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MARKET RESPONSES TO THE PANIC OF 2008

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This is an interim report on on-going research, and undoubtedly contains inadvertent errors. Many of the numerical calculations here are best interpreted as estimates of order-of-magnitude. Readers who would like to see a more polished report may want to wait a few months until we have had more time to digest these findings, and to replace some of the approximations with more precise estimates. For the others, we will provide updates and corrections on Mulligan's blog www.panic2008.net. We appreciate the many comments and conversations on this subject since September 2008, including (but not limited to) those from Fernando Alvarez, Gary Becker, John Haskell, Kevin Murphy, David Shipley, Chris Suellentrop, University of Chicago students, and persons entering comments on Mulligan's blog. The errors that remain are our own. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

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ABSTRACT

We model the panic of 2008 as part of the wealth and substitution effects deriving from a housing price crash that began in 2006. The dissipation of the wealth effect stimulates a reorganization of the banking industry and increases in employment, GDP, and unemployment. The release of resources from the housing sector lowers investment goods prices, and thereby devalues existing non-residential capital while stimulating non-residential investment. These predictions are compared with measured U.S. economic performance from 2006 to 2008 Q2.

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The financial and housing sectors are experiencing dramatic and historically unusual changes. These changes garner world-wide public attention. Rarely do so many people look to economics for a framework for understanding the events and predicting something about the uncertain future.

The purpose of this paper is to forecast sectoral and aggregate market responses (measured as GDP, consumption, investment, entry, etc.) to these changes using simple, off-the-shelf economic models of market fundamentals. I also make attempts to forecast various prices, although in some cases the off-the-shelf models have a better track record for predicting quantities.

There are a couple of reasons why we limit the modeling to market fundamentals, and in the process abstract from game theoretic/strategic considerations, political economy, and nominal rigidities. First of all, the models of fundamentals are simpler ("just" supply and demand), and thereby confer a couple of intellectual benefits: (a) they provide a useful benchmark against which to understand the workings of more complicated models (Barro 1997, chapter 20), (b) they provide a coherent account of both sectoral- and aggregate-level responses without significant modification of the models from the literature, and (c) they generate forecasts with less effort, so that we can provide some forecasts to our colleagues in October 2008 rather than, say, October 2009.

Second, to the extent that existing models (of any kind) can forecast economic quantities, I expect that market fundamentals will do the bulk of the work. Part of our judgment is based on our perception of the empirical success of those models, but part of it is dictated by the situation – as long as the Federal Reserve works (by intention or by accident) to prevent a deflation, various nominal rigidities will conveniently remain less

important. In other words, nominal rigidities would merit more attention if we thought the price level were going to fall.

As with the panic itself, this paper begins in Section I with the housing boom of 2001-2006. By 2006, housing prices had exceeded long run replacement cost by as much as 100%, which motivated lots of residential construction and meant that real housing prices might eventually fall 50% from their peak. In hindsight, we saw housing prices fall this much over a short period of time.

The economic logic of this paper is simple: the housing crash has both an adverse wealth effect and a substitution effect. The adverse wealth effect comes from the fact that the economy spent significant resources to build housing quickly, when ultimately the market did not need the housing so quickly. Similar in character is the adverse wealth effect of the stock market crash, although it is unclear whether the stock market wealth effect is part of the housing crash or is itself an independent stimulus. In any case, it is important to quantify this (these) wealth effect(s).

The substitution effect comes from the release of construction and other resources from the housing sector, which (in addition to the adverse wealth effect on labor supply) stimulates real investment (although it may reduce investment expenditure) in the nonresidential sector and drives down the value of existing capital. Some amount of stock price decline results from the realization that many resources are leaving the residential sector.

Section II examines the banking sector. As Arrow (2008) points out, an adverse shock to the value of houses does not only harm the persons who live in them. A variety of risk-sharing arrangements – especially collateralized home mortgages – serve to dissipate housing losses into the wider economy, and the banking sector is the conduit. Massive capital losses require the industry to reorganize. This reorganization may itself create a liquidity crisis or add to investors' preferences for safety, either of which adds to the stock market crash.

Section III follows the substitution and wealth effects into the nonfinancial economy. Consumers want to work more (especially persons nearing retirement who were planning on cashing in their stock market and home equity), which raises both employment and GDP relative to trend. In the short run, greater labor supply lowers

wages (relative to trend) and raises unemployment rates. As soon as capital can catch up to the extra labor supply, wages return to trend and the unemployment rate returns to normal. We offer some back-of-the-envelope calculations of the potential magnitude of these effects. For now, they can only be considered estimates to an order-of-magnitude, not precise estimates.

Section IV considers the possible intermediation effect, and Section V presents some evidence that intermediation is still functioning normally. Section VI concludes.

I. Housing Sector

I.A. Housing Prices will Fall 50% from their Peak

One simple model of the supply of housing is from Poterba (1984) and Topel and Rosen (1988), and is illustrated in Figure 1. Demand for housing fluctuates over time, as there are changes in demographics, tax laws, credit market conditions, etc. In the short run, the supply of housing is fixed, so higher demand increases prices. The higher prices motivate additional construction (which is itself supplied with elasticity less than infinity in the short run) until prices fall back to long run construction cost. This theory predicts that housing prices tend to revert back to construction cost – in other words, that the ratio of housing prices to construction cost tends to revert back to one. To the extent that the construction industry has some factors of production that are fixed in the short run, construction costs deflated by CPI will themselves be above average during a housing boom and tend to revert back to the average. In this case, the ratio of housing prices to CPI also reverts back to one. The theory also predicts that (a) construction activity is higher when housing prices exceed construction costs and (b) regions whose real housing prices increased more will have the larger price declines in the long run.

Figure 2 displays monthly housing prices from Case-Shiller and OFHEO, deflected by the PPI for the residential construction industry, for the years 1987-2008. For many of the years prior to January 2000, both the Case-Shiller price index and the OFHEO price index indicate that housing prices increased about at the rate of construction costs, which is why the deflated housing prices are constant except for

occasional booms. Although not shown in the Figure, those price booms are also periods of booms in construction activity.[2]

Real housing prices began to increase in 1997, and continued their increase until the end of 2005, according to Case-Shiller.[3] The most rapid decline occurred after November 2006. If instead real housing prices had followed PPI-construction inflation from January 1999 through July 2008, they would have been 30% below their actual values in July 2008. In other words, as of July 2008 housing prices more to fall in order to reach the real value they had for several years prior to the boom.[4]

The high housing prices of 1998-2006 are interpreted as a short run response to high (and perhaps increasing) demand. Although the theory predicts that housing prices will eventually revert back to housing cost, it does not necessarily predict when – that depends on when demand stops shifting out and how long it takes for the construction industry to satisfy that demand. The market in 2006 may well have understood that persons purchasing houses would suffer an inflation-adjusted capital loss over the long term, but it might not have anticipated what the short term gains or losses would be. The expected capital losses in the long run are not necessarily reflective of a "bubble," but may rather have served to ration housing. In 2006, the demand for houses at the long-run construction cost exceeded the supply at that cost.The persons who actually got the houses in 2006 are the ones who were willing to expose themselves to the possible (and, in the long run, inevitable) capital loss.

If this theory is right, housing prices must eventually fall. Any policy attempt (short of changing demographics or destroying some housing) to "stabilize" housing prices above one will only motivate construction beyond what would be demanded at a housing price of one and may even cause housing prices to ultimately fall below one.

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[2] See Chart 1-2 in the February 2007 *Economic Report of the President*.

[3] The OFHEO index shows the peak in 2007, which tells us that it is not suited for high-frequency analysis. Relative to January 2000 (and in nominal terms, the Case-Shiller peak is 30% higher than the OFHEO peak). The BEA's annual implicit price index for the residential housing stock peaks at the end of 2006, and the peak is only 21% higher than the year 2000 value.

[4] Glaeser (2008) shows that regions with larger housing price increases through 2006 had larger decreases since then. Note that economically meaningful prices may have fallen more rapidly than indicated by the Case-Shiller index because of a lack of transactions since the boom's peak.

I.B. The Size of the Adverse Wealth Effect

The housing price crash was an adverse wealth effect; people must behave differently than they would have absent the crash. However, the housing price boom may have been a favorable wealth effect that changed behavior in the other direction. In other words, the impact of the crash itself is different from the impact of the boom and crash combined. We are still working on a theoretical framework that would guide a more precise specification of counterfactuals. For now, we consider two counterfactuals: (a) that the housing boom did not end in a crash but rather remained at 2006 levels and (b) that today's stock of housing was built more smoothly over time (without a boom-bust) so that all houses were built at long-run construction cost rather than the actual prices shown in Figure 2. The wealth effect derived from the latter will be smaller because most houses were not built at 2006 prices.

In both cases, we need to measure how today's housing prices relate to long-run construction cost and to actual historical housing prices. We assume that today's housing real prices are equal to long run construction cost, which is equal to actual real housing prices in a benchmark pre-boom point in time, such as January 1999. Case-Shiller's measure of historical housing prices is the one showing the largest difference between boom prices and January 1999: the latter price was 50% below the boom price. The OFHEO index and the index implicit in the BEA's real housing stock series imply a smaller difference: 27%.

The larger concept of the adverse wealth effect of the housing price crash is equal to the change in price times the quantity of housing, which is equal to the amount by which the pre-crash housing stock exceeded its value at long run replacement cost.[5] Table 1 experiments with two different estimates of how much pre-crash prices exceeded long run replacement cost: 50% (based on Case-Shiller) and 27% (OFHEO).

Table 1's first row displays the total amount of the U.S. residential housing stock in place in January 2006, valued at January 2006 housing prices: $16.5 trillion. The second row calculates the value of the same housing stock, using two scenarios: one with

[5] At first glance, this might seem like an exaggeration because housing prices would have been expected to fall even in a world of perfect certainty – merely because pre-crash prices exceeded long run replacement cost. However, those anticipated price reductions were (in theory) compensated by high rental values that never materialized.

50% lower prices, and the other with 27% lower prices. If a housing price crash were to bring prices down by 50% (27%), $8.3 ($4.5) trillion would be lost. Table 1's third row shows the capital losses.

Table 1 also shows the cumulative cost of building too quickly since 1999. The details are shown in Table 2, which is organized as one row for each year. The first column is actual residential investment expenditure, as measured by the BEA. The next six columns show estimates of actual housing prices and how they compare to the benchmark prices (January 1999). The final three columns display the reduction in nominal investment expenditure that would have occurred had housing prices been as in January 1999, rather than their actual values. The bottom of the table accumulates those reductions. If we interpret the price premia as the cost of building the housing stock more quickly than can be supplied by the normal investment rates (that is, absent a boom), then the cost of building quickly was about one or two trillion dollars.

II. Banking Sector: Risk Sharing, Mergers and Turnover

II.A. Housing Losses are Dissipated Among the Entire Population

Many houses serve as mortgage collateral, which means that (at the home-owner's discretion) houses become the property of mortgage lenders if housing prices fall so much as to eliminate the borrower's equity. The Federal Reserve's Flow of Funds shows that $9.4 trillion in mortgage loans were outstanding in 2006 Q2. We are working on aggregating more detailed information on loan-to-value ratios, but for now, notice that a decline of a $8.3 trillion in home values could result in a loss of just $3.3 trillion (20% of the peak housing stock) for home-owners, with the remaining $5.0 trillion accruing to the mortgage lenders.[6] Note that the market capitalization of the financial component of the S&P 500 fell by about $1.5 trillion from June 2006 to October 2008.

[6] For the purpose of understanding the impact on the banking sector, the larger of the two loss concepts (the loss in housing value from the housing price crash, holding the boom constant) may be more appropriate.

II.B. Efficient Adjustment of Banking Operations

The banking sector losses from the housing price crash are massive. However, these costs are sunk, so there is no efficiency reason why massive losses by themselves would affect bank operations. However, there are a couple of factors that could change the efficient operations of banks and other financial institutions. First, the financial industry has continuously innovated, with its long-lasting achievements including the creation of mutual funds, consumer credit cards, junk bonds, etc. The subprime home loan was a financial innovation that was not as successful on its first try, but may well be improved in the future.[7] The institutions inventing and implementing those improvements may well be different from those that had the largest subprime market shares prior to 2008.

Second, there may be a change in the willingness of persons to hold various financial assets. For example, savers may no longer be willing to hold mortgages without a higher expected return. This supply-of-capital effect would reduce the quantity of mortgages and thereby bank operations. Third, even if portfolio preferences were unchanged at the micro-level, the significant redistribution of wealth resulting from the housing price crash may be correlated with those preferences. Bank operations will have to change to serve the new mix of consumers.

II.C. Distribution of the Capital Losses and the Bank Capital Structure

Even if efficient bank operations were unchanged, a change in the structure of the banking sector may be required to distribute the losses from the housing price crash. Unfortunately, a theory based on first order fundamentals alone does not predict who will pay for the capital losses or what will be a bank's capital structure. However, we know from the form of actual mortgage contracts that homeowners' capital loss is (at their discretion) limited to their home equity. Thus, absent public subsidies, the remaining capital loss must be absorbed by the shareholders of the institutions holding those mortgages and, if any remains, other creditors of those institutions. To the extent that depositors are among the creditors who pay, the FDIC will cover their loss.

[7] We owe this point to Kevin Murphy. By "sub-prime," we refer to borrowers with credit records that were traditionally inadequate for obtaining a home mortgage.

A simple theory of bank capital structure is that the desired capital structure for a solvent bank is a function of the diversity of the bank's loan portfolio and its cost of equity capital (Harding, Liang, and Ross, 2007). When loan values fall, banks seek to sell some of their loans, to raise shareholder equity, or to further diversify their loan portfolio. When loan values fall for a wide cross-section of banks, a bank attempting to sell some of its loans or raise shareholder equity may be frustrated by his competitors' attempts to do the same.[8]

Banks can merge in order to diversify their loan portfolios, especially when those mergers are across international borders. Banks can raise capital by issuing new shares (as Bank of America announced in early October 2008 that it would do), or by being acquired by firms outside the banking industry.

II.D. Public Policy Effects on the New Bank Capital Structure

Both historical and prospective public policies affect bank capital structure and its responses to the housing price crash. Those public policies fit into four or five general areas: anti-trust/merger policy, bankruptcy law, deposit insurance, bank regulation, and (perhaps) financial transactions by the Treasury and the Fed.

Anti-trust enforcement and banking law have arguably been more merger-friendly during the past two decades than they were for the four prior decades. Both merger-friendly anti-trust policy and financial innovation permit banks to further diversify their portfolios, reduce the probability of bankruptcy, and reduce desired capitalization rates.[9]

As explained above, the housing price crash reduced bank capitalization rates and as a result, banks desire to recapitalize and diversify. More merger-friendly policy will cause the banking industry to adjust more on the diversification margin than on the recapitalization margin, as compared to less merger-friendly policy. If in fact banks' costs of capital are also higher, more merger-friendly anti-trust policy will also reduce the

[8] At this level of abstraction, the banking industry is no different than any other. However, because a bank's assets are also traded on financial markets, variations in the supply of capital to financial markets will cause additional correlation between the banking sector's capital losses and the cost of capital. Moreover, because bank deposits have such different risk and liquidity characteristics than do bank assets, changes in the prices of risk or liquidity will affect their net worth even if bank asset fundamentals were unchanged.

[9] Although the additional diversification reduces the probability of bankruptcy, it increases the effect of nation-wide shocks on bankruptcy by reducing the desired capitalization rate.

amount by which the banking sector has to shrink. In the very short run, bank merger policy has been especially merger-friendly, with the Federal Reserve and the Department of Justice expediting the mergers of troubled banks.[10]

Bankruptcy law affects the probability of bankruptcy in part by affecting the costs incurred conditional on bankruptcy. Some economists have proposed a one-time period of expedited bankruptcy proceedings so that the housing losses could be quickly distributed and the bank capital structure could more quickly return to its desired levels. As with any policy whose impact works in part through expectations, a one-time period of expedited bankruptcy may promote the expectation that expedited bankruptcy proceedings will occur again someday and thereby reduce the desired bank capitalization rate.

Deposit insurance has some of the same effects as expedited bankruptcy because it reduces the costs of bankruptcy to bank depositors: absent regulation it reduces desired capitalization rates for a given distribution of bank asset returns (equivalently, increases the riskiness of bank assets for a given capitalization rate) and thereby increases the probability of bankruptcy (Merton and Bodie, 1993). However, deposit insurance is also accompanied by regulation, which in principle directly increases bank capitalization rates.

II.E. Public Transactions are Offset by Private Transactions

In early October 2008, the Treasury proposed spending some of its revenue purchasing equity in struggling banks. This proposal echoed the proposals of a number of academics. However, none of the academics at the time explained how Treasury capitalization will crowd out private capitalization. In the context of the model discussed above, Treasury purchases of bank equity raise the cost of capital to banks and thereby reduce private funding.

To see this, assume for the moment that future taxes are lump sum (with a known incidence) and the economy is closed – i.e., that all potential bank stockholders are also

[10] A change in merger policy should by itself impact output in the banking sector. The direction of the impact depends on whether merger policy had previously been more or less merger-friendly than the output-maximizing policy and whether the output-maximizing anti-trust policy itself changed as a result of the housing price crash.

U.S. taxpayers. In much the same way that taxpayers behave in Barro's (1974) model, taxpayers will recognize that the Treasury has invested more in bank stocks, and has implicitly done so on their behalf because the taxpayers will reap the gains and pay the losses of those investments. As a result, taxpayers will attempt to reduce their holdings of bank stocks by the same amount that the Treasury increased them.

A number of "realistic" modifications to Barro's (1974) model have been proposed, but they do not necessarily weaken the basic result that public transactions are at least partly offset by private transactions, and may strengthen it. Consider first the possibility that taxpayer portfolio decisions are at a corner solution, so that taxpayers desire to reduce their holdings of the equity of existing banks but cannot.[11] If bank management were responsive to shareholder demands, banks would use the cash they obtain from Treasury investment to buy back bank shares from the public.

Again for the sake of argument, suppose that Treasury purchases were accompanied by (perhaps implicit) regulations restricting share repurchases and dividend payments.[12] Investors still desire to hold equity in new banks or in alternative institutions that would compete with banks and likely view that equity as (imperfectly) substitutable for equity in existing banks. In other words, the portfolio-at-corner-solution view may explain how Treasury transactions would not be precisely neutralized by private sector transactions, but it predicts that the Treasury plan reallocates capital from new entrants to the banking industry and toward the existing (and struggling) banks. This reallocation may harm the future efficiency of the banking industry.

Another modification to the Barro (1974) model assumes that taxpayers are unaware of what the Treasury is doing, and therefore have no motivation to offset Treasury transactions. This modification may be applicable in some situations, but seems inapplicable today when (a) the much of America is focused on the financial crisis and public sector responses to it and (b) taxpayers loudly voiced their displeasure with the tax

[11] This logical possibility probably does not accord with the facts, because Bank of America announced in early October 2008 that it would issue $10 billion worth of stock. Furthermore, the banks receiving Treasury funds as of October 20, 2008 were paying dividends at an annual rate of $25 billion (Scharfstein and Stein, 2008).

[12] Note that these regulations are counter to the spirit of many of the academic proposals, which intend to keep the public sector out of bank business decisions.

liabilities they perceived to be created by the Emergency Economic Stabilization Act of 2008.

Yet another modification to the Barro (1974) model recognizes that taxes are not lump sum and do not have a known incidence. But taxation deadweight costs and uncertain incidence only increases taxpayer exposure to bank stock risk, which might cause them to reduce their bank industry investments more than the Treasury increases them.

II.F. The Role of Complementarity in the Neutrality Result

Barro's model does not have industry detail – might those details trump Barro's analysis? Suppose that, when industry capitalization rates become low, each bank's output is complementary with the others.[13] In this case, the most direct public policies for raising bank output would facilitate cooperation among banks by encouraging mergers or the formation of other private-sector institutions such as clearing houses or commercial paper exchanges to align each bank's incentives with the industry-level complementarities.[14] Once banks were the proper size, the industry could otherwise be analyzed as if the complementarities were absent (with the same neutrality or non-neutrality results).

Suppose for the sake of argument that mergers and other private sector efforts were insufficient to internalize the complementarity, and that banks can be prevented from buying back shares or cutting dividends. Even so, the impact of Treasury equity purchases depends on the terms of the purchase. Greg Mankiw has proposed that the Treasury co-invest (on a non-voting basis) with private investors who decide "on their own" to make a purchase of a bank's stock. If (some subset of) taxpayers wanted to invest, say, $20 billion in bank ABC absent the Treasury plan, then there is nothing to stop them from investing $10 billion in the presence of the plan, thereby bringing the total ABC equity sale to $20 billion. In this case, other banks in the industry are unaffected by the Treasury's purchase, because bank ABC sells $20 billion regardless of whether the Treasury participates. Greg Mankiw's plan does nothing to align the

[13] Presumably the complementarity was not significant at normal capitalization rates, or else banks would have already merged or cooperated with each other by contract.
[14] Among other things, we owe these examples to Fernando Alvarez.

incentives of the private co-investors with those of the industry as a whole, and is premised on two of the mechanisms that can deliver Barro's result (that private investors are willing to invest even absent Treasury action and that bank managers are free to make dividend decisions, etc., to the shareholders' advantage).

In order to use complementarity to predict a significant effect of Treasury purchases on bank capitalization, we must also assume that private investments are at a corner solution. In this case, a judicious choice of Treasury investment might raise the marginal product of capital throughout the industry, and presumably stimulate private investment.

In summary, economic theory reminds us that Treasury transactions are at least partly offset by private sector transactions. Each Treasury dollar spent on bank equity will reduce private ownership of bank equity by some multiple. More research is needed to determine whether the multiple is close to zero, close to one, or even larger.

III. Aggregate Market Responses I: The Wealth and Substitution Effects

The housing price crash both moves resources from residential to the non-residential sector and changes household behavior via a wealth effect. I consider these effects first, leaving until the next section possible intermediation effects of the banking crisis.

III.A. Investment Prices and The Stock Market Crash

As part owners of the housing stock, financial sector corporations are expected to have lost market capitalization from the housing price crash. However, the value of nonfinancial capital can be affected as resources are released from the residential sector. In other words, as long as the housing construction boom continued and raised the prices of investment goods generally, the marginal product of nonresidential capital -- and therefore the value of the capital in that sector – was high. The residential construction crash moved the economy down the capital good supply curve, thereby encouraging non-residential investment, lowering the expected marginal product of capital (to the extent that the marginal product of capital diminishes), and lowering the value of existing nonresidential capital.

In order to see the possible magnitude of this effect, consider a simple steady state model of non-residential capital accumulation without adjustment costs. New capital goods and old capital goods (adjusted for depreciation) are identical in production. The resale price of old capital goods is equal to the present discounted value of the marginal product of capital, discounted using the sum of the interest rate and the depreciation rate. The resale price of one unit of old capital goods is also equal to the (assumed constant over time) production cost of one unit of new capital goods. It follows that the quantity of non-residential capital is the amount that equates the marginal product of capital to the annuity value of the production cost of one unit of new capital goods, as shown in Figure 3.

A once-and-for-all reduction in the new capital good production cost increases real investment. In fact, without adjustment costs, the capital stock jumps immediately to the new value: the annuity value of the new (lower) production cost of one unit of new capital goods. The marginal product of that capital jumps down.[15] The resale price of old capital must equal the production cost of one unit of new capital goods, so it also jumps down.[16]

Figure 4 displays the BEA's indices for real investment in residential and nonresidential structures. The residential series increases from 2001 until the end of 2005 (recall from Figure 1 that housing prices follow a similar pattern). The nonresidential series falls from late 2001 through 2003, is flat until late 2005, after which it increases. By 2008 Q2, the real investment rate for non-residential structures was it its highest value for the 7.5 years shown in the Figure.

Figure 4 also offers a rough estimate of how long the high non-residential investment rate will last. If the year 2000 investment rates were considered normal (more work needs to be done to estimate a normal investment rate), then rates were 20% below normal for 4-5 years. In other words, a whole year's investment was lost. In this case, we might expect real investment rates to be x percent above normal for $100/x$ years beyond the year 2005.

[15] With adjustment costs, the capital stock would adjust slowly. Real non-residential investment will be higher than normal while that adjustment occurs. However, non-residential investment *expenditure* could be lower, because expenditure is the product of real investment and price of new capital goods.

[16] The resale price of old capital goods would jump down even if the capital stock itself were slowly adjusting.

Figure 5 displays the BEA's implicit price index for non-residential capital (structures, equipment, and software combined), calculated by dividing the value of non-residential capital by the quantity index for non-residential capital and normalizing the year 2000 to 1. Gordon (1990) has shown how investment goods prices have followed a long term downward trend; Figure 5 shows how the housing boom may have interrupted that trend. Because our economic logic is that housing prices affect residential investment which then impacts the price of non-residential capital, it is important to note that nonresidential investment prices peak in the third quarter of 2006. By this measure, the price of non-residential capital falls by 4 percent from its peak, although less relative to trend.

III.B. The Wealth Effect on Labor Supply

The housing price crash is an aggregate wealth effect. As discussed above, we have considered two benchmarks for this wealth effect. One benchmark – associated with the largest wealth loss – is that housing prices remained at 2006 levels. For the purposes of predicting changes in consumer behavior, this benchmark is appropriate only if the wealth gains prior to 2006 were already fully reflected in behavior. For example, people might have raised their consumption (perhaps with the help of home equity loans) and might have taken early retirements in accordance with their home equity gains. At the other extreme, the wealth gains prior to 2006 had not yet been reflected in behavior, in which case the only wealth loss to consider is the cost of building the housing as quickly as it was built.

Table 1 gives some idea of the magnitude of these two wealth losses. The larger losses we estimated in the range of $4.5 – 8.3 trillion, with more weight on the latter because to the extent that the Case-Shiller prices are more accurate. We estimated the smaller losses in the range of 1.0 – $1.8 trillion, perhaps (for the same reason) with more weight on the latter. Henceforth, we use a $5 trillion loss (that is, 30 percent of the pre-crash housing value); the reader can proportionally rescale the results that follow if she thinks an alternative loss is appropriate.[17]

[17] Some portion of the stock market loss might also be added. We have not yet attempted to do so; we are still developing a theoretical framework for relating these various kinds of losses.

In order to translate a $5 trillion loss into behavior, it is necessary to put it in the context of overall wealth. Table 3 is an attempt to do so. The top part of the Table displays our assumptions about the importance of human and non-residential wealth relative to housing. The bottom part of the Table shows logical implications of the parameters. The housing stock is about half of all private fixed assets. Judging from labor's share of national income, private fixed assets may be about 25% of the combination of nonhuman capital and the human capital used in the market sector, which means that the housing stock is about 12.5% of total capital used in the market sector and perhaps 6 percent of all wealth (including the human capital used outside the market sector). A 30% adverse shock to the value of the housing stock would therefore amount to about a 2% reduction in total national wealth. If preferences were homothetic and the wealth effect were equally distributed, this would reduce consumption and leisure by 2%. Assuming that leisure is four times work time, this amounts to about a 7.5% outward shift in the labor supply curve, as shown in the last row of Table 3.

The stock market crash is some combination of an aggregate wealth effect (to the extent that earnings prospects for a given path for the non-residential capital stock have been reduced), and a redistribution (to the extent that investment goods prices have fallen or discount factors have changed). The housing price crash also has a redistributive component. Of particular interest in this dimension is the redistribution away from (a) those near retirement age and (b) large nuclear families, because they may well have more elastic labor supply.[18] Persons near retirement are expected to bear a disproportionate share of the housing shock because they have the most home equity and because they have significant financial assets (among which are the financial stocks that absorbed much of the lost housing wealth). Persons with large families are expected to bear a disproportionate share of the housing shock because they have larger homes.

III.C. Labor Supply's Impact on GDP, Employment , Wages, and Capital Accumulation

In the long run, an increase in labor supply probably has little impact on wages and a proportional effect on output and the capital stock. A 7.5 percent outward shift in

[18] Large nuclear families are more likely to have the mother out of the workforce absent adverse wealth effects.

labor supply would eventually increase GDP by 7.5 percent. In the short run (i.e., non-labor inputs fixed), an increase in labor supply both raises employment and lowers wages in a proportion that depends on the relative short run wage elasticities of labor supply and labor demand.

Table 4 displays some of the short run possibilities, assuming a Cobb-Douglas production function with labor's share equal to 0.75. This implies that labor demand is pretty wage elastic (4) in the short run, so the labor supply shift has a significant effect on wages unless labor supply is itself quite wage elastic. Each row of the table considers different aggregate labor supply elasticities, expressed as a ratio to the labor demand elasticity.[19] The short run employment impact of a 0.075 log point labor supply shift could easily be (positive) 4 – 5 percent, with a GDP impact of about 3 – 4 percent.

If, for example, the short run employment impact of a 0.075 log point percent labor supply shift were 0.047 log points, then the wage reduction moved along the labor supply curve 0.028 log points in the quantity dimension. Given that the wage reduction is temporary, many of the persons represented on that part of the supply curve could call themselves unemployed. Thus, the labor supply shift induced by the wealth effect of the housing crash could increase the unemployment rate by a couple of percentage points – even while it increases GDP – but less than 2.8 percentage points. This result is shown in the last column of the table.

Another way to predict the behavioral changes resulting from a $5 trillion wealth loss is to examine historical reductions in the resources available to the private sector. During World War II, cumulate government purchases were above normal by about 2 times trend GDP. By today's standards, that would be about a $25 trillion loss, or about five times a $5 trillion loss. Total labor during the war was about 20% above trend, although it was encouraged by patriotism, and discouraged by high taxes and low interest rates (Mulligan 1998). If we suppose that the effects of patriotism, taxes, and interest rates roughly offset, then 20% more labor is an estimate of the wealth effect of $25 trillion. For a $5 trillion wealth loss, Tables 3 and 4 show about 4 – 5% more labor in the

[19] For example, the row labeled one means that the labor supply elasticity is equal to the labor demand elasticity, which is 4.

short run and 7.5% more labor in the long run, which suggests that, to an order of magnitude, Tables 3 and 4 are consistent with the wartime experience.[20]

IV. Aggregate Market Responses II: The Intermediation Effect

IV.A. Substitutes and Complements with Banking Sector Output

Residential construction and automobile purchases are often financed with bank loans, so a bank crisis should impact those sectors more than others. However, it is difficult to separate the impact of the bank crisis from a fundamental reduction in demand for those items. Market demand for housing seemed to be down well before Bear Stearns or Lehman failed. In theory, the high real housing prices of 2000-2006 should have increased housing construction only until the quantity of houses caught up with demand at the long run construction cost, after which construction should return to normal levels. If demand had fallen for any reason, then housing construction should be below normal levels. In fact housing construction (measured, for example, by housing permits) was below normal levels already by mid-2007 – well before the banking crisis – and has continued to fall since then.

One possibility is that housing construction got so low in 2007 because banks had already withheld lending as they became aware of their low capitalization and began to acquire short-term assets. In this case, the banking crisis may well explain the low housing construction via bank anticipation. Notice that this logic implies that we can also learn about the impact of the banking crisis on other sectors from the data since 2007, because the reduction in bank loan supply predated the crisis itself.

Another possibility is that housing demand declined for reasons other than (anticipation of) the banking crisis, in which case further reductions in housing construction cannot be automatically attributed to the banking crisis itself. Yet another possibility is that banks have constrained housing lending because prior lending amounts were beyond what was efficient. For example, persons with low credit scores may be

[20] Interestingly, despite the outward labor supply shift from patriotism and wealth effects, wartime unemployment rates were low.

having trouble obtaining mortgages. In this case, it is not the banking crisis that reduces construction, but a movement to more efficient lending.

Automobile purchases are also subject to fundamental demand reductions. Oil prices are much higher than they were for years, and today's drivers want to "be green" and get good gas mileage. American auto manufacturers are not fulfilling those needs right now, so their sales would be low even without a banking crisis. It is hard to know how much the banking crisis contributed to the overall demand reduction.

One way to determine whether credit supply has constricted is to look at mortgage and auto loan rates – to the degree they are constricted, those rates should be higher. We are not aware of any significant increases those rates (see also Chari, Christiano, and Kehoe, 2008).

IV.B. The potential for retained earnings in today's economy

A significant majority of funds flowing from savers to investors in the U.S. economy do not leave savers in the form of bank deposits and do not arrive at investors in the form of bank loans. Chari, Christiano, and Kehoe (2008) used the Flow of Funds to estimate that 80 percent of business borrowing is done outside the banking system.

Retained earnings can be one of the most important institutions for financing investment, because aggregate corporate earnings significantly exceed corporate investment. The corporate sector pays significant dividends, and these could be cut to finance additional investment at the dividend-paying corporations or to finance investment at firms those corporations might acquire through merger. Thus, even if bank lending disappeared for a time, this need not have a large impact on investment give the amount of corporate earnings in the economy and the banks' small share of overall financial intermediation.

IV.C. Bank Output Declines Have Effects Opposite to the Wealth Effect

There are two shocks supposedly hitting the non-financial sector (which is most of our economy) as a result of the banking crisis. One of them is an adverse saver-investor intermediation shock. That is, the return to saving is low even while the cost of borrowing is high. The second shock is one of "confidence," which is an adverse wealth

effect on consumption and leisure that only adds to the adverse wealth effects cited above. The intermediation shock has the opposite short run effects as do the adverse wealth effects. Even if the intermediation shock were larger than we think, it would still be partly offset by the adverse wealth effects, which is why we are much less confident than many commentators that GDP will fall as a result of the housing and banking events in the last several months.

Although consumption is 2/3 of GDP, a reduction in consumer confidence does not necessarily reduce GDP, because GDP is also related to the amount of capital and number of workers employed. Baby-boomers are productive, knowledgeable people. If they stay in the workforce rather than retiring, that will result in more output, not less.

V. Evidence on Credit Supply to the Nonfinancial Sector

V.A. Credit Supply to Major Corporations, Fall 2008.

The William Wrigley Jr, Company is a Chicago-based gum and confection company. It has lots of growing earnings, new products, and new locations. Back in April when stocks were very high (by today's standards), the Mars Corporation arranged to purchase the Wrigley Company for $23 billion in cash. The deal was set to close 6-12 months later.

By this fall, stock prices were down and the media was expressing a great deal of concern about a "credit crunch" that would stop perfectly good businesses from pursuing their best projects. In conditions like those, it would seem that Mars might be tempted to back out of the deal -- perhaps to complain about credit even if were not really a problem. But Mars made no excuses: on Monday, October 6, Mars brought $23 billion in cash to close its deal with Wrigley. Much of that cash was borrowed. Mars now owns the Wrigley Company. This multi-billion-dollar anecdote suggests opportunities still existed in the non-financial sector even after the bank crisis garnered world-wide attention, and at least some of those opportunities were being realized despite the so-called credit crunch.

More systematic evidence from major corporations is also available. "The Corporate Executive Board finds that large multinationals are using good times of past to buy themselves time – they have long-term credit facilities and large cash holdings. One

of their recent polls found that more than 70% were not planning on proactively drawing down on their credit facilities, and that they believed they could still access 80-90% of their credit lines. Obviously the experience for the lowest rated CP issuers may be different, but most major corporations are not currently suffering from a credit crunch."[21]

V.B. Credit Supply After the Housing Crash

Most of the world had not realized that Fall 2008 would be the time when commercial paper markets would freeze and some major commercial banks would fail (with others gobbled up moments before failing). One story commonly told after the Lehman failure is that banks would cease lending, and this would take a sharp bite out of national investment, which in turn would bring down the economy. Since then, we have been waiting with anticipation to see what would happen to the economy as a whole.

It is quite possible that we do not have to wait. Suppose that, while most of the world did not anticipate these events, the troubled banks themselves understood this much earlier this year. After all, they were involved in the daily operations in a way that most of the world was not.

If the soon-to-be-troubled banks understood in 2008 Q1 and 2008 Q2 that they were flirting with bankruptcy, they should curtail lending in 2008 Q1 and 2008 Q2 in order to improve their short term asset positions. They would add more value to their bank by turning away a mediocre customer in Q2 in order to improve the chances that they could lend it their best customers in Q3 and Q4. In other words, we should have already seen much of the lending and investment impact of the bank troubles already in Q1 and Q2.

We already have data for Q1 and Q2. Residential investment was down, of course, following the downward trend that began mid-2006 when housing prices peaked. But non-residential investment was UP (a bit), not down. In 2008 Q3, gross nonresidential investment expenditure was 4.64% of the capital stock (valued at current cost), as compared to 4.55% a year earlier and 4.58% two years earlier.

[21] Personal communication from Mr. John Haskell of the Corporate Executive Board, October 13, 2008.

VI. Conclusions

In hindsight, the U.S. economy has an improper allocation of capital between the residential and non-residential sectors. Because capital is not readily moved from one sector to another, housing prices crashed and decreased household wealth. Going forward, resources that would have been devoted to residential investment absent the crash will now be devoted to non-residential investment. Pre-existing *non-residential* capital loses market value because of the *residential* price crash.

In this regard, today's U.S. economy has similarities to an economy that had part of its physical capital stock destroyed. Both theory (Mulligan and Sala-i-Martin, 1993) and evidence (Hirshleifer, 1963) suggests that the latter economies would quickly transition from the short run situation to the long run. The U.S. dynamics might be even quicker because the housing stock was not destroyed, but rather was (in hindsight) built too quickly.

Absent a significant intermediation shock, our approach predicts greater employment and GDP. 3-4 percent above the previous trend is a rough estimate of the amount of the short run effect; seven percent is a rough estimate of the long run effect. In the short run, wage rates will be below trend and unemployment higher. For now, these findings can only be considered estimates to an order-of-magnitude, not precise estimates.

In theory, an intermediation shock associated with the banking panic could reduce nonresidential investment. However, there are reasons to believe that the intermediation shock might be quantitatively less important than the wealth and substitution effects coming directly from the housing crash. In fact, data since the housing boom's peak clearly show substitution between residential and non-residential investment. It may take more time to confirm the wealth effects on labor supply, especially to the extent that the greater labor supply comes in the form of delayed retirements for baby boomers.

Table 1: The Size of the Adverse Wealth Effect
trillions of 2006 dollars

	Cost of the Crash, holding the boom constant	
	Crash of 50%	Crash of 27%
U.S. Residential Housing Stock, January 2006		
valued at January 2006 prices	16.5	16.5
post-crash value	8.3	12.0
Capital Loss	**8.3**	**4.5**
Addendum: Cost of Building Quickly	**1.8**	**1.0**
(see Table 2)		

Table 2: The Cost of Building Quickly
Expenditures are in $ millions

		Case-Shiller prices/PPI			OFHEO prices/PPI			Cost of Building Quickly	
year	nominal investment	actual	Jan-99	premium (log points)	actual	Jan-99	premium (log points)	Case-Shiller	OFHEO
1999	424,850	96.0	93.0	0.031	97.2	96.9	0.004	13,148	1,508
2000	446,901	107.8	93.0	0.148	103.1	96.9	0.062	61,331	26,991
2001	469,277	120.7	93.0	0.260	110.4	96.9	0.131	107,621	57,527
2002	503,937	134.5	93.0	0.369	118.7	96.9	0.203	155,580	92,395
2003	572,384	149.6	93.0	0.475	125.0	96.9	0.255	216,594	128,787
2004	675,482	166.1	93.0	0.580	127.7	96.9	0.276	297,320	162,722
2005	769,643	183.1	93.0	0.678	131.7	96.9	0.307	378,778	203,427
2006	756,961	184.9	93.0	0.687	131.6	96.9	0.306	376,233	199,590
					Total, accumulated with 5%/yr interest:			**1,784,327**	**968,202**

Table 3: The Size of the Adverse Wealth Effect, Continued

Parameters	
Pre-crash housing capital as a ratio to nonresidential capital	1
Human capital used outside the market sector, as a ratio to that used in the market sector	1
Leisure as a ratio to work time	4
Nonlabor's share	0.25
Wealth loss from the housing sector, as a share of pre-crash housing capital	0.3
Derived	
Pre-crash housing capital as a ratio to private fixed capital	0.5
Private fixed capital as a share of private fixed capital + market human capital	0.25
Market human capital as a share of private fixed capital	3
Pre-crash housing capital as a ratio to all capital used in the market or housing sectors	0.125
Pre-crash housing capital as a ratio to all capital	0.063
Housing crash as a ratio to all capital	0.019
Crash translated into a proportional shift in labor supply	0.075

Table 4: Equilibrium Short Run Labor Market Response to a 0.075 log point Labor Supply Shift

supply elasticity/ demand elasticity, SR	log labor	log wage rate	log GDP	upper bd on unemployment rate impact (%-pts)
0.2	0.063	-0.016	0.047	1.3
0.4	0.054	-0.013	0.040	2.1
0.6	0.047	-0.012	0.035	2.8
0.8	0.042	-0.010	0.031	3.3
1	0.038	-0.009	0.028	3.8
Addendum: Long Run	0.075	0	0.075	0

Figure 1: Supply and Price Dynamics in the Housing Market

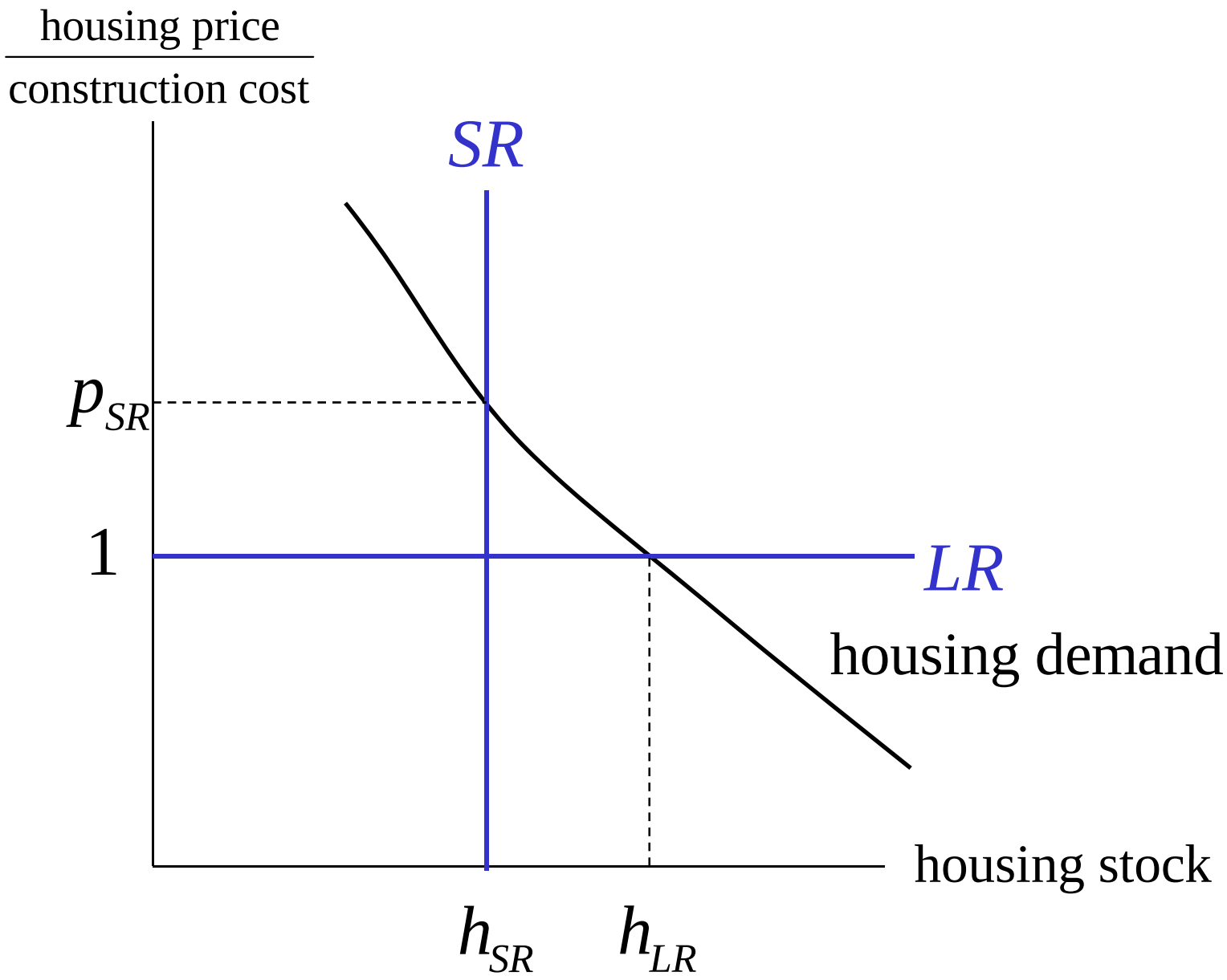


Figure 2: Two Housing Price Indices, January 1987 - July 2008

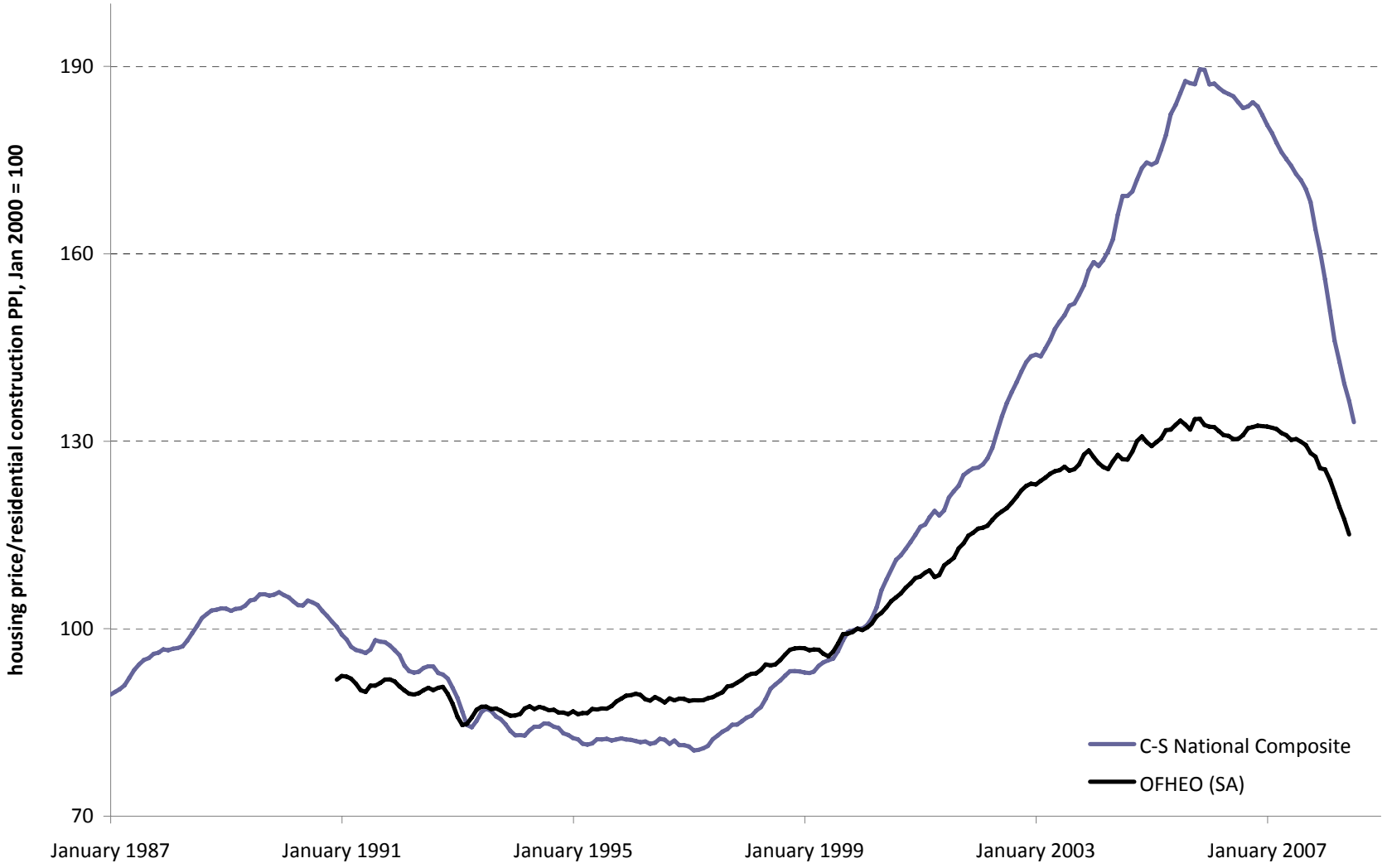


Figure 3: Non-Residential Long Run Capital Supply and Demand

(ρ, δ, and p^k denote the time preference rate, depreciation rate, and capital good acquisition price, respectively)

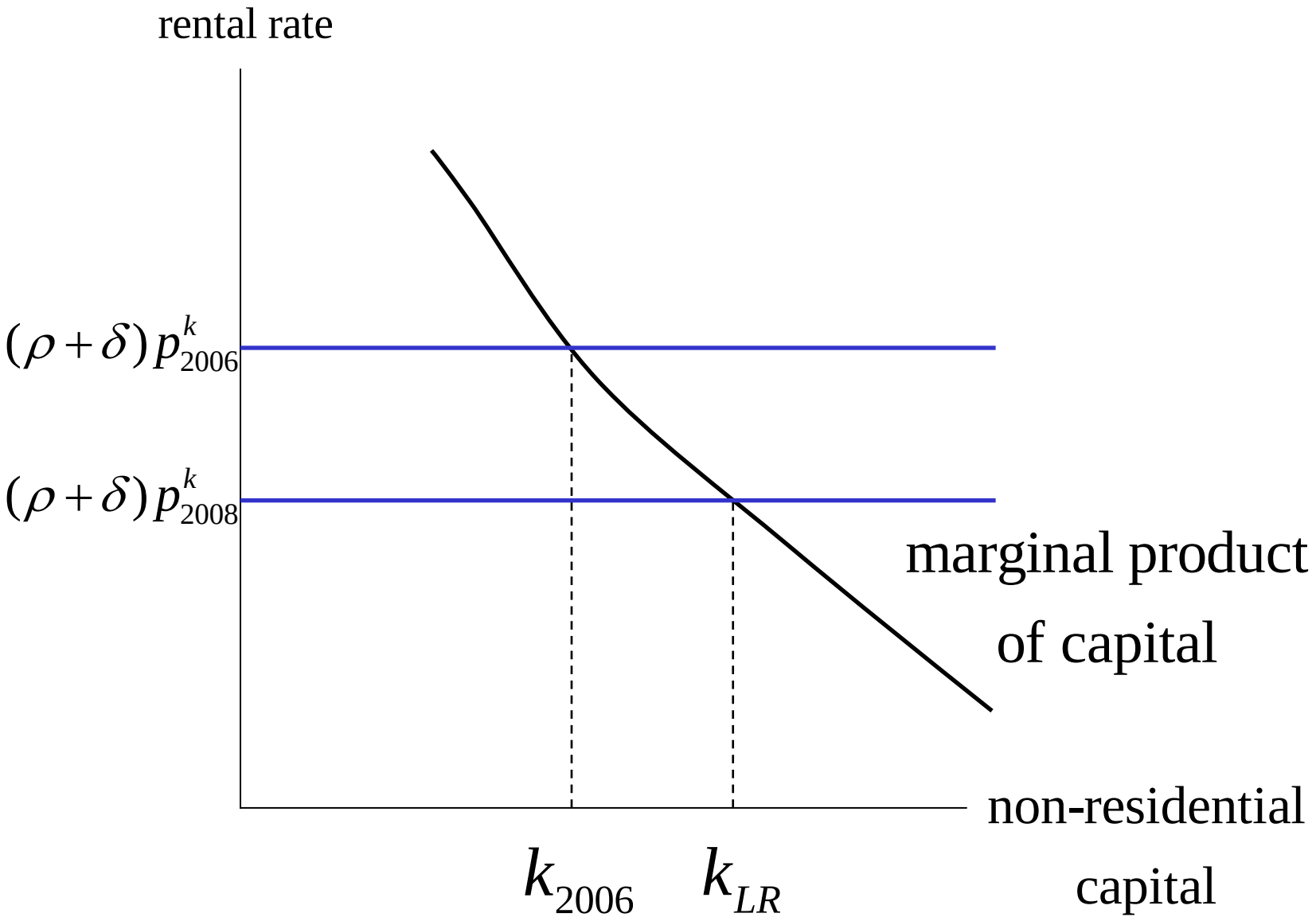


Figure 4. Real investment in structures: residential vs. nonresidential

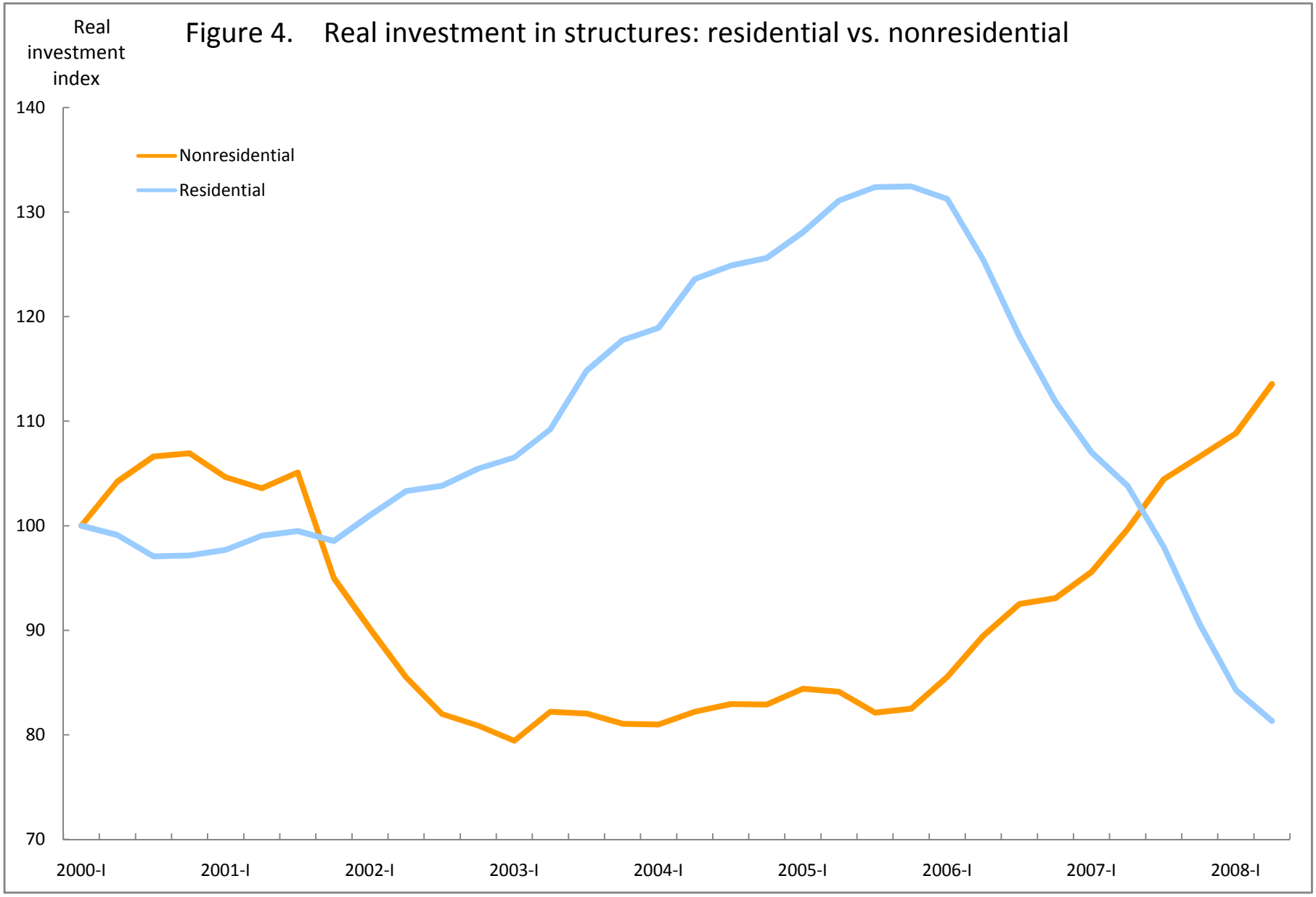
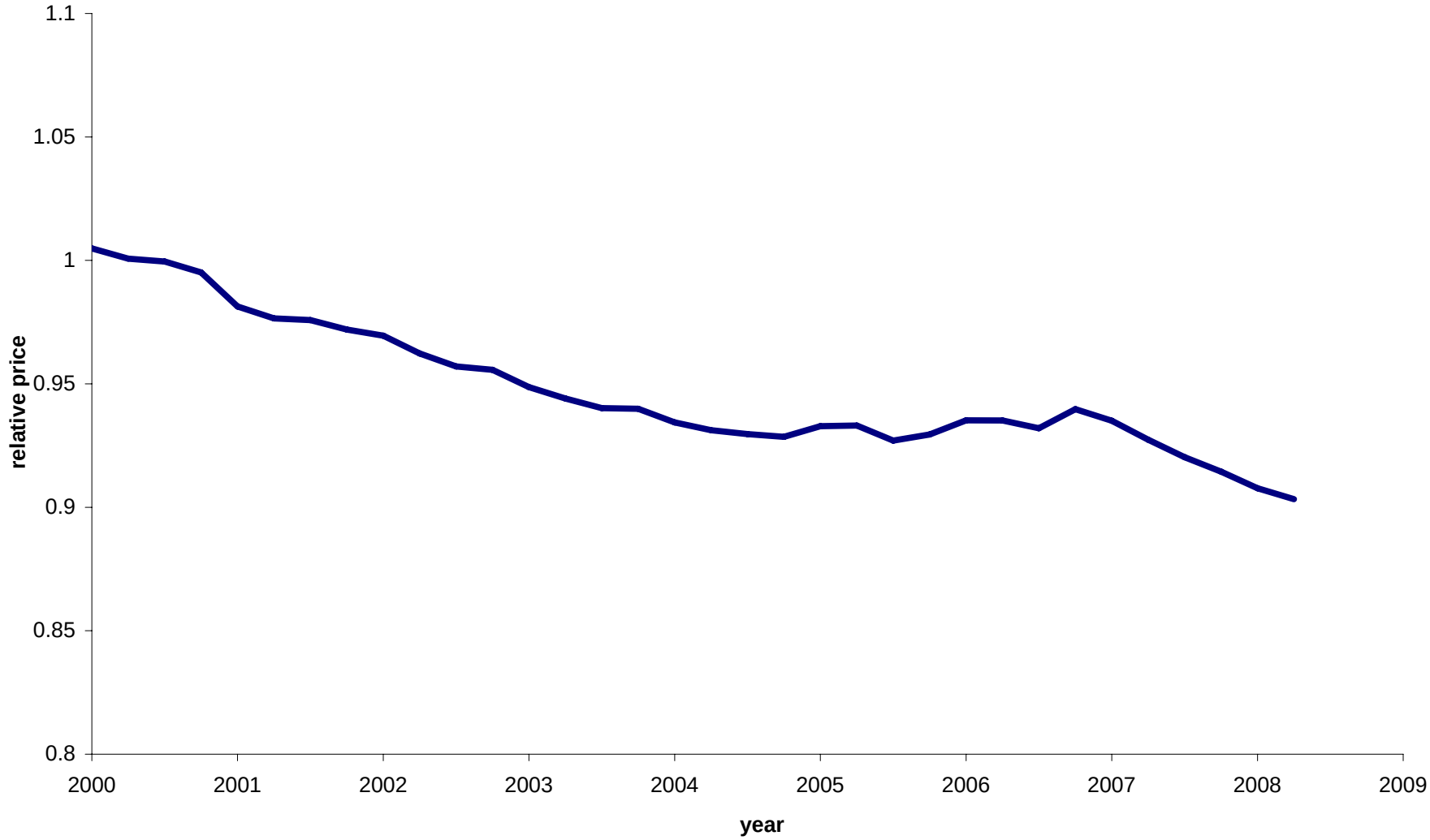


Figure 5: The Relative Price of Nonresidential Investment



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