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Abstract

Mortgage prepayments can contribute significantly to fluctuations in M2 growth rates. These mortgage prepayment effects are primarily driven by certain rules of mortgage-backed-security (MBS) insurers that require mortgage servicers to hold in M2-type deposits the prepayment proceeds due to MBS investors. This paper provides a methodology for estimating prepayment effects on M2. The effects are estimated separately for refinancing and home sales. The results indicate that excluding the mortgage prepayment effects from M2 produces smoother monthly growth rates. The stability of the relationship between money and GDP as measured by M2 velocity is also increased. Refinancing prepayments account for most of the prepayment effects on M2.

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1. INTRODUCTION and SUMMARY

The growth of M2 is affected by a range of fundamental factors, such as general economic activity, the opportunity cost of M2, and equity market fluctuations, as well as by certain special factors.[1] Special factors include unusual overseas currency shipments, the century date change (Y2K), September 11, 2001 terrorist attacks, and mortgage prepayments. Their effects are usually erratic and tend to increase the volatility of M2 growth, creating instability in its relationship to GDP. Since data for M2 are available at a higher frequency than GDP data, M2 can also serve as a leading economic indicator if its relationship with GDP is stable. Thus, it is important to account for the effects of special factors on M2. Mortgage prepayment effects on M2 are studied here.

Mortgage prepayments are a potentially important source of fluctuations in M2 growth. Over 2002 and 2003, the boom and bust of mortgage prepayments appear to have increased the volatility of M2 and, thus, reduced the stability of the relationship between M2 and GDP. This raises two questions: (1) how do mortgage prepayments contribute to volatility in M2; and (2) what is the size of their effects. This study attempts to address these two questions.

While there is a vast literature on mortgage prepayments, little attention has been given to their effects on the monetary aggregates. The prepayment literature is mostly concerned with individual mortgages and mortgage pools, and has focused on two areas: (1) determining factors that affect mortgage prepayments and modeling prepayment decisions (e.g. Green and Shoven, 1986; Richard and Roll, 1988; Hakim, 1997; Mattey and Wallace, 1998; Hayre, Chaudhary and Young , 2000; and J.P. Morgan, 2003); and (2) the effects of mortgage prepayments on the valuation of mortgage backed securities (MBSs) (e.g. Dunn and McConnell, 1981; Schwartz and Torous, 1989; Spahr and Sunderman, 1992; Stanton, 1995; and Jegadeesh 2000). Results from these studies indicate that mortgage prepayments are positively related to the spread between the contract interest rate to the prevailing mortgage rate, the length of periods of low mortgage rates, loan size, mortgage loan to house value (LTV) ratios, and appreciation of housing prices. Other

[1] M2 consists of currency in circulation, demand deposits, other checkable deposits, nonbank travelers checks, savings deposits (including money market deposit accounts), small time deposits, and retail money market mutual funds.

findings include mortgage prepayments being negatively related to mortgage rates, loan age, and MBS pool burnout rates; and prepayments having seasonality and calendar effects. These various effects on mortgage prepayments may depend on whether prepayments are for mortgage refinancing or housing sales. However, existing studies have not distinguished the reason for prepayments.

In a short article, Duca (1990) estimated the effects of refinancing prepayments for MBSs insured by Fannie Mae (FNMA) and Ginnie Mae (GNMA) on demand deposit growth. His estimation is based on prepayments derived as the differences between current new MBS issues and the changes in outstanding MBSs.[2] Duca found that adjusting demand deposits for estimated prepayment effects enhanced the accuracy of model forecasts for demand deposit growth. This paper differs substantially from Duca's article in terms of scope of the study, accuracy and completeness of the data, and the methodology used to estimate mortgage prepayment effects on M2.

The effects of mortgage prepayments on M2 growth are primarily driven by institutional rules that require mortgage prepayments be deposited in M2 accounts while being held by MBS pool servicers. As a result, when mortgage prepayments rise, M2 growth is boosted. When mortgage prepayments slow, M2 growth is depressed.

Mortgage prepayments held in M2 accounts cannot be measured directly but must be estimated from mortgage prepayments. Mortgage prepayment data are also limited (for example, see Duca 1990 and footnote 2 below), and prepayment effects on M2 depend on aggregate mortgage prepayments. A contribution of this paper is to estimate aggregate mortgage prepayments from historical data on mortgage originations reported under Home Mortgage Disclosure Act (HMDA). The HMDA data cover from 76 to 90 percent of monthly amounts of

[2] There are issues concerning the accuracy of prepayments data derived this way in terms of timing and inclusion. Mortgage data published by FNMA and GNMA are calculated based on an "internal reserve accounting" method, which records data for new issues, sales, and purchases in real time, but data on liquidations and mortgage outstanding balances with a one-month delay. Liquidation data released by all GSEs include different kinds of principal paid back, ranging from foreclosures, curtailments, scheduled and unscheduled repayments, etc., for multi-family and 1-4 single–family home mortgages. In addition, repurchases by lenders are included in liquidations but excluded from MBS outstanding balances, as lenders can buy a delinquent loan out of its MBS pool and keep it in portfolio. Thus, lender buyouts cause an under-statement of MBS outstanding balances and over-statement of liquidation/prepayment amounts. During a low mortgage rate period, such as in 2002, lenders have a strong

U.S. mortgage originations since the early 1990s with detailed information for individual mortgage originations.[3] Mortgage prepayments are caused primarily by refinancing and home sales. Prepayments and their effects on M2 are estimated for refinancings and home sales separately using the HMDA data. Refinancings and home sales generate different prepayment effects on M2.

The main contribution of the paper is the methodology used to estimate prepayment effects on M2. The estimation procedure can be briefly summarized as follows. Gross cash outs for mortgage refinancings (the difference between the loan origination and the outstanding balance of the old mortgage) are first estimated. Refinancing prepayments are obtained by subtracting the estimated gross cash out from mortgage refinancing originations. For transfers of existing homes, the ratios of the outstanding balances of sellers' existing mortgages to new mortgage purchase originations are used to obtain estimates of the home sellers' mortgage prepayments. Since only MBS servicers are required to deposit prepayments in M2, prepayments are split into two categories depending on whether or not the loans are securitized. Owing to differences in MBS insurers' institutional rules governing the handling of prepayments, mortgage prepayments for securitized-loans are broken down by the type of MBS insurer – FNMA, Freddie Mac (FHLMC), GNMA, and others (mostly private mortgage conduits).[4] The time that the prepayment proceeds remain in M2 accounts is estimated according to institutional rules by the respective MBS insurer type. The monthly average dollar amounts and time spent in M2 accounts determine the overall effects of mortgage prepayments on M2.

The results of this analysis indicate that M2 adjusted for mortgage prepayment effects, called adjusted M2, has smoother monthly growth rates, and its relationship with GDP as

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incentive to repurchase high-yield delinquent loans. In fact, the buyouts reached such a high volume that in January 2003, GNMA had to tighten its ruling by requiring at least a 90-day consecutive delinquent period for buyouts.

[3] HMDA data for each calendar year are reported annually on March 31 of the subsequent year by depository and nondepository home mortgage lenders and the data are not available for use until August or September. The data provide information on home mortgage applications, originations, and purchases for refinancing, home purchases, and home improvements. Information is reported on a loan-by-loan and application-by-application basis. Items reported include application date, origination date, if any, loan amount, loan type (conventional, FHA-insured, VA-guaranteed, etc.), loan purpose (refinancing, home purchase, or home improvement), whether loan sold in the reporting calendar year and type of loan purchaser.

[4] Conduits are the entities that buy mortgages and pool them into MBSs, and sell the MBSs to investors.

measured by M2 velocity is more stable than actual M2. Furthermore, the results reveal that refinancing prepayments account for most of the prepayment effects on M2.

The rest of this paper is organized as follows. Section 2 explains the flow of mortgage proceeds from lenders to MBS holders. Section 3 describes: (1) the estimation of monthly prepayments due to refinancing and home sales from HMDA mortgage originations; (2) the division of prepayments from refinancing and home sales between securitized and unsecuritized loans; and (3) the allocation of prepayments from refinancing and home sales to securitized-loans of the different MBS insurer types. Section 4 describes the estimation of monthly prepayment effects on M2 according to institutional rules of the different MBS insurers. Section 5 evaluates the dollar effects of monthly mortgage prepayments on M2 in term of smoothness of M2 growth and stability of M2 velocity. Section 6 concludes.

2. FLOW OF MORTGAGE PROCEEDS

Figure 1 shows the flows of mortgage proceeds and the disbursement of mortgage prepayments. The proceeds of new mortgages are typically sent to real estate settlement companies, who disburse prepayments to servicers of old mortgages and any free cash to mortgage refinancers or home sellers. *Prepayments of securitized mortgages are usually required to be kept in M2-type deposits of custodial accounts during a "float period" when the proceeds are held by MBS pool servicers*. Prepayments of third-party-serviced unsecuritized mortgages may be required to be deposited in M2-type accounts. However, prepayments of self-serviced unsecuritized mortgages are not required to be deposited in M2-type accounts. Thus, prepayments of unsecuritized mortgages do not necessarily affect M2.

After a float period, MBS servicers remit prepayment proceeds to FNMA, FHLMC, or trustees of privately insured MBSs. After keeping the funds for another float period, MBS insurers/trustees distribute them to MBS holders. In the second float period, FNMA and FHLMC usually invest the funds in non-M2 short-term financial instruments. Trustees of private-insured MBS pools receive prepayment proceeds from mortgage servicers and are required to keep them in M2-type trust accounts before distributions but the float periods are usually short, ranging one to seven days. For GNMA-insured MBSs, servicers do not remit their

collections to GNMA but keep the proceeds in demand deposits until distribution to MBS holders. *Thus, the main M2 effect for loans insured by the GSEs is during the first float period*.

Figure 2 illustrates institutional rules for remittances of proceeds collected from prepayments of mortgages under FNMA-insured MBSs. Prepayments received in a month by MBS servicers are kept in M2-type deposits until being remitted to the MBS insurer (or holders of GNMA-insured MBSs) in the following month. Thus, most prepayment proceeds are kept in M2-type custodial accounts at depository institutions for a period crossing two consecutive months, yielding first-month and second-month prepayment effects on M2.

3. MORTGAGE PREPAYMENT AMOUNTS

When the origination amount of a refinanced mortgage exceeds the outstanding balance of the corresponding old mortgage, the excess is called gross cash out. The dollar amount of the prepayment is the difference between the origination amount of the newly refinanced mortgage and the amount of gross cash out. Similarly, transfer of an existing home also results in a mortgage prepayment if the home seller has any mortgage on the house sold which is usually required to be paid off. The dollar amount of the prepayment is the outstanding balance of seller's existing home mortgage on the payoff date. As previously indicated, prepayments from MBSs being temporarily held by MBS servicers are normally required to be kept in M2-type deposits. This is the primary prepayment effect on M2.

When the gross cash out exceeds the sum of settlement costs and any payoffs to home equity debt, the excess amount are called free cash out. Borrowers can use free cash out as they wish. A home seller also has free cash when the sale price of the home exceeds the sum of the payoff to the old mortgage, home equity debt, and total transaction costs. Free cash out from refinancing and free cash received by home sellers can also stay in M2 deposits. In addition, mortgage settlements can have an effect on M2 because settlement companies are required to keep all funds collected at settlements briefly in M2-type deposits before disbursement. Thus, there can be secondary effects of mortgage prepayments resulting from free cash effects and the proceeds of mortgage settlements. To conserve space, only the primary effects of mortgage

prepayments on M2 are presented here.[5] Including mortgage prepayment secondary effects does not alter the basic results.

Mortgage refinancing and home purchases are motivated by different incentives. Refinancing activity is mainly driven by coupon rate gap, which is defined as the ratio of the weighted average coupon rate on the outstanding stock of mortgages (WAC) to the prevailing 30-year fixed mortgage rate.[6] Figure 3 indicates a positive relationship between the size of the coupon rate gap, and refinancing activity with about a one-month lag.[7] When the coupon rate gap is greater than 1.0, the volume of refinancing mortgage originations is boosted, resulting in three refinancing waves between 1995 and 2003: early 1996, 1998 to early 1999, and 2001 to 2003. Home purchases are affected by seasonality and income, in addition to the level of mortgage rates. Figure 4 shows a strong seasonality of home purchases and a weaker negative relationship with mortgage rates. Home purchases tend to rise in spring and peak in summer due to preferences to move when schools are closed. Home purchases decline in fall and reach the trough in winter due to year-end holiday effects. Increases in disposable income also are expected to have positive effects on home purchase since higher levels of income raise the affordability of home ownership.

Figure 5 shows how mortgage prepayments from refinancing and home sales are derived, separately, from values of HMDA mortgage originations. Monthly values of mortgage originations for refinancing and home purchases are obtained, respectively, by aggregating HMDA micro data for each month from1995 to 2003. HMDA data cover between 76 percent to 90 percent of monthly total U.S 1-4-family residential mortgage originations. As shown in Figure 5, the aggregated mortgage originations for refinancing and for home purchases are first blown up with the inverse of coverage ratios. The prepayments due to refinancing and transfer of homes are then derived separately following the last three steps in Figure 5:

1. Derive prepayments by netting out some portions of mortgage originations using:

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[5] The secondary effects of mortgage prepayments are estimated in O'Brien (2004).

[6] Following Richard and Roll (1988) and J.P. Morgan Securities Inc. (2003), a ratio of the two rates is used here instead of the difference between the two rates. In term of percent savings (percent change in the present value of the loan), the ratio measure is a better indicator of mortgagor's refinancing incentives than the difference.

[7] The correlation coefficient between one-month-lag coupon rate gaps and the values of HMDA refinancing mortgage originations increases steadily from .64 for the ten-year span of 1994-2003 to .86 for the three-year span of 2001-2003.

a. Ratios of monthly gross cash out to refinancing mortgage originations; and

b. Ratios of home sellers' outstanding balances of existing mortgages to home purchasers' new mortgage originations.

2. Split prepayments from step 1 into securitized (MBS) and unsecuritized (whole) mortgage loans, based on shares of sold loans reported on HMDA with adjustments for year-end reporting bias; and

3. Allocate prepayments from securitized loans among the four types of MBS insurers: FNMA, FHLMC, GNMA, & others.

These three steps are described next.

3.1. Prepayments by loan purpose

3.1.a Gross cash out ratios for refinancing

Gross cash out ratio in month t, $Rgco_t^r$, is defined as the ratio of the dollar amount of gross cash out to the total value of loan originations for refinancing in the month. Gross cash out ratios are affected by financial market conditions and income factors. The financial market factor is the coupon rate gap, $Rgap_t$, measured as the ratio of WAC divided by the prevailing 30-year fixed mortgage rate, Rm_t.[8] When the coupon rate gap is above 1.0, refinancings are mainly to reduce loan rates, not to extract cash, and thus cash out ratios should fall. When the coupon rate gap is below 1.0, refinancings to obtain a rate reduction peter out. The refinancings that take place are more likely to be done by homeowners who need cash, suggesting that cash out ratios should rise. Thus, the expected relationship between gross cash out ratios and coupon-rate gaps is negative.

Because refinancing applications often take more than one month to process, current-month refinancing originations may depend on previous-month coupon rate gaps. HMDA data show the following average processing speeds between application and origination dates for refinancing mortgages: about 20 percent processed within 15 days, 30 percent processed between 15 and 30 days, 30 percent between 30 and 45 days, 10 percent between 45 and 60 days,

[8] The monthly weighted average coupon rate paid on pools of securitized home mortgages, published by Citigroup, is used as a proxy for the weighted average coupon rate on all outstanding mortgages. Rm_t is a monthly average of

and less than 10 percent after 60 days. This pattern suggest monthly originations may be related to the coupon rate gaps in the current and one or two preceding months. However, there may also be a lag in home owners' refinancing decisions in response to changes in the coupon rate gap. Two monthly lags were tested, with the second-month lag having no incremental explanatory power and a very small coefficient. Hence the current and one-month lag coupon rate gaps are used here.

Gross cash out ratios may also be negatively affected by disposable income, since higher incomes reduce home owners' need to take cash out of their home equity. In addition, these ratios could be influenced by house prices, as price appreciation provides more home equity that can be drawn upon. However, both house price and disposable income series are not statistically significant in the regression. Thus, monthly gross cash out ratio, $Rgco_t^r$, can be expressed by:

[3.1.1] $$Rgco_t^r = a + bRgap_t + cRgap_{t-1} + u_t,$$

where u_t is assumed to be an i.i.d. Normal variate, N(0, σ^2).

Historical data on gross cash out ratios are only available at a quarterly frequency.[9] Quarterly gross cash out ratios, $Rgco.q_t^r$ range between 6 percent to 26 percent (average about 14 percent) from 1995Q1 to 2003Q4. In order to estimate monthly regression coefficients in Equation [3.1.1] based on quarterly historical data, an equivalent quarterly version is constructed by expressing a quarterly gross-cash-out ratio as a weighted sum of its monthly counterparts:

[3.1.2] $$Rgco.q_t^r \equiv \sum_{i=1}^{3} (Rgco_{it}^r * \omega_{it}^r),$$

with

[3.1.3] $$\omega_{it}^r \equiv Vorg.h_{it}^r / (\sum_{i=1}^{3} Vorg.h_{it}^r)$$

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weekly average rates weighted by the number of days of the week in the month, on new 30-year fixed-rate home mortgages in Freddie Mac's weekly surveys.

[9] Annual gross cash out ratios are based on published data from Freddie Mac; quarterly ratios are based on a method described in appendix E of Greenspan and Kennedy (2005). Due to a lack of information, they are used as an estimate for total refinancing loans, i.e. the sum of all conforming loans and non-conforming loans.

and where t is the t-th quarter, i is the i-th month in quarter t, and $Vorg.h_{it}^{r}$ is the monthly HMDA refinancing originations for the i-th month in the t-th quarter. Substituting Equation [3.1.1] for $Rgco_{it}^{r}$ in Equation [3.1.2], we have:

[3.1.4] $$Rgco.q_t^r = a + bRgap.q_t + cRgap.q_{i-1,t} + v_t$$

where $Rgap.q_t \equiv \sum_{i=1}^{3} Rgap_{it} * \omega_{it}^{r}$, $Rgap.q_{i-1,t} \equiv Rgap_{3,t-1} * \omega_{1,t}^{r} + \sum_{i=1}^{2} Rgap_{i,t} * \omega_{i+1,t}^{r}$

and $v_t \equiv \sum_{i=1}^{3} u_{it} * \omega_{it}^{r}$. The three coefficients on r.h.s. of Equation [3.1.4] are the same as those on the r.h.s. of Equation [3.1.1]. Historical series were constructed for $Rgap.q_t$ and $Rgap.q_{i-1,t}$ using monthly data (for $Rgap_{it}$ and $Vorg.h_{it}^{r}$) for the estimation of Equation [3.1.4].

Table 1 shows the regression results for quarterly gross cash out ratios Equation [3.1.4]. The coefficients of current and one-month-lagged coupon rate gaps are negative but significant only for the lagged variable.[10] The effect on gross cash out is larger from the lagged coupon rate gap than the current month gap, which is consistent with the HMDA data on processing speeds.

Monthly gross cash out ratios are first derived based on Equation [3.1.1] using values of the coefficients estimated for Equation [3.1.4] (Table 1) and actual current-month and one-month lagged coupon rate gaps. The resulting monthly ratios are then adjusted such that their weighted sum in each quarter (with weights ω_{it}^{r}) is equal to their actual historical quarterly ratio, with the pattern of their monthly movements within quarters preserved. Detailed steps are discussed in Appendix A. Dollar monthly gross cash outs, $Vgco_t^r$, are calculated by multiplying the adjusted monthly gross cash out ratios with monthly dollar amounts of blown-up HMDA refinancing originations, $Vorg_t^r$, i.e.

[3.1.5] $$Vgco_t^r = Vorg_t^r * Rgco_t^r .$$

3.1.b Ratios of home sellers' prepayments to home purchasers' mortgage originations

[10] Estimating how the effects of coupon rate gaps on gross cash out ratios are distributed over the current and the lagged coupon rate gaps is subject to some imprecision. Using an alternative series of actual gross cash out ratios, which are confidential, the coefficients for both the current and the lagged coupon rate gaps are negative and significant. Nonetheless, the resulting conclusions of this paper remain the same.

Monthly historical data for home purchase mortgage originations are obtained from HMDA reports. Total home sellers' prepayment is equal to total payoff of home sellers' old mortgage balances. Due to limited data availability, historical data for total home sellers' prepayments are derived only at a quarterly frequency. However, historical quarterly ratios of prepayments to home mortgage purchase originations are fairly stable. They range from 38.9 percent to 46.5 percent from 1995Q1 to 2003Q4, and average 42.5 percent for 1995Q1 to 2003Q4.[11] Given the temporal stability of the ratios, monthly ratios θ_t, which are needed to derive monthly mortgage prepayments, are estimated simply as the linear interpolations of their quarterly counterparts.

Total prepayments from refinancing originations of MBS mortgages on U.S. 1-4 family homes, TPP_t^r, are equal to total values of the blown-up HMDA refinancing originations, $Vorg_t^r$, minus total amounts of gross cash out, $Vgco_t^r$ as indicated in Equation [3.1.6] below. Total prepayments of MBS mortgages from sales of existing U.S. 1-4 family homes, TPP_t^p, are estimated as a portion (θ_t) of the value of the blown-up HMDA home purchase loan originations, $Vorg_t^p$ (Equation [3.1.7]). Total prepayments of U.S. (1-4 family) home mortgages are then the sum of prepayments for the two loan types.

[3.1.6] $TPP_t^r = Vorg_t^r - Vgco_t^r$, since $Vorg_t^r = TPP_t^r + Vgco_t^r$;

[3.1.7] $TPP_t^p = Vorg_t^p * \theta_t$.

3.2 <u>Prepayments by loan securitization</u>

In the second step, prepayments are split into two categories depending on whether the prepaid mortgages are securitized. Prepayments from securitized mortgages will affect M2. Prepayments from unsecuritized loans serviced by mortgage originators themselves are immediately available funds for the lenders and are assumed to have no effects on M2. Prepayments from unsecuritized mortgages serviced by third-parties may or may not affect M2.

[11] Quarterly ratios were derived by James Kennedy at the Federal Reserve Board, based on data from the American Housing Survey (AHS), and the Residential Financing Survey (RFS), conducted by the U.S. Bureau of Census (USBC) for the Department of Housing and Urban Development (HUD).

Since only a small portion of unsecuritized mortgages are serviced by third-parties, any possible prepayment effect on M2 is small and is excluded from this analysis.[12]

Because HMDA data indicate only whether a mortgage origination is sold or not, we assume that loans sold are securitized and loans not sold are unsecuritized whole loans held by the originators. Monthly shares of loans sold in each year of origination are calculated from HMDA micro data. To limit interest rate risk, mortgages to be securitized are usually sold and securitized within ninety days after originations. Loans originated in one calendar year and sold in a subsequent year, in particular those originated near year end, are reported as not-sold on HMDA reports. As a result, the monthly sold-loan shares of HMDA data toward year end are biased downward and reflected in year-end negative spikes in Figures 6 and 7. To correct the bias, we adjust upward sold-loan shares for the affected months. Adjustments are estimated by loan purposes, based on the estimated regression relationships between sold-loan shares and levels of mortgage rates (adjustment procedures are discussed in Appendix C). As indicated in Figures 6 and 7, the adjusted sold-loan shares do not exhibit the year-end reporting bias.

Shares of prepayments to refinanced, $Rloan.sold_t^r$, (home purchase, $Rloan.sold_t^p$) mortgage originations are assumed to be the same regardless of whether or not mortgages are securitized. Under this assumption, prepayments from securitized mortgages for refinancing, $PP_{mbs,t}^r$, and home sales, $PP_{mbs,t}^p$, are equal to total prepayments times the bias-adjusted shares of loans sold and expressed by

[3.2.1] $$PP_{mbs,t}^r = TPP_t^r * Rloan.sold_t^r \text{, and}$$

[3.2.2] $$PP_{mbs,t}^p = TPP_t^p * Rloan.sold_t^p .$$

[12] The unsecuritized loans serviced by third-parties will have prepayment effects on M2 if the third-party servicers follow similar servicer guidelines of MBSs. Anecdotal information suggests that only a small portion of total portfolio-held loans are serviced by third-party servicers. Prepayment effects on M2 from portfolio-held mortgages are estimated in O'Brien (2004). Exclusion of prepayment effects from portfolio-held loans does not alter the basic results of the analysis.

It is possible that a loan originator may securitize its own-originated loans and keep some of the MBSs in its portfolio as investment. It is also possible that a small portion of sold loans may end up being unintentionally held unsecuritized in conduits' portfolios. For examples, conduits, such as Fannie Mae, Freddie Mac, and a few investment banking firms, hold both MBSs and unsecuritized loans in their portfolios. However, most unsecuritized loans held in the portfolios are conduits' inventories for future securitization. Thus, shares of sold loans serve as a good proxy for shares of securitized loans.

3.3 Prepayments by type of MBS insurers

Prepayments from securitized loans are further allocated among FNMA, FHLMC, GNMA, and others (mostly private conduits) because of differences in the MBS insurers' institutional rules governing the handling of prepayments, as described in Appendix B. An observable breakdown of prepayments cannot be derived directly from the HMDA data.[13] We use total monthly mortgage liquidations for the three GSEs, $LQ_{i,t}$ for i=1,2,3, and prepayments of collateralized residential mortgage obligation (CMO) for private conduits to derive the prepayment share of each MBS insurer type.[14] The share of any insurer type in total liquidations, $\rho_{i,t}$, for i =1,…, 4, is calculated as in Equation [3.3.1]. The shares are then used to break out prepayments from sold-loans by MBS insurer, as shown in Equation [3.3.2] for mortgage refinancing and Equation [3.3.3] for home purchases.

[3.3.1] $$\rho_{i,t} = LQ_{i,t} / \sum_{i=1}^{4} LQ_{i,t} ; \qquad \text{for i= 1,…4;}$$

[3.3.2] $$PP^{r}_{mbs,i,t} = PP^{r}_{mbs,t} * \rho_{i,t} , \qquad \text{for i= 1,…4;}$$

[3.3.3] $$PP^{p}_{mbs,i,t} = PP^{p}_{mbs,t} * \rho_{i,t} ; \qquad \text{for i= 1,…4.}$$

4. PREPAYMENT EFFECTS ON M2

As was described earlier in Section 2, mortgage prepayments affect M2 during the float period in which mortgage proceeds are kept in M2 deposits. The length of the float period varies with institutional rules of MBS insurers, which in turn affect the magnitude of prepayment effects on M2. In addition, mortgage origination dates (at the beginning, middle, or end of a

[13] The breakdown is available for HMDA mortgage originations. However, the insurers of the new mortgages may not be the insurers of old MBS pools from which prepayments came.

[14] Liquidations are published monthly by FNMA and FHLMC. They generally include, with some variations, mortgage prepayments, delinquent mortgage loans and bloom reset mortgage loans out of MBS pools for all 1-4 single family and multi-family MBSs, and whole loans held in insurers' portfolio. Liquidations for GNMA are derived as the difference between new MBS issuance and the change in its outstanding MBS balances. Actual prepayment data for private conduits are the aggregates of available micro data for publicly-traded deals for all existing residential CMO pools, obtained from 'http://www.absnet.net/'.

Due to the use of 'internal reserve accounting' by FNMA and GNMA, the timing of their published liquidation data lag their actual occurrence by one month, resulting in the June prepayments being included in their July liquidations, instead of in their June liquidation data. For this reason, liquidation data for the two GSEs are shifted back one month (e.g. July liquidation shifted back to June) for the calculation of shares in Equation [3.3.1].

month) also affect how long prepayment funds stay in M2 deposits. As a result, prepayments can sit in M2 deposits anywhere from one to fifty-five days. Prepayments received by MBS servicers at the beginning of a month tend to stay longer in M2 accounts than those received near the end of the month. To estimate the average time length that prepayments would stay in M2 accounts, we need to know within-month distributions of prepayments. Within-month distributions of mortgage prepayments to servicers are estimated from daily HMDA mortgage origination dates. The origination dates reported on HMDA are advanced by up to 6 days to reflect the actual payoff dates.[15] Within-month distributions of prepayments are then incorporated with the institutional rules of MBS insurers – FNMA, FHLMC, GNMA, and private insurers -- to get M2 effects.

4.1 FNMA

There are various remittance schedules (see Appendix B) available to mortgage servicers of FNMA-insured MBSs. Most prepayments collected in a month by servicers are remitted to FNMA sometime in the following month. Only the prepayments from a portion of unsecuritized mortgages in its portfolio are remitted on the day of receipt (under the Actual/Actual remittance schedule of Appendix B). Thus, most prepayment proceeds collected from FNMA-insured MBSs have first-month and second-month prepayment effects on M2.

The first-month (or the current-month) prepayment effect on M2 depends on the total value of prepayments and the daily within-month distribution of the prepayments received by servicers. It is estimated as a weighted average of daily prepayments collected by mortgage servicers in the month. The weights equal the fractions of the month remaining on the respective

[15] Origination dates are defined here as the dates on which new loans are issued; while settlement dates are defined as the dates on which borrowers complete the loan process. According to a survey by Washington Mutual, settlement dates are usually reported as 'origination dates' on HMDA. To reflect the true dates of loan originations, we advance HMDA origination dates before calculations. The number of days used for advancing is depending on the day of the week of settlement dates, after accounting for the three-business-day right of recision for refinancing. For Monday refinancing-settlement dates, borrowers' right of recision expires at mid-night of Thursday, so settlement companies will not receive funds until Friday, nor will they record deeds of trust and send out payoffs until that day. For Tuesday settlement dates, borrowers' right of recision expires at mid-night of Friday, so deeds of trust recording, receipt of lenders' funds, and old loan payoffs are normally done on the following Monday. The process is usually completed in one day because settlement documents are signed in advance. Thus, the true loan origination (or payoff) dates are at least four days after Monday settlement dates and six days later for other settlement dates, if there are no holidays in-between. Origination (Payoff) dates used to calculate daily percentage distributions of HMDA refinanced loans are, thus, shifted forward by at least four to six days depending on the day of the week.

payoff dates. Because prepayment amounts from MBSs are derived only on a monthly basis, the daily distributions of prepayments over the month are not available. Thus, daily percentage distributions of HMDA mortgage originations computed with shifted origination dates for each month for 1995 – 2003 are used as proxies for daily percentage distributions of prepayments.[16] The weighted averages of daily percentage distributions of prepayments, W_{tt} , are then multiplied by FNMA monthly prepayments for 1995 – 2003 to obtain estimates of the FNMA first month prepayment effects.[17] Daily percentage prepayments distributions for refinancing and for purchases are derived separately, because of the difference in their distribution patterns.

The effect of prepayments in month *t* on M2 in month *t+1* (the second-month effect) will depend on the daily distribution of remittances of the proceeds to FNMA in the second month. The second month effects on M2 will equal a weighted average of daily remittances, with the weights equal to the fractions of the month expired on the respective remittance dates. Unlike daily prepayment distributions, remittance distributions depend on remittance schedules selected by MBS servicers, and information on the distributions for a sample month was provided by FNMA (see Appendix B, item 5)

The total effect on M2 in month *t* of refinancing (purchase) prepayments from FNMA-insured MBSs equal the current-month effects of the refinancing (purchase) prepayments received in month *t* plus the second-month effects of refinancing (purchase) prepayments received in month *t-1* by servicers. The total effect on M2 in month *t* on FNMA-insured MBS

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[16] Because of interest rate effects, the within-month pattern of either refinancing originations or purchase originations can be different for the same month in different years, so monthly weights are derived for each month in each year for 1995 to 2003 for this analysis.

[17] To be more precise, define p_{jt} as the prepayment proceeds from FNMA-insured MBSs on day *j* in month *t*, J_t as the number of days in month *t*, and PE_{tt} is the effect on M2 in month *t* from FNMA prepayments in month *t*. Then, $PE_{tt} = \sum_{j=1}^{J_t} p_{jt}(J_t - j + 1)/J_t$. Using HMDA daily originations, daily origination rates are obtained for each month: $p_{jt}^{HMDA} / P_t^{HMDA}$, where $P_t^{HMDA} = \sum_{j=1}^{J_t} p_{jt}^{HMDA}$. The FNMA prepayment effects on M2 in month t are estimated by using $PE_{tt}^{e} = P_t \sum_{j=1}^{J_t} \left(p_{jt}^{HMDA} / P_t^{HMDA} \right)(J_t - j + 1)/J_t = P_t.W_{tt}$, where $P_t = \sum_{j=1}^{J_t} p_{jt}$ is the prepayment proceeds received in month

prepayments due to both refinancing and purchases is equal to the sum of the total effect in month *t* from refinancing prepayments and that from purchase prepayments.

4.2 GNMA

Similar to FNMA's standard remittance schedule, all prepayments collected by servicers of GNMA-insured MBSs in a month are distributed to MBS holders in the following month, giving rise to first-month and second-month effects on M2. The within-month distributions of prepayments from GNMA-insured MBSs are assumed to be the same as those from FNMA-insured MBSs. Under this assumption, the weights for the average first-month prepayment effect on M2 derived from HMDA data for FNMA-insured MBSs are used for GNMA-insured MBSs.

As indicated in Appendix B, GNMA-insured mortgages are in two types of MBS pools – GNMA I and GNMA II. Servicers for GNMA I MBSs distribute the prepayment proceeds collected in the previous month directly to the MBS holders on the 15th of the current month, while servicers for GNMA II MBSs distribute the prepayments received in previous month on the 20th of the current month. The composition of GNMA MBSs issued in 2003 is about 71 percent for GNMA I MBSs, and 29 percent for GNMA II MBSs. The monthly weight for the second-month effect on M2, therefore, is estimated as [(0.713*14) + (0.287*19)] / (number of days in the month). The total effect on M2 in a month for GNMA-insured MBSs is derived in the same way as FNMA-insured MBSs.

4.3 FHLMC

As described in Appendix B, mortgage servicers must remit all prepayments from refinancing or purchases to FHLMC by the 5th business day after the payoff date. The prepayments must be initially deposited into custodial accounts (demand deposits), but the proceeds may be withdrawn, on the same day, to be re-invested in fed funds or repurchase agreements. However, the proceeds must be re-deposited into the custodial accounts at least one

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t by servicers of FNMA-insured MBSs, and $W_{tt} = \sum_{j=1}^{J_t} \left(p_{jt}^{HMDA} / P_t^{HMDA} \right)(J_t - j + 1) / J_t$ is the weighted average daily distribution of prepayments for the first-month effect in month t.

business day before the due date, unless the remittance is made before the due date. Thus, the minimum duration of the proceeds staying in demand deposits is one business day.

The prepayments received at least four business days before month end by servicers for FHLMC-insured MBS pools can have only the first-month effect on M2, while those received by the servicers within three business days before month end have only the second-month effect on M2 if all servicers keep the prepayments in demand deposits for a minimum duration. For this analysis, the proceeds are assumed to be in demand deposits on the 1st and 5th days after the payoff date. Under this assumption, the proceeds received from the 1st day of the month to the 6th day before month-end date are in demand deposits for two nights in the month, and those received on the rest of the month are in demand deposits for one night in the current month and one night in the following month.

The weighted average of daily percentage distributions of prepayments for FHLMC-insured MBSs, W_{tt}, and the effects on M2 in month *t* and month *t+1* from month *t* prepayments are calculated following the methodology used for FNMA, based on the FHLMC prepayment options and remittance rules described above.

4.4 Private conduits

Based on information gathered from prospectuses of private-insured MBS pools and analysts at some investment banking firms, servicers for private insured MBS pools are also required to deposit their float of mortgage collections in some type of M2 accounts. Their remittance dates for the previous-month mortgage prepayments are concentrated on the 25th day of the current month. About 90 percent of their prepayments are remitted on that date, with the remaining 10 percent on the 20th day of the current month.[18] Hence, similar to prepayments from GSE-insured MBSs, prepayments from private-insured MBSs have first and second month effects on M2. The weights used to derive the first-month effects of their prepayments on M2 are identical to those derived from HMDA data and used for FNMA or GNMA, under the assumption that daily percentage distributions of within-month prepayments for private-insured MBSs are the same as those for GSE-insured MBSs. The second month effects for private MBSs on M2, therefore, is estimated as [(0.9*24) + (0.1*19)] / (number of nights in the month).

Thus, total effects of prepayments from private mortgage deals are estimated with the same method as that for the GSEs.

4.5 <u>Total prepayment effects on M2</u>

The primary effects of total prepayments of all U. S. securitized refinancing (purchase) mortgages for 1-4 family homes on M2, $TPE.M2_t^r$ ($TPE.M2_t^p$), are the sum of the prepayment effects from the loans insured by each of the four types of MBS insurers, $PE.M2_{i,t}^r$ ($PE.M2_{i,t}^p$) for i=1,…4, shown in Equations [4.5.1] and [4.5.2] below. Equation [4.5.3] shows that the primary effects (in dollar amounts) of total prepayments of all U. S. MBS mortgages on M2, $TPE.M2_t$, are the sum of the prepayment effects from those of prepayments from both refinancing ($TPE.M2_t^r$), and purchase mortgages ($TPE.M2_t^p$). Contributions of the primary effects on monthly M2 growth due to MBS prepayments for refinancing, $TPE.M2gr_t^r$, (home purchases, $TPE.M2gr_t^p$) are calculated as the monthly changes in total dollar effects divided by M2 levels in the previous month, Equations [4.5.4] and [4.5.5]. Equation [4.5.6] indicates that contributions of total MBS prepayment primary effects on monthly M2 growth, $TPE.M2gr_t$, are equal to the sum of those from both refinancing and home purchases.

[4.5.1] $$TPE.M2_t^r = \sum_{i=1}^{4} PE.M2_{i,t}^r .$$

[4.5.2] $$TPE.M2_t^p = \sum_{i=1}^{4} PE.M2_{i,t}^p .$$

[4.5.3] $$TPE.M2_t = TPE.M2_t^r + TPE.M2_t^p .$$

[4.5.4] $$TPE.M2gr_t^r = \Delta TPE.M2_t^r / M2_{t-1} .$$

[4.5.5] $$TPE.M2gr_t^p = \Delta TPE.M2_t^p / M2_{t-1} .$$

[4.5.6] $$TPE.M2gr_t = \Delta TPE.M2_t / M2_{t-1} = TPE.M2gr_t^r + TPE.M2gr_t^p .$$

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[18] Mortgage prepayment data are derived from total outstanding balance of all publicly traded private MBS deals as of July 2004, by Credit Suisse First Boston.

5. EVALUATION OF MORTGAGE PREPAYMENT EFFECTS ON M2

5.1 Effects of mortgage prepayments on M2

Table 2 shows the dollar effects of total mortgage prepayments from MBSs on M2, and the separate effects of refinancing alone and of home sales alone. The dollar effects of total prepayments on M2, column (5), peak in August 2003 at $171.8 billion but drop 61 percent by year end to $67.5 billion. Columns (6) and (7) show, respectively, the breakdown of total dollar effects by loan purpose -- refinancing and home purchases. Columns (8) and (9) present, respectively, the shares of refinancing and purchase dollar effects. These columns clearly indicate that during mortgage refinancing waves -- December 1995 through May 1996, the first four month of 1997, October 1997 through July 1999, and February 2001 through December 2003 -- the dollar effects of mortgage prepayments on M2 from refinancing dominate those from home sales, and conversely during the other periods.

Table 2 also shows levels of actual s.a. M2 and adjusted M2. Three alternatively adjusted M2 levels, columns (2) to (4), are computed as actual M2 levels, column (1), minus the dollar prepayment effects on M2, respectively, due to both refinancing and home sales, column (5), due to refinancing alone, column (6), and due to home sales alone, column (7).

Table 3 presents contributions of mortgage prepayment effects to annualized monthly M2 growth rates, which measure the ratios of current monthly changes in dollar prepayment effects to actual M2 levels in the previous months, Equation [4.5.6]. Contributions from total (refinancing and home sale) prepayment effects on M2 growth rates, column (5), range from +3.9 percentage points to -8.2 percentage points in the nine years from 1995 to 2003. Columns (6) and (7) show the separate contributions to M2 growth rates, respectively, from refinancing and home sales. Column (6), also Figure 8, implies that the contributions to M2 growth from refinancing prepayments are volatile and sometimes large during large refinancing periods. They account for most of M2 volatility induced by mortgage prepayments. In contrast, the contributions from home sales, column (7), also Figure 9, are small (no more one half percentage point) and stable, although seasonal.

Table 3 also shows annualized growth rates of actual M2 and growth rates of three alternatively adjusted M2. Growth rates of three adjusted M2, columns (2) to (4), are computed,

respectively, as the annualized percentage changes of the three corresponding adjusted M2 levels, columns (2) to (4) of Table 2.[19] Table 3 and Figure 10 clearly reveal that monthly growth of M2 adjusted for total prepayment effects is less volatile than actual M2 growth. In particular, during heavy refinancing period of 2002 and 2003, an exclusion of prepayment effects substantially reduces the magnitudes of the fluctuations of M2 growth rates. A comparison of column (2) with column (3) indicates that the growth pattern of M2 adjusted for contributions of total prepayment effects are similar to that adjusted for refinancing prepayment effects. This is because refinancing prepayment effects dominate total prepayment effects. As a result, growth pattern of M2 adjusted for purchase prepayment effects, column (4), resembles that of actual M2, column (1).

5.2 Comparison of smoothness of M2 growth rates

There is a presumption that mortgage prepayments have boosted M2 growth during refinancing surges and depressed them when refinancing subsided. Consistent with this presumption, the results of this analysis indicate that monthly growth rates of adjusted M2 are smoother than actual M2 growth rates.

As expected, the standard deviations in Table 4 indicate that monthly growth rates of M2 adjusted for effects of total mortgage prepayments and those of M2 adjusted for refinancing prepayments have less variation than actual M2, in the period of 1995 through 2003, particularly, in 2002 and 2003. The differences are not statistically significant for the three-year period of 2001 through 2003 and the nine-year period of 1995 through 2003, based on results of F-tests for the standard deviations of actual M2 and adjusted M2. However, excluding the growth rates of September and October of 2001, when M2 growth was distorted in the aftermath of the terrorist attacks, the two adjusted M2 are statistically less variable than actual M2 at a 2.5% level for the three-year period of 2001 through 2003, and at a 5% level for the nine-year period of 1995 through 2003, based on F-test results. Nonetheless, column (4) in Table 4 implies that there is little difference between the variation of actual M2 and that of M2 adjusted for the effects of purchase prepayments.

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[19] They can also be computed directly from Table 3 as growth rates of actual M2, column (1), minus, respectively, contributions of prepayment effects on M2 from both refinancing and home sales, column (5), contributions from

The coefficients of variations of M2 adjusted for total prepayment effects and those of M2 adjusted for the refinancing prepayment effects are marginally smaller than that of actual M2 for the three-year period of 2001 through 2003 and nine-year period of 1995 through 2003.

Columns (5) to (7) in Table 4 show, respectively, standard deviations of the effects of total prepayments, refinancing prepayments, and purchase prepayments, which imply that variation of refinancing prepayment effects accounts for most of the effects of total prepayments. So do the coefficients of variations of the effects of total prepayments, column (11), and refinancing prepayments, column (12). Column (7) indicates that variation of purchase prepayment effects is small. The results are consistent with the variations of actual M2 and adjusted M2.

5.3 Comparison of stability of M2 velocity

The link between money and GDP is presumed to be stable over time under normal conditions. Thus, if mortgage prepayments affect M2 growth rates, then the relationship between adjusted M2 and GDP should be more stable than that between actual M2 and GDP.

Table 5 and Figure 11 present quarterly velocities of actual M2 and the three alternatively adjusted series for M2. Velocity of M2 adjusted for effects of total prepayments and velocity of M2 adjusted for only refinancing prepayments tend to be less variable than velocity of actual M2. In particular, during high refinancing periods, the magnitude of fluctuations of M2 velocity is greatly reduced by adjustments for prepayment effects. Table 6 shows the standard deviations of velocity of actual M2 and adjusted M2. The standard deviations of velocity of M2 adjusted for total prepayment effects and those of M2 adjusted for only refinancing prepayment effects are smaller than those of actual M2 for the three-year period of 2001 to 2003, and the nine-year period of 1995 to 2003, but the differences are not significant based on F-test results. However, there are very little differences between standard deviations of velocity of actual M2 and those of M2 adjusted for only purchase prepayment effects.

Table 6 also presents the coefficients of variation of the velocity of various M2. The coefficient of variation of the velocity of M2 adjusted for total prepayment effects and those of M2 adjusted for only refinancing prepayment effects are smaller than those of actual M2 for the

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refinancing only, column (6), and contributions from purchase only, column (7).

three-year period of 2001 to 2003 and the nine-year period of 1995 to 2003. Hence, the results indicate that the velocity of adjusted M2 is more stable than that of actual M2.

6. CONCLUSIONS

This analysis describes the methodology used to estimate mortgage prepayment primary effects on M2, based on micro data from HMDA for1995 to 2003. The two major sources of prepayments, refinancing and home sales are included and their effects are measured separately.

The results suggest that mortgage prepayments indeed affect M2 growth. Adjusted M2 has smoother monthly growth rates than actual M2. Variation from refinancing prepayment effects on M2 accounts for most of the variation of total prepayment effects. There is little difference between the variation of actual M2 and that of M2 adjusted for the effects of home-sale prepayments. Further, the results clearly show that stability of the relationship between money and GDP as measured by M2 velocity is increased after excluding the primary effects of mortgage prepayments from actual M2. To conserve space, secondary effects of mortgage prepayments on M2, such as from free cash effects and settlement effects, were not included in the estimates. Inclusion of the secondary effects of mortgage prepayments does not alter the conclusion of the study (O'Brien, 2004).

HMDA data are available usually with about an eight-month lag. To analyze mortgage prepayment effects on M2 for periods for which HMDA data are not yet available, the methodology described in this study can be applied to forecasts of mortgage originations. Such forecasts may be produced from econometric models, that link timely mortgage application data published by the Mortgage Bankers Association of America (MBAA) to the mortgage origination data from HMDA (Lehnert, 2002).

APPENDIX A. DERIVATION OF MONTHLY GROSS CASH OUT RATIOS

Monthly gross cash out ratios are derived based on the following steps:

1. Derive monthly gross cash out ratios ($Rgco.e_t^r$) based on Equation [3.1.1] using values of the coefficients estimated for quarterly gross cash out ratios of Equation [3.1.4] (Table 1), and actual current-month and one-month-lagged coupon rate gaps.
2. Take quarterly weighted averages (as specified in Equations [3.1.2] and [3.1.3]) of the estimated monthly ratios from step 1 to get the estimated quarterly gross cash out ratios ($Rgco.e.q_t^r$).
3. Calculate adjustment factors as the ratios of actual quarterly gross cash out ratios to the estimated quarterly ratios from step 2 as below:

   $$Rgco.adj_t^r = Rgco.q_t^r / Rgco.e.q_t^r .$$

4. Obtain the adjusted monthly gross cash out ratio ($Rgco_t^r$) by multiplying the estimated monthly gross cash out ratios from step 1 with the ratios produced from step 3:

   $$Rgco_t^r = Rgco.e_t^r * Radj.gco_t^r .$$

APPENDIX B. INSTITUTIONAL RULES OF MBS INSURERS

I. Fannie Mae's (FNMA's) Portfolio Holdings and its Guaranteed MBSs

1. Flow of mortgage payments -- interests, and scheduled and unscheduled principals (prepayments)

   Home owners (or settlement companies for refinancing and home sales, which receive mortgage proceeds from new loan lenders) → mortgage servicers → FNMA → MBS holders.

2. Financial instruments used to keep floats (temporarily held payment proceeds)
   a. Mortgage servicers must hold floats in demand deposits (DD) or money market deposits accounts (MMDA).
   b. FNMA tends to invest its floats in fed funds, repurchase agreements (RPs), or commercial papers, depending on the yields of short term financial instruments.
3. Duration (time length) of floats held by servicers depends on remittance dates which vary with remittance cycles (listed in item 5 below): ranging 0 – 50 days.
4. Payment date to MBS holders: all prepayments for the current month are distributed on the 25th calendar or next business day of the following month by FNMA.
5. Remittance schedules for mortgage services:
   a. Actual/actual: remit actual interest and actual principals collected when the amount reaches $2,500 (implying about zero day float period)
   b. Scheduled/actual: remit scheduled interest and actual principal by the 20th calendar day of the month (implying 19 – 50 days float period)
   c. Scheduled/scheduled: remit scheduled interest and principal, and prepayments based on 3 cycles below
      1) Standard – by the 18th calendar day of each month (implying 17 – 48 days float period)
      2) Express – prepayments by the 4th business of the month (implying 3 – 34 days float)
      3) Rapid payment method (PM) – designated remittance date as the 6th, 8th, 9th, 10th, 12th, 15th, or 17th calendar day of the month (implying 5 – 47 days float period)

6. Distribution of remittances from servicers to FNMA for June 2003

a. **Portfolio Remittances (Whole Loans, 39.6% of total remittances) :**

Actual/Actual (due daily if more than $2,500): 90.9%

Scheduled/Actual (due on the 20th calendar day): 1.0%

Scheduled/Scheduled MRS (due on the 18th calendar day): ... 8.1%

100.0%

b. **MBS Remittances (for payments collected in the previous month, 60.4% of total remittances):**

Express (due on the 4th business day of the month for prepayments): 21.3%

RPM remittances: Due on the 6th calendar day: 7.4%

Due on the 10th calendar day: 5.2%

Due on the 12th calendar day: 4%

Due on the 14th calendar day: 5%

Standard MBS (due on the calendar 18th): 65.2%

100.0%

7. Duration of prepayments in M2: 0 -- 50 days.

II. Freddie Mac's (FHLMC) Portfolio Holdings and its Guaranteed MBSs

1. Flow of mortgage payments – interests, and scheduled and unscheduled principals (prepayments)

Home owners (or settlement companies for refinancing and home sales, which receive mortgage proceeds from new loan lenders) → mortgage servicers → FHLMC → MBS holders.

2. Financial instruments used to keep floats:

a. Mortgage servicers – (a) Initially must deposit funds into DD;

(b) May re-invest the funds in time deposits or fed funds on the same day after being credited to DD;

(c) Must redeposit the funds back to DD at least one business day before remittance, unless remittances are made before the due dates.

b. FHLMC tends to invest its floats in RPs, commercial papers and occasionally bank certificates of deposits, depending on the yields of short term financial instruments.

3. Duration of floats held by servicers: 5 business days for all prepayments.
4. Payment date to MBS holders: all prepayments for the current month are distributed on the 15th calendar or next business day of the following month by FHLMC.
5. Mortgage servicers remit all payoff (prepaid and scheduled principals) proceeds by the 5th business day after the payoff date.
6. Duration of prepayments in M2: 1-6 days; 1 day if the funds shift to FF on the deposit date until the 4th business days; 6 days if it's weekend & the funds remains in DD all the time.

III. Ginnie Mae (GNMA) Guaranteed MBSs

1. Flow of mortgage payments – interests, and scheduled and unscheduled principals (prepayments)

   Home owners (or settlement companies for refinancing and home sales, which receive mortgage proceeds from new loan lenders) → mortgage servicers → MBS holders.

2. Custodial accounts for servicers – non-interest bearing deposits accounts (DD), funds remain in the accounts all the time until being directly distributed to MBS holders by servicers.
3. Payment dates to MBS holders

   a. GNMA I MBS – all funds received in the previous month, pass-thru to MBS holders by servicers directly on the 15th or next business day of the month (71.3% for 2003).

   b. GNMA II MBS – all funds received in the previous month, pass-thru to MBS holders by servicers directly on the 20th or next business day of the month (18.7% for 2003).

4. Duration of floats: 15-46 days for GNMA I MBS; 19-50 days for GNMA II MBS.
5. Duration of floats in M2 :same as item 4.

APPENDIX C. ADJUSTMENT OF MONTHLY SHARES OF SOLD-LOANS

Sold-loan shares of HMDA data vary greatly with loan purposes and from year to year, as indicated below.

Frequency of Yearly Peak of Sold-Loan-Shares in a Month (1995 to 2003)

Loan Purpose	February	March	July	August	September	Total
Purchase	4	2	1	2	0	9
Refinancing	4	0	2	1	2	9

Source: HMDA micro data

Sold-loan shares for purchase loans are more stable than for refinanced loans. Hence, sold-loan shares and adjustments for reporting bias are derived separately for the two types of loans (see Figures 6 and 7).[20] These two figures also indicate that sold-loan shares rise when mortgage rates decline and vise versa, and they tend to peak near the trough of mortgage rates, indicating their negative relationship. This is because investors' demand for newly securitized MBSs is stronger in the periods of falling than rising mortgage rates. Thus, we allow adjustments for reporting bias to vary from year to year according to movements of mortgage rates.

To estimate adjustments for reporting bias, we first estimate the relationship between sold-loan shares and levels of mortgage rates based on Equations C.1 and C.2 below, respectively, for refinancing and purchase loans (including only monthly dummies with significant coefficients). A lagged dependent variable is added on the right-hand side of each equation to correct the serial correlation of disturbances.

C.1 $$Rloan.sold_t^r = a^r + b^r * Rloan.sold_{t-1}^r + c^r * Rm_t + \sum_{j=10}^{12} d_j^r Dum.sea_j + u_t^r$$

C.2 $$Rloan.sold_t^p = a^p + b^p * Rloan.sold_{t-1}^p + c^p * Rm_t + \sum_{j=9}^{12} d_j^p Dum.sea_j + u_t^p .$$

[20] Yearly peaks of the sold-loan shares range from 68.5% in 1995 to 79.3% in 2003 for purchase loans, and from 59.5% in 2000 to 81.0% in 2003 (the second lowest ratio is 62.9% in 1995) for refinanced loans.

$Rloan.sold_t^r$ ($Rloan.sold_t^p$) is the sold-loan share for refinancing (purchase loans). Rm_t is a monthly average of weekly average rates weighted by the number of days of the weeks in the month, on new 30-year fixed home mortgages in Freddie Mac's weekly surveys. $Dum.sea_j$ is a seasonal dummy variable for month j.

Tables 7 and 8 show the regression results of the two equations. Mortgage rates have significant negative effects on sold-loan shares for both refinancing and purchases. The coefficients of seasonal dummies indicate that reporting bias is significant in only four months -- the last four months of the year for purchases, and the last three months of the year for refinancing. The closer of the month to year end the larger the reporting bias is, as reflected by the more negative of the coefficients. Comparing with purchase loans, refinancing mortgage originations are mostly driven by levels of mortgage rates, instead of seasonal factors, so sold-loan shares for refinancing are less stable. We calculate sold-loan shares for refinancing after advancing HMDA data 4 or 6 days to account for a lag between actual origination dates and the reported origination (i.e. settlement) dates. Thus, loans settled toward the end of December are shifted to January, so January loan-sold shares for refinancing may also contain reporting bias.

To adjust reporting bias, we follow the steps below:

1. Estimate sold-loan share for each month in a year based on estimated regression coefficients for Equations C.1 and C.2 excluding monthly dummies.
2. Calculate monthly changes of the estimated values from step 1.
3. Replace the estimated sold-loan shares obtained from step 1 with actual values from HMDA data for the no-bias months – the first nine months for refinancing and the first eight months for purchases.
4. The final adjusted level series are constructed by linking the changes for the last three or four bias-months of the year (obtained from step 2) to the level series (obtained from step 3) beginning September for refinancing and August for purchases for each year.

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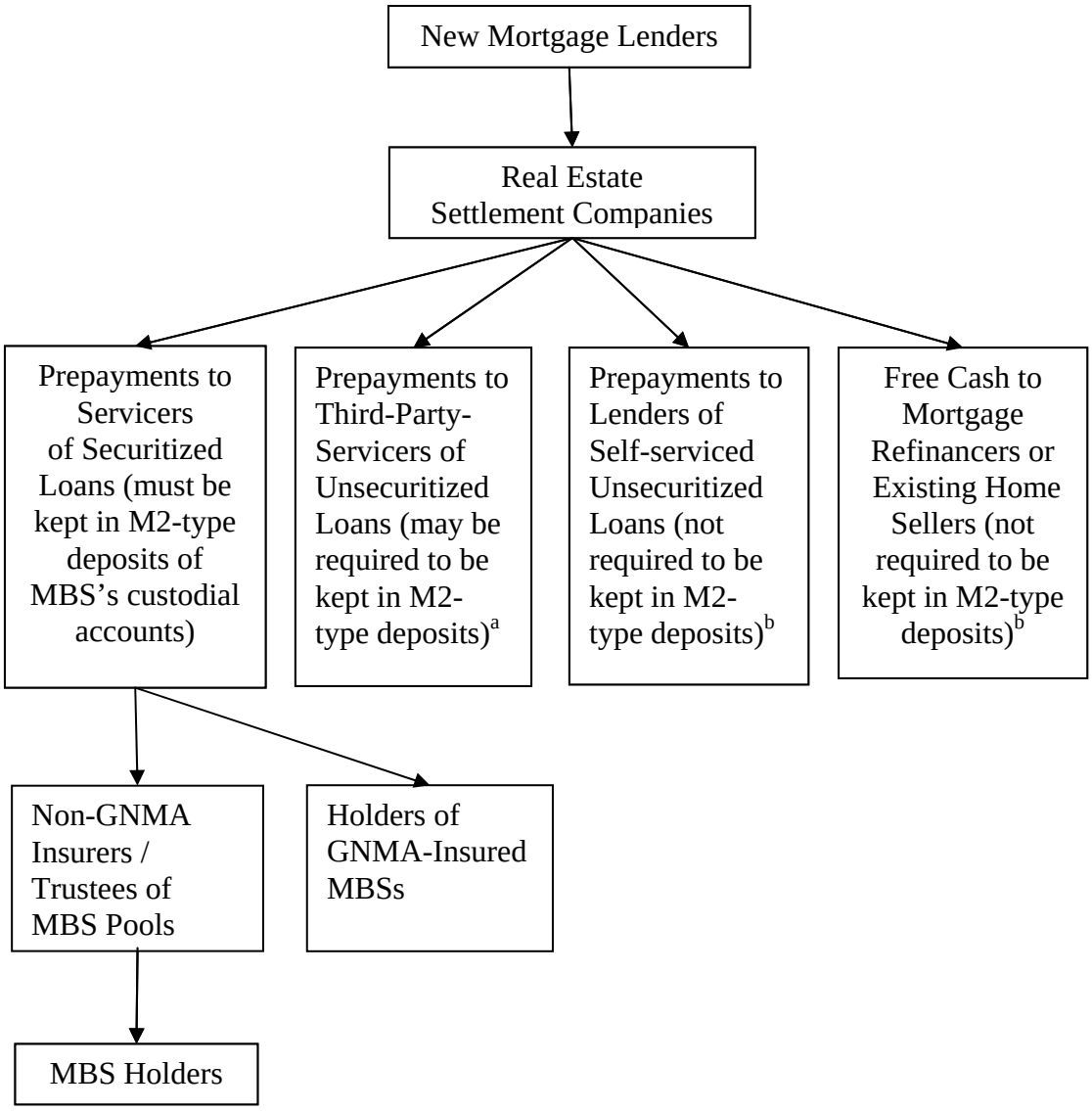
Fig. 1: Flow of Mortgage Proceeds



Notes: a. Prepayments from this item are small so the effects on M2, if any, are small and not covered in this analysis.

b. These items may, but not necessary, have prepayment effects on M2.

Fig. 2: Institutional Rules: Standard Remittance Cycle for FNMA-Insured MBS

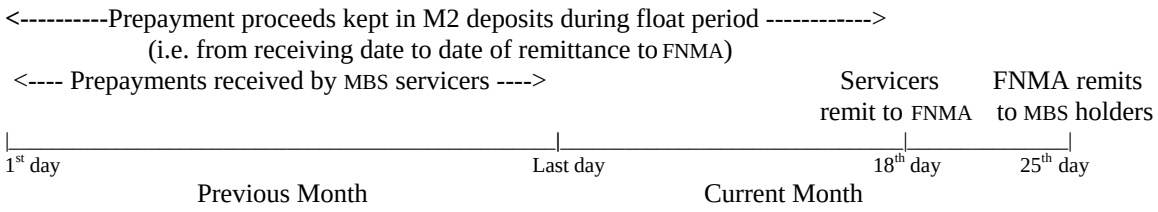


Fig. 3: Values of HMDA Refinancing Mortgage Originations (with Advanced Origination Dates)

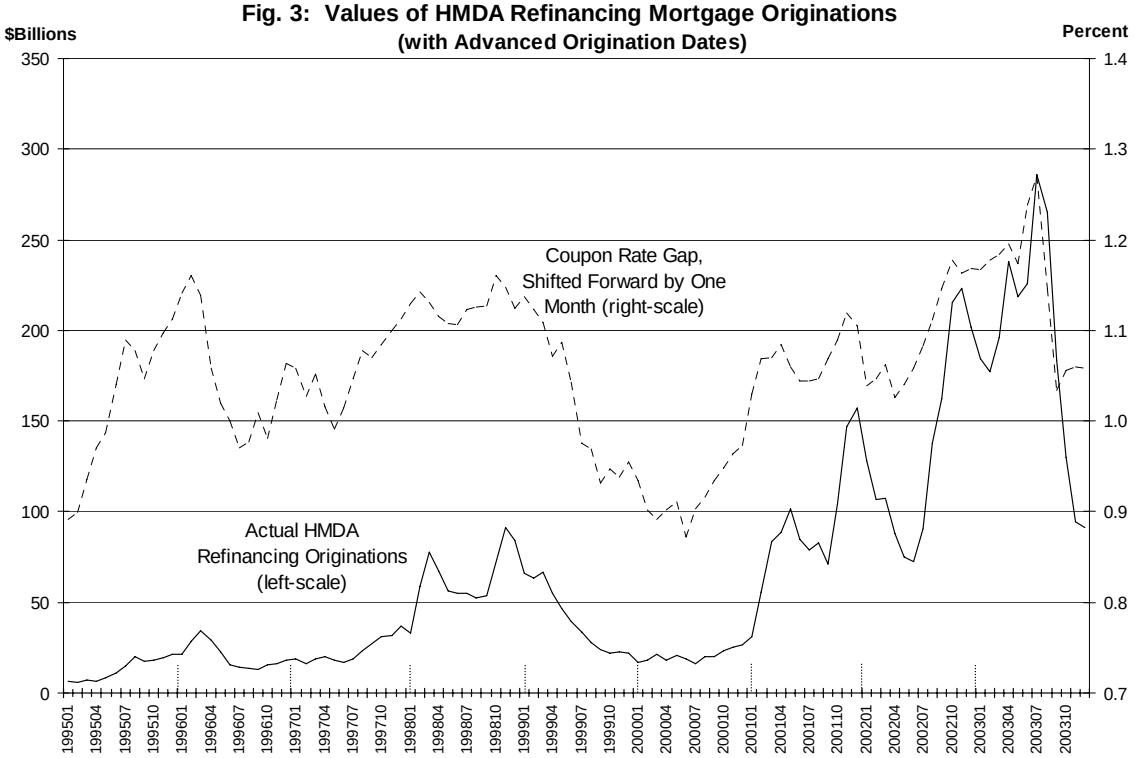


Fig. 4: Values of HMDA Purchasing Mortgage Originations (with Advanced Origination Dates)

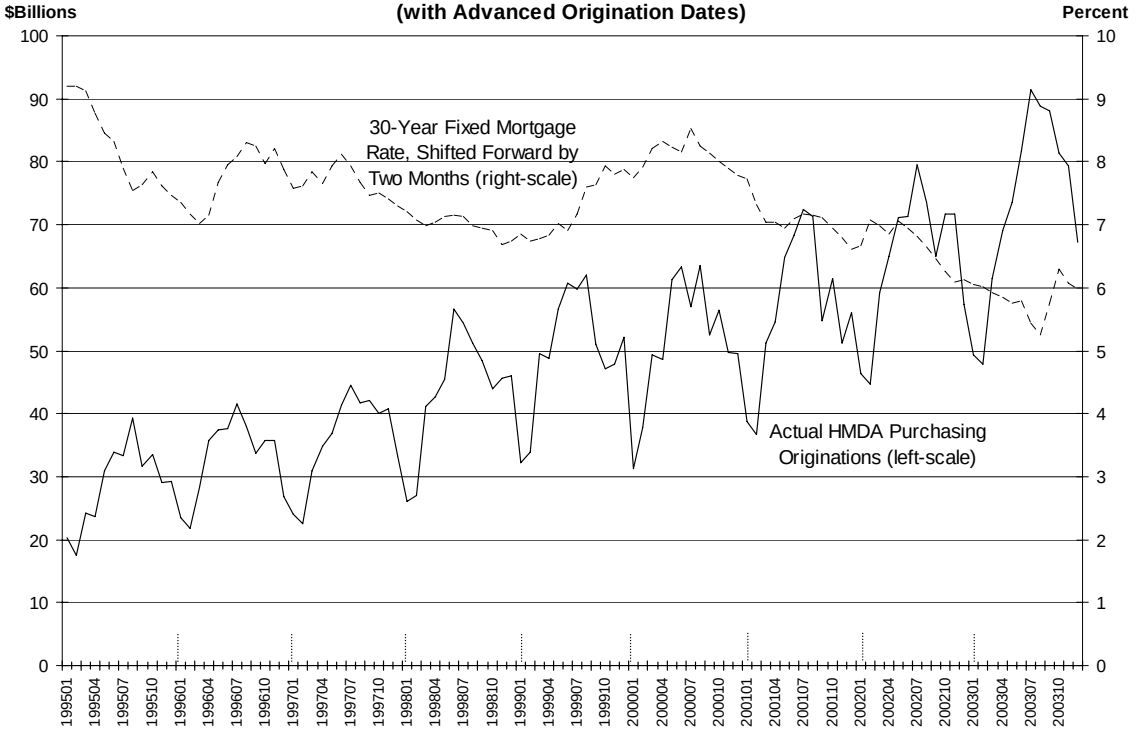
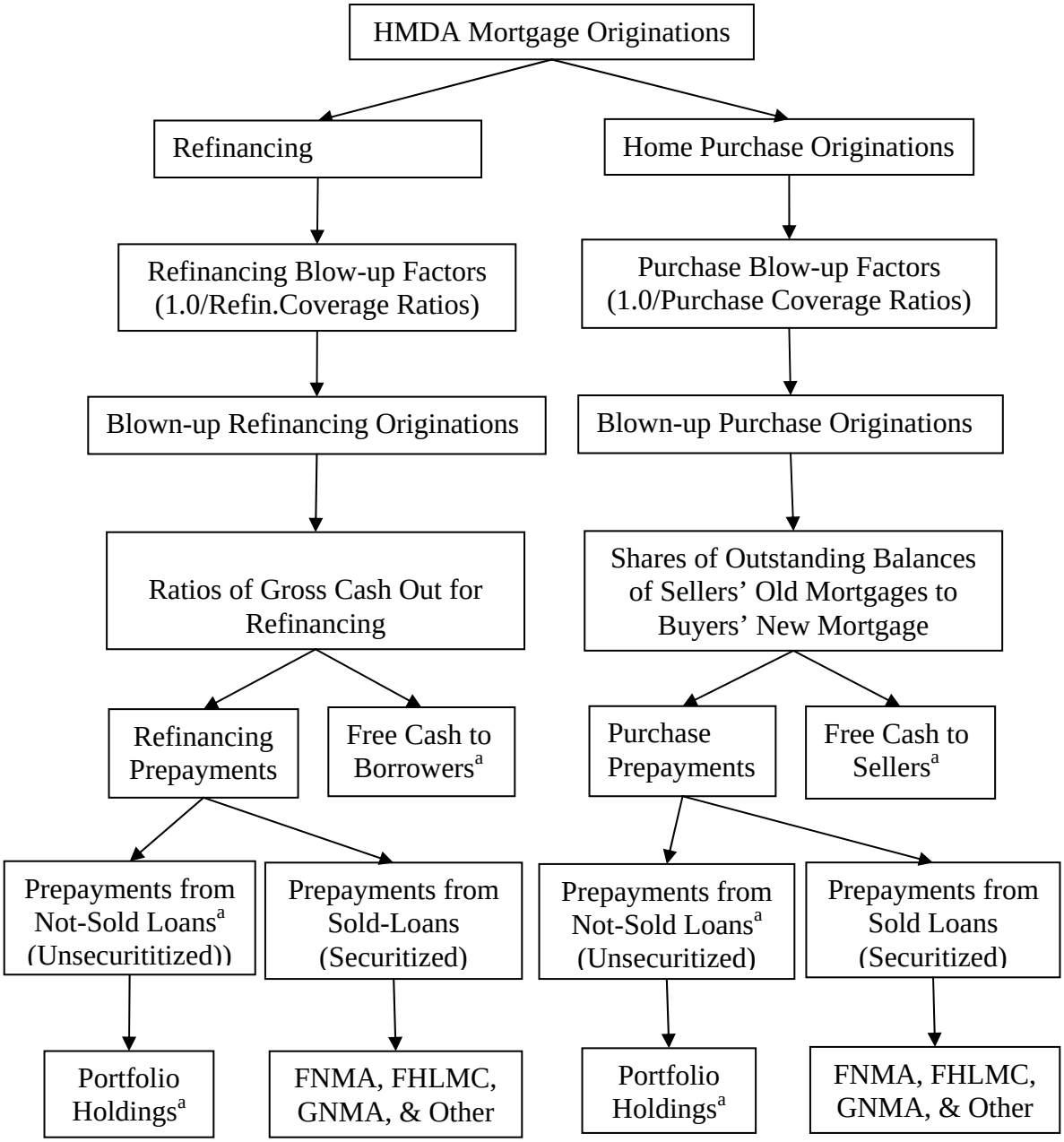


Fig. 5: Mortgage Prepayment Estimation



Note: a. Any prepayment effects on M2 from these items are small and not covered in this analysis.

Fig. 6: Sold-Loan Shares of HMDA Refinancing Mortgage Originations (with Advanced Origination Dates)

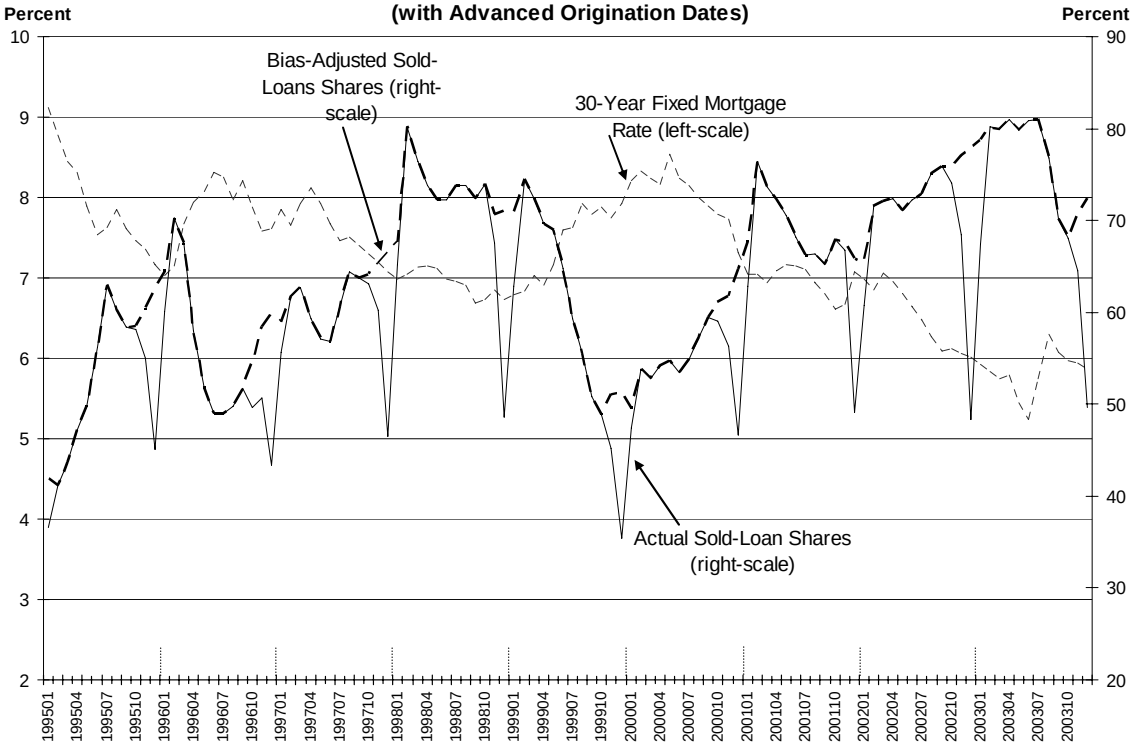


Fig. 7: Sold-Loan Shares of HMDA Purchasing Mortgage Originations (with Advanced Origination Dates)

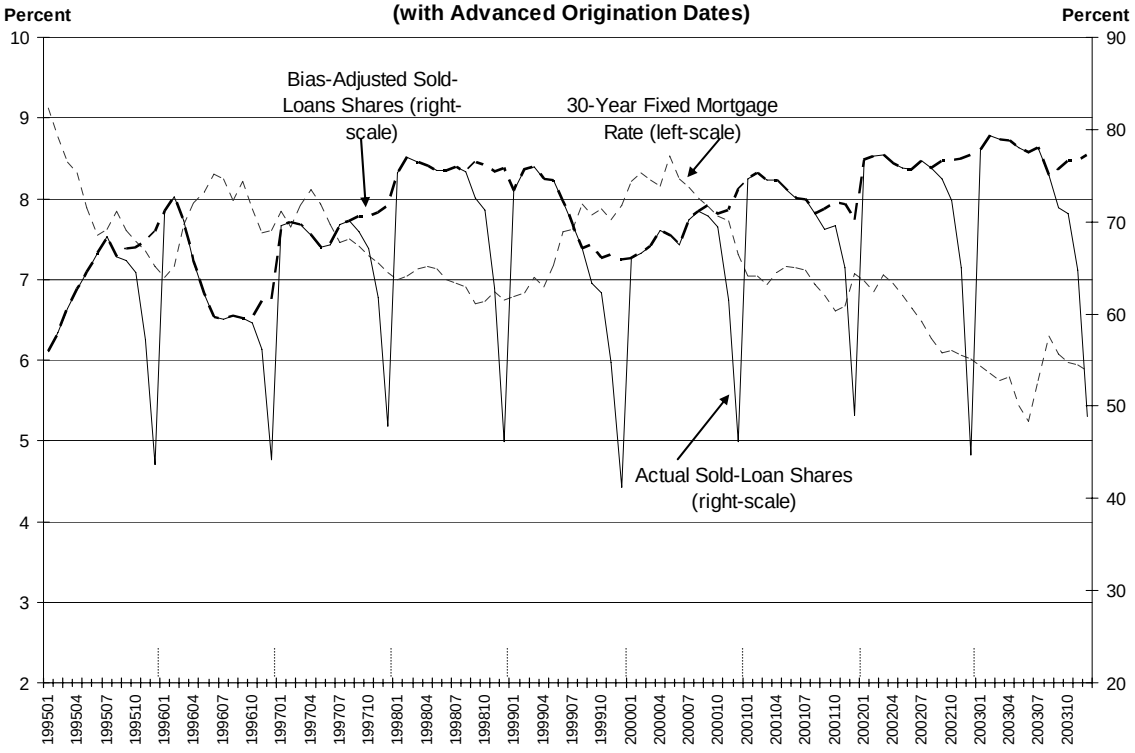
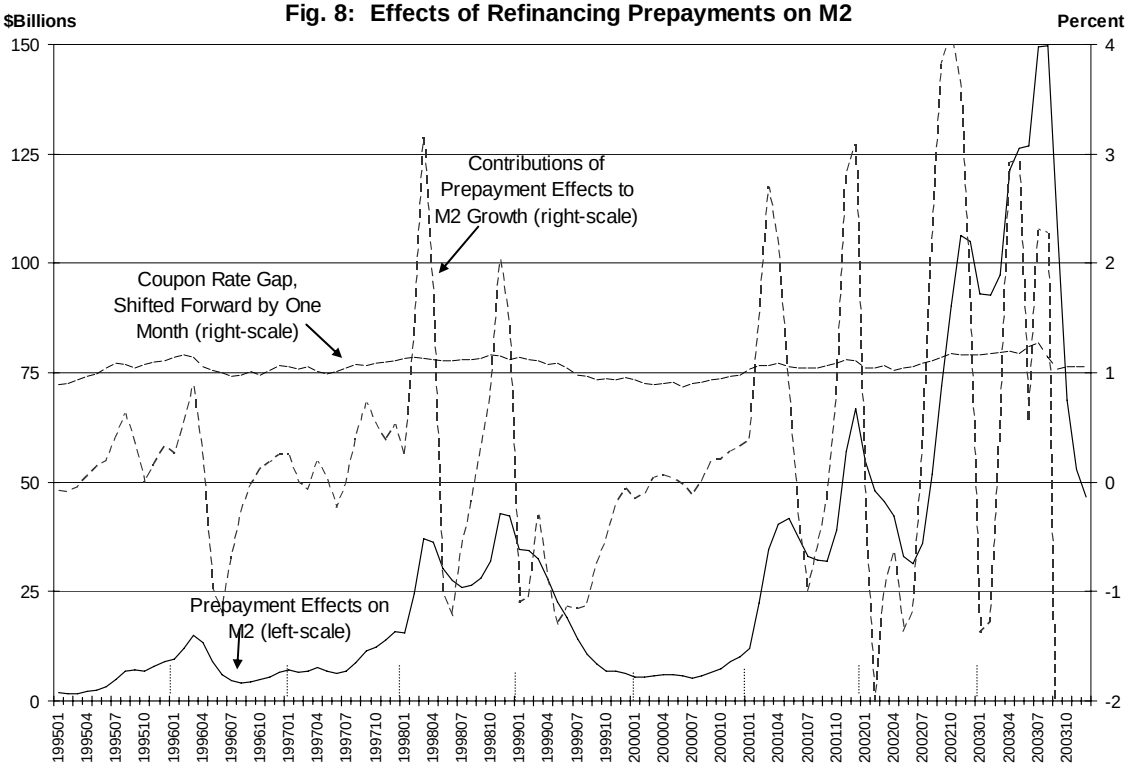


Fig. 8: Effects of Refinancing Prepayments on M2



Note: Contributions of prepayment effect are -4.1, -8.2, -5.8, and -2.5 percent, respectively, for the last four months of 2003, not shown.

Fig. 9: Effects of Purchasing Prepayments on M2

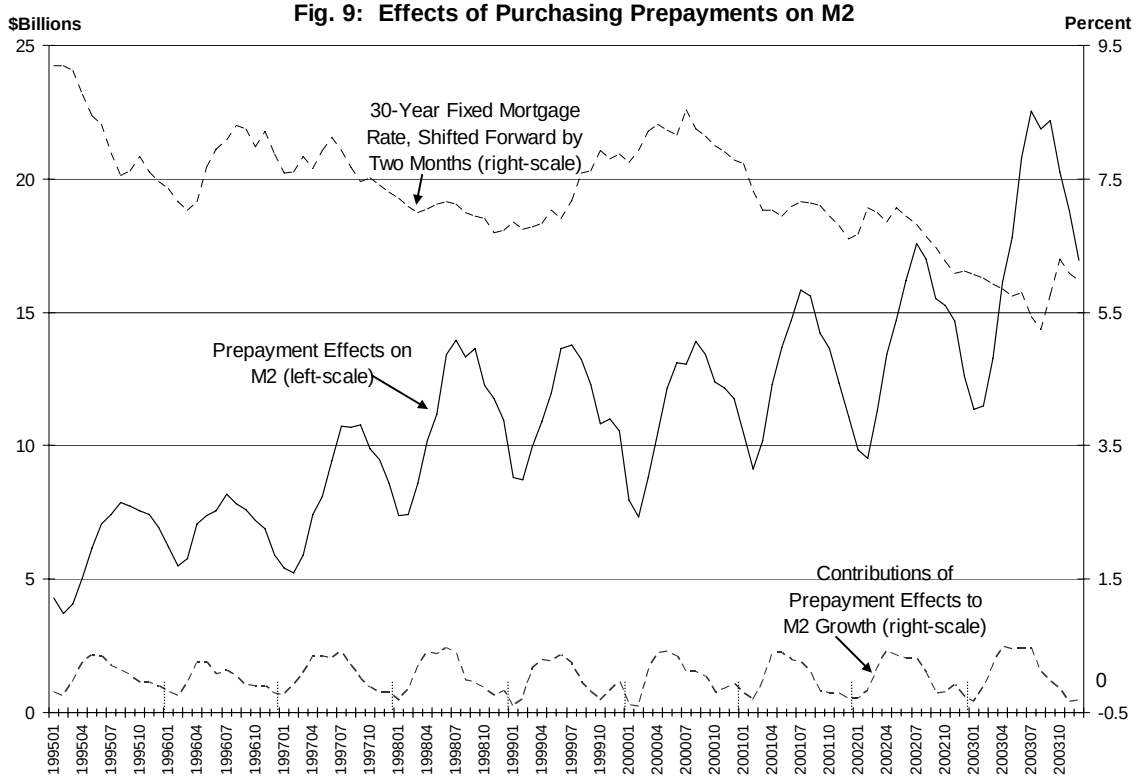
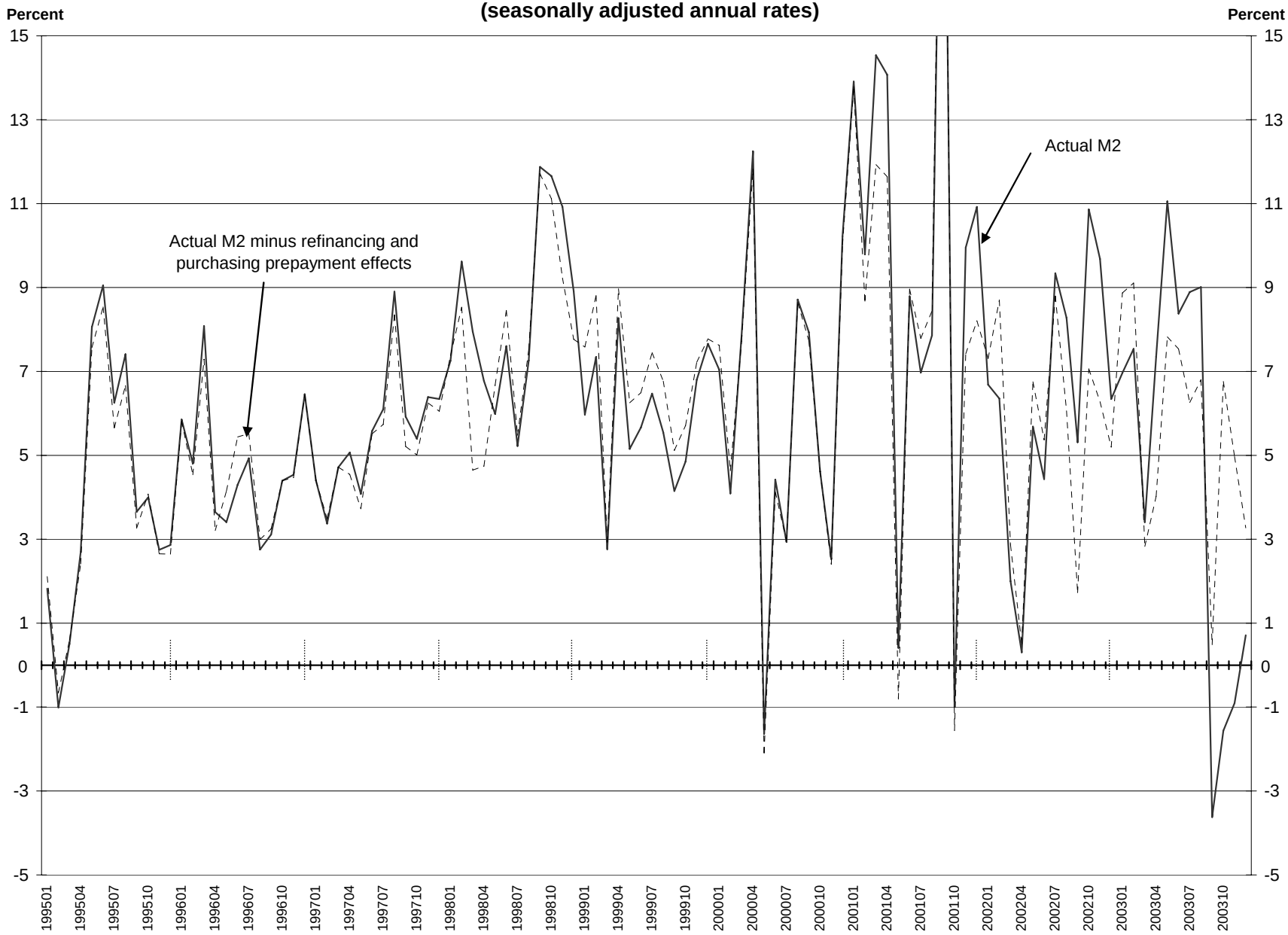


Fig. 10: Monthly Growth Rates of Actual M2 and Various Actual M2 Minus Mortgage Prepayment Effects (seasonally adjusted annual rates)



Note: Owing to terrorist attacks growth rate of acutal M2 surged to nearly 25 percent in September 2001 (not shown), then dropped to about -1 percent in October 2001.

Fig. 11: Quarterly Velocity of Actual M2 and Various M2 Minus Mortgage Prepayment Effects

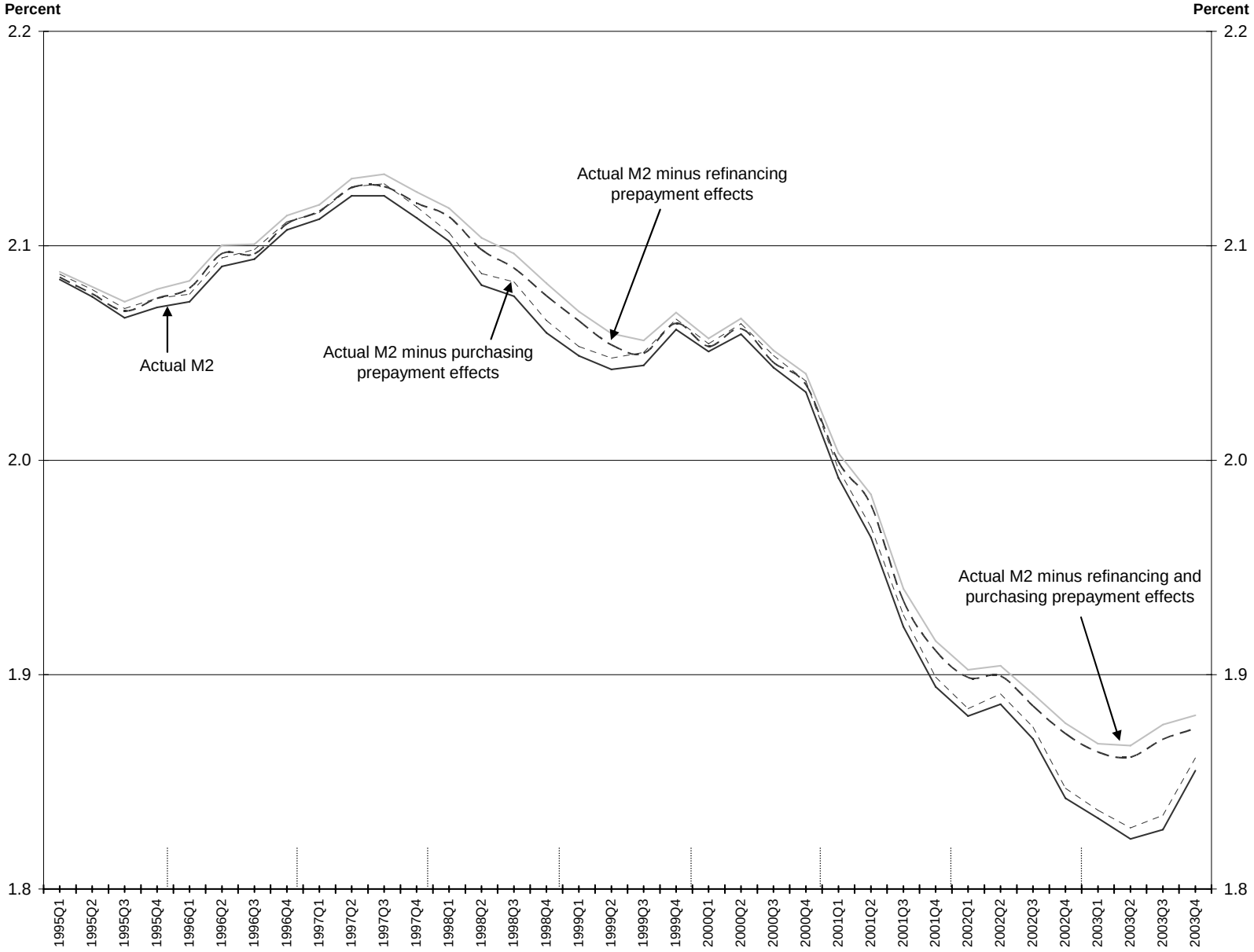


TABLE 1
QUARTER GROSS CASH OUT RATIOS

Sample Period: 1995Q1 – 2003Q4

Variable Name	**Coefficient**	**t-ratio**
Dependent Variable: $Rgco.q_t^r$		
Constant	.7990	20.90
$Rgap.q_t$	-.0448	- 0.21
$Rgap.q_{t-1}$	-.5744	- 2.69
Adjusted R^2		.8518
Lagrange Multiplier (Lag 1)		2.02

Table 2
Levels of M2 and Dollar Effects of Mortgage Prepayments ($Billions)

Date	Actual M2 (SA)	M2 Adjusted For Prepayment Effects			Effects on M2 Level			Shares of Prepayment Effects		Date	Actual M2 (SA)	M2 Adjusted For Prepayment Effects			Effects on M2 Level			Shares of Prepayment Effects	
		Total	Refi.	Purch.	Total	Refi.	Purch.	Refi.	Purch.			Total	Refi.	Purch.	Total	Refi.	Purch.	Refi.	Purch.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1995										**2000**									
January	3,503	3,496	3,501	3,498	6.9	2.1	4.7	0.31	0.69	January	4,676	4,661	4,670	4,667	15.1	5.9	9.2	0.39	0.61
February	3,500	3,494	3,498	3,496	5.8	1.9	4.0	0.32	0.68	February	4,692	4,679	4,686	4,684	13.1	5.4	7.6	0.42	0.58
March	3,502	3,496	3,500	3,498	5.6	1.7	3.9	0.31	0.69	March	4,722	4,709	4,717	4,714	13.7	5.6	8.1	0.41	0.59
April	3,510	3,503	3,508	3,505	6.4	1.9	4.6	0.29	0.71	April	4,771	4,755	4,765	4,761	15.5	5.9	9.6	0.38	0.62
May	3,533	3,525	3,531	3,527	7.9	2.3	5.6	0.29	0.71	May	4,764	4,747	4,758	4,753	17.3	6.0	11.3	0.35	0.65
June	3,560	3,550	3,557	3,553	9.5	2.8	6.6	0.30	0.70	June	4,782	4,763	4,776	4,769	18.5	5.9	12.6	0.32	0.68
July	3,578	3,567	3,574	3,571	11.3	4.0	7.2	0.36	0.64	July	4,793	4,775	4,788	4,780	18.5	5.4	13.1	0.29	0.71
August	3,600	3,587	3,594	3,593	13.6	5.9	7.7	0.44	0.56	August	4,828	4,809	4,823	4,815	18.9	5.4	13.5	0.29	0.71
September	3,611	3,597	3,604	3,604	14.8	6.9	7.8	0.47	0.53	September	4,860	4,840	4,854	4,846	19.8	6.2	13.7	0.31	0.69
October	3,623	3,609	3,616	3,616	14.6	6.9	7.7	0.47	0.53	October	4,879	4,859	4,872	4,866	19.9	7.0	12.9	0.35	0.65
November	3,632	3,617	3,624	3,624	14.9	7.4	7.5	0.50	0.50	November	4,889	4,869	4,881	4,877	20.4	8.1	12.3	0.40	0.60
December	3,640	3,625	3,632	3,633	15.6	8.4	7.2	0.54	0.46	December	4,931	4,909	4,921	4,919	21.4	9.4	12.0	0.44	0.56
1996										**2001**									
January	3,658	3,642	3,649	3,652	15.7	9.2	6.6	0.58	0.42	January	4,988	4,966	4,977	4,977	22.2	11.0	11.1	0.50	0.50
February	3,673	3,656	3,662	3,667	16.6	10.8	5.8	0.65	0.35	February	5,029	5,002	5,011	5,019	26.9	17.1	9.8	0.64	0.36
March	3,697	3,678	3,684	3,692	19.1	13.5	5.6	0.71	0.29	March	5,089	5,051	5,061	5,080	38.2	28.5	9.7	0.75	0.25
April	3,709	3,688	3,695	3,702	20.5	14.1	6.4	0.69	0.31	April	5,149	5,100	5,112	5,138	48.8	37.6	11.3	0.77	0.23
May	3,719	3,701	3,708	3,712	18.3	11.1	7.2	0.61	0.39	May	5,151	5,097	5,110	5,138	54.0	41.0	13.0	0.76	0.24
June	3,733	3,718	3,725	3,725	14.9	7.4	7.5	0.50	0.50	June	5,189	5,135	5,149	5,174	53.7	39.5	14.2	0.74	0.26
July	3,748	3,735	3,743	3,740	13.1	5.2	7.9	0.40	0.60	July	5,219	5,168	5,184	5,203	50.5	35.2	15.3	0.70	0.30
August	3,757	3,744	3,752	3,748	12.4	4.3	8.0	0.35	0.65	August	5,253	5,205	5,220	5,237	48.3	32.6	15.7	0.67	0.33
September	3,766	3,754	3,762	3,759	12.0	4.3	7.7	0.36	0.64	September	5,362	5,315	5,330	5,347	46.9	32.0	14.9	0.68	0.32
October	3,780	3,768	3,775	3,773	12.0	4.6	7.4	0.39	0.61	October	5,358	5,308	5,322	5,344	49.4	35.4	13.9	0.72	0.28
November	3,794	3,782	3,789	3,787	12.3	5.2	7.0	0.43	0.57	November	5,402	5,341	5,354	5,389	61.0	48.0	13.0	0.79	0.21
December	3,815	3,802	3,809	3,808	12.4	6.0	6.4	0.48	0.52	December	5,451	5,377	5,389	5,439	73.6	61.9	11.7	0.84	0.16
1997										**2002**									
January	3,829	3,816	3,822	3,823	12.4	6.8	5.7	0.54	0.46	January	5,481	5,410	5,421	5,471	71.2	60.7	10.5	0.85	0.15
February	3,840	3,827	3,833	3,834	12.1	6.8	5.3	0.56	0.44	February	5,511	5,449	5,459	5,501	61.0	51.4	9.7	0.84	0.16
March	3,855	3,842	3,848	3,849	12.1	6.6	5.6	0.54	0.46	March	5,520	5,462	5,473	5,509	57.2	46.8	10.4	0.82	0.18
April	3,871	3,857	3,864	3,864	13.8	7.2	6.7	0.52	0.48	April	5,521	5,465	5,477	5,509	56.3	43.9	12.4	0.78	0.22
May	3,884	3,869	3,877	3,876	15.0	7.3	7.7	0.48	0.52	May	5,547	5,496	5,510	5,533	51.7	37.7	14.1	0.73	0.27
June	3,902	3,887	3,896	3,893	15.3	6.6	8.8	0.43	0.57	June	5,568	5,520	5,536	5,552	47.6	32.2	15.4	0.68	0.32
July	3,922	3,905	3,915	3,912	16.6	6.5	10.1	0.39	0.61	July	5,611	5,561	5,577	5,594	50.5	33.6	16.9	0.67	0.33
August	3,951	3,933	3,943	3,940	18.5	7.8	10.7	0.42	0.58	August	5,650	5,589	5,606	5,633	61.1	43.8	17.3	0.72	0.28
September	3,971	3,950	3,960	3,960	20.9	10.2	10.7	0.49	0.51	September	5,675	5,597	5,613	5,659	78.1	61.8	16.3	0.79	0.21
October	3,988	3,966	3,976	3,978	22.3	11.9	10.3	0.54	0.46	October	5,726	5,630	5,645	5,711	96.5	81.2	15.4	0.84	0.16
November	4,010	3,987	3,996	4,000	22.8	13.2	9.7	0.58	0.42	November	5,772	5,659	5,674	5,757	113.3	98.3	15.0	0.87	0.13
December	4,031	4,007	4,016	4,022	23.9	14.9	9.0	0.62	0.38	December	5,803	5,684	5,697	5,789	119.3	105.7	13.6	0.89	0.11
1998										**2003**									
January	4,055	4,031	4,039	4,047	23.7	15.7	8.0	0.66	0.34	January	5,837	5,726	5,738	5,825	111.0	99.0	12.0	0.89	0.11
February	4,088	4,060	4,068	4,080	27.5	20.1	7.4	0.73	0.27	February	5,873	5,769	5,780	5,862	104.2	92.8	11.4	0.89	0.11
March	4,115	4,076	4,084	4,107	38.9	30.9	8.0	0.79	0.21	March	5,890	5,783	5,795	5,878	107.3	94.9	12.4	0.88	0.12
April	4,138	4,092	4,101	4,129	46.0	36.6	9.4	0.80	0.20	April	5,926	5,802	5,817	5,911	124.0	109.3	14.7	0.88	0.12
May	4,159	4,115	4,125	4,148	43.8	33.1	10.7	0.76	0.24	May	5,981	5,840	5,857	5,964	140.7	123.8	17.0	0.88	0.12
June	4,185	4,144	4,156	4,173	41.2	28.9	12.3	0.70	0.30	June	6,022	5,877	5,896	6,003	145.8	126.5	19.3	0.87	0.13
July	4,203	4,163	4,176	4,189	40.5	26.8	13.7	0.66	0.34	July	6,067	5,907	5,929	6,045	159.8	138.1	21.7	0.86	0.14
August	4,229	4,189	4,202	4,215	39.8	26.2	13.6	0.66	0.34	August	6,113	5,941	5,963	6,090	171.8	149.6	22.2	0.87	0.13
September	4,270	4,230	4,243	4,257	40.7	27.3	13.5	0.67	0.33	September	6,094	5,943	5,965	6,072	151.0	129.0	22.0	0.85	0.15
October	4,312	4,269	4,282	4,299	43.0	30.1	12.9	0.70	0.30	October	6,086	5,977	5,998	6,065	109.6	88.3	21.2	0.81	0.19
November	4,351	4,302	4,314	4,339	49.4	37.4	12.0	0.76	0.24	November	6,082	6,001	6,021	6,062	80.2	60.7	19.5	0.76	0.24
December	4,383	4,330	4,341	4,372	53.9	42.5	11.4	0.79	0.21	December	6,085	6,018	6,036	6,067	67.5	49.6	17.9	0.74	0.26
1999																			
January	4,405	4,357	4,367	4,395	48.4	38.5	9.9	0.80	0.20										
February	4,432	4,389	4,398	4,423	43.3	34.6	8.8	0.80	0.20										
March	4,442	4,400	4,409	4,433	42.8	33.5	9.3	0.78	0.22										
April	4,473	4,432	4,443	4,463	40.6	30.1	10.4	0.74	0.26										
May	4,492	4,456	4,467	4,481	36.7	25.2	11.4	0.69	0.31										
June	4,513	4,480	4,492	4,501	33.8	21.0	12.8	0.62	0.38										
July	4,538	4,507	4,521	4,524	30.3	16.6	13.7	0.55	0.45										
August	4,559	4,533	4,546	4,545	25.8	12.3	13.5	0.48	0.52										
September	4,574	4,552	4,565	4,562	22.3	9.5	12.8	0.43	0.57										
October	4,593	4,574	4,585	4,581	19.1	7.5	11.6	0.39	0.61										
November	4,619	4,601	4,612	4,608	17.6	6.7	10.9	0.38	0.62										
December	4,649	4,631	4,642	4,638	17.3	6.5	10.8	0.38	0.62										

Table 3
Growth Rates of M2 (S.A.A.R.) and Contributions of Mortgage Prepayments to M2 Growth

Date	Growth Rates of M2				Contributions of Prepayment Effects on M2			Date	Growth Rates of M2				Contributions of Prepayment Effects on M2		
	Actual M2	M2 Adjusted for Prepay. Effects							Actual M2	M2 Adjusted for Prepay. Effects					
		Total	Refi.	Purch.	Total	Refi.	Purch.			Total	Refi.	Purch.	Total	Refi.	Purch.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)		(1)	(2)	(3)	(4)	(5)	(6)	(7)
1995								**2000**							
January	1.8	2.1	1.9	2.0	-0.3	-0.1	-0.2	January	7.0	7.6	7.2	7.5	-0.5	-0.2	-0.4
February	-1.0	-0.7	-0.9	-0.8	-0.4	-0.1	-0.3	February	4.1	4.6	4.2	4.5	-0.5	-0.1	-0.4
March	0.5	0.6	0.6	0.5	-0.1	0.0	0.0	March	7.9	7.7	7.8	7.8	0.2	0.0	0.1
April	2.7	2.4	2.6	2.5	0.3	0.1	0.2	April	12.2	11.8	12.2	11.9	0.5	0.1	0.4
May	8.1	7.6	7.9	7.7	0.5	0.1	0.4	May	-1.6	-2.1	-1.7	-2.1	0.4	0.0	0.4
June	9.1	8.5	8.9	8.7	0.5	0.2	0.3	June	4.4	4.1	4.5	4.1	0.3	0.0	0.3
July	6.3	5.7	5.9	6.1	0.6	0.4	0.2	July	2.9	3.0	3.1	2.8	0.0	-0.1	0.1
August	7.4	6.7	6.8	7.3	0.8	0.6	0.1	August	8.7	8.6	8.7	8.6	0.1	0.0	0.1
September	3.7	3.3	3.3	3.6	0.4	0.3	0.1	September	7.9	7.7	7.7	7.9	0.2	0.2	0.0
October	4.0	4.1	4.0	4.1	-0.1	0.0	-0.1	October	4.6	4.6	4.4	4.8	0.0	0.2	-0.2
November	2.8	2.7	2.6	2.8	0.1	0.2	-0.1	November	2.5	2.4	2.2	2.7	0.1	0.3	-0.2
December	2.9	2.6	2.5	3.0	0.2	0.3	-0.1	December	10.2	10.0	9.9	10.3	0.2	0.3	-0.1
1996								**2001**							
January	5.9	5.8	5.6	6.1	0.1	0.3	-0.2	January	13.9	13.8	13.5	14.1	0.2	0.4	-0.2
February	4.8	4.5	4.3	5.1	0.3	0.5	-0.2	February	9.8	8.7	8.3	10.1	1.2	1.5	-0.3
March	8.1	7.3	7.2	8.2	0.8	0.9	-0.1	March	14.5	11.9	11.9	14.6	2.7	2.7	0.0
April	3.6	3.2	3.5	3.4	0.5	0.2	0.3	April	14.1	11.6	12.0	13.7	2.5	2.1	0.4
May	3.4	4.2	4.4	3.2	-0.7	-1.0	0.3	May	0.4	-0.8	-0.4	0.0	1.2	0.8	0.4
June	4.3	5.4	5.5	4.2	-1.1	-1.2	0.1	June	8.8	9.0	9.2	8.5	-0.1	-0.4	0.3
July	4.9	5.5	5.6	4.8	-0.6	-0.7	0.1	July	7.0	7.8	8.0	6.7	-0.7	-1.0	0.3
August	2.8	3.0	3.0	2.7	-0.2	-0.3	0.0	August	7.9	8.4	8.5	7.8	-0.5	-0.6	0.1
September	3.1	3.2	3.1	3.2	-0.1	0.0	-0.1	September	24.9	25.5	25.2	25.2	-0.3	-0.1	-0.2
October	4.4	4.4	4.3	4.5	0.0	0.1	-0.1	October	-1.0	-1.6	-1.8	-0.8	0.5	0.8	-0.2
November	4.5	4.5	4.4	4.7	0.1	0.2	-0.1	November	10.0	7.4	7.2	10.2	2.6	2.8	-0.2
December	6.5	6.4	6.2	6.7	0.0	0.2	-0.2	December	10.9	8.2	7.9	11.2	2.8	3.1	-0.3
1997								**2002**							
January	4.4	4.4	4.2	4.6	0.0	0.2	-0.2	January	6.7	7.3	7.0	7.0	-0.5	-0.3	-0.3
February	3.4	3.5	3.4	3.5	-0.1	0.0	-0.1	February	6.4	8.7	8.5	6.5	-2.2	-2.1	-0.2
March	4.7	4.7	4.8	4.6	0.0	-0.1	0.1	March	2.0	2.9	3.0	1.8	-0.8	-1.0	0.2
April	5.1	4.5	4.9	4.7	0.5	0.2	0.3	April	0.3	0.5	0.9	-0.1	-0.2	-0.6	0.4
May	4.1	3.7	4.1	3.8	0.4	0.0	0.3	May	5.7	6.8	7.1	5.3	-1.0	-1.4	0.4
June	5.6	5.5	5.8	5.3	0.1	-0.2	0.3	June	4.4	5.4	5.7	4.1	-0.9	-1.2	0.3
July	6.1	5.7	6.1	5.7	0.4	0.0	0.4	July	9.3	8.8	9.1	9.1	0.6	0.3	0.3
August	8.9	8.4	8.5	8.7	0.6	0.4	0.2	August	8.3	6.1	6.1	8.2	2.3	2.2	0.1
September	5.9	5.2	5.2	5.9	0.7	0.7	0.0	September	5.3	1.7	1.5	5.5	3.6	3.8	-0.2
October	5.4	5.0	4.9	5.5	0.4	0.5	-0.1	October	10.9	7.1	6.8	11.1	3.9	4.1	-0.2
November	6.4	6.3	6.0	6.6	0.2	0.4	-0.2	November	9.7	6.3	6.2	9.8	3.5	3.6	-0.1
December	6.3	6.0	5.8	6.6	0.3	0.5	-0.2	December	6.3	5.2	4.9	6.6	1.2	1.5	-0.3
1998								**2003**							
January	7.3	7.4	7.0	7.6	-0.1	0.2	-0.3	January	7.0	8.9	8.5	7.3	-1.7	-1.4	-0.3
February	9.6	8.5	8.3	9.8	1.1	1.3	-0.2	February	7.5	9.1	9.0	7.7	-1.4	-1.3	-0.1
March	7.9	4.6	4.8	7.8	3.3	3.2	0.2	March	3.4	2.8	3.0	3.2	0.6	0.4	0.2
April	6.8	4.7	5.1	6.4	2.1	1.7	0.4	April	7.3	4.0	4.5	6.9	3.4	2.9	0.5
May	6.0	6.7	7.0	5.6	-0.6	-1.0	0.4	May	11.1	7.8	8.3	10.6	3.4	2.9	0.5
June	7.6	8.5	8.9	7.2	-0.8	-1.2	0.5	June	8.4	7.5	8.0	7.9	1.0	0.6	0.5
July	5.2	5.5	5.9	4.8	-0.2	-0.6	0.4	July	8.9	6.3	6.7	8.4	2.8	2.3	0.5
August	7.3	7.5	7.5	7.3	-0.2	-0.2	0.0	August	9.0	6.8	6.9	8.9	2.4	2.3	0.1
September	11.9	11.7	11.6	12.0	0.3	0.3	0.0	September	-3.6	0.5	0.4	-3.6	-4.1	-4.1	0.0
October	11.7	11.1	10.9	11.8	0.6	0.8	-0.1	October	-1.6	6.8	6.6	-1.4	-8.2	-8.0	-0.2
November	10.9	9.2	8.9	11.2	1.8	2.0	-0.3	November	-0.9	5.0	4.6	-0.6	-5.8	-5.4	-0.3
December	8.9	7.8	7.6	9.1	1.2	1.4	-0.2	December	0.7	3.3	2.9	1.0	-2.5	-2.2	-0.3
1999															
January	6.0	7.6	7.2	6.4	-1.5	-1.1	-0.4								
February	7.3	8.8	8.5	7.7	-1.4	-1.1	-0.3								
March	2.8	2.9	3.1	2.6	-0.1	-0.3	0.2								
April	8.3	9.0	9.2	8.0	-0.6	-0.9	0.3								
May	5.2	6.3	6.5	4.9	-1.0	-1.3	0.3								
June	5.7	6.5	6.8	5.3	-0.8	-1.1	0.4								
July	6.5	7.4	7.7	6.3	-0.9	-1.2	0.2								
August	5.5	6.8	6.7	5.6	-1.2	-1.1	0.0								
September	4.1	5.1	4.9	4.4	-0.9	-0.8	-0.2								
October	4.9	5.7	5.4	5.2	-0.8	-0.5	-0.3								
November	6.8	7.2	7.0	7.0	-0.4	-0.2	-0.2								
December	7.7	7.8	7.7	7.7	-0.1	-0.1	0.0								

Table 4
Standard Deviation and Coefficient of Variation of Growth Rates of M2, Adjusted M2, and MBS Effects

Period	Standard Deviations of Growth Rates[a]							Coefficients of Variations of Growth Rates[a]				
	Actual M2	Adjusted M2			MBS Effects			Actual M2	Adjusted M2		MBS Effects	
		Total	Refi.	Purch.	Total	Refi.	Purch.		Total	Refi.	Total	Refi.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Years:												
1995	3.1	2.8	3.0	2.9	0.4	0.2	0.2	0.8	0.7	0.8	1.6	1.3
1996	1.5	1.3	1.3	1.6	0.5	0.6	0.2	0.3	0.3	0.3	-6.3	-9.9
1997	1.4	1.3	1.3	1.4	0.3	0.3	0.2	0.3	0.2	0.2	0.9	1.3
1998	2.2	2.2	2.1	2.4	1.2	1.3	0.3	0.3	0.3	0.3	1.7	2.0
1999	1.6	1.7	1.7	1.6	0.4	0.4	0.3	0.3	0.2	0.2	-0.5	-0.5
2000	3.8	3.8	3.8	3.8	0.3	0.2	0.3	0.6	0.7	0.6	3.8	2.7
2001 [b]	6.8 (4.2)	6.9 (3.9)	6.8 (3.8)	6.9 (4.4)	1.3 (1.4)	1.4 (1.5)	0.3 (0.3)	0.7 (0.4)	0.8 (0.5)	0.7 (0.4)	1.3 (1.2)	1.4 (1.3)
2002	3.1	2.6	2.6	3.2	2.1	2.2	0.3	0.5	0.5	0.5	2.6	2.9
2003	4.9	2.6	2.7	4.7	3.8	3.5	0.3	1.0	0.5	0.5	-4.5	-3.9
Samples:												
1995:01 - 2003:12 [b]	3.9 (3.4)	3.5 (2.9)	3.5 (2.8)	3.9 (3.4)	1.7 (1.7)	1.6 (1.6)	0.3 (0.3)	0.6 (0.6)	0.6 (0.5)	0.6 (0.5)	10.8 (10.9)	13.3 (13.8)
2001:01 - 2003:12 [b]	5.5 (4.5)	4.7 (3.3)	4.7 (3.2)	5.5 (4.5)	2.7 (2.7)	2.6 (2.7)	0.3 (0.3)	0.8 (0.7)	0.7 (0.5)	0.7 (0.5)	8.4 (8.3)	9.2 (9.5)

Note: a. Based on monthly annualized growth rates.
b. Values in parentheses exclude September and October of 2001 in which monthly growth rates of M2 were distorted due to terrorist attacks.

Table 5
Quarterly Velocities of M2 and Adjusted M2

Period	Velocity				Period	Velocity			
	Actual M2	M2 Adjusted for Prepayment Effects				Actual M2	M2 Adjusted for Prepayment Effects		
		Total	Refi.	Purch.			Total	Refi.	Purch.
	(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
1995					**2000**				
Quarter 1	2.084	2.088	2.085	2.087	Quarter 1	2.050	2.056	2.053	2.054
Quarter 2	2.076	2.081	2.078	2.080	Quarter 2	2.058	2.066	2.061	2.063
Quarter 3	2.066	2.074	2.070	2.071	Quarter 3	2.043	2.051	2.045	2.049
Quarter 4	2.071	2.080	2.076	2.076	Quarter 4	2.032	2.040	2.035	2.037
1996					**2001**				
Quarter 1	2.074	2.084	2.080	2.077	Quarter 1	1.990	2.002	1.998	1.994
Quarter 2	2.090	2.101	2.097	2.094	Quarter 2	1.962	1.982	1.977	1.967
Quarter 3	2.094	2.101	2.096	2.098	Quarter 3	1.920	1.938	1.932	1.926
Quarter 4	2.107	2.114	2.110	2.111	Quarter 4	1.893	1.914	1.910	1.897
1997					**2002**				
Quarter 1	2.112	2.119	2.116	2.115	Quarter 1	1.877	1.899	1.896	1.881
Quarter 2	2.123	2.131	2.127	2.128	Quarter 2	1.880	1.898	1.893	1.885
Quarter 3	2.123	2.133	2.128	2.129	Quarter 3	1.865	1.886	1.880	1.870
Quarter 4	2.113	2.125	2.120	2.118	Quarter 4	1.836	1.872	1.867	1.841
1998					**2003**				
Quarter 1	2.102	2.117	2.113	2.106	Quarter 1	1.827	1.861	1.857	1.831
Quarter 2	2.081	2.103	2.098	2.086	Quarter 2	1.815	1.857	1.852	1.820
Quarter 3	2.076	2.096	2.089	2.083	Quarter 3	1.820	1.870	1.863	1.827
Quarter 4	2.059	2.082	2.076	2.065	Quarter 4	1.847	1.873	1.867	1.853
1999									
Quarter 1	2.048	2.069	2.065	2.053					
Quarter 2	2.042	2.059	2.054	2.047					
Quarter 3	2.044	2.056	2.050	2.050					
Quarter 4	2.060	2.068	2.064	2.065					

Table 6
Dispersion of Velocity of M2 and Adjusted M2

Period	Standard Deviation of Velocity				Coefficients of Variation of Velocity			
	Actual M2	M2 Adjusted for Prepayment Effects			Actual M2	M2 Adjusted for Prepayment Effects		
		Total	Refi.	Purch.		Total	Refi.	Purch.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Years:								
1995	0.008	0.006	0.007	0.007	0.004	0.003	0.003	0.003
1996	0.014	0.012	0.012	0.014	0.007	0.006	0.006	0.007
1997	0.006	0.006	0.006	0.007	0.003	0.003	0.003	0.003
1998	0.018	0.015	0.015	0.017	0.008	0.007	0.007	0.008
1999	0.008	0.007	0.007	0.008	0.004	0.003	0.004	0.004
2000	0.011	0.011	0.011	0.011	0.006	0.005	0.005	0.005
2001 [a]	0.043 (0.020)	0.040 (0.014)	0.040 (0.015)	0.043 (0.019)	0.043 (0.010)	0.040 (0.007)	0.040 (0.007)	0.043 (0.010)
2002	0.020	0.013	0.013	0.020	0.011	0.007	0.007	0.011
2003	0.014	0.007	0.007	0.014	0.008	0.004	0.004	0.008
Samples:								
1995:01 - 2003:12	0.102	0.094	0.094	0.102	0.051	0.046	0.047	0.051
2001:01 - 2003:12	0.056	0.047	0.047	0.056	0.030	0.025	0.025	0.030

TABLE 7
SHARES OF REFINANCING LOAN SOLD

Sample Period: January 1995 – December 2003

Variable Name	**Coefficient**	**t-ratio**
Dependent Variable: $Rloan.sold_t^r$		
Constant	.8336	10.31
$Rloan.sold_{t-1}^r$	.4355	7.89
Rm_t	-.0633	-8.85
$Dum.sea_{10}$	-.0346	-2.52
$Dum.sea_{11}$	-.0677	-4.27
$Dum.sea_{12}$	-.1919	-17.11
Adjusted R^2		.8984
Lagrange Multiplier (Lag 1)		40.25

TABLE 8

SHARES OF PURCHASE LOAN SOLD

Sample Period: January 1995 – December 2003

Variable Name	**Coefficient**	**t-ratio**
Dependent Variable: $Rloan.sold_t^p$		
Constant	.9940	27.16
$Rloan.sold_{t-1}^p$	.1143	3.94
Rm_t	-.0490	-14.69
$Dum.sea_9$	-.0379	-3.68
$Dum.sea_{10}$	-.0515	-4.87
$Dum.sea_{11}$	-.1172	-9.48
$Dum.sea_{12}$	-.2640	-27.67
Adjusted R^2		.9042
Lagrange Multiplier (Lag 1)		70.42