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Goldman Sachs -Global Economics Paper No. 177- Home Prices and Credit Losses, Projections and Policy Options

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Home Prices and Credit Losses: Projections and Policy Options

- We Introduce Two New Models to Track Metro Area Home Prices and Loan-Level Mortgage Credit Performance
- National Housing Valuations Have Largely Normalized, but Excess Supply Is Likely to Result in Further Price Declines
- Loan-Level Model Shows that Home Prices Are the Primary Driver of Mortgage Credit Performance
- Risk of Feedback from Foreclosures to Further House Price Declines Justifies Aggressive Policy Response
- Bulk Loan Modification: Microeconomic Costs, Macroeconomic Benefits
- A Government Subsidy for Writedowns of Mortgage Principal?

We are grateful to our colleagues in economic research, banks equity research, and mortgage strategies for generously sharing their data and insights. All opinions and remaining errors are our own.

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Highlights

- In this paper, we introduce two disaggregated econometric models to track home prices at the metropolitan area level and mortgage credit performance at the loan level. We then use these models to evaluate different types of broad mortgage modification programs.
- Our models yield two basic conclusions. First, home prices depend primarily on the supply/demand balance in the local housing market as measured by the inventory of existing homes at the metropolitan area level, as well as housing valuations, local unemployment rates, and past local home price trends. Second, mortgage credit performance depends primarily on local home prices, as well as a host of loan-level characteristics such as FICO scores, debt-to-income ratios, and owner occupancy status.
- Regarding home prices, the good news is that housing valuations at the national level have largely normalized following the price declines of the past 2½ years. Nevertheless, our model suggests that the current level of excess supply and the persistence of past home price trends is consistent with a further price decline through mid-2010 of 5%-10% in terms of the FHFA (formerly OFHEO) index and 20%-25% in terms of the Case-Shiller index.
- Regarding mortgage credit performance, feeding the predictions from the home price model into the mortgage loss model results in a projection of $1.1 trillion in lifetime credit losses on the currently outstanding $11.3 trillion stock of US residential mortgage debt. This includes losses of $422 billion on private label securities and $402 billion on whole loans held at depository institutions, with the GSEs' book of business, FHA loans, and other smaller mortgage holders making up the remainder.
- Our results imply a strong case for aggressive foreclosure mitigation efforts. While we believe that our loss model correctly pegs the likely losses given the home price path implied by the *current* level of excess supply, failure to stem foreclosures could result in a further *increase* in excess supply and thus push up mortgage losses even beyond our baseline estimates. The recent stability in existing home inventories holds out hope that we may avoid such a worst-case scenario, but it would be a mistake for policymakers to ignore the risks.
- We therefore use our model to estimate the benefits and costs of different types of bulk mortgage modifications. We find that modifications are more cost-efficient if they focus on nonprime rather than prime loans, and if they involve principal writedowns rather than note rate reductions. While most bulk modification programs still have a negative "private" net present value (NPV), their broader "public good" benefits can be large because excess supply is such an important driver of home prices. This may justify significant public outlays on foreclosure prevention efforts, even in cases where the private NPV is negative. For example, the government might offer to pay for a certain percentage of the cost of any large-scale principal writedown program.

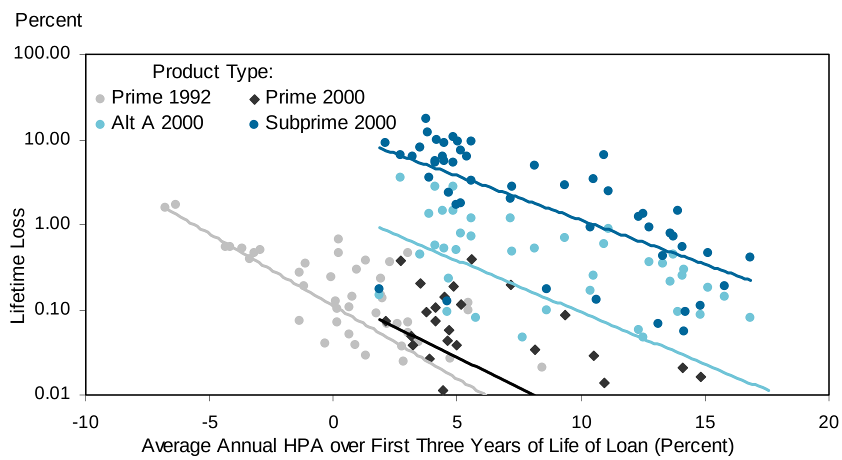
I. Supply Overhang Pushes Home Prices Below Fair Value

The main goal of this paper is to estimate credit losses on the currently outstanding stock of mortgage debt, and to propose policy options designed to reduce the associated downside risks to the housing market and the broader economy. However, a sensible loss forecast needs to start with a sensible home price forecast because home prices are by far the most important macroeconomic determinant of losses. They have substantially higher explanatory power than unemployment rates, interest rates, or rate resets on adjustable-rate mortgages (ARMs).

While the lifetime losses on alt-A or subprime loans far exceed those on prime loans, the proportional increase in lifetime losses as a function of HPA is relatively stable across different product categories and vintages.

Exhibit 1 clearly shows the strength of the relationship of house prices to losses for several product categories and vintages. For example, for the 1992 vintage of prime loans, lifetime losses average only 0.01% in metropolitan statistical areas where home price appreciation (HPA) in the first three years averaged 6%, but this number rises to 1.00% in metro areas where home price appreciation averaged -6%. While losses on alt-A or subprime loans far exceed those on prime loans, Exhibit 1 shows that the proportional increase in losses as a function of HPA is relatively stable across different product categories and vintages. Hence, the remainder of this section gauges the outlook for US home prices at the metropolitan statistical area (MSA) level.

Exhibit 1: Tight Links Between HPA and Loan Losses



Note: Each dot represents a different metropolitan area. Each color represents a different product type and/or period. HPA was calculated over a 3 year period after loan origination.
Source: LoanPerformance. FHFA. Goldman Sachs.

Most of the home price valuation excess has been corrected, at least at the national level.

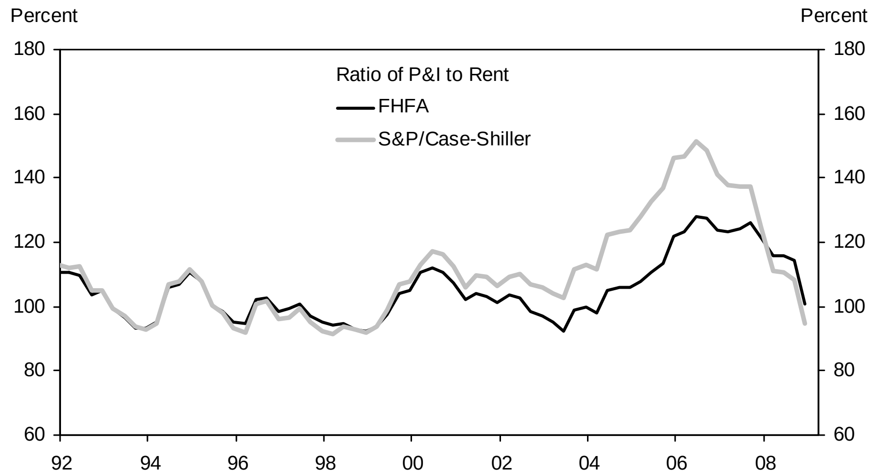
Before presenting our econometric model, we take a look at housing valuations at the national level. Our reading is that most of the valuation excess has been corrected, at least at the national level, though prices probably remain somewhat above sustainable levels. This assessment is based on two measures that compare mortgage payments—which depend on home prices and nominal interest rates—with rents and household incomes, respectively. Exhibit 2 shows the cost of owning versus renting, calculated as principal and interest payments (P&I) relative to rents for both the Federal Housing Finance Agency (FHFA, former OFHEO) index and the Case-Shiller (CS) index. (The differences between the two house price indexes are discussed in Box 1 on page 4.) Exhibit 3 shows our measure of mortgage affordability, defined as the ratio of mortgage payments to household income. In both cases, we use 1993-2003 as a reference period because inflation during that decade was low and stable and the housing "bubble" had not yet gathered steam.[1] Both charts show that the price decline over the past 2½

[1] The series shown in Exhibits 2 and 3 are only meaningful for periods of relatively low and stable inflation. In a period of higher inflation, we would

years and the recent sharp decline in mortgage rates have eliminated most of the valuation excess in the broad US housing market. Admittedly, the affordability chart suggests that prices are still modestly above fundamental values if we use the FHFA measure of house prices, but broadly speaking, we no longer see a large-scale valuation problem in the US housing market.

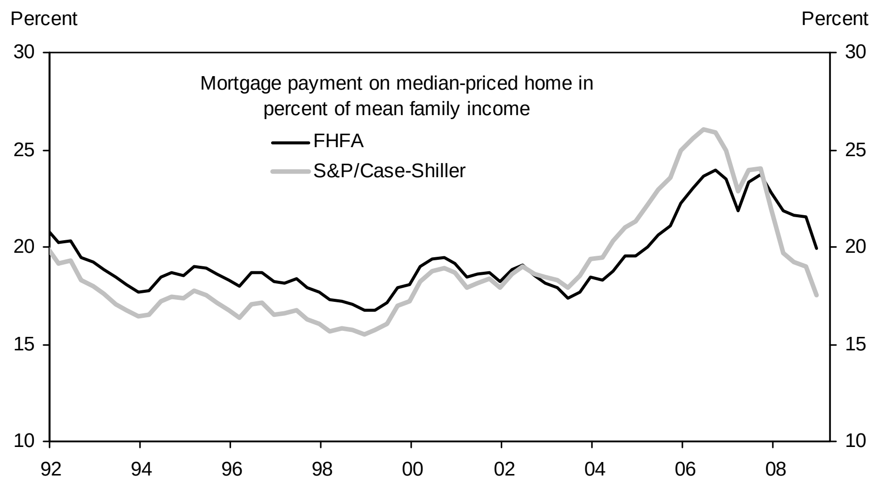
Prices are still modestly above fundamental values if we use the FHFA measure of house prices.

Exhibit 2: Cost of Owning vs. Renting Back to Pre-Bubble Norm



Note: 1993-2003 average is set equal to 100%.
Source: FHFA. S&P/Case-Shiller. Freddie Mac. Department of Labor. Goldman Sachs.

Exhibit 3: Affordability Has Also Improved Significantly



Note: Data for Q4 2008 are our estimates.
Source: FHFA. S&P/Case-Shiller. Goldman Sachs.

expect higher levels of home prices than suggested by this analysis because homebuyers face a much larger incentive to "stretch" and incur larger payments in the early years of a mortgage in the expectation that the real value of their debt will be inflated away quickly in subsequent years.

The bad news is that our formal house price models suggest that it may not matter all that much how close house prices are to fundamental value.

So much for the good news. The bad news, unfortunately, is that our formal house price models suggest that it may not matter all that much how close house prices are to fundamental value. It shows that while fundamental values act as an anchor for house prices in the long run, their short term behavior is dominated by "technical" factors such as the extent of oversupply and self-fulfilling expectations of further house price declines. These factors are likely to push down home prices considerably further over the next two years.

Our econometric house price model predicts metro area level house prices over short and medium term horizons for both the FHFA and CS indexes. However, because our loss model uses the FHFA index as an input we will focus on the forecasts for this index.

While fundamental values act as an anchor for house prices in the long run, their short term behavior is dominated by "technical" factors such as the extent of oversupply and self-fulfilling expectations of further house price declines.

The model combines "fundamental" variables such as housing affordability and unemployment rates with "technical" measures such as housing inventories, lagged changes in home sales volumes, and short term house price momentum. The estimation technique is a panel regression of current house price changes on lagged values of the fundamental and technical variables. National forecasts are obtained by aggregating the MSA level forecasts. For details on the variables and the estimation technique see Box 2 on page 6.

Box 1: FHFA versus CS House Price Indexes

Both the Federal Housing Finance Agency (FHFA) and the Case-Shiller (CS) national house price index exhibit several biases. On net, the FHFA index paints too optimistic a picture while the CS index paints too pessimistic a picture of house prices.

The FHFA index currently understates the rate of house price decline for three reasons.[2] First, it is based on transactions involving conforming mortgages only and thus leaves out the worse performance of prices in the nonprime sector. Second, it is aggregated using unit weighting, although total mortgage risk is better measured using value weighting. Since the highest priced metro areas have been seeing the biggest price drops, this understates the rate of decline. Third, it includes appraisals, which tend to be inflated and "sticky."

Meanwhile, the national CS index currently exaggerates the price declines for two reasons. First, its more limited geographic coverage excludes most of the mid-sized and smaller metro areas that have performed better during the downturn than larger metro areas. Second, because of the inclusion of subprime and alt-A loans, a substantial amount of all transactions are distressed sales. The associated "foreclosure discount" depresses the CS index further. Although inclusion of distressed sales is the correct choice if the objective is to accurately measure true transaction values, an index that contains few distressed sales is better suited for loss modeling because it allows an apples-to-apples comparison with historical house price downturns during periods of better overall loan quality and fewer distressed sales.

Time series analysis on the two indexes at the MSA level shows that each index "Granger causes" the other. This means that in a time series regression of one index on lagged values of both indexes, the other index is statistically significant. At the local level, the CS index predicts subsequent FHFA HPA more strongly than the other way around, suggesting that it is the better index. Nevertheless, its limited geographical coverage distorts the picture it paints at the national level.

Historically the CS indexes have been more volatile at the MSA level than their FHFA counterparts. This, together with the aggregation properties, suggests that CS will continue to underperform FHFA in the current downturn.

[2] See the excellent analysis by Andrew Leventis (FHFA) for further details. "Revisiting the Differences between the OFHEO and S&P/Case-Shiller House Price Indexes: New Explanations," January 2008.

As shown in Exhibit 4, our model predicts cumulative house price declines over the 2008Q3 to 2010Q3 period of 9% for the FHFA index and 27% for the CS index. This implies declines of about 6% for the FHFA index and 23% for the CS index from the (estimated) yearend 2008 level. The projected declines are due to three main factors: (1) a large excess inventory, (2) very strong persistence in downward HPA momentum (especially in the short run), and (3) falling sales volumes. All three have a large amount of predictive power and look very weak at present. In contrast, the underlying economic factors are less important for our projections. Valuations have at least partly normalized, and the unemployment rate has less predictive power than generally believed.

Exhibit 4: House Price Projections across Metro Areas

National or Metro Area	Fundamental Factors			Technical Factors			House Price Forecasts		
	% Unemploy -ment 9M08	% DTI (1)	% DTI De-meaned (2)	Months Supply 2Q08 (3)	% YoY HPA (FHFA) 3Q07-3Q08	% Change in Sales Volume 2Q07-2Q08	%2Yr HPA Forecast (FHFA) 3Q08-3Q10 (4)	%2Yr HPA Forecast (CSW) 3Q08-3Q10 (4)	%1Qtr HPA Forecast (FHFA) 3Q08-4Q08
All MSAs (6)	**4.7**	**21**	**-2**	**11**	**-4**	**-15**	**-9**	**-27**	
Atlanta-Sandy Springs	4.9	16	-6	15	0	-24	-9	-19	-1.9
Chicago-Naperville-Joliet	5.4	18	-2	15	-1	-29	-16	-30	-3.7
Dallas-Plano-Irving	4.0	13	-10	6	2	-17	7		
Denver-Aurora	4.3	15	-5	6	0	-12	3	-7	-1.2
Houston-Sugar Land	3.8	12	-9	6	4	-17	8		
Las Vegas-Paradise	5.5	19	-6	3	-20	16	-21	-32	-7.9
Los Angeles-Long Beach	5.7	37	4	10	-16	4	-26	-39	-7.3
Miami-Miami Beach-Kendall	4.7	24	3	55	-12	-14	-36	-51	-8.3
Minneapolis-St. Paul	4.5	14	-3	9	-4	-11	-7	-21	-3.3
Nassau-Suffolk	3.9	23	2	11	-4	-12	-14	-24	-2.4
New York-White Plains	4.5	26	1	11	-2	-12	-10	-19	-1.6
Oakland-Fremont-Hayward	5.3	23	-2	4	-17	4	-18	-32	-7.2
Orlando-Kissimmee	4.4	24	-2		-12	-14	-15	-26	-5.2
Phoenix-Mesa-Scottsdale	3.2	26	-2	10	-12	-4	-20	-36	-7.1
Riverside-San Bernardino	6.9	33	0		-27	4	-29	-41	-9.4
San Diego-Carlsbad	5.1	25	-3	10	-16	4	-21	-30	-5.6
Santa Ana-Anaheim-Irvine	4.4	38	1	10	-18	4	-26	-34	-6.3
Seattle-Bellevue-Everett	3.2	26	2		0	-46	-8	-19	-1.7
Tampa-St. Petersburg	4.9	18	-3	15	-15	-14	-26	-37	-5.7
Washington-Arlington	3.2	22	-1	9	-10	-33	-20	-32	-4.6
Top 20 MSAs	**4.7**	**24**	**-1**	**12**	**-8**	**-11**	**-15**	**-31**	
MSAs (n=99) with CS&FHFA not in top 20 (5)	**5.1**	**20**	**-2**	**12**	**-6**	**-16**	**-10**	**-21**	
MSAs (n=262) with FHFO Indices Only (6)	**4.4**	**17**	**-3**	**9**	**1**	**-22**	**-2**		

Note:
1) Estimated average 2008 front end debt to income ratio calculated using average 2007 household income, loan amounts estimated using 2007 HMDA data projected to 2008 using FHFA HPI, Freddie Mac PMMS interest rates, and estimated option ARM and IO shares.
2) DTI demeaned calculated as 2008 DTI ratio minus MSA specific long term average.
3) Months' supply (homes listed for sale divided by average monthly sales volume) Source: NAR.
4) National fundamental balance weighted averages of the MSA figures; national historical and forecasted HPA calculated as the loan count weighted average for OFHEO and loan balance weighted average for CSW; MSA loan count and loan balance obtained from HMDA 2007.
5) Average of 99 mostly larger MSAs for which both CS and FHFA indexes are available, excluding top 20 MSAs
6) Average of 262 mostly smaller and midsize MSAs for which only FHFA indexes are available, but not CS.

Source: FHFA. Fiserv Case Shiller Weiss. NAR. Department of Labor. Department of Commerce. HMDA. Freddie Mac. Inside Mortgage Finance. Goldman Sachs.

Our analysis suggests that large metro areas are likely to see much worse performance than smaller ones.

Our house price projections vary widely across metro areas. In Miami, we expect house prices over the next two years to decline by 36% (using the FHFA index), with extremely high housing inventory as the main driver. In Los Angeles, we expect prices to drop by 26%, because of downward price momentum, high housing inventory, and poor affordability. In contrast, in Houston we project an 8% house price increase because of good fundamentals and moderate inventory. In general, our analysis suggests that large metro areas are likely to see much worse performance than smaller ones. As shown in the table, the two-year forecast for the top 20 metro areas is -15% HPA, but for the typically smaller 262 metro areas for which no CS indexes are available the two year forecast is -2% HPA.

Box 2: Modeling House Prices

The two-year FHFA house price model is estimated using a panel regression of the general form

$$\Delta fhfa_{t,i} = \beta_0 + \beta_1 \Delta fhfa_{t-8,i} + \beta_2 \Delta cs_{t-8,i} + \beta_3\, fund_{t-8,i} + \beta_4 tech_{t-8,i} + \beta_5 global_{t-8} + \varepsilon_{t,i}$$

where $\Delta fhfa_{t,i}$ is the FHFA HPA at the metro area level, defined as $\log(FHFA_{t,i}) - \log(FHFA_{t-8,i})$, which is the difference of the logarithms of the FHFA house price index at time t in MSA i and 8 quarters prior. $\Delta fhfa_{t-8,i}$ is lagged HPA, defined as $\log(FHFA_{t-8,i}) - \log(FHFA_{t-16,i})$. The actual models use a richer lag specification than the one shown here. For MSAs for which the Case Shiller index is available, some model specifications use lagged values of this index. $\Delta cs_{t-8,i}$ is defined analogously to the FHFA counterpart. We find that both lagged house price indexes are significant and useful for forecasting. The national HPA forecast is a weighted average of the MSA level forecasts.

The variables $fund_{t,i}$ and $tech_{t,i}$ capture fundamental and technical variables at the metro area level. At the MSA level the fundamental variables are unemployment rates and front-end (*i.e.,* mortgage-only) debt service to income ratios. Technical variables are housing inventory levels at the MSA level and lagged changes of sales volume. The debt service to income ratio is calculated as a standard front end debt to income (DTI) ratio using average house price, interest, and income variables at the MSA level. The variables are deseasonalized using X11 or X12 and then demeaned at the MSA level such that each variable is defined as its current value minus its long term average up to this point. For instance,

$$DTI\_demean_{t,i} = DTI_{t,i} - \frac{1}{t}\sum_{\tau=0}^{t} DTI_{\tau,i}$$

We prefer this method of demeaning variables over using fixed effects, because fixed effects in short panels essentially introduce future information into current variables. Consider the following example: affordability in LA in 1990 was worse than average and house prices dropped after that point in the early 1990s. Does this mean that bad affordability caused the downturn? Not necessarily, because the fact that house prices dropped after 1990 improved average affordability for LA and makes 1990 look worse than it would otherwise have. So the causality found with this method (which is effectively how fixed effects regression works) is partially spurious. On the other hand, a finding that LA had poor affordability in 1990 compared with periods *prior* to that point, and that house prices dropped subsequently contains real information. Thus, using the particular variable specification chosen in our models gives us a more credible estimate of how fast house prices mean revert from extreme affordability levels.

All the predictive variables are used in lagged form, which means the HPA forecast over the next two years uses current values of unemployment, affordability, and other variables as inputs. This technique avoids the need to forecast any of the explanatory variables. To make forecasts over different time horizons a model with different lag structures is used.

We performed substantial testing for structural stability, and in-sample as well as out-of-sample goodness of fit measures. We aim to ensure that the model as estimated in one subperiod performs reasonably well when used for forecasting in another period, and put a premium on the stability of the coefficients over time. A simple, but credible and robust structure is the best way to ensure that the model performs reasonably during periods that are clearly very different from any of the observation periods.

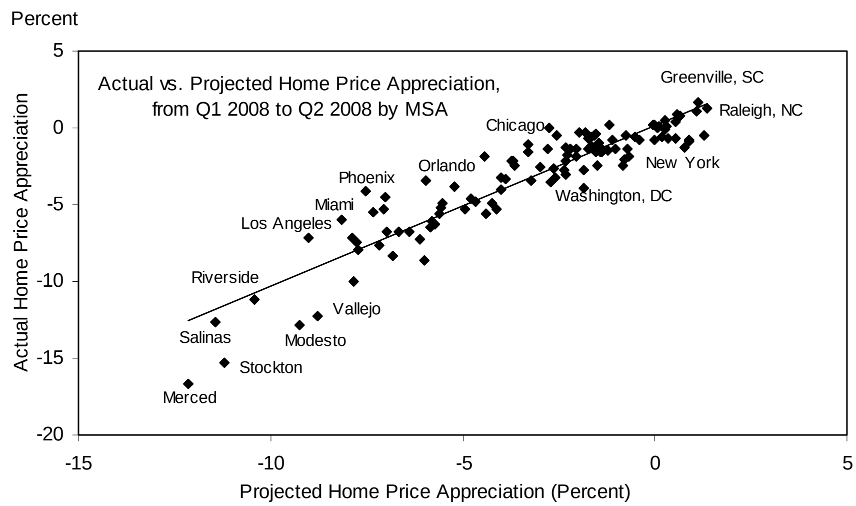
This is a panel regression, which means the coefficients are the same for all metro areas. Some variants of the model use several panels to estimate high and low volatility metro areas separately. However, the time series are not long enough to allow independent estimation of the coefficients at the MSA levels. We are careful when dividing the panel into subpanels for separate estimation. While there is strong statistical evidence that some groups differ from other groups at certain times, over the entire sample the evidence that these differences persist over time is much weaker.

As shown in Exhibit 4, our model predicts respective declines of 9% and 27% for the FHFA and CS indexes from 2008Q3 to 2010Q3. However, much of this apparent difference is due to technical differences in the indexes discussed in Box 1. Of the 18-point gap, 3 points reflects the fact that the FHFA index is unit-weighted while the CS index is value-weighted; 4 points reflects the fact that the FHFA index includes a much larger number of metro areas, and many of the areas left out of the CS index are relatively stable; and perhaps 5 percentage points reflects the inclusion of distressed transactions in the CS index.

An important takeaway from our model is the prediction of very sharp downturns in the worst hit metro areas for the next quarter, in a range of -7% to -9% (not annualized!) in Los Angeles, Miami, and Riverside. This is important because it will inevitably drive up default rates and losses significantly further. Moreover, Exhibit 5 shows that the model has historically been highly accurate over such short time periods.

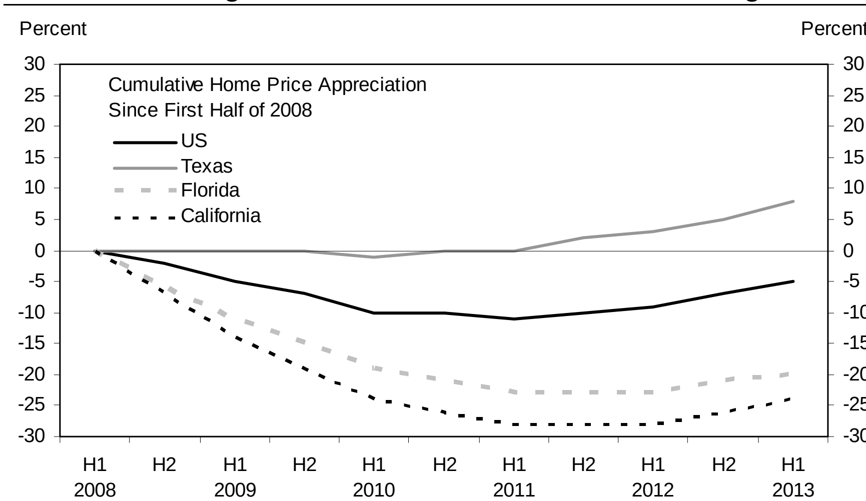
The loss models described in the next section use a simplified version of the house price model, which produces house price paths for different metro areas that are consistent with a given national projection. We choose a 10% price decline for the FHFA index as our base case, a rounded version of the central model forecast. The metro area paths are scaled such that the weighted average of their two-year growth rates equals -10%, as illustrated in Exhibit 6. We also look at loss forecasts using a 0% HPA scenario as a best case and a 25% HPA scenario as a worst case.

Exhibit 5: HPA Model Predicts Well Over Short Time Periods



Source: FHFA. Goldman Sachs.

Exhibit 6: Scaling a 10% Home Price Decline Across Regions



Source: Goldman Sachs.

II. Projecting Aggregate Mortgage Credit Losses

We now turn to the impact of home prices on mortgage credit performance. Our approach is as follows. First, we estimate loan-level models for defaults and losses from data on the performance of the roughly $2 trillion outstanding in private-label securitizations and use our house price model described in the previous section to project total losses for each segment of the private-label securities market. Second, using information on the outstanding volumes, characteristics, and delinquency rates of other sectors—whole loans held by depositary institutions, the Fannie Mae/Freddie Mac book of business, and the FHA/VA sector—we extrapolate our private-label projections to the entire $11.3 trillion home mortgage market.

Default and Loss Models for Private-Label Securitizations

We use LoanPerformance data as our primary estimation dataset. It contains rich historical loan level information on virtually all loans securitized by private labels. The data cover mostly the last ten years, with a few deals going back to the early 1990s. For each loan, we know the date of origination, the metro area, credit information such as FICO scores, owner occupancy status, and the loan-to-value ratio, the date of prepayment or default, the ultimate loss, and other variables. We augment this dataset with historical information on house prices and interest rates. The basic idea behind our model is to find stable patterns in the historical relationships between risk characteristics, defaults, and losses. More specifically, we model the default probability of a loan at a given point in time as a function of its vintage (origination year), product type, credit characteristics, cumulative HPA at the metro area level, and numerous other factors. We then use our three house price scenarios to run our models forward and sum across loans to obtain aggregate loss forecasts.

The historical data include observations of bad collateral in good house price environments, such as subprime loans prior to 2006, and good collateral in bad house price environments, such as prime loans in southern California in the early 1990s.

The historical data include observations of bad collateral in good house price environments, such as subprime loans prior to 2006, and good collateral in bad house price environments, such as prime loans in southern California in the early 1990s. We use this variation to estimate mortgage credit performance in the current situation of bad collateral in the worst house price environment seen since the Great Depression. Box 3 on page 9 provides additional technical details.

If done right, this method works reasonably well in practice. In other words, we disagree with the view that the loss rates in the current downturn could not have been predicted using historical data. For instance, while the data underlying Exhibit 1 are from 2006, before the beginning of the credit crisis, an extrapolation of the relationships to the current pace of home price declines results in predicted loss rates that are not far from reality, at least thus far.

To illustrate some of the model results, Exhibit 7 shows our predictions of aggregate lifetime default, severity, and loss rates for the various product categories of the 2007 private label securities vintage using our central -10% HPA scenario. Absent significant new policy intervention, we expect default rates—the dollar-weighted lifetime share of loans defaulting—ranging from 13.6% for jumbo prime mortgages to 63.2% for subprime mortgages, and severities—the dollar-weighted loss given default—ranging from 48.7% for jumbo prime to 117.5% for home equity lines of credit (HELOCs). This results in losses—the product of default rates and severities—ranging from 6.6% for jumbo prime mortgages to 46.0% for HELOCs.[3]

[3] Two points are worth making on severities. First, the poor outlook for severities on jumbo prime mortgages is partly due to their unusually high concentration in California, where home prices are falling particularly rapidly.

Exhibit 7: Model Forecasts for the 2007 Vintage under a -10% HPA Scenario

Model Lifetime Loss, Default, and Severity Rate Projections 2007 vintage, -10 HPA scenario, % of Current Balance			
Product	**Default**	**Severity**	**Loss**
Jumbo Prime	13.6%	48.7%	6.6%
Alt-A	32.6%	53.0%	17.3%
Subprime	63.2%	56.8%	35.9%
Option ARM	60.8%	53.3%	32.4%
HELOCs	39.2%	117.5%	46.0%

Source: Goldman Sachs.

Armed with our models for the $2 trillion private-label securities market, we now proceed to estimate aggregate US mortgage losses for the entire $11.3 trillion US mortgage market. We first discuss the risk characteristics of the entire outstanding stock of mortgage debt, and we then extrapolate our loss forecasts for securitized loans to the rest of the market.

Armed with our models for the $2 trillion private-label securities market, we can estimate aggregate US mortgage losses for the entire $11.3 trillion US mortgage market.

Exhibit 8 shows our estimate of the breakdown of outstanding mortgage debt as published in the Fed's flow of funds tables and the statistical supplement to the Federal Reserve Bulletin. The first major bucket consists of $2.0 trillion in private label securities. The ultimate holders are a wide range of institutions ranging from commercial banks in the United States and abroad to life insurers, money managers, and hedge funds. We have very good data on loan level characteristics as well as the breakdown into prime, alt A, subprime, closed end 2nd liens and HELOCS from LoanPerformance.

Exhibit 8: Breaking Down the US Mortgage Market

Outstanding Residential Mortgage Loans by Holder of Risk and Product Category							
		1 Holders of Private Label Securities	2 Depositories Banks, Savings Inst., Credit Unions, whole loans only	3 GSEs (guarantee business & whole loans), and Mortgage Insurers	4 Ginnie, FHA, VA, other gov't (sec&w.l.)	5 Finance companies, REITs, Life insurers, other	Total
1st lien	**Prime**	508	1,251	3,545	0	407	5,711
	Alt A	589	670	891	0	218	2,368
	Subprime	623	208	8	515	68	1,421
	Option Arm	252	257	35	0	84	628
2nd lien	**Closed End**	48	225	0	0	19	293
	HELOC	5	763	0	0	65	833
	Total	2,025	3,375	4,480	515	860	**11,254**

Source: Federal Reserve Board. LoanPerformance. HMDA. SNL. Corporate disclosures. Goldman Sachs.

The second major bucket consists of whole loans held by depository institutions (commercial banks, savings institutions, and thrifts), which total $3.4 trillion. This does not include loans held in securitized form. The flow of funds data only allow a disaggregation into first and second-lien loans. However, we have used data from Home Mortgage Disclosure Act (HMDA) filings and other sources to estimate the breakdown into different product categories. We describe our procedure in Box 4 on page 11.

The third bucket consists of government-sponsored enterprises (GSEs) and mortgage insurers, and it includes both the GSE guarantee business and whole loans held on their books. However, it excludes both the GSEs' multifamily business and wrapped subprime deals (which are already

Second, we expect severities—ultimate losses per dollar of currently outstanding principal—on home equity lines of credit to exceed 100% because many borrowers increase their balance just prior to default.

Box 3: Loss and Default Models

Our loan level loss models are based on a "gradual double trigger" theory. Most defaults occur if two things happen simultaneously: the borrower is in some kind of financial distress, and there is not enough equity in the property to take evasive action, such as borrowing more against, or selling, the house. The probability that a borrower experiences financial distress varies tremendously: from very low for pristine prime borrowers to very high for low FICO subprime borrowers without income verification and a co-borrower. From the perspective of our models, there is no single tipping point when there is suddenly "not enough" equity in the property. Instead, a lack of equity becomes more and more likely as house prices decline. One can think of the default probability as the product of these two probabilities. On empirical grounds, we reject the "ruthless default" hypothesis that all borrowers default once they have negative equity. However, our models are consistent with the notion that some borrowers default strategically.

Our view of defaults has several implications. First, loss rates increase as home price declines cumulate. As illustrated in Exhibit 1, this relationship is very strong and approximately exponential. The relationship is gradual; it does not take the form of a cliff at 100% combined loan-to-value (CLTV) ratio. Prime loans will continue to perform better than subprime loans even if they are under water. We find empirically that the majority of prime borrowers *do not* default even if they have negative equity. Defaults do not necessarily occur immediately once the borrower starts having negative equity but simply occur at higher frequency. The life time default probability increases the longer this situation lasts. Even if house prices stop falling, high rates of default will continue if equity remains negative.

Among the environment variables (variables that are not determined at underwriting), house prices dominate in terms of impact. Changes in affordability due to interest rate resets or unemployment rates are really second order effects compared to that.

In more technical terms, we use discrete period hazard models with time-varying covariates, a popular technique. They predict default, loss, and prepayment probabilities for any given month of the life of a loan, given credit risk characteristics at origination, delinquency status and history at time of prediction, and uses house price and interest rate scenarios as environment variables. It consists of default, prepay, and severity sub models. A simplified version is shown below.

The conditional prepay probability and default probabilities are modeled with a multinomial logistic functional form. The prepay probability in month t given that the loan is still outstanding in the previous period, and given a vector of explanatory variables x at time t is:

$$E(p_t|x_t) = \frac{e^{x'_{p,t}\beta_p}}{1+e^{x'_{p,t}\beta_p}+e^{x'_{d,t}\beta_d}}$$

The corresponding default probability using the same notation is:

$$E(d_t|x_t) = \frac{e^{x'_{d,t}\beta_d}}{1+e^{x'_{p,t}\beta_p}+e^{x'_{d,t}\beta_d}}$$

Where β_p denotes a vector of model coefficients for the prepay equation and β_d are the coefficients for the default equation.

These are single monthly mortalities (SMM) that can be converted into conditional prepayment rates (CPR) and conditional default rates (CDR).

Loss given default model (loss severity model):

$$E(sev_t \mid x_{s,t}) = x_{s,t}'\beta_s$$

The estimates of CPRs, CDRs, and severities can be used to derive default and loss timing curves.

This is a stylized version of the models only. The actual models consist of numerous sub models depending on product category, lien type, whether the loans is current or delinquent, etc.

The model uses several categories of variables:

a) variables known at origination, such as product type, LTV, FICO, loan balance, documentation type, etc.
b) variables known at time of prediction (for seasoned loans): home prices and interest rates at time of prediction, delinquency history, and updated credit scores.
c) derived time varying variables, such as loan age, current CLTV, current HPA, current note rate, burnout, amortization etc.

In order to construct many of the time varying variables, we use forecasts of house prices and interest rates. Note that we do not try to forecast delinquency rates. Rather, we use delinquency information known at the time of prediction to forecast defaults and losses directly. Also note that we are not using unemployment rates as an environment variable, because we find that including them on top of house prices adds little predictive ability.

In a first step the model coefficients are empirically estimated with maximum likelihood using LoanPerformance data. Then the model is adjusted such that it performs well during situations that were not encountered during the estimation period. In particular, there are no major house price downturns in the data, which means we need to extrapolate how high losses will go during the current downturn. We do this by closely analyzing loss and default numbers from previous regional downturns, in particular the early 1990s downturn in southern CA, by using structural insights gained from our models, and by using theoretical considerations. Whenever possible, we use additional datasets that have better coverage of previous house price downturns than LoanPerformance for model adjustments. Finally, we continually monitor the forecast errors of the model as new data come in, and reestimate or adjust the model if necessary.

Box 3: Loss and Default Models (continued)

We adhere to the modeling principle that simplicity is a virtue. Whenever possible, we use the risk factors additively in the logit (i.e. approximately multiplicatively in probabilities), work mostly with univariate transformations, and avoid interactions if possible. We also try to use simple variable specifications whenever possible and try to avoid constructing unobserved intermediate variables (e.g. probability of negative equity, monetary value of refi-incentive). In general, we deviate from these principles only if it improves model fit significantly or if needed to model structural changes or impose theoretical constraints that are not observable in historical data.

The structural form of the model implies that the risk factors are approximately multiplicative, i.e. if being a low doc loan doubles expected losses, and being an investor loans triples them, then a low doc investor loan has approximately six times the expected losses of a full doc owner occupied loan. This specification choice was made deliberately. Of all the simple specifications the near multiplicity of risk factors fits the data best. For instance, we can empirically reject additive behavior of credit factors, as well as the threshold conditions that dominate underwriting guidelines.

For legacy reasons, our loss models use the FHFA index. Despite the well known issues with this index, this does not invalidate the model results. First of all, FHFA has always been less volatile than CS, which means that a model estimated with FHFA will project higher losses for the same HPA than a model estimated with CS indexes. However, the current divergence between FHFA and CS is unprecedented in its magnitude, and a model estimated using FHFA will nonetheless tend to underestimate current losses. Note that using CS indexes instead results in the opposite problem: such a model will actually tend to overstate current losses (see Box 3 on page 6 for why CS is overstating the severity of the current downturn). Our approach is to stick with the FHFA indexes, but adjust the coefficients such that the model performs well in recent error tracking and that the long term loss numbers extrapolate reasonably from experiences of previous downturns. While there are several methods for dealing with the challenges posed by the indexes, there is one approach that is not acceptable: estimate the model using FHFA indexes but use CS based HPA forecasts for the loss projection. This method would overestimate losses on a grand scale.

Box 4: Classifying Whole Loans Held at Banks

We use several datasets to break down whole loans held by depositories into different categories. First, we use HMDA loan level data to determine by vintage how many loans originated by depositories were either sold or retained on balance sheet. Second, we apply model prepay curves to estimate the number of loans that are still outstanding. The aggregate numbers tie out reasonably well with flow of funds numbers, which gives us some confidence in this approach. Third, we combine HMDA data on vintage and lien distribution, note rates (a proxy for subprime loans), loan balances, and geographic distribution, with other data from public disclosures and a sample of loan-level data on the characteristics and performance of whole loans at depository institutions. These data allow us to classify different buckets of loans held at depositories into our different product categories.

Our classification is shown in Exhibit 8 (p. 9). The upshot is that a surprisingly large share—almost half of all first-lien mortgages—of the $3.375 trillion in whole loans held at depositories consists of lower-quality subprime, alt-A, or option ARM loans. If this looks high, consider that as of 2008Q2 an estimated 5.8% of all first-lien whole loans held by depositories were at least 60 days delinquent, whereas the comparable numbers for Fannie Mae and Freddie Mac was 2.3% and 1.6%, and for securitized jumbo prime loans it was 1.9%. On a more positive note, however, we find that HELOCs and closed end second-lien loans held in bank portfolios are of substantially higher average quality than their securitized counterparts.

In addition, a look at the vintage distribution in Exhibit 9 is instructive. The data suggest that while private label securitization has slowed down substantially since its peak in 2006, the banking sector stepped up its portfolio growth after the start of the crisis in 2007, not just in the prime sector but also in subprime and especially alt-A. This is quite concerning. Since recently originated loans are still moving up the delinquency ramp but have higher ultimate losses than more seasoned loans, it is likely that depositories will see a disproportionate deterioration in performance relative to securitized products.

included in the private label securities bucket). The GSE numbers are based on corporate disclosures, which also provide information on the breakdown into different product categories.

The fourth bucket includes Ginnie Mae securities and other Federal Housing Administration (FHA) and Veterans Administration (VA) loans. These are also taken from the flow of funds statistics, and we classify them as subprime loans based on their characteristics and delinquency rates.

The fifth and final category including the finance companies is a catch all category for the rest. We do not have detailed data for this category and assume that it mimics the depositories.

Exhibit 9: Vintage Distribution of Mortgages in Securities and Depositories

Private Label Outstanding ($ billions) Vintage								
Product	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008Q1**
Jumbo Prime	$ 1.0	$ 5.4	$ 64.3	$ 71.2	$ 118.9	$ 108.2	$ 134.3	$ 5.0
Alt A	0.3	2.6	21.1	51.3	154.1	196.2	165.1	0.0
Subprime	3.9	6.1	20.1	54.8	143.6	281.1	158.4	1.7
Option Arm	0.6	0.2	0.1	5.5	54.1	112.5	78.5	0.0
HELOC	0.0	0.0	0.1	0.1	0.8	1.6	2.6	0.0
Total	$ 5.7	$ 14.3	$ 105.7	$ 182.9	$ 471.4	$ 699.7	$ 538.8	$ 6.7
Depository Outstanding ($ billions) Vintage								
Product	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008Q1**
1st liens, prime	$ 13.3	$ 27.4	$ 100.4	$ 139.5	$ 249.1	$ 293.5	$ 320.5	$ 107.5
1st liens, alt A	7.5	16.1	67.8	70.1	117.2	107.7	203.8	79.6
subprime	2.9	2.4	4.3	10.0	33.0	69.8	75.3	10.4
option arm	2.3	4.2	6.6	33.3	67.4	109.8	33.7	0.0
2nd prime	1.4	2.8	10.3	16.2	43.0	69.1	63.5	0.5
2nd subprime	0.0	0.0	0.0	0.9	3.8	7.9	5.9	0.0
heloc	42.7	29.8	56.4	75.0	128.0	166.9	169.4	94.5
Total	$ 70.1	$ 82.7	$ 245.8	$ 345.0	$ 641.5	$ 824.8	$ 872.2	$ 292.6

Source: LoanPerformance. Federal Reserve Board. HMDA. SNL. Corporate disclosures. Depository sample data. Goldman Sachs.

Extrapolating Losses to the Broader Market

The assumed proportionality of defaults and delinquencies is a reasonable simplification that is empirically supported as long as the matched buckets contain the same vintages and product types and the delinquency ratios do not deviate too far from unity.

To extrapolate from our models for securitized loans to the broader market, we create buckets by product categories and vintages for the securitized loans and match them to comparable buckets for the sector for which we want to create a forecast. We then scale the loss forecasts by the ratio of current delinquency rates in the two corresponding buckets. The assumed proportionality of defaults and delinquencies is a reasonable simplification that is empirically supported as long as the matched buckets contain the same vintages and product types and the delinquency ratios do not deviate too far from unity.

Exhibit 10 illustrates this method using Freddie Mac 2006 alt-A loans as an example. Private-label alt-A loans show a current delinquency rate of 11%, while Freddie Mac alt-A loans show an estimated current delinquency rate of only 5.5%. Hence, we scale down the predicted lifetime loss rate of 18.4% from our model for the securitized market proportionately to 9.2% for Freddie Mac.

Exhibit 10: An Illustration of Our Approach

Alt A loans, 2006 vintage, -10% HPA scenario				
	Outstanding Balance ($bn)	**Current D60+**	**Expected Loss Rate of Current Balance**	**Expected Remaining Losses ($bn)**
(1) Securities	196	11%	18.4%	36
(2) Freddie Mac	94	5.5%	9.2%	9

Source: LoanPerformance. Corporate disclosures. Goldman Sachs.

Our estimate of total losses is based on a generalization of this example for a total of 150 different buckets. We have delinquency information for most of these buckets, although we often need adjustments to make them comparable with the delinquency rates measured for the securities data. Once we have loss rates for each bucket we simply multiply these by the outstanding balance to obtain a dollar loss forecast. The aggregate loss forecast under a particular home price assumption is then simply the sum of the losses in all of our buckets.

One key result in Exhibit 11 is that projected losses at depositories ($402bn) rival those on private label securities ($422bn).

Projected losses for Fannie Mae ($92bn), Freddie Mac ($54bn), and the government sector ($33bn) add up to "just" $179bn in our baseline scenario of a 10% home price fall.

Exhibit 11 presents our loss forecasts for each of the three home price scenarios. If home prices fall another 10%—our central scenario—we expect total future realized losses on residential mortgages of $1,100 billion (bn). If home prices instead remain flat at the national level, we see $767bn in losses; if home prices fall 25%, we see $1,842bn.

One key result in Exhibit 11 is that projected losses at depositories ($402bn) rival those on private label securities ($422bn). As discussed, these losses are only on whole loans and do not include securities held by banks, nor do they include commercial mortgages. Moreover, bank loan losses are significantly more sensitive to changes in the home price outcome. For example, if home prices decline 25% instead of 10%, this implies $675bn in losses on whole loans compared with $644bn for securitized mortgages. The reason is that securitized losses are more highly concentrated in the subprime sector, whose performance is already so poor that there is less room for additional deterioration as home prices fall further.

Projected losses for Fannie Mae ($92bn), Freddie Mac ($54bn), and the government sector ($33bn) add up to "just" $179bn in our baseline scenario of a 10% home price fall. However, this number rises to $354bn if home prices fall 25%, as—for the same reasons as noted above for depositories—the Fannie Mae/Freddie Mac prime mortgage book is very sensitive to changes in the home price assumptions.

Exhibit 11: Aggregate Loss Estimates under Different Home Price Assumptions

		Balance	Life time expected losses for 0% HPA (in billions of dollars)	-10%HPA	-25%HPA
Private Label securitization	Jumbo Prime	508	13	24	55
	Alt A	591	57	83	144
	Subprime (incl 2nds)	670	183	234	325
	Option Arm	252	55	78	118
	HELOC	5	2	2	3
	Sub-total	**2,025**	**310**	**422**	**644**
Banks, S&Ls, Credit unions (portfolio only)	Prime	1,251	36	65	148
	Alt A	670	59	87	152
	Subprime	208	33	43	60
	Option Arm	257	47	67	103
	Closed End 2nds	225	40	61	107
	HELOC	763	62	78	105
	Sub-total	**3,375**	**278**	**402**	**675**
Fannie Mae (securities + whole loans)	Prime	2,102	28	50	116
	Alt A (incl IO & subp)	539	27	41	71
	Option Arm	21	0.9	1.3	2.0
	Sub-total	**2,662**	**56**	**92**	**189**
Freddie Mac (securities + whole loans)	Prime	1,443	11	21	48
	Alt A (incl IO)	360	21	31	53
	Option Arm	14	1.2	1.8	2.9
	Sub-total	**1,818**	**34**	**54**	**104**
Ginnie, FHA, VA, other government (securities + portfolio)		515	22	33	61
Finance Companies, REITs, Life Insurers, other	1st liens	776	57	85	150
	2nd liens	84	9	12	18
	Sub-total	**860**	**66**	**97**	**168**
Total		**11,254**	**765**	**1,100**	**1,842**

Source: LoanPerformance. Federal Reserve Board. HMDA. Corporate disclosures. Goldman Sachs.

III. Loss Recognition Still Has a Way to Go

Our baseline estimate that mortgage losses will total $1.1 trillion only tells part of the story on US credit losses. In addition, financial institutions are likely to suffer significant losses on other types of debt—commercial real estate loans (including commercial mortgage-backed securities), credit cards, auto loans, commercial and industrial loans, and corporate bonds.[4]

Exhibit 12 combines our residential mortgage loss estimates with estimated losses on other types of private nonfinancial debt—commercial real estate, consumer credit, and corporate loans and bonds—from our colleagues in the Goldman Sachs Banks equity research team. As shown in the table, combining the results of this paper with our colleagues' estimates results in total losses of $2.1 trillion. As shown in Exhibit 12, we believe that US banks—defined broadly to include thrifts and credit unions—will bear just under $1 trillion of the total loss. This estimate includes $402bn in losses on whole-loan residential mortgages, an estimated 25% of the $422bn in losses from private-label RMBS, and $454bn in losses from debt other than residential mortgages.

Exhibit 12: Total Credit Losses ($ billions)

	Estimated losses	of which: US banks*
Residential mortgages	1,100	508
Commercial real estate	234	125
Credit cards	226	169
Auto loans	133	78
C&I loans and corporate bonds	390	81
Total	2,083	962

* We assume that US banks are exposed to one-quarter of all private-label RMBS losses.
Source: GS Global ECS Research. GS Equity Research.

From a practical perspective, perhaps the most important question is what portion of the likely losses has already been recognized.

The total loss figures in Exhibit 12 are higher than our previous estimates. In particular, our first detailed quantitative analysis of total losses in March 2008 predicted losses of $1.168 trillion, including $500bn from residential mortgages.[5] Although this estimate was viewed as quite pessimistic at the time, it has grown by over 80% in the meantime, for three main reasons. First, we now assume a 40% peak-to-trough decline in the Case-Shiller home price index, versus 25% back in March. Home prices are the dominant variable in our loss model, and the 15-percentage-point difference in cumulative HPD accounts for an estimated $300-$400bn in additional losses.[6] Second, we now use a considerably more sophisticated model to estimate the relationship between home price declines and losses, and the results are somewhat more pessimistic than our earlier calculations. Third, our estimate of non-mortgage losses has grown, largely because the recession now looks likely to be significantly deeper than we expected in March.

From a practical perspective, perhaps the most important question is what portion of the likely losses has already been recognized. As of year-end

[4] Our estimates cover all losses on debt owed by private US nonfinancial borrowers. We ignore both financial sector liabilities (*e.g.*, liabilities owed by hedge funds to their prime brokers, or commercial paper issued by bank holding companies) and losses on non-US credit exposures, but include all US debt regardless of the residence of the creditor. We believe these choices are fairly standard, although there is no universally agreed definition of "total" losses from the credit crisis.

[5] See "More Thoughts on Leveraged Losses," *US Economics Analyst*, 08/10, March 7, 2008.

[6] This estimate is only approximate because the model is specified in terms of the FHFA rather than Case-Shiller index.

2008, data collected by our equity research colleagues show that global financial institutions have recognized about $975bn in losses from US credit exposures via a combination of writedowns on securities, above-trend loan loss provisions, and equity lost in defunct financial institutions. This is equal to just under half of the total losses that our estimates suggest will actually occur. In aggregate, financial institutions are therefore likely to remain under considerable pressure from rising US credit losses.

Most of the "recognition gap" seems to involve whole loans held on the balance sheets of US banks and thrifts.

However, the picture becomes more nuanced once we look separately at whole loans versus securities. Most of the "recognition gap" seems to involve whole loans held on the balance sheets of US banks and thrifts. As of the third quarter of 2008, these institutions had built reserves against losses on whole loans of $156bn. Meanwhile, our residential loss model predicts that banks and thrifts will suffer $402bn in losses on whole-loan residential mortgages alone. In addition, we could see another $300-$400bn in whole-loan losses in commercial real estate, auto, credit card, and corporate loans for a total whole-loan loss among banks and thrifts of $700-$800bn. To reduce the gap of around $600bn between likely whole-loan losses and current reserve levels, the quarterly flow of loan loss provisions—which replenish loan loss reserves and constitute a direct hit to bank earnings—could pick up substantially further from the roughly $50bn (not annualized) pace seen in Q2/Q3 2008. Indeed, the adverse outlook for provisions is a key reason why our colleagues have retained a cautious rating on US bank stocks.

The good news is that the recognition of securitized losses appears to be significantly further advanced. The reason is that securities portfolios are generally marked to market, and market prices of mortgage-related securities now discount losses that are even larger than the predictions of our model. For example, we estimate that the ABX.HE index for the 2007 subprime vintage now discounts losses of 40.4%, which is somewhat above the 35.9% estimate from our model. These lower market prices have translated into much greater loss recognition on securities portfolios held by financial institutions. According to our Banks team, cumulative writedowns on private-label RMBS exposures now total $338bn, more than three-quarters of the $422bn in private-label RMBS losses predicted by our model.[7]

IV. The Risk of Adverse Feedback Loops

We have characterized the current crisis as a story of three adverse feedback loops.

The current recession is largely due to three distinct feedback loops, all of which at least partly involve house prices.[8] First, the "credit supply loop"—discussed extensively in our "leveraged losses" research—involves feedback from house prices to credit losses, lending supply, economic activity, and back to house prices. Second, the "aggregate demand loop" involves feedback from house prices (and other shocks to demand) to employment, household income, aggregate demand, and back to house prices. Third, the "housing loop" involves feedback from house prices to mortgage defaults, an increasing supply of distressed housing units, and back to house prices.

This section focuses on the housing loop. In the timeline of a default, the foreclosed property typically hits the market shortly after the foreclosure process ends and the property becomes real estate owned (REO) of the lender. At this time, the property adds to the inventory of homes available for sale and starts to affect house prices.

7 The writedown figure includes securitization warehouses, RMBS CDOs, and other (mostly RMBS-related) exposures by insurances companies and financial guarantors.

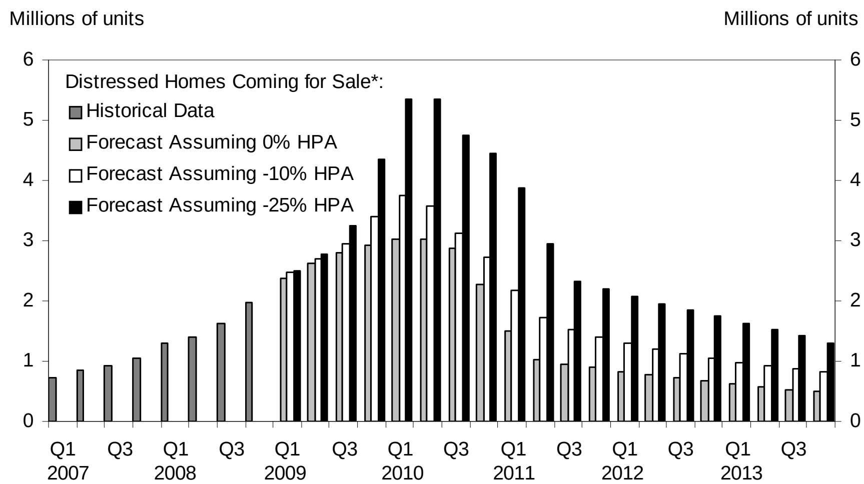
8 See "Housing Throws the US Economy for a Loop," *US Economics Analyst*, 08/02, January 11, 2008.

According to our model, continued house price declines and the large number of already delinquent loans imply that distressed supply will continue to increase for the next two years, with only a gradual decline thereafter.

According to our model, continued house price declines and the large number of already delinquent loans imply that distressed supply will continue to increase for the next two years, with only a gradual decline thereafter. Exhibit 13 shows the flow of distressed supply under our three home price assumptions. Assuming a distressed home comes on the market 6 months before it is sold (default in the securities definition), for the -10% home price scenario, our model implies 13 million defaults beginning in 2008Q4 until the end of 2014, including 3.4 million in the six quarter period from 2008Q4 until 2010Q1.

We can cross-check our model output using the delinquency and foreclosure survey published by the Mortgage Bankers Association (MBA). As of the third quarter of 2008, 6.6% of all mortgages were at least 60 days delinquent or in foreclosure. With an estimated 2% of all mortgaged homes in REO, we have a total of 8.6% of loans in the default pipeline. Assuming 55 million mortgaged homes, this implies 4.8 million homes are either seriously delinquent or already in REO. If 75% of these default over the next 6 quarters—a number broadly consistent with observed transition rates—this implies 3.5 million defaults, very similar to our model projections.

Exhibit 13: Projecting Defaults over Time



*Annualized.

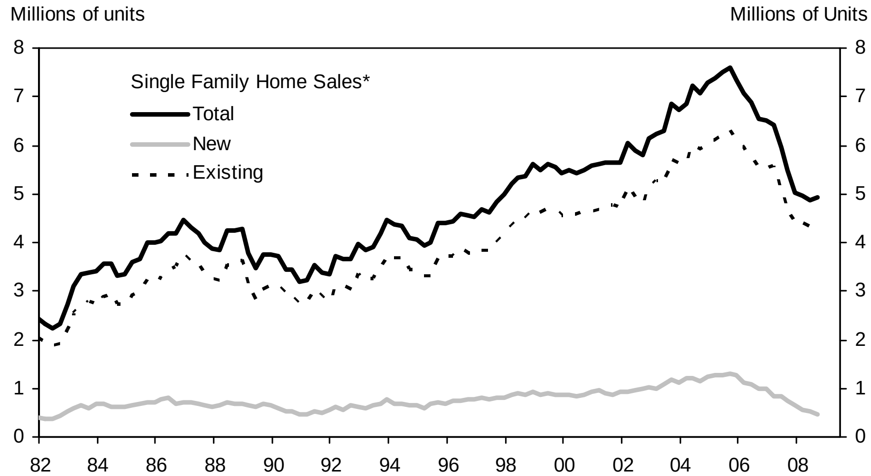
Source: Mortgage Bankers Association. Goldman Sachs.

According to our model, continued house price declines and the large number of already delinquent loans imply that distressed supply will continue to increase for the next two years, with only a gradual decline thereafter.

Until late 2009, changes in the house price assumptions do not make a big difference to the default projections because most of the ultimate defaults are already in the pipeline in the form of delinquencies. After that, the supply of distressed homes becomes more sensitive to the house price path. Over the next three years, our model implies that distressed supply totals 7.9 million in the -10% house price scenario, but as much as 11.0 million in the -25% house price scenario. Most of the difference is back-loaded toward the end of the projection horizon.

To gauge the potential second-round effects on home prices—effects which are not incorporated in the house price and loss estimates discussed above—it is instructive to scale the volume of distressed supply by new and existing single-family home sales, which currently total about 5 million at an annual rate (see Exhibit 14). In our central scenario, distressed supply over the next two years will total about 5.4 million. Relative to the pre-crisis average of 0.5 million per year or 1.0 million over two years, this adds the equivalent of 4.4 million homes or 10 months' worth of sales to housing supply, which in the absence of other supply and demand shifts would increase inventory levels by the same amount.

Exhibit 14: Single-Family Home Sales Have Fallen to 5 Million



*Seasonally Adjusted Annual Rate.
Source: National Association of Realtors. National Association of Home Builders.

According to our home price model, an additional month of inventory lowers home prices two years later by 0.8% in terms of the FHFA index. Hence, if the distressed supply surge pushed up inventories by 10 months on net by the end of the 2-year house price forecasting period in 2010Q3, it would lower house price growth for the subsequent 2-year period from 2010Q3-2012Q3 by 8%. This downward pressure could overwhelm the fundamental forces that would otherwise tend to increase house prices, possibly extending the period of flat or falling house prices by another 1-2 years. Since this in turn would have repercussions for losses and defaults, there would be a risk of a downward spiral between falling prices and rising defaults.

Factors that could dampen the rise in housing inventories are sharp reductions in homebuilding and voluntary home sales, as well as large-scale conversion into rental units, big increases in first-time home purchases, or even demolitions of existing homes in fringe locations.

This assumed surge in inventory in response to excess distressed supply is not inevitable. Factors that could dampen the rise in housing inventories are sharp reductions in homebuilding and voluntary home sales, as well as large-scale conversion into rental units, big increases in first-time home purchases, or even demolitions of existing homes in fringe locations.

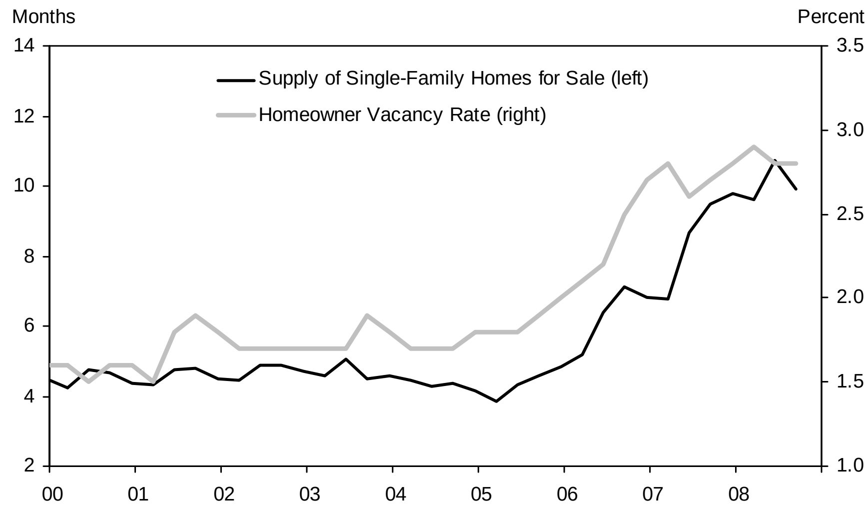
Unfortunately, the data required to model all these different factors properly and assess their net impact on housing inventories are not available. The best we can do instead is to look directly at home inventories and the homeowner vacancy rate—the number of vacant homes for sale in percent of the owner-occupied housing stock—to get a sense of whether the distressed supply surge is already feeding through into a net increase in housing inventory.

At least so far, the answer fortunately seems to be no. Exhibit 15 shows that the level of excess supply has been broadly stable over the past year, at about 10 months for the inventory of unsold homes and 2.8% for the homeowner vacancy rate. This stability suggests that, despite the weak demand for housing, the increase in distressed supply has so far been offset by reduced construction and fewer voluntary homes sales.

Despite the weak demand for housing, the increase in distressed supply has so far been offset by reduced construction and fewer voluntary homes sales.

However, according to our model, the distressed supply surge is still in its early stages. There is unfortunately no guarantee that it will continue to be offset by other factors in coming years. Hence, a surge in the home inventories and vacancies that further pushes down home prices and feeds back into yet greater defaults remains a very real risk. To reduce this risk, large-scale policy interventions may be required.

Exhibit 15: Excess Supply Measures Are High But Stable



Source: Department of Commerce. National Association of Realtors.

V. Policy Options for Reducing Defaults

Two years ago, policies to stabilize house prices would have had little chance of success, given the egregious level of valuations prevailing at the time. But now the prospects of large-scale intervention may be better, as prices have fallen at least to the neighborhood of fair value. Moreover, the risk of a downward spiral between falling home prices and rising defaults discussed in the previous section has grown sharply alongside the deterioration in the broader economy. Thus, it seems appropriate to consider aggressive intervention to reduce the number of defaults. Such a policy, if successful, could limit the upward pressure on home inventories and thereby promote an eventual stabilization in home prices as well as the broader economy.

The huge number of potential defaults over the next few years suggests a focus on bulk programs that can be implemented across the board and do not require detailed knowledge of the situation of each individual borrower.

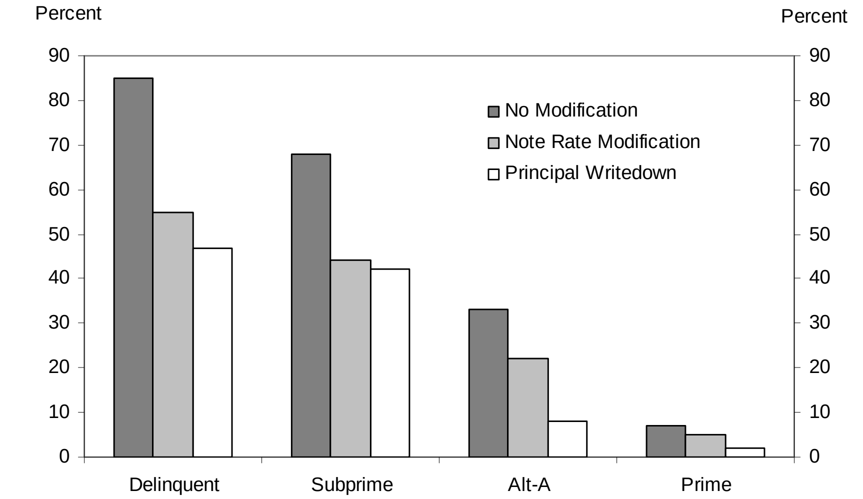
The huge number of potential defaults over the next few years suggests a focus on bulk programs, which can be implemented across the board and do not require detailed knowledge of the situation of each individual borrower. This does not rule out a role for more tailored modifications at the grassroots level. However, in what follows we concentrate on a bulk approach.

The Benefits and Costs of Bulk Modification

We use our models to estimate the impact of two types of bulk program—(1) mortgage interest reductions and (2) principal writedowns—applied to four alternative groups of borrowers: (1) all delinquent borrowers, (2) all subprime borrowers, (3) all alt-A borrowers, and (4) all prime borrowers. In each case, we consider a modification that reduces the net present value (NPV) of the contractual payment stream by 20%. This could be a mortgage note rate reduction from about 8% to about 5%, or it could be a 20% reduction in the value of the principal. For simplicity, we assume that each borrower in the group receives the same modification—*i.e.*, every mortgage contract is modified such that the NPV of the contractual payment stream falls by 20%.

Exhibit 16 shows the impact of these policies on lifetime default rates. For each borrower group, the first column shows the default rate in the absence of a modification, while the second and third column shows the default rate following, respectively, a note rate reduction and a principal writedown that reduces the net present value of the contractual payment stream by 20%.

Exhibit 16: Lifetime Default Rates under Alternative Assumptions



Source: Goldman Sachs.

Principal writedowns are always more effective in reducing default rates than note rate reductions.

We find that principal writedowns are always more effective in reducing default rates than note rate reductions. This should not be surprising. Since our model shows that the surge in defaults is largely due to the negative equity epidemic resulting from the decline in house prices, the most effective way to reduce defaults is to restore positive equity positions by writing down mortgage principal. The difference between the two types of modification is particularly large for alt-A and prime loans because our model tells us that for these borrowers the relative importance of equity versus affordability is more tilted towards equity than for subprime borrowers.

Focusing specifically on delinquent borrowers, Exhibit 16 also shows that we should expect relatively high re-default rates for delinquent borrowers following a bulk modification program. Even after modification, around 50% of all delinquent borrowers end up defaulting at some point over the life of the mortgage. This is consistent with a recent report from the Office of the Comptroller of the Currency and the Office of Thrift Supervision, which found very high re-default rates for loans modified in 2008.[9]

We should expect relatively high re-default rates for delinquent borrowers following a bulk modification program.

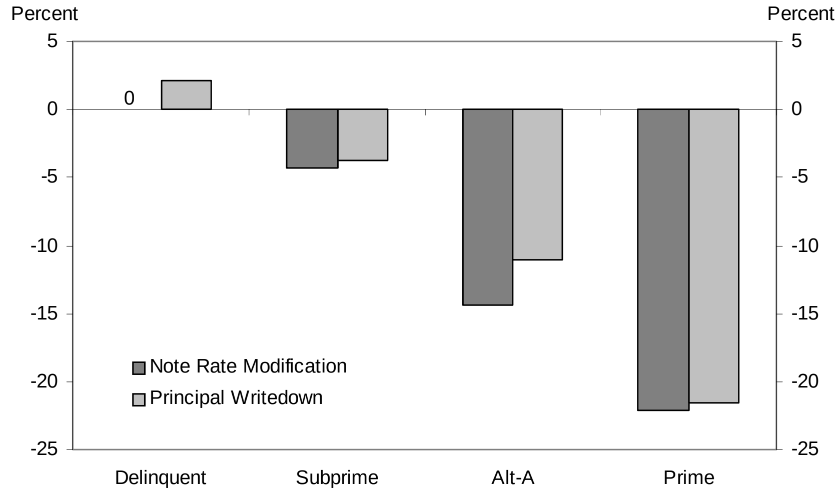
Exhibit 17 goes a step further in evaluating the different policy options by calculating the net present value of each program, expressed in percent of the unpaid principal balance (UPB). The NPV depends on the benefits of modification in the form of reduced default rates versus the cost of modification in the form of reduced payments from borrowers that would have stayed current even without a modification plus the administrative cost of modification.[10]

Exhibit 17 demonstrates the obvious appeal of focusing on those borrower groups that are most likely to default in the absence of a modification, namely currently delinquent borrowers. Despite the high redefault rates, NPVs range from about zero in the case of note rate reductions to +2.1% of the unpaid principal balance in the case of principal writedowns. These relatively favorable results reflect the fact that the additional payments received from the 30%-40% of currently delinquent borrowers who would

[9] See *OCC and OTS Mortgage Metrics Report, Third Quarter 2008*, December 2008.

[10] To calculate the different NPVs, we assume a flat administrative cost of $8,000 per modification.

Exhibit 17: NPVs of Alternative Bulk Modification Programs



Source: Goldman Sachs.

have defaulted without a modification but stay current with a modification are enough to cover both the cost of modifying borrowers who would have become current even without a modification and the administrative cost of modification.

An exclusive focus on delinquent borrowers raises serious concerns of both moral hazard and basic fairness.

However, an exclusive focus on delinquent borrowers raises serious concerns of both moral hazard and basic fairness. At a minimum, it is necessary to establish a cutoff point at which a borrower must already have been delinquent to qualify for the program. Otherwise, many solvent and current borrowers would likely decide to become delinquent in order to lower their debt. Even with such a cutoff point, moral hazard will be a problem because many borrowers will expect repeated modification programs, even if they are labeled as "one-off." In addition, many homeowners (and renters!) who have been making their payments on time are likely to resent a policy of systematically rewarding other borrowers who have failed to do so.

The alternative option of modifying both not only delinquent but also current borrowers generally results in negative NPVs. These range from -3.7% of UPB in the case of principal writedowns for all subprime borrowers to a whopping -22.1% of UPB in the case of note rate reductions for all prime borrowers.[11] In all cases, the benefits in terms of reduced default rates fall short of the costs of modifying borrowers who would have stayed current plus the administrative cost of modification. This imbalance is greatest for prime borrowers. This is because, according to our model, the vast majority of prime borrowers would have stayed current even without a modification.

The negative NPVs for all of our modification schemes that include current as well as delinquent borrowers suggest that lenders generally do not have an incentive to move forward on their own with bulk modification programs. This may explain why there have been only limited moves in this direction so far.

[11] The total cost exceeds the 20% reduction in the NPV of the contractual payment stream because the administrative cost exceeds the value of the foreclosure reduction.

Policymakers Could Subsidize Principal Writedown

Bulk modification programs typically have negative NPVs, but we believe there is a good case for using some public resources to make them more attractive. The issue is the adverse effect of excess housing supply on house prices, foreclosures, and the broader economy. Economists generally view this type of "externality"—a cost caused by private activity that is borne by the public—as a convincing justification for policy intervention.

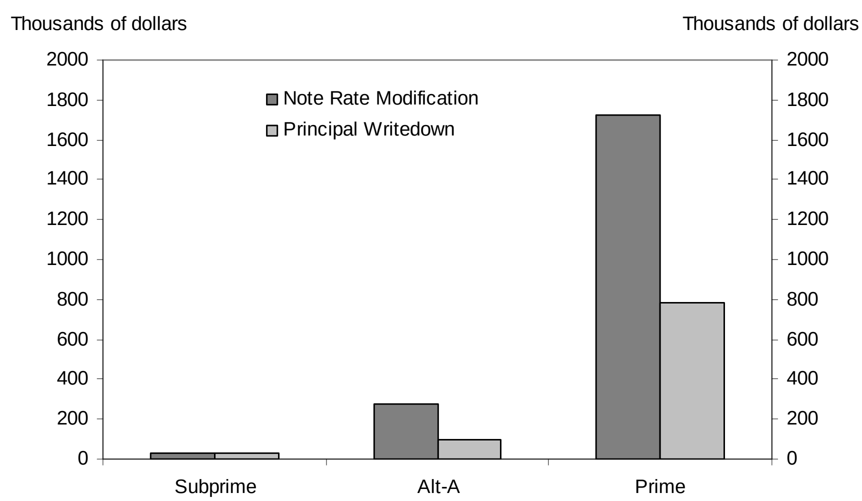
Policymakers may want to expend significant resources on subsidizing modifications since excess housing supply has a large negative impact on house prices, with a severe risk of adverse feedback effects.

Indeed, we can use our models to estimate how large a subsidy might be warranted. According to our home price model, one additional month of inventory—roughly 500,000 defaults at present—lowers the value of the housing stock by 0.8%—roughly $150bn at present—on a 2-year horizon. These numbers suggest that each default lowers the value of the housing stock by as much as $300,000 (=$150bn/500,000) on a 2-year horizon. This suggests that policymakers might be willing to intervene in favor of programs where the cost per prevented default is below $300,000.[12]

Which programs might pass this test? Exhibit 18 uses our models to answer this question. We simply divide the total negative NPV of each bulk modification program by the number of prevented defaults. Subprime modification passes the test easily, as the cost per prevented default is only around $30,000. Alt-A modification only passes the test clearly when implemented via principal writedown (which costs about $100,000 per prevented default) but not necessarily when implemented via note rate reduction ($270,000). Prime modification never passes the test, with costs of $780,000 per prevented default for principal writedowns and as much as $1.7 million for note rate reductions.

One might decide to provide a certain percentage subsidy for each principal writedown.

Exhibit 18: Cost per Prevented Default



Source: Goldman Sachs.

[12] The implicit assumption in the calculations that follow is that the impact of foreclosures on home values is a reasonable estimate of the social cost of default. Under normal circumstances, and especially during a home price bubble, this would be inappropriate. For example, lower home prices in 2004-2006 would have been a very good thing. But now that prices have fallen back to the neighborhood of fair value and further home price declines are likely to result in a large amount of economic and financial distress, equating home price declines with social costs seems more defensible.

Hence, we conclude that there may be a role for expending some public resources on subsidizing modifications. For example, policymakers might decide to provide a certain percentage subsidy for each principal writedown. If the subsidy were set at 25%, this would raise the private NPV of a bulk modification positive for subprime loans from -3.7% of UPB to +1.3% of UPB, but leave it negative for alt-A and prime modification. Alternatively, if the subsidy were set at 75%, this would raise the private NPV positive for alt-A modification from -11.0% of UPB to +4.0% of UPB, but would still leave it negative for prime modification.

The Devil Is in the Details

A practical program to subsidize principal writedowns—as opposed to the thumbnail sketch we have provided above—would need to consider several important issues before it could become operational. First, and perhaps most obviously, subsidizing principal writedowns would require strict controls on mortgage records, so that unscrupulous borrowers and lenders are prevented from engaging in fictitious transactions that are solely designed to collect the government subsidy. This is simple in theory but could be quite difficult in practice.

Why should we subsidize a debt reduction for, say, a borrower who has a current LTV of 50% and is extremely unlikely to default even in the event of a dramatic further home price decline?

Second, a true across-the-board principal writedown raises the obvious question of why we should subsidize a debt reduction for, say, a borrower who has a current LTV of 50% and is extremely unlikely to default even in the event of a dramatic further home price decline. It would be much more efficient to focus only on borrowers who are already in, or close to, negative equity and therefore at a higher risk of default. The counterargument is that a focus only on negative-equity borrowers would raise some of the same moral hazard and fairness concerns that we used above to argue against an exclusive focus on already delinquent borrowers.

Third, policymakers would need to decide whether to claw back some of the subsidy via “shared appreciation” clauses in which a borrower who has received a subsidized writedown would be required to transfer part of any future capital gain to the government. Depending on the design, such a clause could be used to reduce concern about subsidizing borrowers at very low risk of default, who might well decide to opt out of any program involving shared appreciation.

Fourth, there is a question whether the writedown subsidy should apply equally to first- and second-lien mortgages. One could argue that it is particularly unfair to pay, say, $10,000 for a $20,000 writedown of a second lien if the market value of such a claim is well below $10,000 in many cases. The counterargument is that the market value of the second lien is so low precisely *because* the risk of default is so high. This means that this is a case where a government subsidy is a particularly effective means of reducing distressed supply and thus limiting the downward pressure on home prices.

VI. Concluding Remarks

Even an aggressive foreclosure prevention effort alone is unlikely to stabilize the housing market and the broader US economy on its own.

Even an aggressive foreclosure prevention effort alone is unlikely to stabilize the housing market and the broader US economy on its own. Hence, we would also recommend several other measures.

First, it would be helpful to encourage the development of a larger rental market so that families who lose ownership of their home have the option of staying on as renters. The costs of foreclosure are mostly due to the physical removal of owner-occupiers from their homes. This is true in terms of the disruption of lives, in terms of the costs of eviction, repairs, and listing of the property, and in terms of the negative impact of vacancies on broader home prices. Hence, policymakers may want to encourage lenders that take ownership of a home to either enter the rental management business or to sell to investors who are willing to do so. In an extreme case—that is, if conditions deteriorate further and home prices overshoot substantially on the downside—the federal government might consider becoming a "landlord of last resort" by buying up houses at low prices and renting them out in size.

Second, it makes sense to aim for further reductions in mortgage rates via increased Fannie Mae/Freddie Mac securitization activity, as well as further purchases of mortgage-backed securities by the Treasury and the Federal Reserve. At least in the conforming market, this process is clearly underway as Fed officials plan to buy $500bn in agency-backed MBS. An extension to the nonconforming market is possible in 2009. This would probably involve the creation of special purpose vehicles backed jointly by the Treasury and the Fed, which either purchase or lend against securities in order to provide more balance sheet capacity in the system.

Third, further significant equity capital injections into financial institutions are likely to be needed. As discussed in Section III, loss recognition by US financial institutions still has a long way to go, and this recognition will substantially deplete equity capital levels. In addition, banks are reducing their target leverage, which also implies that increased equity capital is needed to support a given amount of lending.

Fourth, broader economic policy measures to boost the economy remain essential. In this respect, it is encouraging that the incoming Obama administration is planning a bold fiscal stimulus program. Moreover, the Federal Reserve is swiftly moving toward quantitative monetary easing and substantial further balance sheet growth, even beyond the purchases of MBS noted above.

However, it is important to be realistic. Even if policymakers are successful in averting a worst-case outcome, the US housing market will likely remain a drag on the financial system and the broader economy for an extended period. Unfortunately, the seeds for this outcome were sown during the housing bubble years in 2003-2006. At this point, we can only hope for damage control.

Jan Hatzius
Michael A. Marschoun
January 13, 2009

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