Exploring Basel 2 Implications and Internal Risk Based Assessments for Residential Mortgage Loans: The Opportunity to Provide Better Risk Assessment Tools

by Norm Miller and Michael Sklarz

What is the Basel II accord?

- Originally negotiated by over 100 countries in 1988 and revised in April of 2003 the new Basel (pronounced Bah'zel) accord is an agreement developed at Basel, Switzerland where the meetings on international banking take place. Any institution that does international banking and investing must comply with the Basel II accord set for implementation in 2008. The Federal Reserve Bank is now in the process of determining rules for compliance.
- The purpose of the accord is the protection of depositors.
- The key regulation is a determination of the appropriate level of reserves to hold based on the risk of the portfolio assets.

Minimum Tier 1 and 2 Reserve Capital

- Reserve capital (assets defined as Tier 1 and 2) must be a minimum of 8% of the assets “at risk”.
- Tier 1 capital is shareholders equity.
- Tier 2 capital is mostly subordinated debt. Tier 2 capital can’t be more than 100% of Tier 1 assets or 50% of the total reserve capital.
- “At risk” refers to a risk weight that every asset is assigned. See next page for an example using S&P credit type ratings.

Risk weights

Credit	AAA- to AAA	A- to A+	BBB- to BBB+	B- to BB+	Below B-	Unrated
Risk Weight	0%	20%	50%	100%	150%	100%

Note that a portfolio of all BBB rated assets would be treated as a 50% risk weight thus, 50% times the 8% reserve needed for a 100% risk weight would result in a 4% reserve calculation. Mortgages are generally viewed as 50% risk weight assets.

Our Research Based Conclusions

- A geographically focused portfolio will require reserves substantially higher than a managed portfolio.
- A strategically managed portfolio (aimed at minimizing peak short term losses) could hold a much lower reserve compared to a naively managed portfolio. Mortgage losses are often negatively correlated from one geographic market to another over annual horizons.

Our Research Based Conclusions

- If historical default and foreclosure rates can be used as indicators of future losses then a significant reduction in expected losses can occur by avoiding certain markets with historically high foreclosure rates and or those areas with extreme price volatility and likely price declines over the next few years.

Our Research Based Conclusions

- While Basel II suggests stress tests based on recession scenarios it is more logical to argue for stress tests based on mortgage rate increases and employment declines.
- Using mortgage rate increases and employment declines most markets decline in value but not all. That is some markets are surprisingly stable. Others are more susceptible.
- The most sensitive markets decline about 15% in price over several years after a significant mortgage increase and employment decline.
- PMI has a huge impact on loss exposure given foreclosure is necessary.
- State laws also affect fixed foreclosure costs and the speed of foreclosure and these must be factored into any estimation of losses.

Conclusions

- A risk assessment tool that calculates the risk weight and required reserve for every mortgage at issuance is possible with a given an assumption about loss correlations.
- This would require a calculation of the probability of negative equity over the next several years for every mortgage as well as the local market likely reaction to economic stress tests.

More on the Mechanics of Basel II

- Basel II allows those investors/lenders who wish to develop an internal risk based (IRB) assessment tool to do so.
- The process must be built on at least 5 years of data, with at least 7 risk gradients, and it must consider default risks, exposure to losses and probable losses. The risk analysis techniques that are to be internally based must consider credit risk, market risk (general trends and trends and fluctuations in interest rates) and operational risk (portfolio considerations).
- Stress tests are aimed at the 99.9% confidence limit worst case scenario.

Internal Risk Rating systems

- Internally driven risk rating systems must be in place by the end of 2007 and satisfy 6 criteria:
- Objectivity, independence, transparent, fully disclosed (of methodology and terms and process), credible, and with sufficient resources applied so as to be able to maintain the approach. They also must be auditable looking for double counting of credit enhancements known as credit risk mitigation (CRM) or anything that would lower the estimate of the risk weight of the assets.

The Federal Reserve Board Model for Mortgage Risk Weight Assessment*

- To assist in the Internal Ratings Approach a model was developed that considered market risk (volatility) and portfolio risk based on asset correlations as well as credit risk (default). The model is shown below after some review of term definitions.

*From the work of Jim Follain and Paul Calem, see “The Asset Correlation Parameter in Basel II for Mortgages on Single Family Residences” Oct. 15, 2003, Board of Governors of the Federal Reserve System

Key Acronyms

- IRB approach = Internal ratings based approach
- CRM = credit risk mitigation such as the use of PMI (private mortgage insurance)
- LGD = loss given default (includes fixed and legal costs)
- PD = probability of default (note this is an annual calculation)
- EAD = exposure at default (% of exposure)
- EL = expected loss (again an annual calculation)

Below k = the minimum total capital (reserve) requirement for a residential mortgage
PD = probability of default
LGD = loss given default
EAD = exposure at default
C = confidence level set at 99% by Basel for a one tail test
Φ = the cumulative normal density function
p= .15 set by Basel but theoretically a correlation coefficient of this asset loss with other assets.

The Follain paper supports this .15 assumption for a national portfolio.

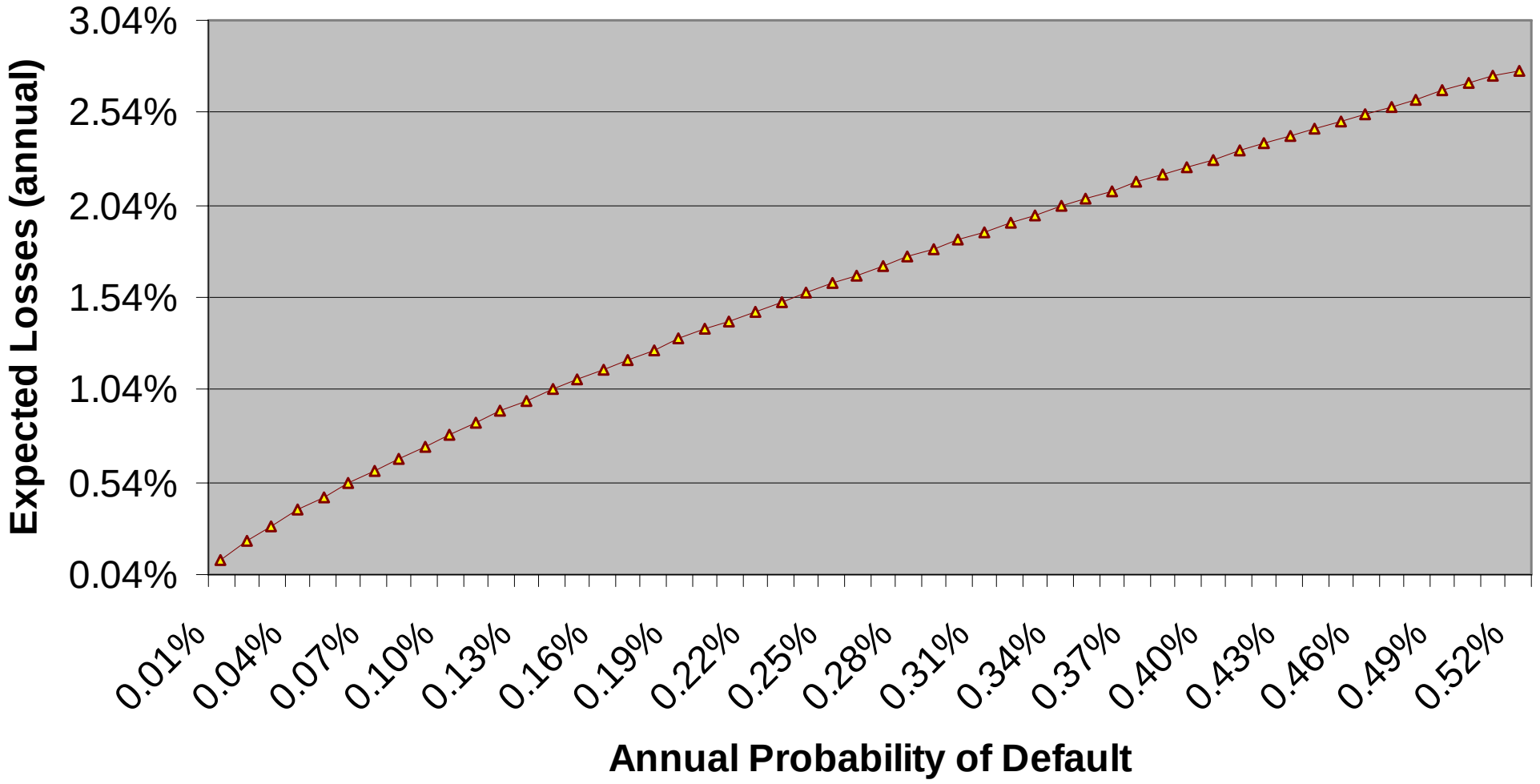
$$k = \phi\left[\frac{\phi^{-1}(PD) + \sqrt{\rho}\,\phi^{-1}(C)}{\sqrt{1-\rho}}\right] * LGD * EAD$$

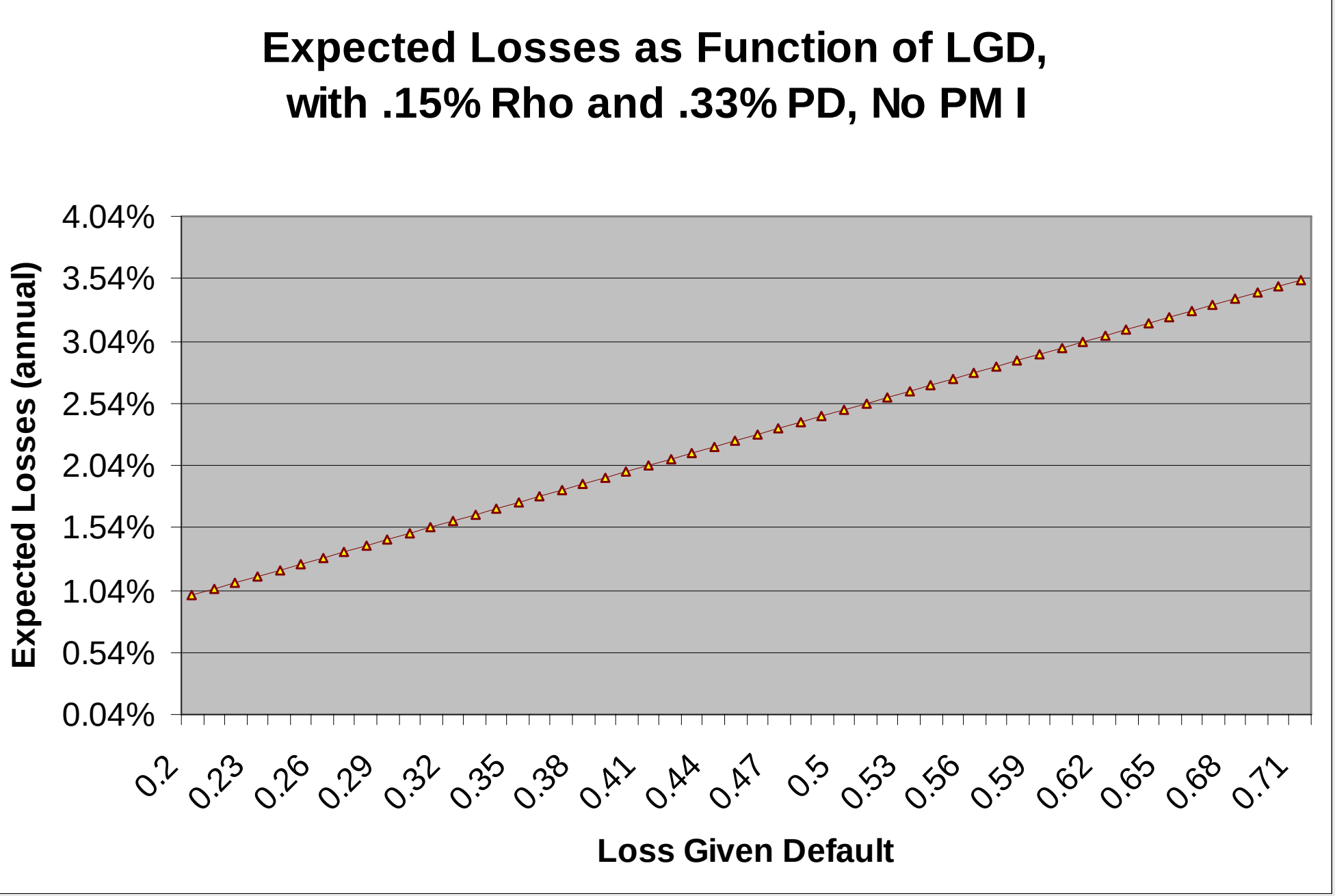
- In the above formula the concern is with 99.9% tail risk, C, defined by the Basel accord as the likely result in a recession. For mortgages the more appropriate tail risk is reflected by a sudden and large increase in market interest rates and possibly a loss in local employment.

The results of such a model

- We develop different risk weights for different mortgage loans. Remember that a risk weight of 100% requires 8% capital reserves. Examples:
- FICO 740, LTV 70% = risk weight of 3%
- FICO 620, LTV 95% = risk weight of 62%
- Recall the average mortgage risk weight is 50%.

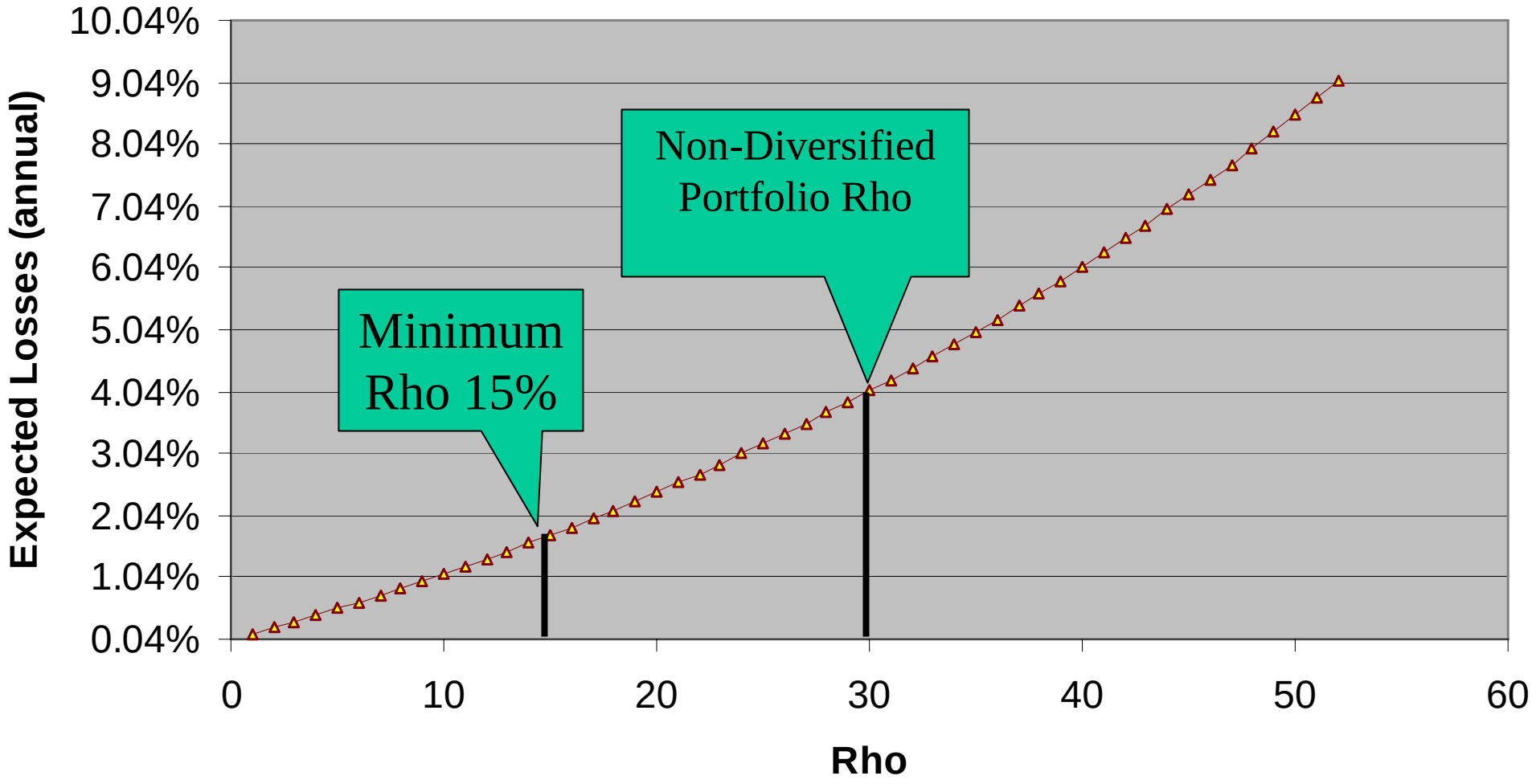
Expected Losses as Function of PD, with .15% Rho and 40% LGD, No PM I





The maximum loss rates for a prime mortgage pool run .88% without PMI and .18% with PMI while the subprime mortgage pool losses are reduced from 3.48% to 1.03%.

Expected Losses as Function of Rho, with .33% PD and 40% LGD, No PM I



Based on 1972-2002 Data Foreclosure Rates (%) Vary Greatly By State

State	**Average Annual Foreclosure Rate %**	**99.9% Worst Case Foreclosure Rate**
AK	1.72	8.61
CA	.64	1.39
FL	.73	1.23
MO	.35	.91
ND	.91	3.52
TX	.71	1.69
VA	.22	.41
WY	1.11	5.68
USA	.63	1.74%

There has been a trend towards curing or working out defaults rather than foreclosing.

- Subprime mortgages that went into default were cured 21% of the time and foreclosed 79% of the time according to Capozza and Thomson (2004).
- This subprime foreclosure rate is far more than observed for prime mortgages while the workout ratio for prime mortgages has been increasing with nearly half never going into foreclosure.
- Fannie Mae reported as many as 53% of the defaulted problem mortgages being worked out in 2002 up from 35% in the previous year.

Speed of foreclosure and thus loss a varies by state

- For example, in a state like Hawaii foreclosure is faster on average by 150 days compared to Idaho where judicial foreclosure is required.
- Using a mortgage rate of 6% the extra 150 days amounts to approximately 2.47% in required extra interest.

Strategically Managed Portfolios Could Further Reduce Maximum Annual Losses

For examples a portfolio of 5 states with the following weights:

30% CA
20% NM
25% NY
10% OR
15% WA.

Would observe an average annual foreclosure rate = .63% the same as the national average but a 99.9% confidence limit foreclosure rate = 1.13% compared to 1.74% for a naïve national portfolio. This is a result of the negative foreclosure rate correlations among many states. At the MSA level strategically managed results could be even better.

Improving Risk Analysis: Step 1

- Start with AVMS
  - Unbiased.
  - Allow (uncertainty) price volatility to be factored into the risk analysis. Note example:

Property	Market Value	Std Dev	Mortgage	LTV	Probability that the Market Value Is Less Than the Mortgage
A	**$230,000**	**$34,500**	**$184,000**	**80%**	**9.12%**
B	**$200,000**	**$15,000**	**$160,000**	**80%**	**0.38%**
B	**$200,000**	**$15,000**	**$180,000**	**90%**	**9.12%**

Improving Risk Analysis: Step 2

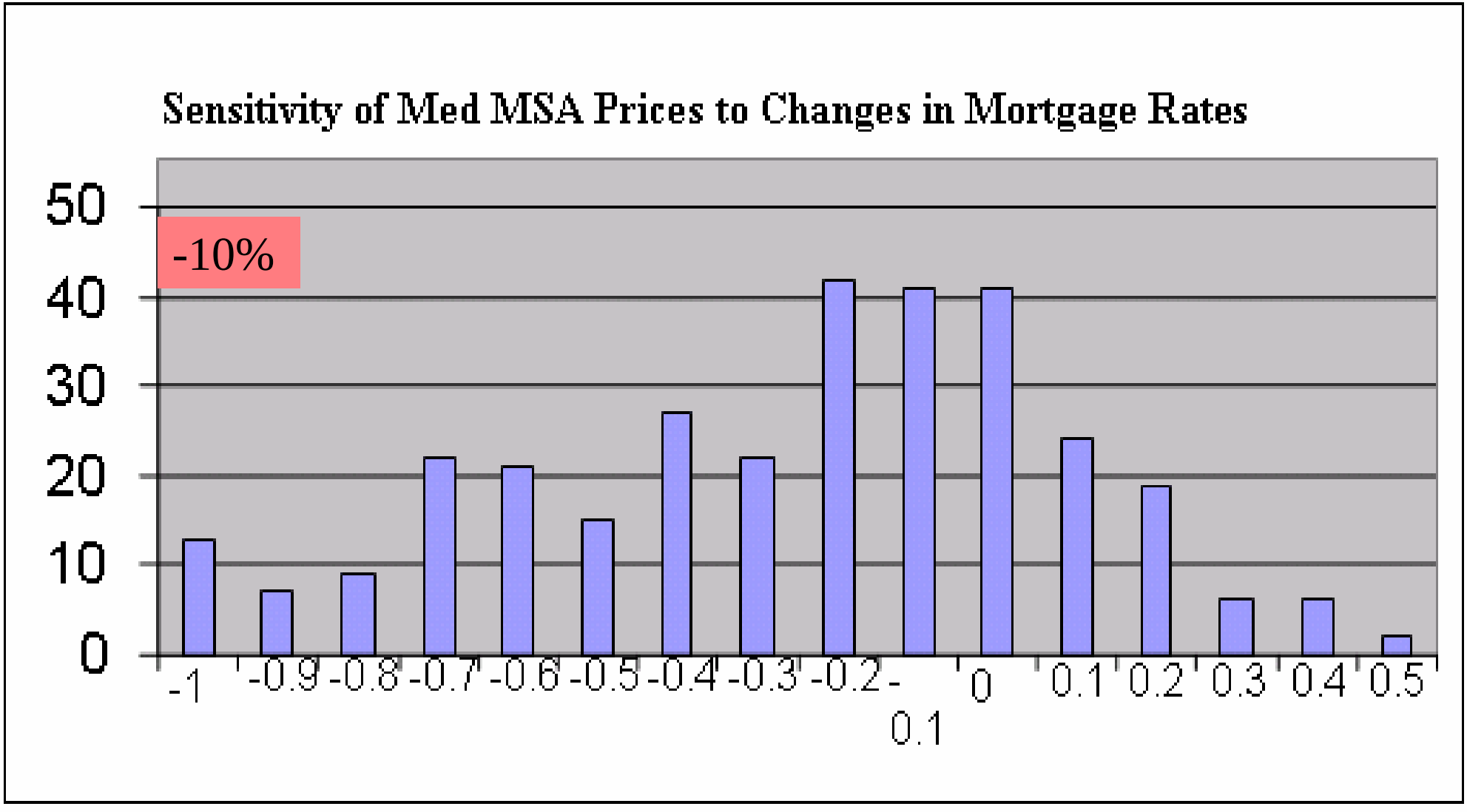
- Add a locally derived forecast of future prices based on fundamental and autoregressive models.
  - This allows an estimate of the future probability of negative equity.
  - Bring in volatility to this measure.
- Allows Basel II type stress tests to be applied via the forecast price by changing mortgage rates and employment rates.

The Generalized Forecast Model Developed for Every Market

- $HPt = \beta1(AP)t + \beta2(FE)t + \beta3(HP)t\text{-}n + \beta4(FE)(HP)t\text{-}n + \varepsilon$
- Here Affordable Price =AP is calculated as follows: AP = HHMImsa/3.3/AMCi,n/LTV
- Mortgage rates are brought in via AP
- Employment effects are brought in via FE

Various lags may be used in different markets for previous price (HP)

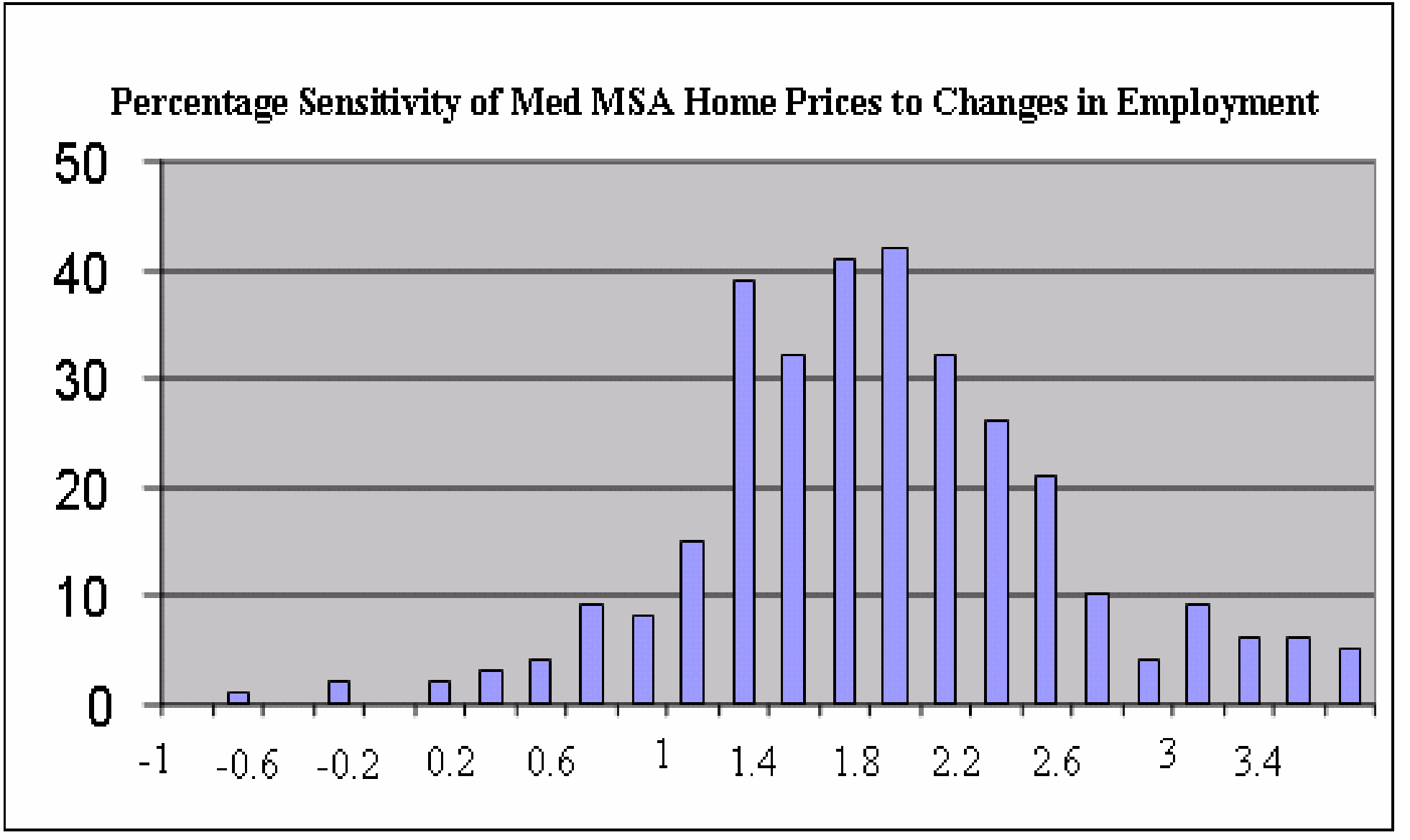
The Average Change in Median MSA Price in Response to a 1% Incremental change in Mortgage Rates is About 2% Decline in Price Over 3 Years



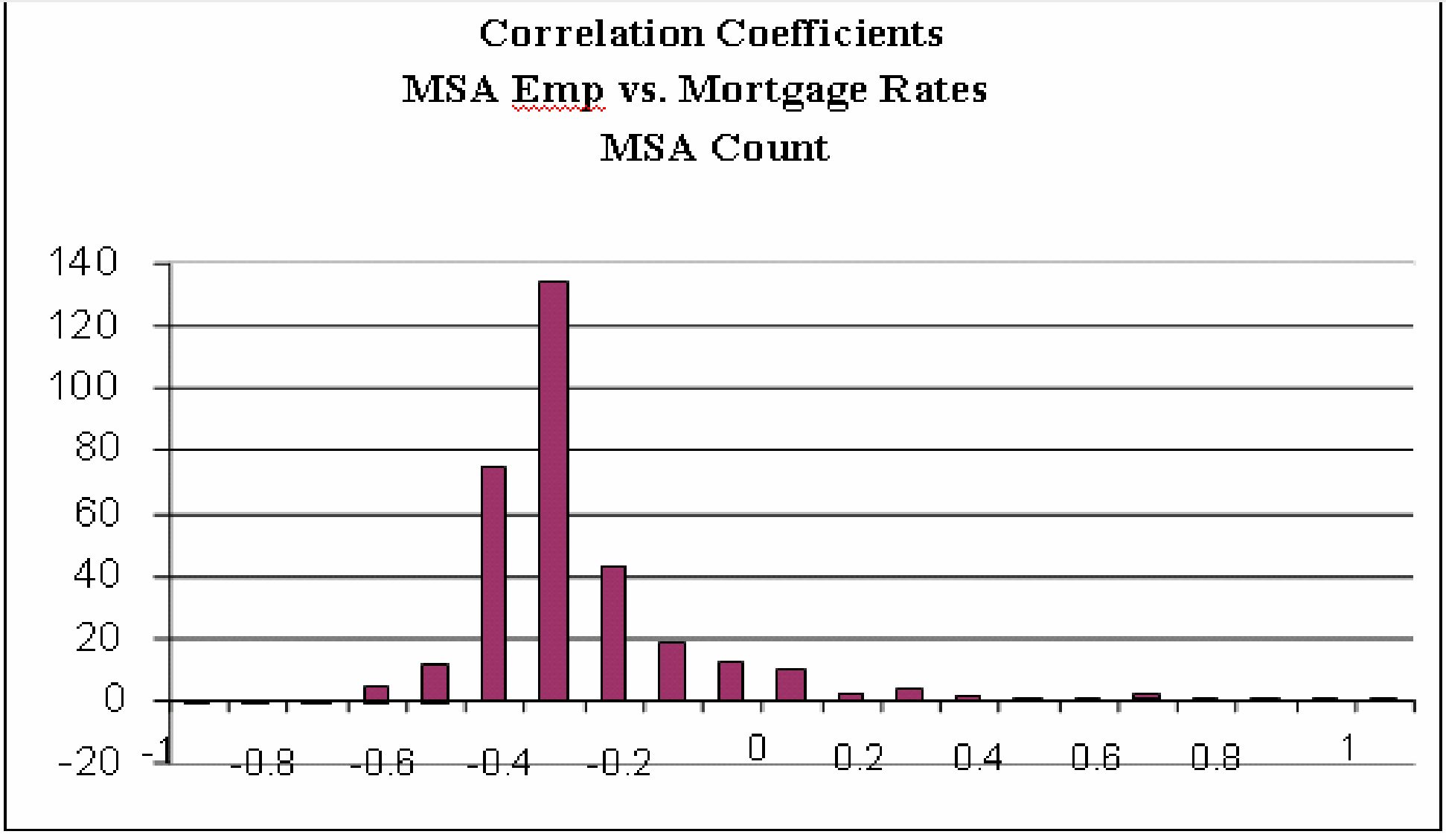
The Effect of Increasing Rates by 3% (300 BP) on the Median Price of Selected Markets Ignoring Mortgage Principal Pay Down Over 3 Years

MSA	Price Effect	New LTV from 80% Originally	Increased Loss
Wash DC	-14.84%	93.94	-16.49%
Orange Cty	-9.90%	88.79	-11.0%
Seattle	-9.74%	88.63	-10.82%
Atlanta	-6.12%	85.22	-6.80%
San Diego	-4.45%	83.73	-4.95%
Denver	-1.66%	81.16	-1.85%
Miami	-.79%	80.63	-.87%
Cleveland	0	80.00	- 0%

The Average Increase in Median MSA Price in Response to a 1% Increase in Employment is About a 1.65% Increase in Price Over 3 Years

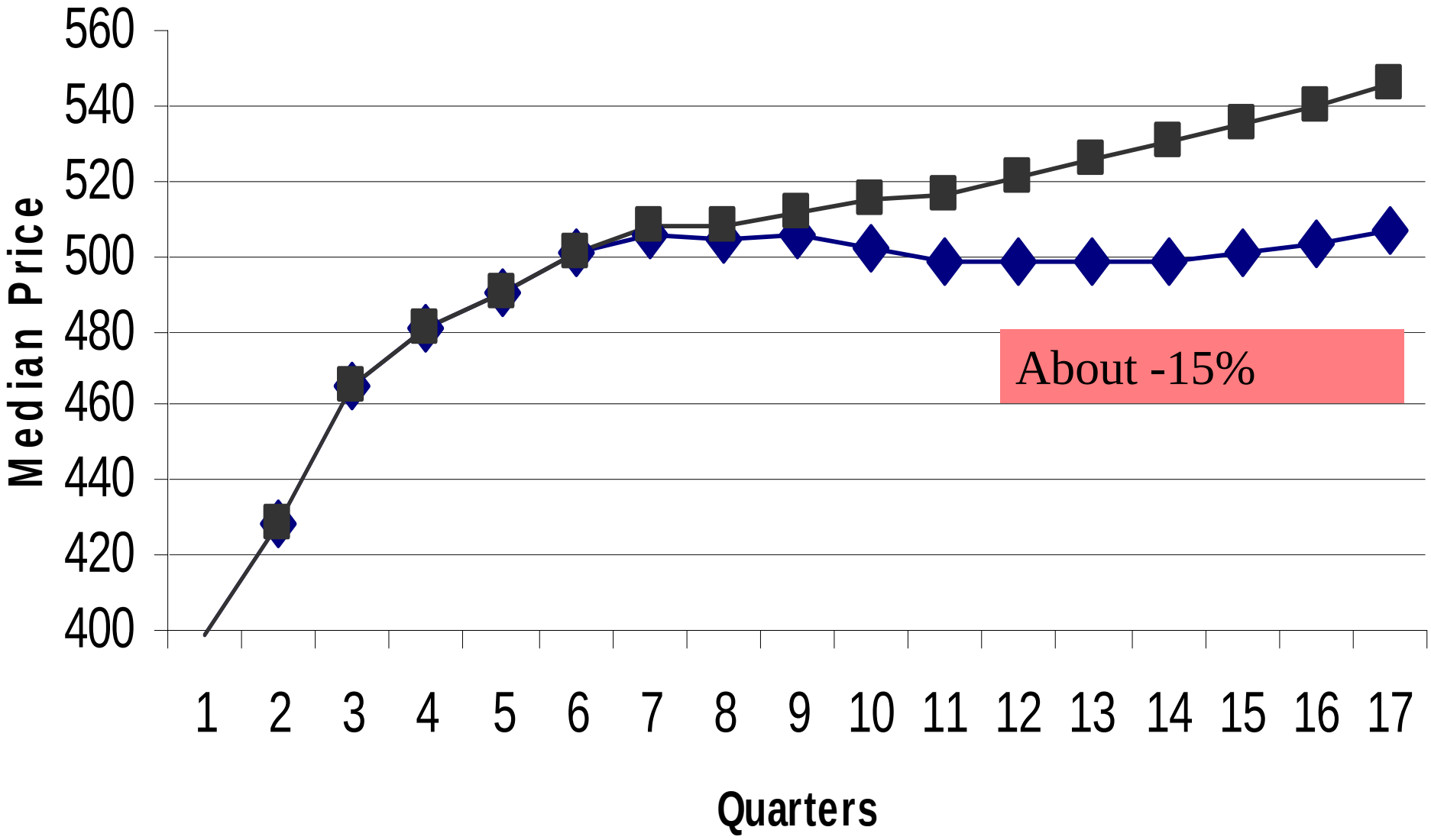


Examining the Effects of Changes of Both Mortgage Rates and Employment on Various Markets: The Interaction of Both Show That Mortgage Rates and Employment Tend to Be Inversely Correlated at -.35. That is if mortgage rates go up employment rates tend to go down and vice versa for all MSAs.

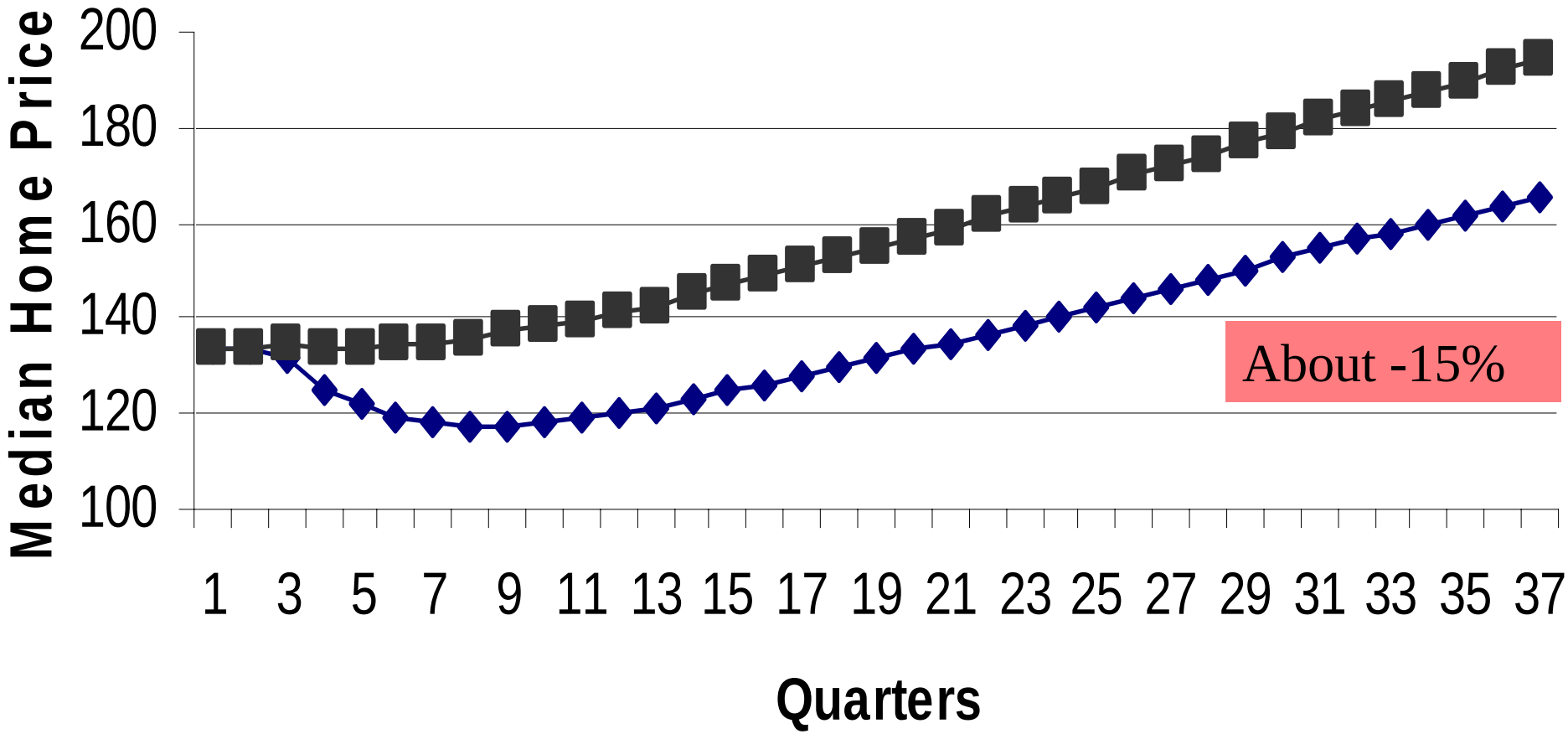


Looking at the Worst Case of Mortgage Rates and Employment Using a Model That Incorporates Both Effects and the Interaction on Selected Cities using data that ends in 2003

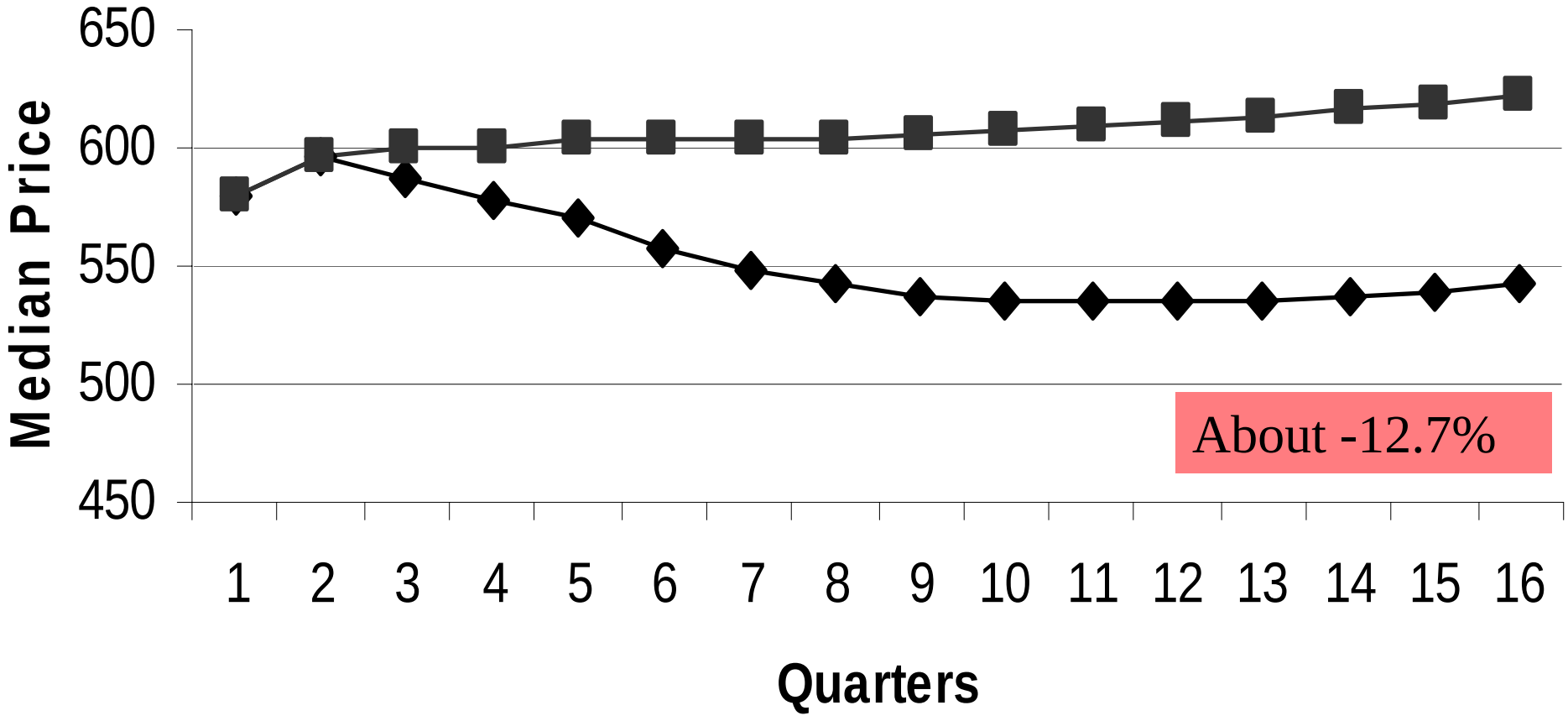
Housing Price Forecast San Francisco From 2003-2007 Base Versus Worst Case



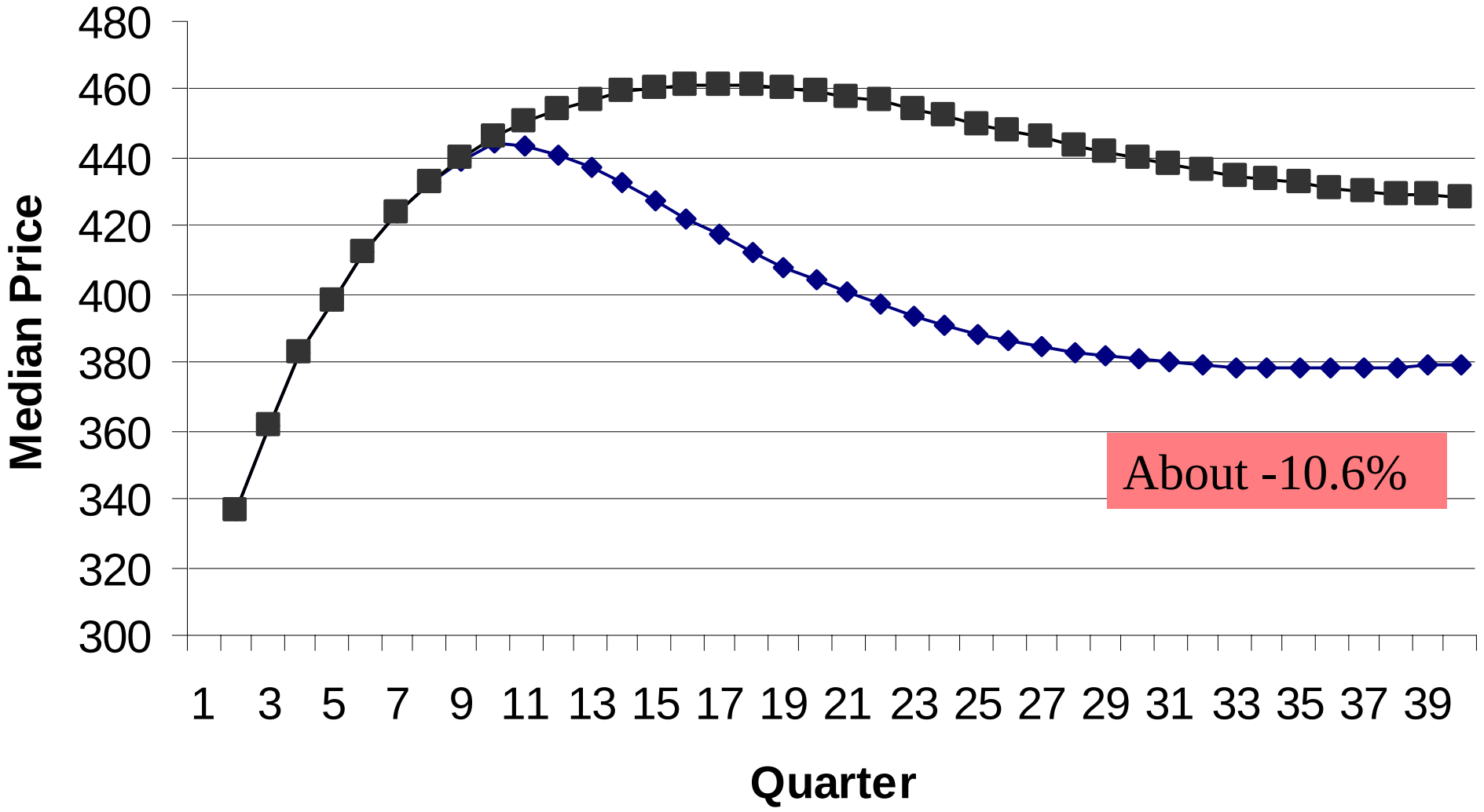
Housing Price Forecast for Houston 2003-2012 Base Case Versus Worst Case



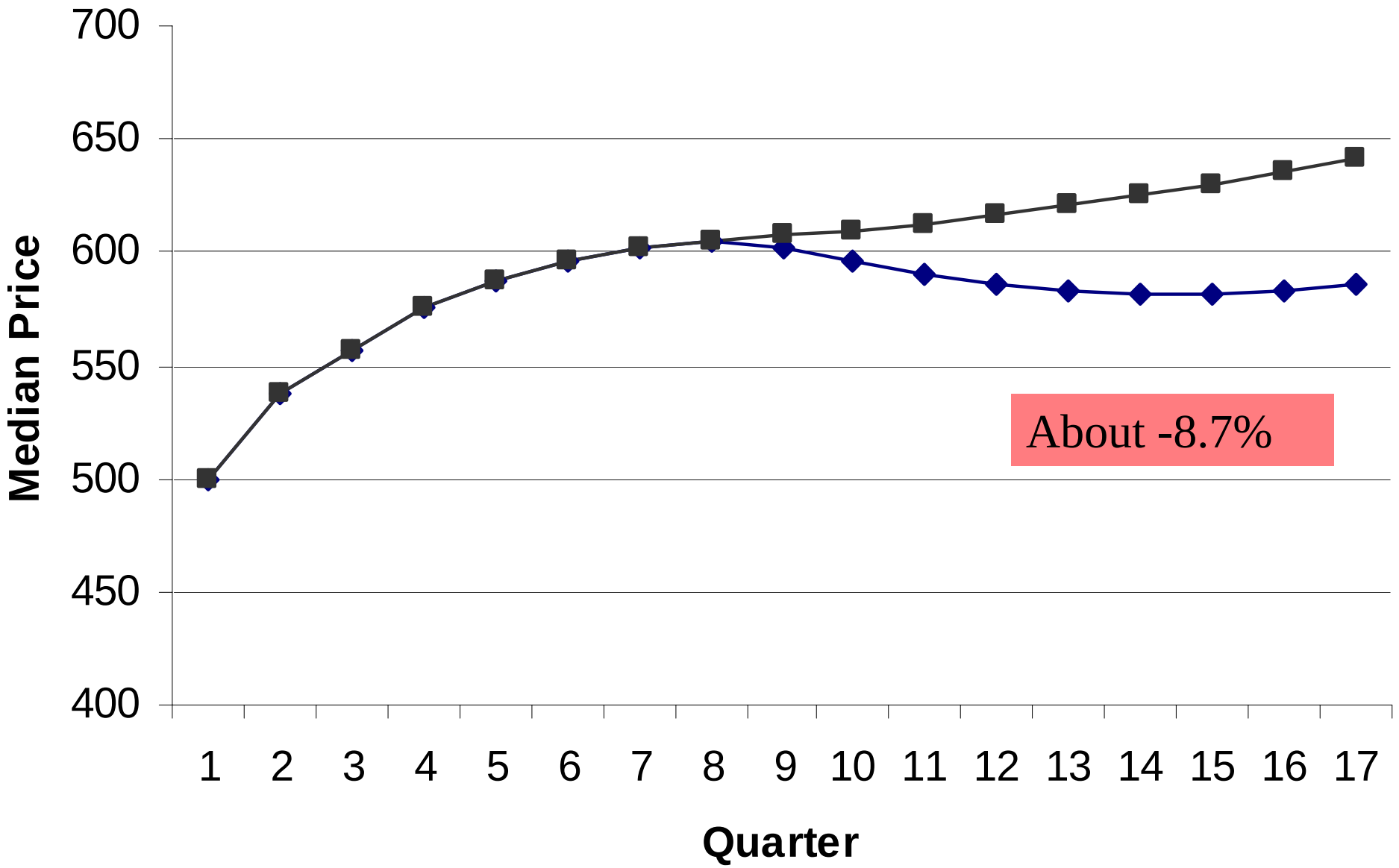
Housing Price Forecast San Jose 2003-2007
Base Case Versus Worst Case



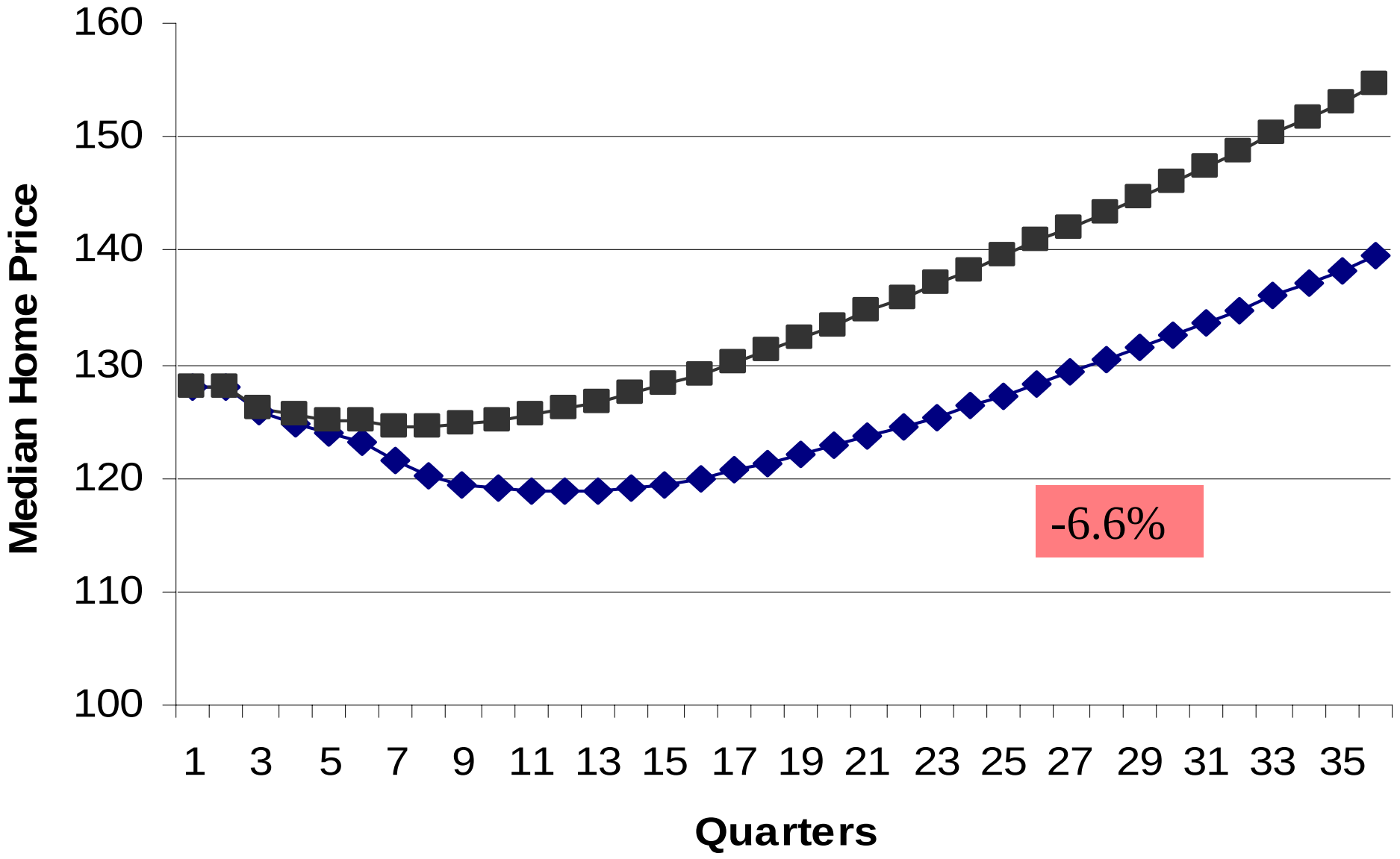
Housing Price Forecast LA 2003-2012 Base Case Versus Worst Case



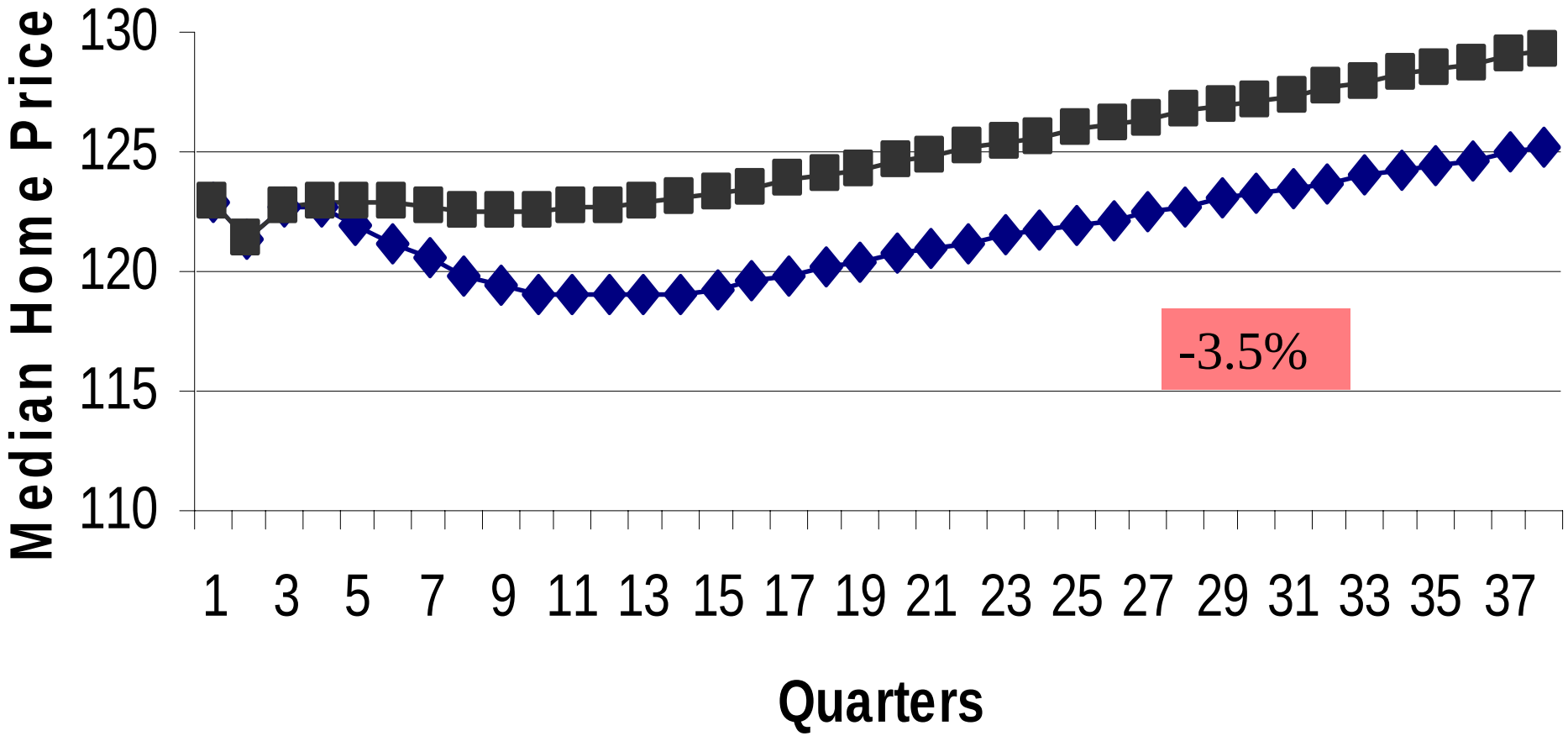
Housing Price Forecast from 2003-2007 for Orange County Base Case Versus Worst Case



Housing Price Forecast for New Orleans 2004-2012 Base Case Versus Worst Case



Housing Price Forecast for Baton Rouge
2003-2012 Base Case Versus Worst Case



Probability of Default

- The probability of default is not considered in our model and needs to be added into a BASEL calculation. This probability is generally based upon the FICO score and the age of the loan as well as other factors that we would need to include, but FICO and loan age are the most important. Loan Performance Corp is probably the most referenced independent estimator of the probability of default with the best data.

Foreclosure Expenses and Lost Interest

- The FRB model assumes 10% of the loan balance as foreclosure expenses. This is probably a less accurate approach then using some fixed cost that varies by state and then adding a percentage of the loan balance, such as $7,500 plus 5% of the loan balance. To estimate the loss given foreclosure the FNIS Model should develop an estimate of the fixed costs to foreclose and then some variable costs where the average is at least 10% of the loan balance. Lost interest may be added as well through a simple estimate of 3 months times the loan balance at the monthly mortgage contract rate. This calculation is simply CR/12*LB*3 or more simply CR/4*LB, where LB is the loan balance. Both of these items should be included in a new calculation of expected loss given foreclosure. We could provide this estimate based on our probability of negative equity.

Influence of Loan Life

- Basel tends to look out over the typical life of a loan. The probability of default in any given year is typically the cumulative default probability divided by the expected life of the loan. In recent years the average loan term has been rather short going out no more than a few years. This will change when interest rates are rising.

Backing into BASEL Risk Weighted Capital

This ignores the capital cost part

- Assume we have 35% plus 12.5% or 47.5% times 6% which equals 2.85% in the first year as the appropriate risk premium. This seems to be the appropriate reserve using our model but we can verify this with external experts. In the second year this would drop down to .9%.

- We could back engineer this estimate to develop the risk weighted capital for any given year. For example if the average mortgage requires a 4% reserve and is assumed to have a 50% risk weight or 12.5 times the 4%. Thus, we can simply multiply our risk premium reserve estimate times 12.5 to derive the risk weight so for example:

- 2.85% equals a Basel risk capital weight of 35.625%

Our derived risk weights will vary with LTV, property value trends and also market volatility.

- Note that only the higher loan to value mortgages are going to have significantly above 4% reserve requirements in our average scenarios.
- For example assume a 112.5% LTV plus 12.5% for the foreclosure expenses so the total is 125% effective LTV may result in a 97% probability of negative equity in the first year and with a 6% PD we get 5.85% reserves required which times 12.5 results in 73% “risk weighted” capital which is significantly above the 50% average assumed.
- Note that if the probability of default was increased to 12% versus 6% the required risk weight would be twice as high as the 73%.

Summary

Many mortgage lenders are starting to worry about how to handle the requirements of Basel II.

We can provide a Basel type tag for any mortgage but the piece we miss is the Probability of Default.

We need estimates of the probability of default, localized foreclosure costs, and more testing as well as market verification of the approach we develop, but we already have built the bulk of the process elements considered essential by the FRB and just getting to this point will not be easy for most lenders.

Sophisticated mortgage portfolio analysis needs to consider how different markets react to interest rate changes and employment changes based on localized price forecasts.

We can provide such analysis as well as providing AVMs and volatility measures.

Now we have demonstrated the process in more depth and we are convinced that this is a solid way to stress tests mortgage portfolios and develop a Basel risk weight.

Thank You!

Presentation by Dr. Mike and Dr. Norm