

# **AN ANALYSIS OF THE POTENTIAL COMPETITIVE IMPACTS OF BASEL II CAPITAL STANDARDS ON U.S. MORTGAGE RATES AND MORTGAGE SECURITIZATION**

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April 2005

## **ABSTRACT**

U.S. regulators have proposed that the new Basel II capital standards would be required of only the largest or most internationally active depositories, while other depositories could choose between opting into such standards or remaining under the existing capital standards. We consider potential impacts of this “bifurcated” approach on competition in the market for residential mortgages. Specifically, we analyze whether this approach could translate into: (1) a cost advantage, and correspondingly a pricing and/or profit advantage, in mortgage markets for the depository institutions that adopt the new Basel II standards, and/or (2) provide incentives for these adopters to retain mortgages in their own portfolios.

In the prime mortgage markets, we find that mortgage rates are likely to be largely unaffected by the adoption of a bifurcated Basel II capital standard because such rates would continue to reflect GSE capital requirements. In addition, prime mortgages are priced using uniform pricing methods, which suggests that a pricing advantage would not result from differences in capital requirements across depositories. Without a pricing advantage, an adopter’s market share of prime mortgage funding would be unaffected. As for near-prime and subprime loans, we conclude that capital allocated to back residential mortgages would continue to reflect market-determined capital needs, and therefore, their mortgage rates also would remain unchanged.

Our main conclusions are: (1) it is unlikely that there would be any measurable effect of Basel II implementation on mortgage rates and, consequently, any direct impact on the competition between adopters and nonadopters for originating or holding residential mortgages; (2) the most significant competitive impact might be the pressure on GSEs to lower their guarantee fee to adopters for prime mortgages; and (3) adopters might have increased profits from some mortgages relative to nonadopters because they will capture some of the deadweight losses that occur under the current regulatory capital frameworks imposed on depositories and on securitizers, but nonadopters would likely retain their mortgage market positions.

To the extent that adopters seek a credit agency rating that is better than A-, that mortgage pricing is more risk-sensitive, or that the system of prompt corrective actions impinges on depositories’ decision-making with respect to capital holdings, competitive impacts would be smaller than we predict. Potential income gains could flow in the long-run to adopters or homeowners, but we remain reasonably certain that nonadopters would be largely unaffected by the implementation of Basel II capital standards.

<sup>†</sup> The opinions, analysis, and conclusions of this paper are solely the authors’ and do not necessarily reflect those of the Board of Governors of the Federal Reserve System. We thank Tom Boemio and Brad Case for their assistance with understanding Basel I and Basel II capital standards, Gerhard Fries, Arthur Kennickell, and Kevin Moore for their helpful suggestions on using the Survey of Consumer Finances, Cathy Gessert, Jonathan Hershaff, and Laura Kawano for their excellent research assistance, and Glenn Canner, Ed Ettin, Michael Gibson, David Jones, Jonathan Jones, Paul Kupiec, Myron Kwast, David Malmquist, and Steve Oliner for their insightful comments and suggestions.

## 1. INTRODUCTION AND SUMMARY

Beginning in 2008,<sup>1</sup> U.S. depository institutions will operate under a so-called “bifurcated” capital regime: the larger entities would likely be subject to a new set of capital rules (Basel II) and all others would operate under the current (Basel I-based) capital rules.<sup>2</sup> Under the U.S. proposal, depositories with consolidated banking assets of \$250 billion or more and/or foreign exposures of \$10 billion or more would be *required* to adopt the advanced approaches of Basel II. Other depositories that meet the infrastructure requirements may *opt in* to Basel II. All other U.S. depositories would remain under the current (Basel I-based) capital regime.<sup>3</sup>

The greater risk sensitivity of Basel II is expected to lower the *regulatory* capital requirements on the credit risk of most residential first-lien mortgages, although it might raise them on the most risky mortgages. Those depositories that remain under the current capital regime, which imposes a four percent regulatory capital charge on all residential mortgages regardless of risk, are thus expected to face higher regulatory capital requirements on their residential mortgage portfolios than would Basel II adopters. The difference in capital treatment has been criticized by some as placing those who do not adopt Basel II at a competitive disadvantage in the residential mortgage credit market.<sup>4</sup>

Specifically, critics of the U.S. bifurcated proposal have argued that the lower regulatory capital requirements for adopters would result in a cost advantage for the latter. These observers argue that such a reduction in costs could translate into (1) a pricing advantage for adopters in mortgage markets, who might then increase their market share of originations at the expense of

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<sup>1</sup> The Basel Committee on Banking Supervision (BCBS) has proposed a more risk-sensitive Capital Accord (Basel II) that would replace the existing capital regime among G-10 and other countries. Basel Committee on Banking Supervision (June 2004).

<sup>2</sup> In the United States, the banking agencies have proposed that only one variant of Basel II would be permitted – the Advanced Internal Ratings Based (A-IRB) approach for credit risk and the Advanced Measurement Approach (AMA) for operational risk. See *ibid.* and Advance Notice of Proposed Rulemaking on Risk-Based Capital Guidelines: Implementation of New Basel Capital Accord (68 FR 45899, August 4, 2003). In the United States, the other variants of Basel II may not be used.

<sup>3</sup> The agencies have indicated their intention to propose simple modifications to the current U.S. Basel I-based capital standards designed to make the current standards more risk sensitive – in part to address potential competitive distortions that might result from more risk-sensitive capital requirements for adopters of Basel II-based rules.

<sup>4</sup> See, for example, Macomber (2004) and Independent Community Bankers of America (2003).

nonadopters; and/or (2) an increase in the adopters' profits that would provide them greater competitive strength in all credit markets. In addition, regardless of the effect on mortgage interest rates, some have reasoned that the greater risk sensitivity in Basel II residential mortgage regulatory capital requirements could provide incentives for adopters to either (1) retain in their own portfolios mortgages that they now securitize and sell themselves, sell to other private securitizers, or sell to government-sponsored enterprises (GSEs); or (2) out-bid the GSEs and provide credit risk protection on low-risk mortgages in securitization markets.<sup>5</sup>

This paper addresses the potential effects of bifurcated capital regulations in the United States on residential mortgage rates and mortgage securitization markets in order to evaluate the competitive concerns described previously. The paper presents a conceptual framework of the residential mortgage market and the role of securitizers. This framework is used to examine the potential effects of Basel II implementation on mortgage pricing, credit guarantee fees, and the incentive of adopters to retain mortgages in their portfolio. These results are then used to address how the bifurcated application of Basel II might affect the competitive relationships among adopters, nonadopters, and GSEs.

We begin by summarizing some important institutional facts that are critical to understanding the conclusions of this paper. The most important of these are that (1) almost all residential first-lien mortgages held by depositories under the current regulatory regime are subject to the same four percent *regulatory* capital charge (regardless of the underlying risk of the exposure); (2) the *regulatory* capital charge on about 90 percent of all residential first-lien mortgages exceeds the capital that either the market or the depository itself would impose (*economic capital*) for the credit risk in these exposures; and (3) GSEs and other mortgage securitizers now play the dominant role in bearing the credit risk of mortgages.

This structure has two important implications. First, it creates incentives for depositories to engage in so-called "regulatory capital arbitrage." That is, depositories have an incentive to sell the credit risk on loans whose *regulatory* capital exceeds their *economic* capital to institutions not bound by the same capital regulations, and also to hold the credit risk on loans whose regulatory capital is below their economic capital. Second, in order to make the regulatory capital charge on mortgages held about equal to the *average* economic/market capital

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<sup>5</sup> See, for example, Frame and White (2004a), Federal Financial Analytics, Inc. (2004), and Calem and Follain (2005).

charge, depositories are motivated to balance or blend lower-risk holdings with higher-risk holdings of mortgages. For example, a depository could meet a 4 percent minimum regulatory capital requirement by holding equal dollar amounts of mortgages at opposing ends of the credit risk spectrum, say with economic capital needs equal to 2 percent and 6 percent.

Thus, within broad credit risk-based market segments, depositories currently tend to hold both higher-risk and very low-risk whole mortgages in their portfolios and, while originating mortgages throughout the risk spectrum, to shift the holdings of all other whole mortgages to others. They do so by (1) securitizing those mortgages they choose not to hold and selling the resultant mortgage backed securities (MBS) to others,<sup>6</sup> (2) selling such mortgages to other private securitizers, or (3) selling them to a GSE. All MBS have a credit enhancement provided by either a private issuer, usually in the form of the originator retaining a first-loss tranche that exceeds the credit risk in the mortgage pool, or through a GSE guarantee purchased by the private securitizer or placed by the GSE on the MBS it issues backed by whole mortgages it has purchased. The regulatory capital charge on credit-enhanced MBS is greatly reduced.<sup>7</sup>

Almost two-thirds of all first-lien conventional residential mortgages (i.e., mortgages not explicitly backed by the government) are now securitized. GSE guarantees are placed on almost three-quarters of conforming, prime, first-lien residential MBS, and on much of the non-prime mortgage market as well.<sup>8</sup> A GSE guarantee, of course, places the credit risk of the underlying mortgages on the GSE. That credit risk is subject to a minimum *regulatory* capital charge on the GSE of 45 basis points. Thus, a significant proportion of residential mortgage credit risk is already subject to a low minimum regulatory capital charge relative to that imposed on depository institutions.

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<sup>6</sup> Not all securitizations are for the purpose of shifting credit risk for regulatory capital reasons. Depositories also securitize mortgages to fund their assets and, when they hold the MBS, to enhance the liquidity of their mortgage portfolios and to ease the hedging of interest rate risk.

<sup>7</sup> Under the current regime, GSE and very high-rated tranches of private securitizations have a 1.6 percent capital charge. Adopters of Basel II (A-IRB) would face capital charges ranging from 56 basis points to the current 1.6 percent on higher-quality tranches of purely private securitizations. The capital charge on GSE-guaranteed MBS has not yet been determined. Under both the current and proposed rules, capital charges on the privately held first-loss tranches is 100 percent.

<sup>8</sup> Conforming mortgages are those mortgages that are eligible to be purchased by the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac). Jumbo mortgages are loans larger than the conforming loan limit (\$322,700 for single-family homes in 2003 and \$359,650 in 2005). Prime mortgages are those with the lowest credit risk. (See section 2, below, for a detailed description of the U.S mortgage market.)

Under Basel II, only a small portion (perhaps a little over 10 percent) of the outstanding stock of prime mortgages would have regulatory capital requirements that would be higher than what is now imposed on GSEs. Most of the prime mortgages held by depositories under Basel II would be subject to regulatory capital requirements *below* the low levels of the capital required of GSEs. However, the analysis presented in this paper suggests that the carrying cost savings for adopters from shedding capital (because of lower regulatory capital requirements) and replacing the capital shed with other funds (probably, for adopters, uninsured deposits) is only a few basis points. That small difference is critical to assessing the potential implications of Basel II on competition between adopters and GSEs, summarized below.

Before summarizing the assessments made in this study, some additional understanding of pricing of credit risk in the residential mortgage market is important. The U.S. residential mortgage market is divided into several segments, each of which has similar credit risk characteristics. We group the \$5.3 trillion of first-lien, conventional, residential mortgages into segments by the borrower's credit score, as well as the mortgage's loan-to-value (LTV) ratio; the higher the credit score and the lower the LTV ratio, the lower the credit risk associated with the mortgage market segment.<sup>9</sup> These segments are stylized by necessity and do not take into account many of the nuances of the marketplace, where originators and securitizers have more detail about each borrower's financial history and debt obligations, as well as more information about the loan and property characteristics. Nevertheless, these groupings proved tractable in developing a data base that could be analyzed, and the results seem to capture what is observed in the marketplace.

Mortgage rates differ much more across these market segments than within them. Since mortgage rates are typically charged in eighths of a percentage point, rounding limitations require capital savings would need to be quite substantial before actual rates would change because of rounding. Anecdotal evidence suggests that rates do not differ at all across individuals within fairly broad credit score ranges. In addition, statistical evidence supports the hypothesis that mortgages within a market segment are priced on a *uniform* basis at the marginal cost of bearing credit risk of the marginal borrower within the market segment. This uniform pricing practice is rational: actual differences in risk within segments are small relative to the

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<sup>9</sup> The segments are prime, near-prime, and subprime. There are further subdivisions made between conforming and jumbo mortgages. Again, these divisions are very stylized and aggregated; the U.S. mortgage market offers a wide range of products that may segment markets further than indicated here.

abilities of lenders to measure and model credit risk and because costs of capital may vary little within each market segment. Moreover, econometric analysis presented in section 4 suggests that within the prime and near-prime market segments, changes in capital would have statistically insignificant and economically small effects on mortgage rates and suggests further that mortgages are priced uniformly within a market segment, rather than individually priced based on estimates of an individual borrower's creditworthiness.<sup>10</sup>

Within the subprime mortgage market segment, however, we find that mortgage rates are statistically sensitive to changes in borrower credit quality. In fact, these borrowers pay a significantly higher rate on average than do prime or near-prime borrowers. And, because this mortgage market segment is likely divided into finer grades than are analyzed here, credit quality matters within our subprime market segment. Nevertheless, it is very unlikely that changes in capital within mortgage market segments affect mortgage rates actually charged to borrowers, in large part because of uniform pricing within these risk segments.

Based on these institutional facts, the econometric analysis just described, and additional analysis not included in this summary of the highlights of the paper, this study reaches the following conclusions regarding the potential competitive implications of the bifurcated application of Basel II in the United States.

*First, it is unlikely that there would be any measurable effect of Basel II implementation on mortgage rates and, consequently, any direct impact on the competition between adopters and nonadopters for originating or holding residential mortgages.* The market has effectively adjusted to a lower regulatory capital charge by using GSE-guarantees, by using other forms of securitizations, and by blending higher- and lower-risk mortgage portfolios to arbitrage the current one-size-fits-all capital regulations. *If there were any effect on mortgage rates, such adjustments have already occurred.* Estimates of the maximum number of mortgages for which adopters may compete with nonadopters indicate that only a small portion of the US mortgage market would be affected by Basel II implementation. More important, perhaps, there is no evidence, especially with uniform pricing within mortgage market segments, that regulatory capital has any economically significant effect on mortgage rates, a conclusion only strengthened by the requirement of U.S. depositories to meet both a leverage ratio (i.e., a minimum capital-to-

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<sup>10</sup> A one percent change in capital is estimated to change the prime mortgage rate by one-half of a basis point; for near-prime the effect is essentially zero.

asset ratio) and Prompt Corrective Action (i.e., minimum risk-based capital requirements to meet the supervisory designation of “well-capitalized”) under both capital regimes. In addition, depositories’ demonstrated preference to hold a buffer capital stock above regulatory minimums, the importance of market demands for capital to meet rating agency requirements, and depositories’ increasing use of economic capital for both prudential and risk management purposes further blunt the possible effects of minimum regulatory capital requirements on the pricing of credit risk. Moreover, the same incentives that exist now for securitizations – both private and through GSEs – and risk-blending in portfolios will continue for nonadopters under Basel II. In other words, nonadopters’ effective capital requirements will remain extremely low.

Second, *the most significant competitive impact might be the pressure by adopters on GSEs to lower their guarantee fee for prime mortgages.* We find that close to 90 percent of prime mortgages would have a lower regulatory capital charge for adopters than is currently imposed on GSEs. As noted earlier, this difference amounts to only a few basis points that adopters could use either to divert business from GSEs by offering lower guarantee fees to others or to pressure GSEs to reduce the guarantee fee on prime mortgages for adopters. This reduction in guarantee fees would likely not extend to nonadopters or to the public in the form of lower mortgage rates; instead they are likely to be totally captured by adopters. GSEs already discriminate in their guarantee fee by quoting lower fees to larger entities, so it seems likely that this effect would be very small in terms of the GSE guarantee fee on a given mortgage loan, although the aggregated effects on total GSE revenues might be substantial. In addition, the estimated maximum number of mortgages for which adopters might compete with purely private securitizers (i.e., back with capital the credit risk undertaken) is small, in the order of 2.5 million mortgages out of the over 40 million outstanding.

Third, it is nevertheless true that *adopters of the Basel II (A-IRB) approach might have increased profits from some mortgages relative to nonadopters because they will capture some of the deadweight losses<sup>11</sup> that occur under the current regulatory capital frameworks imposed on depositories and on securitizers.* However, only a relatively small number of mortgages would likely be affected and mortgage rates would remain unchanged, particularly in the near-

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<sup>11</sup>A deadweight loss is a loss in social welfare deriving from a policy or action that has no corresponding gain. Deadweight losses represent economic inefficiency and usually result when there is some flaw in the price-setting mechanism. (*Dictionary of Economics*, 2003). In this case, the flaw in the price-setting mechanism is that, for some mortgages, regulatory capital requirements have resulted in an artificially high price for bearing credit risk associated with these mortgages.

term. Importantly, the increased profits for adopters would not be direct income transfers from nonadopters of the new framework; instead, the adopters would capture the deadweight losses, while the nonadopters are likely to maintain their market shares.<sup>12</sup> Still, some modest competitive advantage could be provided to adopters for some mortgages if the non-capital operating costs associated with Basel II are similar to those associated with operating under Basel I.

The balance of this paper provides the detailed support for these conclusions. Section 2 describes the mortgage market in the United States. Section 3 describes the current (Basel I-based) and proposed Basel II (A-IRB) capital standards for residential mortgages that are fully secured by one- to four-family residential properties and for MBS held, assumed, or issued by depositories. Section 4 provides our conceptual framework for analyzing the potential competitive effects of the bifurcated application of Basel II in the United States. Section 5 analyzes the effects of the bifurcated Basel II application on various segments of the U.S. mortgage market. Section 6 discusses whether competitive impacts would be larger if (1) adopters seek a better credit agency rating than we have assumed, (2) mortgage pricing is more risk-sensitive than we have assumed, or (3) if the system of prompt corrective actions impinges more on depositories' decision-making with respect to capital holdings than we have assumed; and concludes that our estimates of potential competitive impacts are likely overstated, rather than understated. Section 7 concludes with an evaluation of the potential competitive effects among depositories and GSEs.

## **2. MORTGAGE MARKETS IN THE UNITED STATES**

In this section, we describe the U.S. mortgage market and the broad credit risk segments that are analyzed in this paper. As of the third quarter 2003, single family mortgage debt in the United States totaled roughly \$6.6 trillion, of which roughly 94 percent was conventional — i.e., not insured by either FHA or VA.<sup>13</sup> Some of these mortgages were second liens, meaning that

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<sup>12</sup>Calem and Follain (2005) argue that revenue gains to adopters would be less than the revenue lost by nonadopters because nonadopters lose market share and the price they earn on their lower market share declines.

<sup>13</sup>Our estimates for the mortgage market combine several primary data sources over the period 2001-2003. Loan quantities were gauged using 2003:Q3 sources. See footnotes for figure 2.1 below.



they are most likely home improvement or home equity loans. Excluding these loans, the first-lien, conventional mortgage market was about \$5.3 trillion.

In the marketplace, there is no generally-accepted definition of prime and subprime mortgages. Rather, prime and subprime designations are usually made by a mortgage institution (often an originator or a servicer) with an intent to sell the mortgage into the secondary market, and these designations often are based on a combination of the borrower's creditworthiness and the collateral value of the home being financed. In particular, a borrower's creditworthiness is frequently measured by his or her credit score and the degree of collateralization is measured by the LTV ratio of the mortgage. However, other measures of creditworthiness, such as a household's debt ratio, might also be used.<sup>14</sup> "Prime" borrowers are seen as less likely to default than "subprime" borrowers, with the default risks associated with "near-prime" borrowers or "alt-A subprime" borrowers being somewhere between prime and subprime borrowers.<sup>15</sup>

Given the lack of generally accepted definitions for "prime" and "subprime," we propose a straightforward split of the mortgage market that is consistent with industry practice and is tractable for understanding how the Basel II capital requirements might influence mortgage pricing.<sup>16</sup> Specifically, our mortgage market segments are based solely on credit scores and LTV ratios. Therefore, many of the nuances of the marketplace, where originators and securitizers have more detail about each household's financial history and debt obligations, are not taken into account.

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<sup>14</sup>See Raiter and Parisi (2004) for the Standard & Poors description of these classifications.

<sup>15</sup>The strong correlation between measures of borrower creditworthiness and collateral, and default and loss rates has been established by many studies, including Avery, Bostic, Calem, and Canner (2000) and Cotterman (2004).

<sup>16</sup>For a description of subprime lending, see Canner, Laderman, and Passmore (1999), NEC (2004), and Pennington-Cross, Yezer, and Nichols (2000). Our definitions draw a clear distinction between "near-prime" and subprime, whereas industry practice is to commingle these two groups. Indeed, some so-called "subprime" mortgage pools have high credit scores, low LTVs, and no straightforward reason for their subprime designation. Part of the difficulty in defining these markets is the wide variety of different mortgage types. In particular, the "near-prime" market encompasses a variety of sub-markets that reflect the many different ways that underwriting can deviate from conforming loan standards, including loans that are low risk but have less documentation, that are low-risk but are unusual ARM contracts, that are extended to borrowers with slightly higher than typical debt ratios, that are collateralized by condo, co-op, or investor properties, or that are extended to borrowers who have recently missed a small number of non-mortgage loan payments. The credit scores and LTV ratios may or may not capture some of this variation, making our reliance on such scores and LTV ratios for defining this market only a rough approximation.

We divide the first-lien, conventional mortgage market into three broad credit risk segments: (1) prime mortgages, (2) near-prime mortgages, and (3) subprime mortgages. We define “prime” mortgages as those extended to borrowers with a credit score greater than or equal to 660 and a LTV ratio of 80 percent or less. “Near-prime” mortgages are defined as those extended to borrowers with a credit score greater than or equal to 580 but less than 660 and a LTV ratio less than or equal to 90 percent, or to borrowers with an LTV ratio greater than 80 percent and less than or equal to 90 percent and a credit score above 660.<sup>17</sup> “Subprime” mortgages are defined as those extended to borrowers with a credit score less than or equal to 580 or an LTV ratio greater than 90 percent.<sup>18,19</sup> These definitions are summarized in table 2.1. As we discussed, individual financial institutions almost certainly classify mortgages into more than these three broad categories. However, even this coarse taxonomy required estimating the number of mortgages in each of nine separate credit score/LTV ranges. Individual financial institutions have complete data on the mortgages in their portfolio. Available data on all mortgages in the U.S., by contrast, cannot reasonably support finer categories without serious loss of precision.

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<sup>17</sup>In the Expanded Guidance for Subprime Lending Programs that is dated January 31, 2001, bank supervisors indicated that non-prime borrowers display a range of credit characteristics that include: (1) two or more 30-day delinquencies in the last 12 months, or one or more 60-day delinquencies in the last 24 months, (2) judgement, foreclosure, repossession, or charge-off in the prior 24 months, (3) bankruptcy in the last 5 years, (4) a relatively high default probability as evidenced by a credit bureau score (FICO) of 660 or below (depending on the collateral), and (5) a debt service-to-income ratio of 50% or greater, or otherwise limited ability to cover family living expenses after deducting total monthly debt-service requirements from monthly income (Federal Reserve Board, Banking Supervision and Regulation SR Letter 01-4). This supervisory guidance applies specifically to institutions that have subprime lending programs with an aggregate credit exposure greater than or equal to 25 percent of their tier 1 capital, to institutions that have experienced rapid growth or adverse performance trends, and to institutions that have inadequate or weak controls.

<sup>18</sup>In all cases, the LTV ratio here refers to the LTV ratio calculated by the lender after accounting for risk mitigation efforts, such as private mortgage insurance.

<sup>19</sup>In the Interagency Guidance on High LTV Residential Real Estate Lending that is dated October 8, 1999, bank supervisors stated that “first-lien mortgages or home equity loans on owner-occupied, 1- to 4- family residential property loans whose LTV ratios equal or exceed 90 percent should have appropriate credit support, such as mortgage insurance, readily marketable collateral, or other acceptable collateral” (Federal Reserve Board, Banking Supervision and Regulation SR Letter 99-26). If these loans do not have appropriate credit support, then they should be identified in the institution’s records, their total amount should not exceed 100 percent of the institution’s total risk-based capital, and the permanent credit file should set forth the relevant credit factors (e.g., credit score or debt-to-income ratio) that justified the underwriting decision.

**TABLE 2.1: SUMMARY OF CONVENTIONAL MORTGAGE MARKET SEGMENT DEFINITIONS**

|                    |               | LOAN-TO-VALUE (LTV) RANGE |               |              |
|--------------------|---------------|---------------------------|---------------|--------------|
|                    |               | < 80 percent              | 80-90 percent | > 90 percent |
| CREDIT SCORE RANGE | 660 or higher | Prime                     | Near-Prime    | Subprime     |
|                    | 581 to 659    | Near-Prime                | Near-Prime    | Subprime     |
|                    | 580 or lower  | Subprime                  | Subprime      | Subprime     |

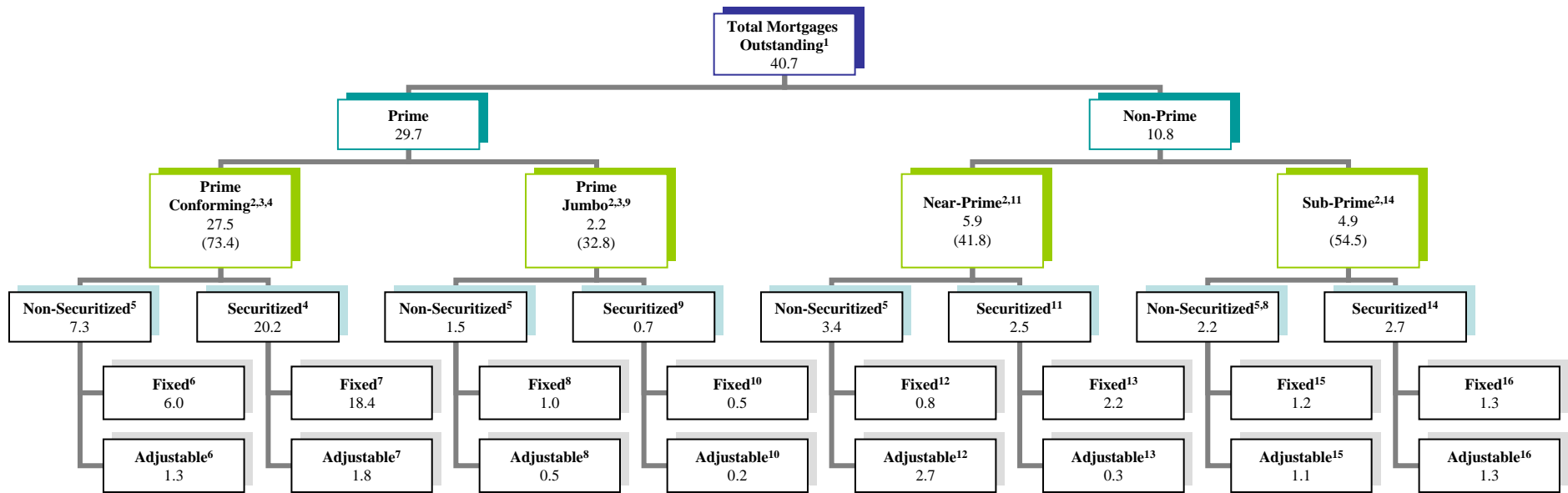
As shown in the top box of figure 2.1 below, we estimate that there were roughly 40.7 million single-family, first-lien, conventional mortgages outstanding in the United States at the end of the third quarter of 2003.<sup>20</sup> Using a national sample of credit scores provided by one of the three national credit reporting agencies, LTV ratios from LoanPerformance Corp., and imputed credit scores derived from the Survey of Consumer Finances,<sup>21</sup> we estimate the amount of mortgages held in the credit score-LTV ranges for prime, near-prime, and subprime mortgages.<sup>22</sup> Our analysis suggests that 29.7 million mortgages are prime, 5.9 million are near-prime, and 4.9 million are subprime, which represents 73 percent, 15 percent, and 12 percent of outstanding mortgages, respectively.

<sup>20</sup>We take the aggregate mortgage debt for these types of mortgages (from the Federal Reserve’s Flow of Funds accounts) and divide it by the average loan amount (using LoanPerformance Corporation data).

<sup>21</sup>The method used to impute credit scores from Survey on Consumer Finances data is described in Barakova, Bostic, Calem, and Wachter (2003).

<sup>22</sup> For this analysis, we adjusted the proprietary credit risk scores assigned to individuals in the national sample of credit scores to match the distribution of FICO credit history scores for which information is publicly available (see Avery, Calem, and Canner, 2004). The Survey of Consumer Finances is used to derive the proportion of mortgage holders in each credit score-LTV category. These proportions are then adjusted to match the national distribution of credit scores and the national distribution of LTVs using a least-squares algorithm. We assume that the shares of the population in LTV cells with credit scores of less than 580 are equal because there are so few households in the SCF (and thus in the mortgage-holding population) that have such low scores.

**Figure 2.1**  
**Description of US First-Lien Conventional Mortgage Market as of 2003:Q3**  
**Millions of Loans**  
**(Percent of Loan Amount Securitized)**



\* Components may not sum to totals because of rounding.

## FOOTNOTES

### FIGURE 2.1: DESCRIPTION OF U.S. FIRST-LIEN CONVENTIONAL MORTGAGE MARKET AS OF 2003:Q3

1. The total number of mortgages outstanding is calculated by dividing the level of first-lien conventional mortgage debt from the 2003:Q3 Flow of Funds Accounts by the average loan size from the September 2003 LoanPerformance (LP) prime and subprime data. First-lien conventional mortgage debt is household home mortgages (Table L.218, line 2) minus FHA/VA loans (U.S. Department of Housing and Urban Development and Veteran's Administration) minus 2<sup>nd</sup> Liens (Table L.218, line 24).
2. Prime, near-prime, and subprime splits are calculated using the 2001 SCF, 2001 Residential Finance Survey (RFS), FICO distributions from 2003 Credit Bureau data, and LTV distributions from the September 2003 LP prime and subprime data.
3. The split between the number of prime conforming and prime jumbo is the percentage of conforming and jumbo loans with prime characteristics from the 2001 RFS (92.5% conforming and 7.5% jumbo) applied to the calculated number of prime loans.
4. The percent of securitized prime conforming loans is a 3-year average (2001–2003) securitization rate for Fannie/Freddie from the 2004 Mortgage Market Statistical Annual. This securitization rate is percent of loan value.
5. The number of non-securitized loans is the total number of loans minus the securitized loans.
6. From the 2001 RFS, 88.6% of non-jumbo loans that have prime characteristics are fixed-rate and 11.4% are ARMs. Thus, the number of non-securitized prime fixed-rate conforming loans is the total number of prime fixed-rate conforming loans ( $0.886 \cdot 27.5 = 24.4$ ) minus the number of securitized prime fixed-rate conforming loans (18.4). The number of non-securitized prime ARM conforming loans is the total number prime ARM conforming loans ( $0.114 \cdot 27.5 = 3.1$ ) minus the number of securitized prime ARM conforming loans (1.8).
7. Fannie Mae reports in its 2003 annual report that 9% of its mortgages are ARMs and 91% are fixed-rate. These percentages are applied to the total number of securitized conforming prime loans.
8. From the 2001 RFS, 70.0% of jumbo loans that have prime characteristics are fixed and 30.0% are ARMs. Thus, the number of non-securitized prime fixed-rate jumbo loans is the total number of prime fixed-rate jumbo loans ( $0.7 \cdot 2.2 = 1.5$ ) minus the number of securitized prime fixed-rate jumbo loans (0.5). The number of non-securitized prime ARM jumbo loans is the total number of ARM jumbo loans ( $0.3 \cdot 2.2 = 0.7$ ) minus the number of securitized prime ARM jumbo loans (0.2).
9. The percent of securitized prime jumbo loans is a 3-year average (2001–2003) securitization rate for jumbo loans from the 2004 Mortgage Market Statistical Annual.
10. From the January 2004 LP Securities Coverage Report, 76.2% of securitized jumbo loans are fixed and 23.8% are ARMs. These percentages are applied to the total number of securitized jumbo loans.
11. The percent of securitized near-prime loans is calculated by dividing annual A- issuance volume from Inside MBS/ABS by A- origination volume from the LP subprime database and taking a 3-year average (2001–2003) of the securitization rate. The LP origination volume is blown up to reflect the entire market; the fraction of A- loans in the LP subprime database is then applied to the entire market to estimate the near-prime loan origination volume.
12. From the September 2003 LP subprime database, 50.0% of near-prime loans are fixed and 50.0% are ARMs. Thus, the number of non-securitized near-prime fixed-rate loans is the total number of near-prime fixed-rate loans ( $0.5 \cdot 5.9 = 3.0$ ) minus the number of securitized near-prime fixed-rate loans (2.2). The number of non-securitized near-prime ARM loans is the total number of near-prime ARM loans ( $0.5 \cdot 5.9 = 3.0$ ) minus the number of securitized near-prime ARM loans (0.3).
13. From the January 2004 LP Securities Coverage Report, 89.6% of near-prime loans are fixed and 10.4% are ARMs. These percentages are applied to the total number of securitized near-prime loans.
14. The percent of securitized subprime loans is calculated by dividing annual issuance volume from the 2004 Mortgage Market Statistical Annual by subprime origination volume from the LP subprime database and taking a 3-year average (2001–2003) of the securitization rate. The LP origination volume is blown up to reflect the entire market.
15. From the September 2003 LP subprime database, 51.1% of subprime loans are fixed and 48.9% are ARMs. Thus, the total number of non-securitized subprime fixed-rate loans is the total number of subprime fixed-rate loans ( $0.511 \cdot 4.9 = 2.5$ ) minus the number of securitized subprime fixed-rate loans (1.3). The number of non-securitized subprime ARM loans is the total number of subprime ARM loans ( $0.489 \cdot 4.9 = 2.4$ ) minus the number of securitized subprime ARM loans (1.3).
16. From the January 2004 LP Securities Coverage Report, 50.0% of subprime loans are fixed and 50.0% are ARMs. These percentages are applied to the total number of securitized subprime loans.

## 2.1 THE PRIME MORTGAGE MARKET SEGMENT

### 2.1.1 PRIME CONFORMING MORTGAGES

Conforming mortgages are those that can, by statute, be purchased by the GSEs. In the United States, the conforming mortgage market is dominated by the GSEs.<sup>23</sup> Generally, conforming mortgages are those with LTV ratios of 80 percent or less (or mortgages with equivalent credit risks to a mortgage with an 80 percent LTV) and principal balances below the conforming loan limit (the limit was set at \$322,700 for single-family homes in 2003). By extending their guarantee, the GSEs bear the credit risk on about 60 percent of all mortgages in the United States and purchase between half and three-quarters of all mortgages originated in the United States.<sup>24</sup>

We estimate that roughly 27.5 million of the 40.7 million mortgages in the United States are prime conforming mortgages (figure 2.1). Of these mortgages, about 73.4 percent have been securitized by the GSEs during 2001-2003, i.e., purchased, guaranteed, and converted to pools by GSEs.<sup>25</sup>

The GSEs purchase most of their mortgages from large mortgage originators, many of whom are large depository institutions that are likely to adopt Basel II. Fannie Mae depends heavily on companies like Countrywide Financial, CitiMortgage, Bank of America, and Washington Mutual. Freddie Mac relies on Wells Fargo, Chase Home Finance, ABN AMRO, and National City.<sup>26</sup> As of mid-year 2004, Fannie Mae's top ten mortgage originators accounted for about 60 percent of its mortgage purchases, whereas Freddie Mac's top ten originators

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<sup>23</sup>Congressional Budget Office (2001), Hermalin and Jaffee (1996), and Goodman and Passmore (1992). When we refer to GSEs, we include Fannie Mae and Freddie Mac, but exclude the Federal Home Loan Bank System. We also exclude mortgages insured by the Federal Housing Administration (FHA) from our discussion.

<sup>24</sup>See Table 1.54 in the *Federal Reserve Bulletin* and Mortgage Market Abstract. Since the GSEs purchase loans with the equivalent of an 80 percent LTV ratio or better, the homeowner actually bears the bulk of the credit risk associated with his or her mortgage. Stocks differ from flows purchased because of refinancings, prepayments, and other forms of mortgage terminations (e.g., defaults).

<sup>25</sup>This is the average GSE securitization rate of non-jumbo, non-subprime conventional mortgages over the years 2001 to 2003, inclusive (*Inside Mortgage Finance*, 2004).

<sup>26</sup>The large originators for mortgages for the GSEs are often also the largest mortgage servicers of mortgages generally, suggesting that these institutions are well-positioned to hold mortgages or sell them to non-GSE purchasers.

accounted for about 80 percent of its purchases.<sup>27</sup> The GSEs often have strategic alliances or master contracts with originators who provide large numbers of mortgages to them. These alliances allow the largest mortgage originators to receive a GSE guarantee for covering the credit risk of their mortgages for a smaller fee than is paid by smaller mortgage originators.

Another GSE, the Federal Home Loan Bank (FHLB) System, also plays a large role in the mortgage market. Traditionally, FHLBs provide thrifts and banks with loans (called advances) that are collateralized by mortgages, providing a lower overall cost of funds for a depository institution's loans and investments.

During the past few years, the FHLBs have begun directly purchasing mortgages through their "Mortgage Finance Partnership" program and their "Mortgage Purchase Program." As of the end of June 2004, the FHLBs held about \$115 billion in mortgages directly. Almost all of these mortgages have the characteristics of prime mortgages, with a weighted-average credit score above 730 and a weighted-average loan-to-value ratio at origination of around 68 percent.<sup>28</sup>

The bulk of the mortgages sold to the FHLBs are sold by "community financial institutions" with assets less than \$600 million. Almost 800 community banks, thrifts, and others participate in the program, suggesting that it is a viable outlet for smaller institutions.<sup>29</sup> Similar to Fannie Mae's and Freddie Mac's mortgage securitization program, the FHLBs' mortgage programs appear to give many institutions, including many smaller depositories, a viable method of effectively lessening, or perhaps even removing, the influence of regulatory capital requirements on the pricing of mortgage loan credit risks.

### **2.1.2 PRIME JUMBO MORTGAGES**

Mortgages with principal amounts above the conforming loan limit and with an LTV ratio less than 80 percent are "prime jumbo mortgages." These mortgages, which are too large to be purchased by the GSEs, make up approximately 7.5 percent of prime mortgages outstanding. About one-third of prime jumbo mortgages are securitized. And about one-third of prime jumbo mortgages are ARMs; the remaining two-thirds carry a fixed rate.

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<sup>27</sup>*Inside the GSEs*, August 11, 2004.

<sup>28</sup>Federal Home Loan Banks Quarterly Financial Report, June 30, 2004.

<sup>29</sup>Statistics are from "Mortgage Partnership Finance" press release, August 10, 2004.

By statute, GSEs cannot purchase prime jumbo mortgages. Instead, securitization is undertaken by a variety of purely private securitizers, who lack the implicit government backing of the GSEs.<sup>30</sup>

Purely private securitizations of prime jumbo mortgages use a variety of methods to mitigate credit risk for the holders of the securities. One common method is a senior/subordinate structure, where the cash flows from the underlying mortgages are split into separate securities or tranches. These securities are usually ordered by their relative riskiness, with the highest-rated tranche bearing little, if any, of the underlying credit risk associated with the underlying mortgage pool. At the other extreme, an unrated tranche usually takes the first loss incurred by the mortgage pool up to a certain limit. This first-loss position is either retained by the originator or sold privately to unregulated purchasers such as hedge funds or private partnerships. Between the almost-riskless and riskiest securities can lie many other securities, each with their own provisions for absorbing losses on the mortgage pool and hence with their own risk rating.

Both depository and non-depository institutions play a major role in non-GSE securitizations. Among the top securitizers of jumbo mortgages are non-depositories such as Countrywide Financial, Bear Stearns, and Lehman Brothers. But Bank of America, Wells Fargo, and Washington Mutual are depositories that play a major role in this market.<sup>31</sup> Traditionally, most jumbo loans that have been securitized have been fixed-rate mortgages. However, the increasing popularity of hybrid ARMs (i.e., loans with interest rates that are fixed for a set period and then become ARMs) has led to an increase in ARM securitizations among jumbo mortgages.

## **2.2 THE NON-PRIME MARKET SEGMENTS**

We estimate that there were 5.9 million near-prime and 4.9 million subprime mortgages at the end of the third quarter of 2003, roughly 15 percent and 12 percent of the total number of mortgages, respectively (figure 2.1). Both of these mortgage market segments are about equally divided between fixed- and adjustable-rate mortgages.

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<sup>30</sup>The GSEs' scale of operations and their implied guarantee from the government limits competition in the conforming securitization market. In contrast, there are many different jumbo securitizers. For example, "Charlie Mac," a unit of the U.S. Central Credit Union, securitizes jumbo mortgages for credit unions. A detailed overview of this market is provided in Bruskin, Sanders, and Sykes (2001).

<sup>31</sup>Based on rankings of non-agency MBS issuers provided in *Inside MBS and ABS*.



Secondary markets play a large role in the near-prime and subprime mortgage market segments. While it is difficult to get a distribution that aligns precisely with our definitions of these market segments, it appears that many mortgages in each segment are securitized, and that this share has been growing over time.<sup>32</sup> Many of the originators and issuers of near-prime mortgages, such as Countrywide Financial and Wells Fargo, are the same as those found in the jumbo secondary markets. Some of these institutions are also found in the subprime market. There are also some speciality lenders that play major roles only in the subprime market, although some of these lenders have stepped up their involvement in the near-prime market recently.<sup>33</sup>

One striking aspect of the near-prime and subprime markets is the large, and growing, involvement of the GSEs. Near-prime and subprime MBS issuers structure their securities so that some tranches can be purchased, often *in toto*, by the GSEs.<sup>34</sup> Indeed, selling mortgage-backed securities backed by subprime mortgages to the GSEs has become a key part of the strategies of subprime mortgage originators. The non-prime mortgages backing these tranches are all below the conforming loan limit and have very high credit ratings associated with them. In the first half of 2004, the GSEs purchased over a quarter of the issuance of near-prime MBS and about half the issuance of subprime MBS.<sup>35</sup>

### **3. CAPITAL CONCEPTS: ECONOMIC CAPITAL ALLOCATIONS, RISK-BASED CAPITAL STANDARDS, AND PRUDENT ECONOMIC CAPITAL**

In this section, we consider three capital concepts and the interactions among them. We do so because some observers postulate that differences in regulatory capital will translate into

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<sup>32</sup>We derive this value by comparing our estimated dollar volumes with the issuance figures reported by *Inside MBS & ABS*. This approach has two drawbacks: First, we are comparing our estimate of the stock of these mortgages with an estimate of the stock of securities issued based on the *Inside MBS & ABS* issuance numbers; second, the definitions of near-prime and subprime mortgages we use are related, but not identical, to those used by the issuers.

<sup>33</sup>Some of the lenders are directly or indirectly owned by bank holding companies.

<sup>34</sup>At the end of 2003, the GSEs held about \$155 billion in non-agency MBS, or about 22 percent of the roughly \$700 billion outstanding non-agency MBS. In August 2004, Fannie Mae issued one of the largest mortgage-backed securities, \$11.7 billion, backed by subprime MBS classes.

<sup>35</sup>*Inside MBS & ABS*, June 25, 2004. Again, note that these definitions of near-prime and subprime do not exactly match our definitions.

cost advantages for adopters of Basel II. Clearly, regulatory differences can potentially bestow competitive advantages or disadvantages among market participants. However, the effects of such distortions must be judged case-by-case. With respect to the mortgage industry, as we will argue in sections 4 and 5, market developments and innovations by depository institutions that occurred during the 1980s and 1990s, partly in response to Basel I capital regulations, may have significantly diminished the role of depository capital requirements in determining mortgage rates.

The three capital concepts considered are (1) *economic capital allocations* that the largest depositories use for their decision making purposes (i.e., to price, extend, sell, or securitize mortgage credits); (2) the *risk-based (regulatory) capital standards* that apply to mortgage-backed assets under the current Basel I-based regime and under the proposed Basel II framework; and (3) *market-determined capital* needs that satisfy counterparties and rating agencies (i.e., an amount of capital that includes a cushion above model-determined economic capital to reflect modeling uncertainty and expected losses).

### **3.1 ECONOMIC CAPITAL ALLOCATIONS**

Large depositories typically have internal economic capital allocation systems that embody either an implicit or explicit estimate of the *probability density function* (PDF) of credit losses for their credit portfolio or for sub-portfolios. Although the precise definitions of credit loss tend to vary across depositories depending on the type of model they use for credit risk measurement, risky portfolios are those with a PDF that has a relatively long, fat tail (i.e., where there is a relatively high likelihood that losses will be substantially higher than mean, or expected, losses).

For purposes of internal decision making and internal capital allocation, depositories generally collapse the estimated PDF into a single measure, termed the “economic” capital allocation for credit risk (Jones and Mingo, 1999). In principle, the economic capital allocation is determined so that the probability of *unexpected* credit losses exhausting economic capital is less than some targeted level (e.g., the level of economic capital may be set to achieve a particular estimated probability that unexpected credit losses will exceed it). The target insolvency rate is typically chosen to be consistent with the depository’s desired credit rating for

its liabilities: if this desired rating is AA, the target insolvency rate might be set at the *historical default rate* for AA-rated corporate bonds, which is about 0.03 percent.

### 3.2 REGULATORY CAPITAL REQUIREMENTS

Risk-based regulatory capital standards provide a set of rules for calculating risk-weighted assets and define regulatory capital measures (i.e., total capital, tier 1 capital, and tier 2 capital).<sup>36,37</sup> Risk-based capital ratios are calculated by dividing a depository's qualifying capital (the numerator of the ratio) by its risk-weighted assets (the denominator). Generally, a depository institution is expected to operate with a total risk-based capital ratio in excess of the minimum regulatory 8 percent and minimum regulatory tier 1 capital ratio of 4 percent.<sup>38</sup> The current (Basel I-based) and proposed (Basel II) capital standards differ from each other

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<sup>36</sup>Under the current regime, a depository's "total" capital consists of two components called "tier 1" and "tier 2" capital. Tier 1 capital is primarily common equity and qualifying non-cumulative perpetual preferred stock (including related surplus). It also includes the minority interest in the equity accounts of consolidated subsidiaries less some deductions and for bank holding companies, it includes cumulative perpetual preferred and trust preferred stock. Tier 2 capital consists mainly of a limited amount of the allowance for loan and lease losses, and an assortment of other hybrid capital instruments, including limited amounts of term subordinated debt. Tier 2 capital also includes perpetual preferred stock that does not qualify for tier 1 capital, certain other hybrid capital instruments, including mandatory convertible securities, long-term preferred stock with a maturity of 20 years or more, intermediate-term preferred stock (including related surplus), and unrealized holding gains on qualifying equity securities. The maximum amount of tier 2 capital that may be included in a depository institution's qualifying total capital is limited to 100 percent of tier 1 capital (net of goodwill, other intangible assets, and interest only strips receivables and nonfinancial equity investments that are required to be deducted).

<sup>37</sup>Under the proposed Basel II framework, general provisions (general loan loss reserves held for expected losses) would no longer be included in tier 2 capital. Depository institutions under Basel II would be required first to deduct *expected* losses from eligible provisions: if total expected loss exceeded total eligible provisions, a deduction would be made from total regulatory capital with 50 percent coming from tier 1 capital and 50 percent coming from tier 2 capital; otherwise, the depository institution could add the difference to tier 2 capital. Thus, capital charges on *expected* losses will be implemented through adjustments to the regulatory capital measures (i.e., the numerator of the capital ratios) in the Basel II framework.

<sup>38</sup>The Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 established the system of prompt corrective actions (PCA) to be taken toward troubled *insured depository institutions (other than credit unions)*, referred to hereafter as DIs. Risk-based capital ratios are used as a basis for categorizing DIs for purposes of prompt corrective action. For example, "well-capitalized DIs" are those with a tier 1 risk-based ratio greater than 6 percent, a total risk-based capital ratio greater than 10 percent, and a tier 1 leverage ratio greater than 5 percent. In contrast, "undercapitalized DIs" have a tier 1 risk-based capital ratio under 4 percent, a total risk-based capital ratio under 8 percent, or a tier 1 leverage ratio under 4 percent (3 percent for most DIs that have a composite supervisory rating equal to one). The PCA system imposes more penalties on undercapitalized DIs as their capital ratios decline, including restrictions on deposit interest rates, elimination of brokered deposits, restrictions on asset growth, restrictions on inter-affiliate transactions, and required approvals for acquisitions, branching, and new activities. Bank and thrift holding companies are *not* subject to the PCA system; bank holding companies, however, are subject to minimum consolidated capital guidelines.

substantially with respect to the framework that is used to calculate risk-weighted assets and somewhat with respect to what is included in the regulatory capital measures.

### **3.2.1 REGULATORY CAPITAL REQUIREMENTS FOR WHOLE LOANS**

Under the proposed Basel II framework, minimum regulatory capital requirements are designed to cover *unexpected losses*. In addition, depositories' *own* assessments of risk – contained in their economic capital allocation systems – are used as inputs to regulatory capital calculations. More specifically, a depository institution would have to estimate, in the case of residential mortgages, the probability of default (PD) for each mortgage pool, and the likely size of the loss that would be incurred in the event of default (i.e., the loss given default or LGD).<sup>39,40</sup> These inputs would be used in formulas provided by bank and thrift supervisors to determine the minimum required capital for a given portfolio exposure.<sup>41</sup> In addition, a capital charge would be required for *operational risks*.<sup>42</sup>

For whole loans, a depository institution would estimate the PD and LGD<sup>43</sup> for each of its internal rating categories, which are distinguished by the risk characteristics of the loans. For example, an institution's mortgage portfolio may be divided into several internal risk rating categories distinguished by borrower credit history (e.g., credit score) and the LTV ratios for the mortgages. These inputs, together with an assumed 0.15 asset correlation, would be used to

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<sup>39</sup>In addition, depositories must estimate their *exposure at default* (EAD); however, for closed-end loans such as mortgages, this is trivially just the outstanding principal value on the loan.

<sup>40</sup>Depository institutions may reflect the risk-reducing effects of guarantees and credit derivatives, in support of either an individual obligation or a pool of exposures, through an adjustment to either the PD or LGD estimate, subject to minimum requirements described in Basel Committee on Banking Supervision (2004, pp. 98-99).

<sup>41</sup>PD and LGD estimates would have to be based rigorously on empirical information, using procedures and controls that are validated by bank and thrift supervisors, and would have to accurately measure risk. The PD for residential mortgages is the greater of the one-year PD associated with the internal borrower grade to which the pool of mortgage exposures is assigned or 0.03 percent.

<sup>42</sup>The size of this capital charge would be established using the Advanced Measurement Approach (AMA) and would depend on the institution's own assessment of its operational risks, environment, and controls.

<sup>43</sup>LGD estimates must be calibrated to reflect a period of high default rates for residential mortgages. See Callem and Follain (2003) for illustrative calculations of PDs and LGDs for prime, conventional, first-lien, 30-year mortgages.

calculate the amount of regulatory capital required for each internal rating category.<sup>44</sup> However, because Basel II encourages depositories to assign internal ratings to mortgages, it is reasonable to presume that adopters of Basel II would be more likely to align their ratings to be consistent with industry practices that segment the mortgage market; these mortgage market segments arose independently of depository institution capital requirements and are likely to persist regardless of these capital requirements.

The proposed Basel II capital requirements for first-lien residential mortgages were calibrated using economic capital *estimates* that were derived using the Federal Reserve Board (FRB) credit risk model.<sup>45</sup> This model estimates PDs, LGDs, and economic capital for various credit score-LTV pairs using (1) a target insolvency rate consistent with historical default rates in the BBB+ to A- ratings range, and (2) expected loss estimates that are based on the PD estimates and recession-based LGDs.<sup>46</sup> Figure 3.1 (top panel) presents these economic capital estimates (as magenta diamonds) for mortgage pools corresponding to 184 different credit score-LTV pairs (measured on the vertical axis) against a credit quality index (shown on the horizontal axis) that equals one for the credit score-LTV pair with the lowest estimate for economic capital and nears zero for the credit score-LTV pair with the highest estimate for economic capital.<sup>47,48</sup>

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<sup>44</sup>The asset correlation parameter included in the derivation of the minimum capital requirement for each credit exposure accounts for the likelihood that, for some mortgages, if one mortgage defaults then all of the mortgages in the group are likely to default. The A-IRB methodology (as described in Basel Committee on Banking Supervision (2004, p.70)) attempts to account for this correlation but maintains the simplicity of using only one asset correlation parameter. See Calem and Follain (2003) for a discussion of the derivation of the asset correlation parameter. See also Kaskowitz, Kipkalov, Lundstedt, and Mingo (2002).

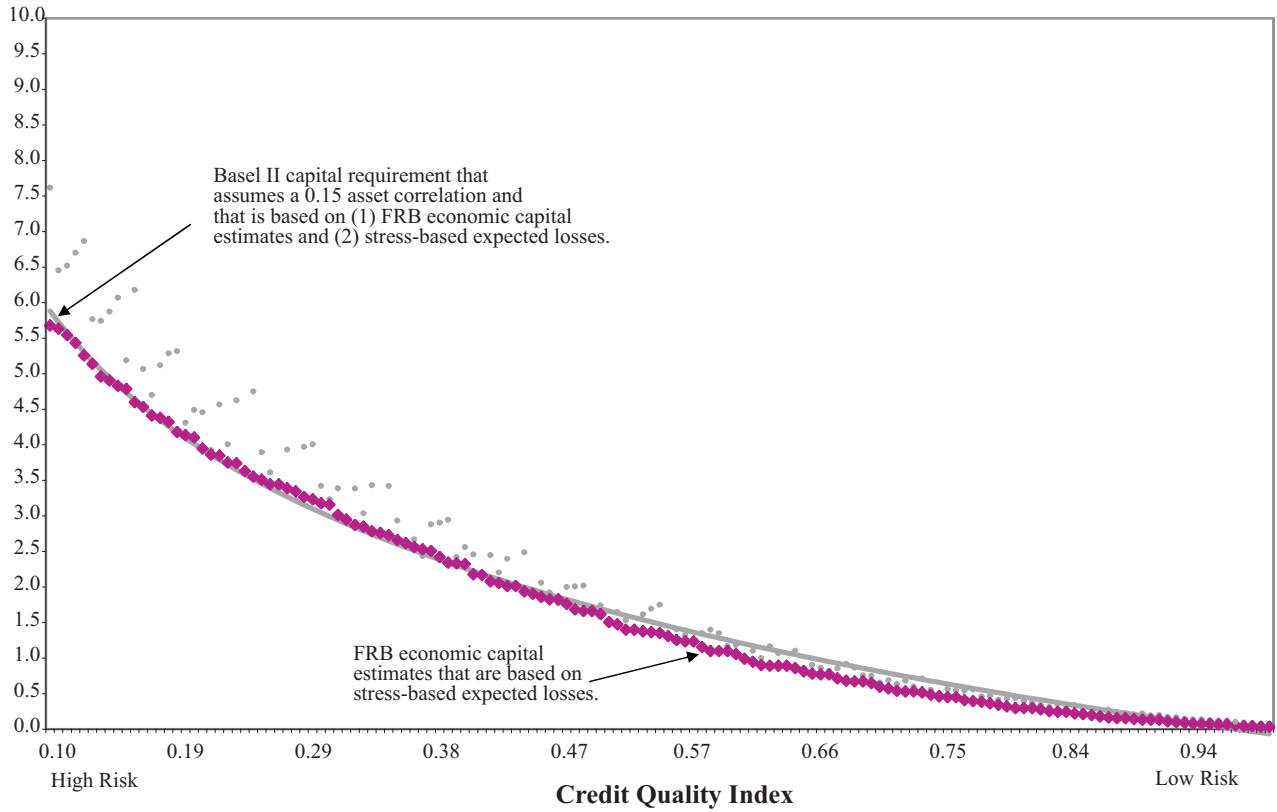
<sup>45</sup>Economic capital typically includes only equity. Under the proposed Basel II framework, subordinated debt and various hybrid capital instruments would continue to be included in the definition of total regulatory capital.

<sup>46</sup>The FRB credit risk model was calibrated to prime, fixed-rate mortgages and is described in Calem and Follain (2003). For each credit score-LTV pair, the model estimates cumulative discounted losses using paths for house prices (from the Office of Federal Housing Enterprise Oversight) and for interest rates (from Freddie Mac) over 10-year horizons with a random “start quarter” during the 1982:Q1 to 1991:Q4 period. Fifteen thousand such paths for these variables are used to construct a probability distribution for credit losses for each FICO-LTV pair. The 99.9 percentile of the loss rate from the resulting cumulative credit loss distribution, less the expected loss, is the estimate of economic capital.

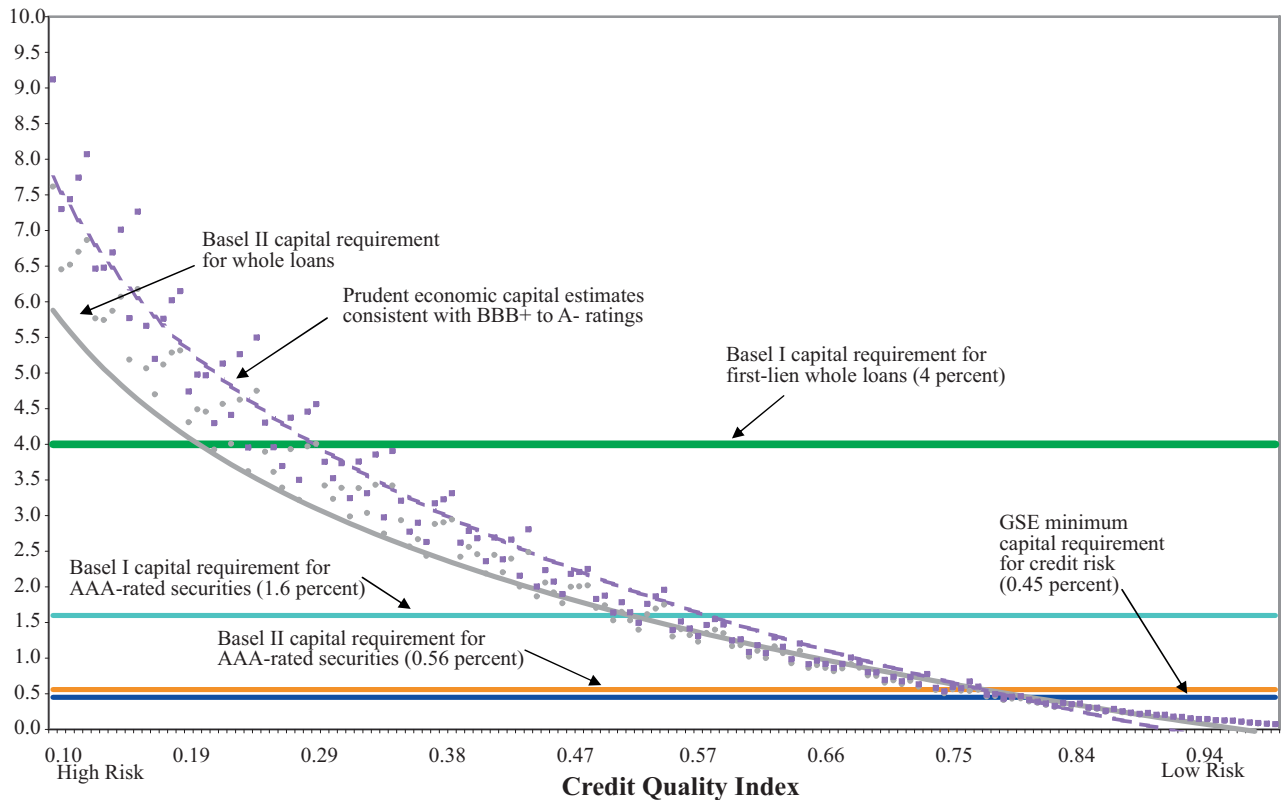
<sup>47</sup>In these calculations, the LTV ratios ranged from 60 to 105 in 5 unit increments and the credit scores ranged from 500 to 800 in 20 unit increments. We applied the FRB credit risk model to the non-prime mortgage market using the methods of Calem and Follain (2003) and described in more detail in Calem and LaCour-Little (2004). In essence, higher risk loans are modeled as defaulting in shorter horizons, resulting in larger losses because of less home equity accumulation. For examples of economic capital estimates for non-prime mortgages, see table 2

**FIGURE 3.1: ECONOMIC CAPITAL CONCEPTS**

**BASEL II REGULATORY CAPITAL REQUIREMENTS FOR WHOLE LOANS**



**COMPARISON OF REGULATORY CAPITAL REQUIREMENTS UNDER BASEL I AND BASEL II WITH GSE CAPITAL REQUIREMENT FOR CREDIT RISK, AND PRUDENT ECONOMIC CAPITAL**



Note: The credit quality index equals 1 for the lowest risk credit score-LTV pair and approaches 0 for the credit score-LTV pair with the highest risk using the FRB credit risk model's estimates of economic capital.

Using the formula provided by bank and thrift supervisors, the minimum required capital for each credit score-LTV pair is represented by a grey dot in figure 3.1.<sup>49</sup> By design, the outer boundary of the Basel II regulatory capital estimates, which is represented by the solid grey line in figure 3.1, is a fairly close *approximation* to the FRB credit risk model economic capital estimates (magenta diamonds), except for those credit score-LTV pairs corresponding to the lowest values of the credit quality index (i.e., the riskiest potential mortgage borrowers) where a higher capital charge is implied.

In the bottom panel of figure 3.1, the risk-sensitivity of the proposed Basel II capital requirements are compared to the risk-sensitivity of Basel I capital requirements.<sup>50</sup> Under Basel I, most mortgages that are fully secured by first liens on one- to four-family residential properties are backed by a minimum of “total risk-based” capital requirement equal to 4 percent on these assets, regardless of their credit quality, represented in the lower panel of figure 3.1 as the horizontal dark green line. Clearly, the proposed Basel II capital requirements (the grey line, repeated from the upper panel) are more credit risk-sensitive than the Basel I capital requirements, being higher for riskier loans and lower for safer loans.

Another important difference between the two capital standards is that Basel II tries to account for any credit risk mitigation measures a depository institution might employ. For mortgage holdings, such measures include private mortgage insurance and regional portfolio diversification.

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of Calem and Follain and tables 6 and 8 of Calem and LaCour-Little. The credit quality index is constructed using the fractional rankings of the economic capital estimates in descending order for the 184 credit score-LTV pairs.

<sup>48</sup>The Basel II framework also establishes a minimum PD that can be used in the supervisory formula (equal to 0.03%) so regulatory capital would also be higher than economic capital when the internal borrower grade is assigned a PD less than 0.03%.

<sup>49</sup>Because the credit quality index is constructed using the FRB credit risk model economic capital estimates, the Basel II regulatory capital estimates are not rank-ordered from highest to lowest as the credit quality index rises. In other words, the rank order between the Basel II regulatory capital estimates and the FRB credit risk model economic capital estimates is correlated, but not exact.

<sup>50</sup>Under Basel I, each asset and the credit equivalent amounts of off-balance-sheet exposures are generally assigned to one of four broad risk categories that are based on the perceived credit risk of the obligor or, if relevant, the guarantor, type of collateral, or external ratings, if applicable. These risk categories are assigned weights of 0 percent, 20 percent, 50 percent, and 100 percent and are thus associated with 0 percent, 1.6 percent, 4 percent, and 8 percent capital requirements.

### 3.2.2 REGULATORY CAPITAL REQUIREMENTS FOR MORTGAGE-BACKED SECURITIES (MBS)

Under the Basel I-based regime, MBS retained, assumed, or issued in connection with a securitization or structured finance program can qualify for a ratings-based approach under the current capital regime.<sup>51</sup> Risk-weights for each rating category are presented in the top panel of table 3.1. For example, if a depository held an MBS with a AAA or AA long-term external rating by one or more rating agencies, it would multiply the face amount of the position by a 20 percent risk weight. But an MBS with an A external rating by one or more agencies would be assigned a 50 percent risk weight. The MBS guaranteed by GSEs are assigned a 20 percent risk weight. Thus, there is a minimum “total risk-based” capital requirement of 1.6 percent on these assets, represented by the blue-green line in the lower panel of figure 3.1.

The risk-weights for external (or inferred) ratings under Basel II are presented in the bottom panel of table 3.1. These risk-weights depend on external (or inferred) ratings, the effective number of underlying exposures, and the seniority of the position. They are only used when the implied capital requirement is smaller than the capital requirement derived using the supervisory formula because, in the Basel II framework, the *maximum* regulatory capital requirement for a securitization exposure is set equal to the amount that would have been required if the exposure had not been securitized.<sup>52</sup>

Importantly, the risk weights for the ratings-based approach under the proposed Basel II framework have a wider range than do the risk weights for the ratings-based approach under Basel I. Therefore, there is greater risk-sensitivity to external long-term ratings under the proposed Basel II framework than under Basel I. For example, a AAA-rated long-term senior position has a risk weight as low as 7 percent under the proposed Basel II framework, but the same position would have a risk weight of 20 percent under Basel I. These two different risk weights correspond to 56 (orange line, lower panel figure 3.1) and 160 (blue-green line, lower panel figure 3.1) basis points of capital per dollar of MBS, respectively.

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<sup>51</sup>Securitization is defined as the pooling and repackaging by a special-purpose entity of assets or other credit exposures that can be sold to investors. A structured-finance program is one in which receivable interests and asset-backed securities issued by multiple participants are purchased by a special-purpose entity that repackages those exposures into securities that can be sold to investors.

<sup>52</sup>There are some exceptions to this rule. For example, credit-enhancing interest-only strips are more conservatively treated. See Basel Committee on Banking Supervision (2004).



**TABLE 3.1****BASEL I RISK-WEIGHTS FOR EXTERNALLY RATED LONG-TERM POSITIONS**

| RATING CATEGORY                            | RATING DESIGNATION<br>EXAMPLES | RISK WEIGHT<br>(in percent) |
|--|--------------------------------|-----------------------------|
| Highest or second-highest investment grade | AAA, AA                        | 20                          |
| Third highest investment grade             | A                              | 50                          |
| Lowest investment grade                    | BBB                            | 100                         |
| One category below investment grade        | BB                             | 200                         |

**BASEL II RISK-WEIGHTS FOR EXTERNAL RATING GRADES  
OR AVAILABLE INFERRED RATINGS FOR LONG-TERM POSITIONS**

| LONG-TERM CREDIT RATING AND/OR<br>INFERRED RATING DERIVED FROM A LONG-<br>TERM ASSESSMENT | RISK-WEIGHT FOR SENIOR<br>POSITIONS<br>(in percent) | BASE RISK WEIGHTS<br>(in percent) |
|---|---|-----------------------------------|
| (1)   | (2)   | (3)                               |
| AAA   | 7   | 12                                |
| AA  | 8   | 15                                |
| A+  | 10  | 18                                |
| A   | 12  | 20                                |
| A-  | 20  | 35                                |
| BBB+  | 35  |                                   |
| BBB   | 60  |                                   |
| BBB-  | 100   |                                   |
| BB+   | 250   |                                   |
| BB  | 425   |                                   |
| BB-   | 650   |                                   |
| Below BB- and unrated   | Deduction   |                                   |

Source: Basel Committee on Banking Supervision (2004, pp. 128-129). Deductions of investments will be 50 percent from tier 1 and 50 percent from tier 2 capital.

Basel II also tries to account for any credit risk mitigation measures a depository institution might employ.<sup>53</sup> For securitizations, such measures include guarantees,<sup>54</sup> credit derivatives, collateral,<sup>55</sup> and on-balance-sheet netting.

### 3.2.3 COMPARISON AND DISCUSSION

Under the Basel I framework, whole mortgages held in the depository institution's portfolio are subject to the same amount of regulatory capital regardless of the credit riskiness of the portfolio, but equivalent MBS can be backed by lower amounts of capital. Most estimates of the economic capital needed to support the credit risks of typical mortgages are well below the four percent regulatory capital required.<sup>56</sup> Consequently, the mismatch between economic capital measures and regulatory capital requirements have provided a strong incentive to trade mortgages for equivalent MBS, thereby pushing mortgages off the balance sheets of the originating depository institutions and into the secondary markets.<sup>57</sup>

In addition, the regulatory capital estimates for covering *unexpected* credit losses (shown in the top and bottom panels of figure 3.1 as the grey line) do not incorporate the fact that, in the Basel II framework, capital charges on *expected* losses will be implemented through adjustments to the regulatory capital measures (i.e., the numerator of the capital ratios). Therefore, if a comparison is to be made between Basel I and Basel II, a measure of expected loss needs to be added back to each economic capital estimate of Basel II to make it comparable to the Basel I capital requirement for first-lien mortgages (equal to 4 percent, as indicated by the horizontal dark green line in figure 3.1).

### 3.3 PRUDENT ECONOMIC CAPITAL ESTIMATES

Basel II regulatory capital estimates are unlikely to reflect the *total* amount of capital

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<sup>53</sup>If the risk mitigation measure is already reflected in the rating of the security, the Basel II framework would not give additional credit for the mitigation.

<sup>54</sup>If an institution other than the originator provides credit protection to a securitization exposure, it must calculate a capital requirement on the covered exposure as if it were an investor in that securitization.

<sup>55</sup>Collateral in this context refers to that used to hedge the credit risk of a securitization exposure, rather than that securing exposures underlying the securitization transaction.

<sup>56</sup>See, for example, Calem and LaCour-Little (2004), Calem and Follain (2003), and Kaskowitz, et al. (2004).

<sup>57</sup>There is a long literature on capital arbitrage as a motivation for securitization; see Ambrose, LaCour-Little, and Sanders (2004), DeMarzo (2004), Jones (2000), Mingo (2000), or Passmore (1994).

needed by a depository to bear the credit risk of mortgage pools. First, some depositories will choose a target insolvency rate that is consistent with better than an A- rating.<sup>58</sup> Second, investors are aware that the dependence across risk exposures may be driven by more than a single systematic risk factor.<sup>59</sup> Third, potential credit modeling errors would need to be covered by a capital charge in part because proprietary models will not be completely transparent to investors.

We proxy the total amount of capital needed by a depository to reflect these factors, which we refer to as “prudent economic” capital, as the sum of the FRB credit risk model estimate of economic capital and an estimate of expected loss (PD•LGD) that uses an LGD set equal to loss severity rates when credit losses are particularly high.<sup>60</sup> In figure 3.1 (bottom panel), these capital levels are represented by purple boxes. The corresponding dashed purple line, which is a trend line through these prudent economic capital estimates, lies everywhere above the Basel II capital requirements. Thus, these estimates are consistent with the view that Basel II regulatory capital estimates are *minimums* under which depositories should not pass without causing supervisory and investor concern, but may be insufficient to meet the needs for capital as seen by both management and the market place. To the degree that credit agency ratings, in effect, rely on prudent economic capital as the support for creating highly-rated MBS, that measure of capital, not the regulatory

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<sup>58</sup>FRB credit risk model economic capital estimates shown in figure 3.1 are derived using a target insolvency rate consistent with historical default rates in the BBB+ to A- range. Economic capital estimates based on an A rating, for example, would always be larger. If depositories hold capital consistent with a better than A- rating, then the competitive effects described below would be lower, since the capital buffer over the minimum regulatory capital would be larger.

<sup>59</sup>See Gordy (2003) for a discussion of the dependence of ratings-based capital rules on a single systematic risk factor.

<sup>60</sup>These “stress LGDs” were calculated using historical housing market data and the FRB credit risk model described in Calem and Follain (2003). A three-step procedure was used. In the first step, the fourth year after origination was selected to represent the average age when a mortgage loan goes into default (i.e., 180 day delinquency). Expected foreclosure and loss rates were calculated for such loans, with selected credit score-LTV characteristics, using historical paths for house prices and interest rates. The maximum value of the conditional LGD for origination quarters during the 1986-1993 period was defined as the “historical stress-period LGD.” In the second step, the FRB credit risk model was used to estimate LGD distributions for the 184 credit score-LTV pairs with LTV ratios ranging from 60 to 105 in 5 unit increments and credit scores ranging from 500 to 800 in 20 unit increments. In the third step, the historical stress period LGDs were mapped to percentiles of the estimated LGD distributions for the selected credit score-LTV pairs, and the remaining credit score-LTV pairs were assigned a percentile for historical stress using linear interpolation techniques. The resulting “stress LGDs” are about 1.5 times larger than expected LGDs. Annualized probabilities of default were used for each credit score-LTV pair.

standard, becomes the effective “market-based capital requirement” for mortgages that tend to be securitized.<sup>61</sup>

By using the credit loss distribution generated by the FRB credit risk model in our prudent economic capital estimate, we are essentially assuming that depository institution managers would use their own model-based estimates of credit losses<sup>62</sup> for their decision making, rather than use an economic capital estimate based on the Basel II capital formula. We include the stress-based expected loss in the prudent economic capital estimate for at least three reasons. First, to make the Basel II capital estimates comparable to Basel I capital estimates, some measure of expected loss needs to be added to the Basel II capital estimate. Second, it is reasonable that bond market investors and the rating agencies would want depositories to hold some capital to cover losses that are historically consistent with the severe losses observed during previous recessions. And third, by including the stress-based expected losses in prudent economic capital, depositories with riskier portfolios would have larger observed buffers over the proposed Basel II regulatory minimums than depositories with safer portfolios (i.e., the vertical distance between prudent economic capital (represented by the purple line) and the Basel II capital requirement (represented by the grey line) for whole loans is greatest for portfolios with the lowest credit quality index scores). In this manner, the prudent economic capital estimate includes a buffer over the Basel II capital requirement that is conservative and dependent on the credit quality of the mortgage portfolio. In effect, prudent economic capital is our approximation of what a prudent manager with an economic capital allocation system would hold given the predictability of potential credit losses over a business cycle.

### **3.4 A COMPARISON OF CAPITAL CONCEPTS**

Prudent economic capital estimates have often been inconsistent with regulatory capital requirements. For example, our prudent economic capital estimates, which include an expected

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<sup>61</sup>There is some evidence that the credit agencies engage in such behavior. As stated by Standard & Poor’s, “if a banking group were to reduce capital materially due to the anticipated change in the regulatory calculation of risk assets, without any change in the bank’s current economic risk profile, it would be subject to a ratings review that could lead to a downgrade.” However, we should note that rating agencies give explicit credit for future interest rate margins and other forms of credit enhancement that are not in the form of directly held capital. Thus, our prudent economic capital estimates do not incorporate all forms of market-determined capital support. See Standard & Poors’s (2004) and Simensen (2004).

<sup>62</sup>Such estimates are proxied using the actual economic capital estimates derived using the FRB credit risk model.

loss measure, are less than the Basel I regulatory requirement (of 4 percent shown by the dark green horizontal line in the bottom panel of figure 3.1) for about 70 percent of the credit score-LTV pairs considered, which are associated with over 90 percent of outstanding mortgages in the United States.<sup>63</sup> But, for the lowest quality mortgage pools, our estimates of prudent economic capital are greater than the Basel I regulatory minimum of 4 percent. In addition, the minimum GSE regulatory capital requirement for credit risk – 45 basis points (dark blue line, figure 3.1, bottom panel) – is *above* our prudent economic capital estimates for the *highest* credit quality mortgages (i.e., those with a credit quality index greater than about 0.8 – lower right corner of the bottom panel of figure 3.1).<sup>64,65</sup>

For some observers this would suggest that adopters would likely have to hold much less capital against most mortgages than nonadopters. Such a conclusion, however, would ignore developments in mortgage markets and innovations by depositories that occurred during the 1980s and 1990s. For example, the role of the GSEs (which are not subject to depository capital regulations) has become more dominant in recent years and there has been robust growth in purely private securitization markets. Moreover, depositories have become ever more sophisticated in structuring portfolios whereby capital held for regulatory requirements is consistent with the prudent economic capital needed to back such portfolios. We now turn to these topics in sections 4 and 5.

#### **4. MORTGAGE PRICING AND DEPOSITORY BEHAVIOR**

The institutional structure of U.S. mortgage markets suggests that most depository institutions will not actually realize a change in their capital costs for most mortgages even if they do adopt Basel II with its lower regulatory capital requirements. The mortgage market consists of large market segments where mortgage rates do not vary with respect to credit risks even though

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<sup>63</sup>To receive a 50 percent risk weight, first-lien mortgages must be made in accordance with prudent underwriting standards, not be past-due, and performing under their original terms.

<sup>64</sup>A GSE meets its minimum capital level if its core capital — common stock, perpetual non-cumulative preferred stock, paid in capital, and retained earnings — equals or exceeds minimum capital. Minimum capital is 2.5 percent of assets plus 0.45 percent of adjusted off-balance sheet obligations (OFHEO Report to Congress, 2004). Since the off-balance-sheet obligations are almost exclusively mortgage-backed securities, the 45 basis points is informally taken as the GSEs' minimum regulatory capital requirement for bearing the credit risk associated with a conforming mortgage.

<sup>65</sup>OFHEO can add a financial cushion above the minimum regulatory requirement to protect a GSE from unforeseen economic downturns, or internal risks that might threaten its well-being.

there may be measurable differences in credit risk within these segments (i.e., mortgage pricing within each market segment is characterized by uniform pricing).

In this section, we begin by providing a conceptual framework of how mortgage rates are determined in a given mortgage market segment. Then, we provide several reasons why uniform mortgage pricing probably prevails within broad market segments. This evidence establishes that our conceptual framework is relevant for analyzing potential competitive impacts of Basel II capital standards on mortgage rates and on mortgage securitization. The most obvious reason for uniform pricing is that capital charge differences among prime borrowers are too small to translate into price differences. We also provide some direct evidence from mortgage originators that quote interest rates to potential borrowers based on several characteristics, including their FICO score. Also, liquidity costs discourage MBS issuers from making too many distinctions among the borrowers in their pools. Finally, we use the Survey of Consumer Finances to test whether observed mortgage rates on first-lien, fixed-rate, 30-year mortgages originated during 1998-2001 were consistent with uniform pricing methods being used within each mortgage market segment. We find that the data are consistent with the prevalence of uniform pricing within mortgage market segments.

In this section, we also provide the reasoning behind our main conclusion: that regulatory capital standards are unlikely to significantly affect U.S. mortgage rates. This is because of regulatory capital arbitrage that prevails for two reasons: (1) the GSEs and other securitizers currently bear the credit risk on most U.S. mortgages and their required capital ratios for bearing that risk are generally lower than those that would apply to bank and thrift organizations; and (2) banks and thrifts can currently combine some low-risk and high-risk mortgages to meet Basel I-type capital standards and leverage requirements. Thus, the financial system as a whole *already* holds only a small amount of capital against the credit risk posed by conforming mortgages.

#### **4.1 A CONCEPTUAL FRAMEWORK**

To understand who bears mortgage credit risks, it is important to consider the roles of originators and securitizers in funding residential mortgages. Both GSEs and purely private securitizers typically purchase mortgages that are originated by others. Because they do not originate mortgages, securitizers must guard against originators selling them a relatively high proportion of higher-risk mortgages (i.e., originators sell “lemons” to the securitizer). In general,

this “first mover” advantage of originators, combined with the prevalence of uniform pricing in the mortgage markets, implies that mortgage securitizers will set tougher underwriting standards than mortgage originators, who can both extend and hold mortgage credit risk.<sup>66</sup>

Because the differences in credit risks are small within a market segment relative to the uncertainties in modeling and measuring credit risks, mortgage markets are characterized by *uniform pricing*, where the mortgage rate equates the marginal cost of bearing credit risk for the *marginal* borrower in each market segment to that borrower’s willingness to pay for the mortgage. Below we will use the 2001 Survey of Consumer Finances to show that uniform pricing is prevalent in mortgage markets. Other researchers have found similar results. Duca and Rosenthal (1994) argue that mortgage originators are frequently subject to fair lending standards, which discourage loan-specific pricing that would appear to price discriminate between borrowers, and conclude that “conventional lenders do not vary fixed-rate mortgage rates on the basis of observable differences in credit risk.” Gates, Perry, and Zorn (2002) argue that the high degree of uncertainty in identifying loans that will ultimately default has resulted in mortgage lenders pricing risk on average within broad segments. They also argue that uniform prices promote affordable housing goals, and demonstrate that usage of Freddie Mac’s Loan Prospector automated underwriting system, together with the business practice of setting fixed guarantee fees for all loans delivered under a contract, results in higher borrower approval rates, especially for underserved applicants.

Uniform pricing can lead to “cherry picking,” where a mortgage originator, who has the option to hold a mortgage in its portfolio, withholds safer mortgages from a mortgage pool. By keeping the safer mortgages, the originator avoids paying the guarantee fee to a mortgage securitizer or insurer, which is often an average fee for a pool of mortgages. In response, mortgage securitizers generally set tougher underwriting standards than mortgage originators. Heuson, Passmore and Sparks (2001) show that tougher standards can arise even when all market participants have full information about the credit risks associated with the mortgages. In addition, Passmore and Sparks (1996) show that adverse selection, where the originator has better information relative to the mortgage guarantor, can also lead to tighter underwriting standards. As noted by Cutts, Van Order, and Zorn (2001), the practice of average pricing and the resulting

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<sup>66</sup>For a detailed description of this framework, see Heuson, Passmore and Sparks (2001).

concern over adverse selection causes mortgage guarantors, such as Freddie Mac and Fannie Mae, to set a maximum risk level they are willing to take that is enforced through underwriting standards. In addition, Steinbach (1998) argues that mortgage pricing maintains an element of cross-subsidization (and thus average pricing) because collateral risk is more dominant than credit risk and collateral risk cannot be forecast with a high degree of precision.

Depository institutions, however, may not be able to exploit their “first mover” advantage or their knowledge of primary mortgage markets to the same extent as other originators because their capital requirements for mortgages, under Basel I, exceed the appropriate economic capital for the credit risk associated with some safe mortgages. As we describe below, depository institutions can effectively remove this constraint for their safest mortgages by blending both very safe and higher risk mortgages in their mortgage portfolios.<sup>67</sup>

#### 4.1.1 SUPPLY WITHIN A GIVEN MORTGAGE MARKET SEGMENT

A graphical representation of the industry supply curve for a given mortgage market segment is provided in the top panel of figure 4.1.<sup>68</sup> On the horizontal axis is the probability that mortgage will *not* default,  $q$ , in a given market segment, which ranges from 0 to 1. Mortgages with higher probabilities of not defaulting (i.e., those closer to 1 in the right corner of the top panel of the chart) have the lowest credit risks. The marginal cost of bearing mortgage credit risks declines as  $q$  increases, so the lowest rate that a lender is willing to accept falls as the probability of *not* defaulting on a loan rises.<sup>69</sup>

The dark green line (both solid and dashed) is the depository institution marginal cost curve for bearing credit risk within the given mortgage market segment that incorporates the

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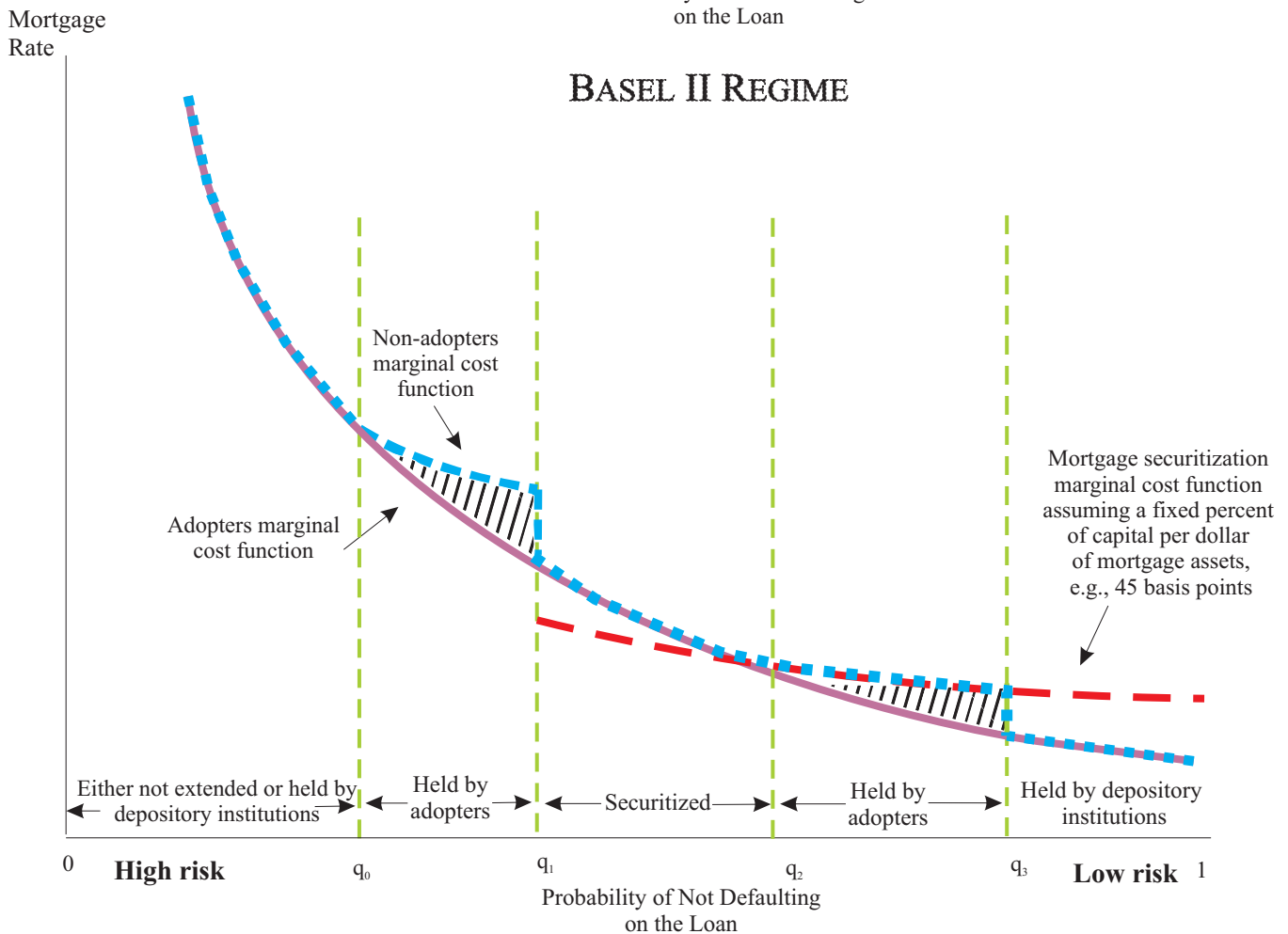
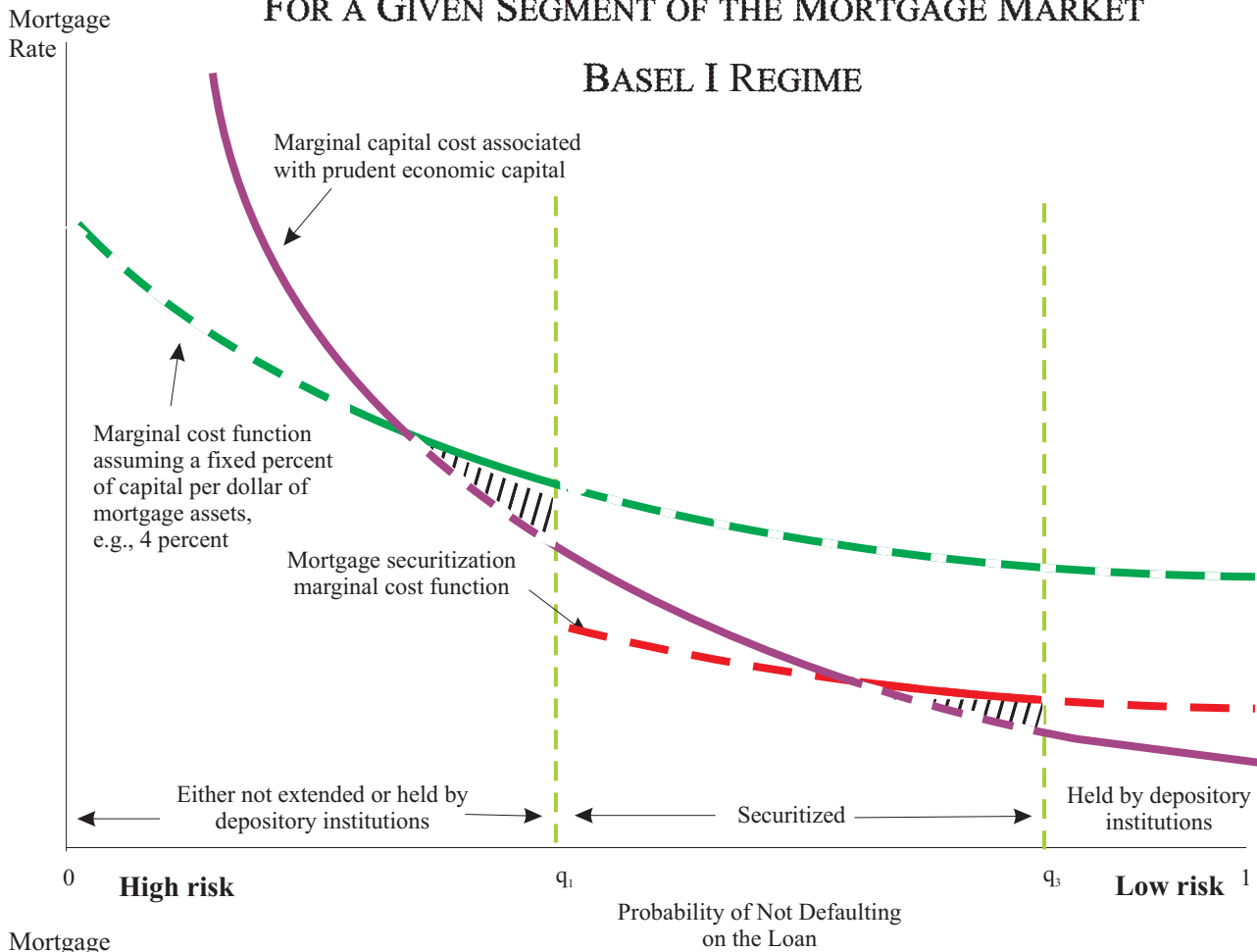
<sup>67</sup>Frame and White (2004b) also discuss how banks adjust to capital requirements by blending loans across the risk spectrum in their portfolios.

<sup>68</sup>This graph is taken from Heuson, Passmore, and Sparks (2001).

<sup>69</sup>Focusing on the portfolio decision in the absence of capital requirements, a risk-neutral mortgage originator will offer a mortgage if  $qr + (1-q)r_d \geq r_f$  where  $r$  is the mortgage rate received by the lender if the borrower does not default,  $r_d$  is the expected return to the lender if the borrower does default, and  $r_f$  is the expected return on an alternative investment. Rewriting this expression in terms of an equality and solving for  $r$ , it is easily demonstrated that the inverse supply function for mortgages is decreasing in  $q$  and  $r_d$ , but increasing in  $r_f$ . See Heuson, Passmore, and Sparks (2001, p. 340).



**FIGURE 4.1**  
**MORTGAGE FUNDING COST CURVES**  
**FOR A GIVEN SEGMENT OF THE MORTGAGE MARKET**



current “fixed” capital requirement.<sup>70</sup> This line flattens as credit risk falls ( $q$  rises) because the minimum “total risk-based capital” requirement, as well as the leverage requirement, are constant. As we will argue below, this marginal cost curve is not the one that effectively constrains the decisions made by depositories subject to Basel I-type capital standards.

The purple line (both solid and dashed) represents the marginal capital costs associated with holding prudent economic capital to back mortgages of different credit quality. This line is steeper than the dark green line because prudent economic capital, unlike Basel I capital standards and leverage requirements, varies with respect to mortgage credit quality. Because the dark green and purple lines are of different slopes and curvature, the distance between these lines is indicative of potential distortions associated with leverage ratios and the Basel I capital standards.

The securitizer is assumed to hold prudent economic capital needed to back the mortgage (represented by the purple line) when it is higher than its corresponding minimum capital requirement (represented by the red line).<sup>71</sup> The securitizer’s marginal cost curve, composed of the solid purple and red line segments (which fall between  $q_1$  and  $q_3$ ), is lower than the dark green line because securitizers sometimes have greater geographic diversification in their mortgage pools than banks and thrifts have in their mortgage pools, because the securitizers can be subject to lower capital requirements for mortgage credit risk, and because securitizers may have greater liquidity for their publicly-traded MBS. In particular, for market segments where the GSEs purchase mortgages, the marginal cost curve for the securitizer may be lower because they can issue securities in larger amounts and because investors perceive they are implicitly backed by the government.<sup>72</sup>

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<sup>70</sup>Using the formula provided in the previous footnote, which is explained in greater detail in Heuson, Passmore, and Sparks (2001), the dark green line incorporates a fixed capital requirement – that may result from a risk-insensitive mortgage capital regulation or a leverage requirement – when calculating the depository’s expected return on the alternative investment. In contrast, the purple line incorporates the market’s credit risk-sensitive capital requirement. This marginal cost curve with respect to credit quality implicitly assumes that other marginal costs for mortgage financing do not vary with respect to credit quality. Thus, the curvature simply reflects the effective cost of capital to back the credit risk (or an equivalent credit guarantee).

<sup>71</sup>The securitizer may be a purely private entity, a government-sponsored agency, or an affiliate of a bank holding company. Regardless, the securitizer’s marginal cost will be determined by the market’s demands and conditions and the regulatory capital framework they face, if any.

<sup>72</sup>The GSEs’ mortgage-backed pools often are backed by only a small number of mortgages and are not geographically diversified (Downing, Jaffee, and Wallace, 2004). For example, as of September 2003, the average Fannie Mae MBS pooled 58 loans with a principal balance of \$8.2 million (Congressional Budget Office, 2003). However, investors are indifferent to the size and diversification of these pools because all the pools are backed by

Because of adverse selection, the securitizer only wants to *purchase* mortgages between  $q_1$  (demarcated by the leftmost vertical light green line) and 1. Because of cherry picking, the originators (including depositories) only want to *sell* mortgages between 0 and  $q_3$  (demarcated by the rightmost vertical light green line).<sup>73</sup> The light green line at  $q_3$  is determined by the originator's comparison of the marginal profit derived from holding the loan to the price offered by the securitizer for selling the mortgage.

In the case of depositories, the decision to sell to a securitizer must take account of regulatory capital requirements, which would negate much of the additional profitability from holding a very low risk mortgage unless the depository can “blend” it with higher-risk mortgages. When blending assets, the depository combines the lowest risk loans (i.e., the cherries on the right hand side of figure 4.1) with higher risk loans to create a portfolio that is consistent with the 4 percent regulatory capital requirement; blending effectively raises prudent economic capital for the blended portfolio to a level commensurate with required regulatory capital.<sup>74</sup> This blending process allows depositories effectively to hold the appropriate prudent economic capital for bearing the credit risk of a pool of mortgages. In essence, from  $q_3$  to 1, the depository is bearing the cost of the prudent economic capital (the purple line) for carrying low-risk mortgages because of the mortgages' value in being “blended” with high-risk mortgages (i.e., those in the 0 to  $q_1$  range) that have prudent economic capital above the regulatory 4 percent requirement (to the extent that these high-risk mortgages meet the depository's underwriting standards).

The effective marginal cost curve for mortgage credit risk in a given market segment is represented by the solid dark green, red, and purple line segments in figure 4.1. *Because of regulatory capital arbitrage (through blending and securitization), the marginal cost curve is determined by prudent economic capital for most mortgages, even under Basel I capital standards.*

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the same GSE guarantee.

<sup>73</sup>Note that cherries are not necessarily conforming mortgages; indeed, some may not be conforming by design to save some costs associated with conforming mortgages. For example, some “low-doc” mortgages are made to very low-risk borrowers and, because of the lack of documentation, are not conforming mortgages.

<sup>74</sup>For depositories that are not monolines, these higher risk credits can be other types of loans, such as small business loans. The process of blending loans of high and low risks will remain important for Basel II adopters, since they will continue to be subject to leverage requirements. Banks with a composite supervisory rating equal to one are subject to a minimum leverage ratio of 3 percent. For lower rated institutions, however, the minimum tier 1 leverage ratio is 3 percent plus an additional cushion of at least 100 to 200 basis points.

Note, however, that there are two portions of the prudent economic capital line – the purple line – that are dashed: These are the regions of credit risk where regulatory capital constraints influence mortgage funding and create deadweight losses (denoted by black cross-hatches). In these cases, regulatory capital constraints may have resulted in artificially high prices for bearing the credit risk associated with these borrowers.

In the leftmost of these regions, which is bounded by the solid dark green line, Basel I regulatory capital rules influence mortgage funding because the depositories cannot sell mortgages originated to any securitizer with a lower capital requirement. In other words, the depository institution cannot communicate the quality of these mortgages to the secondary market (and thus cannot sell them into the market or securitize the mortgages itself).

In the rightmost of these regions, which is bounded by the solid red line, the securitizers' capital requirement influences mortgage funding because there are no other competitors (e.g., depositories) with a lower prudent capital requirement. (Note that securitizers, unlike originators, generally cannot blend mortgages because they lack the information to effectively judge the risks associated with the individual mortgages within a market segment. However, to the degree that securitizers can develop specific risk information that is not easily duplicated or revealed to originators, some blending might be possible.)

Basel II increases the risk-sensitivity of capital requirements so the marginal cost curve of adopters for bearing mortgage credit risk more closely reflects prudent economic capital, which is again represented by the purple line in the bottom panel of figure 4.1. To understand differences in the marginal costs of adopters versus nonadopters, one compares the effective marginal cost curve under Basel I (indicated by the dashed blue line) with the marginal cost associated with prudent economic capital (which will apply under Basel II). This comparison assumes that these marginal cost curves only differ with respect to regulatory capital requirements. Other costs are assumed to be the same and, in particular, non-capital operating costs are assumed to be identical for adopters and nonadopters under Basel II.

There are two regions where the adopter marginal cost curve falls below the marginal costs of nonadopters, which represent the deadweight costs associated with risk-insensitive regulatory capital requirements (e.g., 4 percent for depositories and 45 basis points for GSEs). In the rightmost cross-hatched region, the marginal cost curve for adopters could fall below the mortgage

securitizer marginal cost curve (which is also the marginal cost curve for nonadopters) for a region of  $q$ . In the bottom panel of figure 4.1, this region is from  $q_2$  to 1. Here, the adopters would choose to hold mortgages with  $q$  above  $q_2$  and would sell fewer loans to the securitizer. Thus, Basel II could potentially place some of the safer mortgage loans back on depository institution balance sheets and reduce the role of securitization in funding mortgage loans. In addition, adopters would hold a higher-quality segment of the low-quality credits (with probabilities of not defaulting on the loan ranging from  $q_0$  to  $q_1$ ) in a mortgage market segment because, under Basel II, they would be able to carry only the prudent economic capital needed to back these loans and not the higher Basel I requirement.

Finally, depository institutions would likely continue to retain and not sell the safest mortgages with probabilities of not defaulting ranging from  $q_3$  to 1. Adopters would retain these mortgages because of their low prudent economic capital required to back the associated credit risk. Nonadopters would continue to blend these highest-quality loans with their riskier mortgages (and possibly other credit risk intensive assets) to meet their Basel I capital requirements.

#### **4.1.2 POTENTIAL EQUILIBRIUM MORTGAGE RATES**

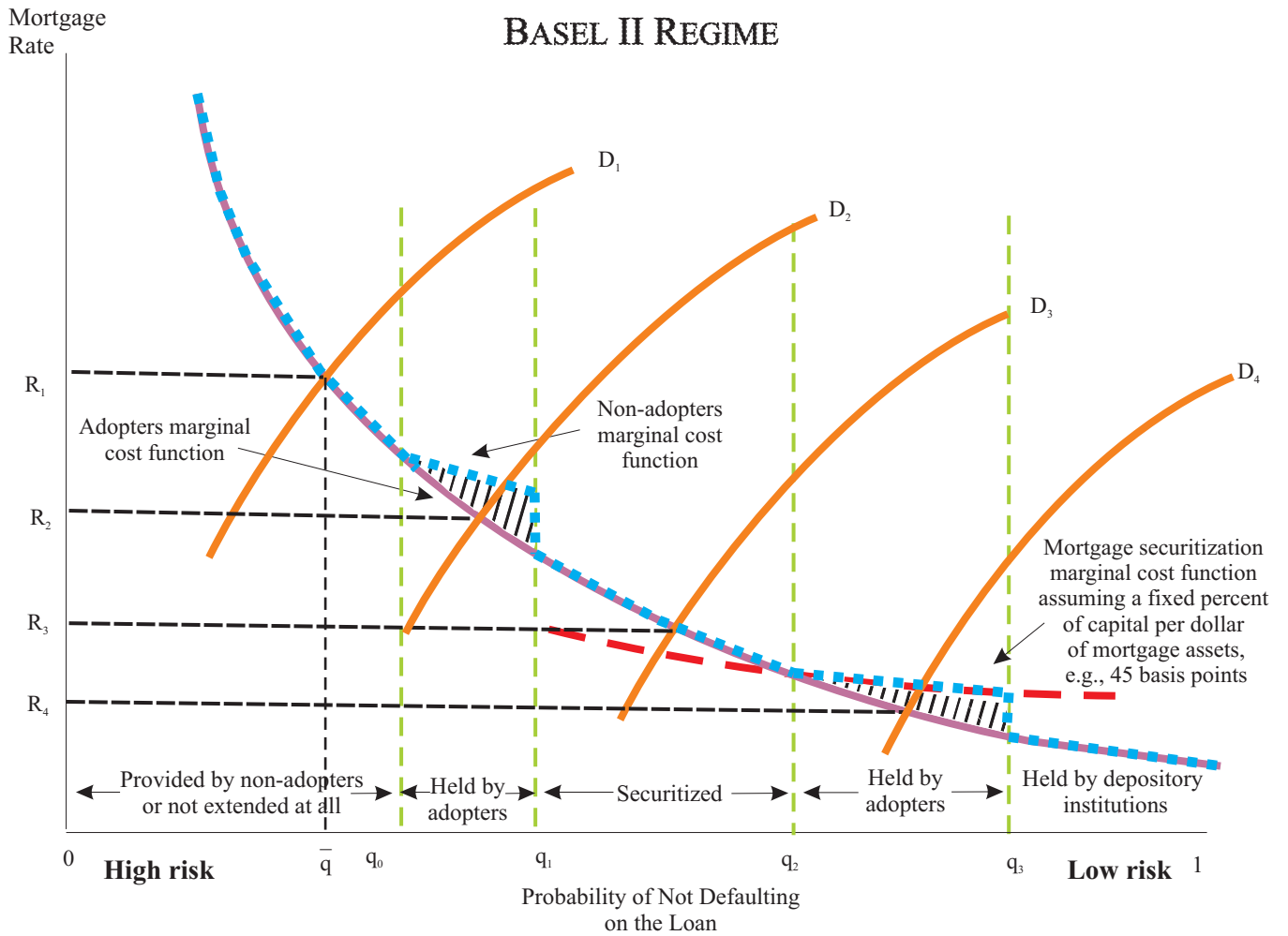
The equilibrium mortgage rate for a mortgage market segment is determined where the demand curve for that segment crosses the industry supply curve.<sup>75</sup> The demand curve in this model (e.g.,  $D_1$  in figure 4.2) ranks borrowers by the maximum mortgage rate they are willing to pay for a mortgage, suggesting that borrowers with a high probability of paying back their mortgage are more willing to pay higher mortgage rates, all other things equal. This is because mortgage default is very costly for borrowers, so that when high mortgage rates prevail, only borrowers with low odds of default stay in the mortgage applicant pool.<sup>76</sup> With demand curve  $D_1$  in figure 4.2, all borrowers willing to pay more than the equilibrium mortgage rate,  $R_1$ , both

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<sup>75</sup>The model presented here is a stylized version of Heuson, Passmore, and Sparks (2001). More generally, the underwriting standards of market participants – depositories and securitizers alike – may change as mortgage rates change (i.e., the light green vertical dashed lines may move to the left or the right).

<sup>76</sup>In contrast, in an adverse selection model (such as proposed by Stiglitz and Weiss, 1981), when mortgage rates rise lower risk borrowers drop out of the pool of potential borrowers. This type of adverse selection model assumes that borrowers with higher default risks have higher expected returns from their investment projects (in this case, the project is a home purchase). In our model, however, the benefits associated with homeownership are not related to a household's default probability. In this case, rising mortgage rates simply raise the cost of homeownership without any offsetting effects.

FIGURE 4.2  
 POSSIBLE EQUILIBRIA IN A GIVEN SEGMENT  
 OF THE MORTGAGE MARKET



demand and receive a mortgage (i.e., borrowers with a probability of not defaulting on their mortgage greater than or equal to  $\bar{q}$ ).

As discussed earlier, there is only *one* prevailing mortgage rate in each mortgage market segment because the differences in credit risks are small relative to the uncertainties in modeling and measuring credit risks, leading both mortgage originators and secondary market participants to pool mortgages into broad credit risk categories. As shown in figure 4.2, Basel II has the potential to lower mortgage rates charged to borrowers only if a mortgage market segment demand curve crosses the industry supply curve in the areas where Basel II would effectively lower the cost of mortgage funding through reductions in capital needed for credit risks (as shown by the demand curves  $D_2$ , which crosses the supply curve between  $q_0$  and  $q_1$ , and  $D_4$ , which crosses the supply curve between  $q_2$  and  $q_3$ — i.e., the rates  $R_2$  and  $R_4$  are lower than they would be under Basel I). Depending on the shape of demand and supply curves, adopters might have lower costs and therefore a pricing advantage over nonadopters for a mortgage market segment. In contrast,  $R_1$  and  $R_3$  are unaffected by the implementation of Basel II capital standards because regulatory capital requirements are not binding for the marginal borrower under the current capital standards and therefore adopters would not realize a pricing advantage under Basel II. Only if mortgage demand falls in the particular regions that are delineated with cross-hatching will mortgage rates fall; otherwise, the marginal cost of bearing the credit risk of the marginal borrower in the particular mortgage market segment is not affected and the mortgage rate is unchanged. As discussed below, it seems unlikely that mortgage rates for most mortgage market segments are determined by demand falling in these cross-hatched regions.

#### **4.2 EVIDENCE FOR UNIFORM PRICING WITHIN MORTGAGE MARKET SEGMENTS**

The most obvious reason to expect uniform pricing within the prime mortgage market segment is that capital charge differences among prime mortgages are not large enough to warrant pricing differences. Mortgage rates are traditionally quoted in increments of 12.5 basis points (i.e., in eighths of a percentage point). With a required rate of return to capital of 15 percent, for example, two mortgages whose capital charges differed less than about 40 basis points would be quoted the same interest rate, even under strict risk-based pricing. From inspecting figure 3.1, it is

apparent that, for the safest borrowers, even large variations in the credit quality index would not translate into a 40 basis point difference in capital charges.

Internet websites, such as myFICO.com and RealEstateJournal.com (the *Wall Street Journal* Guide to Property), as well as rates quoted in newspapers, offer direct evidence that mortgage rates are not particularly sensitive to credit risk.<sup>77</sup> These sources typically group borrowers into five or six separate credit score categories, rather than the three credit score categories we used. For example, on RealEstateJournal.com on March 22, 2005, mortgage rate quotes were provided by state and by lender for a zero point, 30-year, fixed-rate conforming mortgage with an 80% LTV. Interestingly, the quoted rates for each lender in each state did not vary across FICO scores in 660-679, 680-699, and 700-759 ranges, but rates did vary by modest amounts across lenders. This pattern for quoted rates is consistent with uniform pricing in our prime mortgage market segment. In contrast, quoted rates for a one point, 30-year, fixed-rate conforming mortgage with an 80% LTV did vary across two FICO ranges, 500-549 and 550-579, for each lender in each state. This pattern suggests that risk is more finely priced within our subprime mortgage market segment.

Mortgage securitizers also often group mortgages into broad categories and the securities are uniformly priced within those categories. This practice helps to enhance MBS liquidity. Intuitively, there is a tradeoff between information and liquidity. Perfect information would require a myriad of small securities that would trade infrequently. Because larger issues trade more readily than do smaller ones, MBS investors may be willing to make this tradeoff, as long as all market participants have access to the same information.<sup>78</sup>

While this anecdotal evidence is highly suggestive, we also test more rigorously for uniform pricing in our mortgage market segments using household-level survey data. Although these data are by no means ideal for a study of mortgage pricing, they are certainly among the best available data in terms of household-level financial characteristics. Furthermore, they should capture any differences in contract interest rates on mortgages associated with fine differences in

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<sup>77</sup>We thank Paul Kupiec for drawing the myFICO.com website to our attention. Even though posted rates may not differ across borrowers with different credit quality, it is possible that lenders ration the amount of credit extended with better credits receiving more funding. Because quoted rates are based on only a few borrower characteristics, certain individual borrowers may not qualify for a particular posted rate.

<sup>78</sup>See Cutts, VanOrder, and Zorn (2001); note, however, that if some market participants are better informed about the underlying mortgages, market liquidity will suffer because of adverse selection.



credit risk.<sup>79</sup> Specifically, we employ the 2001 Survey of Consumer Finances to consider whether 286 observed mortgage rates on first-lien, fixed-rate, 30-year mortgages originated in 1998-2001 were consistent with uniform pricing methods within our three broad credit risk segments. Each mortgage was assigned to one of our market segments using imputed credit scores and calculated LTV ratios (53% of the households were classified as prime borrowers, 18% of the households were classified as near-prime borrowers, and 29% of the households were classified as subprime borrowers using the mortgage market segment definitions described in table 2.1).<sup>80</sup>

Parameter estimates for three mortgage pricing models are presented in table 4.1. The dependent variable for each pricing model is the household's mortgage rate spread at origination, where the spread is relative to a benchmark rate constructed from monthly data on Freddie Mac contract mortgage interest rates for 30-year, fixed-rate, mortgages.<sup>81</sup> Although we present only parameter estimates for mortgage pricing models where credit quality was measured using the imputed credit score<sup>82, 83</sup> and the calculated LTV ratio at mortgage origination, similarly specified

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<sup>79</sup>The Survey of Consumer Finances does not provide information on mortgage points and fees at origination. These pricing factors might be more important for lower credit quality borrowers within each mortgage market segment.

<sup>80</sup>The proportion of mortgages in each market segment for this sample differs from the proportion for outstanding mortgages in part because this sample is for mortgages originated in 1998-2001. Because risk-based pricing methods may be becoming more, not less, pervasive, it is important to consider the risk-sensitivity of mortgage pricing using only fairly recent data.

<sup>81</sup>Because the mortgage rate observed at issuance varies over time and reflects the amount of time it takes between an application and a loan origination, we constructed a market benchmark rate for each mortgage using the average times from application to closing for purchased mortgages and lagged values for the monthly Freddie Mac contract mortgage interest rates for 30-year fixed rate mortgages. Since the actual benchmark rate at the time of application is not known, inclusion of this variable as an explanatory variable could produce biased parameter estimates. Our procedure of using mortgage spreads, however, avoids this type of bias. Usage of our constructed benchmark rate, instead of the reported Freddie Mac contract mortgage rate for the month of mortgage origination, did not influence the statistical significance of any of the parameter estimates in the mortgage pricing models reported below.

<sup>82</sup>The imputed credit score approximates statistically based credit scores that are widely used by lenders to assign credit ratings to consumers based on information in their credit records. In the Summer 2004 *Federal Reserve Bulletin*, Avery, Canner, and Calem (2004) report that they used standard statistical regression techniques to fit actual proprietary credit risk scores against selected credit factors for 250,000 individuals in the Federal Reserve sample of credit records. Estimated parameters were allowed to differ across three population subgroups and the percentage of the variation in credit scores explained for the full population was quite high, about 94 percent. Key predictors of these proprietary credit risk scores were the existence of delinquencies of 30 and 60 days or longer in the past year, the aggregate balance and utilization rate on bank credit cards, and the age of the individual.

<sup>83</sup>In our pricing models we use the Barakova, Bostic, Calem, and Wachter (2003) credit scores that were imputed for Survey of Consumer Finances households using credit factors that depended only on survey data and that could also be mapped to the credit factors that were used in the 2004 *Bulletin* article to predict proprietary credit

**TABLE 4.1: PARAMETER ESTIMATES FOR MORTGAGE PRICING MODELS**

| EXPLANATORY VARIABLES           | DEPENDENT VARIABLE: Spread of the Mortgage Rate over a Constructed Freddie Mac Benchmark Rate |  |                                      |                             |  |                                      |                            |  |                                      |
|---------------------------------|---|--|--------------------------------------|-----------------------------|--|--------------------------------------|----------------------------|--|--------------------------------------|
|                                 | Model 1   |  |                                      | Model 2                     |  |                                      | Model 3                    |  |                                      |
|                                 | The Effect for Prime Loans  | Additional Effect for Near-Prime Loans | Additional Effect for Subprime Loans | The Effect for Prime Loans  | Additional Effect for Near-Prime Loans | Additional Effect for Subprime Loans | The Effect for Prime Loans | Additional Effect for Near-Prime Loans | Additional Effect for Subprime Loans |
|                                 | (1)   | (2)                                    | (3)                                  | (4)                         | (5)                                    | (6)                                  | (7)                        | (8)                                    | (9)                                  |
| INTERCEPT                       | -0.084<br>(-0.76)   | -0.007<br>(-0.03)                      | <b>0.539 **</b><br>(3.30)            | 0.632<br>(0.24)             | 0.621<br>(0.24)                        | <b>3.484 **</b><br>(2.45)            | 1.593<br>(0.65)            | 1.549<br>(0.56)                        | <b>4.792 **</b><br>(2.33)            |
| <b>CREDIT QUALITY MEASURES</b>  |   |  |                                      |                             |  |                                      |                            |  |                                      |
| Credit Score                    |   |  |                                      | -0.001<br>(-0.36)           | 0.001<br>(-0.20)                       | -0.003<br>(-0.76)                    | -0.002<br>(-0.78)          | 0.001<br>(0.13)                        | -0.001<br>(-0.36)                    |
| Loan-to-Value Ratio             |   |  |                                      | 0.009<br>(1.42)             | 0.014<br>(-0.40)                       | -0.010<br>(-1.08)                    | 0.006<br>(0.94)            | -0.006<br>(-0.19)                      | -0.011<br>(-1.23)                    |
| <b>LOCATION</b>                 |   |  |                                      |                             |  |                                      |                            |  |                                      |
| East                            |   |  |                                      | -0.172<br>(-1.09)           |  |                                      | -0.069<br>(-0.25)          | 0.259<br>(0.57)                        | -0.457<br>(-1.09)                    |
| Mountain                        |   |  |                                      | <b>-0.926 **</b><br>(-3.14) |  |                                      | -0.537<br>(-1.19)          | 0.852<br>(0.82)                        | 0.141<br>(0.22)                      |
| Pacific                         |   |  |                                      | 0.217<br>(0.91)             |  |                                      | 0.257<br>(0.64)            | -0.302<br>(-0.35)                      | 0.035<br>(0.06)                      |
| Rural                           |   |  |                                      | <b>0.766 **</b><br>(2.60)   |  |                                      | -0.198<br>(-0.46)          | <b>2.106 **</b><br>(1.96)              | <b>1.405 **</b><br>(2.34)            |
| Herfindahl Index                |   |  |                                      | 0.648<br>(0.63)             |  |                                      | 2.477<br>(1.23)            | -2.757<br>(-0.90)                      | -1.766<br>(-0.73)                    |
| <b>YEAR INDICATOR VARIABLES</b> |   |  |                                      |                             |  |                                      |                            |  |                                      |
| 1999                            |   |  |                                      | <b>-0.696 **</b><br>(3.20)  |  |                                      | -0.366<br>(-1.24)          | 0.073<br>(0.14)                        | -0.501<br>(-0.92)                    |
| 2000                            |   |  |                                      | <b>-0.737 **</b><br>(-3.39) |  |                                      | <b>-0.651 *</b><br>(-1.78) | 0.375<br>(0.55)                        | -0.252<br>(-0.37)                    |
| 2001                            |   |  |                                      | -0.140<br>(-0.50)           |  |                                      | -0.454<br>(-1.22)          | 0.705<br>(0.82)                        | 0.942<br>(1.51)                      |
| <b>LENDER TYPE</b>              |   |  |                                      |                             |  |                                      |                            |  |                                      |
| Depository                      |   |  |                                      |                             |  |                                      | -0.114<br>(-0.23)          | -0.284<br>(-0.35)                      | -0.447<br>(-0.43)                    |
| Mortgage Company                |   |  |                                      |                             |  |                                      | -0.169<br>(-0.31)          | -0.406<br>(-0.48)                      | -0.940<br>(-0.92)                    |
| Credit Union                    |   |  |                                      |                             |  |                                      | -0.207<br>(-0.278)         | --                                     | -1.231<br>(-1.00)                    |
| Family or Friend                |   |  |                                      |                             |  |                                      | <b>-4.36 **</b><br>(-4.41) | 3.353<br>(1.06)                        | <b>2.560 *</b><br>(1.79)             |
| R-Square (Adjusted R-Square)    | 0.0483 (0.0429)   |  |                                      | 0.2386 (0.1904)             |  |                                      | 0.4432 (0.3245)            |  |                                      |

Note: Standard errors and t-statistics (in parentheses) were corrected for multiple imputation using tools available on the Survey of Consumer Finances website. See Kennickell, McManus, and Woodburn (1997) for a discussion of the techniques that were used. Parameters that are significant at the 10 percent level have one asterisk next to them, and those that are significant at the 5 percent level have two asterisks next to them.

models where credit quality was measured using our estimate of prudent economic capital<sup>84</sup> were also estimated and yielded qualitatively similar findings.

The first mortgage pricing model, identified as model 1 in table 4.1, considers whether (unadjusted) mean spreads are statistically different across our three mortgage market segments.<sup>85</sup> The observed mean spread for borrowers in the prime mortgage market segment is -0.08 percentage points (column (1)) is not significantly different from the observed mean spread for borrowers in the near-prime mortgage market segment, which equaled -0.09 percentage points. This finding is not surprising since anecdotal information on rate quotes suggests that some near-prime borrowers (i.e., those with FICO scores in the 620 to 659 range) appear to receive the same quotes from lenders as do (prime) borrowers with higher FICO scores. In contrast, the unadjusted observed mean spread for borrowers in the subprime mortgage market segment is about ½ a percentage point higher than the unadjusted mean spreads observed in the other two mortgage market segments. Importantly, this difference is statistically significant at the five percent level.

The second mortgage pricing model, identified as model 2 in table 4.1, not only allows adjusted means to vary *across* mortgage market segments, but also allows credit quality measures (the imputed credit score and the calculated LTV) to influence spreads differently *within* each mortgage market segment. This model also includes as independent variables some indicator

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risk scores. These authors report that using only such credit factors, the percentage of the variation in actual proprietary credit scores (for the sample of 250,000 individuals) explained using standard regression techniques was 0.70. The predicted scores ranged from 561 at the 1<sup>st</sup> percentile to 818 at the 99<sup>th</sup> percentile, with a median score of 738 and a mean score of 724. This fitted credit score prediction model was then applied to the households in the 2001 Survey of Consumer Finances. That is, the imputed credit scores were calculated as  $Zb$ , where  $Z$  was the vector of credit factors calculated using only survey data and  $b$  was the vector of estimated parameters from the credit score prediction model. Given this procedure, there could, of course, be a temporal mismatch between the imputed credit score and the date of each mortgage. This is because the mortgage may have been originated in 1998, but the score that is imputed uses subsequent information. In essence, our application of the Barakova, Bostic, Calem, and Wachter procedure implicitly assumes that lenders have rational expectations as to the credit quality of the borrowers.

<sup>84</sup>Section 3.3 describes the procedure used to calculate our prudent economic capital estimates. In the mortgage pricing models, these estimates were based on the imputed credit scores for each household.

<sup>85</sup>The three independent variables in model 1 are (1) an intercept, (2) an indicator variable that equals one if a mortgage is classified as a near-prime loan, and zero otherwise, and (3) an indicator variable that equals one if a mortgage is classified as a subprime loan, and zero otherwise. Parameter estimates for these variables are provided in columns (1), (2), and (3) of table 4.1, respectively. With this specification, the parameter estimates for the indicator variables measure whether the mean is different between the prime market segment and the other two mortgage market segments. Means for the near-prime and subprime segments are derived by summing the intercept estimate and the parameter estimate for the respective indicator variables. This is why we call the parameter estimates on the indicator variables “additional effects” in table 4.1.

variables for the location of the household as well as three year-specific indicator variables. This model explained about 20 percent of the variation in observed mortgage spreads.

Model 2 parameter estimates are consistent with uniform pricing in the three mortgage market segments considered. Turning to the first row of table 4.1, the conditional means for mortgages in the prime and near-prime segments (columns (4) and (5)) were statistically indistinguishable from zero after controlling for the other factors included in the model 2, but the conditional mean for mortgages in the subprime market was about 3.5 percentage points higher and the difference between this conditional mean and the conditional means for prime mortgages and for non-prime mortgages was significant at the 5 percent level. These estimates imply that subprime borrowers pay substantially higher conditional spreads than do other borrowers. Moreover, credit quality variables did not independently or jointly significantly influence observed spreads *within* the prime and near-prime mortgage market segments. The joint test of parameter estimates (an F test) of credit quality measures (credit score and LTV) jointly equaling zero yielded test statistics equal to 2.22 and 1.32 for the prime and near-prime market segments, respectively.<sup>86</sup> Each of these test statistics is less than the respective critical values of a the one-sided F test at a five percent confidence level, equal to 2.60 and 3.00, respectively. The individual estimates and the F tests for joint effects of the credit quality measures suggest that the risk-sensitivity of mortgage spreads is limited within the prime and near-prime mortgage market segments. Although each of the credit quality measures individually is insignificant in model 2 for subprime loans, a joint test for the credit quality measures indicates that together they influence spreads of mortgages within the subprime market segment. The F test statistic weighed in at 3.86 and is greater than the 3.00 critical value for a one-sided F test at a five percent confidence level. As indicated above, anecdotal information suggests that depositories and other mortgage providers may divide the subprime market into finer grades than are considered in this study. But, uniform pricing is likely to pertain within each of these finer grades. The significant joint effect of credit quality measures on spreads in the subprime market segment is consistent with this finer gradation.

Focusing on the other significant parameter estimates for model 2, it is apparent that the location of the household may matter as far as mortgage spreads are concerned. Borrowers located in the mountain census region appear to have had lower spreads than borrowers located in other census regions. And although market concentration did not significantly influence mortgage

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<sup>86</sup>The F test statistics were computed as the simple average of F test statistics across imputations.

spreads,<sup>87</sup> borrowers located in rural locations appear to have paid significantly more than their peers that were located in a metropolitan statistical area (MSA).<sup>88</sup>

Year-specific indicator variables were included in the mortgage pricing model to account for business cycle and other macroeconomic effects.<sup>89</sup> The significantly lower spreads in 1999 and in 2000 are consistent with mortgage borrowers being affected by tighter lending standards as their prospects deteriorated during the macroeconomic downturn that began in March 2001 and ended in November 2001.

The third mortgage pricing model, denoted as model 3 in table 4.1, allows all of the parameter estimates on the explanatory variables included in model 2 to vary across mortgage market segments. In addition, this pricing model allows spreads to vary across lender types in each mortgage market segment. This richer specification explains more than 30 percent of the variation in observed mortgage spreads.

Model 3 parameter estimates are again consistent with uniform pricing in the three mortgage market segments considered. Although the conditional spreads for prime mortgages and for near-prime mortgages are not significantly different from zero, the conditional spread for subprime loans is significantly different from zero after controlling for the other factors included in model 3. This evidence suggests that prime and near-prime loans are fairly similar from a credit risk perspective, but that lenders do price for differences in risk *between* loans in these segments and loans in the subprime market segment. As with model 2, in model 3, the credit quality measures neither independently nor jointly significantly influenced spreads within the prime and near-prime mortgage markets. The joint test of parameter estimates (an F test) of credit quality measures (credit score and LTV) jointly equaling zero provided test statistics (critical values) equal to 1.14 (2.60) and 1.03 (3.00) for the prime and near-prime market segments, respectively. Each of these test statistics is less than the respective critical value for a one-sided F test at a five percent confidence level. The individual estimates and the F tests for joint effects of credit quality

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<sup>87</sup>Rhoades (1992) found that market concentration affects prices charged for mortgages. The Herfindahl index we used is the sum of squared percentage market shares of deposits for commercial banks, thrifts, and credit unions in the MSA or county where the household lives (maximum value equals 10,000).

<sup>88</sup>There are fewer and less frequent real estate transactions in rural markets compared to markets within MSAs. With fewer transactions the uncertainty about house prices is greater, in such circumstances, a higher mortgage spread may be warranted, holding all else constant.

<sup>89</sup>The year-specific indicator variable for 1998 was excluded from the mortgage pricing models.

measures suggests that risk-sensitive pricing is not pervasive *within* the prime and near-prime mortgage market segments. Although each of the credit quality measures individually was insignificant in model 3 for subprime loans, a joint test for credit quality measures indicated that they significantly influence spreads *within* the subprime mortgage market segment.<sup>90</sup> As with model 2, this finding raises the possibility that depositories and other mortgage market providers divide the subprime market into finer grades than are considered in this study. Section 6 discusses how greater risk-sensitivity for mortgage pricing influences the magnitudes of our projected competitive impacts.

Model 3 parameter estimates suggest that rural spreads are higher only for non-prime (i.e., near-prime and subprime) borrowers. But, macroeconomic factors affect prices similarly across the mortgage market segments. The significantly lower spreads observed in the prime mortgage market segment in 2000 were not statistically different from the significantly lower spreads that were observed in the non-prime market segments.

Plausibly, marginal costs for mortgage funding could differ across mortgage lenders because of differences in regulatory environments and applicable tax policies. Whether the household received mortgage financing from a depository (e.g., bank, savings and loan, or savings bank), a mortgage company, a credit union, or other firm, however, did not significantly influence the mortgage rate at origination, regardless of the credit quality of the borrower. Since regulatory environments and tax policies vary across these institutional lenders, this finding provides additional support for the use of uniform pricing methods *within* mortgage market segments. Interestingly, prime and near-prime borrowers who received mortgage financing from a friend or relative,<sup>91</sup> who, of course, would not be subject to regulatory capital requirements, paid significantly lower spreads on average. But, subprime borrowers who borrowed from a friend or relative paid significantly larger spreads on average, even accounting for the higher adjusted mean rate that is observed in the subprime market. Nevertheless, these borrowers still paid less on average than if they had received financing from another lender type.

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<sup>90</sup>The test statistic at 3.90 is greater than the 95 percent critical value (3.69).

<sup>91</sup>Estimation of each of the three pricing models excluding the mortgages that were provided by a friend or relative yielded qualitatively identical estimates (i.e., the same parameters were significant and their magnitudes were only different in the third decimal place).

To summarize, the fairly substantial capital charge changes required to move a borrower's mortgage rate by an eighth of a percent, the business practice by mortgage securitizers to group mortgages into broad categories and to charge uniform interest rates within those categories, the anecdotal evidence, as well as the parameter estimates from our empirical mortgage pricing models, all support the view that there is uniform pricing within mortgage market segments. Indeed, within the prime and near-prime mortgage market segments, the observed spread is not statistically influenced by our credit quality measures. But, unconditional and conditional spreads alike are economically and statistically larger in the subprime mortgage market segment than in the prime and near-prime market segments. In addition, rates within the subprime market are statistically sensitive to credit quality measures. This finding is consistent with mortgage providers dividing this market into finer grades and using uniform pricing methods within each grade. Because credit risk does not affect mortgage pricing within our prime and near-prime market segments, and it is likely that credit risk does not affect mortgage pricing in more finely graded subprime market segments, changes in credit risk capital requirements are unlikely to substantially influence mortgage pricing or the market shares of mortgage funding by adopters.

#### **4.3 THE COSTS ASSOCIATED WITH HOLDING CAPITAL**

As we argued in previous sections, it is difficult to know if minimum regulatory capital requirements are meaningful constraints on depository institution behavior, and indeed, such constraints often do not appear to be binding.<sup>92</sup> Moreover, depository institutions in the United States generally hold much more equity capital than is required by the minimum regulatory capital requirements. If equity capital were relatively costly, this would seem to be a paradox, because it would suggest that this capital may not be much more costly than other forms of non-deposit funding. In this section, we assume that regulatory capital requirements impinge on banks (even though it seems unlikely) and calculate the cost of capital associated with these constraints. We find these costs are fairly small, suggesting that changes in depository regulatory capital requirements – when they actually would affect rates (i.e., in the cross-hatched areas on figure 4.1) – would have a minimal effect on mortgage rates.

Indeed, if investors arbitrage between debt and equity markets then as a depository institution's equity capital decreases, the yields on its uninsured deposits and non-deposit

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<sup>92</sup>See, for example, Lang, Mester and Vermilyea (2005) and deFontnouvelle, Garrity, Chu, and Rosengren (2005).

liabilities should rise, reflecting the greater risks to the debt holders.<sup>93</sup> As shown in Modigliani and Miller (1958), under conditions where debt and equity are treated similarly, debt and equity capital are interchangeable because debt spreads adjust to reflect the risks to debt holders given a firm's capitalization. Thus, less equity capital means higher debt costs and more equity capital means lower debt costs. Of course, debt holders and shareholders are not treated similarly and tax policies, bankruptcy procedures, and the presence of federal deposit insurance suggest that costs of equity and debt differ, particularly for depositories.<sup>94</sup>

Many academics have focused on deposit insurance as a significant violation of the Modigliani and Miller insight that investors desire to equate the marginal costs of debt and equity. Depositories supposedly wish to fund all assets with insured deposits because insured depositors have no incentive to demand yields that reflect the credit risk associated with a depository. However, even though retail insured deposits might be a cheap source of funding, they can be costly to raise. For example, banks must build and staff a significant retail branch network to raise deposits.

Indeed, the largest bank holding companies do not find it cost effective to raise core deposits (i.e., transactions deposits, savings deposits, and small time deposits) to fund most of their assets. As shown in table 4.2, the ten largest bank holding companies fund only 30 percent of their assets with core deposits. This ratio rises as bank holding companies become smaller, but even then only about 50 percent of assets at bank holding companies not among the largest 50 companies are funded with core deposits.

Beyond this, depositories may *desire* to hold capital above either prudent economic or regulatory capital (i.e., buffer capital) because of rigidities and adjustment costs. In practice, depositories may not be able to instantaneously adjust capital or portfolio risk, due to market illiquidity, transactions costs, and other factors. Moreover, under asymmetric information, raising capital could be interpreted as a negative signal with regard to a depository's value (Myers and Majluf (1984)), so managers may be unable or reluctant to react to negative capital shocks

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<sup>93</sup>Giles and Milne (2004) point out that the expected return on capital may rise (and substantially so) as capitalization approaches low levels. Berger (2004, pp. 25-32) also highlights the importance of these concerns when he discusses the potential competitive effects of Basel II on credit to small and medium business enterprises. Moreover, Dimou, Milne, and Lawrence (2004) have concluded that capital and debt have similar costs so that changes in capital requirements do not appreciably alter a depository's cost of funds.

<sup>94</sup>Still, there is some evidence for the Modigliani and Miller effect in banking. See, for example, Berger (1995).



**TABLE 4.2: LIABILITY STRUCTURE OF BANK HOLDING COMPANIES IN THE UNITED STATES**

(Rankings by Asset Size are Computed as of 2003)

| BANK HOLDING COMPANY SIZE<br>Balance Sheet Items      | 1999                   |                               | 2001                   |                               | 2003                   |                               |
|---|------------------------|-------------------------------|------------------------|-------------------------------|------------------------|-------------------------------|
|   | Billions of<br>Dollars | Percent of<br>Total<br>Assets | Billions of<br>Dollars | Percent of<br>Total<br>Assets | Billions of<br>Dollars | Percent of<br>Total<br>Assets |
| <b>10 LARGEST</b>                                     |                        |                               |                        |                               |                        |                               |
| Total Liabilities                                     |                        |                               |                        |                               |                        |                               |
| Core Deposits *                                       | 899                    | 30                            | 1199                   | 30                            | 1387                   | 30                            |
| Managed Liabilities *                                 | 1401                   | 47                            | 1816                   | 45                            | 2138                   | 46                            |
| Other   | 447                    | 15                            | 693                    | 17                            | 773                    | 16                            |
| Total Equity Capital                                  | 212                    | 7                             | 289                    | 7                             | 328                    | 7                             |
| Total Assets  | 3011                   | 100                           | 4048                   | 100                           | 4695                   | 100                           |
| <b>NEXT 10 LARGEST</b>                                |                        |                               |                        |                               |                        |                               |
| Total Liabilities                                     |                        |                               |                        |                               |                        |                               |
| Core Deposits *                                       | 244                    | 36                            | 300                    | 37                            | 345                    | 36                            |
| Managed Liabilities *                                 | 267                    | 39                            | 287                    | 35                            | 337                    | 35                            |
| Other   | 37                     | 5                             | 58                     | 7                             | 68                     | 7                             |
| Total Equity Capital                                  | 50                     | 7                             | 65                     | 8                             | 82                     | 9                             |
| Total Assets  | 675                    | 100                           | 817                    | 100                           | 957                    | 100                           |
| <b>NEXT 30 LARGEST</b>                                |                        |                               |                        |                               |                        |                               |
| Total Liabilities                                     |                        |                               |                        |                               |                        |                               |
| Core Deposits *                                       | 297                    | 42                            | 360                    | 42                            | 418                    | 41                            |
| Managed Liabilities *                                 | 239                    | 34                            | 269                    | 31                            | 314                    | 31                            |
| Other   | 22                     | 3                             | 61                     | 7                             | 68                     | 7                             |
| Total Equity Capital                                  | 56                     | 8                             | 80                     | 9                             | 97                     | 10                            |
| Total Assets  | 706                    | 100                           | 864                    | 100                           | 1015                   | 100                           |
| <b>ALL OTHER REPORTING BANK HOLDING<br/>COMPANIES</b> |                        |                               |                        |                               |                        |                               |
| Total Liabilities                                     |                        |                               |                        |                               |                        |                               |
| Core Deposits *                                       | 840                    | 51                            | 818                    | 49                            | 989                    | 47                            |
| Managed Liabilities *                                 | 510                    | 31                            | 382                    | 23                            | 542                    | 26                            |
| Other   | 126                    | 8                             | 277                    | 17                            | 355                    | 17                            |
| Total Equity Capital                                  | 128                    | 8                             | 143                    | 9                             | 185                    | 9                             |
| Total Assets  | 1639                   | 100                           | 1656                   | 100                           | 2115                   | 100                           |

Source: Bank Holding Company Consolidated Reports and bank Call Reports as of December 31.

\* Bank holding company information derived as the sum of subsidiary bank data. Core deposits consist of transactions deposits, savings accounts, and small time deposits. Managed liabilities mainly consist of deposits booked in foreign offices, large time deposits (with values equal or greater than \$100,000) and subordinated notes and debentures.

instantaneously.

Furthermore, supervisory prompt corrective actions required by the Federal Deposit Insurance Corporation Improvement Act of 1991, which are based on regulatory capital ratios, may induce depositories to hold capital as insurance against the violation of capital ratio trip wires that would impinge on their operations. The incentive to hold buffer capital increases with the probability of breaching these trip wires and, hence, with the volatility of capital ratios.

Determination of the optimum buffer capital stock not only considers rigidities, adjustment costs, and the costs associated with the imposition of PCA, but also the cost of quickly raising (relatively costly) capital compared to raising other forms of funding. Consequently, lowering a depository institution's regulatory capital requirement also may lower its desired buffer capital. But, as the capital requirement declines, buffer capital may not fall one-for-one with a lowered capital requirement, depending on the asset volatility associated with a depository's portfolio. Overall, a decline in a depository institution's *minimum regulatory* capital requirement may not lead to much change in a depository institution's *actual* capitalization.

In this paper, we provide a range for the potential decline in mortgage lending costs that could result from lower regulatory capital requirements that allow depositories to replace some of their equity capital holdings with debt financing. (If depositories do shed equity capital because of lower regulatory capital requirements, they must fund existing and increased asset holdings from other sources, i.e., debt). For the low end of the range for cost savings, we assume an equity premium equal to 2.7 percent, which implies that a one percentage point decline in required equity capital would result in a funding cost saving of 2.7 basis points.<sup>95</sup> For the high end of the range for cost savings, the before-tax return on equity is assumed to equal 15 percent<sup>96</sup> and the cost of debt is

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<sup>95</sup>In 1999, the equity premium was approximately 2.7 percent. Sharpe (2002) discusses the method used to calculate this estimate. The equity premium estimate for 1999 using this method is relatively low compared to other years, however, the technique uses a Treasury security as its benchmark, which may overstate the equity premium relative to a calculation that uses a corporate security as its benchmark.

<sup>96</sup>This assumption is based on data from the 1999 Federal Reserve Board Survey of the Performance and Profitability of CRA-Related Lending. In this survey, depositories reported their *overall* return on equity for their 1-4 family mortgage lending. For the 89 depositories that reported this return, it was on average 14.1 percent. But, for those that were also among the 10 largest depositories (ranked by asset size), this return was slightly above 15 percent on average.

assumed to equal 6.25 percent,<sup>97</sup> the latter of which implies that a one percentage point decline in equity capital would result in a funding cost saving of 8.8 basis points (i.e.,  $0.01 \cdot [0.15 - 0.0625]$ ).

Whatever the actual cost savings from the reduction in minimum regulatory capital, if any, only if the adopter offers a lower mortgage rate in response thereto would Basel II affect the adopter's market share of mortgage originations. Such changes, should they happen, may come at the expense of the GSEs or they may come at the expense of nonadopters. Regardless, as we will argue below, our analysis suggests that any changes will likely be rather small and limited to market sub-segments.

## **5. CAPITAL EFFECTS ON MORTGAGE MARKETS**

In this section, we estimate prudent economic capital levels for the credit risks of mortgages within each of the mortgage market segments described in section 2 (prime, near-prime, and subprime) and compare these levels to (1) Basel II regulatory capital requirements, (2) Basel I capital requirements for holding mortgage loans on the balance sheet, and (3) GSE capital requirements for bearing credit risk. We also consider capital levels established via private securitizations, which are assumed to be at least equal to prudent economic capital. These comparisons allow us to infer the proportions of each mortgage market segment where competition would likely be affected by the bifurcated approach for implementation of the Basel II capital standards.<sup>98</sup>

### **5.1 DATA CONSTRUCTION**

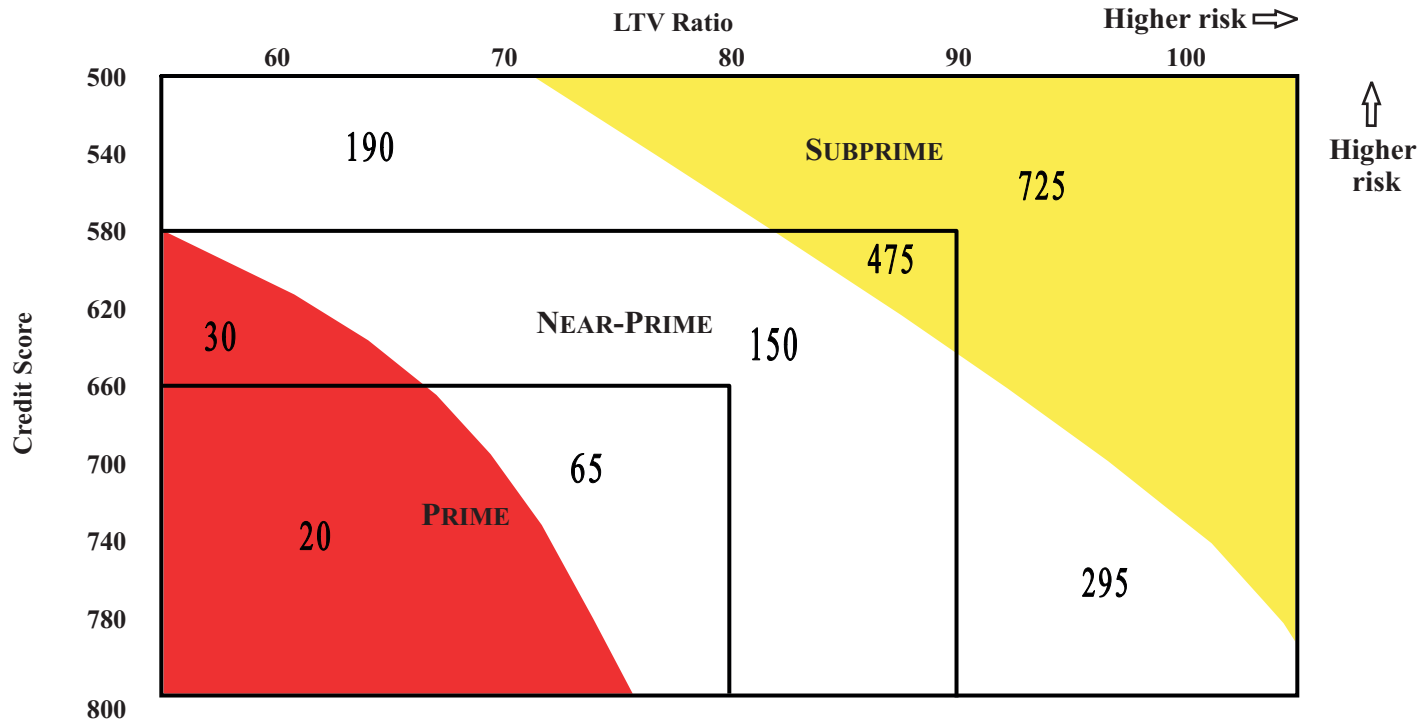
We estimated both the prudent economic capital levels and Basel II minimum capital requirements for credit score-LTV ratio pairs and then sorted these estimates by the credit score-LTV ratio pairs associated with the three mortgage market segments described in section 2 above, (1) prime, (2) near-prime, and (3) subprime. In figure 5.1, we compare this division of Basel II regulatory capital for non-securitized whole mortgage loans to current regulatory minimum capital

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<sup>97</sup>This is the average yield on senior bank debt rated AA or A with maturities of at least three years issued by the largest bank holding companies.

<sup>98</sup>These comparisons are conducted assuming that the leverage requirement on depositories does not influence adopters' decision-making in mortgage markets at the margin. This assumption implies that the changes in marginal capital requirements under Basel II are important and yields calculations of larger potential effects of the bifurcated implementation of Basel II on mortgage pricing than otherwise. If the leverage requirement influences adopters' decisions at the margin, Basel II implementation would have smaller effects than projected in this paper.

**FIGURE 5.1**  
**MEDIAN ESTIMATED PRUDENT ECONOMIC CAPITAL**  
 (Basis Points)



Prudent economic capital is the greater of Basel II's minimum capital requirement and economic capital (rated BBB+) under a stressed LGD. The red region depicts mortgages for which prudent economic capital falls below 45 basis points. The white region is where prudent economic capital lies between 45 and 400 basis points. The yellow region shows mortgages that have prudent economic capital in excess of 400 basis points. The values indicate the median prudent economic capital for the region.

requirements for such loans at depositories and GSEs; the current capital rule would, of course, apply to nonadopters of the A-IRB framework. In particular, in the high-credit score, low-LTV region (shown in red), the Basel II minimum capital requirement is *lower* than the minimum capital requirements for both nonadopters (4.0 percent for holding the whole mortgage) and the GSEs (45 basis points).<sup>99</sup> In contrast, in the low-credit score, high-LTV region (shown in yellow), the Basel II minimum capital requirement is *higher* than either the capital requirements for nonadopters or for the GSEs.<sup>100</sup> In the intermediate region, which is white, Basel II adopters have *lower* minimum capital requirements than nonadopters, but a *higher* minimum capital requirement than the GSEs' minimum capital requirement. (We assume, however, that in this case the GSEs would hold the prudent amount of economic capital, not just their minimum capital requirement.) In addition, in the intermediate and yellow regions, private securitization would establish a minimum benchmark of prudent economic capital.

In figure 5.1, we present the unweighted medians of the estimates of Basel II capital for the intersections of the mortgage market segments and the capital requirement regions. For example, the median Basel II regulatory minimum capital estimate for a prime mortgage (in the inner left box) given that the capital requirement is below the GSEs' minimum capital requirement (in the red region) is 20 basis points. As another example, the median Basel II minimum regulatory capital estimate for a subprime loan (in the outer right box), given that it has an estimate exceeding the Basel I requirement of 4 percent (in the yellow region), is 7.25 percentage points.

## 5.2 BASEL II CAPITAL STANDARDS AND SECURITIZATION INCENTIVES

During the late 1980s and early 1990s, depositories developed relationships with the GSEs to securitize mortgages partly to avoid regulatory capital requirements and, instead apply what we have termed appropriate prudent economic capital. These conduits are now well-embedded in U.S. mortgage markets. By using GSE securitization, the depositories get a capital savings under the current regime (by dropping from a risk-weight of 50 percent to a risk-weight of 20 percent),

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<sup>99</sup>In the bottom panel of figure 4.1, the Basel II capital requirement is lower than the minimum capital requirement for both the nonadopters and the GSEs for borrowers with a probability of not defaulting on their loan greater than  $q_2$ . For the market segments in figure 5.1, this corresponds to the red regions.

<sup>100</sup>In the bottom panel of figure 4.1, prudent economic capital is higher than 4 percent for borrowers with a probability of not defaulting on their loan less than  $q_0$ . For market segments in figure 5.1, this corresponds to the yellow regions.

but pay the GSEs' guarantee fee. Roughly speaking, for \$100 of mortgages, the marginal capital requirement drops from \$4.00 to \$1.60 by using a GSE securitization to hold mortgages under Basel I. Using our estimates of the net costs of capital, a depository likely saves between 6 and 22 basis points in its gross costs of bearing the credit risks by purchasing the GSE guarantee. However, with the GSEs' average guarantee fee around 21 basis points, the net savings to a depository appears to be quite minimal. When a depository (particularly a large depository) compares its cost of capital to its marginal cost of funds, which likely would not be insured deposits, the savings are likely nonexistent. Also note that, given our estimates of the (separate and joint) effects of credit scores and of LTV ratios on mortgage rates in the prime market, which provide statistical evidence that uniform pricing is commonplace in the prime market, mortgage rates likely would not be influenced by these small savings in credit guarantee costs.

A second, and perhaps even more important, reason for securitization is to increase the depository's funding capacity by selling the higher-rated portions of the securitization to other institutions in a better position to hold such assets. Non-GSE mortgage securitization is often an activity of large banks, who originate a large volume of mortgages and then package those mortgages so that they back a variety of securities with different credit ratings and payment characteristics. As described earlier, under the current Basel I-type U.S. rules, depositories usually hold on their balance sheets a first-loss position in the securitization designed to absorb most, if not all, of the credit risk in the total pool. By taking the first-loss position, depositories pledge enough credit support to the securitization, in the form of capital and other loss-absorbing mechanisms, so that the securities achieve a desired investment grade rating.

Under Basel II, depositories will still be able to create a first-loss position to guarantee the credit risk and have the opportunity to sell the rest. Capital would continue to be held dollar-for-dollar behind the first-loss position. Thus, mortgages that have tended to be securitized in the past under Basel I will likely continue to be securitized and backed by the appropriate level of prudent economic capital under Basel II because the depository's primary concern is usually funding and liquidity of assets, not regulatory capital arbitrage.

The one exception to this conclusion is GSE securitization. GSE securities are not backed by depository capital holdings; instead, they are backed by GSE capital holdings. The GSEs have a minimum capital requirement of 45 basis points and, as described earlier, often price their

guarantees to reflect the average risk of a mortgage pool.<sup>101</sup> As we spell out below, adopters might be more prone not to sell conforming mortgages to the GSEs unless GSE guarantee fees are lowered.

In contrast to GSE securitization, the pricing of credit risk associated with purely private MBS is unaffected by the implementation of Basel II because these securities are already backed by prudent economic capital. Therefore, Basel II does not alter the cost of guaranteeing the credit risk of a particular mortgage pool because ultimately some entity already holds the economic capital needed to cover the credit risk of the underlying mortgages and market participants will continue to seek the appropriate economic capital backing for mortgage pools even after the implementation of Basel II.

### **5.3 THE PRIME MORTGAGE MARKET AND THE POTENTIAL BASEL II ADVANTAGE**

In the prime mortgage market, we argue that the mortgage rate is determined by a securitized mortgage that is already backed by prudent economic capital. In other words, we argue that the mortgage rate is determined by a demand curve that falls in the region between  $q_1$  and  $q_2$  (e.g.,  $D_3$ ) in figure 4.2. In addition, as suggested by figure 4.2, there can be substantial changes in marginal costs (e.g., the distance between the blue-dashed and solid purple lines between  $q_2$  and  $q_3$ ) without influencing the equilibrium mortgage rate,  $R_3$ . These changes may, however, result in changes in revenues of market participants and also influence securitization activities.

#### **5.3.1 THE MARKET FOR CONFORMING FIXED-RATE PRIME MORTGAGES**

Prime mortgages are by far the largest mortgage market segment. GSE dominance in this mortgage market segment suggests that it is the GSEs' capital backing that underlies the market price for the credit risk of prime conforming mortgages.<sup>102</sup> These very low-risk mortgages flow to the GSEs because such entities generally have lower capital requirements with regard to credit risk than any other mortgage guarantor, unless the originator, as discussed earlier, decides to "cherry pick" the mortgages.

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<sup>101</sup>See also Gates, Perry, and Zorn (2002) as well as Cutts, Van Order, and Zorn (2001).

<sup>102</sup>Roughly 15 to 20 percent of these mortgages carry private mortgage insurance, suggesting that the capital needs of the PMI companies also play a role in determining the total cost of the mortgage to the borrower (see Canner and Passmore, 1996). In addition, some borrowers now obtain a second mortgage to cover some or all of the down payment (so-called "80-10-10s" and "80-15-5s"). Almost all of these borrowers are prime borrowers.

In figure 5.1, the median total capital requirement under Basel II for a prime mortgage in the red region is around 20 basis points by our estimates – for all prime mortgages the median total capital requirement would be around 30 basis points. In figure 5.2, we present estimates of the shares of each market segment that fall under different capital regimes. For example, for the prime mortgage market, we estimate that adopters will have credit risk capital costs lower than those of either nonadopters or GSEs for about 88 percent of prime mortgages (the red region of the prime market).

As noted above, Basel II could increase the adopters' share of the prime mortgage market only if it lowers the capital required for the mortgage extended to the *marginal* mortgage borrower within a market segment. Only in this case would the *uniform* price change in a given mortgage market segment. However, in the prime market, the pricing for the credit risk portion of mortgage rates probably will continue to be heavily influenced by the GSEs' underwriting standards, with its 45 basis points of minimum regulatory capital, and not by the changes brought about by Basel II. The more marginal borrowers in the prime mortgage market tend to require more than 45 basis points of prudent economic capital (as shown by the white area in the prime mortgage box in figure 5.1, the median prudent economic capital estimate is 65 basis points). As a result, there will likely be little change in prevailing mortgage rates for prime fixed-rate mortgages because of Basel II (since, as illustrated by  $D_3$  in figure 4.2, mortgage demand does not cross the mortgage supply curve in a region where adopter capital constraints are currently binding).

### 5.3.2 NEW COMPETITION AMONG ADOPTERS AND GSEs

The adopters of Basel II could also insure against the credit risk of prime mortgages by purchasing a credit guarantee from the GSEs. The average GSE mortgage guarantee fee is around 21 basis points, but most adopters would also likely be large originators of mortgages and thus probably pay less than this average fee – more like 15 to 18 basis points.

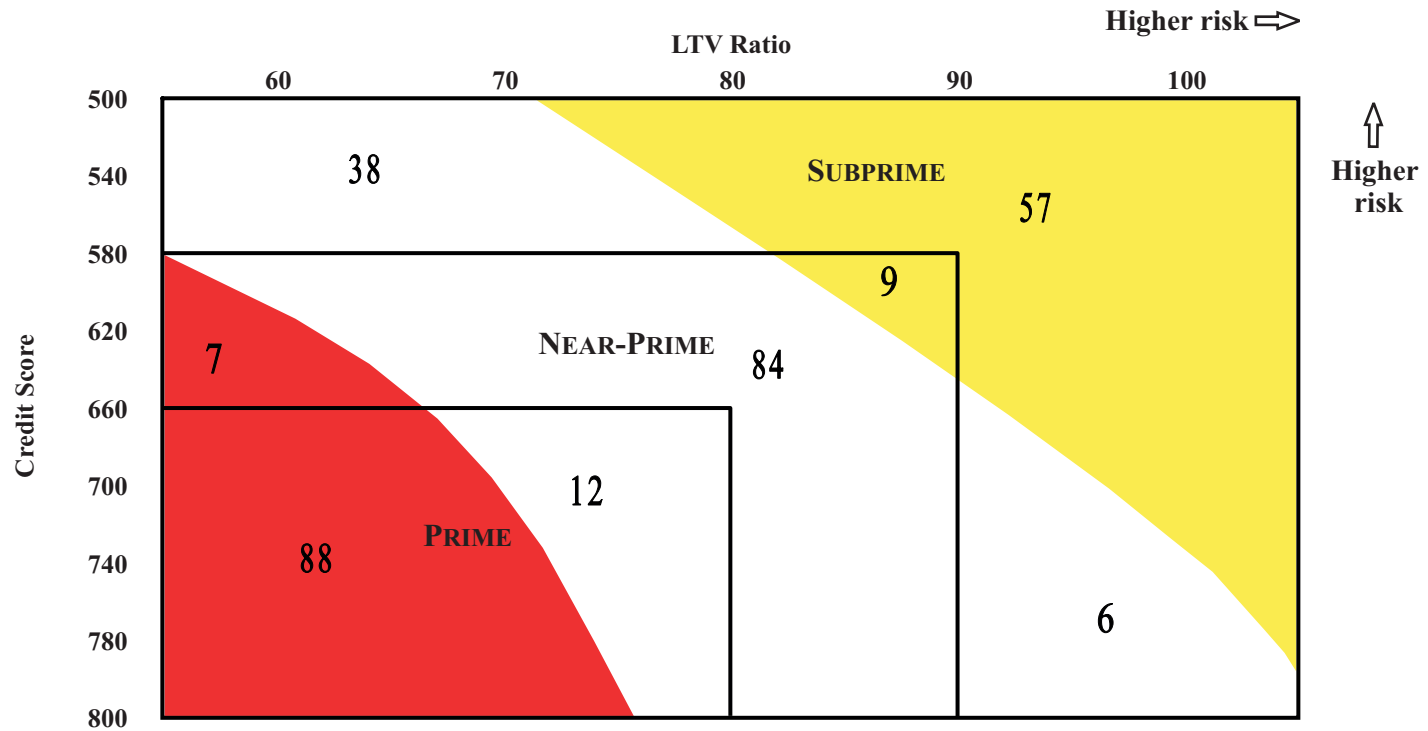
An adopter's costs associated with the capital to back a credit guarantee for a conforming prime mortgage would, we estimate, be about 2 basis points, seemingly much less than a 15 to 18 basis point guarantee fee.<sup>103</sup> However, the total cost to an adopter of keeping a mortgage is more than just the capital carrying costs. Indeed, the other costs associated with providing a credit

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<sup>103</sup>Two basis points is derived in the following manner. Twenty basis points is the median estimated prudent capital required for prime loans (see lower left-corner of figure 5.1). This estimate is multiplied by 8.8 percent, which is the maximum carrying cost of capital calculated in section 4.3, yielding 1.76 basis points.



**FIGURE 5.2**  
**DISTRIBUTION OF MORTGAGES**  
 (Percent of Loans per Market Segment)



Prudent economic capital is the greater of Basel II's minimum capital requirement and economic capital (rated BBB+) under a stressed LGD. The red region depicts mortgages for which prudent economic capital falls below 45 basis points. The white region is where prudent economic capital lies between 45 and 400 basis points. The yellow region shows mortgages that have prudent economic capital in excess of 400 basis points. The values indicate the median prudent economic capital for the region.

guarantee, such as dealing with foreclosures and managing the cash flows coming from mortgage payments, often exceed the costs of the carrying capital. To make an appropriate comparison of an adopter's choice of buying a guarantee fee versus holding the credit risk of a mortgage directly, we must extract these other costs from the GSEs' guarantee fee.

For example, using Fannie Mae's 2003 financial data reported by line of business, it appears that *net income* on its credit guarantee business, calculated as a share of the stock of outstanding MBS, was about 13.4 basis points. Fannie Mae's credit losses on mortgages were minimal – about 0.6 basis points. For illustrative purposes, we will roughly approximate Fannie Mae's income *net* of ongoing credit risks and other costs as 12 basis points.<sup>104</sup> Assuming that the GSEs' net costs of capital are the same as the adopters' costs, their carrying costs of capital range from 1 to 4 basis points.<sup>105,106</sup> Thus, the remaining 8 to 11 basis points in net income represents an extra return on GSE capital, part of which may reflect the liquidity benefits of the GSE MBS market, part of which may be an implicit subsidy derived from the GSEs' implicit government backing, and part of which may reflect the GSEs' market power in pricing MBS guarantees.

An adopter might view this remaining 8 or 11 basis points of GSE's net income as the contestable portion of the GSE's mortgage guarantee fee. With such a large difference in returns on equity, the GSEs apparently would be under some pressure to reduce their guarantee fee. However, the adopter would need to analyze the other possible reasons for the apparently large difference between the GSE's return to capital and the competitive return to capital, and might find these other reasons compelling and thus continue selling their mortgages to the GSEs. Overall, it is difficult to know if this apparent difference between the adopter's costs and the GSE's guarantee fees would result in a substantial number of mortgages not being sold to the GSEs. In terms of

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<sup>104</sup>Ideally, one would want to subtract *expected* losses from net income. Fannie's actual losses have been around 0.6 basis points for some time (even during the past recession). Thus, using this figure probably approximates the expected loss rather well. But to provide a conservative comparison, we will use 12 basis points (rather than 12.8 basis points) as the net income figure.

<sup>105</sup>The equity premium for GSEs would also range between 2.7 and 8.8 percentage points and, given that the GSEs minimum capital cost is 45 basis points, their competitive capital carrying cost would range between 1.22 (i.e.,  $0.027 \cdot 45$ ) and 3.96 (i.e.,  $0.088 \cdot 45$ ) basis points.

<sup>106</sup>Our calculations appear to be consistent with OFHEO calculations. They estimate that the average guarantee fee ranges from 20 to 24 basis points and the costs related to GSE guarantee activities range between 11 and 19 basis points. These costs include estimates of credit losses (in the 3 to 5 basis point range), administrative costs (in the 5 to 8 basis point range), and equity capital costs (in the 5 to 8 basis point range). See *Inside Mortgage Finance* (January 21, 2005, p. 6).

basis points, it may not seem like the savings from Basel II on the credit guarantee for prime mortgages are large. But the prime mortgage market is a very large market, and a few basis points can represent a substantial amount of income.

Indeed, one might even argue that the adopters would enter the mortgage securitization business and compete directly with the GSEs. But, as noted earlier, most adopters are large originators and sellers of mortgages to the GSEs. Given the high returns on capital currently earned by the GSEs, the guarantee fees charged to adopters seem likely to fall once Basel II is adopted. Thus, the GSEs might face some loss of income with the adoption of Basel II. However, the appeal of the GSE credit guarantee to depository institutions is not exclusively its lower capital costs. Instead, the appeal may be the liquidity associated with implicitly government-backed securities, suggesting that the adoption of Basel II might not alter current arrangements substantially.

For nonadopters, any decline in guarantee fees for adopters seems unlikely to influence their guarantee costs. The GSEs already negotiate separate guarantee fees for large originators who sell their mortgages to the GSEs and thus the guarantee fees charged to nonadopters are not linked to the fees charged to adopters. In addition, as described earlier, the mortgages held by nonadopters and not sold to the GSEs are likely effectively carried with the appropriate amount of prudent economic capital through the use of blended portfolios. Indeed, given the GSEs' significant regulatory capital advantage relative to depositories for bearing the credit risk of prime mortgages under Basel I, it seems that nonadopters would be unlikely to sell mortgages not currently sold to the GSEs to anyone else with a similar capital standard.

Still, nonadopters might, over time, forge relationships with adopters that would allow them to purchase guarantees from the adopters rather than from the GSEs. But given the small size of the adopters' regulatory capital advantage over GSEs for prime mortgages under Basel II and the relatively large proportion of non-capital-related costs associated with running a mortgage guarantee business, these relationships seem unlikely to evolve quickly, if at all. In the short term, nonadopters appear most likely to continue to sell their higher-risk prime, fixed-rate mortgages to the GSEs, holding in their own portfolios a few of the lower-risk mortgages to offset the credit risk associated with holding near-prime or subprime mortgages.

### **5.3.3 THE MARKET FOR PRIME ADJUSTABLE RATE MORTGAGES (ARMS)**

About 11 percent of prime mortgages have adjustable rates. The conventional wisdom is that GSEs tend not to purchase many ARMs because depositories are loath to sell them. ARMs are a better match, with regard to interest rate risk, to the liabilities that depositories originate in their deposit business. However, this explanation by itself does not explain the puzzle of why depositories tend to hold the credit risk of many of their ARMs.<sup>107</sup> Banks and thrifts could still have the GSEs' guarantee and securitize the ARMs. The resulting ARM-backed MBS could be placed in the bank or the thrift's portfolio, and this security would match depository liabilities as well as the whole-loan ARMs.

Our earlier capital cost calculations for GSE securitizations suggest that banks and thrifts likely do not securitize many of their mortgages because such small savings simply may not warrant the effort, and this behavior seems unlikely to change once Basel II is implemented. ARMs, in particular, are unlikely to be securitized because (1) the administrative costs associated with securitizing these mortgages might be large because of a lack of product standardization, or (2) the depository never intends to sell the mortgage (and thus never needs the liquidity provided by the GSEs' guarantee). In contrast, the depository might be eager to rid itself of fixed-rate mortgages because of the associated interest rate risk management problems and the low costs involved in using the highly standardized programs of the GSEs for such mortgages. Thus, the bulk of the prime mortgage credit guarantees that might be contested by adopters after the implementation of Basel II likely are fixed-rate mortgages sold to the GSEs under the current capital regime.

### **5.3.4 BASEL II IMPACTS ON THE PRIME MARKET SEGMENT**

Overall, the main effect of Basel II in the prime market segment appears likely to be a possible wealth transfer from GSEs to adopting banks and thrifts. In contrast, the mortgage rate would likely be unaffected because the marginal capital requirement underlying mortgages extended to the marginal borrower in the prime market would likely remain unchanged.

With respect to the wealth transfer from GSEs, although the number of basis points to be split between the GSEs and the adopters is small, the number of mortgages that might be affected

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<sup>107</sup>In the prime market, over 40 percent of ARMs are not securitized whereas about 25 percent of fixed-rate mortgages are not securitized.

is large. We provide estimates of the number of mortgages affected by Basel II in figure 5.3. These estimates are based on the existing stock of mortgages, and thus do not represent the numbers that would be affected in any given year. The stock of mortgages, however, gives us an indication of whether a potential change may affect many or only a few households. Also, it gives an indication of what proportion of the mortgage market might be affected over a long time horizon.

As shown in figure 5.3 (in the orange box for fixed-rate, securitized prime mortgages), we estimate that 16.2 million of the 18.4 million mortgages securitized are prime fixed-rate mortgages sold to the GSEs and thus would have guarantee fees that could have been affected by the Basel II capital standards. As noted in the previous section, when all factors are considered, the incentives for the GSE guarantee function to be displaced by adopters are small and, of course, any change brought about by Basel II would take years to influence all mortgages. Thus, these numbers based on our estimates of current mortgages outstanding should be taken as only indicative of the maximum long-run competitive effects and the speed of adjustment in mortgage terms and prices would depend on many factors, including factors that influence mortgage turnovers such as interest rates and house prices.

As discussed above, the mortgages originated and sold by adopters to the GSEs are likely to be the mortgages most directly influenced by Basel II. Likely adopters (proxied by the ten largest bank holding companies ranked by asset size, the ten largest non-mandatory adopters, and the largest and most active mortgage-oriented non-mandatory adopters) sold about 58 percent of the mortgages that were bought by the GSEs. Thus, we estimate that up to 9.9 million mortgages of the existing prime mortgages securitized might have been under greater competitive pressure, and thus may have had lower guarantee fees, had Basel II been in effect in earlier years.<sup>108</sup> However, these lower guarantee fees would not, we believe, have affected mortgage rates very much, if at all, because of the prevalence of uniform pricing methods.

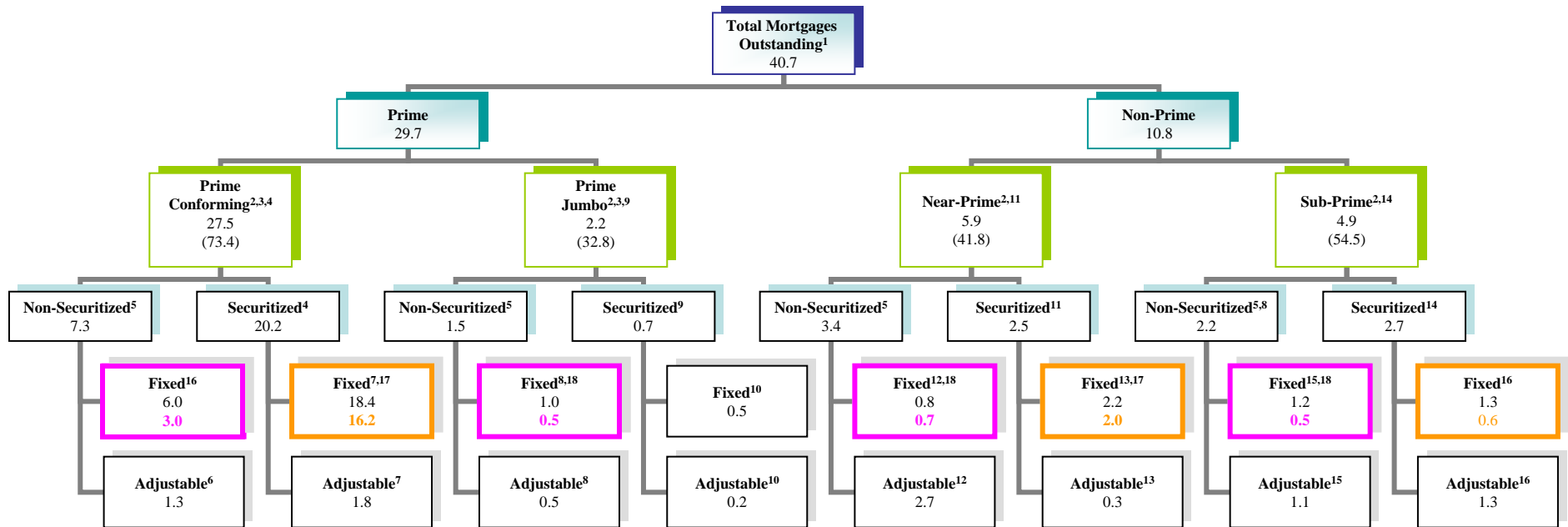
### **5.3.5 NON-SECURITIZED FIXED-RATE MORTGAGES**

By our estimate, roughly 6 million outstanding prime fixed-rate mortgages are not securitized. Our conceptual framework suggests that these mortgages are very low-risk mortgages that depository institutions keep in their portfolios. At first glance, the regulatory capital charges associated with such mortgages seem to be substantial. However, as we have argued above, the

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<sup>108</sup>Since some institutions are among the largest bank-holding companies and are also very active in mortgage markets, they are in more than one group. There are 26 institutions in total.

**Figure 5.3**  
**Description of US First-Lien Conventional Mortgage Market as of 2003:Q3**  
 Millions of Loans  
 (Percent of Loan Amount Securitized)



\* Components may not sum to totals because of rounding. The orange numbers are our estimates of the maximum number of loans contested by adopters and securitizers over a long period after the implementation of the proposed Basel II regulatory capital framework. The magenta numbers represent our estimates of the maximum number of loans contested by adopters and non-adopters over a long period after Basel II implementation.

## FOOTNOTES

### FIGURE 5.3: DESCRIPTION OF U.S. FIRST-LIEN CONVENTIONAL MORTGAGE MARKET AS OF 2003:Q3

1-16. See figure 2.1, footnotes 1-16.

17. About 88 percent of prime mortgages are estimated to require an economic capital backing of less than 45 basis points. We apply this fraction to the outstanding 18.4 million of fixed-rate mortgages that have been currently securitized to get 16.2 million. Similarly, 91 percent of the near-prime securitized fixed-rate mortgages require prudent economic capital of less than 4 percent, suggesting that up to 2.0 million of these 2.2 million mortgages might be contested by adopters and securitizers. Finally, 44 percent of the subprime securitized fixed-rate mortgages have economic capital that fall under 4 percent, suggesting adopters and securitizers might contest up to .6 million of these 1.3 million mortgages.
18. To estimate the number of blended mortgages, we look at the capital surplus of the subprime fixed-rate mortgages (the difference between the economic capital and 4 percent) and derive the percent of prime fixed-rate mortgages (with a prudent economic capital of less than 4 percent) that might be funded with this surplus. For example, if a subprime mortgage has a surplus of 1.2 percent and prime mortgages require 30 basis points of economic capital, then with constant dollar amounts four prime mortgages can be backed by holding one subprime mortgage. Our calculations are very rough and aggregated, and suggest that about half of the fixed-rate prime mortgages are blended but that almost none of the near-prime and subprime mortgages are blended (because we assume that mortgages with the least amount of capital are blended first, this assumption may be unrealistic for individual institutions because they might specialize in a market segment). Thus, under these assumptions we get an upper-bound for our estimate of contested mortgages for the fixed-rate non-securitized mortgages in the near-prime and subprime markets. (The only mortgages not contested are those that require more than 4 percent prudent economic capital.)

actual capital held on such mortgages is likely close to prudent economic capital, which is substantially smaller than regulatory capital, as depositories blend loans of different credit quality into their overall asset portfolio. (And such blending, of course, may not diminish even after the implementation of Basel II because of the tier 1 leverage requirement imposed by PCA).

In addition, the capital carrying costs of discrepancies from prudent economic capital may be outweighed by other considerations. As shown in figure 5.1, adopters' marginal capital requirement might fall from 4 percent to as low as 20 basis points, but the actual capital savings from these discrepancies would, at most, range from 10 to 33 basis points, which could easily be offset by other factors. For example, many of these mortgages appear to be "low documentation" mortgages, which might be offered to depository institution customers with established relationships. In addition, some of these mortgages might be extended to low-risk borrowers to finance unusual property types (e.g., second homes and co-ops). Regardless, given the low credit risk of these prime borrowers and the seemingly high regulatory capital requirement under Basel I, it appears unlikely that capital costs played a large part in the depository institution's decision to keep many of these loans in their portfolio. And thus we do not expect Basel II implementation to greatly influence mortgage pricing in this mortgage market segment (as shown in figure 5.3, we estimate that at the very most only 3 million mortgages might be affected).

#### **5.4 THE PRIME JUMBO MARKET**

Analogous to the prime conforming mortgage market, we argue that the mortgage rate in the prime jumbo market is most likely determined by a securitized mortgage that is already backed by prudent economic capital. Although GSEs cannot purchase or securitize jumbo mortgages, about a third of these mortgages are securitized by purely private securitizers. Because of the presence of substantial securitization activities, along with the very small amounts of prudent economic capital associated with such mortgages, we argue that the mortgage rate in the prime jumbo market seems to be determined by a demand curve that falls in the region between  $q_1$  and  $q_2$  (e.g.,  $D_3$ ) in figure 4.2. The difference is, however, that Basel II would induce no wealth transfer between adopters and securitizers because in this market securitization methods effectively employ prudent economic capital for all mortgages, parsing the credit risk of the mortgage into different tranches to sell to investors with different risk preferences.

Using similar reasoning, the fact that non-securitized mortgages today might have been securitized but were not, suggests that the difference between prudent economic capital (held by



the securitizers) and Basel I-type capital requirements was not sufficient to entice mortgage originators to sell these mortgages. This is particularly telling because many of the big holders of these jumbo mortgages are the same bank and thrift holding companies that are heavily involved in securitization of non-conforming mortgages. One reason capital requirements seem unlikely to change the status of prime jumbo mortgages is that some of these mortgages are ARMs (see section 5.3.3). The capital costs of the fixed-rate component can be offset by other factors (see section 5.3.4). We estimate that at most only half a million prime jumbo mortgages might be affected by Basel II implementation (second magenta box from the left, figure 5.3). Moreover, given the prevalence of uniform pricing in the prime mortgage market, it seems unlikely this small change in mortgage carrying costs would yield any meaningful change in mortgage rates.

### **5.5 NEAR-PRIME MORTGAGES AND BASEL II IMPLEMENTATION**

As shown in figure 5.1, the near-prime mortgage market covers a wide range of Basel II capital estimates. This range mirrors the underlying wide range of risks, suggesting that many institutions, with their varying regulatory and prudent capital standards, might play a role in this market. It also suggests that the mortgage extended to the marginal borrower has a rate that is consistent with the amount of prudent economic capital needed to back said mortgage. In other words, the mortgage rate in the near-prime market segment seems to be determined by a demand curve that falls in the region between 0 and  $q_0$  (e.g.,  $D_1$ ) in figure 4.2. Because uniform pricing appears commonplace in the near-prime market, the implementation of Basel II capital standards seems unlikely to result in a significant change in mortgage rates. Thus the benefit would be captured by adopters in higher profits (in other words, the adopters capture the cross-hatched areas that represent the deadweight losses that occur under the current regulatory frameworks imposed on depositories and on securitizers, since, as suggested by our conceptual framework, the mortgage rate would be  $R_1$  as determined by  $D_1$ ). Indeed, some mortgages in this market seem to warrant substantial amounts of economic capital, as shown by the yellow shaded region in figure 5.1, so that the more risk-sensitive Basel II capital requirements might well exceed the current capital requirements by significant amounts.

As shown in figure 5.2, we estimate that 9 percent of the outstanding mortgages in the near-prime market segment have prudent economic capital greater than 4 percent. Since the prudent economic capital required is likely in excess of the depository regulatory minimum for the marginal borrower in the near-prime market segment, the mortgage rate (e.g.,  $R_1$ ) would likely be

unaffected by the implementation of Basel II capital standards. Thus, calculations of the competitive impact of Basel II on the market shares of adopters and nonadopters must operate through another mechanism other than through changes in the mortgage rate.

One mechanism that might result in adopters increasing their mortgage market share is through additional revenues that they might accrue because of their lower capital costs (as shown by the cross-hatched region between  $q_0$  and  $q_1$ , which represent the deadweight losses associated with the current capital regulation regime, in figure 4.2). By our calculation, adopters would have capital requirements that would range from 2.5 to 3.7 percentage points lower than the requirement for nonadopters for these types of mortgages, implying a cost of capital advantage ranging from 7 to 33 basis points. As we discussed earlier, however, this type of calculation fails to capture competitive impacts on nonadopters because on many of these mortgages the effective capital requirement would be lower than 4 percent because of securitization and blending, and because capital requirements are often not important factors in determining mortgage rates. Furthermore, to the extent that operating costs might be higher for adopters under Basel II than for nonadopters, the increased revenues captured from recouping deadweight losses might be partly or completely offset by these expenses.

Indeed, we estimate that most near-prime mortgages are likely not affected by Basel I-type capital requirements. First, as indicated in figure 5.3, we estimate that 2.2 million of the 5.9 million near prime mortgages are fixed-rate, securitized mortgages (orange box on right) and thus seem unlikely to be affected by Basel II implementation. Second, as discussed above, we argue that ARMs are unlikely to be heavily influenced by the capital needed to guarantee credit risk, accounting for about 3 million mortgages in this market. Of the roughly 6 million mortgages in the near-prime market segment, we believe that only some of the fixed-rate, non-securitized mortgages (about 0.7 million mortgages in the near-prime magenta box in figure 5.3) might fall in the region where regulatory capital constraints influence capital costs.

Although adopters might have some capital savings for non-securitized fixed-rate near-prime mortgages, without knowing more details it is difficult to know why the mortgage was not securitized or blended to take advantage of lower capital requirements that exist now. The mortgage, for example, might be a very low risk mortgage and thus backed with prudent economic capital. In such circumstances, the adopter would not have a capital advantage once Basel II is implemented.

As in the prime market, adopters are likely to put downward pressure on credit guarantee fees, including GSE guarantee fees, in this market segment (as shown in the cross-hatched region between  $q_2$  and  $q_3$  in figure 4.2). As described earlier, since adopters will be able to hold capital more in line with prudent economic capital under Basel II, selling mortgages to the GSEs and through other securitization outlets will need to be motivated by reasons other than the arbitrage of capital regulations.

## **5.6 SUBPRIME MORTGAGES AND BASEL II IMPLEMENTATION**

Under Basel II, most subprime mortgages (57 percent) would require capital in excess of 400 basis points (the yellow region in the subprime market in figure 5.2), particularly if the mortgage had been securitized and prudent economic capital was held behind the loan. Indeed, we estimate about 0.4 million of the 4.9 million outstanding subprime loans would require prudent economic capital equal to or in excess of 800 basis points. In addition, because we believe the constant asset correlation assumption of the Basel II framework is least applicable to mortgage loans of the highest credit risk, the Basel II requirements may be higher than depositories' own estimates of the amount of prudent economic capital needed to fund such loans.<sup>109</sup> Consequently, adopters may find themselves at a competitive disadvantage relative to nonadopters in this market segment.

About 23 percent of currently outstanding subprime loans have both an LTV ratio in excess of 90 percent and a credit score less than 660. Under the current supervisory framework, examiners might reasonably expect a depository to hold capital in excess of 4 percent, or even 8 percent, on such loans, with the capital amount depending on the level and volatility of the institution's loss rates on mortgages, on the quality and liquidity of the collateral securing the loans, and on the quality of risk management and control processes in place at the depository. It is therefore plausible that some depositories that would remain under Basel I-type capital standards might be encouraged to hold more capital than would be required of adopters for loans in this portion of the subprime market. In this manner, adopters that invest in sophisticated risk management systems would potentially have a competitive advantage over some nonadopters (e.g., those with inadequate control processes) even in the most risky portion of the subprime mortgage market. The number of nonadopters that would be at a disadvantage, however, is likely to be very

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<sup>109</sup>As discussed in Calem and LaCour-Little (2004), the use of a single risk-factor model in the Basel II framework "is a significant omission in the case of mortgages." For subprime mortgages in particular, the internal ratings-based approach may be limited by the use of a single systematic risk factor (as discussed in Gordy (2003)), thereby perpetuating regulatory capital arbitrage.

small because the vast majority of depositories receive supervisory ratings consistent with sound risk management and prudent underwriting standards.

Since most depositories that would remain subject to the current Basel I-based regulatory regime would be required to hold just 4 percent of capital for subprime loans, we estimate that only about 0.5 million subprime, fixed-rate, non-securitized mortgages (in the current stock) would have lower capital backing under Basel II (based on our arguments concerning securitization and blending provided above). As in previous sections, the estimate of the number of mortgages in this market is an upper bound because we do not have information about why the mortgage was not securitized. Thus, overall, we do not foresee that Basel II will significantly influence mortgage rates in the subprime market.

## **6. SENSITIVITY ANALYSIS**

In this section, we consider how the estimates of the potential competitive impacts from the implementation of Basel II capital standards that are provided above would change with respect to (1) a higher prudent economic capital standard, (2) more comprehensive risk-sensitive pricing in mortgage markets, and (3) decisions by managers of depositories to maintain a “well-capitalized” designation from bank and thrift supervisors. That is, we explore the adjustments to our conclusions that would follow from higher than postulated capital positions at adopters and more sensitive mortgage pricing than we have assumed.

### **6.1 WHAT IF OUR PRUDENT ECONOMIC CAPITAL ESTIMATES ARE TOO LOW?**

The largest U.S. depositories typically maintain issuer ratings that are better than the BBB to A- standard that we use in our proxy for capital demanded by the marketplace (i.e., prudent economic capital). In fact, 18 of the 20 largest U.S. bank holding companies ranked by total assets had Standard and Poor’s issuer ratings better than A- as of year-end 2004. Therefore, it is likely that adopters would hold more, not less, market-determined capital than we have estimated.<sup>110</sup>

If our proxy for prudent economic capital is systematically too low, then our estimates of the maximum number of mortgages for which adopters may compete with nonadopters and of the

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<sup>110</sup>In addition, the models used by adopters may be more conservative than the FRB credit risk model. See, for example, Kupiec (2005).

maximum number of mortgages for which adopters may compete with securitizers (such as the GSEs) would be too high. The prudent economic capital demanded by the marketplace would be higher than the 4 percent required by regulators for a larger proportion of existing mortgages, so it would be *less* likely that Basel I capital regulations are influencing the amount of capital held on the balance sheets of depositories. Similarly, prudent economic capital would be less than 45 basis points for a smaller proportion of the prime mortgages than we estimated. As a result, there would be *less* competitive tension between the adopters and the nonadopters and between the adopters and the GSEs than we have estimated.

Thus, if we have underestimated the amount of prudent economic capital, the implementation of Basel II capital standards would have even smaller competitive effects than we have predicted. Not only would there be no direct effect on the mortgage rate from the implementation of Basel II, but also the indirect effects would be smaller – adopters would have *smaller* potential increases in their profits from capturing the deadweight losses that occur under the current regulatory frameworks imposed on depositories and on securitizers.

## **6.2 WHAT IF MORTGAGE PRICING IS MORE RISK-SENSITIVE?**

In the foregoing discussion, we considered a coarse taxonomy of three broad credit-risk mortgage market segments using data from the U.S. mortgage market, which capture much of the credit risk distinctions found between mortgages. In particular, once this segmentation is made, other characteristics of the mortgages, such as documentation status, often become more important than credit risk in mortgage pricing. Still, it is true that mortgage markets are today more segmented by credit risk than we have assumed. In the limit, it is possible in the future that each mortgage could potentially be individually priced using, for example, a borrower's credit rating (e.g., FICO score).<sup>111</sup>

Even if highly risk-sensitive pricing were to become pervasive, the current portfolio strategy described above for depositories subject to (risk-insensitive) Basel I capital requirements would continue to be sensible, even after the implementation of the Basel II framework.

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<sup>111</sup>In fact, Edelberg (2003) uses data from Surveys of Consumer Finances (1983-1998) and data on bankruptcy from the Michigan Panel Study of Income Dynamics to provide evidence that lenders have increasingly used risk-based pricing of interest rates in mortgage markets as data storage costs have fallen and underwriting technologies have improved.

Depositories would still be motivated to sell credit risk on loans whose regulatory capital exceeds their economic capital. Indeed, this strategy would be even more important if the price of each mortgage reflected the amount of capital that is demanded by the marketplace for its risk.

Depositories would still structure portfolios so the capital held for regulatory capital requirements is consistent with the capital demanded by the marketplace (i.e., they would be motivated to balance, or blend, lower-risk holdings with higher-risk holdings of mortgages). Moreover, depositories would continue to hold the credit risk on mortgages where the regulatory capital is *less* than the capital that is demanded by the marketplace.

In addition, even if risk-sensitive pricing were to become more pervasive, there would potentially be some mortgages where mortgage pricing would be influenced by Basel I regulatory constraints. For example, there would likely be some mortgages along the credit risk continuum where a securitizer could not be found that would back the mortgage with prudent economic capital. Similarly, if risk-sensitive pricing became pervasive, there still might be some prime conforming mortgages where the GSE regulatory capital requirement, equal to 45 basis points, would influence the costs of bearing credit risk and therefore mortgage rates.

Under Basel II and in a more risk-sensitive pricing environment than we assumed, it would be feasible for every mortgage rate to reflect market-determined capital demands. That is, mortgage rates would reflect prudent economic capital throughout the credit risk continuum. Importantly, in such a world competitive markets for the provision of mortgages would ensure that mortgage borrowers—and not adopters—would be the long-run beneficiaries of Basel II because mortgage rates would fall for the small number of mortgages where current capital standards influence mortgage pricing.

Specifically, competitive forces would likely operate in something like the following manner. Competition among adopters would ensure that each mortgage would be priced so the rate would be consistent with the amount of capital demanded by the marketplace to bear its credit risk. In addition, adopters would be able to bear the credit risk of borrowers that previously was borne by institutions outside the banking system because the adopters' prior Basel I regulatory capital standards influenced the rates that they needed to charge to recoup the costs associated with bearing (uneconomic) regulatory capital. Moreover, adopters would also be able to bear the credit

risk associated with prime borrowers who had previously paid rates that embodied the GSE capital requirement, rather than the lower amount of capital that would be demanded by the marketplace. Nonadopters would continue to be able to bear the credit risk of mortgages extended to the same types of borrowers that they have provided mortgages to in the past. This competitive process would, in the long-run, potentially eliminate the deadweight losses associated with the current framework of regulatory capital requirements for depositories and for securitizers, and thus lower mortgage rates for some borrowers. As a result, the indirect gain to adopters that follows from our assumption about pricing would be less, reducing the modest competitive effect that would have otherwise been implied.

### **6.3 WHAT IF DEPOSITORIES DESIRE TO MAINTAIN A “WELL-CAPITALIZED” STATUS?**

The Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 established the system of prompt corrective actions (PCA) to be taken with troubled insured depository institutions (other than credit unions). Under this system, risk-based capital ratios are used as a basis for categorizing depositories for purposes of prompt corrective action. “Well-capitalized” depositories are defined as those with a tier 1 risk-based ratio greater than 6 percent, a total risk-based capital ratio greater than 10 percent, and a tier 1 leverage ratio greater than 5 percent.<sup>112</sup>

The PCA system imposes more penalties on undercapitalized depositories as their capital ratios decline, including restrictions on deposit interest rates, elimination of brokered deposits, restrictions on asset growth, restrictions on inter-affiliate transactions, and required approvals for acquisitions, branching, and new activities. Although bank and thrift holding companies are *not* subject to the PCA system, bank holding companies are subject to minimum consolidated capital guidelines.

The fairly severe penalties associated with being designated as undercapitalized by bank or thrift supervisors could potentially increase depositories’ desire to hold capital above either prudent economic or regulatory capital. As noted in section 4.3 above, a reduction in a depository institution’s *minimum* regulatory capital requirement may not lead to much of a change in the

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<sup>112</sup>In contrast, “undercapitalized” depositories have a tier 1 risk-based capital ratio under 4 percent, a total risk-based capital ratio under 8 percent, or a tier 1 leverage ratio under 4 percent (3 percent for most depositories that have a composite supervisory rating equal to one).

depository institution's *actual* capitalization under such circumstances. Without the replacement of some equity holdings with debt financing, the implementation of Basel II capital standards would *a fortiori* lead to smaller competitive impacts than we have estimated.

After implementation of the Basel II framework, adopters and nonadopters alike would continue to be subject to PCA, regardless of whether the insured entities are banks or thrifts. To achieve "well-capitalized" status, for example, a depository would need to maintain at least a five percent tier 1 leverage ratio.<sup>113</sup> It is therefore plausible that depositories might target a leverage ratio in excess of this minimum. If such targets influence adopters' decision-making at the margin, Basel II implementation would have *much* smaller competitive effects than we have projected. Under such circumstances, adopters would continue to implement portfolio strategies just like those that would be used by nonadopters, regardless of whether they specialize in mortgage financing or other forms of financing, to meet or exceed the (fixed) risk-insensitive mortgage capital requirements that are the hallmark of current capital standards.

#### **6.4 SENSITIVITY ANALYSIS FINDINGS**

Because higher prudent economic capital estimates, more risk-sensitive mortgage pricing, and greater significance of PCA standards would each reduce, not increase, the potential competitive effects of Basel II implementation on mortgage markets, it is more than likely that we have overstated, not understated, such effects. Moreover, it is clear that developments in mortgage markets (e.g., more risk-sensitive pricing), innovations by depositories (e.g., more complex securitization techniques), and competition between adopters may dissipate any potential supernormal profits earned by adopters under the Basel II framework. Thus, speculation on whether the potential income gains from the implementation of Basel II capital standards flow in the long-run to adopters or homeowners would be highly uncertain, particularly in light of the foregoing discussion. However, we remain reasonably certain that nonadopters would be largely unaffected by the implementation of Basel II capital standards; the issues reviewed in this section would all move in the direction of strengthening that conclusion.

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<sup>113</sup>As indicated above, banks with a supervisory rating equal to one are subject to a minimum leverage ratio of 3 percent. For lower-rated institutions, however, the minimum tier 1 leverage ratio is 3 percent plus an additional cushion of at least 100 to 200 basis points.



## 7. CONCLUSION

Our conclusion is that it seems unlikely that Basel II implementation will have significant effects on residential mortgage market competition between adopters and nonadopters. The market has already effectively adjusted to a lower regulatory capital charge by using GSE-guarantees, by using other forms of securitizations, and by blending higher- and lower-risk mortgage portfolios to arbitrage the current one-size-fits-all capital regulations. If there were any effect on mortgage rates, such adjustments have already occurred. Moreover, depository institutions will still be subject to leverage requirements and prompt corrective actions, suggesting that depositories will continue to be conservative in their capital management, and thus would likely continue to blend mortgages and other assets.

Our results also suggest that the major competitive tension after the implementation of Basel II will be between the largest depositories and the GSEs. Because both Basel II regulatory capital requirements and adopters' estimates of the amount of prudent economic capital needed to back some high credit-quality loans may be less than the GSEs' regulatory capital required on such loans, the Basel II adopters may retain more mortgages on their balance sheet. To stem the wealth transfer from securitizers to Basel II adopters, the securitizers might respond by lowering the credit guarantee fees they demand from Basel II adopters. However, the appeal of GSE securitization may be mainly the liquidity associated with implicitly government-backed securities, suggesting that the adoption of Basel II might not alter current arrangements substantially. This competition between the largest depositories and the GSEs likely will not benefit the community banks and thrifts who are already at a competitive disadvantage relative to their larger peers because they cannot bilaterally negotiate their (GSE) guarantee fee. Moreover, it is far from clear that the lower guarantee fees for adopters would translate to lower mortgage rates for consumers given the small size of the changes relative to mortgage rates and the prevalence of uniform pricing in mortgage markets.

In addition, adopters of the Basel II (A-IRB) approach might have increased profits from some mortgages relative to nonadopters because they will capture some of the deadweight losses that occur under the current regulatory capital frameworks imposed on depositories and on securitizers. However, only a relatively small number of mortgages would likely be affected and

mortgage rates would remain unchanged. Importantly, the increased profits for adopters would not be direct income transfers from nonadopters of the new framework; instead, the adopters would capture the deadweight losses, while the nonadopters would likely maintain their market shares, particularly in the near-term.

Finally, to the extent that adopters seek a better credit agency rating than we assumed, that risk-based pricing in mortgage markets is more pervasive than we assumed, or that the system of prompt corrective actions impinges on depositories' decision-making more than we have assumed, competitive impacts from the implementation of the Basel II capital standards would be *smaller* than predicted. Indeed, potential income gains from capital cost savings could flow in the long-run not to adopters, but to homeowners through lower mortgage rates. Nevertheless, we remain reasonably certain that nonadopters would be largely unaffected by the implementation of Basel II capital standards.

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