. Finally, as expected, non-interest income is more important for large banks than for small banks. The data suggest the existence of a spectrum with TOM on the far left side and ROM on the far right, with large banks (assets >$20B) occupying the left of this spectrum and small community banks (assets <$500M) occupying the right. These statistics corroborate the results of DeYoung *et al.* (2004), DeYoung and Rice (2004b) and DeYoung (2007, 2010).

Next, table 2 provides some descriptive statistics regarding earnings volatility of U.S. commercial banks during the period 1992 – 2010. It is not immediately clear that a move towards TOM results in improved *risk-adjusted* returns. Research by DeYoung and Rice (2004a) and Stiroh (2006) suggests that the return volatility of non-interest income is significantly higher than that for traditional activities. Thus, the risk-adjusted returns of transaction banks may actually be comparable to (DeYoung and Rice 2004b) or worse (Stiroh 2006) than those of traditional, community banks.

In the pre-crisis period (1992 – 2007), large banks clearly outperformed smaller banks in terms of mean ROE. It would thus appear that their different activity mix, which includes fee income from loan origination, securitization and servicing, achieves a higher average ROE. These high ROE ratios plummeted during the crisis years (2008 – 2010), which could point to excessive risk-taking. In contrast, small community banks, with a modest pre-crisis ROE of 10.97%, remained profitable during these years, maintaining a ROE of 4.31%. Notably, even in the pre-crisis period (1992 – 2007), large banks (with assets >$20B) show evidence of higher earnings volatility. When adding non-interest income (relative to average assets) to interest margin (calculated using interest income minus interest expense divided by average assets), large banks display higher mean returns to assets than smaller banks. However, the volatility of these earnings is also significantly higher: a standard deviation of 4.63% versus 1.56% for e.g. medium-sized banks. Dissecting this into the volatility of interest margin and that of non-interest income, table 3 shows that both the standard deviation of interest margin and of non-interest income are higher for large banks. These findings are in accordance with the research by DeYoung and Rice (2004) and Stiroh (2006). If a move towards TOM is risk-return inefficient, this lends some plausibility to the conclusions of Kane (2000), Bliss and Rosen (2001), Penas and Unal (2004) and others, who suggest that banks' decisions to expand or merge may have been influenced by motives other than maximizing the firm's value, such as increased managerial compensation and a desire to obtain 'too-big-to-fail' status. These statistics raise some concerns about the desirability of the shift from relationship to transaction banking.

[insert tables 1 and 2 here]

Table 3 presents the results of our factor analysis. In this analysis, we include five different dimensions of a bank's business model: (i) the core deposits-to-liabilities ratio, (ii) the ratio of commercial and industrial loans plus farm loans to total assets, (iii) the ratio of interest income to total income, (iv) the number of domestic offices divided by total loan volume, and (v) bank size. The reported fit indices provide an indication of the overall fit of the measurement model.[8]

Since theory is not specific about the number of factors to extract, we first perform a test for a single (common) factor, using maximum likelihood estimation (see e.g. Kline 2005). The values of selected fit indices obtained testing for a single factor are $\chi^2 = 5668.411$, $p < .001$, CFI = 0.859, RMSR = 0.067 and RMSEA = 0.104. This indicates a poor fit. We therefore proceed to a factor analysis again using maximum likelihood estimation, but now adopting a Kaiser-Guttman criterion to select the number of factors. Convergence was achieved after four iterations. The resulting two-factor model shows a far better fit. Table 3 presents the results.

[insert table 3 here]

[8] In general, it can be submitted that the smaller the χ^2, the better the fit (conversely, the p-value should be large, preferably above 0.05, see e.g. Kline 2005 and Byrne 2001). Both the generalized fit index (GFI) and comparative fit index (CFI) should be close to 1, with a revised cut-off value of 0.90 or, more recently, 0.95 (see Byrne 2001). Finally, values for the root mean squared residual (RMSR) and the root mean square error of approximation (RMSEA) should be close to 0. Values for RMSEA less than 0.05 indicate a good fit, however, values as high as 0.08 represent reasonable errors of approximation in the population (Byrne 2001).

With values of selected fit indices of χ^2 = 4.682, p = 0.03, GFI = 0.999, CFI = 0.999, RMSR = 0.002 and RMSEA = 0.006, the measurement model reported under (1) 1992 – 2010 shows a good fit. The table displays the rotated factor loadings. The first factor loads on *branchnet* and *depliab*, and to a lesser extent on *assetclass*. The second factor loads on *corploass*, *intincrel* and *assetclass*.

So as to test the reliability of these results, we re-run this factor analysis using, first, the quarterly dataset and, secondly, the June schedule dataset (which includes data on loans to small businesses). Table 3 shows the results. The goodness of fit of the measurement model is even better using quarterly data, with selected fit indices of χ^2 = 0.737, p = 0.39, GFI = 0.999, CFI = 1.000, RMSR = 0.000 and RMSEA = 0.000. Also the fit of the model obtained using the June schedules, which provide information on small business loans, is satisfactory, with a CFI of 0.999 and RMSEA of 0.020. The latter uses the same five variables, only it substitutes small business loans (*sbloass*) for commercial and industrial loans (*corploass*).

Importantly, the results are very consistent across the different samples. Also the factor loadings are consistent, with a similar pattern arising from the three different samples. Thus, the first common factor consistently loads on the core deposits-to-liabilities ratio and branch network, and to a lesser extent on asset class. The second common factor consistently loads on the corporate loans-to-assets ratio (or alternatively the small business loans-to-assets ratio) and the ratio of interest income to total income, as well as asset class. In the following, we will refer to these two factors using the labels *factor1* and *factor2*.

Table 4 provides a correlation matrix for the different variables included in specification (8). There are no significant problems of multi-collinearity between the regressors. The relationship banking variables are positively correlated. There is some correlation between the macro-economic variables (viz. *dgdp*, *inflation* and *i-short*), further, *scale* is negatively correlated with *branchnet* and the two relationship banking factors (which load on *branchnet* and *assetclass*). These correlations do not bias our results. The correlation between *scale* and *branchnet* is sufficiently large to pose a problem. Potential remedies to such a problem of multi-collinearity include gathering more data and omitting regressors. Since *scale* is often insignificant, we therefore at times exclude this variable from the specification.

[insert table 4 here]

Figures 1 to 3 provide some first observations. Figure 1 displays the mean interest margins of U.S. commercial banks during the period 1992 – 2010. The figure shows both the industry-wide downward trend in interest margins and the within-industry differences in average margins of banks in different asset classes. It appears from this figure that smaller, community banks have considerably higher interest margins than larger banks (with assets >$10B). Notably, the interest margins of the largest banks (with assets >$20B) show the strongest decline in the period leading up to the credit crisis (1992 – 2006). This provides some support for our hypothesis that bank business model influences the size of interest margins.

[insert figures 1 and 2 here]

Figure 2 shows mean yields on loans and securities as well as mean rates on deposit-funding and non-deposit funding for community banks (with assets <$2B) versus large commercial banks (with assets >$10B). The literature suggests that small banks have a competitive advantage in lending technologies that are based on relationship lending and 'soft' information (Berger and Udell 2002; Berger *et al.* 2004; Elyasiani and Goldberg 2004). Large banks have a competitive advantage in analyzing and producing 'hard' information and trading in standardized products. Although these business lines enjoy easy scalability, the margins on transaction loans are likely to be lower than those on relationship loans (e.g. DeYoung *et al.* 2004, DeYoung and Rice 2004b and DeYoung 2010). Figure 3 shows that community banks earn a substantially higher rate on their loans than large banks do. These results confirm those obtained by DeYoung (2010).

Figure 3 illustrates how market concentration may be too simple a measure when estimating the effect of competitive conditions on the size of interest margins, as intended by HS. The figure displays the mean interest margin of the five largest banks in the industry versus that of smaller banks. This ratio is considerably lower for the banks making up the concentration index (C5) and appropriating a growing share of the market. If the largest banks adhere to a more transactions-oriented model of financial intermediation and, as hypothesized, margins are characteristically lower in this model (in part because of different competitive dynamics for these activities), their appropriation of a growing share of the market is likely to exert a downward pressure on the average interest margins in the industry, resulting in a negative coefficient for market concentration in an empirical model of interest margins.

[insert figure 3 here]

5. Results

First, we perform unit root tests on the dependent and independent variables of our model. For the bank-level variables, we use Levin-Lin-Chu (2002) panel unit root tests; for the macro-level variables, we use both augmented Dickey-Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992) tests. Table 5 reports the results. For *implint* and *scale*, we fail to reject the null hypothesis of a unit root (table 5A). We therefore run the regression with a level-specification as well as in first differences to see whether this affects our results. As it turns out, restating these variables in first differences does not affect the significance or direction of the relationships measured. We therefore proceed to report the outcome of our regression in levels.[9] Also for *factor2* we cannot reject the null hypothesis of a unit root using the annual dataset. Yet, in the quarterly dataset and the June dataset, the series is stationary. We therefore refer to these datasets for its interpretation. The reverse holds for *branchnet*, so for the impact of this variable we refer to the annual and June dataset. Turning to the macro-level variables (table 5B), the ADF-test fails to reject the null of a unit root for the concentration index (*c3* and *c5*) and *i-short*. The KPSS-test affirms that both *c3* and *c5* have a unit root. With a KPSS test-statistic of 0.391, the presence of a unit root in *i-short* is less

[9] The absence of cointegration precludes running a vector error correction model.

obvious. We run the regression restating *i-short* in first differences, but this renders a previously significant coefficient insignificant, leaving the other coefficients unchanged. Conceptually, it makes more sense to include *i-short* in levels. We therefore proceed with our regression, using *c3* and *c5* restated in first differences, but leaving *i-short* in levels-specification. The following section reports our results.

Table 6 summarizes the results of our panel regression. We use two sample periods, one excluding the recent crisis period (1992 – 2007) and one including the crisis years (1992 – 2010). The estimations use panel least squares, White period standard errors to account for serial correlation, and cross-section fixed effects.[10]

[insert tables 5 and 6 here]

Table 6A shows the results obtained using the annual dataset. The table shows a significant, positive effect of the relationship banking variables on bank interest margins.

Panels (1) and (4) include both the core deposits-to-liabilities ratio (*depliab*) and the ratio of commercial and industrial loans plus farm loans to total assets (*corploass*). For the 1992 – 2007 sample period, the coefficient for *depliab* is 0.009. This means that if the core deposits-to-liabilities ratio were to drop by 10%, interest margins are reduced by 9 basis points. The coefficient for the corporate loans-to-assets ratio (*corploass*) is slightly higher: 0.011. This indicates that if the ratio of a bank's commercial and industrial loans plus farm loans to total assets drops by 10%, its interest margin is reduced by 12 basis points. Including the crisis years in our sample affirms these results. Also for the period 1992 – 2010, both *depliab* and *corploass* have a significant, positive coefficient (0.008 and 0.014, respectively).

Panels (2) and (5) in addition include the ratio of interest income to total income (*intincrel*) and the natural logarithm of the number of domestic offices divided by total loan volume (*branchnet*). All four proxies of relationship banking activity exert a robust, positive effect on interest margins in this specification. The coefficients for *depliab* and *corploass* remain unchanged. The coefficient for *intincrel* is significant and positive in both sample periods: 0.036 in the pre-crisis period, and 0.029 in the total sample period. The coefficient for *branchnet* is insignificant in the 1992 – 2007 sample period, yet it is positive and significant in the total sample period.

Panels (3) and (6) show the results obtained using the composite measures of relationship banking activity: *factor1* and *factor2*. These variables load on five different dimensions: (i) the core deposits-to-liabilities ratio, (ii) the ratio of commercial and industrial loans plus farm loans to total assets, (iii) the ratio of interest income to total income, (iv) the number of domestic offices divided by total loan volume, and (v) bank size (see sections 3 and 4). We again see a significant, positive relationship with interest margins.[11] This relationship holds for both sample periods (in- and excluding the crisis years).

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[10] Note that the high goodness of fit (adjusted R^2 values of around 70%) is in part due to the inclusion of cross-section fixed effects, which because of size and nature of the dataset explain a relatively large part of the variance.

[11] To illustrate the strength of the relationship, the standard deviation of *factor1* for the period 1992 – 2010 is equal to 0.777. The coefficient of 0.158 indicates that with a one standard deviation increase in

To ensure robustness of these results, we next turn to the results obtained using the quarterly dataset. Table 6B displays significant, positive coefficients for all the different relationship banking variables. Note that for this dataset, a bank's interest margin is defined as the net interest income earned in one quarter as a percentage of total assets. To obtain the annual equivalent would require adding the interest income earned in four consecutive quarters. Thus, for example, the coefficients for *depliab* and *corploass* of 0.002 and 0.003 in the period 1992Q4 – 2007Q4 correspond to and confirm the coefficients obtained using the annual dataset.

Also the factors show significant, positive signs in both sample periods (in- and excluding the crisis). The coefficient of 0.092 for *factor1* in the 1992Q4 – 2007Q4 sample period indicates that with a one standard deviation (0.795) decline of *factor1*, quarterly interest margin would decline with 7 basis points. The annual equivalent can be said to be approximately four times larger, or 28 basis points. Note that the mean quarterly interest margin for the entire sample of U.S. commercial banks in the pre-crisis period was equal to 1% or 100 basis points (corresponding to 4% annually, see also figure 2 for reference). This is an economically significant effect. The coefficient for *factor2* is 0.124 in the pre-crisis period, which means that a one standard deviation (0.663) would have caused an 8 basis points drop of quarterly interest income (the annual equivalent being 32 basis points). This positive relationship between the two composite measures of relationship banking activity and interest margins also holds for the entire sample period, including the crisis years (1992Q4 – 2010Q4), with only slightly smaller coefficients.

Finally, we look at the results obtained using the June schedules. These schedules provide additional information on the small business loans extended by a bank. Note that the number of observations in this dataset is somewhat smaller than that in the annual and quarterly datasets. For this dataset, interest margin is defined as the net interest income earned in quarters 1 and 2 as a percentage of total assets.

Panel (1) in table 6C shows that the impact of the core deposits-to-liabilities ratio (*depliab*) and the ratio of small business loans (with original amounts of $1M or less) to total assets (*sbloass*) on a bank's interest margins is positive and significant. The coefficient for *sbloass* is 0.008, indicating that a 10% reduction in the ratio of small business loans to total assets would result in an 8 basis points reduction of interest margin, as earned over two quarters (the annual effect is approximately two times as large). Panel (2) shows the impact of a larger number of different business model proxies. Again, all variables display significant, positive coefficients, except for *branchnet*, which could be due to a small sample problem.

Panel (3) shows the impact of the two composite measures: *factor1* and *factor2*. In this dataset, the factors load on: (i) the core deposits-to-liabilities ratio, (ii) the ratio of small business loans to total assets, (iii) the ratio of interest income to total income, (iv) the number of domestic offices divided by total loan volume, and (v) bank size. *Factor2* does not display a significant relationship with margins, which is likely due to the lack of observations.

Overall, tables 6A through C all document a consistently positive relationship between the variables reflecting a bank's business model and the size of interest margins. Thus,

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factor1 during this period, a bank's interest margin would rise by a little over 12 basis points. Conversely, a one standard deviation decrease in *factor1* in the same period would cause a bank's interest margin to decrease by 12 basis points.

adherence to a more traditional model of financial intermediation appears to influence margins positively. This finding is in line with the theoretical predictions by, amongst others, DeYoung *et al.* (2004), Elyasiani and Goldberg (2004), DeYoung and Rice (2004b) and DeYoung (2010). Also, it is in line with the empirical findings by Liebeg and Schwaiger (2009), who, in a small-scale study of small, Austrian banks find a positive and significant effect of relationship banking on interest margins.

The positive and significant relationship between relationship banking and interest margins indicates that an industry-wide reduction in these ROM-activities would reduce the mean interest margin measured in the industry significantly. According to these results, transaction banks' appropriation of a growing share of the U.S. market in the period 1992 – 2007 should thus be part and parcel of any explanation of the industry-wide decline of interest margins.

We will briefly comment on the results for the other, control variables. These largely confirm our hypotheses. Bank capital structure (*capstruc*) shows a significant, positive sign, which would suggest that better capitalization lowers the cost of debt, thereby contributing to higher margins. This is in line with the findings of Angbazo (1997), Demirgüc-Kunt and Huizinga (1999), Valverde and Fernández (2007) and Claeys and Van der Vennet (2008).

Economic growth (*dgdp*) exerts a significant, positive influence on interest margins. This is in accordance with the findings of Claeys and Van der Vennet (2008), which indicate that the business cycle is positively related to interest margins in developed financial markets, but not in transition economies.

Inflation (*inflation*) displays a small, negative impact on interest margins in most of the specifications. This is somewhat contrary to expectations, as both Demirgüc-Kunt and Huizinga (1999) and Claeys and Van der Vennet (2008) find evidence for a positive relationship (see also Boyd *et al.* 2001). However, these are international studies and as such cover a large number of countries. Inflation in the U.S. was relatively low and stable during our sample period (1992 – 2007/2010). This lack of sample variance could help explain why we do not find the regular, positive relationship.

Next, the coefficient for interest rate level (*i-short*) has a significant, positive sign. This is in accordance with the empirical research by a.o. Jiménez *et al.* (2007), Ioannidou *et al.* (2009), and Altunbas *et al.* (2010), who find that low interest levels increased bank risk-taking substantially in the period leading up to the crisis. Thus, lower interest rates motivated banks to expand their balance sheets, making use of money-market financing to fund investments in riskier, non-traditional activities (such as transaction loans), which we expect to affect interest margins negatively.

Interest rate risk (*i-vol*) displays a significant, negative coefficient (except in the more recent 2003Q2 – 2010Q2 sample).[12] This is an interesting result. The original HS model assumes bank management to be risk-averse. In this model, banks require a risk premium for assuming additional risk. Variables such as credit and interest rate risk are therefore expected to be positively related to interest margins. The research by all Angbazo (1997), Saunders and Schumacher (2000), Maudos and De Guevara (2004), Valverde and Fernández

[12] Using, alternatively, the standard deviation of the rate on 6-month and 1-year T-bills yields the same result (*i-vol* displays a significant, negative coefficient).

(2007) and Hawtrey and Liang (2008) attests to this positive relationship. However, the sample periods used in these researches do not stretch beyond 2001. More recent literature suggests that banks have become increasingly risk-taking in the past decade (Rajan 2006; Borio and Zhu 2008; Maddaloni and Peydró 2010). The negative coefficient for *i-vol* (and *riskexp*, see table 6) provides some evidence for this risk-taking hypothesis. It suggests that banks no longer require compensation for an increase interest rate risk in the form of higher interest margins.[13] We also tested for an interaction effect between credit and interest rate risk, but the interaction term turns out to be insignificant, contrary to predictions by Angbazo (1997), Maudos and De Guevara (2004) and Hawtrey and Liang (2008).

Table 6A shows the coefficient for credit risk (*credrisk*), measured using the ratio of loan charge-offs to assets, to be positive and significant in the sample excluding the crisis years (1992 – 2007). This would indicate that banks charge a mark-up on loan rates for higher credit risk and is in accordance with the theory and findings of HS, Angbazo (1997), Maudos and De Guevara (2004) and Hawtrey and Liang (2008). This finding is robust to using alternative measures of credit risk, such as (i) the ratio of total loans to assets, (ii) loan loss allowances as a percentage of total assets, and (iii) provisions for loan losses divided by average assets. However, the positive effect fails to persist for the entire sample period including the crisis years (1992 – 2010). Using the quarterly dataset, with more frequent data available for the more recent period, we find that credit risk is insignificant for the 1992Q4 – 2007Q4 period, and significant and negative for the 1992Q4 – 2010Q4 period (see table 6B).[14] We therefore analyze only the crisis years (2006Q4 – 2010Q4). Now, we find a significant, negative relationship between the measures of credit risk and interest margins. It would thus appear that in a normal, non-crisis regime, banks charge extra for taking on more credit risk (i.e. for higher expected loan losses). This is in accordance with theory. However, during the crisis years, the materialization of (unexpected) loan losses depresses bank interest margins, giving cause for a negative relationship.

In line with expectations, operating costs (*opex*) exert a strong, positive influence on interest margins. This confirms our hypothesis that banks pass higher operating costs fully onto customers (see Demirgüç-Kunt and Huizinga 1999, Maudos and De Guevara 2004, Claeys and Van der Vennet 2008, and Hawtrey and Liang 2008).

Market concentration, measured using *d(c5)*, displays a significant, negative coefficient (see table 6A). Alternatively using *d(c3)* yields the same negative relationship. However, using the quarterly dataset, we document a significant, positive relationship for the same sample

[13] This could suggest one out of three things, or most likely a combination of the three: (i) bank management has become less risk averse; (ii) maturation of the derivatives markets has further perfected banks' capabilities to hedge their interest rate risk exposures; and (iii) banks seek to optimize a risk/return trade-off that is measured using other decision variables than those incorporated in the HS model. In this context, we would like to direct attention to the rise of risk-adjusted return on capital (RAROC) as a popular risk management and performance evaluation metric amongst banks.

[14] Only using loan loss allowance as a percentage of total assets or provisions for loan losses divided by average assets as alternative measures of credit risk yields a small, significant positive coefficient in the pre-crisis period. All three measures (ratio of loan charge-offs to assets, loan loss allowance as a percentage of total assets, and provisions for loan losses divided by average assets) yield a significant, negative coefficient for the sample period including the crisis years (the same effect appears from table 6C).

periods (the same holds for the June dataset, see tables 6B and C). This lack of robustness of the results obtained using the concentration indices is in line with the findings of De Guevara *et al.* (2005), Valverde and Fernández (2007) and Claeys and Van der Vennet (2008), who suggest that market concentration is not a good proxy for competitive conditions (or at least not as intended by HS).

In line with the predictions of HS, implicit interest payments (*implint*) are significantly and positively related to interest margins (except in the 2003Q2 – 2010Q2 sample). This provides evidence for the hypothesis that banks view these as an additional expense and include them in their mark-up, and accords with previous findings by HS, Saunders and Schumacher (2000), Maudos and De Guevara (2004) and Hawtrey and Liang (2008).

The coefficient for opportunity costs (*oppcost*) is insignificant in most specifications (except in the most recent sample period, 2003Q2 – 2010Q2, in which it displays a small, negative coefficient).

Risk exposure (*riskexp*) displays a strong, negative relationship with net interest margins. This is in line with our hypothesis. In the scenario where banks have become increasingly risk-taking in the past decades, this measure of relative risk exposure (defined as securities plus other assets divided by loans) can be interpreted as a bank's deliberate engagement in transaction banking activities. We expect this to exert a downward pressure on its interest margin.

Managerial efficiency (*maneff*), measured using operational expenses over gross income, displays a significant, negative relationship with interest margins (albeit small). This lends some support to the hypothesis that increased managerial efficiency brings costs down and decreases interest margins (e.g. Gischer and Jüttner 2003; Hawtrey and Liang 2008). However, using the loans-to-employees ratio as an alternative measure of managerial efficiency results in a very small, but positive significant coefficient (when excluding the crisis years). This would point to the truth of the competing rationale, i.e. that higher efficiency leads to higher profitability and thus margins (e.g. Angbazo 1997; Maudos and De Guevara 2004). The result is thus inconclusive.

Finally, the coefficient for *scale* is at times insignificant, at times positive and significant, and at times negative and significant. As such, we do not find a robust effect of transaction size or scale on margins.

We conclude with the estimation of a panel regression using changes in the core-deposits-to-liabilities ratio (*ddepliab*) as dependent and asset growth as independent variable. The specification includes economic growth, inflation and interest rate levels as macro-economic control variables. The estimation uses panel least squares, with White period standard errors, and cross-section fixed effects.

Taking into account the literature by Rajan (2006), Borio and Zhu (2008) and Maddaloni and Peydró (2010), we anticipate a significant, negative relationship between asset growth and changes in the core deposits-to-liabilities ratio. We use two sample periods, one excluding the recent crisis years (1992 – 2007) and one including the crisis (1992 – 2010). In the run-up to the credit crisis, banks were eager to expand their balance sheets and moved towards TOM. The crisis period has shown us the reverse side of the same coin; now that disaster had struck and banks' asset growth had halted, banks have started expanding their deposits base and moved back to ROM.[15]

Table 7 displays the results of the regression for both the entire sample and four subsamples based on asset size.

[insert table 7 here]

Table 7A documents a significant, negative relationship between asset growth and changes in the core deposits-to-liabilities ratio. This relationship is strongest for large banks (with total assets > $20B), for which the coefficient for asset growth is -0.294. Also medium-sized banks (with assets $10B – $20B) have a relatively high coefficient: -0.233. These results suggest that (aggressive) balance sheet expansion causes a bank to move into the capital markets and towards a transactions-oriented model of financial intermediation. This negative relationship becomes stronger with asset size, as large banks have arguably pursued a more aggressive growth strategy during the 1992 – 2007 period.

With comparable coefficients and slightly higher R-squared values, table 7B shows that the negative relationship between asset growth and changes in the core deposits-to-liabilities ratio indeed holds equally well for the sample including the crisis years. Also these outcomes are robust to estimation using quarterly data (yielding comparable coefficients and significance levels).

6. Conclusion

This paper analyzes the determinants of interest margins in the U.S. commercial banking sector using a comprehensive dataset with bank-level data obtained from the FDIC call reports. The main contribution of this paper is the inclusion of a bank's business model as an explanatory variable in an empirical model of margins. During the 1992 – 2007 period, many banks in the U.S. moved from a relationships-oriented (ROM) to a transactions-oriented model of financial intermediation (TOM). By making the impact of this strategic shift amongst banks explicit, we provide a more accurate description of the chain of causality leading to lower interest margins in developed banking industries than the one that is available now.

We test the hypothesis that by investing in customer-specific information, relationship banks can produce differentiated products, create local market power and establish information monopolies, which allows them to charge higher margins. Transaction banking, which focuses the advantages of scalability, precludes this.

We find a significant, positive relationship between a bank's business model, measured using a multi-dimensional proxy of relationship banking activity, and net interest margins. This outcome is consistent with the predictions of the financial intermediation literature (e.g. Rajan 1992, Boot 2000, DeYoung *et al.* 2004, Elyasiani and Goldberg 2004, DeYoung and Rice

[15] For example large banks (with assets >$10B), for which the mean core deposits-to-liabilities ratio had steadily been decreasing from 62% in 1993 to an all-time low of 48.6% in 2007, have, within three years, raised their core deposits-to-liabilities back up to an average of 60.8% (as at year-end 2010).

2004b and DeYoung 2007, 2010). Conversely, a move away from this model, towards transaction banking, reduces interest margins considerably. Transaction banks' appropriation of a growing share of the U.S. market in the period 1992 – 2007 should thus be part and parcel of any explanation of the decline of average interest margins in the industry.

Running a separate regression shows that there exists a significant, negative relationship between asset growth and the change in the deposits-to-liabilities ratio. This suggests that bank balance sheet expansion was an important driver of the move towards TOM.

We would like to conclude by considering a statement by Allen and Santomero (2001, p. 274): "As traditional businesses began to dry up, the management of those institutions was forced to become entrepreneurial and develop new businesses in order to survive." Our research qualifies this statement. We put forward that as traditional businesses, while profitable, offered few opportunities for higher growth, the management of those institutions became more risk-seeking and expanded into transactions-oriented activities. And although transaction banks achieve higher returns on equity and assets, these returns are marked by higher earnings volatility. Our results show that relationship banks still enjoy considerable interest margins and were better equipped to weather the financial crisis than transaction banks. These findings raise some concerns about the desirability of the shift from relationship to transaction banking.

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Figures and tables

Figure 1: Mean interest margins for U.S. commercial banks 1992 – 2010

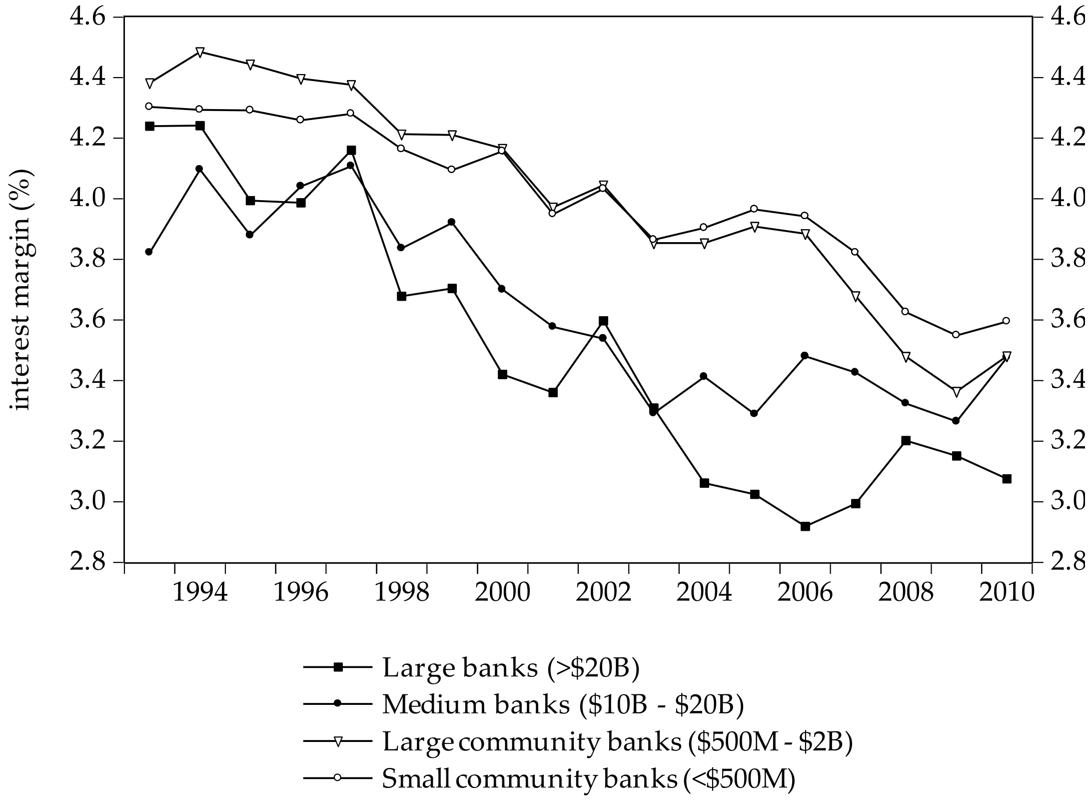

Figure 2A: Mean yields and cost of funding – community banks (assets <$2B)

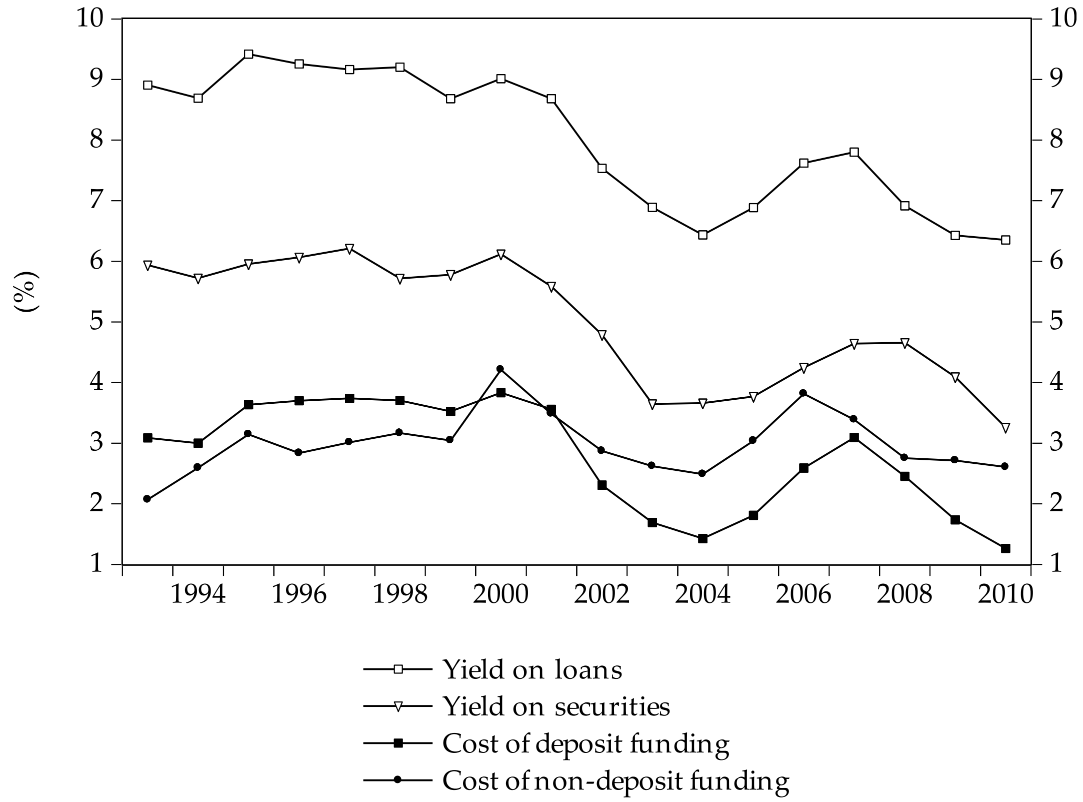

Figure 2B: Mean yields and cost of funding – medium and large banks (assets >$10B)

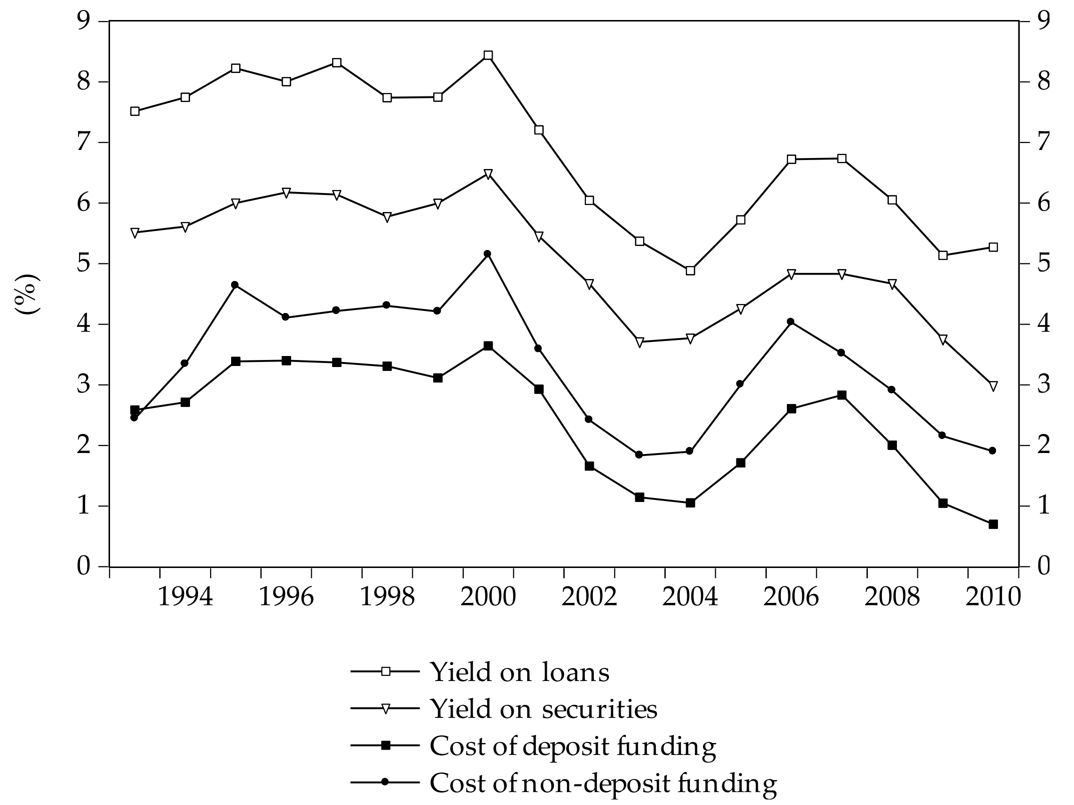

Figure 3: Market concentration and interest margins

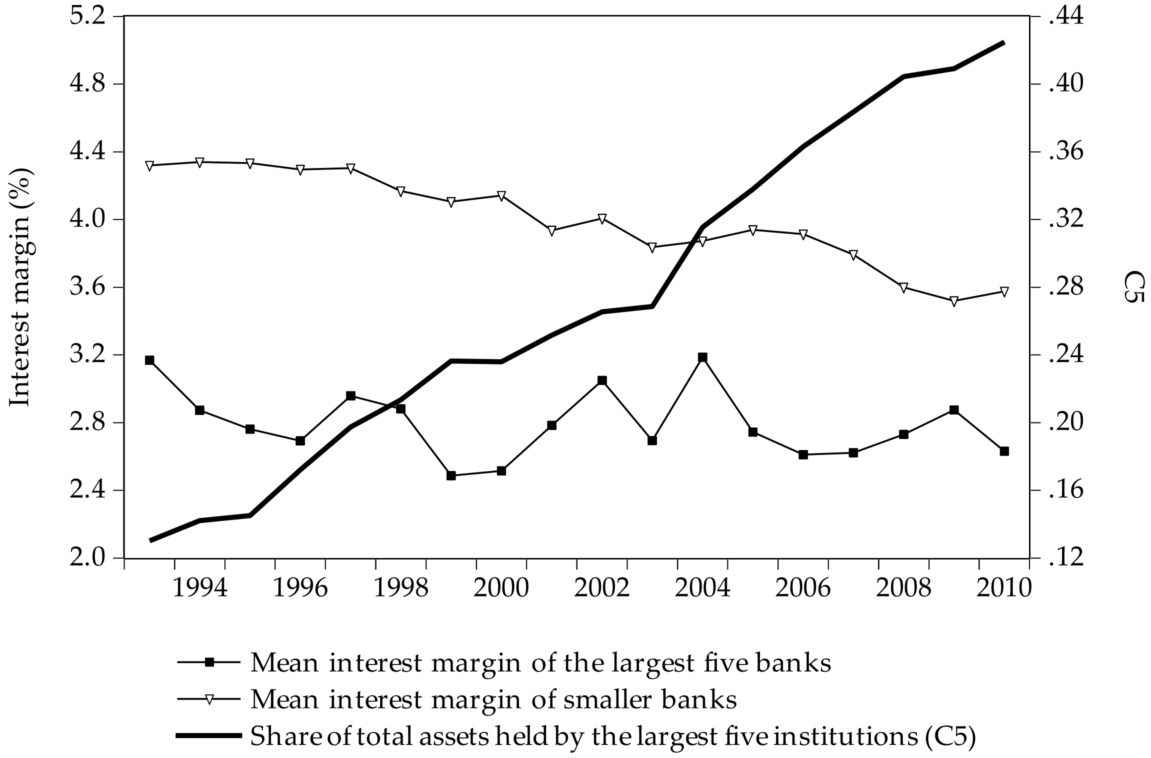

Table 1: Mean values for U.S. commercial banks 1992 – 2010 (%)

	Large banks	Medium banks	Large community banks	Small community banks
Asset size	>$20B	$10B - $20B	$500M - $2B	<$500M
Number of observations	718	503	11,244	92,751
Credit card loans/Loans	11.24	1.74	0.90	0.37
Small business loans/Loans*	6.79	12.36	24.69	42.71
C&I loans w. orig. amts. <$1M/Loans*	3.56	5.79	8.83	12.28
Fed funds purchased/Total assets	7.73	8.52	3.02	1.04
Retail deposits/Deposits	70.59	79.74	82.78	84.98
Deposits/Total liabilities and equity	66.54	73.47	81.86	85.01
Net interest margin	3.49	3.61	3.99	3.99
Non-interest income/Total income	27.59	20.12	13.73	9.97

Note: Compare DeYoung (2007). Variables indicated (*) derive from schedule SB, published in June from 2003 onwards, and provide mean values for the period 2003 – 2010. Number of observations is (i) 384 for large banks; (ii) 268 for medium banks; (iii) 5,759 for large community banks; and (iv) 50,742 for small community banks. ANOVA F-test for the equality of by-group means shows differences to be significant with *p*-values of 0.000.

Table 2: Earnings volatility at U.S. commercial banks (%)

	Large banks	Medium banks	Large community banks	Small community banks
Asset size	>$20B	$10B - $20B	$500M - $2B	<$500M
Mean ROE 1992 – 2007	15.70	15.25	13.11	10.97
Mean ROE 2008 – 2010	0.95	-0.24	2.30	4.31
St. dev. of ROE 1992 – 2010	10.93	11.42	9.02	8.37
Mean interest margin augmented with non-interest income 1992 – 2007	6.66	5.42	5.24	4.84
St. dev. of interest margin augmented with non-interest income 1992 – 2007	4.63	1.56	1.86	1.24
St. dev. of interest margin 1992 – 2007	1.64	0.88	0.94	0.78
St. dev. of non-interest income 1992 – 2007	3.32	1.51	1.25	0.72

Note: ANOVA F-test for the equality of by-group means and Bartlett test for the equality of the by-group standard deviations show differences to be significant with *p*-values of 0.000.

Table 3: Factor analysis

	(1) 1992 – 2010			(2) 1992Q4 – 2010Q4			(3) 2003Q2 – 2010Q2		
	factor 1	*factor 2*	Comm.	*factor 1*	*factor 2*	Comm.	*factor 1*	*factor 2*	Comm.
branchnet	0.707	0.016	0.51	0.808	0.012	0.66	0.998	0.007	1.00
assetclass	0.215	0.368	0.23	0.248	0.396	0.27	0.208	0.487	0.34
depliab	0.616	0.057	0.40	0.518	0.056	0.29	0.339	0.155	0.17
corploass	-0.034	0.163	0.02	-0.027	0.168	0.03			
sbloass							0.022	0.487	0.24
intincrel	-0.049	0.639	0.39	-0.081	0.611	0.36	-0.143	0.513	0.24
N	104,453			261,720			56,175		
χ^2	4.682			0.737			24.157		
p-value	0.03			0.39			0.00		
GFI	0.999			0.999			0.999		
CFI	0.999			1.000			0.999		
RMSR	0.002			0.000			0.005		
RMSEA	0.006			0.000			0.020		

Note: The table displays the rotated factor loadings (oblique Varimax rotation). The 2003Q2 – 2010Q2 sample derives from schedule SB, published in June from 2003 onwards, and offers fewer observations; as some of the uniqueness estimates were non-positive, it uses a Heywood solution.

Table 4: Correlation matrix

	depliab	*corploass*	*intincrel*	*branchnet*	*factor1*	*factor2*	*capstruc*	*dgdp*	*inflation*	*i-short*	*i-vol*	*credrisk*	*opex*	*d(c5)*	*implint*	*oppcost*	*riskexp*	*maneff*	*scale*
depliab	1,000																		
corploass	0,041	1,000																	
intincrel	0,101	0,110	1,000																
branchnet	0,446	0,029	0,073	1,000															
factor1	0,787	0,039	0,139	0,888	1,000														
factor2	0,322	0,237	0,891	0,288	0,432	1,000													
capstruc	-0,182	-0,008	0,032	0,077	-0,020	0,045	1,000												
dgdp	0,224	0,046	0,073	0,264	0,274	0,110	-0,016	1,000											
inflation	0,037	0,025	0,054	0,071	0,062	0,053	0,003	0,400	1,000										
i-short	0,201	0,061	0,173	0,273	0,270	0,186	-0,004	0,601	0,453	1,000									
i-vol	-0,067	0,010	0,027	-0,058	-0,069	0,007	-0,001	-0,126	0,432	0,106	1,000								
credrisk	-0,136	-0,004	-0,113	-0,178	-0,192	-0,149	-0,042	-0,194	-0,171	-0,192	-0,054	1,000							
opex	0,022	-0,021	-0,596	0,129	0,083	-0,458	0,010	-0,005	-0,009	-0,002	-0,004	0,208	1,000						
d(c5)	-0,078	-0,002	-0,036	-0,093	-0,097	-0,045	0,015	0,268	0,243	-0,023	0,202	-0,060	-0,017	1,000					
implint	0,186	0,049	0,153	0,239	0,267	0,230	-0,076	-0,015	-0,018	0,005	-0,009	0,059	0,407	-0,033	1,000				
oppcost	0,248	0,069	-0,193	0,298	0,312	-0,066	0,007	0,111	0,023	0,116	-0,012	-0,056	0,243	-0,050	0,139	1,000			
riskexp	0,072	-0,218	0,004	0,317	0,250	0,039	0,254	0,092	0,021	0,077	-0,038	-0,121	-0,079	-0,045	-0,161	0,059	1,000		
maneff	0,012	-0,009	-0,052	0,041	0,034	-0,030	-0,022	-0,012	0,002	-0,020	0,007	-0,021	0,093	-0,002	0,086	0,043	-0,015	1,000	
scale	-0,378	-0,129	-0,226	-0,646	-0,685	-0,519	-0,235	-0,186	-0,048	-0,193	0,043	0,158	-0,062	0,067	-0,232	-0,269	-0,368	-0,034	1,000

Note: Period 1992 – 2010. Ordinary Pearson product-moment correlations.

Table 5A: Panel unit root tests

	1992 – 2010 *p*-value	1992Q4 – 2010Q4 *p*-value	2003Q2 – 2010Q2 *p*-value
margin	0.000	0.000	0.000
depliab	0.000	0.000	0.000
corploass	0.000	0.000	
sbloass			0.000
intincrel	0.000	0.000	0.000
branchnet	0.000	1.000	0.000
factor1	0.000	0.000	0.000
factor2	1.000	0.000	0.000
capstruc	0.000	0.000	0.000
credrisk	0.000	0.000	0.000
opex	0.000	0.000	0.000
implint	1.000	1.000	0.000
oppcost	0.000	0.000	0.000
riskexp	0.000	0.000	0.000
maneff	0.000	0.000	0.000
scale	1.000	1.000	0.000

Note: Levin Lin Chu (common unit root, individual effects, automatic lag selection)

Table 5B: Unit root tests macro-level variables

1992 – 2010	*p*-value (ADF)	*LM* Stat. (KPSS)
c3	0.945	0.574
c5	0.978	0.581
dgdp	0.051	0.276
inflation	0.010	0.232
i-short	0.173	0.391
i-vol	0.007	0.451

Note: ADF test – level, intercept in test equation, automatic lag selection; KPSS test – level, intercept in test equation, Bartlett kernel spectral estimation method, automatic bandwidth selection. Asymptotic critical values: 0.347 (10% level), 0.463 (5% level) and 0.739 (1% level).

Table 6A: Determinants of interest margins

Dependent variable: *margin*

	(1) 1992 – 2007		(2) 1992 – 2007		(3) 1992 – 2007		(4) 1992 – 2010		(5) 1992 – 2010		(6) 1992 – 2010	
	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat
intercept	2.262 ***	4.53	-1.30 *	-1.74	1.484 **	2.54	2.693 ***	6.15	-0.259	-0.40	2.054 ***	4.00
Relationship banking measure												
depliab	0.009 ***	9.16	0.009 ***	9.81			0.008 ***	9.56	0.009 ***	10.72		
corploass	0.011 ***	12.61	0.011 ***	12.68			0.014 ***	17.66	0.014 ***	17.22		
intincrel			0.036 ***	7.06					0.029 ***	6.76		
branchnet			0.013	0.45					0.057 ***	2.31		
factor1					0.139 ***	3.83					0.158 ***	5.18
factor2					0.551 ***	6.39					0.456 ***	6.46
Other variables												
capstruc	0.010 ***	2.87	0.014 ***	4.42	0.025 ***	6.97	0.019 ***	5.84	0.020 ***	6.78	0.031 ***	9.53
dgdp	0.032 ***	14.03	0.037 ***	15.53	0.043 ***	17.09	0.040 ***	13.86	0.041 ***	14.16	0.045 ***	12.95
inflation	-0.016 ***	-2.68	0.006	1.04	0.010	1.45	0.005 *	1.95	0.009 ***	3.81	0.008 ***	2.92
i-short	0.036 ***	18.5	0.004	1.02	-0.001	-0.30	0.049 ***	22.42	0.024 ***	7.50	0.025 ***	6.83
i-vol	-0.102 ***	-16.77	-0.107 ***	-18.04	-0.114 ***	-18.63	-0.069 ***	-15.00	-0.082 ***	-18.77	-0.081 ***	-14.29
credrisk	0.101 *	1.95	0.098 *	1.94	0.168 ***	2.68	-0.049	-1.40	-0.029	-0.83	-0.017	-0.41
opex	0.152 ***	4.63	0.268 ***	4.97	0.276 ***	4.12	0.146 ***	4.90	0.242 ***	5.05	0.251 ***	4.33
d(c5)	-1.526 ***	-10.46	-1.208 ***	-8.43	-1.426 ***	-8.86	-1.313 ***	-9.22	-0.994 ***	-7.02	-1.024 ***	-6.33
implint	0.309 ***	4.33	0.195 **	2.51	0.196 **	1.99	0.220 ***	3.80	0.138 **	2.08	0.122	1.52
oppcost	-0.004	-1.24	0.000	0.06	0.001	0.17	0.000	-0.01	0.001	0.36	0.001	0.46
riskexp	-0.156 ***	-5.40	-0.160 ***	-5.61	-0.181 ***	-4.64	-0.184 ***	-7.32	-0.182 ***	-7.14	-0.225 ***	-6.75
maneff	-0.003 ***	-6.58	-0.003 ***	-6.57	-0.003 ***	-5.91	-0.001 ***	-4.14	-0.001 ***	-4.05	-0.001 ***	-3.45
scale	-0.032	-1.09			0.089 ***	2.84	-0.072 ***	-2.98			0.045 *	1.65
N	119,968		119,774		86,193		139,362		138,541		104,423	
Adj. R^2	0.737		0.747		0.751		0.707		0.720		0.712	

Note: Fixed effects, White period standard errors, p <.10*, p <.05**, p <.01***.

Table 6B: Determinants of interest margins

	Dependent variable: *margin*											
	(1) 1992Q4 – 2007Q4		(2) 1992Q4 – 2007Q4		(3) 1992Q4 – 2007Q4		(4) 1992Q4 – 2010Q4		(5) 1992Q4 – 2010Q4		(6) 1992Q4 – 2010Q4	
	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat
intercept	0.818 ***	7.07	0.223	1.25	0.111	0.79	0.958 ***	12.64	0.482 ***	3.42	0.350 ***	2.86
Relationship banking measure												
depliab	0.002 ***	9.82	0.002 ***	10.16			0.002 ***	7.86	0.002 ***	8.39		
corploass	0.003 ***	13.80	0.003 ***	14.16			0.004 ***	20.24	0.004 ***	20.49		
intincrel			0.006 ***	4.91					0.005 ***	4.65		
branchnet			0.013 *	1.87					0.027 ***	5.56		
factor1					0.092 ***	6.99					0.085 ***	7.50
factor2					0.124 ***	4.86					0.099 ***	4.85
Other variables												
capstruc	0.002 **	2.05	0.002 ***	2.63	0.004 ***	3.36	0.006 ***	8.41	0.005 ***	7.78	0.007 ***	8.84
dgdp	0.004 ***	2.78	0.004 ***	2.75	0.006 ***	3.05	0.017 ***	23.83	0.017 ***	23.92	0.018 ***	24.94
inflation	-0.004 ***	-4.41	-0.001	-0.90	-0.001	-0.51	-0.004 ***	-6.50	-0.003 ***	-3.23	-0.003 ***	-3.46
i-short	0.009 ***	18.99	0.005 ***	6.06	0.004 ***	4.17	0.015 ***	32.75	0.011 ***	19.36	0.012 ***	16.95
i-vol	-0.022 ***	-3.91	-0.033 ***	-5.14	-0.040 ***	-5.15	-0.025 ***	-11.75	-0.036 ***	-11.77	-0.037 ***	-10.94
credrisk	0.019	0.78	0.018	0.77	0.027	0.96	-0.070 ***	-6.67	-0.063 ***	-5.74	-0.065 ***	-5.50
opex	0.073 **	2.14	0.117 **	2.37	0.134 *	2.10	0.070 ***	2.76	0.107 ***	2.78	0.121 **	2.51
d(c5)	0.446 ***	11.39	0.356 ***	8.58	0.343 ***	6.01	0.406 ***	13.92	0.321 ***	10.28	0.372 ***	10.36
implint	0.154 ***	2.85	0.107 *	1.74	0.093	1.28	0.050 *	1.86	0.025	0.69	0.010	0.23
oppcost	0.000	0.58	0.001	1.43	0.001	1.13	0.000	0.51	0.001	1.20	0.001	0.95
riskexp	-0.065 ***	-8.69	-0.065 ***	-8.62	-0.070 ***	-7.62	-0.075 ***	-14.44	-0.074 ***	-13.89	-0.086 ***	-13.80
maneff	-0.000 ***	-4.39	-0.000 ***	-4.06	0.000 ***	-3.91	0.000	0.57	0.000	0.36	0.000	0.65
scale	-0.016 **	-2.36			0.063 ***	6.27	-0.028 ***	-6.27			0.041 ***	4.23
N	232,027		231,546		185,027		313,219		310,758		261,541	
Adj. R^2	0.692		0.698		0.694		0.653		0.663		0.654	

Note: Fixed effects, White period standard errors, $p < .10$*, $p < .05$**, $p < .01$***. For this dataset, interest margin is defined as the net interest income earned in one quarter as a percentage of total assets.

Table 6C: Determinants of interest margins

	Dependent variable: *margin*								
	(1) 2003Q2 – 2010Q2			(2) 2003Q2 – 2010Q2			(3) 2003Q2 – 2010Q2		
	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat
intercept	1.233	***	4.91	0.878	**	2.56	1.705	***	23.88
Relationship banking measure									
depliab	0.003	***	4.72	0.004	***	5.39			
corploass				0.005	***	5.87			
sbloass	0.008	***	14.68	0.006	***	12.72			
intincrel				0.007	***	2.25			
branchnet				0.023		1.20			
factor1							0.039	**	2.22
factor2							0.014		1.61
Other variables									
capstruc	0.012	***	4.14	0.011	***	3.49	0.011	***	3.46
dgdp	0.079	***	6.15	0.074	***	5.87	0.091	***	7.17
inflation	-0.052	***	-5.62	-0.057	***	-5.48	-0.040	***	-4.28
i-short	0.025	***	19.19	0.022	***	13.34	0.025	***	18.67
i-vol	0.144	***	6.16	0.127	***	5.30	0.109	***	4.63
credrisk	-0.081	**	-2.51	-0.061	*	-1.65	-0.084	**	-2.50
opex	0.016		0.30	0.032		0.54	0.017		0.32
d(c5)	0.792	***	7.52	0.790	***	7.66	0.915	***	8.80
implint	0.037		0.83	0.024		0.40	0.041		0.88
oppcost	-0.004	**	-2.43	-0.003	**	-2.22	-0.004	**	-2.57
riskexp	-0.162	***	-4.11	-0.157	***	-3.99	-0.224	***	-5.82
maneff	-0.000		-1.39	-0.000		-1.19	0.000		-1.44
scale	0.003		0.13						
N	47,653			47,090			44,749		
Adj. R^2	0.744			0.752			0.737		

Note: Fixed effects, White period standard errors, $p < .10$*, $p < .05$**, $p < .01$***. For this dataset, interest margin is defined as the net interest income earned in quarters 1 and 2 as a percentage of total assets.

Table 7A: Growth and balance sheet composition

Dependent variable: *ddepliab*
1992 – 2007

	All institutions			i. Large banks (>$20B)			ii. Medium banks ($10B - $20B)			iii. Large community banks ($500M - $2B)			iv. Small community banks (<$500M)		
	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat
intercept	3.215	***	24.04	2.678		1.04	5.285	*	1.78	2.650	***	4.88	3.179	***	21.72
assetgrowth	-0.088	***	-19.76	-0.294	***	-4.10	-0.233	***	-3.06	-0.093	***	-6.89	-0.073	***	-12.98
dgdp	-0.423	***	-18.04	-0.531		-0.95	-0.462		-1.11	-0.708	***	-7.38	-0.325	***	-12.54
inflation	-0.786	***	-19.95	0.026		0.03	-1.030		-1.43	-0.586	***	-3.66	-0.873	***	-19.95
i-short	-0.116	***	-7.68	-0.141		-0.34	-0.146		-0.61	0.159	***	2.58	-0.153	***	-9.17
N	119,698			583			406			9,285			75,894		
Adj. R^2	0.028			0.070			0.138			0.017			0.034		

Note: Fixed effects, White period standard errors, p <.10*, p <.05**, p <.01***.

Table 7B: Growth and balance sheet composition

	Dependent variable: *ddepliab* 1992 – 2010														
	All institutions			i. Large banks (>$20B)			ii. Medium banks ($10B - $20B)			iii. Large community banks ($500M - $2B)			iv. Small community banks (<$500M)		
	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat	Coeff.		*t*-stat
intercept	1.963	***	26.42	6.390	***	3.87	6.809	***	5.79	2.405	***	9.73	1.742	***	22.25
assetgrowth	-0.089	***	-21.82	-0.229	***	-3.70	-0.229	***	-3.86	-0.100	***	-8.19	-0.075	***	-14.91
dgdp	-0.132	***	-8.26	-1.289	***	-3.53	-0.947	***	-4.28	-0.454	***	-8.34	-0.013		-0.78
inflation	-0.446	***	-15.31	-0.305		-0.46	-0.577		-1.04	-0.402	***	-4.02	-0.483	***	-14.91
i-short	-0.240	***	-17.86	-0.358		-1.15	-0.397	**	-2.20	-0.055		-1.08	-0.276	***	-18.57
N	138,988			695			488			11,166			92,561		
Adj. R^2	0.035			0.091			0.198			0.042			0.039		

Note: Fixed effects, White period standard errors, *p* <.10*, *p* <.05**, *p* <.01***.