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# Vertical Scope Revisited: Transaction Costs vs Capabilities & Profit Opportunities in Mortgage Banking

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# Vertical Scope Revisited: Transaction Costs vs Capabilities & Profit Opportunities in Mortgage Banking

## **Abstract**

What determines vertical scope? Transactions cost economics (TCE) has been the dominant paradigm for understanding “make” vs. “buy” choices. However, the traditional focus on empirically validating or refuting TCE has taken attention away from other possible drivers of scope, and it has rarely allowed us to understand the explanatory power of TCE versus other competing theories. This paper, using a particularly rich panel dataset from the Mortgage Banking industry, explores both the extent to which TCE predictions hold, and their ability to explain the variance in scope, when compared to all other possible drivers of integration. Using some direct measures of transaction costs, we observe that integration does mitigate risks; yet such risks and transaction costs do not seem to drive firm-level decisions of integration in retail production of loans. Rather, capability-driven and capacity- (or limit to growth-) driven considerations explain a significant amount of variance in our sample, under a variety of specifications and tests. We thus conclude that while TCE explanations of vertical scope are important, their impact is dwarfed by capability differences and by the desire of firms to leverage their capabilities and productive capacity by using the market.

## **Keywords**

Mortgage banking, transaction costs, integration, capabilities, capacity constraints, limits to growth

## **Disciplines**

Finance and Financial Management | Growth and Development | Other Business

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Financial  
Institutions  
Center

*Vertical Scope Revisited: Transaction  
Costs vs Capabilities & Profit  
Opportunities in Mortgage Banking*

by  
Michael G. Jacobides  
Lorin M. Hitt

01-17

The Wharton School  
**University of Pennsylvania**

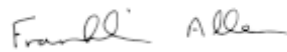


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**VERTICAL SCOPE, REVISITED:**

**TRANSACTION COSTS VS CAPABILITIES & PROFIT OPPORTUNITIES IN MORTGAGE BANKING**

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## VERTICAL SCOPE, REVISITED:

### TRANSACTION COSTS VS CAPABILITIES & PROFIT OPPORTUNITIES IN MORTGAGE BANKING

#### Abstract

What determines vertical scope? Transactions cost economics (TCE) has been the dominant paradigm for understanding “make” vs. “buy” choices. However, the traditional focus on empirically validating or refuting TCE has taken attention away from other possible drivers of scope, and it has rarely allowed us to understand the explanatory power of TCE versus other competing theories. This paper, using a particularly rich panel dataset from the Mortgage Banking industry, explores both the extent to which TCE predictions hold, and their ability to explain the variance in scope, when compared to all other possible drivers of integration. Using some direct measures of transaction costs, we observe that integration does mitigate risks; yet such risks and transaction costs do *not* seem to drive firm-level decisions of integration in retail production of loans. Rather, capability-driven and capacity- (or limit to growth-) driven considerations explain a significant amount of variance in our sample, under a variety of specifications and tests. We thus conclude that while TCE explanations of vertical scope are important, their impact is dwarfed by capability differences and by the desire of firms to leverage their capabilities and productive capacity by using the market.

**Keywords:** Mortgage Banking; Transaction Costs; Integration; Capabilities; Capacity Constraints; Limits to Growth

## 1. Introduction

What determines vertical scope? In the last three decades, transactions cost economics (TCE) has been the dominant paradigm for understanding why firms choose to “make” rather than “buy” required production inputs. The basic TCE argument is that the hazards of the market, especially those created by information asymmetry, lead firms to increase vertical scope, while absence of such hazards and efficiencies of production in specialized firms lead firms to use “the market”. Several empirical studies on vertical scope have been produced over the last fifteen years, and in most of them transaction costs (TC) have been shown to be of some import (see Shelanski and Klein, 1995). However, the attention to validating or refuting the propositions of TCE and related propositions from organizational economics may have taken the focus away from understanding the different factors that can come into play in explaining vertical scope. Moreover, these studies rarely explore the relative importance of transactions costs explanations as compared to other possible theories.

Of late, a number of management scholars have voiced their concerns with the predominance of TCE-based views of vertical scope, and there is a nascent “capability-based view” of integration, which favors more the factors that relate to firms’ relative advantages, as well as other non-TCE factors (e.g. Argyres, 1996). We consider this debate to be important, and believe that we are in a dire need of direct empirical investigations not only of the validity of the TCE tenet, but also of its relative explanatory power, especially when compared to other potential sources of explanation.

The setting in which we will analyze this empirical issue is mortgage banking – that is, the segment of non-depository financial institutions which originate, process, approve, and then (in most cases) sell mortgage loans to the secondary market. The mortgage banking industry is an almost ideal setting to study vertical scope, as it has a complex value chain (see Figure 1) which has increasingly been fragmented into quasi-independent parts, which are performed both by integrated firms as well as narrowly targeted specialists. The feasibility of a wide range of vertical scope decisions and the observed variety in the industry provide a rich setting for empirical study. In addition, we have access to a previously untapped and highly detailed firm-level data source on firm structure and productivity from the Mortgage Bankers Association, the leading trade organization for the industry. This enables us to construct and validate measures for transactions

costs (a historically difficult empirical task) and vertical scope, as well as measures required to test several other competing theories including the “capabilities-based” view, which we will also analyze in depth.

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Insert Figure 1 about here  
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Our principal analyses will focus on the decision to integrate retail production (the process of finding customers and closing the loans) along with other downstream activities (secondary marketing or “warehousing”, and servicing<sup>1</sup>) for different types of loans. There are two potential vertical configurations – firms can either use their own, captive retail branches to originate loans, or they can use (partially- or fully-independent) outside brokers and correspondents. Through these channels, firms can originate a variety of different types of loans (conventional vs. jumbo, fixed vs. variable interest rate, government guaranteed) and can make different vertical scope decisions for each type of loan. Because these loans vary significantly in their risk profile, degree of potential information asymmetry, and capability requirements, we can examine how firms’ matching of channel to loan type is consistent or inconsistent with different theories of vertical scope.

Using both industry-level and firm level data, we show that loan type is indeed a good surrogate for transaction risks, and that vertical integration can help mitigate these risks, validating our measurement approach. We then examine several different theories of vertical scope using an unbalanced panel dataset of an average of 187 firms per year over ten years. We find that firms do indeed have a greater degree of vertical integration for high-risk loans consistent with TCE, but that TCE-related explanations account for only about 4% of the variance in our measure of integration. Using two different measures of a firm’s capabilities (capabilities in upstream and downstream divisions, respectively), we are able to explain up to 30% of the variance in integration. These results appear robust to different specifications and analysis techniques including robust regression and fixed-effects panel data models. Our results are not consistent with simpler stories of vertical integration such as economies of scale or capital constraints, and

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<sup>1</sup> Secondary marketing or “wholesaling” is the management of the process between closing the loan for the retail customer and the resale in the secondary market. Servicing is the processing of ongoing transactional activity of a



given the nature of the industry do not believe that integration could be explained by non-competitive effects (e.g., monopoly rent seeking and vertical foreclosure), the other leading explanation of vertical scope. We thus conclude that while TCE explanations of vertical scope are important, their impact is dwarfed by capability differences and by the desire of firms to leverage their capabilities and productive capacity by using the market.

The structure of this paper is as follows: Section 2 reviews the relevant literature and theoretical explanations as for the possible drivers of vertical scope, and we provide the hypotheses to be tested. Section 3 explains our empirical setting, data and methods used. In Section 4, we examine our measures of transaction cost, and how these are derived from existing theory. Section 5 provides contains the tests of both the TCE and the capability-based hypotheses, and compares their explanatory power, giving due attention to control variables such as scale. Section 6 concludes by considering the theoretical and empirical implications of our findings.

## **2. Drivers of vertical Scope: Existing Literature**

In the last thirty years, much discussion has taken place with regard to the role of transaction costs in determining the decisions to use the open market rather than vertical integration. However, a number of different factors can be put forth to explain vertical scope, both on the firm and on the industry level of analysis.

In our setting, integration into retail production could be due to four reasons, according to the extant literature. First, it could be the result of oligopolistic rent-seeking, as the industrial organization literature suggests. Firms may want to integrate in order to “raise rivals’ costs” (Salop and Scheffman, 1983), control scarce resources (Galbraith, 1967; Porter, 1980), eliminate multiple marginalization<sup>2</sup> (Salop, 1979; Dixit, 1983), improve the ability to price discriminate (Wallace, 1937; Stigler, 1951; Arrow, 1975; Riordan and Sappington, 1987), or to obtain a strategic upstream supply. However, in mortgage banking no firm has significant market power overall or in the supply or consumption of any input or output in any segment of the value chain.

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loan through the remainder of its lifecycle (e.g., collecting payments, generating statements and tax-related documentation, and release of the lien at the end of the loan, among others).

<sup>2</sup> The essential argument is that when because monopolies distort prices and quantities away from the competitive ideal, a series of monopolies selling vertically to each other can create large inefficiencies because the distortions are

Therefore, it is highly unlikely that the exercise of market power is a significant factor in determining vertical scope in this industry.

Second, integration could be due to scale, inasmuch as a minimum scale might be required to be integrated, and hence vertical scope might be technologically determined. A closely related issue is that size may be determined by capital requirements – integration may reduce overall volatility and thus alleviate capital constraints for those without easy access to internal or external sources of financing. Both of these explanations are testable, although our priors are that these are not likely to be significant.

Third, it could be driven by the TCE-type costs of using the market. If the TCE hypothesis is correct, then firms would decide their degree of integration on the basis of the transaction costs of the loans to be procured. While asset specificity may not be particularly relevant in explaining scope, transaction costs and information asymmetry may be a significant driver of vertical integration. If there are loans whose attributes are unknown and hard to verify, and if some loans have higher default risks than others, then firms should tend to produce these in-house, as market-based procurement is bound to be fraught with transactional dangers (Akerlof, 1972; Barzel, 1982; Williamson, 1985). That is, firms will be integrated in the production of loans that both have a higher propensity to present problems, and where trading “through the market” exacerbates these problems. In particular, the party that produces a loan may have an information advantage over those that purchase loans, and may have an incentive to strategically withhold or misrepresent information in order to close the loan and get the commission. Therefore, extant theory would lead us to expect that loans with significant transactional hazards (the quality of the underlying loan cannot be easily verified) should not be purchased through the market, but rather should be “produced” in-house. Thus, integration should be a function of the loan type composition of the origination portfolio: Firms trading in “dangerous” loans should be integrated, whereas “plain vanilla” loans would be traded through the market.

The final possibility is that integration is largely a function of the capabilities of firms in particular parts of the value chain, by their capacity constraints (and dynamically, their ability to grow each part of the value chain) and by the existing opportunities to profit (Jacobides, 2000). That is, the

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magnified at each step in the chain. Significant gains can often be had by coordinating production among successive

vertical scope of the firms under this hypothesis is to be explained by its abilities in each vertical segment, and it may be the case that several firms may chose to specialize and use the market *despite* the transactional risks that imperfect information on loans would impose (cf. Argyres, 1996, Langlois and Robertson, 1995). Simply stated, vertical specialization could be born from the opportunities of *gains to trade* (Ricardo, 1844), despite the “taxes” that the market imposes through transaction costs – much like international trade, which is driven by differences in productive capabilities or by capacity (and which may or may not be curbed through international taxation).

There are two basic drivers of such potential gains from trade. The first is a simple difference in their capabilities: mortgage banks would use brokers or other firms to originate loans where their in-house capability is inferior, even when added costs of transactional hazards are included. The TCE framework already anticipates this story (see Riordan and Williamson, 1995; Williamson, 1999), although the production cost advantages are typically less emphasized than disadvantages of transaction risks, and have not generally been directly incorporated in empirical analyses. As Demsetz (1988), Winter (1988) and Langlois and Foss (1998) remarked, the TCE “school” seems to focus excessively on the exchange conditions, disregarding the potentially much more important production conditions and capability differences.

The second source of “gains from intermediate good trade” (and hence reason for using “the market” rather than “the firm”) may be capacity constraints or limits to growth, an aspect of capabilities that has not been explicitly considered in extant theory. Consider a bank that has equally good origination and loan warehousing / secondary marketing, but has a higher capacity in warehousing. Such a bank may decide to use the market for origination because its warehousing is profitable *even* if it buys loans from the market, despite the fact that such purchased loans may be more expensive to buy than to produce in-house, and regardless of the fact that there may be added risks in using the market. This may also occur if say, origination is hard to scale in the short-run (as it requires the physical outlay of branches, representatives, etc.) whereas warehousing may be easy to scale up. This would predict downstream expansion concurrent with increased upstream integration (see Jacobides, 2000, for formal proofs). A closely related, but distinct, story in the dynamic setting is that limits to growth differ between segments. In our prior example, if it is not

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monopolies – often this coordination is created by vertical integration.

time that prevents origination from being scaled, but simply that origination is subject to much greater diseconomies of scale than warehousing, firms will expand warehousing and buy loans from the market. Therefore, being profitable downstream should lead to a *ceteris paribus* greater use of the market, which will be even more pronounced if (a) the upstream segment is not as efficient; and (b) if the upstream segment is hard to grow. In our setting, we know that origination is much harder to grow than secondary marketing (“warehousing”), hence we do expect to see higher downstream capability to be associated with higher use of the market.

To summarize, vertical scope will be explained in terms of capabilities of the firms in the market; if all firms have similar upstream and downstream capabilities, then no specialization will occur, regardless of the level of transaction costs. On the other hand, if there is significant inter-firm dispersion of upstream and downstream capabilities, then even in the presence of transaction costs specialization will occur and intermediate markets will be active, motivated by the latent gains from trade along the value chain. Differential limits to growth in each segment will exacerbate this capability-driven integration. (A formal analysis of this “capability” and “limit to expansion” hypothesis of vertical scope, with qualitative illustrations from the mortgage banking setting, is provided in Jacobides, 2000).

Monopolistic rent maximization; scale; transaction costs; and capability differences/limits to growth, then, are the potential explanations of vertical scope. Based on our prior discussion, we know at the onset that all the neoclassical economic hypotheses as for why firms should integrate can be ruled out. Thus, there still remain three different explanations: Scale; transaction costs and risks; and capability differences. While the role of scale is not related to any particular hypothesis (it is, quite simply, a significant issue we have to control for in order to have a greater degree of confidence in our predictions), we still have two major theoretically-driven explanations for the choice of scope on the behalf of firms.

First, TCE and institutional economics lead us to expect that (H1) *Transaction Costs matter, and that on the margin they drive firms’ choices of scope*. In addition to this hypothesis, we also posit that (H2) *capability differences and limits to expansion drive vertical scope*. Furthermore, the more important empirical question is, if both H1 and H2 are supported, which of them is the more successful in explaining variation in vertical scope. Thus, rather than simply examining the extent

to which the directional predictions do or do not hold, we will try to explore the extent to which either of these two sets of complementary and compatible solutions explain the variance in our setting.

### **3. Setting, Data, Methods**

#### *3.1. Setting: Mortgage Banking*

Mortgage banks are the non-depository financial institutions that have grown from the development of the securitized mortgage finance provision system in the US, illustrated in Figure 1. They originate loans, which they also service, but typically do not hold the loans as assets; rather, they sell them to the secondary market through large securitizers (quasi-public such as Fannie Mae and Freddie Mac or private such as Citibank Mortgage). Mortgage banks generated more than 56% of the total loan production in 1999, about \$660 billion in new loans. Mortgage banks, therefore, are a very important sector, despite the dearth of studies thereupon.

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Insert Figure 2 about here  
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Mortgage banks make money in different parts of the value chain; a graphical representation in Figure 2 summarizes the activities along the value chain. Profit is made in three increasingly distinct areas: Loan origination; loan warehousing, wholesaling and secondary marketing; and loan servicing. For the purposes of this paper, we will term the origination “upstream” (it’s the “production” of the raw loan); and the warehousing and then servicing as “downstream” activities. To understand how profits are made and how intermediate markets operate, it is easier to move from the furthestmost upstream segment – servicing, to the downstream activities. The mortgage bank that has a loan to be serviced, earns money on (a) servicing fees, which are a percentage of the balance outstanding- anywhere from 18 to 44 basis points, and (b) on escrows and other fees paid by the borrower directly to the mortgage bank. Given the average costs in the industry, this represents a comfortable spread that is earned, and hence servicing is a profitable business. Therefore, a loan to be serviced represents an annuity.<sup>3</sup> The fact that each loan has an annuity value has led to the creation of “Mortgage Servicing Rights” (MSRs) which can also be sold to the open market. Mortgage Banks can make money only in the servicing side of the business by

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<sup>3</sup> The specific value of this annuity is determined by the interest rate at which the loan has been made, the subsequent possibility of it being refinanced, and the resulting expected life of the annuity.

buying MSRs and then servicing the loans for which they have purchased the portfolio, or only on the production side by producing loans and then selling the MSRs, hence capitalizing the value of servicing.

Moving further upstream, we go to the production side, where money can be made on two major segments, as we can see from Figures 1 and 2. The first segment is loan origination, which is the process of identifying and selecting borrowers, processing loan applications, and closing the loan for the customer. Ability to reach and counsel potential borrowers, hand-hold them through the process and help them close the loan is critical here. The second segment is loan secondary marketing, which is also called loan warehousing, i.e. holding the loan which has been just closed and until it is sold to investors to the secondary market (e.g. to Fannie Mae or Freddie Mac), and then arranging for the transfer of the loan to the securitizer / secondary market investor. A mortgage firm may also decide to sell the related servicing rights, or it will keep them for its servicing portfolio. In this segment, money is made by effectively managing the pipeline of closed loans and selling them to the investors at the best possible price; managing interest rate differences, especially when loans are closed in rising interest rate environments, when they may be refinanced before they even reach the ultimate investors; and packaging the loans for sale to securitizers / secondary market investors.

This paper focuses on the decisions of scope with regard to the *production* of loans. We examine what affects the decision of mortgage banks to remain integrated (producing the loans they sell through their own captive branches or representatives) or become specialized in warehousing and secondary marketing of loans which have already been produced by other firms' branches or by mortgage brokers (firms specialized solely in origination). Hence mortgage banks can choose their vertical scope (and indeed can do so in real time, and on a per-loan basis) by deciding whether they want to buy loans for warehousing "from the market", or whether they want to produce these loans themselves, through their own retail network. So mortgage banks can be active downstream (warehousing, servicing), upstream (retail production) or both.

What makes this setting particularly interesting is that we have loans that differ markedly with regard to their transactional attributes, as well as to their risk profiles – and the downstream side of

the business (warehousing) can be affected by information misrepresentation of the upstream side (production). Hence we might expect that firms would be reluctant to buy “dangerous” loans, which are characterized by high transaction costs, but would gladly buy the “plain vanilla” ones. This would mean that transactions costs would really affect the extent of integration. Alternatively, it may be that the capability of each firm on each segment is the primary driver of scope.

### 3.2 *Data: The MBFRF*

The data we have on mortgage banks comes from the quasi-regulatory Mortgage Bankers’ Financial Reporting Form (MBFRF) that they submit to the Mortgage Bankers Association. These statements describe in very fine detail their operations, margins, per segment activities, loan portfolio, pipeline composition, and a variety of other operational or financial characteristics. The data covers around 36% of total mortgage loan volume originated in the U.S and contains an average of 187 firms over 10 years (although it does not track the same firms each year). As this data is collected for quasi-regulatory reasons, MBA tries to capture all the types of firms in its survey, thus leading to healthy levels of variation. Given that the MBFRF is used to compile key industry statistics, and that it is the only data that investors have for mortgage bankers, substantial time and attention is expended on preparing it. It should be noted that this is the first time that any strategy research is done on this data; moreover, this data has never been made available for analyses of any type on the firm level of detail. The reason for MBA’s reluctance to let researchers use the data has to do with the wealth of firm-level detail, which were able to get through a carefully structured data analysis mechanism that preserved bank anonymity while allowing us to test firm-level hypotheses.<sup>4</sup>

The MBFRF contains information on a number of different items. First, it contains information on the composition of the origination portfolio of each firm, by loan type. Second, it contains detailed information on the default rates of the firms’ loans closed. Third, it contains information on all the balance sheet and income statement lines that are relevant in this industry. More important,

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<sup>4</sup> Note, however, that although we were allowed to run regressions on the full data and obtained all the results and statistics for our analyses, we did not have the possibility to examine each observation separately, so as to ensure the confidentiality of the data. This is one of the reasons for which we use extensively the robust regression technique, which we will explain shortly, that successfully deals with outliers, as we could not examine each specific outlier case.

perhaps, it contains income level information per stage of the production process (that is, separately for retail production and wholesale production, as well as servicing). From this segment-level income statement, we created performance metrics (margins or income per loan) that gauge the efficiency of mortgage banks in each type of activity. Such metrics are often used by practitioners to measure the health of a mortgage operation. The major dependent variable we will want to explain is *RPOALNPD*, which is the percentage use of retail over total production. *RPOALNPD* thus measures integration into the retail production. Other dependent variables are used as well; all variables, dependent and independent, are listed in Table 1, which provides their description and symbols.

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Insert Table 1 about here  
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Note that in addition to the MBFRF data, we also use the aggregate data on characteristics of all mortgage loans (volume, type, default risk, etc.), as collected by the Department of Housing and Urban Development (HUD) and reported through Inside Mortgage Finance publications. This data is used to provide yet another check on the “riskiness” of different loan types.

### 3.3. *Methods*

There are three different types of tests we use in our empirical analysis. First, for examining the relative risk of the various loan types, we use the non-parametric sign-rank tests (the Mann-Whitney two sample statistic), which establish whether the means of two populations are identical – an established method, discussed in Wilcoxon (1945), and Mann and Whitney (1989). The second family of techniques, which is the most extensively used in this paper, consists of different variants of regression analysis. For most analyses we report the results from ordinary least squares (OLS) with all firms and years pooled, and parallel robust regression estimates that iteratively reweights points that have a high influence on the coefficients as measured by Cook’s distance to reduce the effect of outliers (Cook, 1979; Berk, 1990; Hamilton, 1991).<sup>5</sup> Given that in a financial industry we tend to have significant problems due to outliers (financial assets and returns vary much more widely than in “real” corporations), and as we cannot do a case-by-case analysis

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<sup>5</sup> This procedure estimates an OLS regression, calculates the Cook’s D influence statistic and then reweights observations based on this statistic for a generalized least squares (GLS) regression. We utilized the *rreg* procedure in Stata using the default parameters.



of the outliers due to the confidentiality agreement, this technique is particularly helpful, especially in the correlation between non-scaled measures (e.g., assets).

Given that we have panel data, we can also perform fixed-effects regressions (see e.g., Baltagi, 1995), which effectively control for time-invariant firm specific factors. We typically use these analyses for two purposes: 1) investigating the robustness of our general results, and 2) examining the effect of changes in various factors rather than levels, which are measured in the OLS/robust regressions.

Finally, we do our comparisons of the predictive ability of various theories by comparing the  $R^2$  figures for each regression (or alternatively, the regression F-statistic) and by using scatterplots which, as we will show later, provide a clear contrast in predictive ability that is not reliant on any particular set of statistical assumptions.

#### **4. Assessing Transaction Costs: Loan Type and the Role of Lemons**

While we do not have any direct measures of transaction costs, we do have information about the different types of loans. The perception in the industry is that loan types differ with regards to information mis-representation, transactional problems, and the possibility of default. With default come significant costs not only to the secondary investor, but the mortgage banker as well.<sup>6</sup> In this subsection perform two types of tests to validate that variation in transactions cost are indeed captured by variation in loan types. First, we show that different loans vary systematically in their risk of default – when there is larger quality variation in the underlying loan pool, it exacerbates problems of information asymmetry and opportunism as the information needed to manage these risks may be imperfectly communicated across firm boundaries both unintentionally and strategically. Second, we show that vertical integration can reduce default risk, suggesting that integration is indeed a policy instrument that enables this risk to be managed as would be predicted by TCE.

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<sup>6</sup> Loan defaults are costly for mortgage banks in several ways. First, if a loan defaults and there were underwriting errors, mortgage banks are often obligated to buy back the loan from secondary investors and bear the credit loss directly. Secondly, even if the mortgage bank is not responsible for credit risk (for example, due to a Government

In Figures 3a and 3b, we plot Department of Housing and Urban Development data over the period 1989-1999 on (a) total delinquent loans (i.e. loans in arrears greater than 30 days, bad loans, etc), and (b) of loans foreclosed, where the property has been taken from the proprietor. The data are aggregated to three major loan categories: FHA (Federal Housing Authority) loans, VA (Veteran Administration) loans (a.k.a. Government loans) and conventional loans, where FRM's (Fixed Rate conventional Mortgages) and ARMs (Adjustable Rate conventional Mortgages) have been bundled together. The figures clearly show a significant difference in credit risk between the various loan categories. With these yearly averages, the non-parametric Wilcoxon sign test that the mean delinquency and default rates are the same for government loans and conventional loans is rejected ( $p < .00001$ ). If the two loan types were the same, we would expect that conventional loans would have a higher default rate than either government loan category in 5 out of 10 years, in our sample, it is 0 out of 10 for both types. Within the conventional loan category, we have further data on the differences between ARMs and FRMs produced by Freddie Mac. In these loans, we see that ARM's are indeed more prone to default than the FRM's (Wilcoxon sign test,  $p < .00001$ ).

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Insert Figures 3a and 3b about here  
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Our results suggest that defaults are higher in the government categories- FHA/VA; then come ARM's; and then FRM's. Qualitative evidence supports and explains this tendency. The reason for higher defaults in Government loans, for instance, is that the minimum requirements on these loans are more "generous", as a matter of social policy. This means both that the mean default is higher (adverse selection is encouraged in FHA/VA loans) and that there should be a higher variation around the expected returns mean. Similarly, ARMs have significantly higher risk because they are utilized by customers with less financial strength (due to lower initial interest rates) which is exacerbated by the presence of varying monthly payments, especially when interest rates are volatile or rising. In such cases, marginal borrowers can produce greater foreclosure and delinquency costs. So, aggregate data suggests that transactions costs are highest in Government

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guarantee), managing default creates significant operational costs of collections, foreclosure and subsequent asset management. Thus, the costs of procuring a "lemon" from the market is large.

loans, somewhat lower in ARM conventional loans, and lowest of all in the plain vanilla FRM conventional loans.

These differences in loan risk are mirrored in our more detailed, firm-level data from the MBFRF, also over the period 1989-1999. We consider the same categories as before, but can also include larger “Jumbo” loans from 1996-1998.<sup>7</sup> This is important as it also establishes the trends within our own data, and enables us to investigate whether higher mean default rates are also associated with higher variance in default rates across firms. Greater heterogeneity of borrowers may also lead to greater variance of defaults across firms if firms have different capabilities in managing credit risk (either due to their ability internally, or their ability to manage external contractors).

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Insert Table 2 about here  
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These arguments are borne out in our data (see Table 2) – government loans are indeed more risky than conventional loans in both mean and variance terms. FHA-VA loans have higher default rates in 892 observations (firm-year) compared with only 204 firm-years of data where conventional has a higher default rate (Mann-Whitney test of equality rejected,  $p < .0001$ ). The evidence is less clear for the difference between FRMs and ARMs – ARMs are higher risk in 52.1% of the observations, which enables us to reject equality with the Mann-Whitney test only at  $p < .08$ . Jumbo mortgages are in the middle, a higher mean than conventional and a much higher variance (the point estimate of the variance even exceeds that of Government loans). This suggests that Jumbos are somewhat riskier in general and may also require specialized skills, given this higher variance in outcomes.

Collectively, these tests indicate that there are systematic differences between each loan type, and that it would be reasonable to expect these differences to affect the expected transaction costs and dangers for each category.<sup>8</sup> But, the question becomes, just *how* reasonable? It may be that each loan type differs by the extent to which it creates a risk (in terms of expected loss), but perhaps in this industry, trading loans through the market has no real “transaction cost”; perhaps integration

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<sup>7</sup> Jumbo loans are those with initial outstandings greater than ~220K. This is approximate, as the cutoff has increased over our sample period.

into retail does *not* mitigate risks, and thus the fact that some loans are riskier than others would be inconsequential with regard to the choice of vertical channel. To resolve this important question, we have to look at the extent to which in-house procurement is negatively associated with default. If making rather than buying loans lessens the risks for these loans, then there are some true transaction costs of using the market. And hence our suggestion that higher-risk loans ought to be made in-house rather than purchased would be a faithful and consistent application of TCE.

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Insert Table 3a about here  
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In Table 3a, we report robust regression results that relate firm level risk of default to integration for each category of loan (different columns of the Tables). We begin first with an integration measure of retail production (fractions of loans produced in each category). Starting with the “high-risk” loans (FHA-VA), we see that the expected negative correlation between the degree of integration into retail production and the level of defaults does obtain, and with a statistically significant margin. The more retail is used, the smaller the default rates. If we look at the second most “dangerous” category, ARM’s, we see that the same patterns still obtain. The same happens with the third “risky” category, Jumbo loans. Interestingly, the impact of the choice of a procurement channel is statistically stronger here, although its coefficient is roughly equal to that of the ARM. This finding is in line both with our theoretical expectations, and qualitative evidence. Jumbo loans not only have a relatively higher default rate, but also the highest variance, and therefore it is to be expected that producing these loans in-house is particularly helpful in mitigating loan defaults. In the “plain vanilla” FRM category, on the other hand, production mode does not seem to be particularly important, as the coefficient is essentially zero. This is probably because the informational discrepancies between in-house and market-based origination are so limited that it does not make much difference how the loan is produced, consistent with a more elaborate TCE explanation. Interestingly, these results are similar in magnitude and statistical significance (except for the ARM result) if we lag the dependent variable by one or two periods which allows for some adjustment in outcome since default outcome typically follows origination (one period lags are shown in Table 3b, two period lags not shown).

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<sup>8</sup> These results also hold in aggregate – the larger the fraction of high risk loans in a firms’ portfolio, the greater risk of default overall (results not shown).

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Insert Table 3b about here  
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These regressions suggest that the use of the market is indeed associated with higher risks, and that, especially for the riskier types of loans, it is indeed beneficial to avoid brokers and correspondents – just as TCE would suggest. Further evidence that using the market matters to the eventual risks, and that each loan type differs *both* for the risks *and* for the extent to which the market is desirable, can be obtained by the regression of per-category defaults on whether the loans were produced (warehoused) by the firm that services them, or whether they were bought on the open market – that is, whether there was full vertical specialization. To do that, we regress the default percentage to the extent to which loans were purchased as closed loans or as Mortgage Servicing Rights. As this is a measure of specialization rather than integration, TCE would predict a positive correlation.

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Insert Table 4 about here  
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The results reported in Table 4, again by loan category. The independent variable is the extent to which loans serviced were purchased from the open market (servicing released or as MSR's); the specific regressor is lagged for one period (similar results hold for either two or zero lags, not shown). These results indicate that “full marketization” comes with significant dangers. The more the market is used, the greater the possibility of default, in each loan category. Hence if the market is relied upon to obtain everything but the servicing rights, even the plain vanilla loans may exhibit transactional problems. Also, the impact of using the market differs between loan categories, as we also observed in the previous set of results. The coefficient of FRM's is around .002; for the more dangerous ARM's and Jumbos it is around 0.004; and for the most dangerous FHA/VA around 0.08. Hence the more risky / uncertain the loan, the greater the benefit from producing it in-house, in terms of risk mitigation.

In conclusion, we do have evidence that (a) loan types are a good proxy for transaction costs; (b) production choices (degree of integration) do mitigate these risks, especially in the most dubious products. Therefore, our data enables us to bypass one of the major problems in measuring the

drivers of vertical scope – namely, the difficulty of finding adequate measures of transaction costs. This allows us to provide unusually direct tests of the theory, to which we move.

## **5. Explaining Vertical Scope: Transaction Cost, Scale, and Capabilities**

In the following sections, we systematically evaluate different possible explanations for the integration decision.

### *5.1. Vertical Integration and Transaction Costs*

In the previous section, we saw that the TCE rationale (that integration helps mitigate risks) is correct. We also saw that loan types come with different transaction costs, and that integration protects firms from hazards, especially in the high-risk loans. We thus concluded that we can use loan types as a reasonable surrogate of TC, and that we would expect that origination portfolio composition should be a statistically significant driver of integration. But the question now becomes, how important is it, really?

The first objective is to examine whether the degree of integration in origination is determined types of loans that a firm produces. The general model we will estimate relates percentage of retail loan production (overall) to the composition of loan production in different types and various control variables. In all specifications we will include time dummy variables to capture short-term effects of loan composition and also to partially correct for the mean integration changing over time due to changes in the sample composition in our unbalanced panel. TCE would predict a significant positive correlation with the number of government (FHA / VA) loans, and a mild negative with FRM's, the plain vanilla safe haven. Also, as most of the variation in integration choices should be due to transactional factors, we would expect a significant degree of variance explained by this regression. The results of this analysis are shown in Table 5, where we estimate this base model with OLS and robust regression, and on the full sample versus a restricted sample where we also have Jumbo loan production information.

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Insert Table 5 about here  
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A number interesting results stand out from these regressions. First, the total percentage of variance explained is very small; the  $R^2$  is around 2%. If the year dummy variables are removed,

this is even lower without a substantial change in the rest of the results. Second, the statistically significant coefficients are not quite in the direction that we would expect on the basis of our TCE predictions. In the OLS regressions, we do observe a negative association between FRM and degree of integration. This finding, however, becomes statistically insignificant when we move to the more reliable robust regressions. As the FRM's are the least risky loans, it would be reasonable to expect to see a smaller degree of integration in the presence of a high proportion of FRM's. On the other hand, given that the previous sets of regressions indicated that the choice of loan channel does not help mitigate transaction risks for FRM's, we are cautious about this result. The more interesting finding, however, is that the most "dangerous" category (FHA / VA) isn't, as expected, positively associated with integration, either in the entire sample, or in the post-1996 sample, which includes Jumbos. Furthermore, the coefficient of the FHA loans, in the more reliable robust regressions, is a *higher* negative number than that of the "docile" FRM. That is, having more FHA-VA's than FRM's seems to be positively associated to specialization, contrary to what we would expect on the basis of TCE.<sup>9</sup>

Another interesting result is the strong negative coefficient on Jumbo loans (columns 2 and 4), which means that the more Jumbos a firm has, the less it tends to use its own retail network. This was not expected, due to the fact that (a) Jumbo loans have high risks, and (b) retail production has the highest impact on Jumbo loans – this is the category where default is mitigated the most when loans are produced in-house. So this result runs against the grain of the TCE predictions.

As a final test, we perform the same regressions described earlier in a fixed effects model, essentially including a separate dummy variable for each firm to remove any firm-related effects that are constant over time, and thus focus on changes on the margin. There are a variety of reasons (some more plausible than others) why it might be useful to remove firm effects from the analysis. It may be that each firm faces a different transactional environment (while this is highly unlikely in our context, and our qualitative evidence points away from that, we still concede this possibility). Perhaps some other factors shape the absolute level at which the firm can be integrated – for example, age or local access to correspondents or brokers. Thus, a refined TCE

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<sup>9</sup> The qualitative assessment of this result from industry experts has been that retail branches are usually better able to seek and aggressively serve that particular part of the market- a capability hypothesis that we cannot test. Yet it is

argument would suggest, even if each firm's *level* of integration may be due to such firm-specific factors, the decisions of the firm *on the margin* should be affected by the expected impacts of transaction risks, driven by the underlying loan attributes. Thus, if a firm *increases* its share of FHA/VA, it should be expected to increase its degree of integration, for whatever level of integration it is in. To see if this is the case, we ran the fixed-effects panel model on the data, with and without the Jumbo loans.

These results (Table 5, columns 5 and 6) are remarkable. First, the explanatory power (once the firm effects are removed) is practically nil. Firms, even on the margin, do not base their integration decisions on the loan types and the resulting levels of expected transaction costs. There is quite simply another set of factors at play. Second, even the limited statistical evidence in this analysis runs against our theoretical predictions. The coefficient for the FHA/VA loans is *negative*; that is, a firm which increases its share of more dangerous loans, where integration would help it keep the risks down, appears to move concurrently to greater outsourcing.

To conclude, the evidence is that loan types do not drive the degree of integration, although they do mitigate transaction risks. The explanatory power of transactional variables (or their proxies) appears to be low, and the results often run against the grain of our theoretical expectations. Thus, while we do find support for some aspects of TCE (regarding risk mitigation), it is not particularly good at explaining heterogeneity across firms. If integrating mitigates the risks, then why should integration not be associated with the reliance of potentially costly loans? The answer seems to be that there are other factors at play – which is the impression we obtained from the qualitative analysis and by archival research. The question now becomes, what are these other factors?

## 5.2 *Firm-Specific Drivers of Vertical Scope*

In order to see whether there is some firm-specific driver of vertical scope, which cuts across loan categories, we examine how the percentage use of retail in one category (FRM conventional loans – the biggest category) is associated with the percentage use of retail in the other production categories. The basic premise is that we do not have any a priori expectation that the integration is

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clear that the TCE hypothesis cannot find support.



one loan type will co-vary with that of another. As a matter of fact, we would expect the association between different loans to be negative inasmuch as these would represent different transaction costs; integration in high-TC loans like FHA-VA should be negatively associated with low-TC loans like FRM.

Rather than doing a simple correlational analysis, we will provide a regression. This is mathematically equivalent, but it also enables us to use the more reliable robust techniques. We regress the integration of FRM loans on the integration of all the other loan categories to see whether we will obtain this conditional relationship (negative or zero) as hypothesized by TCE, or a positive relationship which cuts across loan categories, presumably driven by some firm-specific capability or resource constraints. We include year dummy variables in all specifications. In this analysis, we care about the sign of the coefficient and the degree of variance explained; the specific point estimates obtained are not to be interpreted (as the choice of which variable is dependent and which is independent is arbitrary). The analyses were done both in OLS and in robust regressions, and were run separately in the full sample and the restricted sample which includes Jumbo loan information, as before (Table 6).

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Insert Table 6 about here  
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The results are stark. In the simple model (OLS) between 71% and 82% of the variance is explained (as opposed to 2-3.5% in the TCE-based model presented in the previous section). The explanatory power is even stronger in the robust regressions, although the coefficients are not particularly stable – this is likely due to substantial multicollinearity between integration in different loan types (this multicollinearity is to be expected if our predictions on firm-specific factors are correct). All loan types are very strongly and positively associated with the mode of production of FRM's, with t-scores from the teens to close to three hundred. If a firm tends to use retail to procure only a portion of its FRM loans, chances are it will do the same with its Government (FHA/VA) loans, despite the drastically higher TC in FHA/VA. As before, the year dummies do have some explanatory power, but they account for only a small fraction of the variance explained (~1-2%). Thus, there is something which is firm and year specific in the decision to integrate, and which explains almost all the variance; and this is apparently unrelated to TC.

Overall, our analysis suggests that firms do not choose their degree of integration on the basis of the transactional properties of the underlying loans, despite the fact that (a) such loans have a significant difference in their potential risks / costs, and (b) that the choice of procurement mode mitigates these risks. We also see that the degree of integration co-varies very strongly within firms across loan types. To further explore this finding, we estimate fixed effects regressions to understand whether it is due to static firm-specific factors or whether the relationship is also dynamic (that is, each firm could have a resource / expansion constraint that makes it change its scope, for all loan types, in the same way each year, over and beyond its mean level.) The capability – limits to growth model would lead us to expect both, which should appear as positive correlations between integration in different loan types with and without fixed effects. Note that a TCE story in this model would again posit negative relationships between integration in the different loan types – firms choosing to outsource some loans will do this in the lower TC channels, while integrating loans in the high TC channels.

We show the results of fixed effects models in Table 6, columns 5 and 6. In both of these models, the correlations are large and significant. While the significance of the coefficients falls noticeably, going from t-value close to 300 to t-values of 11 and less, the same general patterns of a positive association between loan types with a firm remain important, even in the fixed-effect context. The coefficient values are, as we expected, generally reduced – the joint impact of the integration of all the other loan types added together is reduced from .99 or so to around .7. A subtler change is that the extremely strong association of ARM's with FRM's is reduced when we introduce the firm fixed effect. So, in the presence of a firm-effect, we see a more “balanced” pattern whereby FRM's co-vary “equally” with all loan types.

One striking observation is that dynamic (non-firm effect) factors appear to account for a very large fraction of the variance – if capabilities were constant over time we should see virtually no correlation between retail integration in a fixed effects models. There are two possible explanations for this finding. First, we could take the result at face value and conclude that which implies that most of the “action” is dynamic – it is the firms' adjustments to resource constraints

and expansion opportunities (the limits to growth hypothesis) that explains the match between integration of different loan types.

However, it may also be due to a closely related story of modeling error. The fixed effects regression will remove all the variance if indeed the structure of the firms over time are roughly constant. A sub-study for M&A's which we did with the MBA, revealed 101 Mergers or Acquisitions in our sample. Given that the firms for which we have more than 2 periods are 369 to 459 (depending on the variables required for the analysis), this amount of M&A is enough to contaminate the importance of the firm effect. The reason is that what is a firm with a set of capabilities  $C_1$ , leading to a choice of integration  $I_1$  at some initial time, will become a different firm, with a different set of capabilities  $C_2$  (and resulting integration  $I_2$ ) after a merger. We also have a reason to suspect that the difference will not be randomly distributed since M&A is one common way for financial firms to acquire new capabilities or overcome barriers to expansion (e.g. a servicing mostly mega-firm gobbles up an origination firm to ensure smooth flow of servicing in the future) -- this further decreases the magnitude of the firm-effect. The fixed-effects coefficient cannot "find" the commonalities of firms across different time periods because the firms are indeed different. And given that 24-31% of our sample has undergone such activities, we have good reasons to believe that, with our current data, the impact of the firm effect is systematically under-estimated, and, unfortunately, the obvious solution of identifying M&A in the sample is not feasible due to our data privacy restrictions.

### 5.3. *Vertical Scope and Firm Scale*

It appears that the capability and growth dynamics we suggested are consistent with the data, that transaction costs are not the primary driver of vertical scope in our sample, and firm- and time-specific factors can explain the choice of vertical scope. This being said, it would be clearly premature to jump to a conclusion that this finding lends support to a capability-based approach. What we first have to establish is that there is no other, obvious candidate that explains this important firm-specific component – such as economies of scale.

In order to test whether scale affects integration, e.g. by requiring some minimum amount of loans before in-house production becomes economically feasible, we estimated models that relate firm assets and firm capitalization (equity) to the overall degree of integration. If there is some minimum scale or if scale is a requirement for integration, then we would expect either a monotonically increasing relationship, either approximately linear or on the increasing portion of an inverted-u relationship. A similar relationship could also hold for financial capital if there exists some minimum scale for capital; an opposite relationship could hold if integration smoothes volatility and therefore requires a firm to have less financial capital. Different variants of this analysis are presented in Table 7.

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Insert Table 7 about here  
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Note that rather than a normal positive association between asset size and degree of integration, or even an inverted-u shape, there seems to be a u-shaped relationship (a negative coefficient on the linear term and a positive coefficient on a quadratic term): small firms are integrated, then grow and then become dis-integrated further on at very large scale levels. So scale is not a real driver of vertical scope. (It is hard to justify a “u” relationship between size and integration on the grounds of economies of scale). Qualitative data are consistent with this observation. Very small firms, according to additional MBA surveys, are integrated, relatively larger ones make greater use of their warehousing network (being less integrated), and some of the larger ones may be in between, using both their retail network and brokers and correspondents.

The reason for which the asset-squared coefficient is positive, i.e. that there is some increase of integration as firm size increases, is that the very big firms (which are more than two orders of magnitude bigger than the average firm) are usually less integrated than the medium-sized firms. The statistical reason we observe this is that the extrapolation of a linear trend would make us expect that larger firms would not have any retail production (whereas in reality they have 30-60% of their production in retail.) The business reason for which some of the larger players use their in-house staff more is that they tend to be the mortgage banks that are large enough to engage in national advertising, like Norwest / Wells Fargo, CitiMortgage or Countrywide. Smaller players are more integrated as their comparative advantage lies in origination, hence they would not be interested in purchasing others’ loans.

The same logic applies to equity as well. The relationship between integration and equity is also negative – meaning that the more firms become capitalized, the less integrated they become, with capital being measured in absolute terms.<sup>10</sup> Similar results were obtained through both a log-level and a log-log regression. The coefficients on  $\log(\text{assets})$  for the log-log regression are negative, meaning that on average an increase of scale leads to a decrease of integration. To provide yet another test, we examined whether an increase of a particular firm’s size or equity level was related to an increase to its degree of integration. The fixed-effects models presented in the last two columns of Table 7 suggest that firms that as firms grow, they tend to shrink their retail network. This is squarely inconsistent with an economies of scale hypothesis.

We should, however, note that the fixed-effect model also indicates that the growth in equity size (up to a limit, as the squared term is negative) is associated with an increase in integration; the same result obtains for capitalization (equity/assets). So it may be the case that integration into retail is associated with added requirements for capitalization. However, the regression results and visual inspection of the data suggest that there is no evidence of a “limit” preventing small firms from becoming integrated. There may even be a case for *dis*-economies of scale, or at least of growth for retail; as a firm increases in size, this regression tells us, it is more likely to become more vertically specialized (albeit with some limit as firms grow.). While this finding is too isolated to provide adequate support for our “impediment to growth” hypothesis, it clearly points away from the “usual suspects” such as scale and capital as drivers of scope.

#### 5.4. *Firm-based Proclivities: Capabilities (Efficiency Measures) and Integration*

The results from our analysis strongly suggest that there are some firm-specific factors which affect the degree of integration; these effects are not driven primarily by scale, and they also tend to exist both on the cross-sectional level (each firm having a different proclivity to use retail, across loan categories) and, more so, at the dynamic level (each firm deciding, year-per-year, how to shift its entire production strategy, irrespective of loan type and the resulting TC levels). The

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<sup>10</sup> The capital structure, expressed here as equity over total assets is positively associated with the use of retail; so proportionately well capitalized firms may tend to use retail more; yet this does not relate to size. Equity levels, however, do.

question now is, what is this firm-specific factor? The answer that some recent research provides is, “mostly, capabilities” (Argyres, 1996), as well as “limits to adjustment” (Jacobides, 2000). Unfortunately, these constructs are not directly measurable. However, we can provide some indirect evidence based on productivity measures, to the extent that capabilities should appear as higher (relative) efficiency.

The best measures that we can use are the productivity metrics we have on the level of the production employees per loan. Specifically, we will use the measure of the number of Full-Time-Employee equivalent in retail production and divide it with the number of loans produced; and likewise, we will take the number of FTE’s in origination overall (including Warehousing / Wholesaling / Secondary marketing) and divide it with the number of loans produced (total).

The problem in estimating this relationship is that we have two opposing effects. On the one hand, the more a firm is integrated into retail, the more employees that firm will have. By using the market, a firm trades off salaried labor (FTE’s) to work done on a contract. So we expect for this simple reason to see the degree of integration be positively associated with the number of employees per loan handled. On the other hand, though, the better a firm is in the *production stage itself*, that is, the fewer people it needs to originate a loan, the more it will be integrated – if it is efficient at it, it will probably chose to do more of it itself.

To separate out these effects, we can obtain simultaneous estimates of three different productivity measures we have available. The first measure,  $FTE_{orpv}$ , is the overall number of employees for each loan, for the entire origination process (divided by the number of all loans, originated by all channels). The second measure ( $FTE_{prpv}$ ) is the number of FTE in retail production – divided by the number of loans produced only. The third measure ( $FTE_{wmpv}$ ) is the number of FTE’s used in warehousing and purchased production, divided by the loans of that category.

The expectation is that the positive association between the extent of retail and the degree of integration would be captured by the overall efficiency / staffing figures – that is, the more integrated the firm, the higher the overall number of FTE per loan. On the other hand, the local efficiency in production should lead to greater integration – firms that are good at retail, will do

more. (Hence the more FTE's are needed for a loan, the smaller the degree of integration into retail). Finally, if a firm is particularly adept in the warehousing side, i.e. if it has a low FTE, then we would expect it to leverage this by using the market, *ceteris paribus*. So we would expect a positive association between the number of employees (inefficiency) in warehousing and the degree of integration. The results of the correlations, in OLS and robust regression are provided in Table 8.

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Insert Table 8 about here  
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As shown in the table, the hypotheses on both upstream and downstream capabilities are borne out. Also, despite the relative lack of sophistication in our measures, the variance explained is above 30%, even in OLS regression (again, compared to the 2-4% of the TCE-based analyses). It appears that inasmuch as firms are efficient in retail production, they tend to focus on it, and be integrated in it.<sup>11</sup> Inasmuch as they are efficient in warehousing, they tend to use the market, to leverage their capabilities.

### 5.5. *Firm-based Proclivities: Capabilities (Income-Based Measures) and Integration*

Having established that some measure of capability may be used to determine scope, let us now shift to another way of estimating the impact of capability on vertical scope. As mentioned before, the problem with capabilities is that they cannot be measured directly. In addition to the efficiency measures of capability that we analyzed in the previous section, we can also gauge the impact of capabilities per segment through the profitability and margin metrics per segment.

In line with the work in the structural equation modeling tradition (Bagozzi, 1991), we assess the impact of an unobservable / latent variable (capability) through one of its visible impacts (profitability rate / margin). The data we have at our disposal are the net and gross income, as well as the margins in retail production, warehousing, and production, warehousing and marketing

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<sup>11</sup> A comment is in order for the difference in the coefficient value of the warehousing FTE vs. the production FTE, as these are different by three orders of magnitude. This difference was entirely expected. The number of individuals involved in the warehousing of a loan is indeed a very small fraction of the number of people needed to produce and close it. One person can help warehouse a very significant volume of loans, given the nature of their work.

alike. Given that we are interested in assessing capabilities, we will be focusing on the profitability metrics, i.e. the per-loan net income measures and the margin measures, which presumably are most closely related with (and are the manifestation of) capabilities.

Specifically, we can stipulate that vertical integration in retail is positively associated with the net income per loan volume in production (the more attractive it is, the more a firm does); it will be negatively associated with net income per loan as well as net margin in warehousing, as well as the marketing margin (the better a firm is in warehousing, the more it will attempt to use the market to profit from its capability); and the overall margin should not have any significant correlation with integration.<sup>12</sup> These measures were run in natural logs, given their distributional properties.

These results are shown in Table 8, columns 3 and 4. First, despite the relative coarseness of the measures, the explanatory power is quite good- around 22%. Second, the results are all in the expected direction and significant. Efficiency in production, as measured by the profitability in production, is very strongly associated with integration into retail production. Conversely, warehousing or marketing efficiencies lead to greater use of the market, as we would expect. While both measures for warehousing seem to work in the OLS, one is dominated by the other in the robust regression. But the qualitative results remain, and receive good support. Hence we do have good evidence that capabilities, measured either in terms of efficiencies or in terms of profitability rates, do explain integration.

## **6. Transaction Costs, Capabilities, and Integration Revisited**

Summarizing the results, let us compare the predictive capabilities of the three main models – the model that uses loan types (a surrogate for differential TC); and the two models that use the proxies for per segment capabilities to predict integration into retail. In order to examine their relative efficiency, we provide here the graphs of the predicted versus the actual values. The regressions used are the robust regressions, without the firm dummies, to show the force of the

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<sup>12</sup> Note that our measures were taken from the industry “standard” way of measuring performance. Production, in all the industry publications, is measured on a “per loan” basis, and so is warehousing. Warehousing and marketing can



argument. The spread in the values indicates not only the predictive capability, but also which way the predictions are “off”. The respective graphs are in Figures 6a-6c. To summarize, the TCE-only model explains only about 1.4% of the variance compared to the Capability (efficiency) model which explains 30% of the variance and the Capability (margin) model which explains 21.9%. Combining the efficiency and margin models explains a total of 35.3% of the variance, a number that only increases to 35.4% if the TCE measures are also included.

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Insert Figures 5a-5c about here  
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Thus, the explanatory power of the capability-related metrics is very strong, whereas the explanatory power of the TCE-based loan-type hypothesis is practically nonexistent. So while, strictly speaking, both of the original hypotheses were vindicated (both the transaction-cost and the capabilities-based Hypotheses are borne out) they do differ markedly in their ability to explain heterogeneity in firms’ choices of vertical scope.

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Insert Table 9 about here  
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Finally, Table 9 shows a regression including all factors and shows that the coefficients do not change dramatically and all remain in the right direction when we consider a “maximal” model. The measures of capability in particular, appear to be quite robust despite their cross-correlations. It also provides the year dummy estimates, which have been consistent throughout most of the regressions (year 6 is particularly different partly because of sampling problems in that year.)

To conclude, TCE is vindicated by the data inasmuch as the choice of production channel / degree of integration mitigates risks, especially in the most “dangerous” and TC laden loan types, as we saw in Section 4. On the other hand, and despite the fact that we know the transactional advantages of using integration, the decision of what channels will be used, and where, is *not* driven by TC considerations. Not only is the explanatory power of the TC factors minimal, but also some of the predictions on coefficients are not borne out. So there are some other factors that dominate TC in driving the degree of integration. We further saw that there is a strong, firm-

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also be measured by looking at their returns on the capital committed to support these activities, so I used the net margin measures for these activities, whereas retail production is labor-intensive.

specific driver of vertical scope, which also varies with time. This is not due to scale, as we established; rather, it appears to be correlated with the relative efficiencies in each stage of the production process, or the resulting profitability therein. Although the lack of good capability measures as well as the weaker-than-expected inter-temporal firm effect do not allow us to make unambiguous conclusions, the surprisingly solid explanatory power of capability-related measures, as well as the fact that all the relevant hypotheses were borne out, suggest that there is good empirical validity in the capability-based explanation of scope.

The results, then, are consistent with the nascent literature on capability-driven accounts of vertical scope (Langlois and Robertson, 1992; 1996; Argyres, 1996) and in particular with the formal model recently proposed by Jacobides (2000) that combines transaction cost with capability-based factors in explaining integration patterns. We thus conclude that while TC are important as an analytical category, they do not dominate the explanation of actual integration patterns in this industry, and that in order to understand the evolutions of vertical scope as well as the individual choices of governance we need to look to TC, limits to growth and capabilities alike. We thus conclude that the way the empirical question has been predominantly posed so far in our field has been posed (do TC matter, *on the margin?*), may be misleading, and that significant headway can be made by looking at the relative explanatory power of different potential drivers of scope.

**Appendix to Chapter 5**  
**The Database: Data & Structure**

This database, called Mortgage Banking Association Database, contains data that has been gathered through the Mortgage Banking Financial Reporting Form (MBFRF). The MBFRF contains detailed and sensitive information about mortgage banking companies, and is collected jointly by the Mortgage Bankers Association, and the three major (government-sponsored -GSE) securitizers - Fannie Mae, Freddie Mac and Ginnie Mae. Given that the Mortgage Banking companies are not directly regulated by any governmental body, the MBFRF database is designed to gather sufficiently detailed information on a wide part of the mortgage banking firm population. The MBFRF is thus structured to help diagnose not only financial health, but also business and strategic soundness for all major value-adding activities of mortgage banks. The GSE's in particular want to know what the cost structures and financial viability of the mortgage bankers. Note that GSE's charter bans them from selling directly to the primary market or servicing the loans, and they hence need to know that those who bring them loans from the primary sector, and who also service the holders of their securities, are healthy from a financial and strategic viewpoint. This explains why the data is so detailed.

Until now, the MBFRF data have only been made available in the form of aggregate statistics; this is the first time that information originating from the MBFRF is used in a strategic study, and the first time that firm-level implications are analyzed. At the firm level this data is strictly confidential. The MBA, however, has allowed us indirect access to the data, which allows for a structural analysis. It has allowed us to submit queries, as well as to analyze a micro-aggregated database (the MBAD) which also preserves bank's anonymity.

The dates for which the data are available are 1989 to 1998. The data in the MBFRF cover an extensive and representative sample of mortgage banks, which average 192 per year, and range from 97 to 269 per year. These firms cover up to a significant percentage of the industry activity. Some data selection bias might exist, as only firms larger than \$1 million in assets, or firms who can close loans in their own names are included. Given our specific analyses, this simple selection criterion should not affect our results, as we do not use full-fledged population tests where data selection would be important. (The threshold for inclusion is so low, that only small brokers are essentially left out of our data-set.)

The data in the MBFRF, and subsequently for the MBAD, have been checked for consistency in three stages. First, KMPG, which does the initial data collection, verifies that the data is input correctly, and checks for the existence of particular records, fields, etc. Second, in the completed reporting forms, several firms do not provide a full analysis of their activities. The MBA thus separates firms who reported on most areas from those who made minimal reporting. The minimal-reporting firms, and otherwise unusable records, are excluded from the data set. This restricts the data-set from 700-1100 firms to 200-350 firms. (The entire universe of firms in the industry is around 3,000.) Several studies from the MBA have shown that there is no systematic non-response bias, and that respondents are a representative sample of the overall sample. The only bias might be towards bigger, established firms that are consistent in providing their information. Third, once the "narrow" group of firms is selected, a consistency check is made. (For instance, if servicing income is reported, an expert system looks for the corresponding servicing expense).

This consistency audit highlights irregularities with the data, which may be due to incorrectly filling the form, or other firm-specific reporting particularities. Each inconsistency, presumably, raises a “flag”, and then the MBA economists contact the firms who have “flags”, to verify the information and make any necessary amendments. A similar check is run cross-sectionally for the entire sample, and data points that seem particularly improbable in the distribution also raise flags that are further investigated by MBA economists. The same procedure is run every year. (For the years prior to 1996, consistency check was run in a non-automated basis.) However, there are some elements that make us wary of a need for yet another check that our data are the cleanest possible.

In terms of contents, this firm-level data-set contains detailed information on both balance sheet and income statement. The balance sheet information is detail for all components. In addition, there is detailed information on the loan portfolio and its composition, the types of loans that are originated or serviced (government insured, conventional, jumbo, etc.), the mix between service purchased and service produced, the mix between loans purchased from brokers or correspondent and loans produced, etc. Some of the measures (e.g. the break-up between broker production and correspondent production) have been implemented in 1996, reflecting trends in the industry (such as the broker’s growth to prominence.)

Very detailed information exists on the income statement level. Revenue is broken down in components (different types of fees and income components for each part of the value chain), and so are expenses, which are broken down to expenditure types (personnel, technology, education, other inputs, other expense items as appropriate- e.g. depreciation, etc.) In addition, all income statement information is recorded on a functional level, for the four major processes, i.e. origination, marketing, warehousing, and servicing, for the full detailed revenue, expense, and gross and net profitability data. So we have a very fine detail in the composition of income and expense for all parts of the value chain. We also have detail on each aspect of the origination and servicing portfolio, with a breakdown on the type of loans produced or serviced, as well as information on the types of loans purchased for servicing, or obtained from brokers / correspondents for production. Several additional items exist in the database, such as: institutional type (independent private or public mortgage banking company / subsidiary of bank or S&L / etc.—used in our analysis as dummy variables); years of operation; links with parents and affiliates; etc. (To give a sense of breadth, the total number of observation fields for each firm-year is between 682 and 818, depending on the year).

As for interpretation of our data, exogenous factors (other than the underlying economic and competitive pressures considered in the thesis) do not seem to have affected the industry during our sample span. Regulatory changes have not affected the industry in any dramatic fashion during the 1989-1998 period. (A major legislative and regulatory act, FIRREA, which affected the entire industry and the mortgage banker segment, was put into effect in 1989). The only notable change happened in terms of accounting conventions with the institution of the Financial Accounting Standards Board Directive FAS 122/5, which allowed origination expenses to be capitalized (rather than fully expended in the year production occurred) even if production was done in house. FAS 122/125 was ratified in 1995. Finally, we should note that some items in the database have been added in the last few years, reflecting changes in business practices. For instance, some information on sub-servicing was added in 1996, when it became important enough to prompt the MBAD administrators to include it in their reporting form.

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Figure 1: The Mortgage Lending Value Chain

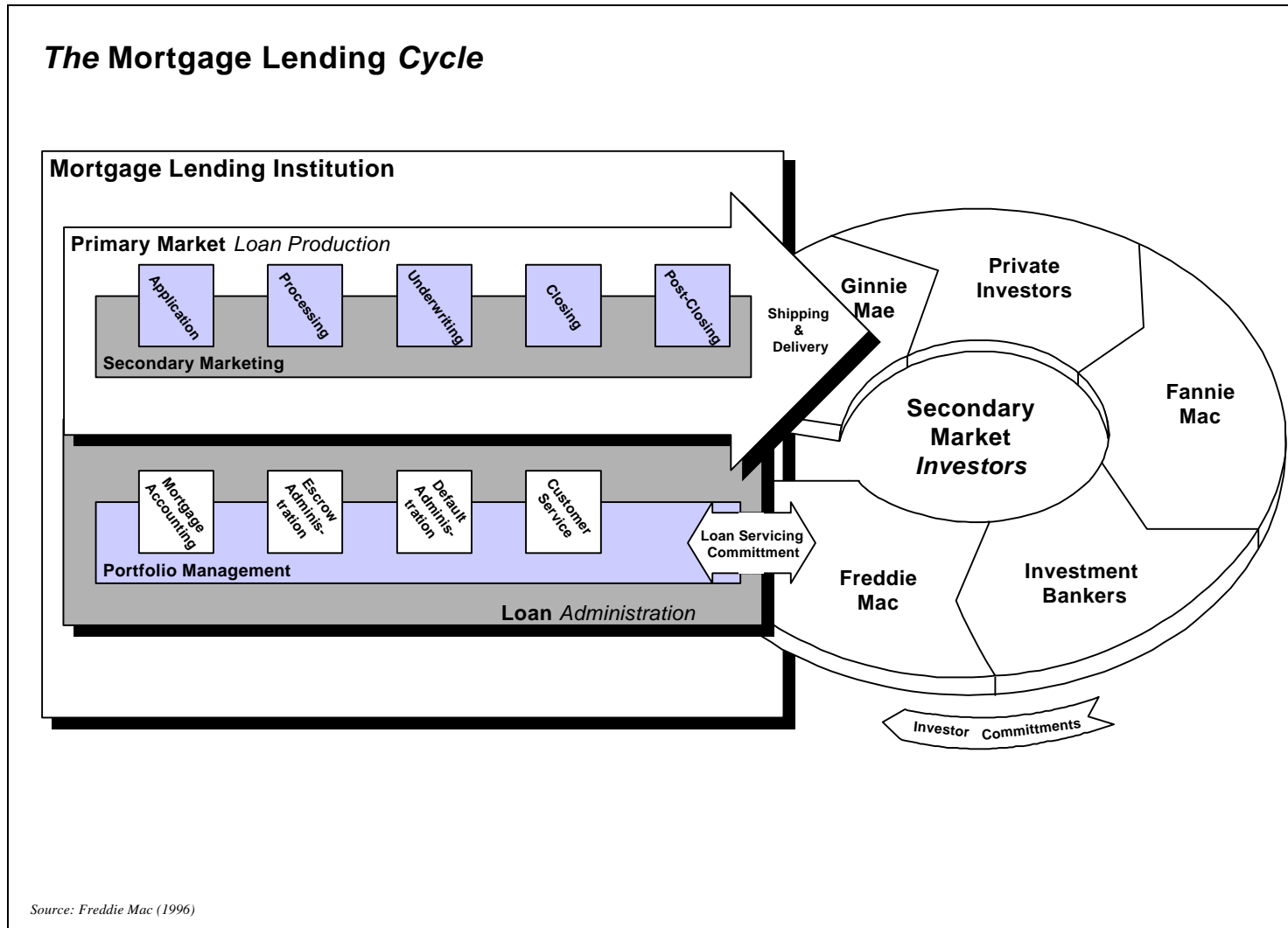
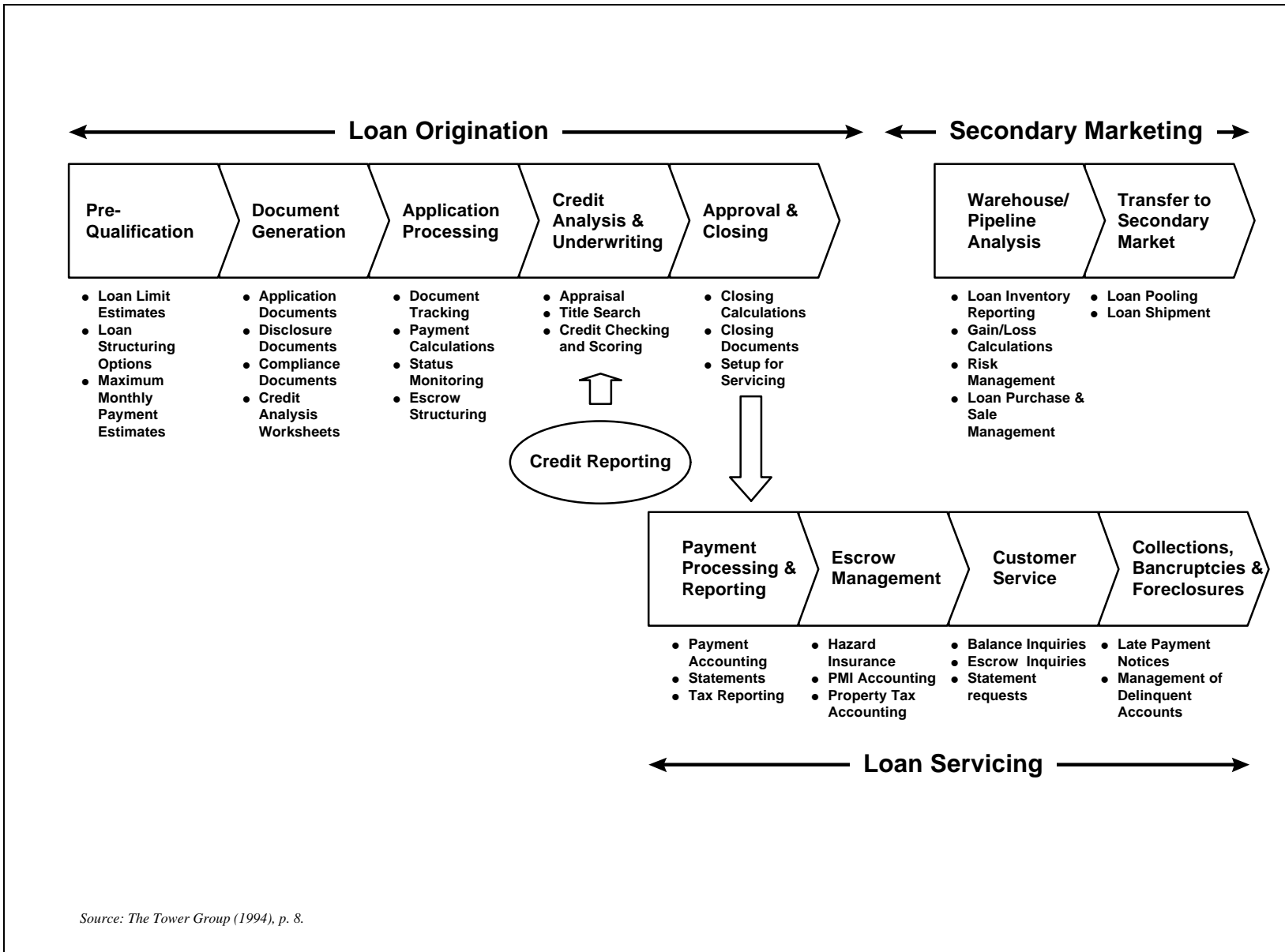
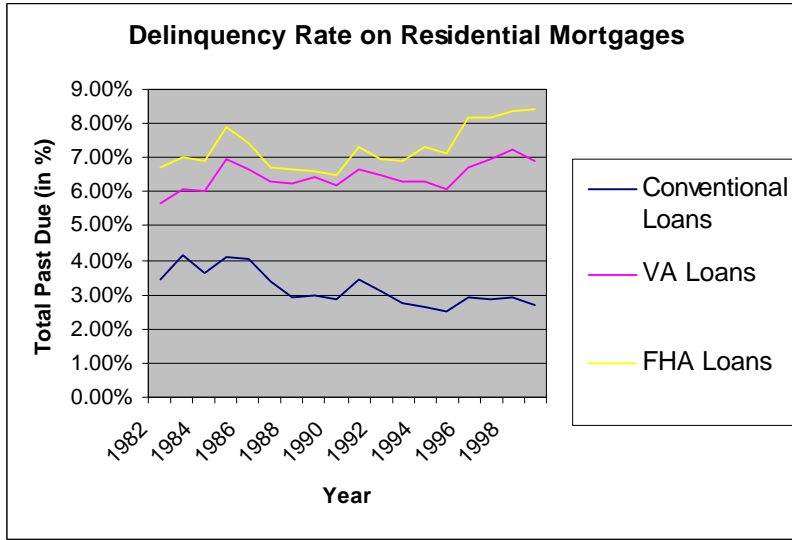


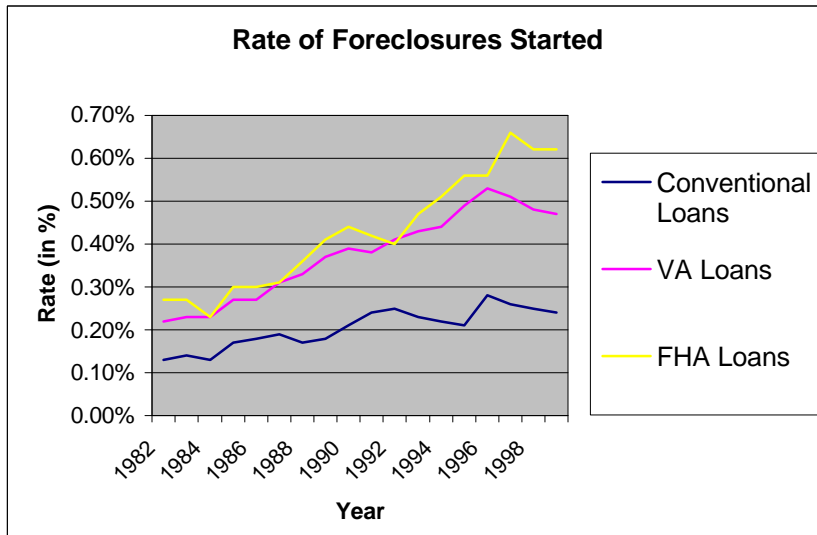
Figure 2: Major Industry Segments



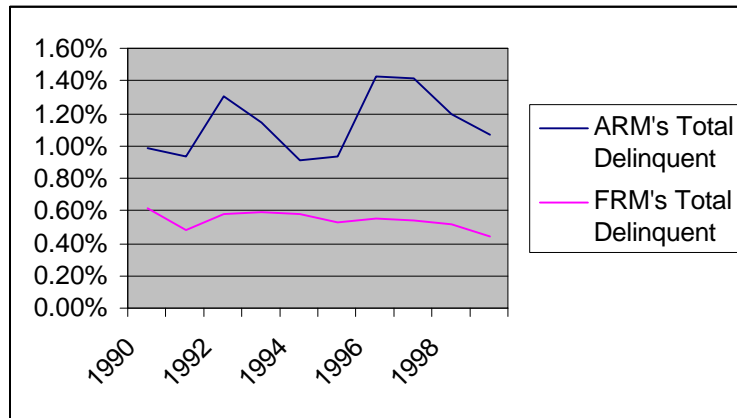
**Figure 3a: Loan Delinquency Rates – Government vs. Conventional Loans**



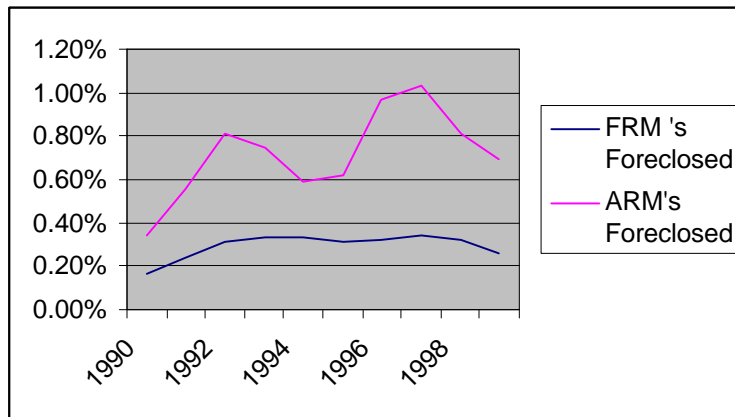
**Figure 3b: Loan Foreclosure Rates – Government and. Conventional Loans**



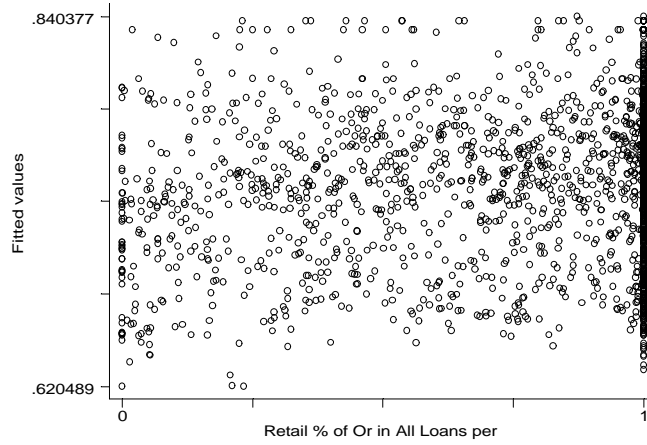
**Figure 4a: Loan Delinquency Rates (FHLMC): ARM vs FRM**



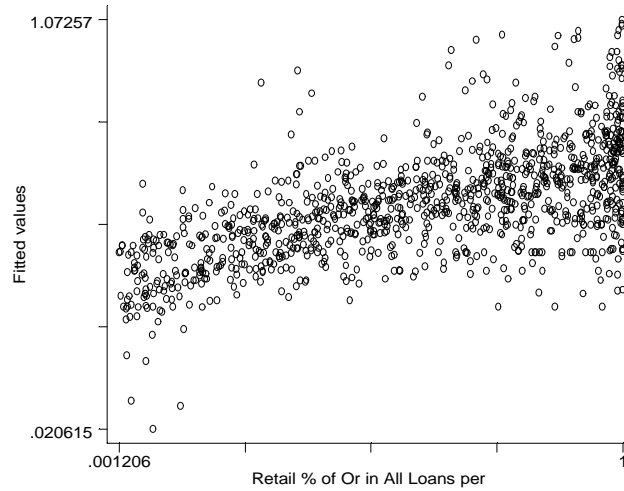
**Figure 4a: Loan Foreclosure Rates (FHLMC): ARM vs FRM**



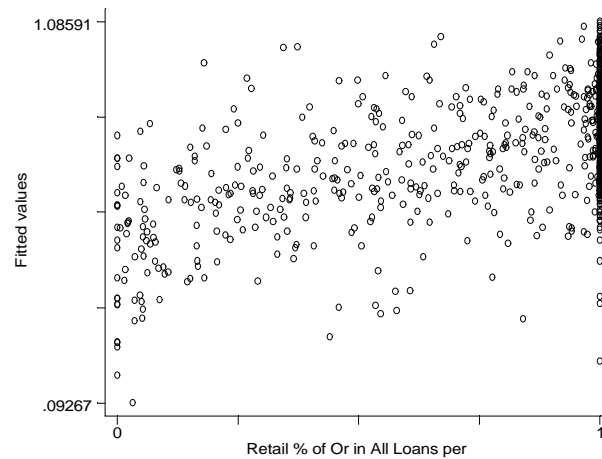
**Figure 5a: Predicted vs. Actual Integration based on Loan Types (Transaction Cost Hypothesis)**



**Figure 5b: Predicted vs. Actual Integration based on Efficiency in Production (Capability Hypothesis)**



**Figure 5c: Predicted vs. Actual Integration based on Margins in Production (Capability Hypothesis)**



**Table 1: Variables Used, and their Definition**

RPOALNPD	Percentage of Retail Production / Total Origination , All Loans
-----	
FVApcord	Percentage of FHA-VA loans in origination volume (Also FVAOT)
FRMpcord	Percentage of FRM loans in origination volume (Also FRMOT)
ARMpcord	Percentage of ARM loans in origination volume (Also ARMOT)
JMBpcord	Percentage of Jumbo loans in origination volume (Also JMBOT)
defFVA	Percentage of defaults in FHA-VA / total FHA-VA loans
defFRM	Percentage of defaults in FRM / total FRM loans
defARM	Percentage of defaults in ARM / total ARM loans
defCNV	Percentage of defaults in Conventional (ARM+FRM) / total cnv loans
defJMB	Percentage of defaults in Jumbo / total Jumbo loans
defTOT	Percentage of defaults in All Loans / total loans
RPOFVNPN	Percentage of Retail Production / Total in FHA-VA Loans
RPOFRNPN	Percentage of Retail Production / Total in FRM Loans
RPOARP	Percentage of Retail Production / Total in ARM Loans
RPOJPN	Percentage of Retail Production / Total in Jumbo Loans
RPOALNPD	Percentage of Retail Production / Total in All Loans
Lrtfvav	Lagged Percentage of Retail Production / Total in FHA-VA Loans
Lrtfrm	Lagged Percentage of Retail Production / Total in FRM Loans
Lrtarm	Lagged Percentage of Retail Production / Total in ARM Loans
Lrtjmb	Lagged Percentage of Retail Production / Total in Jumbo Loans
Lsvfvav	Lagged Percentage of Purchased / Total servicing in FHA-VA Loans
Lsvfrm	Lagged Percentage of Purchased / Total servicing in FRM Loans
Lsvarm	Lagged Percentage of Purchased / Total servicing in ARM Loans
Lsvjmb	Lagged Percentage of Purchased / Total servicing in Jumbo Loans
A400	Total Assets (in thousand of Dollars)
assetsq	Assets, squared
lnassets	Assets in natural logarithm
lnrtprod	Percentage of retail production / total in natural logarithm
B200	Total Equity (in thousand of Dollars)
equsq	Equity, squared
lnequity	Equity in natural logarithm
FTEprpv	Full-Time Equivalent Employees in retail production/loans produced
FTEorpv	FTE in total origination / loans originated
FTEwmpv	FTE in warehoused production / loans originated
lnPrpV	Log of Retail Production only Net Income per Loan (in volume)
lnPwV	Log of Warehousing Net Income per Loan (in volume)
lnPmM	Log of Marketing Margin
lnPwM	Log of Warehousing Margin
YEAR1-10	Dummy variables for each year, 1989 - 1998

**Table 2: Defaults by Loan Type 1989-1999 (MBFRF Data, Firm Level)**

Variable	Observations	Mean	Std. Dev.
Defaults in FHA	1425	.0245	.0611
Defaults in VA	1092	.0256	.0759
Defaults in FRM	1758	.0087	.0293
Defaults in ARM	1336	.0113	.0386
Defaults in Jumbos	237	.0177	.0958

**Table 3a: Default in Loans as a Function of Integration Into Retail- by Loan Type**

<i>Robust Regression</i>	Integration in FHA-VA loans (RPOFVNPN)	Integration in ARM loans (RPOARPN)	Integration in Jumbo loans (RPOJPN)	Integration in FRM loans (RPOFRNPN)
Delinquencies FHA-VA (delFVA)	-.00283*** (.00119)			
Delinquencies ARM (delARM)		-.00133** (.00062)		
Delinquencies Jumbo (delJMB)			-.00145*** (.00032)	
Delinquencies FRM (delFRM)				-.00001 (.00031)
Regression F	16.47 (p<.001)	8.45 (p<.001)	7.33 (p<.001)	17.3 (p<.001)
Number of Obs	1222	1120	199	1700

\*\*\*- p<.001, \*\* - p<.01, \* - p<.05

**Table 3b: Default in Loans as a Function of Lagged Integration Into Retail- by Loan Type**

<i>Robust Regression</i>	Lagged Integration in FHA-VA loans (Lrtfvav)	Lagged Integration in ARM loans (Lrtarmv)	Lagged Integration in Jumbo loans (Lrtjmbv)	Lagged Integration in FRM loans (Lrtfrmv)
Delinquencies FHA-VA (delFVA)	-.00361*** (.00153)			
Delinquencies ARM (delARM)		-.00145 (.00095)		
Delinquencies Jumbo (delJMB)			-.00187*** (.00057)	
Delinquencies FRM (delFRM)				.00020 (.00039)
Regression F	13.5 (p<.001)	5.67 (p<.001)	3.87 (p<.01)	12.57 (p<.001)
Number of Obs	688	624	109	893

\*\*\*- p<.001, \*\* - p<.01, \* - p<.05

**Table 4: Default in Loans as a Function of Lagged Integration Into Retail- by Loan Type**

<i>Robust Regression</i>	Lagged Specializ/n within FHA-VA (Lsvfvav)	Lagged Specializ/n within ARM (Lsvarmv)	Lagged Specializ/n within Jumbo (Lsvjmbv)	Lagged Specializ/n within FRM (Lsvfrmv)
Delinquencies FHA-VA (delFVA)	.00784*** (.00108)			
Delinquencies ARM (delARM)		.00430*** (.00077)		
Delinquencies Jumbo (delJMB)			.00427*** (.00052)	
Delinquencies FRM (delFRM)				.00229*** (.00038)
Regression F	21.31 (p<.001)	8.49 (p<.001)	68.56 (p<.01)	35.48 (p<.001)
Number of Obs	738	682	56	907

\*\*\*- p<.001, \*\* - p<.01, \* - p<.05

**Table 5: Retail production as function of loan composition (Test of TCE predictions on Integration)**

Dependent Variable	Retail Integration	Retail Integration	Retail Integration	Retail Integration	Retail Integration	Retail Integration
Model	OLS	OLS	Robust	Robust	Fixed Effects	Fixed Effects
Sample	1989-98	1996-98	1989-98	1996-98	1989-98	1996-98
% of FHA-VA's (FVApcord)	.00307 (.03770)	-.13154 (.08597)	-.03631 (.02813)	-.09676 (.0597)	-.10416** (.04223)	-.21046* (.11344)
% of FRM's (FRMpcord)	-.10702** (.03193)	-.23380** (.08229)	-.02240 (.02382)	-.06309 (.05716)	.02988 (.03098)	-.04956 (.1004)
% of ARM's (ARMpcord)	-.03007 (.06359)	-.17869 (.12511)	-.02690 (.04743)	-.11850 (.08691)	.03751 (.06215)	-.11999 (.15382)
% of Jumbos (JMBpcord)		-.31633** (.12739)		-.24436*** (.08849)		-.33793** (.14974)
Controls	Year Dummies	Year Dummies	Year Dummies	Year Dummies	Year & Firm Dummies	Year & Firm Dummies
R <sup>2</sup>	2.00%	2.43%	1.40%	2.17%	0.06%	0.09%
Regression F	3.12 (p<.001)	2.93 (p<.001)	2.18 (p<.05)	2.58 (p<.05)	4.07 (p<.001)	5.22 (p<.001)
Number of Observations	1854	824	1854	824	1203	447

\*\*\* - p<.001, \*\* - p<.01, \* - p<.05; R<sup>2</sup> for robust regression is computed as the R<sup>2</sup> that would yield the same F-statistic if this were an OLS regression; R<sup>2</sup> for fixed effects is after removing the firm effects.



**Table 6: Correlation between % pf Retail / Total Production in different categories of loans  
(Testing commonalities in integration in and despite of different TC categories)**

Dependent Variable	Retail Integration of FRMs	Retail Integration of FRMs	Retail Integration of FRMs	Retail Integration of FRMs	Retail Integration of FRMs	Retail Integration of FRMs
Model	OLS	OLS	Robust	Robust	Fixed Effects	Fixed Effects
Sample	1989-98	1996-98	1989-98	1996-98	1989-98	1996-98
Retail Integration of FHA-VA	.30573*** (.02051)	.42263*** (.03514)	.03519*** (.00332)	.50075*** (.01266)	.32532*** (.02914)	.37900*** (.05088)
Retail Integration of ARM	.62101*** (.02018)	.23243*** (.03975)	.96297*** (.00327)	.1328*** (.01432)	.46266*** (.02391)	.32324*** (.04590)
Retail Integration of Jumbos		.28117*** (.03691)		.34498*** (.01330)		.21233*** (.05171)
Controls	Year Dummies	Year Dummies	Year Dummies	Year Dummies	Year & Firm Dummies	Year & Firm Dummies
R <sup>2</sup>	71.36%	82.02%	99.2%	97.8%	70.63%	81.68%
Regression F	261.65 (p<.001)	275.29 (p<.001)	13655.93 (p<.001)	2358.41 (p<.001)	75.34 (p<.001)	93.77 (p<.001)
Number of Observations	1155	362	1155	362	697	181

\*\*\* - p<.001, \*\* - p<.01, \* - p<.05; R<sup>2</sup> for robust regression is computed as the R<sup>2</sup> that would yield the same F-statistic if this were an OLS regression; R<sup>2</sup> for fixed effects is after removing the firm effects.

**Table 7: Integration of retail production as a function of asset size and equity  
(Test of scale predictions)**

Dependent Variable	Retail Integration	Retail Integration	Retail Integration
Model	OLS	Robust	Fixed Effects
Sample	1989-98	1989-98	1989-98
Assets (\$ Billion)	-10.0*** (2.25)	-18.7*** (1.43)	-7.80*** (2.17)
Equity (\$ Billion)	-20.3 (17.4)	-14.5 (11.0)	35.1* (16.0)
Assets Squared	7.57*** (1.85)	13.2*** (1.17)	4.21** (1.53)
Equity Squared	44.5 (66.5)	-2.90 (4.22)	-18.1** (5.84)
Controls	Year Dummies	Year Dummies	Year & Firm Dummies
R <sup>2</sup>	5.39%	25.8%	4.48%
Regression F	8.13 (p<.001)	49.27 (p<.001)	5.35 (p<.001)
Number of Observations	1867	1867	1867

\*\*\* - p<.001, \*\* - p<.01, \* - p<.05;

R<sup>2</sup> for robust regression is computed as the R<sup>2</sup> that would yield the same F-statistic if this were an OLS regression.

R<sup>2</sup> for fixed effects is after removing the firm effects.

**Table 8: Correlation between % of Retail / Total Production and Capability Measures**  
**(Test of capabilities predictions, based on efficiency / FTE's and Margins)**

Dependent Variable	Retail Integration	Retail Integration	Retail Integration	Retail Integration
Model	OLS	Robust	OLS	Robust
Sample	1989-98	1989-98	1989-98	1989-98
FTE/Total Loans (FTEprpv)	-3.222*** (0.296)	-11.57*** (0.588)		
FTE Orig/Loans Orig (FTEorpv)	12.101*** (0.599)	17.12*** (0.608)		
FTE/Loans Downstream (FTEwmpv)	0.00778* (.00222)	0.00392 (0.00218)		
Log of net <i>production</i> income per loan (lnPprV)			.16631*** (.01577)	.19535*** (.01549)
Log of net <i>warehousing</i> income per loan (lnPwV)			-.03718* (.01852)	.00507 (.01819)
Log of net <i>warehousing</i> Margin (lnPwM)			-.03941 (.02316)	-.05883* (.02275)
Log of net <i>marketing</i> Margin (lnPmM)			-.09349*** (.01404)	-.10362*** (.01379)
Controls	Year Dummies	Year Dummies	Year Dummies	Year Dummies
R <sup>2</sup>	30.91%	46.06%	21.91%	31.89%
Regression F	41.38 (p<.001)	79.23 (p<.001)	17.68 (p<.001)	25.55 (p<.001)
Number of Observations	1122	1122	774	774

\*\*\* - p<.001, \*\* - p<.01, \* - p<.05; R<sup>2</sup> for robust regression is computed as the R<sup>2</sup> that would yield the same F-statistic if this were an OLS regression; R<sup>2</sup> for fixed effects is after removing the firm effects.

**Table 9: Vertical Integration into Production: A Comprehensive Regression (Dependent Variable is Retail Integration)**

Variable	Coefficient	Std. Error	Theory
% of FHA-VA's (FVApcord)	0.0253	0.0613	TCE
% of FRM's (FRMpcord)	-0.0404	0.0527	TCE
% of ARM's (ARMpcord)	0.1693	0.1251	TCE
YEAR=1990	-0.0315	0.1043	Control
YEAR=1991	-0.0088	0.0856	Control
YEAR=1992	0.0845	0.0831	Control
YEAR=1993	0.0775	0.0811	Control
YEAR=1994	-0.0342	0.0965	Control
YEAR=1995	-0.0607	0.0836	Control
YEAR=1996	0.1277	0.0811	Control
YEAR=1997	-0.0651	0.0803	Control
YEAR=1998	-0.1184	0.0795	Control
FTE/Total Loans (FTEprpv)	-2.3453***	0.3349	Capability (efficiency)
FTE Orig/Loans Orig (FTEorpv)	9.1384***	1.0155	Capability (efficiency)
FTE/Loans Downstream (FTEwmpv)	0.0039	0.0038	Capability (efficiency)
Log of net <i>production</i> income per loan (lnPprV)	0.1143***	0.0200	Capability (margin)
Log of net <i>warehousing</i> income per loan (lnPwV)	-0.0476^	0.0247	Capability (margin)
Log of net <i>warehousing</i> Margin (lnPwM)	-0.0410***	0.0173	Capability (margin)
Log of net <i>marketing</i> Margin (lnPmM)	-0.0372	0.0276	Capability (margin)
R <sup>2</sup>	38.3%		
Regression F	13.12 (p<.001)		
Number of Observations	422		

\*\*\* - p<.001, \*\* - p<.01, \* - p<.05; ^ - p<.1; Largest common sample used