

# De-Leveraging and the Financial Accelerator: How Wall Street Can Shock Main Street\*

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he severity of the recent economic downturn raises questions about the role of financial markets in modern market economies. Why did rising defaults in a relatively small portion of the U.S. housing market cause a financial crisis?

Why do financial crises have outsized adverse effects on the rest of the economy? As a general rule, a decline in economic activity in the nonfinancial sector, such as occurs during a typical recession, induces greater restraint on the part of the financial sector and that restraint — manifested usually in a pullback of credit and funding — in turn causes further setbacks to the nonfinancial sector. In the academic literature, this feedback effect is called the financial accelerator. In this article, Satyajit Chatterjee looks at what underlay the financial shock that emanated from Wall Street in the fall of 2007. Then he focuses on the channels through which the financial accelerator works and how the accelerator can turn a financial market disruption into a deep recession.

percent within a year and a half. What began as a problem in the subprime segment of the U.S. mortgage market snowballed into a full-blown financial crisis and one of the worst recessions of the postwar era.

The severity of the current downturn raises questions about the role of financial markets in modern market economies. Why did rising defaults in a relatively small portion of the U.S. housing market cause a financial crisis? Why do financial crises have outsized adverse effects on the rest of the economy?

As a general rule, a decline in economic activity in the nonfinancial sector, such as occurs during a typical recession, induces greater restraint on the part of the financial sector and that restraint — manifested usually in a pullback of credit and funding — in turn causes further setbacks to the nonfinancial sector. In the academic literature, this feedback effect is called the financial accelerator. The terminology alludes to the fact that greater financial restraint can cause a downturn to gather additional speed or lesser financial restraint can cause an upturn to do the same. When the initial shock is a shock to the financial sector itself, the financial accelerator can combine with the shock to produce a particularly steep decline in economic activity.

First we'll look at what underlay the financial shock that emanated from Wall Street in the fall of 2007, and then we'll focus on the channels through which the financial accelerator works and how the accelerator can turn a financial market disruption into a deep recession.

In the first quarter of 2006, when delinquencies on subprime mortgages

first began their sustained rise, the unemployment rate in the United States stood at 4.75 percent. Under the impact of the ensuing financial crisis, the U.S. economy fell into recession in December 2007, and the unemployment rate shot up to 9.5



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## SOME BACKGROUND ON THE FINANCIAL CRISIS

The financial crisis that erupted in the fall of 2007 has its origins in subprime mortgages, that is, loans made to risky borrowers for the purposes of buying a house. The subprime segment of the U.S. housing market is relatively small, so it is puzzling that default on these loans could become the source of a major financial crisis.

One reason is *leverage*. The financial firms (commercial banks, investment banks, and hedge funds) that bought the risky mortgages funded these purchases by borrowing from other financial market participants. Thus, when these mortgages began failing, it was not just the financial firms that had bought the mortgages that got into trouble, so did the entities that had lent money to the financial firms. These entities, typically other financial firms, in turn had borrowed money to fund *their* loans; so the creditors of these other financial firms also got into trouble. Leverage is the reason that a relatively small pool of failing assets can cause a systemic problem. Leverage makes the insolvency of one financial institution a trigger for the insolvency of other financial institutions.

But leverage alone can hardly be the culprit for the financial crisis. Leverage is at the heart of efficient financial intermediation and has been a fact of life in industrial economies for centuries. A more important proximate cause of the crisis was the manner in which financial firms leveraged their purchase of risky mortgages. They funded their purchases by borrowing short term. They promised their investors that they could have their funds back within a short period of time. Since the mortgages bought would not mature until many years into the future, the cash flow from

the investment was insufficient to pay off the maturing debt. The financial firms made up the shortfall by issuing *new* short-term debt. In most cases, the new debt was absorbed by existing investors. In other words, the financial firms were relying on their investors to “roll over” their loans as the loans matured. The mode of operation of financial firms was to fund purchases

same time, it becomes impossible for the bank to meet its obligations.

Rising defaults on subprime mortgages in 2006 led investors to reassess the risks inherent in assets based on subprime mortgages. As the market value of these assets declined, investors became worried that *future* investors might refuse to issue new loans against these suspect assets.

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of long-term assets (risky mortgages) with a sequence of short-term debt. That is, they engaged in *maturity transformation*.

While maturity transformation is part of a well-functioning financial system and financial firms will engage in it (as well as in leverage) to generate value for their investors, maturity transformation entails some risks. The danger is that if investors become nervous about a firm’s solvency, they can refuse to renew their loans to the firm and thereby put the firm in a real bind. This is called a *rollover crisis*. Bank runs are a famous example of this sort of crisis. In a bank run, depositors rush to withdraw their deposits from the bank because they fear the bank will fail. Banks are subject to rollover crises because they engage in maturity transformation. They borrow very short term (in effect they tell their depositors they can withdraw funds at any time), but they use the deposits to purchase assets that pay off gradually over time. If all depositors (or a good many of them) attempt to withdraw deposits at the

If that happened, the firm would be unable to pay off the new loan it was issued *today*. This lack of confidence led to a rollover crisis in which current investors refused to renew their loans to financial firms. Of course, as investors refused to renew their loans, financial firms holding suspect assets began to experience great difficulty in meeting their short-term obligations. In some cases, the firms simply went bankrupt. In other cases, the firms suffered huge losses in equity, since they had used their own funds to service their short-term obligations.

Leverage and maturity transformation were the main proximate causes of the financial crisis. But it is important to understand that these are *proximate* causes. The reasons why large financial firms engaged in this type of leveraging remain a matter of controversy. As researchers and analysts probe into the ultimate causes of the crisis, they will uncover some of the deeper reasons as to how and why financial firms got themselves into this bind. Also, it is important to remember that leverage

and maturity transformation are not problems *per se*. Perhaps the catalyst that turned these well-known forms of financial intermediation into a recipe for financial ruin was the unwelcome *concentration of financial risk* within a handful of very large financial firms. It appears that the considerable default risk of subprime mortgages was not passed on to ultimate investors such as households, corporations, pension funds, and insurance companies but was instead absorbed by a few large financial firms. Although the subprime segment of the U.S. housing market is relatively small, the concentration of the default risk of subprime mortgages in a few large financial firms ended up causing a problem for the entire financial system.

Now let's turn to a discussion of the main channels through which a loss in equity in the financial sector retards economic activity in the nonfinancial sector. The goal is to provide some perspective on the severity of the downturn that followed in the wake of the financial crisis.

## DE-LEVERAGING AND THE CREDIT CRUNCH

There are several channels through which a loss in equity of financial firms has adverse effects on the nonfinancial sector. Some of these channels involve direct effects and others, indirect effects. Among the direct effects is a pullback in the supply of credit that results from *de-leveraging* by financial firms.<sup>1</sup>

To understand the role of de-leveraging, we need to understand the balance sheet of a financial firm. Table 1 gives a simple example of an investment bank's balance sheet. On the asset side of the balance sheet

<sup>1</sup> The role of de-leveraging in the pullback of credit is discussed at length in the article by Adrian Tobias and Hyun Song Shin.

are loans made by the investment bank. Typically, these loans are made to the nonfinancial sector, which includes businesses, households, and the government. In the example, the investment bank has bought mortgages from households worth \$100 and has business-sector loans worth \$200. On the liability side of the balance sheet, the investment bank has debt worth \$250 in the form of commercial paper and equity worth \$300-\$250, or \$50.<sup>2</sup> What the balance sheet says is that the investment bank has invested \$50 of its own money and \$250 worth of borrowed money to purchase \$300 worth of assets.

An important aspect of the balance sheet is the *leverage ratio*, defined as the ratio of the value of assets to equity; in the example, the leverage ratio is 6 ( $300 \div 50$ ). An investment bank likes to maintain a *target leverage ratio* that is low enough so as to assure investors who lend it money that there is a high probability their loans will be repaid. In the example, the investment bank can sustain losses of up to \$50, or one-sixth of the value of its assets, and still be

<sup>2</sup> Commercial paper is an unsecured promissory note issued by large banks or corporations with a maturity date of less than one year. Since the loan is not backed by collateral, only highly reputable firms can issue commercial paper.

in a position to pay off its creditors. The higher the leverage ratio, the less capacity the investment bank has to absorb losses without affecting its creditors.<sup>3</sup> It stands to reason that an investment bank's target leverage ratio will ultimately depend on investors' perception of risk in the financial system. During periods of low perceived risk, the target can be expected to rise, and during periods of high perceived risk, the target can be expected to fall.

The important point is that an adverse shock to the market value of assets causes the leverage ratio to rise above its target. To understand why, suppose the market value of the mortgages held by the bank declines by 20 percent. In dollar terms, this is a loss of \$20. Generally accepted accounting principles (GAAP) require the investment bank to record the value of mortgages on its books at current market value. Thus, the bank is required to mark down the value of mortgages on its books from \$100 to \$80. This means that the bank's equity (which is simply the difference

<sup>3</sup> A target leverage ratio is not directly observable (since financial firms do not announce it), but its value can be inferred from the observed behavior of financial firms. See the article by Allen Berger, Robert DeYoung, Ozde Oztekin, and David Lee for evidence in support of target leverage ratios.

**TABLE 1**

Assets		Liabilities	
Mortgages	\$100	Commercial Paper	\$250
Business Loans	\$200	Equity	\$50
Total	\$300	Total	\$300

between the value of its assets and the value of its liabilities) drops from \$50 to \$30 (\$280-\$250) and its leverage ratio rises to  $8\frac{1}{3}$ . If the bank's target leverage ratio was 6 to begin with, the loss in the market value of assets results in a leverage ratio higher than the target.

An increase in the leverage ratio above its target value makes investors less eager to lend to the investment bank. Investors will demand a higher interest rate on any new commercial paper issued by the investment bank (to compensate for the higher risk of loss) or stop buying the bank's commercial paper altogether. Thus, market forces make it hard for the bank to maintain the same level of short-maturity debt as before.<sup>4</sup> At this point, the investment bank must either raise more equity or reduce its assets (both of which will lower its leverage ratio). Raising equity is usually not much of an option for banks in the midst of a financial crisis, although some financial firms did raise equity in the early phase of the current crisis and have returned to equity markets in recent months. Typically, in a crisis, the adjustment in the leverage ratio is accomplished by reducing assets. For instance, in the example above, the bank might bring its leverage ratio back to 6 by reducing its loans to the business sector from \$200 to \$100, with a corresponding \$100 reduction

in commercial paper (from \$250 to \$150). The bank's balance sheet after this adjustment will be as shown in Table 2.

The amount by which the investment bank must reduce its assets is closely related to the leverage ratio it would like to maintain, in this case 6. For every dollar decline in equity, the bank must reduce assets by \$6. Therefore, a \$20 decline in equity requires the bank to shrink its assets by \$120. Taking into account the fact that the \$20 decline in equity was triggered by a \$20 decline in the value of mortgages, the bank must reduce its assets by an additional \$100 (\$120-\$20).

This process of reducing the leverage ratio by reducing assets in the wake of a loss in equity is called *de-leveraging*. The important point to note is that since the leverage ratio is a number quite a bit greater than one, de-leveraging can convert any given decline in equity into a much larger decline in investment bank assets. Since a bank's assets are mostly loans to the nonfinancial sector, de-leveraging results in a constriction in the flow of credit to nonfinancial firms. A reduction in the supply of credit, in turn, raises the firm's cost of credit, thereby reducing firms' demand for investment goods and consumer spending by households and, ultimately, lowers employment.

Two additional points are worth making. First, how much assets have to fall because of de-leveraging also depends on what happens to the target leverage ratio following the initial shock to equity. At the start of the current crisis, the rise in uncertainty caused investors to look for lower leverage ratios than was customary in the recent past. This, in turn, led investment banks to lower their target leverage ratio and that became an additional factor in the de-leveraging engaged in by financial firms. To continue with our example, suppose that the new target leverage ratio is 4 instead of 6. Then, starting from the position shown in Table 2, the new balance-sheet position might look like the one in Table 3. To get its leverage ratio down to 4, given equity of \$30, the firm must reduce its asset holdings to \$120 (\$30 times 4). Thus, it must reduce its assets by \$60 (\$180-\$120). In the example in Table 3, the reduction is accomplished by reducing mortgages and business loans by \$30 each. On the liability side, the bank's commercial paper declines by \$60 (from \$150 to \$90).

Second, a reduction in investment bank debt (in the example, commercial paper) goes hand-in-hand with the de-leveraging. Given this, it is important to ask: What happens to the funds that investors were formerly lending to this bank? In a crisis, the funds end

<sup>4</sup>It is worth pointing out that the leverage ratio is closely related to a bank's *capital ratio*, a ratio that plays an important role in bank regulation. The capital ratio is simply the ratio of bank equity (capital) to a risk-weighted sum of bank assets. As such, it is closely related to the inverse of the leverage ratio. A rise in the leverage ratio will be accompanied by a decline in the bank's capital ratio. If a bank's capital ratio falls below the level determined by regulation, the bank is required by law to take steps to increase its capital ratio. Thus, an increase in a bank's leverage ratio resulting from a drop in asset values may force a bank to take steps to lower its leverage ratio for regulatory reasons.

**TABLE 2**

Assets		Liabilities	
Mortgages	\$80	Commercial Paper	\$150
Business Loans	\$100	Equity	\$30
Total	\$180	Total	\$180

up in the hands of entities that can borrow with very low risk of default. Economists refer to this re-allocation of funds from risky borrowers to safe borrowers as a *flight to quality*.<sup>5</sup> Of course, the safe assets are bought from existing holders of these assets, who are likely to use the proceeds from their sale to obtain other safe assets, such as deposits at commercial banks. So the process of de-leveraging during a crisis is likely to increase deposits at commercial banks, and if commercial banks do not lend out this new inflow of funds, it will also increase the reserves that the banks hold with the Fed. Thus, during a crisis, the process of de-leveraging tends to move funds out of circulation and into reserves, which also puts downward pressure on the inflation rate as money in circulation tends to fall (or grow more slowly).<sup>6</sup>

### FALLING PROPERTY VALUES, DEBT CAPACITY, AND THE FINANCIAL ACCELERATOR

The decline in the flow of credit resulting from de-leveraging also has adverse consequences for property values. The reason is that the value of many properties, such as residential homes and office buildings, is sensitive to the free flow of credit. When credit is not easily available, people and businesses cannot easily buy houses and commercial property. This causes a drop-off in the demand for such property and results in a fall in their market price. For instance, when a

<sup>5</sup> See the article by Evan Gatev and Philip Strahan and the article by William Lang and Leonard Nakamura for evidence on the “flight to quality” during earlier contractionary episodes.

<sup>6</sup> A consequence of de-leveraging is that safe borrowers get to borrow at a lower interest rate. This could potentially mitigate the contractionary effects of de-leveraging except that the primary beneficiary of the flight to quality tends to be the government, not the private sector.

**TABLE 3**

Assets		Liabilities	
Mortgages	\$50	Commercial Paper	\$90
Business Loans	\$70	Equity	\$30
Total	\$120	Total	\$120

homeowner who wishes to sell his or her house cannot find many buyers who can get financing (to buy the house), he or she may be tempted to drop the asking price. The same is true for commercial properties.

A decline in the value of residential and commercial properties has further consequences for the level of aggregate spending. The reason is that a decline in property values reduces the *debt capacity* of businesses and households — which is the maximum amount they are permitted to borrow — and thereby reduces business investment and consumer expenditures (and, ultimately, aggregate output). Thus, falling property values lead to a decrease in credit offered to the nonfinancial sector. This effect is what economists call the *financial accelerator*. To understand how the financial accelerator works, we need to understand why there is a debt capacity and why it declines with property values.<sup>7</sup>

Commercial and residential properties often serve as collateral in business and household borrowing.

<sup>7</sup> This discussion draws upon the ideas in the article by Ben Bernanke and Mark Gertler and the article by Nobuhiro Kiyotaki and John Moore, especially the latter.

For instance, a business that wishes to expand its operations could finance the expansion by taking out a loan from a bank using its property as collateral for the loan. What this means is that if the business cannot repay the loan, the bank (the lender) takes ownership of the property offered as collateral against the loan. Banks typically only make loans against collateral because doing so makes the loans less risky and encourages borrowers to spend the borrowed funds wisely (poor use of the funds results in the loss of the collateral). Naturally, there is a close connection between the value of the collateral and the size of the loan offered against it. Banks are typically willing to lend up to some fraction of the value of the property offered as collateral. The maximum amount that banks are willing to lend against the borrower’s property is the borrower’s debt capacity. When there is a decline in the value of property that can be offered as collateral, there is a decline in the debt capacity of the nonfinancial sector.

The reduction in debt capacity reduces the flow of credit to firms with productive uses for funds. Even in the midst of a severe downturn, there will be businesses that can put funds to good use. There will also be some financial intermediaries (the ones unscathed by the crisis, perhaps)

that will be eager to lend. But when the debt capacity of businesses is lowered by a decline in property prices, businesses with good uses of funds cannot borrow as much as they would like. This financial constraint curtails business investment and eventually leads to an output level that is lower than it would be in the absence of a decline in debt capacity.

A decline in debt capacity is also the reason a decline in home equity depresses consumer spending. As has been remarked upon many times during the current crisis, households borrow against their home equity to pay for all kinds of consumer expenditures. These expenditures go well beyond home improvement projects (which remain a main motivation for home equity loans) and encompass expenditures for which it would be hard to get a loan directly. A decline in residential property prices reduces how much households can borrow because the property (the house in this case) being offered as collateral is worth less.<sup>8</sup> Once again, even in the midst of a crisis, there will be households that would like to borrow more than their (reduced) debt capacity, and these households will have to reduce their spending. To the extent that the decline in household debt capacity constrains business investments by small businesses that rely on the owners' assets to get loans, the decline will have deleterious effects on future output and employment as well.

Every decline in property prices reduces the debt capacity of the

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<sup>8</sup>If the household has a mortgage against the property already, only the value of the house in excess of the outstanding mortgage — the owner's *home equity* — can be offered as collateral against the new loan. A decline in the value of residential property reduces home equity dollar for dollar.

nonfinancial sector and thereby adds fuel to the financial accelerator.

The downturn gathers further speed and feedback effects kick in: As unemployment rises and economic activity declines, property prices decline even more, which leads to further decreases in debt capacity and further decreases in expenditures, output, and employment.

Eventually, this downward spiral in property prices and economic activity comes to a halt, in part because the financial accelerator begins to lose its potency. Recall that the accelerator works through a reduction in debt capacity, which is the maximum level of debt the nonfinancial sector can borrow

## Every decline in property prices reduces the debt capacity of the nonfinancial sector and thereby adds fuel to the financial accelerator.

(given existing property prices). But when economic activity is quite low, debt capacity is not what constrains investment on the part of firms and households. They reduce their investment simply because investment is not remunerative when the general level of economic activity is low. When that stage is reached, a further decline in property prices and debt capacity does not cause additional reductions in expenditure and output because there are very few entities (businesses or households) that would want to borrow more than their debt capacity allows. The downward spiral is also arrested in part because of policy actions. Accommodative monetary and fiscal policies shore up expenditures and therefore offset, to some extent, the decline in expenditures that stems from the operation of the financial accelerator.

## OTHER FACTORS FEEDING THE ACCELERATOR

The previous section began with the observation that the credit crunch adversely affected property prices because property prices are sensitive to the free flow of credit. Given the magnitude of the financial shock and the consequent de-leveraging, the credit crunch is probably an important factor in the decline in property values. However, other factors have played a role in the decline in property values as well and have therefore fed the financial accelerator. We discuss the more important channels here.

As already noted, declines in residential house prices result in declines in home equity and therefore

a decline in debt capacity. If the household already has an existing mortgage, the decline in house values can lead to home equity becoming negative. That is, the value of the debt owed becomes larger than the value of the property. In this situation the homeowner may choose to default on his or her mortgage. In the run-up to the crisis, many families bought homes with very low down payments. Consequently, the decline in house prices has resulted in many families having negative home equity. The result has been a huge rise in foreclosures.<sup>9</sup> Foreclosures, in turn, depress house prices. Foreclosed properties are sold at a heavy discount because lenders (banks) that end up

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<sup>9</sup>For an excellent discussion of the connection between negative home equity and mortgage defaults, see the article by Ronel Elul.

owning them find it costly to hold on to the houses. As the number of foreclosures rises, the increased presence of sellers willing to sell homes at low prices puts downward pressure on the price of *all* properties, including those not in foreclosure.

In addition, foreclosures reduce the demand for housing space because families who lose homes in a foreclosure end up renting less space than they owned. They end up renting because they cannot get a new mortgage after defaulting on the previous one, and they rent less space than they owned because renting does not have the tax advantages that homeownership does. Thus, the overall demand for housing space declines with foreclosures. This puts further downward pressure on house prices.<sup>10</sup>

The decline in house prices also reduces the *household net worth* of families who do not go into foreclosure. Household net worth is the difference in the value of all household assets and all household liabilities. It is a measure of household wealth. As house prices decline, the value of household assets declines. But there is no immediate change in household liabilities (if the household does not choose to default on the mortgage), and therefore, there is a decline in household wealth. Lower wealth translates into lower spending because families feel poorer and spend less. Economists refer to this as the *wealth effect*. The negative wealth effect of a decline in household net worth lowers consumer spending, which lowers output and employment and further depresses property prices.

Increased uncertainty about the future also plays a role in reducing current output and depressing

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<sup>10</sup>The interaction between the foreclosures, the tax code, and the demand for housing space was investigated in my recent paper with Burcu Eyigungor.

property prices. Greater uncertainty (higher probability of both good and bad outcomes) makes firms and households delay decisions that cannot be easily reversed. Most investment decisions fall into this category so that uncertainty reduces expenditures on business fixed investment.<sup>11</sup> Greater

## Increased uncertainty about the future also plays a role in reducing current output and depressing property prices. Greater uncertainty makes firms and households delay decisions that cannot be easily reversed.

uncertainty (especially uncertainty regarding future earnings prospects) increases a household's desire for precautionary savings (a rainy-day fund), which reduces aggregate consumer spending. Overall, uncertainty can be a potent force for lowering business and household investment and is undoubtedly an important factor in the current downturn.<sup>12</sup> It should be noted that the increase in the precautionary savings on the part of households and firms (firms that delay investments park their funds in safe financial assets) also means that these entities allocate more of their funds to safe assets, and this is another factor putting downward pressure on the yield on safe assets and, ultimately, causing funds to

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<sup>11</sup> The role of uncertainty in delaying investment is discussed in the article by Ben Bernanke and in the book by Avinash Dixit and Robert Pindyck.

<sup>12</sup> A discussion of how uncertainty affects consumer spending can be found in my recent *Business Review* article. It is worth noting that there has been a sharp increase in the personal savings rate in the U.S. since the crisis began. The savings rate averaged less than 2 percent in 2007 but rose to around 4.5 percent in 2009 and remains elevated.

move out of circulation and into bank reserves.

In sum, there are a host of factors working to reduce property prices in the wake of the crisis. The severity and speed of the current downturn reflects, in part, the operation of the financial accelerator. The good news is that the

financial accelerator works both ways. As economic activity begins to revive, perhaps because of accommodative government policy or some good shock, desired investment on the part of firms begins to rise. At first, firms that desire to borrow less than their debt capacity (unconstrained firms) are the ones that can get funding to undertake their investment. But new investment (and rising economic activity more generally) puts upward pressure on property prices. As property prices begin to recover, *constrained* firms (firms that would like to borrow more than their debt capacity) can borrow more as well because the increase in property prices increases their debt capacity. Of course, additional investment increases aggregate output in the short run and, eventually, in the long run, as well. Thus increases in property prices provide extra impetus to the rise in economic activity in the same way that declines in property prices provided extra impetus to the decline in economic activity at the start of the downturn.


## CONCLUSION

In the wake of the financial crisis, the U.S. economy has suffered one

of the worst recessions of the post-World War II era. There is little doubt that this episode will be the focus of research and analysis for a long time to come and our understanding of the origins of the crisis and its aftermath will evolve over time. At this point, we can only give provisional answers to the question: Why did rising defaults in the subprime mortgage market cause a financial crisis that led to such a severe downturn?

This article suggests that leverage

and maturity transformation are the proximate reasons as to why defaults in a relatively small segment of the U.S. housing market led to a financial crisis. And the severity of the downturn is most likely the result of an interaction between declining property prices — brought on by de-leveraging in the financial sector — and the consequent decline in the debt capacity of the nonfinancial sector. This interaction, called the financial accelerator in the academic literature, has the potential

to feed on itself and cause a large — and more or less simultaneous — decline in property prices and economic activity. This diagnosis has implications for the future: If the financial accelerator played a role in making the downturn steep and quick, we may expect it to play a role in the recovery as well. When the recovery takes root, the workings of the accelerator will tend to make it sharp and rapid. 

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