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Secondary Markets, Risk, and Access to Credit
Evidence From the Mortgage Market

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Abstract

Secondary markets for credit are widely believed to improve efficiency and increase access to credit. In part, this is because of their greater ability to manage risk. However, the degree to which secondary markets expand access to credit is virtually unknown. Using the mortgage market as an example, we begin to fill that gap. Our conceptual model suggests that secondary credit markets have potentially ambiguous effects on interest rates, but unambiguous positive effects on the number of loans issued. We focus our empirical analysis on the latter using 1992-2004 HMDA files for conventional, conforming, home purchase loans in conjunction with Census tract data.

Findings confirm that an active secondary market increases mortgage origination rates. Between 2000 and 2004, for example, conventional loan purchases increased the share of applications originated by 15.6 percent, on average, roughly halving the denial rate (all else equal). In the high risk subprime sector, the analogous figure is 10.9 percent, while the marginal impact of secondary market purchases on origination rates is 3 to 10 times larger than for the market overall. These findings confirm that secondary markets provide opportunities to manage risk more effectively and increase access to credit. Evidence of a higher marginal impact of secondary markets among high-risk borrowers is especially important given recent government efforts to expand lending activity in low-income communities.

Key words: Securitization, Risk, Mortgage Markets
JEL codes: G2, R0, H0

1. Introduction

Secondary markets for credit are widely believed to improve efficiency because of their greater ability to manage risk, enhance liquidity, and arbitrage regional imbalances in the supply and demand for credit. Although in principle these features should result in greater access to credit, the magnitude of such effects is largely unknown and has only rarely been studied.[1] That lack of information is striking, especially in light of recent dramatic expansion of the secondary market for mortgages. This paper begins begin to fill that gap.

Between 1992 and 2002, secondary market purchases of conventional home purchase (CHP) loans boomed, rising from 71 to 93 percent of CHP originations (see Table 1).[2] Expansion of secondary market activity has been even more dramatic among low-income and minority neighborhoods. Among low-income communities, purchases jumped from 33 percent of originations in 1992 to 81 percent in 2002; over this same period, among predominantly African American and Hispanic neighborhoods, the ratio of purchases to originations jumped by roughly 38 and 40 percentage points, respectively (see Table 1). This rapid increase in secondary market activity provides an opportunity to study the impact of secondary credit markets in general and the mortgage market in particular.

The rapid growth in the secondary mortgage market has been facilitated by policies and institutions largely put into place by the federal government over the past 40 years. Most notable, those efforts include the establishment of government and government-sponsored

[1]Gerardi, Rosen, and Willen (2007) argue that as credit markets become more efficient, families should increasingly base their home purchase decisions on permanent rather than current income, and therefore, place increasing weight on future income. Using data from the Panel Study of Income Dynamics, they find evidence of a discrete increase in such behavior in the early- to mid-1980s, consistent with innovations in the mortgage market at that time. Apart from this study, we are not aware of other research that provides direct evidence of the impact of mortgage market innovations on access to credit.

[2]Here we define the secondary market purchase rate as the ratio of secondary market loan purchases to primary market loan originations.

secondary mortgage market enterprises (GSEs), the most prominent of which are Fannie Mae and Freddie Mac.[3] Investors in the mortgage-backed securities of the GSEs attribute an "implicit" U.S. Government guarantee to those securities. In 2002, the GSEs accounted for roughly 60 percent of secondary market purchases of conventional home purchase loans. Moreover, the GSE charters mandate that these institutions enhance the supply of credit to low-income, minority, and other underserved communities. Despite this extensive level of government involvement, there is a stunning lack of evidence on the impact of secondary markets on access to credit.

The belief that secondary markets enhance efficiency is based on scale economies: a large secondary market can increase liquidity in the funding of mortgages, arbitrage regional imbalances in the supply and demand for credit, and more effectively manage risk associated with lending outcomes. Of these mechanisms, our focus will be on risk. In Section 2, a simple conceptual model is presented in which loan rates clear the market. Under those conditions, an active secondary market lowers lending rates and systematic denials of loan applications do not occur. In practice, however, 16 percent of conventional home purchase mortgage loan applications are denied (see Table 1). If those denials arise because lenders sometimes make mistakes and deny profitable loans, or borrowers occasionally apply for credit that they clearly cannot afford, then the basic supply-demand model prevails. However, if denials arise because of concerns about moral hazard and adverse selection that exacerbate interest rate and default

[3]Fannie Mae was initially an agency of the U.S. Government, created in 1938 to make a secondary market in FHA mortgages. In 1968, Fannie Mae became a federally-chartered GSE owned solely by private investors, the primary role of which was to provide lenders with a ready market for their mortgage assets and to assist in promoting uniformly defined mortgage instruments. Freddie Mac was created in 1970 to make a secondary market in the non-FHA mortgages originated by the savings and loan associations. In addition to establishing these GSEs, the Federal government has also facilitated the creation of loan insurance programs, helped to standardize mortgage loan instruments and underwriting, and enhanced the availability of hazard and title insurance.

risk, then arguments based on the Stiglitz and Weiss (1981) model of equilibrium credit rationing imply a different set of outcomes.

As outlined by Stiglitz and Weiss (1981), when borrowers display observable differences in risk attributes, competitive markets will charge higher risk borrowers higher loan rates. Such risk-based pricing has become increasingly common in the mortgage market with the emergence of "prime" versus "sub-prime" lending, and has been the longstanding practice in markets for commercial and industrial loans. But Stiglitz and Weiss further point out that under certain market conditions, the highest risk group to receive credit (e.g. sub-prime) may be subject to equilibrium credit rationing. When we extend the simple supply-demand model to allow for this possibility, the impact of secondary markets on loan rates in the sub-prime sector is ambiguous. On the other hand, regardless of whether loan rates clear the market, an active secondary market has an unambiguous positive effect on the share of loan applications that are originated. Partly for that reason, the primary focus of our empirical work is to measure the extent to which secondary market activity increases mortgage origination rates.

Summary measures based on data provided by the Home Mortgage Disclosure Act (HMDA) provide a first indication of the relationship between secondary market activity and access to credit. In Table 1, notice that in 2002, those MSAs with the lowest conventional home purchase (CHP) loan application denial rates (denials divided by the number of applications) had unusually high levels of secondary market purchases relative to originations, and vice-versa. Clearly, increased secondary market activity is strongly correlated with improved access to mortgage credit.

As implicitly suggested in Table 1, we base our analysis on a largely overlooked feature of the HMDA data. Specifically, HMDA provides detailed information on secondary market

purchases of mortgage loans. But with the exception of a few early studies (see, for example, Canner and Gabriel (1993), Bunce and Scheessele (1996), Manchester, Neal and Bunce (1998), and Bunce (2002)), HMDA information on secondary market loan purchases has been virtually ignored. Instead, researchers and regulators have largely utilized HMDA data to analyze primary market lender accept/reject decisions of loan applications.[4] These studies have typically focused on the role of applicant race and ethnicity with corresponding implications for discrimination and fair lending practices. Although these studies have been influential, they also have been controversial. This is because of well known limitations of HMDA: the data do not provide information on loan applicant wealth and credit history; however, those controls are critical to lender assessments of borrower credit worthiness in the accept/reject decision.[5]

Our study avoids the limitations of the HMDA data while drawing on its strengths. This is because secondary market purchase decisions are not based on the attributes of the individual borrowers. Instead, secondary market purchasers consider the broad features of loan pools that trade in the secondary market. The GSEs, for example, largely purchase pools of conventional loans that conform to their loan size and underwriting guidelines. That information is available in the HMDA data. In addition, while secondary market purchase decisions are often influenced by neighborhood socioeconomic (SES) attributes – indeed, GSE regulations *require* Fannie Mae and Freddie Mac to purchase a share of their loans in low-income and minority communities –

[4]See, for example, Avery, Beeson and Sniderman (1994), Munnell, Tootell, Browne, and McEneaney (1996), Avery, Beeson, and Calem (1997), Huck (2001), and Dietrich (2002).

[5]As a result, early accept/reject studies that did not control for borrower wealth and credit history created a virtual firestorm of debate. In response to those concerns, Munnell et al (1996) supplemented HMDA records in Boston with analysis of individual-level loan files, which included information on borrower wealth and credit scores as well as other borrower-level determinants of loan performance. Results from that study confirmed that minorities in Boston were more likely to have their loan applications rejected than comparable white mortgage applicants. Other studies using HMDA data have focused on subprime lending in low-income markets (see, for example, Harvard Joint Center for Housing Studies (2002)), or the share of primary market originations that are documented in the HMDA data (see, for example, Berkovec and Zorn (1996), FFIEC (1996)).

that information may be obtained from the decennial Census. Combining HMDA and Census data, we are able to bring to bear much of the information used by secondary institutions when deciding whether to purchase loans from primary market lenders.

Nevertheless, challenges remain. Most important, our conceptual model suggests that key measures of mortgage market activity (originations, applications, denials, and purchases) are simultaneously determined. To address that concern, in the origination share regressions we instrument in two ways for endogenous secondary market purchases. First, we instrument for purchases using the "underserved" status of the census tract as defined by the Department of Housing and Urban Development: specifically, whether tract median income is less than 90 percent of area (MSA) median income, or AMI. As HUD requires Fannie Mae and Freddie Mac to purchase over 30 percent of their loans in such tracts, this measure provides an exogenous policy-induced motive for secondary market purchases. The main limitation associated with the use of underserved tract status as an instrument is that tract income affects demand and supply for credit as well. To address that issue, we include a long list of tract SES attributes from 1990 (coded to year-2000 tract geography) in all of our models, including tract average income and income squared.[6] It is through the discrete change in tract status upon passing the 90 percent AMI income threshold that we gain our identification.

In a second IV approach, we estimate the origination share models using 1980 SES attributes of the census tracts (coded to year-2000 tract geography). Those instruments complement 1990 census tract attributes that are included directly in the model to control for demand and risk attributes of the applicant pool. Identification in this case is possible because tract SES attributes change between decades and we assume that lagged SES attributes are

[6]Also included in all of the origination share and purchase regressions are MSA fixed effects for the larger MSAs and MSA-size category fixed effects for the smaller metro areas. These fixed effects further control for the influence of MSA-wide unobserved factors such as variations in mortgage interest rates, local policy, and more.

exogenous to contemporaneous mortgage market activity. However, one could argue that 1980 SES attributes could be included directly in the models to help control for unobserved contemporaneous SES attributes not captured by the 1990 SES control variables. For that reason, results based on the underserved status instrument are preferred.

Our results yield several new insights. First, in each year from 1992 to 2004, secondary market purchases significantly increase the share of applications originated by primary lenders. Between 2000 and 2004, for example, loan purchases increased the share of applications originated by 15.6 percent, on average, roughly equal to the denial rate in 2004 (all else held constant). This suggests that secondary market activity halved the share of applications denied. Among lenders that specialize in high risk subprime loans, the analogous figure is 10.9 percent, somewhat smaller than for the market overall because of the lesser scale of sub-prime activity in the secondary market.[7] At the margin, however, secondary market purchases in the subprime sector increase origination rates by an amount 3 to 10 times larger than for the market overall. The larger marginal impact of secondary markets on high-risk segments of the mortgage market suggests the importance of the secondary market to risk management and to the extension of credit to underserved population groups.

As a final set of exercises, note that if mortgage markets are well-functioning, then primary lenders should not deny loans that could profitably be sold into the secondary market, and denials should have no effect on secondary market purchases.[8] We estimate this relationship to provide further background evidence on the operation of the mortgage market. Note,

[7]In Table 2 (Panels A and C) it is apparent that the level of secondary market purchases is much lower in the sub-prime sector than for the market overall, but in Table 3a (Panels A and C) the estimated marginal effect of secondary market purchases is sharply higher in the sub-prime sector relative to the entire market. A more detailed discussion of these patterns is provided later in the paper.

[8]It is worth emphasizing that these arguments hold regardless of whether loan rates clear the market.

however, that because underserved tract status is a determinant of secondary market activity we cannot use underserved status as an instrument. Instead, for the purchase regressions, we estimate using the 1980 SES variables as instruments, and also the non-IV model. In both the non-IV and IV models, for most years, denials had small effects on purchases. Along with evidence that secondary markets increase originations, these patterns confirm that an active secondary market improves the efficiency with which mortgage credit is provided, and in so doing, increases access to credit.

To clarify these and other results, we proceed as follows. Section 2 develops the conceptual model used to clarify the impact of secondary market activity on primary market outcomes. Section 3 describes our empirical strategy and model. Sections 4 and 5 report on data and estimation results and Section 6 concludes.

2. Conceptual Model

The goal of this section is to clarify two key features of the analysis. First, and most important, how does an active secondary market affect the share of loan applications that are originated in the primary market and hence the availability of credit? Second, to what extent do loan denials in the primary market affect secondary market purchases? As will become apparent, these questions are related. Each is considered in turn, beginning with the first.

2.1 The influence of secondary market purchases on the primary market

As suggested in the Introduction, it is widely believed that an active secondary market for mortgage credit improves efficiency and expands the supply of loanable funds. This occurs in part because scale economies associated with the secondary market enhance opportunities to

manage various sources of risk.[9] As an example, local house price declines, employment shocks, or natural disasters could prove catastrophic to local lenders if they held large stocks of mortgages in portfolio. But those risks are greatly mitigated in the secondary market because of its enhanced ability to diversify investments across regions and loan types.[10]

Consider now a stylized model of the primary market for mortgage credit in which all markets are competitive and markets clear in equilibrium. The model is portrayed in the four quadrant diagram in Figure 1. In the upper right quadrant, loan demand varies with the attributes of the local population (Z) including credit history, income, and other socio-economic factors that influence housing preferences. Loan demand also declines with an increase in the mortgage interest rate in the usual way. Loan supply increases with the mortgage rate and is sensitive to the risk-free cost of funds (c), prepayment and default risk that are sensitive both to economy-wide shocks and the attributes of the applicant pool (Z), and the presence of the secondary market. The manner in which these factors affect the supply of credit is clarified below.

Suppose first that lenders face no risk of any kind. Under those conditions, in the lower right quadrant of Figure 1, the expected return or *yield* to holders of mortgage credit is the mortgage interest rate. This is shown by the 45 degree line. It should also be emphasized that this is an accounting relationship – equilibrium features of the market will be dealt with in the upper right quadrant.[11]

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[9]Secondary markets also improve liquidity and smooth out regional imbalances in supply and demand for credit. In the empirical work to follow, we allow for these effects by including MSA fixed effects that control for MSA-wide factors including interest rates, as well as the local demand for credit.

[10]This certainly was the case in the early 1980s in Texas when oil prices crashed causing many families that worked in the oil industry to default on their mortgages. Another recent example is New Orleans following Hurricane Katrina.

[11]To simplify, the discussion below assumes that mortgage origination and servicing costs are zero. This does not affect the nature of the results.

Consider next the influence of economy-wide shocks such as uncertainty about future interest rate paths. As is well known, increases in market rates above the loan contract rate erode the value of outstanding debt. Sufficient declines in interest rates, however, prompt refinance activity whereby existing debt is prepaid at lower current market rates. Holders of mortgage debt, therefore, suffer when rates rise but do not benefit in a corresponding manner when rates fall. For this reason, interest rate volatility is costly to lenders, and this is commonly referred to as interest rate risk. Moreover, it is well documented that interest rates are more volatile when rate levels are high. Accordingly, lender costs associated with interest rate risk increase with the loan rate, and this causes the return (yield) function in the lower right quadrant of the diagram to bend up and away from the 45 degree line.

Consider now the influence of borrower attributes (Z) on default and prepayment risk, where the latter includes refinance activity as above and also the propensity of borrowers to move and prepay their loans.[12] Moreover, it is realistic to assume that lenders have only imperfect information about Z. Under these conditions, Stiglitz and Weiss (1981) and others argue that as loan rates increase, adverse selection and moral hazard erode the quality of the loan applicant pool. For example, higher rates may skew the applicant pool towards individuals who are more prone to refinance. That is because at higher loan rates individuals who tend not to refinance perceive increasing borrowing costs and disproportionately drop out of the applicant pool (an adverse selection effect). Analogously, higher rates may encourage borrowers to purchase homes in areas subject to greater house price volatility (with greater potential capital gains and loses), or perhaps to seek higher initial loan-to-value ratios, both of which increase the likelihood of default (a moral hazard effect). These effects are costly to lenders, increase with

[12]Default, of course, is costly to lenders, as is prepayment risk.

the loan rate, and further bend upwards the return function in the lower right quadrant of the figure.

Suppose now that a secondary market is introduced. Because the secondary market manages risk more effectively, this reduces the cost of the above sources of risk and rotates the return function back down towards the 45 degree line. In the lower left quadrant, as the expected yield on loans increases, the number of loans supplied increases. Moving clockwise around the diagram, the supply of credit in the upper right quadrant takes on a concave shape, and is sensitive to the risk free cost of funds (c), economy-wide shocks, the level of risk associated with a given pool of applicants, and the presence of the secondary market. Moreover, it is clear that the presence of the secondary market causes the loan supply function to rotate up, increasing the supply of loanable funds for any given mortgage rate. In equilibrium, this causes market interest rates to fall from r^* to r^{**} and the number of loans originated to rise from L* to L**: because secondary markets manage risk more efficiently, loan rates fall and originations rise.

The simple model just outlined is instructive, but incomplete. In particular, summary measures in Table 1 indicate that in 2004 roughly 16 percent of conventional home purchase mortgage applications were denied. However, if all markets clear in equilibrium in the manner described in Figure 1, there is no room for denials. We consider this issue next.

2.2 Denials of mortgage loan applications

Two very different mechanisms may generate the denials of loans applications observed in Table 1. The first is simply that borrowers and primary lenders sometimes make mistakes.[13] To be precise, borrowers may sometimes mistakenly apply for loans that would not be profitable to originate, and lenders may sometimes mistakenly deny loans that could have been profitable

[13]We thank Larry Wall for emphasizing this point in comments on an earlier draft of the paper.

to originate. Under these conditions, the model in Figure 1 remains viable, at least as an approximation.

A second very different explanation for loan denials is that lenders systematically ration credit through terms other than the interest rate. To model this idea we draw upon section IV (p. 406) of Stiglitz and Weiss (1981). As a starting point, suppose that loan applicants can be grouped according to observable differences in credit risk. Then competitive lenders would charge higher rates to higher risk groups to compensate for the higher expected costs of late loan payments, refinancing, default, and the like. Indeed, as noted in the Introduction, risk-based pricing has become increasingly prevalent in the U.S. mortgage market, including the emergence of "prime" and "sub-prime" lending, the latter of which entails more risk. Moreover, Stiglitz and Weiss argue that whereas the highest risk group to receive credit *may* be subject to equilibrium credit rationing, lower risk groups are not. We will clarify the intuition behind the Stiglitz-Weiss result below. For now, note that their result suggests that Figure 1 is likely a good approximation of the market for prime lending in the mortgage market, but not necessarily for the sub-prime sector. With this in mind, the discussion below focuses on the sub-prime portion of the mortgage market, the highest risk group to receive mortgage credit.

We consider two cases. In the first case, the secondary market is not present but credit rationing may occur. This is portrayed in Figure 2a. The key difference from Figure 1 is in the lower right quadrant. Observe that the expected rate of return on the pool of loans issued initially increases with the mortgage interest rate, reaches a peak, and then declines with further increases in the mortgage rate. This hump-shaped pattern is a central to the Stiglitz-Weiss (1981) model. In our context, the pattern owes its form to the assumption that as mortgage interest rates increase, interest rate risk, adverse selection, and moral hazard become so costly

that the expected yield on loans issued begins to decline. Tracing through to the upper right quadrant, the hump-shaped return function causes mortgage supply to be hump-shaped as well.

Two possibilities now arise. In the first case, demand intersects supply on the upward sloping portion of the supply curve. In this case, all loan applications are accepted and no loans are denied. In the second, demand intersects supply on the downward sloping portion of the supply curve. In this case, relative to the market clearing interest rate (r^*), lenders can do better by lowering the mortgage rate so as to increase the number of loans originated. As shown in the lower right quadrant, this would raise the expected rate of return on loans issued. Moreover, this will continue until mortgage rates are reduced to r^{**}, a level equal to the peak in the mortgage supply function. It is worth emphasizing that at r^{**}, the equilibrium mortgage interest rate, excess demand for funds is present in the marketplace and lenders deny some of the loan applications received.

Consider now why the description above may apply to the sub-prime sector but is not likely to hold for the prime segment of the mortgage market. As in Stiglitz and Weiss (1981), one must assume that the peak in the loan supply function for the high-risk group is associated with a lower expected return (yield) relative to the corresponding peak for the low-risk group. That would be consistent with the classification of loan applicants into low- and high-risk categories. Suppose now that sub-prime borrowers receive loans and are subject to credit rationing. As above, they would be charged loan rates associated with the peak in their loan supply function. The same would be true for prime borrowers if they too were subject to credit rationing. But if both groups were subject to credit rationing, lenders would profit by diverting loans from sub-prime borrowers to prime loan applicants that had been denied. With

competitive markets, therefore, it is likely that only the highest risk group to receive credit is exposed to credit rationing, and Figure 2a applies to just the sub-prime sector.[14]

In Figure 2b, we assume now that credit rationing is present and add in the secondary mortgage market. As before, the secondary mortgage market increases the expected rate of return for any given mortgage rate, and this causes the loan supply function in the upper right quadrant to rotate up. As a result, unambiguously, denials of loan applications are reduced while loan originations increase. Interestingly, however, equilibrium mortgage interest rates could in principle either fall or *rise*.

2.3 Testable implications of an active secondary market

The arguments above suggest that secondary markets have an ambiguous effect on mortgage interest rates in the high-risk sector and this complicates efforts to assess the efficiency gains associated with an active secondary market.[15] On the other hand, secondary markets have unambiguous positive effects on loan originations in all segments of the mortgage market. For that reason, in the empirical work to follow, our primary focus will be on measuring the extent to which an active secondary market increases the share of mortgage applications that are originated. Moreover, drawing upon the discussion above, there is good reason to expect that secondary market effects on originations would be greatest in the sub-prime segment of the market; this will be tested.

[14]See Stiglitz and Weiss (1981) for further details of this argument.

[15]Lehnart, Passmore, and Sherlund (2005)), for example, find that GSE portfolio purchases and MBS issuance have negligible effects on mortgage interest rate spreads. Lehnart et al (2005) further finds that purchases are not more effective than securitization in reducing mortgage interest rate spreads. Findings from both studies, however, could be obscured by differential interest rate effects from secondary market activity.

Our discussion above also implicitly suggests a second set of tests that are potentially revealing. Specifically, if primary lenders only deny loans that the secondary market could not profitably manage, then such denials should not affect the number of loans purchased by the secondary market.[16] On the other hand, if primary lenders sometimes mistakenly deny loans that the secondary market would have purchased, those denials should reduce secondary market purchases. Hence, evidence that denials have small effects on secondary market purchases would be suggestive that primary lenders are cognizant of their opportunities to profitably sell loans to the secondary market, thereby achieving a more efficient outcome.[17]

3. Empirical Model

3.1 Origination regression

Our empirical work is guided by the relationships outlined in Figures 1 through 2b. Moreover, it is important to bear in mind that prime (low-risk) and sub-prime (high-risk) segments of the market may be segmented and subject to different equilibrium loan rates. Bearing that in mind, in the discussion below, we develop our estimating equations for the most general case that allows for the possibility of credit rationing.

We begin by recognizing that originations in period t (L_t) equal applications (A_t) minus denials (D_t),

$$L_t \equiv A_t - D_t \quad . \tag{3.1}$$

[16]More generally, any loans originated by primary market lenders must be ones that they want to hold in portfolio or that secondary market investors would want to purchase.

[17]A further implication of the model is that denial rates should be higher in the sub-prime sector to the extent that that sector is subject to credit rationing but the prime sector is not. We return to this point later in the paper.

Applications are simply another name for demand and depend on mortgage rates (r_t) and the attributes of the applicant pool (Z_t),

$$A_t = A(r_t, Z_t) \quad . \tag{3.2}$$

The supply of mortgage credit is sensitive to whether a credit rationing equilibrium prevails, and also the presence of the secondary market,

$$S_t = \left\{ \begin{array}{ll} S(r_t, P_t, Z_t) & , \frac{\partial S_t(r_t^{clear})}{\partial r} > 0 \\ S(r_t^{max}, P_t, Z_t) & , \frac{\partial S_t(r_t^{clear})}{\partial r} < 0 \end{array} \right\} . \tag{3.3}$$

Note that r^{max} is the mortgage rate associated with the peak of the loan supply function in the upper right quadrant of Figure 2b and r^{clear} is the market clearing rate.

Equilibrium in the market is as described in Figure 2b and depends on whether the loan demand function intersects the supply function at a downward or upward sloping point. Accordingly, the equilibrium number of loans originated is given by,

$$L_t^* = \left\{ \begin{array}{ll} S(r_t^{clear}, P_t, Z_t) & , \frac{\partial S_t(r_t^{clear})}{\partial r} > 0 \\ S(r_t^{max}, P_t, Z_t) & , \frac{\partial S_t(r_t^{clear})}{\partial r} < 0 \end{array} \right\} \quad . \tag{3.4}$$

The number of loans denied in equilibrium can then be obtained by differencing (3.2) and (3.3) at the equilibrium mortgage rate,

$$D_t = \left\{ \begin{array}{ll} 0 & , \frac{\partial S_t(r_t^{clear})}{\partial r} > 0 \\ A_t(r_t^{max}, Z_t) - L_t^*(r_t^{max}, P_t, Z_t) & , \frac{\partial S_t(r_t^{clear})}{\partial r} < 0 \end{array} \right\} \quad . \tag{3.5}$$

As noted earlier, in a non-credit rationing equilibrium, markets clear and systematic denials are zero. However, when credit rationing prevails, loan denials equal the difference between A_t and L_t, as implied by (3.1).

It is also useful to formally recognize that equilibrium mortgage rates depend on all of the arguments of the demand and supply functions,

$$r_t^* = r(c_t, P_t, Z_t) \quad . \tag{3.6}$$

Thus, equilibrium mortgage rates depend on the risk free cost of funds (c_t), the intensity of secondary market purchase activity, and also the observable characteristics of the loan applicants.

Using these expressions, we seek to analyze the impact of secondary market activity on access to credit. There are two channels by which this occurs. The first is through the effect of secondary market activity on mortgage interest rates as in (3.6). The second channel is through the effect of secondary market activity on loan denials conditional on the mortgage rate, with related implications for originations. The influence of secondary markets on mortgage rates has been the focus of recent work (see Lehnert, Passmore, and Sherland (2005), for example) and we do not seek to evaluate that relationship here.[18] Instead, as noted earlier, this study focuses on the extent to which secondary market purchases increase the share of applications that are originated.[19] We proceed as follows.

[18]In the empirical model to follow, we control for inter-metropolitan variability in mortgage rates by including MSA and MSA size-related fixed effects in the estimating equations.

[19]In earlier versions of the paper we experimented with estimating the impact of secondary market activity on denials as opposed to originations. For two reasons, however, we favor the focus on originations. First, there are many more census tracts with zero denials as compared to originations. Focusing on originations therefore reduces the sensitivity to censored dependent variables (Tobit models are used in the estimation nevertheless). Second, and more importantly, our goal is to isolate the impact of secondary markets on access to credit. But some denied applications will be resubmitted to the same or alternate lenders and ultimately be approved. As such, denials overstate the effect of secondary markets on access to credit, whereas originations provide a direct measure of the outcome of primary interest.

In each time period *t*, the share of loan applications that are originated is given by *s*, where *s* is bounded below by zero and above by 1:

$$L_t = s_t A_t \quad , \quad for\ 0 \le s \le 1 \tag{3.7}$$

From the expressions above, *A* depends on *r* and *Z*, while *s* also depends on secondary market purchases, *P*, since $s_t = (A_t - D_t)/A_t$. Accordingly, we specify *s* as

$$s(r_t, P_t, Z_t) = e^{r_t b_{o,t} + P_t b_{1,t} + Z_t b_{2,t}} \quad , \quad for\ s \le 1 \tag{3.8}$$

Taking logs and rearranging,

$$\log(L_t/A_t) = r_t b_{o,t} + P_t b_{1,t} + Z_t b_{2,t}, \quad for\ \log(L_t/A_t) \le 0 \tag{3.9}$$

In (3.9), note that *Z* and *P* vary within metropolitan areas, but mortgage rates, *r*, are largely invariant within individual cities, and even across broad regions of the country. Accordingly, we replace $r_t b_{o,t}$ with MSA fixed effects for larger MSAs and MSA-size category fixed effects for smaller MSAs.[20] Our estimating equation is then given by,

$$\log(L_t/A_t) = \theta_{MSA,t} + P_t b_{1,t} + Z_t b_{2,t}, \quad for\ \log(L_t/A_t) \le 0 \tag{3.10}$$

Note that $\theta_{MSA,t}$ controls for MSA-wide mortgage rates as well as any other unobserved factors common to census tracts throughout a given MSA (or group of MSAs for the smaller cities).

From the discussion above, local socio-demographic attributes, *Z*, shift both borrower demand (*A*) and the lenders' supply of credit by influencing taste for credit and credit risk, respectively. For this reason, the coefficients on *Z* are reduced form and reflect the influence of both demand and supply factors. In contrast, *P* does not affect demand, but does influence the

[20]In total, 30 such fixed effects were included in the model. These included 24 fixed effects for each of the largest MSAs in the U.S. in 2000 (MSAs with over 500 census tracts), and 6 fixed effects for different size categories of MSAs with fewer than 500 census tracts in 2000.

supply of credit. Our estimate of b_2, therefore, measures the impact of secondary market activity on the willingness of primary lenders to supply credit and is expected to be positive.[21]

3.2 Purchase regression

As discussed earlier, a further implicit implication of our model is that primary market lenders should deny only those loans that cannot be profitably sold into the secondary market (or held in portfolio). Under these conditions, D should have no effect on P. On the other hand, P is clearly affected by L since L represents the supply of loans potentially available for purchase in the secondary market. Our second estimating equation, therefore, examines the impact of denials on the share of originations purchased by the secondary market. The estimating equation is,

$$P_t/L_t = \phi_{\mathrm{MSA,t}} + p_1 D_t + p_2 \mathrm{Z}_t + e_{2,t} \quad . \tag{3.11}$$

If primary lenders deny loans that could have been profitably sold into the secondary market, then p_1 should be negative. However, with the advent of increasingly effective information technology and the general sophistication of the mortgage market, one would expect such outcomes to be relatively infrequent. If that is the case, then the coefficient on p_1 should be small.

[21]Given the structure in (3.10), it is tempting to analyze the impact of Government Sponsored Enterprise (GSE) and Community Reinvestment Act (CRA) regulations on the availability or mortgage credit. CRA, for example, requires that primary market lenders extend credit to underserved neighborhoods, while GSE regulations require that Fannie Mae and Freddie Mac purchase a minimum share of their loans from low-income and minority neighborhoods. However, by specifying Z in a very general and reduced form manner, this makes precise interpretation of the coefficients on Z difficult. The payoff is that specifying Z in this manner helps to ensure that Z soaks up unobserved credit risk associated with the applicant pool, and in so doing, allows us to obtain consistent estimates of b_2, a primary goal of this paper. Partly for that reason, analysis of the influence of CRA and GSE regulations and the GSEs in general is left for a future paper in which a more structured approach is applied to the specification of Z.

3.3 Endogenous regressors

A final consideration is that the mortgage market control variables in (3.10) and (3.11) may be endogenous. Accordingly, as outlined in the Introduction, when estimating the origination share regressions we employ two strategies. First, we instrument for purchases using the underserved status of the census tracts. At the same time, we control for a long list of 1990 tract socioeconomic attributes, including average income and average income squared. Second, we estimate the origination share equations using 1980 tract socioeconomic attributes as instruments for endogenous secondary market purchases.[22] This latter approach is also used when estimating the purchase regressions. Strengths and limitations of the two approaches are as described in the Introduction.

4. Data

4.1 Sources and variables

As noted in the Introduction, data for the analysis were obtained from the Home Mortgage and Disclosure Act (HMDA) and the decennial Census. Specifically, we drew upon the HMDA data files for every even year from 1992 to 2004 and census tract socio-demographic attributes obtained from 1970, 1980, 1990, and 2000 decennial censuses. The census tract data were obtained from Geolytics, Inc. and were coded to year 2000 census tract boundaries for each of the decades we draw upon. All of the HMDA data was initially reported by financial institutions and coded by FFIEC based on 1990 census tract geography. We converted these data to year-2000 census tract geography. This ensures that we follow the same neighborhoods over time and facilitates proper matching of the HMDA and Census files across years.

[22]Results were similar when 1970 tract attributes were used as instruments instead of 1980 values. However, the geographic coverage of census tracts in 1970 was not as extensive as in 1980. For this reason, we report only results using the 1980 instruments.

Mortgage market variables included in the models are as defined in Section 2. Summary statistics for all of the key mortgage market variables are provided in Tables 1 and 2. Elements of *Z* obtained from the Census data include tract-level measures of socio-demographic and economic variables. These include racial composition, educational characteristics, income, gender, unemployment, poverty status, the presence of female-headed families with children, population density, and characteristics of the housing stock.[23] When estimating the models for HMDA data drawn from the 1992 through 1998 files, we used year-1990 census tract attributes as control measures. When estimating for HMDA data obtained from 2000 through 2004, we used year-2000 census tract attributes for *Z*. In addition, for all years, 1980 census tract attributes were used as instruments for the endogenous mortgage market variables.[24]

To further clean the data, certain observations were dropped. First, in calculating tract-level mortgage attributes (e.g. purchases, denials), individual loan records from the HMDA data were dropped if the type or purpose of the loan could not be determined. Second, we retained only conventional, home purchase loan records for which the size of the loan requested was less than the conforming loan limit stipulated by Fannie Mae and Freddie Mac in each given year.[25] Finally, in the empirical work to follow we focus on three sub-sample based on the type of lending institution: (i) all mortgage lending institutions, (ii) lending institutions that specialize in

[23]Recall also, as noted in the Introduction, the HMDA data do not provide information on individual loan applicant wealth or credit score (credit history). However, as described earlier, our focus on secondary market behavior largely mitigates this limitation in the data because secondary market purchases are based on broad features of the pooled mortgages rather than on the characteristics of specific borrowers.

[24]Results were little changed when we used 1970 tract attributes as instruments instead of 1980 values except that sample sizes were reduced because the geographic coverage of the census tracts was not as complete in 1970. For this reason, we focus on the models that use the 1980 tract attributes as instruments.

[25]We thank Glenn Canner in assisting us in identifying the relevant conforming loan size limits.

sub-prime mortgages,[26] and (iii) non-financial institutions, mortgage bankers and brokers. As noted earlier, sub-prime lenders serve higher risk loan applicants and should be especially sensitive to the presence of an active secondary market. Non-financial institutions typically do not hold loans in portfolio and should also be unusually dependent on the secondary market.

4.2 Sample Means

Table 2 presents sample means for the key mortgage market variables for each year of the HMDA data (1992 to 2004) for each of the groups of lenders noted above. Note that the ratios reported in the last three columns (e.g. purchase/origination ratio) were formed first for each census tract and then averaged across tracts.

Consistent with well known patterns, it is apparent that the level of mortgage activity across the market (Panel A) has increased over the 1992-2004 period, with roughly a 50 percent increase between 2000 and 2004. This is true regardless of whether activity is measured based on applications, originations, or purchases. Observe also that across all lenders (Panel A), there has been an increase in the tract average ratio of secondary market purchases relative to originations since 1994. On the other hand, over that same period, the average tract shares of applications originated and denied have oscillated over a relatively small range and stood at 64 percent and 16 percent for all lenders (Panel A), respectively, in 2004.

Comparing activity at all lenders (Panel A) to sub-prime specialists (Panel B), in every year, the ratio of denials to applications is sharply higher for sub-prime lenders (e.g., 26 percent versus 16 percent, respectively, in 2004). This is consistent with the higher risk applicants served in the sub-prime segment of the market. The ratio of secondary market purchases to

[26] While the HMDA data does not permit identification of sub-prime loans, we are able to identify institutions that specialize in the origination of sub-prime loans, using a list provided by the U.S. Department of Housing and Urban Development.

originations is well above 1 for sub-prime specialists (Panel B) in 1996 and 1998, and then drops down to 0.85 in 2004. In part, the values above indicate that some loan originators (e.g. commercial banks) purchase mortgages from other lenders and then re-sell the purchased loans. Although that practice does not influence the regression work to follow, it inflates the purchase/origination ratios in Panel B.[27] A similar pattern is evident in Panel C for the non-financial institutions (Panel C), indicative of the tendency of non-financial institutions (e.g. mortgage brokers) to also purchase and then resell a portion of their mortgages.

5. Estimation Results

5.1 Origination Share of Applications

This section presents estimates of the regression models outlined in Section 3. We begin with the origination share equation, expression (3.10). In all cases, the estimation is based on a Tobit specification that restricts the range of the log of the origination/application ratio to be non-positive. All of the models are estimated three times, first using IV methods treating purchases as endogenous with underserved tract status as the instrument (Table 3a), again using 1980 SES variables as instruments (Table 3b), and a third time treating purchases as exogenous.[28] In each case, estimates for each year of the HMDA data (1992-2004, even years) are reported. Wald tests provided in Tables 3a and 3b indicate that the IV estimates typically differ significantly from the corresponding non-IV estimates. In addition, the partial-F tests (also reported in Tables 3a and 3b) indicate that the instruments from both IV strategies are very strong predictors of purchases in the first stage. For reasons outlined in the Introduction, we

[27]Purchase/origination ratios in excess of 1 can also reflect timing issues to the extent that some loans are sold in a year subsequent to the one in which they are originated.

[28]The IV models were estimated using Newey's (1987) two-step procedure in Stata9 SE.

favor using tract underserved status as the instrument of choice for the origination share regressions, and our discussion below focuses exclusively on Table 3a for that reason. Results from Table 3b (using 1980 SES attributes as instruments) and Table 3c (non-IV models) are qualitatively similar, although the magnitudes of the estimated relationships are generally smaller.

As outlined in section 3, all of the models include MSA fixed effects for the largest MSAs and MSA size fixed effects for size categories associated with the many smaller MSAs. The models also include a rich set of census tract socioeconomic attributes (*Z*) that control for unobserved taste and risk factors that influence the demand and supply for credit. Because of the reduced form nature of *Z*, we do not report the coefficients on those variables. Instead, only the coefficients on secondary market purchases are reported.

Consider now Panel A of Table 3a. This panel reports the estimated influence of secondary market purchases on all lenders. Reading across columns, it is apparent that in each year of the HMDA data, secondary market purchases increase the share of applications originated by primary market lenders. Also apparent is that the estimates decline somewhat over the 1992-2004 period. Most recently, in 2000, 2002, and 2004, the estimated coefficient on purchases is 0.00348, 0.00200, and 0.00206, respectively. Evaluated at the mean level of purchases in each of these years (from Panel A of Table 2), the average impact of purchases on CHP mortgage origination shares over the 2000-2004 period is 15.6 percent. That magnitude is close to the denial rate in 2004 and suggests that, all else constant, the presence of an active secondary market activity has roughly halved the share of applications that are denied.[29] On the

[29]This is a partial equilibrium result, of course. If the secondary market were eliminated, very likely loan rates and other features of the mortgage market would be affected and those impacts would also influence denial rates. The direction of such general equilibrium effects is difficult to assess.

whole, our estimates confirm that an active secondary market has an important impact on access to credit.[30]

To explore these patterns further, Panel B reports estimates for all lenders based just on those tracts where sub-prime lenders are active, while Panel C reports estimates based on the sub-prime lenders. As before, both panels begin with 1996 given the small size of the sub-prime sector prior to that time.

Notice first in Panel C (sub-prime only) that the coefficient on secondary market purchases in 1996 and 1998 is imprecisely estimated and not significant. That likely reflects the small size of the sub-prime sector at that time. We focus, therefore, on estimates from 2000 on. Combining the coefficient estimates with the sample means in Table 2 (Panel C), the average impact of secondary market purchases on sub-prime origination shares is 10.9 percent. That estimate is somewhat smaller than for the market overall (e.g. the 15.6 percent figure) owing to the lesser scale of secondary market activity in the sub-prime sector. At the margin, the coefficient estimates in Table 3c make clear that secondary market purchases have a sharply higher impact on the sub-prime sector relative to the entire market: in 2000 and 2002, sub-prime effects are roughly ten times higher and in 2004 roughly 3.5 times higher. These findings provide support for the idea that secondary markets enhance efficiency in part because of their greater ability to manage risk.[31]

As a further check, we also compare the impact of secondary market purchases on origination shares at non-financial institutions, Panel D. Recall that non-financial institutions

[30]Our estimates are also consistent with the sharp increase in homeownership rates observed in the 1990s.

[31]The average effect of secondary market activity on sub-prime origination/application ratios for 2000, 2002, and 2004 is roughly 10 percent, somewhat smaller than the average effect on all lenders (15.6 percent) noted above. The smaller average effect on the sub-prime sector reflects the smaller average number of purchases from sub-prime lenders as reported in Table 2, Panel B. At the margin, however, it is clear that secondary market activity has a sharply higher impact on the subprime sector as noted above.

typically do not hold loans in portfolio, and therefore, are clearly dependent on the secondary market. Once again, results are consistent with priors: in each year, the purchase coefficient for non-financial institutions (Panel D) is positive, significant, and typically of a larger magnitude relative to all lenders (Panel A), but in most years smaller than for sub-prime specialists (Panel C). These findings further confirm that the secondary market helps most those institutions for which the greatest arbitrage opportunities exist. This holds for institutions that largely do not retain loans in portfolio (e.g. non-financial lenders), and also for institutions that have a limited ability to diversify risks associated with their applicant pool (e.g. sub-prime lenders).

5.2 Secondary Market Purchases Relative to Originations

As noted earlier, if markets are well functioning, primary lenders should not deny loans that could profitably be sold to secondary market institutions. Under those conditions, denials should have no impact on purchases for any given level of originations. If instead primary lenders sometimes make mistakenly deny loans that could have been profitably sold, then denials should reduce the number of secondary market purchases. Tables 4a and 4b present estimates based on expression (3.11) to examine this question. As before, Tobit models are used, in this case to restrict the range of purchases to be non-negative. IV estimates based on 1980 SES tract attributes are presented in Table 4a while non-IV estimates are provided in Table 4b. Once again, Wald tests (in Table 4a) confirm that the IV estimates typically differ from the non-IV. In addition, partial F tests confirm that the instruments are strong predictors of denials of loan applications. As before, only the coefficients on the key mortgage market variables are reported. Also, in each table (Tables 4a and 4b), Panel A reports results based on all types of primary

market lenders, while Panel B reports results based on just those primary market institutions that specialize in sub-prime lending.

Consider now the impact of denials on purchases. In Panel A (all lenders), the estimated coefficient on denials is consistently negative, often insignificant or only weakly significant, and typically of small magnitude. In 2004, for example, the coefficient on denials is -0.00098. Evaluated at the average number of denials in that year (18.3 as reported in Panel A of Table 2), this implies that primary market denials reduced the share of originations purchased on the secondary market by 1.79 percent, a relatively small amount. Analogous measures from alternate years are similarly small in magnitude. These patterns seemingly confirm that primary market lenders are largely cognizant of their opportunities to sell loans to the secondary market. This result is perhaps anticipated, but nevertheless is necessary if credit markets are to operate in an efficient manner.

Panel B repeats the exercise drawing on just the sub-prime lender specialists. The dominant pattern for this panel is that the coefficients on denials are consistently insignificant, regardless of their magnitude and sign. This could potentially reflect the small size of the sub-prime sector. However, by 2000, the sub-prime sector had become an important part of the mortgage industry. An alternative explanation is that sub-prime specialist lenders often rely heavily on and hence are highly cognizant of opportunities to sell such loans in the secondary market.

6. Conclusion

Although secondary markets for credit are widely believed to improve the efficiency with which risk is managed, empirical evidence on this point has been largely absent. This paper

begins to fill that gap using the mortgage market as an example. Between 1992 and 2004, the secondary market for mortgage credit expanded dramatically. In addition, beginning in the mid-1990s, an active market for high-risk subprime loans began to emerge. Together, these events provide an opportunity to evaluate the impact of secondary markets on access to credit.

Our empirical work draws on a largely overlooked feature of the Home Mortgage Disclosure Act (HMDA). Specifically, HMDA collects information on all secondary market purchases of mortgages. We aggregate these data to the census tract level and combine that information with census tract data from the Decennial census. Results confirm that for each of our sample years (even years from 1992 to 2004), secondary market activity significantly increases the share of conventional home purchase (CHP) applications originated. Moreover, this effect is substantially larger in the high-risk subprime sector. Between 2000 and 2004, secondary market purchases increased the CHP origination share of applications by roughly 15.6 percent, on average. To put that in perspective, that effect is roughly equal to the year 2004 CHP denial rate. Among subprime lenders, the overall impact of secondary market purchases is slightly smaller because of the lesser scale of sub-prime activity in the secondary market. However, at the margin, the impact of one additional secondary market loan purchase on CHP origination shares is roughly 3 to 10 times larger in the sub-prime sector than for all CHP lenders.

Results also confirm that in most years, denials of mortgage applications by primary market lenders had small negative effects on secondary market purchases. This is consistent with the notion that primary lenders try not to deny loans that can be profitably sold to the secondary market, a necessary feature of a well functioning market. That pattern is even more evident in the subprime sector, where demand by mortgage investors for subprime mortgage

pools expanded markedly over our period of analysis. These findings suggest that subprime lenders are better at denying only those loans that cannot be profitably sold to the secondary market, and this also serves to increase access to credit for high-risk borrowers.

Overall, our results demonstrate that an active secondary market increases access to credit, in part because of its greater ability to manage risk. That finding is important for credit markets in general, and for the mortgage market in particular. Indeed, recent aggressive efforts by the Federal government have sought to expand secondary mortgage market activity in low-income, minority, and other underserved neighborhoods, areas that are often associated with the presence of higher risk loan applicants. These efforts include, for example, HUD guidelines that oblige Fannie Mae and Freddie Mac to purchase over 50 percent of their mortgages in such communities. Our findings suggest that such efforts likely do serve to increase credit availability for residents of those neighborhoods.

As a final perspective, it is important to recognize that while expansion of secondary mortgage markets have increased access to credit, that outcome is associated with potential risks and is not always in the best interest of individual borrowers or the economy. Most recently, the marked increases in mortgage default and foreclosure along with related bankruptcy of numerous subprime lenders underscore this point (see, for example, Bosworth (2007) and Morgenson (2007)). A complete assessment of the wisdom of extending secondary market purchases into high-risk market segments requires a balancing of potential gains against heightened risk of borrower default and lender failures. That exercise is left for future work.

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Figure 1: Primary Mortgage Market With No Credit Rationing With and Without a Secondary Market

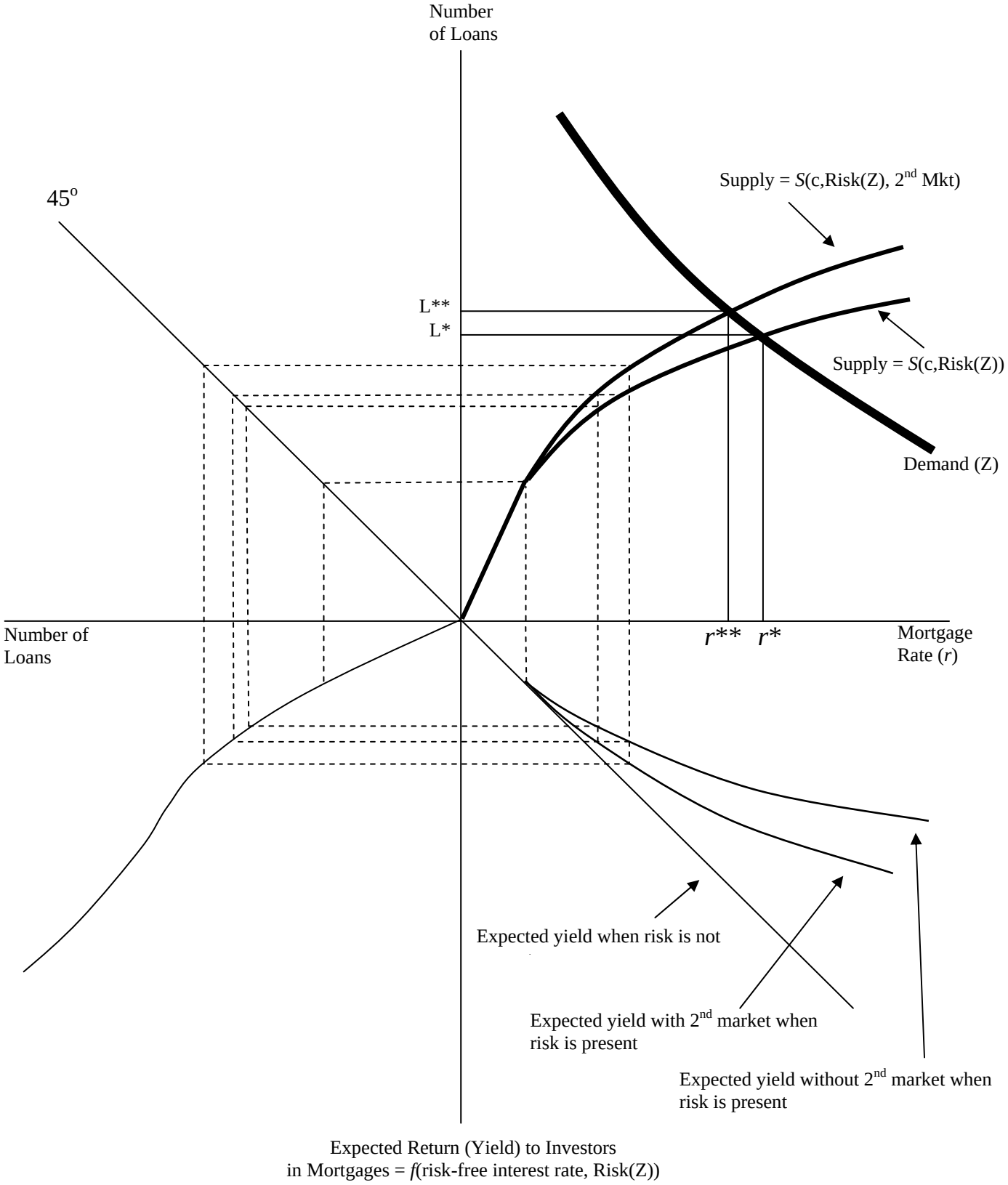

Figure 2a: Primary Mortgage Market With Credit Rationing and No Secondary Market

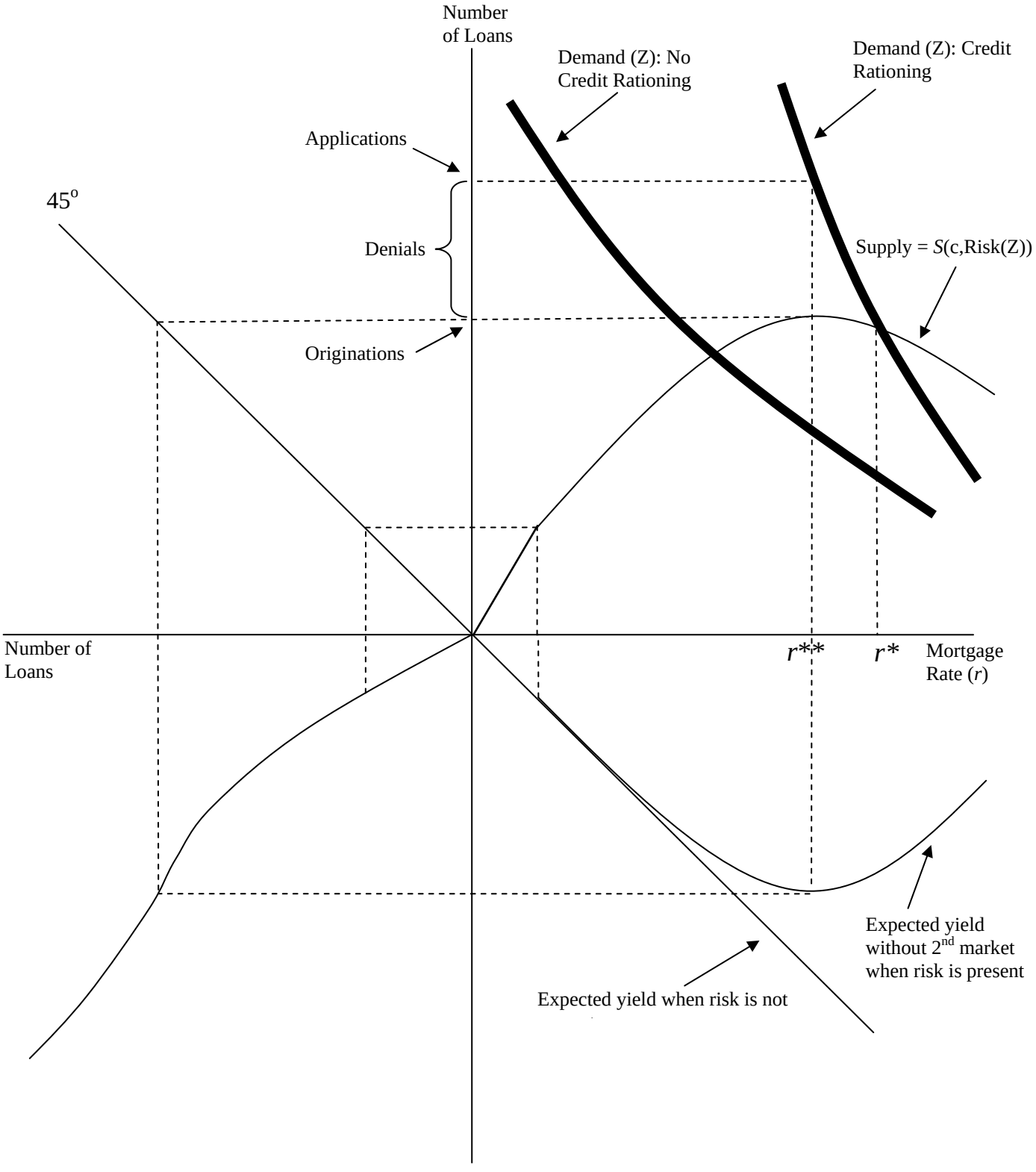

Figure 2b: Primary Mortgage Market With Credit Rationing With and Without a Secondary Market

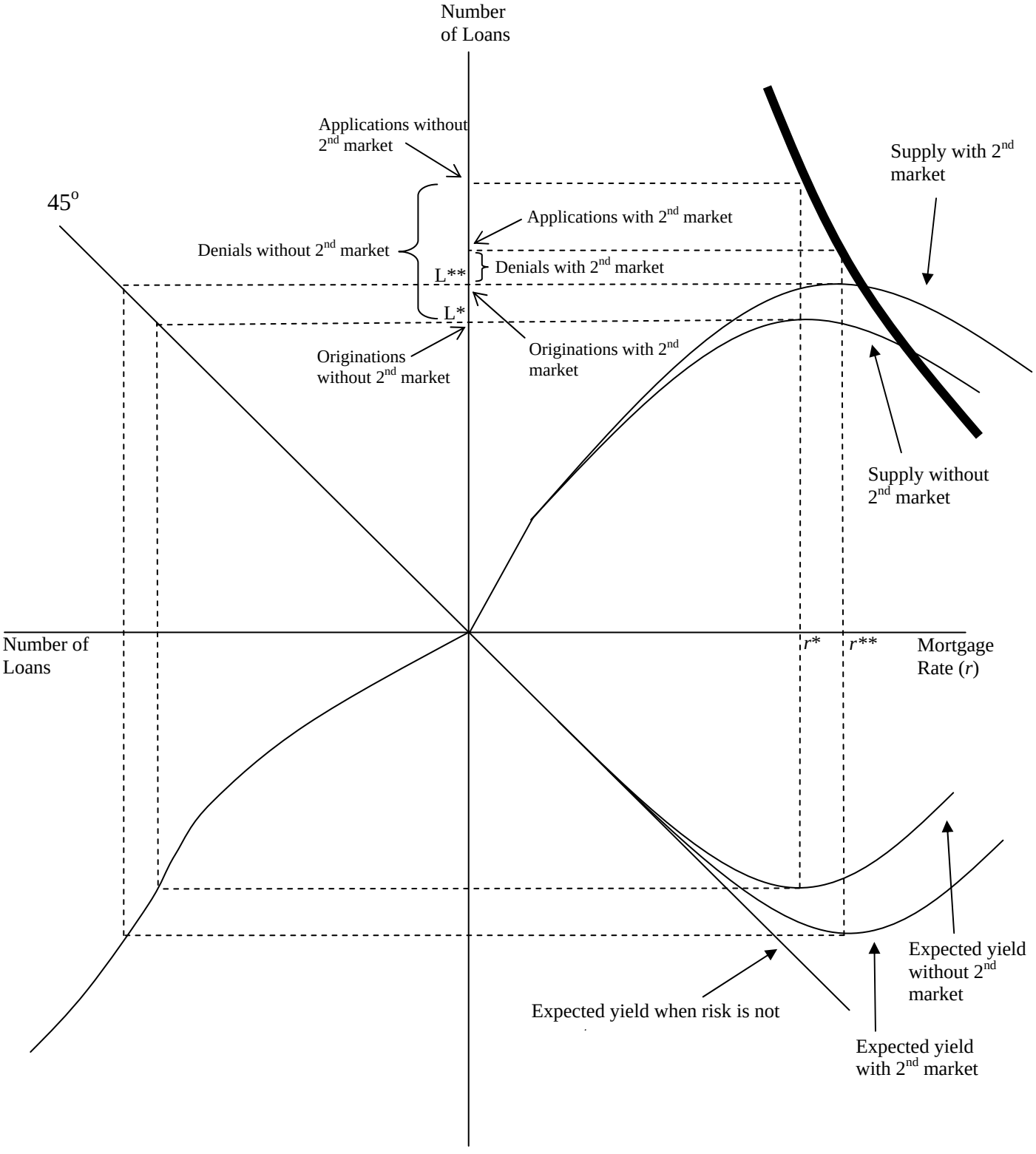

Table 1
Primary and Secondary Mortgage Market Activity in the 1990s
All Mortgage Values are MEDIANS Across Tracts
Based on Conventional Home Purchase (CHP) Loans

	Year	Denial Rate[2]	Origination Rate[2]	2nd Market Purchase to Origination Ratio[1]
Entire US	2002	0.120	0.693	0.931
	1992	0.136	0.745	0.714
Tract Income				
Less Than 25,000	2002	0.263	0.455	0.814
Less Than 25,000	1992	0.255	0.556	0.333
Tract Race and Ethnicity				
Percent Black > 50	2002	0.240	0.491	0.878
Percent Black > 50	1992	0.250	0.588	0.500
Percent Hispanic > 50	2002	0.211	0.546	0.975
Percent Hispanic > 50	1992	0.267	0.568	0.571
Lowest Secondary Market Purchase to Origination Ratio for CHP Loans[1]				
Huntington-Ashland WV-KY-OH	2002	0.338	0.486	0.481
Binghamton NY	2002	0.167	0.681	0.517
Johnstown PA	2002	0.192	0.666	0.541
Utica-Rome NY	2002	0.177	0.627	0.562
Highest Secondary Market Purchase to Origination Ratio for CHP Loans[1]				
Fresno CA	2002	0.129	0.679	1.201
Anchorage AK	2002	0.078	0.764	1.198
Visalia-Tulare-Porterville CA	2002	0.148	0.676	1.171
Eugene-Springfield OR	2002	0.107	0.708	1.163

[1]Secondary market includes FNMA, GNMA, FHLMC, FAMC, commercial banks, savings banks and associations, life insurance companies, affiliates, and other purchasers. MSAs reported in this portion of the table are ones with the lowest or highest secondary market CHP purchase-to-origination ratios from among all MSAs in the U.S. with 50 or more census tracts in 2000.

[2]Denial and origination rates are relative to the sum of primary market originations, denials, withdrawals, approved but not accepted, and files closed because of incomplete information.

Table 2
Sample Means for Mortgage Market Variables from the HMDA Data

Panel A: All Lending Institutions

Year	Applications	Originations	Secondary Market Purchases	Denials	Originations/ Applications[a]	Denials/ Applications[a]	Purchases/ Originations[a]
1992	36.87	27.55	20.18	5.15	0.71	0.17	0.80
1994	52.36	38.62	23.57	7.07	0.71	0.15	0.58
1996	64.79	42.40	30.00	12.94	0.65	0.20	0.69
1998	84.67	52.64	45.62	18.03	0.61	0.21	0.84
2000	89.02	55.47	47.26	18.17	0.61	0.21	0.84
2002	91.51	63.79	60.39	11.62	0.66	0.15	0.92
2004	130.49	86.81	88.26	18.33	0.64	0.16	0.99

Panel B: Sub-Prime Specialist Lending Institutions

Year	Applications	Originations	Secondary Market Purchases	Denials	Originations/ Applications[a]	Denials/ Applications[a]	Purchases/ Originations[a]
1992	-	-	-	-	-	-	-
1994	-	-	-	-	-	-	-
1996	2.79	1.22	1.18	0.71	0.46	0.22	2.6
1998	9.52	3.34	3.28	2.55	0.35	0.25	1.79
2000	13.51	5.28	3.21	4.17	0.39	0.30	0.71
2002	14.07	6.66	5.64	3.39	0.45	0.25	0.97
2004	23.13	12.30	10.19	5.71	0.50	0.26	0.85

Panel C: Non-Financial Lending Institutions

Year	Applications	Originations	Secondary Market Purchases	Denials	Originations/ Applications[a]	Denials/ Applications[a]	Purchases/ Originations[a]
1992	10.06	7.09	7.71	1.56	0.68	0.18	2.54
1994	17.50	11.61	10.68	3.05	0.65	0.18	0.98
1996	23.40	11.85	12.21	7.02	0.55	0.25	1.28
1998	36.84	17.40	18.48	11.29	0.50	0.25	1.15
2000	28.82	15.28	17.77	7.00	0.53	0.22	1.32
2002	29.47	17.57	19.24	5.05	0.57	0.19	1.33
2004	54.76	32.04	34.25	9.23	0.56	0.19	1.11

[a]Reported ratios were first measured for each census tract and then averaged across tracts.

Table 3a
Primary Market Originations (from All Institutions) of Conventional Home Purchase (CHP) Loans
Tobit Two-Step IV Estimates Using Underserved Tract Status as Instrument

Dependent Variable: Log(Originations/Applications)
(Absolute value of t-ratios in Parentheses)

Panel A: All Lenders (All Tracts)

	1992	1994	1996	1998	2000	2002	2004
CHP 2nd Market Purchases	0.00494	0.00405	0.00367	0.00271	0.00348	0.00200	0.00206
	(8.09)	(8.08)	(6.55)	(5.52)	(4.78)	(3.66)	(12.02)
Observations	48385	49970	50082	50338	50025	50027	50278
Right-censored obs	1731	1018	566	287	216	286	268
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30
Exog: Prob > Chi-square(1)[b]	0.0001	0.0001	0.0001	0.0008	0.0001	0.0001	0.0001
Partial F test from first stage	616.89	558.46	347.94	223.06	77.27	45.37	214.03

Panel B: All Lenders (Just those Tracts in which Sub-Prime Specialists are Active)

CHP 2nd Market Purchases			0.00224	0.00214	0.00319	0.00162	0.00198
			(4.16)	(4.35)	(4.15)	(2.86)	(12.06)
Observations			34629	46201	47767	47032	47288
Right-censored obs			110	69	52	60	51
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30
Exog: Prob > Chi-square(1)[b]			0.0069	0.0321	0.0001	0.0001	0.0001
Partial F test from first stage			230.93	186.32	61.68	34.17	204.62

Panel C: Sub-Prime Lenders

CHP 2nd Market Purchases			0.18226	0.04547	0.04415	0.02056	0.00674
			(1.12)	(1.02)	(3.14)	(2.98)	(2.56)
Observations			29223	42205	45354	44868	45268
Right-censored obs			6443	1686	1337	1891	2481
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30
Exog: Prob > Chi-square(1)[b]			0.3728	0.9187	0.2232	0.2588	0.3195
Partial F test from first stage			8.34	21.86	59.47	88.74	78.10

Panel D: Non-Financial Lenders (All Tracts)

CHP 2nd Market Purchases	0.09632	0.01687	0.01003	0.00157	0.00402	0.00747	0.00982
	(4.39)	(4.73)	(2.33)	(0.33)	(0.46)	(0.16)	(5.70)
Observations	40846	46639	47517	49088	48399	48435	49065
Right-censored obs	7174	4352	2445	879	1140	1233	765
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30
Exog: Prob > Chi-square(1)[b]	0.0001	0.0001	0.1807	0.5934	0.0001	0.0001	0.0000
Partial F test from first stage	25.62	149.98	85.71	28.31	6.52	0.15	38.18

[a]All models include as control variables 1990 census tract measures for % population Hispanic; % population African American; average age of population; % population male; average family income; average family income squared; % population age 25 and over with: no high school, some high school, high school degree, some college; % age 16 and over that are unemployed; % population in poverty; % population female-headed families with childrent; average age of housing stock; % single family detached housing; population density.
[b]Wald test of the difference between estimates from the IV and non-IV models.

Table 3b
Primary Market Originations (from All Institutions) of Conventional Home Purchase (CHP) Loans
Tobit Two-Step IV Estimates Using 1980 SES Tract Attributes as Instruments

Dependent Variable: Log(Originations/Applications)
(Absolute value of t-ratios in Parentheses)

Panel A: All Lenders (All Tracts)

	1992	1994	1996	1998	2000	2002	2004
CHP 2nd Market Purchases	0.00452	0.00331	0.00120	0.00193	0.00151	0.00097	0.00046
	(8.33)	(9.55)	(4.79)	(11.62)	(11.63)	(12.16)	(9.48)
Observations	47854	48865	48935	49183	48881	48876	49135
Right-censored obs	1607	933	555	280	209	281	264
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30
Exog: Prob > Chi-square(1)[b]	0.0001	0.0001	0.5354	0.0001	0.0000	0.0000	0.0000
Partial F test from first stage	47.90	69.60	102.48	119.03	130.98	116.64	80.00

Panel B: All Lenders (Just those Tracts in which Sub-Prime Specialists are Active)

CHP 2nd Market Purchases			0.00088	0.00186	0.00159	0.00094	0.00047
			(4.00)	(11.93)	(12.76)	(12.73)	(10.63)
Observations			33981	45149	46664	45936	46206
Right-censored obs			109	69	51	60	51
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30
Exog: Prob > Chi-square(1)[b]			0.8209	0.0000	0.0000	0.0001	0.0000
Partial F test from first stage			83.79	114.49	129.72	116.77	80.55

Panel C: Sub-Prime Lenders

CHP 2nd Market Purchases			0.03512	0.05778	0.02860	0.02349	0.00330
			(1.39)	(7.92)	(6.69)	(10.99)	(5.07)
Observations			28700	41288	44100	43629	44064
Right-censored obs			6315	1666	1309	1864	2436
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30
Exog: Prob > Chi-square(1)[b]			0.7445	0.0177	0.7912	0.0001	0.1408
Partial F test from first stage			19.78	51.99	75.17	75.22	71.13

Panel D: Non-Financial Lenders (All Tracts)

CHP 2nd Market Purchases	0.00364	0.00976	0.00622	0.00496	0.00562	0.00563	0.00226
	(1.61)	(7.09)	(5.77)	(7.77)	(10.07)	(12.59)	(12.03)
Observations	40582	45754	46405	47950	47278	47317	47939
Right-censored obs	7130	4160	2425	862	1120	1218	753
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30
Exog: Prob > Chi-square(1)[b]	0.7538	0.0001	0.0756	0.1741	0.0000	0.0000	0.0000
Partial F test from first stage	44.56	57.76	83.67	97.91	101.48	93.50	62.49

[a]All models include as control variables 1990 census tract measures for % population Hispanic; % population African American; average age of population; % population male; average family income; average family income squared; % population age 25 and over with: no high school, some high school, high school degree, some college; % age 16 and over that are unemployed; % population in poverty; % population female-headed families with childrent; average age of housing stock; % single family detached housing; population density.
[b]Wald test of the difference between estimates from the IV and non-IV models.

Table 3c
Primary Market Originations (from All Institutions) of Conventional Home Purchase (CHP) Loans
Tobit Non-IV Estimates

Dependent Variable: Log(Originations/Applications)
(Absolute value of t-ratios in Parentheses)

Panel A: All Lenders (All Tracts)

	1992	1994	1996	1998	2000	2002	2004
CHP 2nd Market Purchases	0.00152	0.00150	0.00105	0.00111	0.00082	0.00050	0.00022
	(22.83)	(29.41)	(22.95)	(34.43)	(31.23)	(33.15)	(28.73)
Observations	47854	48865	48935	49183	48881	48876	49135
Right-censored obs	1607	933	555	280	209	281	264
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30

Panel B: All Lenders (Just those Tracts in which Sub-Prime Specialists are Active)

CHP 2nd Market Purchases			0.00083	0.00109	0.00082	0.00049	0.00022
			(19.12)	(35.19)	(31.70)	(34.02)	(30.19)
Observations			33981	45149	46664	45936	46206
Right-censored obs			109	69	51	60	51
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30

Panel C: Sub-Prime Lenders

CHP 2nd Market Purchases			0.04325	0.04065	0.02748	0.01293	0.00423
			(16.75)	(39.82)	(35.09)	(33.25)	(32.54)
Observations			28700	41288	44100	43629	44064
Right-censored obs			6315	1666	1309	1864	2436
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30

Panel D: Non-Financial Lenders (All Tracts)

CHP 2nd Market Purchases	0.00293	0.00415	0.00432	0.00409	0.00305	0.00271	0.00086
	(10.01)	(21.72)	(23.88)	(35.84)	(30.05)	(35.02)	(32.79)
Observations	40582	45754	46405	47950	47278	47317	47939
Right-censored obs	7130	4160	2425	862	1120	1218	753
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30

[a]All models include as control variables 1990 census tract measures for % population Hispanic; % population African American; average age of population; % population male; average family income; average family income squared; % population age 25 and over with: no high school, some high school, high school degree, some college; % age 16 and over that are unemployed; % population in poverty; % population female-headed families with childrent; average age of housing stock; % single family detached housing; population density.

Table 4a
Secondary Market Purchases Relative to Originations (from All Institutions)
of Conventional Home Purchase (CHP) Loans
Tobit Two-Step IV Estimates Using 1980 Tract SES Attributes as Instruments

Dependent Variable: Purchases/Originations
(Absolute value of t-ratios in Parentheses)

Panel A: All Lenders (All Tracts)

	1992	1994	1996	1998	2000	2002	2004
CHP Loans Denied	-0.00141	-0.00285	0.00006	-0.00064	-0.00735	-0.00370	-0.00098
	(0.02)	(1.20)	(0.18)	(3.22)	(1.25)	(2.23)	(2.83)
Observations	47854	48865	48935	49183	48881	48876	49135
Left-censored obs	1563	1104	719	294	320	235	166
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30
Exog: Prob > Chi-square(1)[b]	1.0000	0.3300	0.5900	0.0800	0.2500	0.0300	0.0000
Partial F test from first stage	25.17	59.46	99.03	126.82	71.53	72.52	61.43

Panel B: Sub-Prime Lenders

CHP Loans Denied			0.61744	-0.02407	0.03395	0.02172	-0.00147
			(1.27)	(0.11)	(0.49)	(0.30)	(1.23)
Observations			28700	41288	44116	43644	44063
Left-censored obs			4240	1936	5065	1628	1176
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30
Exog: Prob > Chi-square(1)[b]			0.1300	0.8800	0.7300	0.9000	0.5100
Partial F test from first stage			19.78	51.99	75.17	75.22	71.13

[a]All models include as control variables 1990 census tract measures for % population Hispanic; % population African American; average age of population; % population male; average family income; average family income squared; % population age 25 and over with: no high school, some high school, high school degree, some college; % age 16 and over that are unemployed; % population in poverty; % population female-headed families with childrent; average age of housing stock; % single family detached housing; population density.
[b]Wald test of the difference between estimates from the IV and non-IV models.

Table 4b
Secondary Market Purchases Relative to Originations (from All Institutions)
of Conventional Home Purchase (CHP) Loans
Tobit Non-IV Estimates

Dependent Variable: Secondary Market Purchases Divided by Originations[a]
(Absolute value of t-ratios in Parentheses)

Panel A: All Lenders (All Tracts)

	1992	1994	1996	1998	2000	2002	2004
CHP Loans Denied	0.00152	0.00150	0.00105	0.00111	0.00082	0.00050	0.00022
	(22.83)	(29.41)	(22.95)	(34.43)	(31.23)	(33.15)	(28.73)
Observations	47854	48865	48935	49183	48881	48876	49135
Left-censored obs	1607	933	555	280	209	281	264
1990 SES Controls[a]	16	16	16	16	16	16	16
MSA/MSA-Size fixed effects	30	30	30	30	30	30	30

Panel B: Sub-Prime Lenders

CHP Loans Denied			-0.12244	0.00803	0.05706	0.01272	-0.00068
			(2.93)	(0.28)	(5.98)	(1.42)	(4.06)
Observations			29223	42205	45174	44689	45087
Left-censored obs			4319	1979	5191	1688	1203
1990 SES Controls[a]			16	16	16	16	16
MSA/MSA-Size fixed effects			30	30	30	30	30

[a]All models include as control variables 1990 census tract measures for % population Hispanic; % population African American; average age of population; % population male; average family income; average family income squared; % population age 25 and over with: no high school, some high school, high school degree, some college; % age 16 and over that are unemployed; % population in poverty; % population female-headed families with childrent; average age of housing stock; % single family detached housing; population density.