

# Let's Make It Clear: How Central Counterparties Save(d) the Day\*

BY CYRIL MONNET

**T**he bankruptcy of Lehman Brothers in 2008 will certainly be featured in history books as one of the greatest financial failures so far, but it will also be recorded as yet another episode of the historically successful performance of clearing arrangements in ensuring the resiliency of markets. Recognizing the usefulness of safe and sound clearing and settlement procedures, the Federal Reserve has recently supported the attempt to shift the clearing of some contracts to a central counterparty. In this article, Cyril Monnet outlines the arguments in favor of central counterparty clearing, the economic rationale for trade clearing through a central counterparty, and some possible limits to the advantages of clearing trades through a central counterparty.

Following the bankruptcy of Lehman Brothers in September 2008, market participants were worried that Lehman's positions of more than \$500 billion would take ages to unwind. Lehman's creditors did not know whether they would be able to recover all of the funds from their



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positions with Lehman or whether they would have to write them down. The uncertainty surrounding the unwinding process put the market in a frenzy. However, the unwinding of Lehman's positions was concluded in the following month. In doing so, the major clearinghouses, LCH.Clearnet in the UK and DTCC in the U.S., restored some market confidence in only a few days, after their actions made it clear that unwinding Lehman's position would be a smooth process.

Lehman's bankruptcy will certainly be featured in history

\*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

books as one of the greatest financial failures so far, but it will also be recorded as yet another episode of the historically successful performance of clearing arrangements in ensuring the resiliency of markets. Clearing and settlement systems had previously come under severe stress during the stock market crash of 1987. However, as Ben Bernanke noted about that particular crisis, before he was appointed Chairman of the Federal Reserve, clearing and settlement systems, with the help of the Federal Reserve, played a pivotal role in easing liquidity conditions.<sup>1</sup>

Recognizing the usefulness of safe and sound clearing and settlement procedures, the Federal Reserve has recently supported the attempt to shift the clearing of some contracts, such as credit default swap contracts,<sup>2</sup> to a central counterparty. In October 2008, the Federal Reserve Bank of New York stated that setting up a central counterparty for credit default swaps was one of its priorities for addressing both operational and market design concerns for over-the-counter (OTC) derivatives.<sup>3</sup>

To make sense of this policy, we need to understand the arguments in favor of central counterparty clearing. What is the economic rationale for

<sup>1</sup> In the 2008 crisis, the Fed also played a crucial role by taking on the credit default swaps of the insurer AIG. We can only speculate on the outcome, had the Fed allowed AIG to default on its obligations.

<sup>2</sup> A credit default swap (CDS) is an insurance contract whereby the buyer receives insurance on a credit instrument's failure to pay — for example, a bond or loan — in exchange for a series of payments to the seller.

<sup>3</sup> See New York Fed, 2008.

introducing trade clearing through a central counterparty? How did market participants come to use central counterparty clearing in the first place? And are there limits to the advantages of clearing trades through a central counterparty?

## THE CLEARING AND SETTLEMENT SYSTEM

In the 1987 movie “Wall Street,” the opening scene shows the trading room of an investment bank, and the brokers are scrambling for trades. Many of the brokers are shouting about hot leads and talking on the phone to clients, advising them to dump or buy certain stocks. The scene, which shows both the chaos and drama of the trading room, underlines this aspect of Wall Street: Brokers can make a fortune by just taking a few hundredths of cents for each trade they conduct.

But what happens once the brokers hang up the phone? Then it is time for the much less glamorous world of clearing and settlement, also known as the back office. And a central counterparty (CCP) is one piece of the larger clearing and settlement puzzle. (See the *Glossary of Terms* for definitions of some of the terminology used in this article.)

To understand where clearing, settlement, and CCPs fit into the trading process, I will now take you through the different stages of a typical trade. A series of figures will accompany my explanation. For simplicity, consider an example with three traders: Ace (A), Bull (B), and Conservative (C), who wish to place bets on the financial viability of Direstrait, Inc. (D). Why do the traders want to place these bets? Broadly, there are two reasons: Some traders may be hedging their exposure to Direstrait; for example, one of Direstrait’s lenders might want to

limit its losses in the event of a loan default. Other traders may have (or believe they have) information about Direstrait’s prospects. These traders are called speculators because they seek to exploit price movements to make large gains in a very short time.

In the first stage, the *trading stage*,

## A central counterparty (CCP) is one piece of the larger clearing and settlement puzzle.

all traders agree on the terms of their trade. To be concrete, I will use the following contract (a simplified *credit default swap*, or CDS): If Direstrait goes bankrupt, the CDS seller agrees to pay the buyer \$5. No seller would make this promise for free. I will therefore assume that the buyer must pay the seller \$1 today (the *price* of the contract). Often, it is convenient to use the term *counterparty* when we don’t want to be specific about whether we’re talking about buyers or sellers. For example, Bull is Ace’s counterparty and Ace is Bull’s counterparty.

In my example, Ace sells two contracts to Bull (Ace agrees to pay \$10 to Bull if Direstrait goes bankrupt), Bull sells four contracts to Conservative (Bull agrees to pay \$20 to Conservative if Direstrait goes bankrupt), and Conservative sells three contracts to Ace (Conservative agrees to pay \$15 to Ace if Direstrait goes bankrupt). It is important to note that, at this stage, no cash changes hands; negotiation on the terms of the contract is all that’s going on. In the movie, this is when brokers speak (or rather scream) on the phone and write

their trades on tickets. What do they do with these tickets? They send them for clearing.

In the second stage, the *clearing stage*, the terms of the trades (as specified on the tickets) are written down in three formal contracts that Ace, Bull, and Conservative must verify. Once the terms are approved, the contracts become legally binding. The traders can add other clauses, such as the obligation to pledge collateral. For instance, the contract may require a seller to put \$1 of cash in a *margin account* for each \$2 it promises to pay in the event of Direstrait’s bankruptcy.

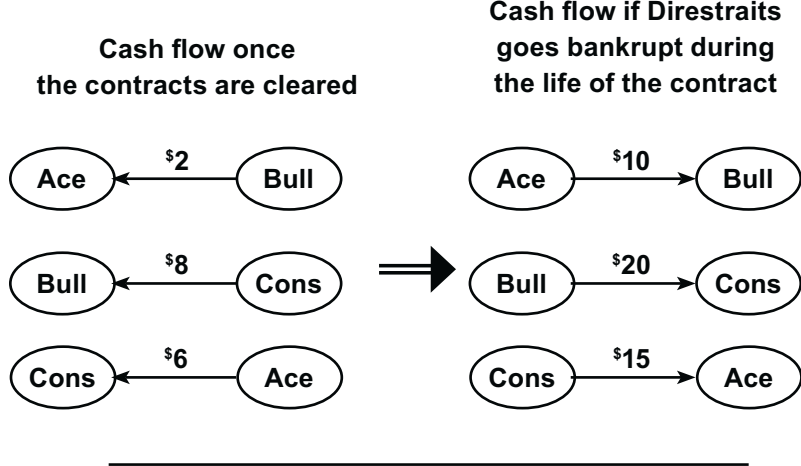
If traders carry out their transactions through a CCP, there is a third stage: the *CCP clearing stage*. In this stage, the three original contracts are being replaced by six new contracts. The essential terms of the original contracts stay the same, but the CCP becomes the buyer to every seller and the seller to every buyer (this process is also known as *novation*). In our example, if Direstrait goes bankrupt, Ace now has to pay \$10 to the CCP, and the CCP has to pay \$10 to B, etc. The CCP may also add clauses, such as an additional collateral requirement.

Finally, at the *settlement stage*, obligations must be executed per the agreed terms. Here, cash changes hands from the buyer of the contract to the seller. Also, in our example, settlement occurs if Direstrait goes bankrupt during the life of the contract. Depending on the contract specifications, the settlement stage can extend months after the contract is cleared. Figure 1 illustrates the payments due once the contracts are cleared and in the case in which Direstrait goes bankrupt, with and without CCP clearing.

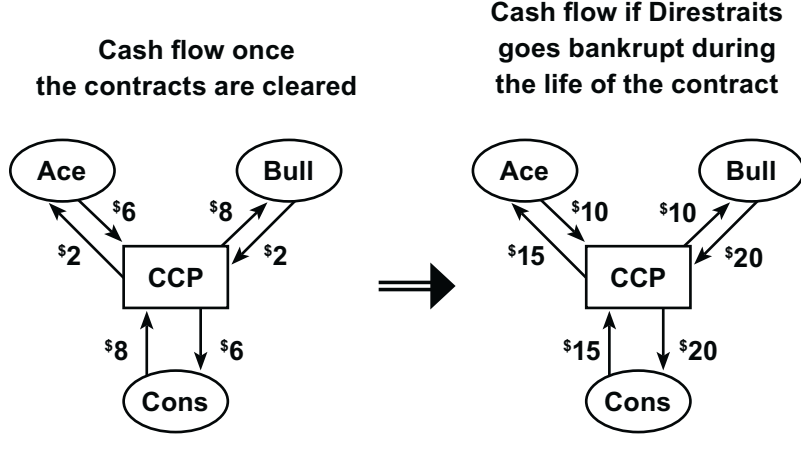
CCP clearing is therefore only an additional step between clearing

**FIGURE 1**

**A. No CCP Clearing**



**B. CCP Clearing**



and settlement. However, this step is not without consequences, and the next section will explain its use and how traders came to introduce CCP clearing.

**EVOLUTION OF CLEARING AND SETTLEMENT MECHANISMS TOWARD CENTRAL COUNTERPARTY CLEARING**

Trade is at the heart of an exchange-based economy. However, counterparties to a trade may not make their promised payments; goods

may be of dubious quality or, at worst, they may not be delivered. The risk that a counterparty will not fulfill its end of the contract is called counterparty risk. As in the example above, I will concentrate on counterparty risk when Direstraits goes bankrupt.

There are obvious ways to reduce these counterparty risks, but they cost time and money, and they may also limit the choices available to a counterparty. One way is to rely on the reputation of trading partners. However, building a reputation takes time, and relying on reputation restricts

competition because it is hard for a new entrant without an established reputation to compete. Also, reputation will not guarantee performance by a trader that is under enough financial stress; that is, a trader may be so desperate that it doesn't really have the luxury to think about tomorrow.

A second way to limit counterparty risk is to impose a collateral requirement. Pledging a sufficiently large amount of collateral can limit counterparty risk or even completely eliminate it, if, for instance, the margin account covers all future payments. Unfortunately, the funds in the margin account are not available for other investments that might be more profitable.<sup>4</sup> Also, traders could monitor their counterparties, but this requires a lot of time and resources.

Conscious of the importance of managing counterparty risk, market participants introduced several modifications to clearing arrangements aimed at reducing counterparty risk in the mid to late 19th century. Improvements have occurred incrementally; however, James Moser, in his study, outlines three particular steps in the historical evolution of clearing and settlement mechanisms. While what follows is a broad historical description based largely on his work, some of the earlier and simpler arrangements are still used.

**Direct Settlement.** The first settlement mechanism is direct settlement. This is the most casual method of settling trades, since settlement is

<sup>4</sup> Collateral also involves a significant cost (and benefit). As Gary Gorton points out, "For the party calling for collateral, collateral becomes a form of funding. Because [interest] is paid on collateral, firms receiving collateral can fund themselves...when issuing debt in the market would cost them much more. This is one reason that the scramble for cash in the form of collateral calls is very important. In fact, it is difficult to convey the ferocity of the fights over collateral" (p.66).

limited to the original counterparties. An example of direct settlement is when you pay cash to buy a newspaper at a kiosk. Direct settlement works well in that case, because if you can't pay, you don't get the newspaper (and conversely, if you don't get the newspaper, the merchant doesn't get the money). In our trading example, direct settlement is represented in Figure 2. The arrows denote the flow of payments due, in the case in which Direstraits goes bankrupt. Under our scenario, Ace pays \$10 to B, and so forth. However, this assumes everything is going according to plan.

In reality, in the event that Direstraits does go bankrupt, Bull (for example) has a choice: Either Bull makes the promised payment to C, or Bull can choose to default. It is important to note here that B's financial condition is not part of our simple CDS contract. In particular, in our simple example, Conservative can't opt out of the contract, even if B's ability to pay deteriorates.

This has several consequences. First, C's expected losses may accumulate if B's financial condition declines. Second, Bull might gamble on resurrection, that is, take a big risk in the slim hope of recovery. To limit losses, the contract may require that Bull place money in a margin account with

C, depending on B's financial condition, for example, as measured by its credit rating. While collateral limits losses, it introduces another problem: If Direstraits does not go bankrupt during the life of the contract, Conservative may be tempted to delay or refuse to return B's collateral. So direct settlement is prone to counterparty risk, and collateral may not work very well with direct settlement.

### To control default risk, ring arrangements often require traders to maintain margin requirements.

**Ring Settlement.** The second mechanism for settling trades is called ring settlement. The purpose of a ring settlement is to allow multilateral netting — that is, the canceling of payments of offsetting trades — by extending the set of counterparties that can settle a single contract.

Let's see how our traders might organize a ring, in which the net obligations replace the obligations of the original contracts. In the event that Direstraits goes bankrupt, Bull has promised to pay out \$20, and it has been promised \$10, so its net payment is \$10. Ace receives a net payment of

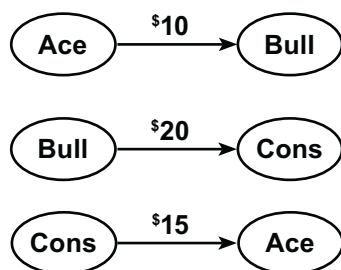
\$5 (it promised to pay \$10 and has been promised \$15) and similarly for Conservative. Therefore, Bull pays Ace and Conservative \$5 each (Figure 3).

Ring settlement requires standard or fungible — that is, easily substitutable — contracts to allow one member to substitute for another. In our example, Ace, Bull, and Conservative can form a ring, since they all trade the same contract (albeit a different number of contracts). The main benefit of netting is that it reduces the cost of open positions and, thus, the costs of a counterparty defaulting. If Direstraits defaults, Bull has to find only \$10, while Ace and Conservative do not need any cash at all.

Ring settlement has three main drawbacks. First, each member must monitor all of the others, since any member may be a substitute for the original counterparty. Second, since ring members may have to monitor each other's positions, traders cannot keep their positions secret; that is, they cannot trade anonymously. This is a problem because revealing information about your position allows other traders to copy your trades or to profit by trading against you. Finally, rings can be fragile and susceptible to systemic failure, in the sense that the failure of one member may cause the failure of other members and, in

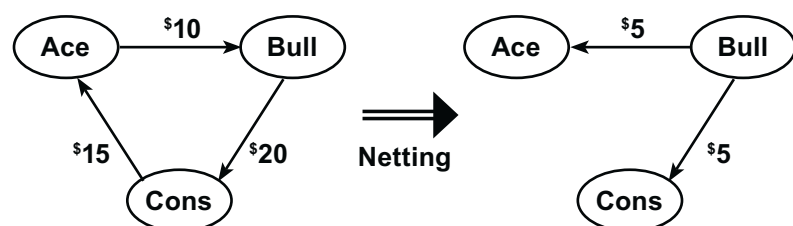
**FIGURE 2**

#### Direct Settlement



**FIGURE 3**

#### Ring Settlement



turn, the collapse of the whole ring arrangement. To control default risk, ring arrangements often require traders to maintain margin requirements.

**Central Counterparty.** The final settlement mechanism is through a CCP, using *CCP clearing*. To improve on the ring, a CCP replaces each existing bilateral contract with two contracts and becomes the sole counterparty (Figure 4).

CCP clearing preserves trading anonymity, since only the CCP knows the overall positions of a trader.<sup>5</sup> Since traders do not reveal their information to other traders, they can profitably conduct more trade. Therefore, a CCP fosters market liquidity. A CCP can also foster liquidity by standardizing the contracts it clears.<sup>6</sup>

The CCP, however, is not immune to the failure of one trader to pay at the settlement date. For example, Bull might not be able to pay \$10 to the CCP when Direstraits goes bankrupt, but the CCP still has to satisfy its obligation to pay \$5 to Ace and Conservative. To cover potential losses, CCPs use three instruments: margin requirements, position limits, and default funds. *Position limits* are limits on the number of positions that a trader can take.<sup>7</sup> A CCP can also use *default funds*. The CCP may require traders, before they trade, to pledge \$2 each to a fund the CCP manages. The CCP then has \$6 available in case Bull does not pay. If Bull pays, the CCP returns \$3 each to Ace and Bull. As a consequence, traders face lower counterparty risk as long as the CCP manages its risk well. Another

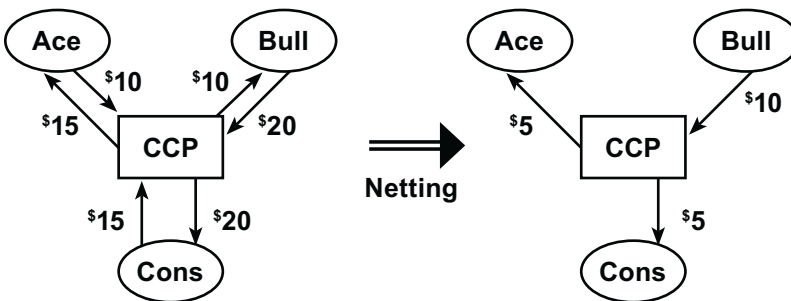
<sup>5</sup> Of course, this requires that the CCP not reveal each member's positions.

<sup>6</sup> See the article by Randall Kroszner.

<sup>7</sup> See the paper by Yaron Leitner for a theory of position limits.

**FIGURE 4**

**CCP Clearing**



advantage of a CCP is to reduce monitoring costs. Indeed, contrary to the clearing mechanisms previously described whereby traders had to monitor each other, here only the CCP has to monitor traders.

As in the settlement ring, the CCP works best if contracts are completely standardized. This is the case in our example, since all traders make payments in case Direstraits goes bankrupt. However, netting is limited if contracts are only imperfectly substitutable. To see this, suppose traders also care about whether Endgame, Inc. (E) goes bankrupt. In particular, suppose Bull sells two CDS to Ace against the event that Endgame goes bankrupt (say, Bull promises to pay \$10 to Ace), while other contracts remain in place. When the bankruptcies of Direstraits and Endgame are not perfectly correlated events, a CCP will not be able to fully net all positions.

Netting is not totally excluded, even if contracts are imperfect substitutes. Rather than the exposure itself, the dollar value of the exposures can be netted. For instance, if two contracts contain obligations in different currencies, it is impossible to net the two contracts directly. However, it is possible to net them

once the obligations have been converted into a single currency. This process, however, is left to the discretion of the rules governing a CCP or in the master agreement of a particular industry.<sup>8</sup>

Unfortunately, limited netting possibilities increase counterparty risk for the CCP. If the CCP can net all positions, it needs collateral only from Bull, who owes \$10.<sup>9</sup> However, when netting is limited, a CCP may have to impose larger margin requirements, larger contributions to the default funds, or stricter position limits.

Finally, in addition to reducing counterparty risk, the CCP can also produce useful information for traders and can do so without compromising anonymity. If all trades have to be cleared through the CCP, the CCP has access to the specifics of all contracts. Therefore, it can gather information and release aggregate statistics on the price or quantities of the contracts traded. This is valuable because prices

<sup>8</sup> See, for instance, the protocols set forth by the International Swaps and Derivatives Association.

<sup>9</sup> Also note that Ace and Conservative are each owed \$5, so that with full netting, their financial condition does not affect counterparty risk.



collectively sum up the information of all traders. For example, each trader may know something about the prospect of default by Bull. Someone observing a rising price for the credit default swaps may infer that traders have raised their forecast of the likelihood of default.

### LIMITS TO CCP CLEARING

CCPs are, however, not immune to failing on their obligations: If many of its counterparties default, a CCP may not have enough resources to cover all its positions. In this case, a CCP is not financially viable. For example, when Lehman Brothers failed in September 2008, markets were under particular stress. All of Lehman's positions had to be unwound, leaving market participants speculating on what the outcome would be. Were CCPs in jeopardy? Could they cover all of their obligations following Lehman's default without tapping into their default funds? Fortunately, CCPs around the world successfully conducted the unwinding process in a timely manner. (See *The Performance of Central Counterparties Clearing Following Lehman's Failure*.) Given the resilience of markets that operate with a CCP, many authorities have recently advocated in favor of extending the use of CCP clearing to other markets. To fully evaluate these proposals, we need to take account of the limits of CCPs, in particular, the difficulties of clearing over-the-counter (OTC) trades.

We can contrast two types of markets in which CCP clearing can take place: centralized markets and OTC markets. In a centralized market, contracts are very uniform, since the terms (products, quality, and settlement date) are fixed, and the only missing information to buy or sell a contract is its price.<sup>10</sup> All traders look at their computer screens to get

price quotes, and they can buy or sell contracts with the push of a button (literally), without even knowing the identity of the seller or buyer.

One problem with standardized contracts is that they are not tailored to the needs of each trader. Traders looking for specifically tailored contracts will access an OTC market.<sup>11</sup> Since the terms are idiosyncratic, traders have to make phone calls or

CDS from Conservative, but suppose the contract specifies that if Direstraits goes bankrupt, Conservative should pay 10 Swedish krona (and not \$10). In the unlucky event that Conservative himself defaults, the CCP still has to fulfill its side of the contract to B. Therefore, the CCP has to find another trader willing and able to provide 10 Swedish krona if Direstraits defaults. This may be difficult and

## If an OTC trader defaults on its promise to pay the CCP, the CCP faces a large replacement cost risk.

send e-mails to other traders to find out how much a specific contract costs. One drawback of an OTC market is that it is not transparent; the terms of the contract remain largely undisclosed to other participants. The lack of transparency impairs the information aggregation process that prices would normally perform.

There are two main limits to a CCP operating on an OTC market. First, Darrell Duffie and Haoxiang Zhu, in their study, show that multilateral netting is the main advantage of a CCP in reducing counterparty risk. But as we saw earlier, multilateral netting can be limited, or even impossible, when the contracts traded are not uniform.

Also, if an OTC trader defaults on its promise to pay the CCP, the CCP faces a large replacement cost risk. The less standardized the contract, the larger the cost. To understand this, suppose once again that Bull buys a

expensive if the Swedish currency is not commonly traded in the U.S. This is an example of the replacement cost risk that a CCP faces, and the more specific a contract is, the higher the replacement cost risk will be.

This is similar to a loss of a hedge by a trader. A hedge is a position with another trader in order to offset the risk originating from an initial trade. For example, wheat producers can hedge against the fluctuations of wheat prices by selling the promise to deliver wheat at a given price. If the buyer of the hedge fails, sometime before the hedge matures but after some information on aggregate wheat production is revealed, the wheat producer may find it impossible to convince another trader to buy his hedge.

To cover these costs, a CCP operating on an OTC market will naturally increase collateral requirements and the contributions to its default funds. However, the cost could be so high, and the collateral so costly to pledge, that OTC traders known to always fulfill their promises (*low-risk traders*) may reduce their trades or simply opt out of the CCP clearing arrangement altogether.

<sup>10</sup> To some extent, the degree of standardization is a policy variable, since the government can, for example, outlaw or tax nonstandardized agreements.

<sup>11</sup> See the study by Darrell Duffie, Nicolae Garleanu, and Lasse Pedersen, and the one by Ricardo Lagos and Guillaume Rocheteau.

## The Performance of Central Counterparties Clearing After Lehman's Failure

# A

s reported in the Bank of England's Financial Stability Report (October 2008), the London-based clearinghouse LCH.Clearnet was exposed, through Lehman's interest rate swap portfolio, to the risk of sharp market movements across a wide range of products. Indeed, the total notional value of the portfolio was \$9 trillion, encompassing a total of 66,390 trades across five major currencies. The unwinding process was achieved through the competitive auctioning of the Lehman OTC interest rate swap portfolio. The default was managed well within the margins posted by Lehman, and LCH.Clearnet did not have to resort to its default fund.

The Depository Trust and Clearing Corporation (DTCC), the largest clearing agent for the U.S., announced in October 2008 that it had successfully closed out over \$500 billion in market participants' exposure from the Lehman Brothers bankruptcy. The unwinding process was carried out by netting Lehman's positions and liquidating any remaining positions, by asset class. The largest of Lehman's positions was in securities based on mortgages, amounting to \$329 billion. DTCC's Fixed Income Clearing Corporation (FICC) had plans to launch a CCP that could net mortgage-backed securities. Although it was not in operation at the time of Lehman's bankruptcy, the FICC put the idea to work and netted out \$300 billion in Lehman trades related to mortgage-

backed securities, or 90 percent of the outstanding value.

Lehman also held trades for \$190 billion in government securities and \$5.85 billion in equities, municipal bonds, and corporate debt. Subsidiaries of DTCC processed \$3.8 billion in options exercises and assignments that were expiring and arranged for the release of \$1.9 billion in securities with Lehman's bank to satisfy Lehman's open trades. The remaining positions were liquidated in the market. The unwinding process was therefore conducted swiftly and without resorting to DTCC's subsidiaries' default funds.\*

Lehman's bankruptcy also highlights the role of information anchor that a clearing agent can play for OTC markets. With Lehman's bankruptcy, market participants speculated that the CDS market had exposure of as much as \$400 billion for payments on a Lehman default. However, as DTCC announced in a press release on October 11, 2008, the payment calculations performed by the DTCC Trade Information Warehouse relating to the Lehman Brothers bankruptcy indicated that the net fund transfers from net sellers of protection to net buyers of protection were expected to be in the range of \$6 billion. At the end of the unwinding process, DTCC calculated and bilaterally netted all amounts due on credit default swaps written on Lehman for \$72 billion. This resulted in approximately \$5.2 billion owed from net sellers of protection on Lehman to net buyers of protection.

\*Source: DTCC Annual Report 2008.

If only higher risk traders use CCP clearing, the CCP may become financially unsound, unless it raises its collateral requirements, thus deterring even more traders from CCP clearing. In the end, only very high-risk traders may be willing to use the CCP, which obviously limits the insurance benefits the CCP should provide. Also, if only high-risk traders use CCP clearing, the

aggregate price that the CCP would announce would not reflect all trades and would therefore limit the diffusion of the information. The bottom line is that the participation of low-risk traders in markets that trade over-the-counter and use CCP clearing is important to ensure that the market is efficient and safe.

In an article with co-authors Thorsten Koepl and Ted Temzelides, I examine one solution to the problem of inducing low-risk traders to participate in CCP clearing. Clearly, they will participate only if the costs of using CCP clearing are sufficiently low. To reduce the cost incurred by low-risk traders, a CCP can either limit the participation of high-risk traders — for

example, through stringent position limits — or shift the cost elsewhere. Therefore, the CCP has to use another source of finance to keep contributions to the default fund and margin requirements low and position limits relatively high.

The CCP can achieve this by establishing CCP clearing that is common to both centralized and OTC markets. Suppose the CCP operates in both an OTC market and a centralized market in which traders must clear through the CCP. Then the CCP could increase the default fund contributions of traders in the centralized market and use it to finance a lower default fund for OTC market trades. The fund's contributions for OTC traders can be adjusted so that they are willing to clear through the CCP. While this hurts traders on centralized exchanges, one has to recognize that many participants are active in both types of markets, so that the overall gains from introducing a single CCP clearing arrangement can be positive.

For example, according to our analysis, it may be most efficient for a clearinghouse to clear both CDS index swaps,<sup>12</sup> which are standardized and could easily be traded on a centralized exchange, and bespoke CDS, which

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<sup>12</sup> In contrast to a simple CDS, a CDS index swap gives insurance on a fixed basket of credit entities. In a simple CDS, the buyer gets insurance on any credit entity of his choice. A CDS index swap is therefore a much more standardized product than a plain CDS.

are very idiosyncratic. Collateral requirements or default funds might be set somewhat higher for those trading index swaps so that they can be set lower for those trading bespoke CDS.

To summarize, a CCP operating in several markets could subsidize its risk management activities in the OTC market using its clearing activities conducted in a centralized market. In the end, this could induce low-risk traders to participate in the CCP clearing arrangement in the OTC market

### CONCLUSION

Given the large growth in trades of credit default swap contracts in the last decade, regulators and some market participants have pressed for the establishment of CCP clearing in this market. In the last year or so, considerable progress has been made, and industry participants have taken a number of steps: Multiple CDS CCP platforms are now close to starting or have already started operations. For example, NYSE Euronext through Liffe's BClear platform has been operating in Europe since October 2008. ICE Clear US has been clearing agricultural swap contracts since February 2009, and in March 2009, the Fed approved its application to become a member of the Federal Reserve System, which moves it a step closer to operating as a CCP for CDS transactions. Also in March 2009, CME Group and its associated joint venture, CMDX, announced that they have received regulatory approvals

from the Federal Reserve and the Securities and Exchange Commission for clearing and trading credit default swaps through CME Clearing and the CMDX platform. Finally, Swiss-German futures exchange Eurex is also planning to launch a CCP for CDS in Europe.

In April 2009, at a meeting hosted by the New York Fed, market participants also supported broadening the use of CDS CCPs to include a wider set of firms and CDS products. They also agreed to report all CDS trades not cleared through a CCP to a central trade repository. CCPs and their members agreed to release information about their activities as they go live. In November 2008, the Depository Trust and Clearing Corporation began releasing weekly data about aggregate volume on the CDS market.

I have tried to shed light on the economic forces that lead to CCP clearing and, to some extent, explain the recent push toward the establishment of CCP clearing in CDS markets. I have also highlighted some of the difficulties of CCPs for OTC markets. Despite the clear benefits of CCP clearing, it is not obvious that this clearing arrangement fits all financial instruments. Some degree of uniformity in traders' risk profile and instruments appears to be needed to extract all of the benefits of CCP clearing. Whether we will observe a specialization of CCPs in clearing only a certain kind of trade remains to be seen. ☞



## GLOSSARY OF TERMS

The Bank for International Settlements, an international organization that fosters communication and cooperation among central banks, has explained a number of terms relevant to central counterparty clearing arrangements. The glossary has been published by the BIS' Committee on Payment and Settlement Systems (CPSS) and can be found at <http://www.bis.org/publ/cpss00b.htm>.

*Central counterparty (CCP)*: an entity that is the buyer to every seller and the seller to every buyer of a specified set of contracts, e.g., those executed on a particular exchange or exchanges.

*Clearing*: the process of transmitting, reconciling, and, in some cases, confirming payment orders or security transfer instructions prior to settlement, possibly including netting and the establishment of final positions for settlement. Sometimes the term is used (imprecisely) to include settlement.

*Counterparty*: the opposite party to a financial transaction, such as a securities trade or swap agreement.

*Default funds (also called Loss-sharing pools)*: cash, securities, or possibly other assets that are provided by the participants in advance and are held by the system to ensure that commitments arising from loss-sharing agreements can be met.

*Margin*: margin has at least two meanings. In the futures/commodity markets, margin is a good faith deposit (of money, securities, or other financial instruments) required by the futures clearing system to ensure performance. In the equities markets, margin is a sum of money deposited by a customer when borrowing money from a broker to purchase shares. The money deposited with the broker is the difference between the purchase value of the shares and the collateral value of the shares.

*Netting*: an agreed offsetting of positions or obligations by trading partners or participants. The netting reduces

a large number of individual positions or obligations to a smaller number of obligations or positions. Netting may take several forms that have varying degrees of legal enforceability in the event of default of one of the parties.

*Master agreement*: an agreement that sets forth the standard terms and conditions applicable to all or a defined subset of transactions that the parties may enter into from time to time, including the terms and conditions for closeout netting.

*Multilateral netting*: an arrangement among three or more parties to net their obligations. The obligations covered by the arrangement may arise from financial contracts, transfers, or both.

*Novation*: satisfaction and discharge of existing contractual obligations by means of their replacement by new obligations (whose effect, for example, is to replace gross with net payment obligations). The parties to the new obligations may be the same as those to the existing obligations or, in the context of some clearinghouse arrangements, there may additionally be substitution of parties.

*Position limit*: a restriction on the number of contracts or share of a contract's open interest that a single entity may hold.

*Settlement*: an act that discharges obligations in respect to funds or securities transfers between two or more parties.

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# How Much Is That Home Really Worth?

## Appraisal Bias and House-Price Uncertainty\*

BY LEONARD NAKAMURA

# W

ith house prices often below the face value of mortgages these days, the expected return on many mortgages has tumbled, since one of the major forces supporting mortgages, the collateral, has weakened. One source of these mortgage problems has been the validity of the home appraisal, which is supposed to be an objective and expert dollar valuation of the house that should help make a mortgage less risky. Unfortunately, the appraisal process can go awry and often has. As Leonard Nakamura shows in this article, appraisals have been biased upward, making mortgages riskier. Now a reverse risk is at work: The bias is going the other way, causing home valuations to be underestimated, possibly making new mortgages harder to obtain. In addition to problems of bias, Nakamura discusses the appraisal process, how it's supposed to work, and how it can go awry.

When housing prices fall and mortgage borrowers lose their jobs and fall behind on mortgage payments, an important question arises: How much



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is any given house worth if it were to be sold? In the not-too-distant past, say, 2005, when house prices were still spiraling upward, the answer was almost always "more than the amount borrowed." However, more recently, a typical answer has been, "not so much." With many house prices below the face value of mortgages, the expected return on many of these mortgages has tumbled since one of

\*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

the major forces supporting mortgages, the collateral, has weakened.

As we now know, that situation fed the creation of a major world financial crisis. As we pick ourselves up from the crisis, we see that one source of these mortgage problems has been the validity of the home appraisal, which is supposed to be an objective and expert dollar valuation of the house that should help make a mortgage safer and more marketable. Unfortunately, the appraisal process can go awry and often has. As we shall see, appraisals have been biased upward. This made mortgages riskier, since too much was lent out on homes. One of the safeguards, the appraisal, failed to perform its role of limiting mortgages to the underlying value of the houses.

Now a reverse risk is at work: The bias is going the other way, causing home valuations to be underestimated, and this may make new mortgages harder to obtain. If so, this could delay improvement in housing markets, which, in turn, could cause house prices to fall more than they otherwise would, possibly causing additional losses to mortgage lenders.

One way in which an appraisal can go awry is that the information upon which the house is valued may be very thin; recent nearby comparable house sales may be so few that the price at which the house is likely to be resold may be difficult to predict precisely. A second reason the appraisal process can go awry is that all parties may not want a genuinely independent appraisal.

As we reform our system of mortgage lending, one piece we might

wish to focus on is the appraisal system. Indeed, some steps have already been taken in this direction.

## HOW APPRAISALS ARE SUPPOSED TO WORK

A standard part of a home mortgage is an appraisal, an independent evaluation of the home's value. After the seller and buyer have agreed on a price, the mortgage lender usually requires an appraisal. This is an estimate of the value of the house, made by a professional appraiser and based on local market conditions; the appraiser examines nearby recently sold houses and compares them in terms of characteristics such as size, location, and condition with the house to be mortgaged.

A typical appraisal costs \$250 to \$400. In a boom year like 2005, when there were more than 7 million new home mortgages on purchases of new and existing one- to four-unit family homes and a similarly large number of refinancings, roughly \$4 billion was spent on appraisals in the U.S. These appraisals are part of an underwriting process whose aim is to determine whether lenders accept mortgage applications. This is a serious process with trillions of dollars at stake. In that same year, more than 5 million mortgages were denied, representing nearly \$1 trillion of loans applied for.<sup>1</sup>

The appraisal further certifies to the mortgage originator and — if the loan is securitized — to the ultimate lender the value of the collateral for the mortgage. The appraisal addresses the lender's worries about whether the

loan will be repaid. In the past, mortgages have generally been relatively safe loans because the borrower's home backs the promise to repay.<sup>2</sup> A house as collateral has two advantages for the lender: First, the borrowing household is usually loath to lose its home: Moving is costly and so is the loss of concomitant personal ties to neighbors and schools. So if a family can make the payments, it generally will. Second, even if the household cannot make the payments, the house can be resold, and the loan usually can be mostly or entirely repaid out of the proceeds.

The typical mortgage loan's safety is connected to the down payment made by the borrower; this fact is well-established by empirical research on U.S. data. Briefly, the down payment provides an equity stake for the borrower — a commitment of dollars by the borrower that the borrower loses if he or she defaults — as well as security for the mortgage lender.<sup>3</sup> One cause of recent mortgage losses has been house values that have fallen below the amount borrowed, a case in which the borrower's home equity stake has disappeared as a consequence of borrowing too much and the price of the house falling.

While most homeowners will continue to pay their mortgages even after their home equity has disappeared, many find themselves unable to keep up with payments, often as a result of unemployment or illness, and some of them will eventually lose their homes to foreclosure. In addition, in recent years, a significant proportion of homes were bought by investors,

many of whom are more likely to default as home equity is lost.<sup>4</sup> During the recent housing boom, housing market participants lost sight of the importance of the down payment, in many cases because house prices kept rising so consistently. If house prices rise continuously, the down payment may not matter. If a house is purchased without a down payment, the mortgage loan is worth the same as the house, and the lender has no margin of safety. But if the house price goes up 20 percent, the margin of safety will have reappeared, and the loan will turn out to be safe. In the U.S., during the six years from the end of 1999 to the end of 2005, house prices rose at an annual rate of 11.3 percent (according to the Case-Shiller U.S. house-price index). During that period, on average, house-price appreciation created more than a 20 percent margin of safety in two years' time. During this period, it appeared as if mortgages made with no down payments were reasonable investments. By contrast, in the longer period from 1970 to 1999, house prices appear to have risen about 5 to 6 percent annually.

In more normal times, when prices aren't rising quite so quickly, the precise value of the home on the market, and whether it will be sufficient to repay the mortgage, is crucial information for the mortgage lender, since it influences both the likelihood that the mortgage will lose value and how the mortgage lender will approach legal options if the borrower falls behind in payments.

One way the lender attempts to gauge the underlying value of the house at the time the loan is made is

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<sup>1</sup> National mortgage data are from the HMDA National Aggregate Report, 2005, available at <http://www.ffiec.gov/hmdaadwebreport/NatAggWelcome.aspx>. It is difficult to know from these data how many of the denials were due to appraisals, but the limited data suggest that appraisals were responsible for only a small proportion of denials.

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<sup>2</sup> In the 1980s, the savings and loan crisis also had mortgage lending at its root, but this had less to do with mortgage defaults and more to do with unusually high long-term interest rates.

<sup>3</sup> For a fuller discussion of the risks of loans and the value of the down payment, see Ronel Elul's *Business Review* article.

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<sup>4</sup> See, for example, Shane Sherland's working paper on default rates of subprime mortgages and Yuliya Demyanyk and Otto Van Hemert's forthcoming article on the decline in mortgage lending standards in recent years.

from the sale price of the house: What the borrower is willing to pay for the house is usually a good measure of its worth. But the buyer may have overpaid. Worse yet, the buyer may have deliberately overpaid to a partner, with the pretend “transaction” intended to fraudulently extract money from the lender. In a classic “land flip,” criminal A sells a house to criminal B at an inflated price, and the two then abscond with the cash lent by the mortgage lender.

To collect more information about the underlying value, the lender obtains an appraisal of the house’s value, that is, an estimate by a professional appraiser, based on prices paid for local comparable houses. This additional information may be needed because the borrower may have overbid for the house, in which case the lender may be leery of financing it. Moreover, even if the borrower has paid the right price for the house, other sales testify that the market for houses in that neighborhood is active, and that if the house needs to be sold, the market is not so thin that an additional house for sale will result in a large drop in price.

How is the information from the appraisal used in the mortgage? First, if the information from the appraisal does not give the lender confidence in the appraisal valuation, the lender may refuse to make the mortgage loan. For example, if the comparable houses used in the appraisal are in a different neighborhood from the house being appraised, the loan may be refused. Second, a conservative rule is used to determine the value of the house for the purposes of the mortgage. The lender bases whether to approve the mortgage on whichever is lower, the appraised value or the transaction price. The standard conventional prime mortgage must have a loan-to-value (LTV) ratio of 80 percent

to qualify for a low interest rate; the valuation used for this purpose is the lower of the appraised value or the transaction price.<sup>5</sup>

Suppose a prospective home buyer reaches a purchase agreement to buy a house for \$100,000. The buyer has \$20,000 with which to make a down payment, so she just qualifies for the lowest interest rate, borrow-

do cash-out refinancing, where they increase the size of the mortgage loan and reduce their implied home equity. Freddie Mac has estimated that from 2002 to 2008, over \$1 trillion in cash was taken out of prime mortgages. While in many cases this cash was used to improve the properties — improvements that may raise the properties’ value

## One way the lender attempts to gauge the underlying value of the house at the time the loan is made is from the sale price of the house: What the borrower is willing to pay for the house is usually a good measure of its worth.

ing \$80,000. However, suppose the appraisal comes in at \$95,000. In calculating the loan-to-value ratio, the mortgage lender will set the value of the house at the lesser of the appraisal valuation (\$95,000) or the sale price (\$100,000). Thus, the mortgage document records a house value of \$95,000 and a loan of \$80,000, so the loan-to-value ratio is 84 percent, too high to qualify for the best interest rate.

Appraisals are also used by lenders when the borrower wants to refinance an existing mortgage or take out a second mortgage, also called a home equity loan. Whenever mortgage rates have fallen, as they did dramatically in 2003, households have refinanced their homes to take advantage of lower interest rates. Many households have taken these opportunities to

and thus only partially reduce home equity — research shows that many of these cash-outs were used to finance consumer expenditures or to reduce other debts.<sup>6</sup> The high loan-to-value ratios resulting from cash-out refinancing are by no means limited to low- and moderate-income populations; many examples come from expensive houses in wealthy neighborhoods.

### APPRAISALS, MORTGAGES, AND LOCATION

**Location and Valuation.** Let us briefly explore the relationship between location and value that underlies the appraisal and justifies the real estate motto: location, location, location. One way that houses differ from mass-produced goods is that each house’s value is in part based on its unique location. Location affects various attributes of the house, in particular its distance to other locations, such as work sites, shopping, transportation,

<sup>5</sup> In its guide to mortgage originators (known as underwriters), Fannie Mae states, “For a purchase mortgage, the LTV ratio is calculated by dividing the amount of the mortgage by the lower of the appraised value or the sales price of the property” and that “an LTV ratio greater than 80 percent requires credit enhancement, such as primary mortgage insurance.”

<sup>6</sup> See the article by Alan Greenspan and James Kennedy.



and leisure amenities. Houses together constitute neighborhoods, united by schools, social networks, building codes, and political units. Houses close to one another are relatively substitutable, and their prices will tend to move together; houses distant from one another are not such easy substitutes for one another, and their prices may not move together.

Put another way, a house consists of a structure and a piece of land. The structure can be valued at its replacement cost, which is likely to be similar from one location to the next. As a result, structures are more like mass-produced goods than unique goods. The value of the land, which differs by location, can differ very substantially from place to place.<sup>7</sup>

Economists group the determinants of land valuation into amenities and work opportunities. Although labor economists often see work as the main determinant of wages, urban economists see amenities and work opportunities as jointly determining both wages and land prices.<sup>8</sup> In particular, the greater the amenities and the higher the productivity of nearby work opportunities, the greater the price of land. By contrast, greater amenities tend to lower the wage rate because workers may be willing to work for lower pay to live in a nice location.

**The House Sale.** A homeowner will typically have a general idea of what the house is worth. However, ex-

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<sup>7</sup> This distinction is not absolute, of course, and structures can become highly idiosyncratic, while plots of land within a single development or homes within an apartment building may be quite similar. Moreover, a structure may be unsuited to its location, in which case the structure does not add its full value to the land. In this case, it is inappropriate to value a house as the sum of its value as a structure and a piece of land, which can be seen as an upper limit on the value of the house.

<sup>8</sup> See Gerald Carlino's *Business Review* article and the chapter by Glenn Blomquist.

actly what the house will fetch on the market from an actual sale may depend on many factors. The potential buyers of a given unit have some knowledge of the house's value to themselves as specific households relative to other units. In addition, they may know the prices of recently purchased nearby units and the offering prices of nearby for-sale units. They then bargain with the seller over the particular unit, and a sale may take place.<sup>9</sup> The price paid will depend on bargaining skill, the availability of substitute units, characteristics of the particular unit, and the buyer's and seller's tastes for the amenities offered by the particular unit. For example, committed sellers, that is, those who must sell because they are moving to another city or have already agreed to purchase another house, are more likely to accept a sale price below the expected value than sellers who are waiting to see what their home will fetch.

All of this matters to the mortgage lender because the fact that a house has sold at a given price may not be a strong guarantee that the house can be resold at that same price, should a resale prove necessary. In a foreclosure sale, that might mean that the lender will not be fully repaid for the loan. To get a better fix on the underlying value of the house, the mortgage lender turns to an appraiser.

**The Appraisal.** In making a home appraisal, the appraiser typically presents the lender with sales data on recent comparable house sales. As part of this process, the appraiser will note whether these sales are indeed recent and closely comparable. All this information helps the lender know how accurate the appraisal is likely to be. The lender wants to know how much

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<sup>9</sup> A formal model that describes a housing market in this way is set forth in the article by Daniel Quan and John Quigley.

the house in question is likely to sell for if a resale is necessary, that is, how much the collateral is worth. If a lot of similar houses have been sold in the neighborhood for similar prices, the lender can be reasonably sure that the house can be resold, if necessary, for a price close to the sale price. However, when there aren't many comparable sales, it is possible that no other buyers will be found for this particular house at or near the sale price.

In a typical appraisal, the appraiser is expected to give an appraised value and to document the basis of the valuation. Appraisers are subject to state regulation; typically, they have certification that they have met both education and experience requirements. In addition, appraisers are expected to be objective and not be swayed by the participants in the transaction. Yet the participants have an important stake in the success of the transaction.<sup>10</sup>

From the buyer's perspective, the down payment represents the difference between the sale price and the amount the buyer must borrow. If the house costs \$180,000 (the median sale price in the fourth quarter of 2008) and the buyer can put \$36,000 down after meeting transaction costs so the down payment is 20 percent of the house value, the amount the buyer needs to borrow is \$144,000. However, if the resale value of the house is really, say, \$160,000, from the perspective of the lender, \$20,000 has been lost due to the borrower's overpaying for the house, and the effective down payment is only \$16,000, or 10 percent of the house value.

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<sup>10</sup> "Today, many appraisers feel that their ethics are under assault from clients who expect favorable assignment results in return for future business... Even so, the pressures appraisers feel today are little different from those of the past..." See Bruce M. Closser's article.

Discrepancies between the sale price and the appraised value thus create a problem for the lender. If the appraisal comes out to be less than the agreed sale price, the down payment may be insufficient for the loan, and the loan may be canceled or lose its prime status.

Because each house is unique, there is no perfect estimate of its underlying true value. What the lender and the borrower both want to know is: What would the house sell for if it were sold again? The answer to that question can only be an estimate, subject to some uncertainty.

## HOUSE APPRAISALS ARE SYSTEMATICALLY BIASED

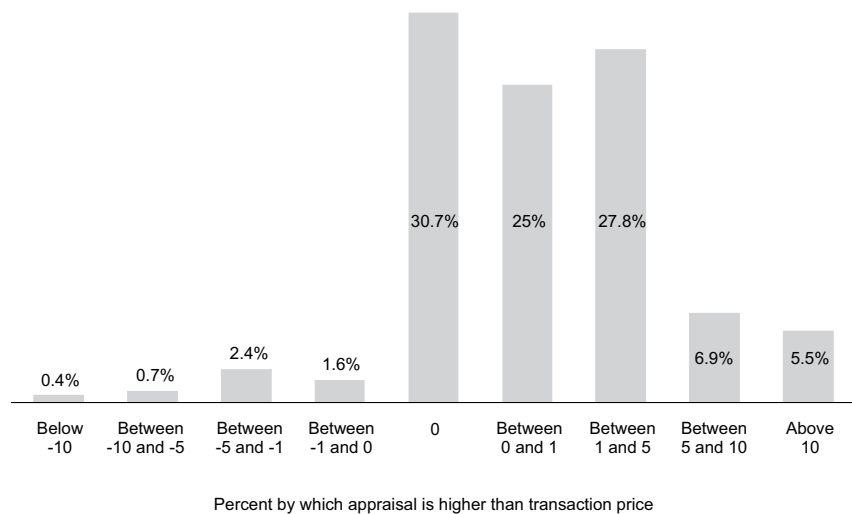
**Empirical Evidence Shows That Appraisals Have Been Biased Upward in the U.S.** Modern studies of the accuracy of home mortgage appraisals in the U.S. began with an article by Man Cho and Isaac Megbolugbe, economists at Fannie Mae's Office of Housing Research, who studied the 1993 Fannie Mae loan acquisition file, which contained over 600,000 home-purchase mortgages. They found that in this group of prime mortgages, only 5 percent had appraisals that were lower than the transaction price, while over 30 percent had appraisals that were exactly the transaction price. The other 65 percent were above the purchase price. On its face, these data suggest that appraisals may be biased. Too many mortgage appraisals are exactly at the transaction price, and the distribution is highly asymmetric (Figure 1).

Similar evidence is found in the article by Terry Loeb, published by the Collateral Assessment and Technologies Committee, a group founded by real estate information companies. The article takes a sample of 2.9 million home appraisals, from

**FIGURE 1**

### Appraisal Bias

Positive bias means appraisal higher than transaction price



Appraisal bias is defined as appraised value less transaction value as a percent of transaction value. When the bias is positive, the appraised value is greater than the transaction value, and there is no impact on the mortgage loan-to-value ratio. On the other hand, when the bias is negative, the appraised value is less than the transaction price, and the mortgage loan-to-value ratio will be higher (see text).

Source: Cho and Megbolugbe, 1996, Table 1, p. 48

1977 to 2004, and finds that the appraisal price is greater than or equal to the transaction price more than 97 percent of the time.

The reason for this asymmetry is that appraisals below the sale price have a different impact from appraisals above the sale price. Specifically, the home valuation, for the purposes of calculating the loan-to-value ratio, is equal to the lower of the sale price or the appraisal. An appraisal above the sale price does not affect the loan-to-value ratio, but one below the transaction price does. If the loan-to-value ratio rises, this may influence whether the mortgage lender makes the loan. To quote Cho and Megbolugbe, "The way to ensure the deal is to appraise slightly high. The appraiser asks for or receives the transaction price and then adds a bit to it. Since the mortgage lenders employ the lesser of the sale price or the appraisal, whichever is

lower, in determining the loan value, no further information is added because of the appraisal."

It is clear that, in some cases, when the appraiser reports that the appraised value of the house is below the transaction price, the seller lowers the price, and so the transaction price and the appraised value of the house come out exactly the same. In addition, it is possible that when the appraised value is below the sale price, the borrower may withdraw from the sale, since the mortgage becomes harder to complete.<sup>11</sup>

This would account for some of the bias and some of the large propor-

<sup>11</sup> Note a further asymmetry here. An appraisal that is too low may cause the mortgage to be turned down and may allow the borrower to back out of the transaction. An appraisal that is too high doesn't affect the mortgage contract directly and doesn't allow the seller to renegotiate.

tion of appraisals in which the bias is exactly zero. However, as shown in Figure 1, 25 percent of mortgages were between zero and 1 percent above the purchase price, while only 1.6 percent were between zero and 1 percent below the purchase price. If this were resulting from the transaction price being changed or the mortgage being denied, it would imply that roughly one-fourth of all mortgages were being changed or lost due to a 1 percent difference in appraisals. This seems unlikely on its face and is not confirmed by professionals.<sup>12</sup>

**Why Are Appraisals Likely to Be Biased Upward?** What appears to be occurring is that the parties directly involved in the transaction have a mutual interest in a somewhat upwardly biased appraisal. A difficulty with the underlying contract is that if a house's value is taken to be the lesser of the sale price or the appraisal, and both are good but imperfect estimates of the true value of the house, the lesser of the two will be biased low.

If the house value was taken to be the average of the two values, and both the appraisal and the sale price reflected the underlying value of the house but with some error, the house value would be unbiased. The lesser of either value, however, is always going to be less than the average of the two and hence biased downward.

As we have seen, when the appraiser typically errs by setting the appraised value at or above the sale price, the loan-to-value ratio is

<sup>12</sup> A further indication of the bias is that house-price indexes that were created using both sale prices and refinancing appraisals are now widely considered to be biased relative to house-price indexes constructed using only sale prices, despite the fact that a lot of observations are lost when refinancing appraisals are ignored. Indeed, Andrew Leventis has written a paper on how to eliminate the bias from the Federal Housing Finance Agency's (formerly the Office of Federal Housing Enterprise Oversight, or OFHEO) house-price index while continuing to incorporate information from appraisals.

unaffected. This appears to be what happens overall; only in relatively few cases (perhaps 5 percent) are the appraisals below the sale price. Such a practice deprives most appraisals of having independent value as measures of the value of the house. Only if the appraiser is convinced that the home buyer has substantially overpaid for the house will the appraiser signal this to the lender by setting an appraisal below the sale price.

## A somewhat different issue arises with appraisals to refinance mortgages because there is no sales transaction, since the homeowner stays in place.

With this criterion for estimating house value, the mortgage contract gives the appraiser too much power to accidentally prevent house sales from concluding. This creates a strong incentive for the appraiser to bias the appraisal upward and for the other parties — the mortgage lender and the real estate broker — to want to hire biased appraisers.

Note that typically the buyer is not a “victim” of an appraisal that is biased high. If the appraisal is too low, and if the seller will not lower the price, the buyer will have to come up with a larger down payment.

**Appraisals for Refinancings May Be Even More Biased.** A somewhat different issue arises with appraisals to refinance mortgages because there is no sales transaction, since the homeowner stays in place. Thus, when a house is refinanced, there is no sale price with which to compare the appraisal. However, there may be a “target” price the borrower is hoping for. In any case, it is generally believed that, in recent years, the appraisals for refinancing have been more biased than those for home-purchase loans.

According to Loebs' report, refinance transactions had a somewhat greater appraisal bias (5.6 percent) than purchase transactions (3.6 percent), when median values are compared.

Apparently, this was a particular problem during the recent subprime boom. Many subprime mortgage loans were refinanced from prime to subprime mortgages. When borrowers who had originally had good credit and prime mortgages ran into financial

difficulties, perhaps because of job loss, illness, or divorce, these borrowers were faced with a choice: They could sell their homes and pay off the mortgage, or they could refinance. But, as mentioned before, homeowners generally will avoid having to move if at all possible. Such borrowers were encouraged to refinance their mortgages with a subprime loan while taking cash out. The cash-out would then permit the borrower to become current on the new but more expensive and larger mortgage and thus to remain in their homes rather than be forced to sell or be foreclosed on.<sup>13</sup> As we can see in Figure 2, as long as home prices kept rising ever faster, through late 2005, foreclosure rates were kept artificially low, even though the underlying mortgages were increasingly risky.

These subprime mortgages made sense as long as house prices kept rising; however, they become highly

<sup>13</sup> See the article by Kristopher Gerardi, Adam Hale Shapiro, and Paul Willen for a discussion of the history of borrowers who wind up using subprime loans.

risky when house prices began falling. They were even more tempting during the period from 2003 to 2005, when long-term interest rates, and mortgage interest rates in particular, were unusually low. In Figure 3, we see that beginning at 2003, 30-year mortgage rates (as measured by Freddie Mac) fell below 6 percent for the first time in over 30 years. As a consequence, the rate of mortgage originations rose to about \$1 trillion a quarter! Refinancings drove these record rates of originations.

**Consequences of Bad Appraisals.** If appraisals are not trustworthy, lenders may wind up lending too much money relative to the home's value. When this happens, defaults are more likely to occur.<sup>14</sup> Unfortunately, there has been very little academic work on the impact of biased appraisals despite the importance of the subject.

The lone published academic article, by Michael Lacour-Little and Stephen Malpezzi, uses a small data set from Alaska in the 1980s to show evidence that for a single thrift institution in Alaska, appraisal bias was positively associated with more frequent default.

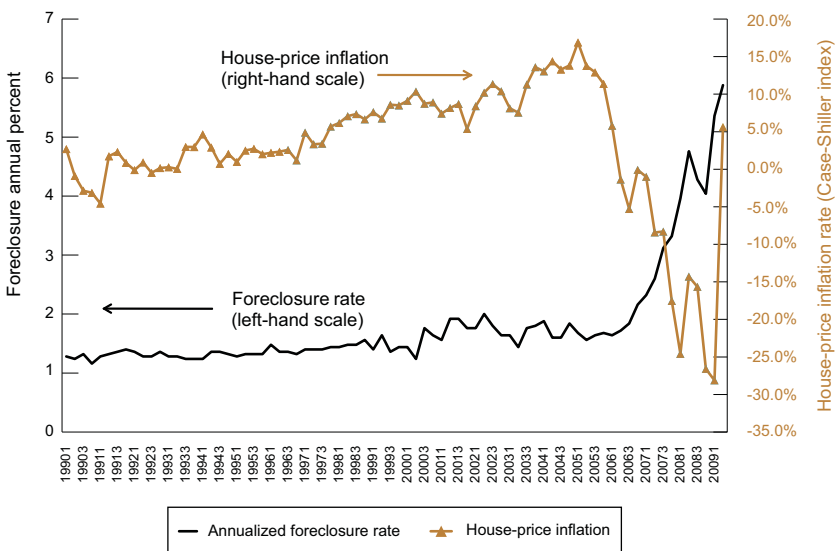
If, indeed, appraisal bias has been larger for *subprime* loans, then since we know that subprime loans have experienced a very high rate of delinquency and loss,<sup>15</sup> there may be a substantial relationship between appraisal bias and poor loan performance. But, in general, one might expect a relationship between appraisal bias and subsequent loan performance, not only because

<sup>14</sup>An article by Yongheng Deng, John Quigley, and Robert Van Order provides the best evidence of the size of this default impact, and Ronel Elul's *Business Review* article provides a more accessible qualitative view.

<sup>15</sup>As of mid-2009, reports say that half of all subprime loans are either in foreclosure or are delinquent, that is, at least 30 days behind in payment.

**FIGURE 2**

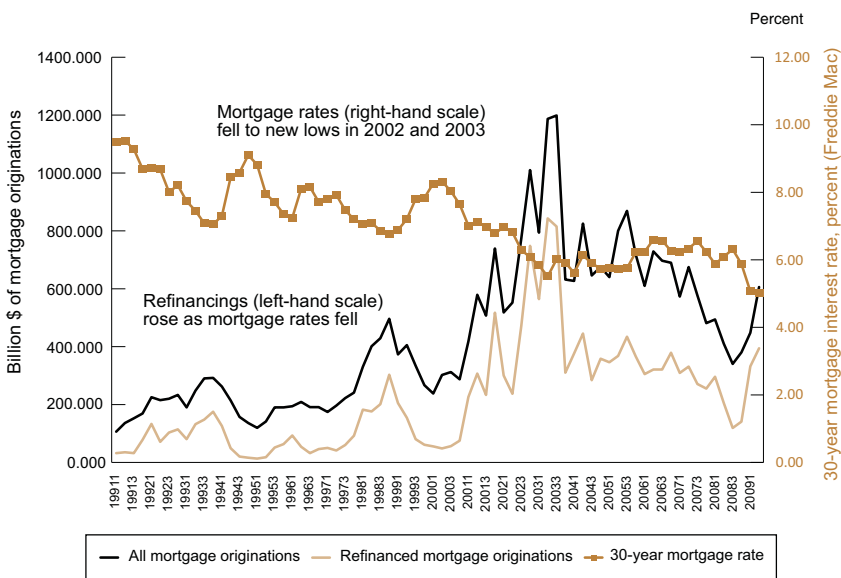
**Foreclosure Rates Remained Low As Long As House-Price Inflation Remained High**



Sources of data: (1) Foreclosure rate: Mortgage Bankers Association, mortgage foreclosures started, quarterly, seasonally adjusted, and annualized, Haver Analytics; (2) House-price inflation: S&P/Case-Shiller U.S. National House Price Index, seasonally adjusted, quarterly, at annual rates, Haver Analytics.

**FIGURE 3**

**Total Mortgages, Refinances, and Interest Rate**



Sources of data: All data, Freddie Mac, Primary Mortgage Market Survey, Haver Analytics. (1) Mortgage rates: 30-Year Fixed Rate Mortgage Interest Rate, percent; (2) Total Mortgages and Refinancings: Mortgage Originations, 1-4 Family: Total and Refinance, billions of dollars, nominal.

appraisal bias may be evidence of poor lending practices but also because appraisal bias may permit weak or fraudulent loans. Disentangling the role of appraisal bias in the recent housing crisis is an important avenue for research.

## A FEEDBACK LOOP IN APPRAISAL ACCURACY

### The Current Situation.

Beginning in 2008, we have entered a period of high home foreclosures in which many homeowners have lost their homes due to nonpayment of their mortgages. A large proportion of all house sales in 2009 appear to have been homes that had been foreclosed in the 12 months before sale, as much as 20 percent, according to zillow.com.<sup>16</sup> While this report is difficult to verify, it is clear that total foreclosures — whether they are soon sold or not — are indeed very substantial. According to the Mortgage Bankers Association, as we can see in Figure 1, the annual foreclosure rate has risen to over 5 percent. Since in 2007, according to the American Housing Survey, there were an estimated 50 million mortgages held by households who occupy their own homes, and that number is unlikely to have fallen much by 2009, that implies over 2 million foreclosures. With total single-family home sales running less than 5 million annually in 2009, this suggests that the zillow.com rate of foreclosures is by no means implausibly high.

Why does the proportion of foreclosure sales matter? Because they could be reducing even further the appraised value of homes. In some areas, many of the house prices

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<sup>16</sup> Zillow.com is a website that seeks to aggregate information about home sales. This estimate is taken from Dan Levy, “U.S. Underwater Mortgages May Reach 30%, Zillow Says,” Bloomberg News, August 11, 2009.

available for comparison in appraisals may be from foreclosure or otherwise distressed sales. Many of these houses are being sold at foreclosure auctions.

**While auctions are often a good way to sell objects, it is not clear that they fetch the best price in real estate, where information costs are high, and when obtaining finance is often difficult.**

This may cause some of them to be sold below their usual market price and may cause a downward drag on estimates of house prices.

While auctions are often a good way to sell objects, it is not clear that they fetch the best price in real estate, where information costs are high, and when obtaining finance is often difficult. Indeed, there is some evidence that an impatient seller does not get the best price.<sup>17</sup> According to a study by John Campbell, Stefano Giglio, and Parag Pathak, using data from Massachusetts, they find that foreclosed homes sell for nearly 30 percent less than they otherwise would. If foreclosure sales, on average, produce low prices, this may make it more difficult to ascertain what the true underlying value of homes is.

Uncertainty and foreclosure may now be causing house appraisals to be biased too low. Under current arrangements, low mortgage appraisals will tend to cause too few mortgage loans to be approved. This, in turn, lowers the demand for homes and may cause the price of homes to sink lower than they otherwise would.

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<sup>17</sup> See the article by David Genesove and Christopher Mayer.

In addition to these distressed-market price distortions, the *volume* of sales affects the accuracy of appraisals. This is a network effect that generates

economies of scale<sup>18</sup> — the more participants, the better — that can create a feedback loop: Fewer sales mean less accurate appraisals, thereby making lenders leery of lending, which further reduces sales. William Lang and I developed a model of home sales and appraisals back in 1993 in which a reduction in completed home-sale transactions can feed on itself.

**A Possible Vicious Cycle.** The reason for this particular feedback loop is that if the pace of home sales slows, the appraisal becomes less precise. This makes the mortgage riskier, making it more likely the lender will reject it. If the home mortgage application is rejected, the transaction may fall through and thus no sale will be made. This further reduces the precision with which the underlying value of houses in that neighborhood is known and possibly induces more mortgage rejections.

Our model identifies two somewhat separate issues. One is that *small* changes in, say, borrowers' risk, which

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<sup>18</sup>A classic economy of scale exists when a firm's per unit costs fall the more output increases. When this is true, the most efficient way to produce is to have a single firm produce for the entire market. Another kind of economy of scale is a network economy of scale: The more participants there are, the more valuable participation is.



may cause a given loan to be rejected, can lead to *large* and persistent changes in the market equilibrium. The feedback effect can cause mortgages to become much riskier and therefore make a real estate market face lower transactions and lower prices for a sustained period of time. The second issue is that these effects may be inefficient because they are caused by a market failure and therefore may call for some form of public intervention.

The problem is that one person's transaction provides information (about the local value of homes) that is useful to others' ability to complete their own transactions on nearby homes. In an ideal world, the buyers who come later would be able to compensate earlier buyers for providing this information. But there is no simple way for a potential buyer to compensate an earlier buyer. In turn, the number of transactions will typically be lower than would occur if some system of compensation were feasible.

This type of market failure is called an *externality*: An activity external to a given economic action affects the value of the action. Other, more familiar examples of externalities are air pollution (such as carbon emissions) and pollination by insects such as bees. When an externality occurs, existing markets may not be efficient, and it is possible that a government policy intervention could improve economic outcomes. For example, the Internet presents a network externality: The greater the number of people who use the Internet, the more valuable the Internet becomes. Government assistance helped establish the first Internet link-up, and we can argue that this was a good use of public funds because the first users of a network such as the Internet do not gain as much value as those who use it once there is widespread adoption.

But these externalities cut both ways. Growing networks add value to all users, but shrinking networks fall in value. When a given technology becomes less used, it may become less efficient for all users. Anyone who has recently rented a shopworn videocassette of a classic movie has experienced this effect.

Similarly, a mortgage loan may be denied because the lender thinks there is a chance the borrower may default on the loan. But if the loan is close to being acceptable, perhaps the lender would make the loan if the borrower paid a small amount extra. Now because future buyers and sellers (and lenders) would benefit from the sale going through (because it would shed light on the value of properties in that neighborhood), this information might be worth enough to warrant paying the additional amount the lender would require to make this loan. That is, society as a whole might be better off if the mortgage was accepted, although private incentives lead to the mortgage being rejected.

#### **Quantitative Importance of Appraisal Information Externalities.**

Empirical papers, some gathered in two issues of the *Journal of Real Estate Finance and Economics*, have served to confirm a number of the points raised in this model. For example, Paul Calem showed that in white households, the mortgage denial rate rises as the number of home sales increases. It does appear that fewer transactions are associated with a higher rate of loan rejection. However, an interesting variation can occur.

The model we have been discussing supposes that borrowers and lenders are individual players in a large, competitive market, rather than dominant players, so that the price information provided by a transaction is not of much value to either party: It can be used by any lender or borrower. As a

result, neither party has an incentive to go the extra mile to conclude the deal because of the information value alone. However, if one lender is a predominant lender in an area, the lender may take future potential transactions into account: In a neighborhood where deals are few, the lender may push through a mortgage for the sake of providing more information, knowing that by encouraging future transactions, the lender may be recompensed for making a slightly excessively risky loan. That is, the externality can be *internalized* by the lender.<sup>19</sup>

To the extent that this occurs, the externality may be mitigated by the marketplace, and public intervention may not be justified. However, monopoly lending will itself tend to be a problem: Ignoring the informational externality, monopolists tend to charge higher rates and make fewer loans than would competitive lenders.

A more recent paper by McKinley Blackburn and Todd Vermilyea presents a test of the relevance of these informational externalities on mortgage loan data primarily from 1998. To test for information externalities, they use a sample of over 2,000 mortgage loans that comes with detailed data about the borrowers. They confirm the existence of these informational externalities and estimate that 10 percent of the tracts in their sample are materially affected by the externality. This is in addition to the economies of scale by lender that Avery and co-authors found.

In essence, what Blackburn and Vermilyea do is show that the probability that a lender will turn down a particular mortgage application varies

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<sup>19</sup> A paper by Robert Avery, Patricia Beeson, and Mark Sniderman argues that all of the externality was internal to the lender. However, this paper had the weakness of not having detailed information about the borrowers.

with the average number of home sales successfully completed in the census tract. Unlike previous studies, their study has detailed data about the mortgage applicant and the mortgage application, including detailed credit information about the applicant and the applicant's income, employment history, race, sex, and marital status. These effects on denials apply to census tracts with 20 or fewer home sales in the previous year, or about 10 percent of census tracts. In addition, more denials occur when the lender has fewer than eight sales in a given tract.

One reason that house prices might fall further than they otherwise would is that after a period of having appraisals that were biased upward, we have entered a period in which appraisals are being performed with less bias and which are now less precise. This may well have resulted in a substantial increase in the number of mortgage applications denied, applications that would have been accepted a few years earlier. This in turn may have made it harder for purchasers to buy houses, reducing effective demand and resulting in lower house prices.

#### **APPRAISAL INACCURACY: CAN SOMETHING BE DONE?**

Appraisals have become more inaccurate for three reasons: bias, fewer home sales, and foreclosures. Can the contract be rewritten so that there is more room for variation in the appraisal, so that the appraisal will typically be more informative? This is a matter for future research, but it is an urgent question.

Negotiations between Fannie Mae, Freddie Mac, and the New York attorney general's office have resulted in a "Home Value Protection Program and Cooperation Agreement," whose main aim is to prevent lenders from influencing appraisals.

The major impact of the new agreement is to ensure that appraisers are not chosen by parties whose only incentive is to make the loan and who have little regard for the loan's safety. Thus, mortgage brokers are excluded from choosing appraisers, and restric-

able leeway for the possible error in the appraisal. Then the house value used in determining the loan-to-value ratio would be the sale price or the appraisal plus 3 percent, whichever was lower. In most cases, this would mean that the appraisal (plus 3 percent) was higher

## **Appraisals have become more inaccurate for three reasons: bias, fewer home sales, and foreclosures.**

tions are placed on how the "in-house" appraisers used by mortgage lenders are chosen; in particular, the process must be independent of the loan production staff.

This agreement will tend to ensure that appraisals are arrived at more objectively. However, it may have the side effect of making mortgage loans harder to obtain and may cause some sound home loans to be rejected.

Moreover, we have emphasized that if appraisals are unbiased estimates of a house's value, the house value — which is based on the lesser of the sale price and the appraisal value — is biased downward. So the downward bias will likely have a larger impact on causing sound mortgages to be rejected as appraisals become more objective.

How to reduce the incentives for an upwardly biased appraisal is a difficult problem that has not been solved. The fundamental problem is that a low appraisal can cause the mortgage to be rejected, and this may be due not to the intrinsic value of the house, but to the fact that the appraisal is an estimate, and is not exact.

One possible solution to this problem is to deliberately add a small, fixed amount, say, 3 percent, to the appraisal. This would provide a reason-

than the sale price, and the house value would be affected only when the appraisal was substantially below the sale price. This would largely eliminate the direct incentive for the appraisal to be biased upward and permit the appraiser to honestly value the house without excessively discouraging home mortgages. If appraisers become used to unbiased appraisals, this might also encourage more balanced appraisals of refinanced properties.<sup>20</sup> However, possible changes to the mortgage contract like this one need much careful study.

Here it would be helpful if more appraisal data were available. Although both the appraisal and the sale price are recorded as part of the mortgage data required by the lender, many real estate data sets do not separately include the appraisal and the sale price. Rather, what is recorded is the house value, almost always the sale price in a home-purchase mortgage and the appraisal in a refinance. This

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<sup>20</sup> If the procedures used by the appraisers are the same for home-purchase mortgages as for refinancings, lower bias in the home-purchase mortgage may spill over into the refinanced mortgage. In either case, lenders and others can monitor the bias of appraisers using tools such as automated appraisal systems.

makes it difficult for most researchers to examine appraisal practices.

For those who have the data, Fannie Mae, Freddie Mac, and other processors of mortgage data have created proprietary loan valuation products, called automated valuation models, to estimate the underlying value of mortgages, that is, to create an automated second appraisal that can be used to further judge the value of a house. These statistical models do not provide as good an appraisal as the local appraiser on the ground could, but they are highly useful in helping lenders to gauge the risk in valuations and to detect appraisal bias.

It would be very helpful if the data sets that include appraisals — such as those of Fannie Mae and Freddie Mac and the other mortgage-lending government entities such as the Federal Housing Administration and the Veterans Administration — were made broadly available to researchers,


analysts, lenders, and appraisers, subject to standard privacy protections. These data sets could, for example, be used to verify that appraisers have in fact reformed their procedures and are generally providing unbiased appraisals.

**If we do not act to improve the appraisal system, we may end up with the worst of both worlds.**

Note, however, that basing appraisals on sales of foreclosed homes is likely to cause a further downward bias. On the other hand, appraisers may not be able to find enough sales of nonforeclosed homes to provide a good estimate of normal home sales. To the extent that more data can be made

easily and quickly accessible, some of these problems may be overcome.

The current appraisal process may make it more difficult for sound borrowers to conclude home purchases. If so, that could be limiting the demand for existing homes, which could result in house values falling further. And that could worsen financial losses and delay a return to normalcy in home real estate markets.

If we do not act to improve the appraisal system, we may end up with the worst of both worlds. That is, we may experience a period of objective appraisals that cause more mortgages to fail, but as the current crisis fades from memory, end up back in a situation in which all parties desire biased appraisals. And that might well mean that biased appraisals could eventually reappear and help reflate another housing bubble. 

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# Riding the Revenue Roller Coaster: Recent Trends in State Government Finance\*

BY TIMOTHY SCHILLER

**T**he fall in state tax revenue during the current recession and the one in 2001 highlights an increase in the variability of this source of revenue that has been observed over the past two decades or so. But states have sources of revenue other than taxes. However, while providing a relatively constant portion of total revenue over the past several years, these sources have generally not damped variability in state revenue arising from variability in taxes. Consequently, variation in state tax revenue remains an important issue for state government finances. In this article, Tim Schiller looks at the causes of the increased variation in state tax revenue during recent business cycles compared with earlier ones. He also reviews strategies for coping with fluctuations in state tax collections.

Growth in state government tax revenue slowed around the start of the recession that began in December 2007, then declined in late 2008. Although a decline in state tax revenue is to be expected during a recession, the current decline in state tax revenue has been sharper than the decline in

overall economic activity. A similar relationship was observed in the 2001 recession. In fact, in these two recessions, state tax revenue exhibited much more significant weakness than would have been predicted based on previous recessions. This has been the case for the total tax revenue of all states and for the tax revenue of the states in the Third District (Pennsylvania, New Jersey, and Delaware). The fall in state tax revenue in these two



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recessions highlights an increase in the variability of this source of revenue that has been observed over the past two decades or so.

States have sources of revenue other than taxes. However, while providing a relatively constant portion of total revenue over the past several years, these sources have generally not damped variability in state revenue arising from variability in taxes (see *Nontax Sources of State Revenue*). Even the funds provided to state governments under the recently enacted federal economic stimulus program will go only a short way in counterbalancing the falloff in state revenue occasioned by the current recession.<sup>1</sup> Consequently, variation in state tax revenue remains an important issue for state government finances.

This article looks at the causes of the increased variation in state tax revenue during recent business cycles compared with earlier ones. The most important cause has been the shift by many states, including the Third District states, toward increased reliance on more variable tax bases — specifically, individual income taxes — and decreased reliance on more stable tax bases, such as sales taxes. In addition, broad changes in the forms of economic activity from which states derive

<sup>1</sup>The American Recovery and Reinvestment Act of 2009 includes approximately \$150 billion in total for state governments over each of the three fiscal years beginning with 2008-09. By comparison, this amount is just a small portion of the nearly \$2 trillion in total state revenue collected in fiscal year 2007. Even with the stimulus funds, analysts estimate that states will face large gaps between projected revenues and expenditures in the next several years. See the article by Donald J. Boyd.

\*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.



## Nontax Sources of State Revenue

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tate governments have sources of revenue other than taxes. They receive revenue from other levels of government (intergovernmental transfers), chiefly the federal government, although some states receive funds from local governments. Some states operate utilities (such as water, electric, and gas) and mass transit systems. States also provide products and services for which they charge fees, for example, education, hospitals, highways, housing, port facilities, waste management, parks and recreation, sale of minerals from public lands, and so forth. States obtain funds through fines, rents, and lotteries. States earn interest on funds held on deposit. States collect contributions from employees for trust funds for state employee pension plans, retiree pensions and medical insurance, and workers' compensation insurance. These contributions and the earnings and capital gains on the funds are sources of state government revenue.

Intergovernmental transfers are a large share of the nontax revenue of the states. This share has been roughly constant at around one-fifth of total revenue over the past 20 years (see the Table on page 25). Some of the transfers from the federal to the state governments are programmatic in such a way that they do not vary so as to offset declines or increases in state tax revenue over the course of the business cycle, although some transfers have that effect. Specifically related to the business cycle are federal transfers that have been enacted during past national economic downturns and in the current recession. Although helpful in counteracting shortfalls in state revenue generally, such transfers tend to be based on broad outlines that do not necessarily take individual state conditions into account, and the actual disbursement of funds at the state level often comes late or even after a recession ends.<sup>a</sup>

Beside intergovernmental transfers, the shares of revenue provided by most other nontax sources listed above have remained roughly constant for the past 20 years or more. However, among other nontax sources of funds, a large and growing share is accounted for by states' insurance trust funds. This share has increased from approximately 18 percent of total revenue in 1987 to 26 percent in 2007. (This amount is included in the "Other" category in the table.) These funds are not available to help states deal with cyclical fluctuations in revenue because they are dedicated to specific purposes, mainly state employee and retiree health-care benefits and pensions. And although investment returns on these funds were high until 2007, recent returns have been low or negative, presenting many states with the need to replenish the funds. So, instead of adding to states' financial strength, these insurance programs are actually financial burdens, and they are becoming more pressing as pension obligations increase.<sup>b</sup>

Theoretically, the more different sources of funds that states have, the less impact changes in the flow of funds from any single source will have on the total. However, in fact, nontax revenues are positively correlated with tax revenue; that is, they tend to vary together in the same way. This is not too surprising because many sources of nontax revenue are affected by the same national and state economic conditions that affect the sources of tax revenue. Thus, the increased variation in state tax revenue that has resulted from the changes in taxation and the economy discussed in this article has not been mitigated by nontax revenue. Despite nontax sources of revenue, fluctuating tax revenue remains a problem for state governments' fiscal management.

<sup>a</sup> See the article by Richard H. Mattoon and the article by Daniel Wilson.

<sup>b</sup> See my previous *Business Review* article.

their tax revenue, mostly income and retail sales within their borders, have affected tax collections from these sources. Coping with fluctuations in state tax collections has become increasingly important, and this article reviews strategies for doing so.

### CHANGES IN SOURCES OF STATE TAX REVENUE

The major sources of tax revenue for the states are individual income taxes, sales taxes, and corporate income taxes. Over the past several decades, the percentage of total tax

revenue raised by individual income taxes has increased, and the percentage raised by sales taxes has decreased. Because taxes are based on these and other economic activity within a state, tax revenue varies with state economic conditions. This has always

been the case. However, in the past two decades, state tax revenue has varied more over the course of the business cycle than it did in post-World War II business cycles before the 2001 recession.<sup>2</sup> Changes in sources of state tax revenue over the past 40 years or so have been the cause of the greater variation. Perhaps the most important of these changes has been the shift toward increased reliance on individual income taxes and less on sales taxes.

Data from the U.S. Census of Governments provide a consistent estimate of state tax revenue amounts and sources. These data are available for fiscal years from 1961.<sup>3</sup> For all states in total, from 1961 to 2007 (the latest year for which annual data are available), the tax revenue raised by individual income tax increased from 12 percent to 35 percent of total tax revenue. Sales taxes decreased from 58 percent to 46 percent. The corporate income tax was unchanged at 7 percent. (A range of other taxes, which varies widely across the states, make up the balance of total tax revenue.)

For the three states of the Third Federal Reserve District, the changes among tax sources have been greater than the average among all states. From 1961 to 2007, individual income taxes rose from 0 to 32 percent and 40 percent of total tax revenue in Pennsylvania and New Jersey, respectively, following the inception of the personal income tax in those states.<sup>4</sup> In Delaware, individual income

<sup>2</sup> See the paper by Richard Mattoon and Leslie McGranahan.

<sup>3</sup> The Census Bureau conducts two surveys of state taxes and spending. The quarterly survey covers estimates of revenues received by state revenue departments. The annual survey covers revenues and spending for all state government departments and agencies. The quarterly data are collected by calendar quarter; the annual data are collected for fiscal years (beginning in July for most states).

taxes were practically the same portion of total tax revenue in 1961 — 36 percent — as they were in 2007 — 35 percent. Sales taxes declined from 64 percent to 47 percent in Pennsylvania, 58 percent to 41 percent in New Jersey, and 24 percent to 16 percent in Delaware.<sup>5</sup> Corporate income taxes decreased from 13 percent to 7 percent of total tax revenue in Pennsylvania but rose from 7 percent to 10 percent in New Jersey and were practically the same in both years in Delaware, moving up from 9 percent to 10 percent. (The corporate income tax is very variable year to year in all states, so its percentage for any individual year must be interpreted cautiously.)

Since about 1960, revenue in the states in the region as well as across the country has gradually shifted toward greater reliance on income taxes and less reliance on sales taxes, and the shift has continued strongly in the past 10 years. Two factors are responsible for these changes in sources of state

<sup>4</sup> Personal income taxes were first collected in fiscal year 1962 in New Jersey and fiscal year 1971 in Pennsylvania.

<sup>5</sup> Delaware does not have a general sales tax but does tax certain items, such as tobacco and motor fuels.

tax revenue: One reflects a policy choice by state governments; the other is a consequence of changes in the economy that have altered the ways in which workers are compensated and the ways in which consumers spend their money.<sup>6</sup>

Both of these factors contributed to increased state revenue from individual income taxes during this period. The policy factor was the implementation or increase in individual income taxes. Many states, including Pennsylvania and New Jersey, instituted individual income taxes, raised rates in existing income taxes, and expanded the range of incomes subject to tax, leading this form of taxation to account for a growing share of tax revenue over the years. This policy-induced change was compounded by changes in the ways in which workers are compensated that affected both the amounts and types of individual income. During the 1990s capital gains income rose both absolutely and as a share of individual income. This happened for two reasons. One is that individuals sold financial assets during a period

<sup>6</sup> See the article by William F. Fox.

**TABLE**

**Percent of Total Revenue**

	Intergovernmental		Taxes		Other	
	1987	2007	1987	2007	1987	2007
All States	19.8	21.6	47.7	37.6	32.5	40.8
Pennsylvania	19.8	19.6	47.8	37.0	32.4	43.4
New Jersey	15.4	17.5	48.6	44.4	36.0	38.1
Delaware	14.1	16.7	47.8	39.1	38.1	44.2

Source: U.S. Census Bureau, State Government Tax Collections

of rising prices for stocks and bonds, generating taxable income. The other is that stock options became more common as a form of employee compensation, and the exercise of these options generated taxable income.

While these changes were boosting state tax revenue from individual income taxes, several factors were diminishing the relative amounts raised by sales taxes. One factor was a policy change: States exempted some goods, mainly food and medicine, from sales taxes. Other changes that tended to reduce the relative amounts raised by sales taxes resulted from changes in consumer spending patterns. One of these changes was a gradual shift toward more consumption of services and less consumption of goods. The decline of sales tax revenue from this cause is due to the fact that many services are exempt from state sales taxes and that states have difficulty enforcing compliance with taxation of services. Another, more recent change is the growth in shopping across state borders, which has been facilitated by the Internet.

### **VARIABILITY OF STATE TAX REVENUE HAS INCREASED**

Income tends to vary more over the business cycle than consumption: People tend to maintain consumption through borrowing or drawing on their savings when their income declines during economic slowdowns, and they tend to save at least a portion of their income when it increases during economic expansions. Consequently, tax revenue derived from income varies more than tax revenue derived from consumption (sales tax). (See Figures 1 to 4.) Therefore, the shift in sources of state tax revenue to greater reliance on the income tax base and less reliance on the sales tax base has increased the variation of state tax

revenue over the course of the business cycle. This variability is absolute; that is, tax revenue in any given period varies compared to its average over a number of periods. It is also relative; that is, variation in tax revenue is greater than the variation in economic

**As reliance on the less stable income tax has grown, states have experienced a two-thirds increase in the standard deviation of annual total tax growth from the 1960s to the early 2000s.**

conditions in each state. The overall variability in tax revenue occurs even when states have not enacted increases or decreases in taxes (although many states, including those in the Third District, have during the years under review here).

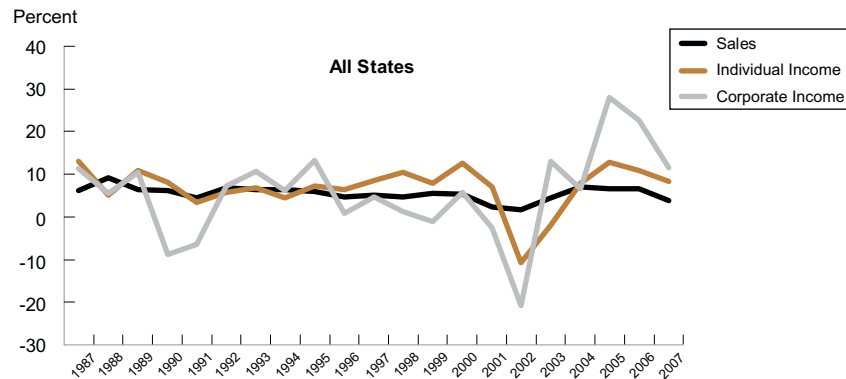
Variability, as measured by standard deviation, in the annual growth rate of individual income taxes is nearly twice that of sales taxes. As reliance on the less stable income tax has grown, states have experienced a two-thirds increase in the standard deviation of annual total tax growth from the 1960s to the early 2000s. For the Third District states, the standard deviation of annual growth was less in the early 2000s than in the 1960s, but — as is the case for the national average — the standard deviation increased from the 1980s to the 1990s and early 2000s. (These annual data are not adjusted for occasional legisla-

tive changes that raised or lowered taxes, but other research that takes these changes into account still finds increased variability. See below.)

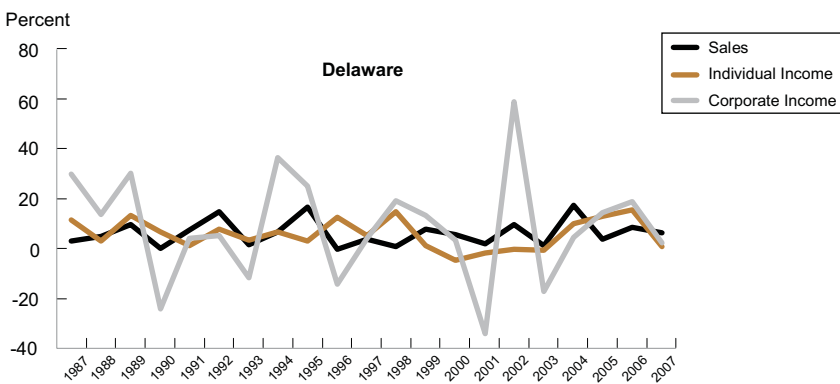
Besides the increase in absolute variability, state tax revenue has also become more variable with respect to state economic conditions. That is, changes in measures of economic activity in a state, such as employment, output, and income, have become associated with proportionately larger changes in state tax revenue in recent years, mainly the past 10 years, than in earlier years. (For example, see Figures 5 to 8, which illustrate that state tax revenue varies more than total income within a state.) The increased variability in total state tax revenue is almost wholly due to a large increase in the variability of income tax revenue. Research cited earlier (Mattoon and McGranahan) indicates that changes in a state's economic conditions as measured by state employment or a composite index of state economic conditions have been associated with twice as much change in income tax revenues in the years since 1998 than in the years before 1998.<sup>7</sup> This research controls for large changes in taxation and the timing of collections in individual states. It finds that the increase in cyclical variability of income tax revenue since 1998 is measurable in 36 of the 43 states with an income tax and statistically significant in 10, including two Third District states, New Jersey and Pennsylvania.

As noted earlier, income taxes have become a larger share of total state tax revenue in recent years, and capital gains have become a larger portion of income. In combination,

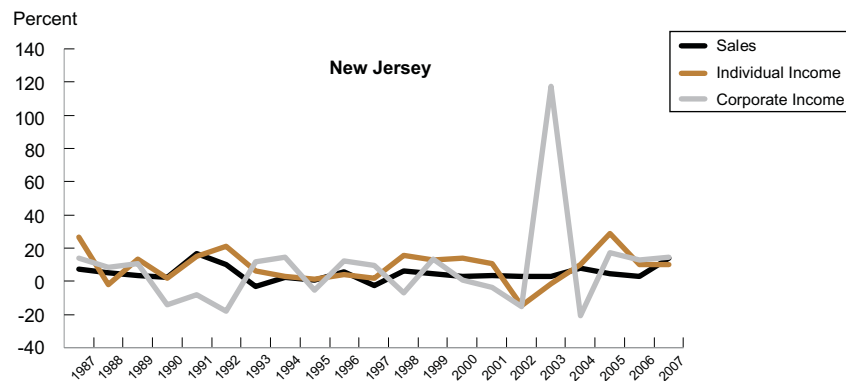
<sup>7</sup> The composite index is the state coincident index computed by the Federal Reserve Bank of Philadelphia. The components of the index are employment, the unemployment rate, average hours worked in manufacturing, and wages and salaries adjusted for inflation.

**FIGURE 1****Annual Change in Tax Revenue**

Source: U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

**FIGURE 2****Annual Change in Tax Revenue**

Source: U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

**FIGURE 3****Annual Change in Tax Revenue**

Source: U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

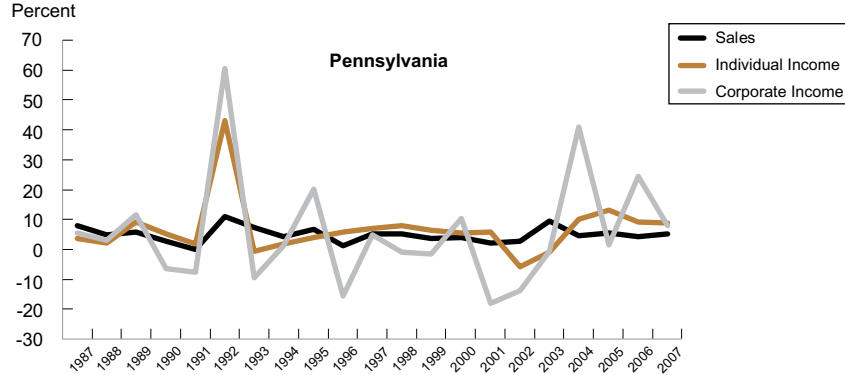
these two factors have made capital gains a larger share of taxable income. Furthermore, most states, including Delaware and New Jersey in the Third District, have progressive income tax rates, so variations in capital gains income that move taxpayers across tax brackets tend to have magnified effects on the variation of income tax revenue. Because capital gains are more variable than wage income, especially over the course of a business cycle, and because they can have a more than proportional effect on income taxes, the increase in their share of total income has been a primary factor in the increase in the variability of income tax revenue and total revenue.

### COPING WITH THE INCREASED VARIABILITY OF STATE TAX REVENUE

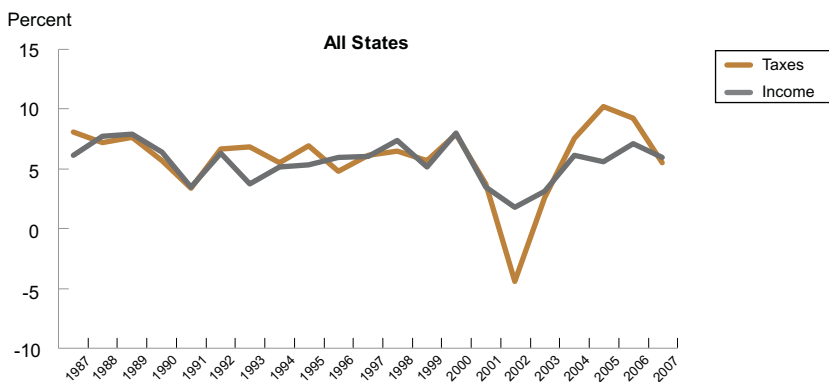
During much of the time when the variability of state tax revenue was rising, it was not a problem because the variability was mostly positive; that is, state tax revenue was rising, usually by as much as or more than state income. But variability showed its other face when a national recession occurred in 2001. In fiscal year 2002, total state tax revenue for the 50 states declined 4 percent in nominal terms, the first decline in the history of the census data series on annual state revenue since its inception in 1962. Besides the usual recession-related weakness in state revenue, a decline in investment-related income was a significant cause of a drop in individual income tax revenue. This was in sharp contrast to the late 1990s when rising investment returns boosted individual income tax revenue.<sup>8</sup>

Because the 2001 recession was relatively mild and brief, it did not prompt much change in state tax poli-

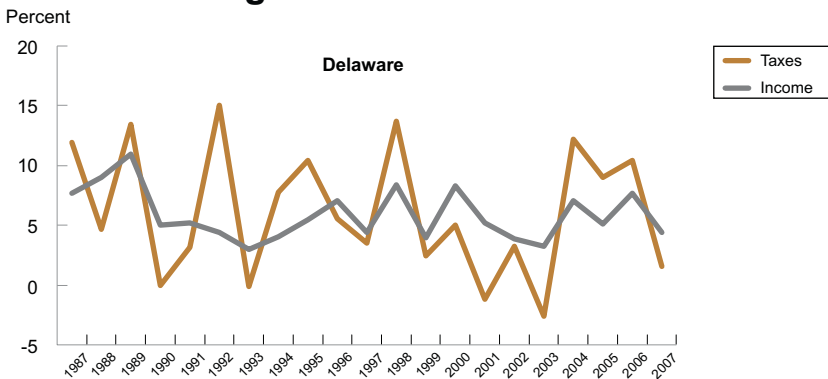
<sup>8</sup> See the article by Nicholas Jenny.

**FIGURE 4****Annual Change in Tax Revenue**

**Source:** U.S. Bureau of Economic Analysis, State Annual Personal Income: U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

**FIGURE 5****Annual Change in Tax Revenue and Income**

**Source:** U.S. Bureau of Economic Analysis, State Annual Personal Income: U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

**FIGURE 6****Annual Change in Tax Revenue and Income**

**Source:** U.S. Bureau of Economic Analysis, State Annual Personal Income: U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

cies in response, although some states enacted tax increases to compensate for the shortfall in tax collections. The recession that began in 2007 appears to be having the same negative influence on state individual income tax revenues as the 2001 recession. Furthermore, the current recession has also brought a larger drop in consumption spending than the 2001 recession. The decline in consumption spending has been especially sharp for expensive durable goods, such as motor vehicles and home appliances. Consequently, state sales tax revenues have fallen more than in the 2001 recession.<sup>9</sup>

Most state governments are legally required to balance expenditures and revenues for each fiscal year.<sup>10</sup> Consequently, when actual revenues fall short of the amounts needed for budgeted expenditures, there are only a few ways the gap can be closed.<sup>11</sup> First, taxes can be increased. Second, spending can be cut. Third, temporary strategies can be used, such as reassignment of funds in state accounts. For example, some states have a limited ability to record expenditures and revenues in prior or subsequent fiscal years, most states can postpone capital expenditures, and some states might be able to restructure payment schedules for long-term debt. Fourth, states can use their rainy day funds: savings accumulated from prior years and reserved for recourse when revenues fall below budgeted amounts.

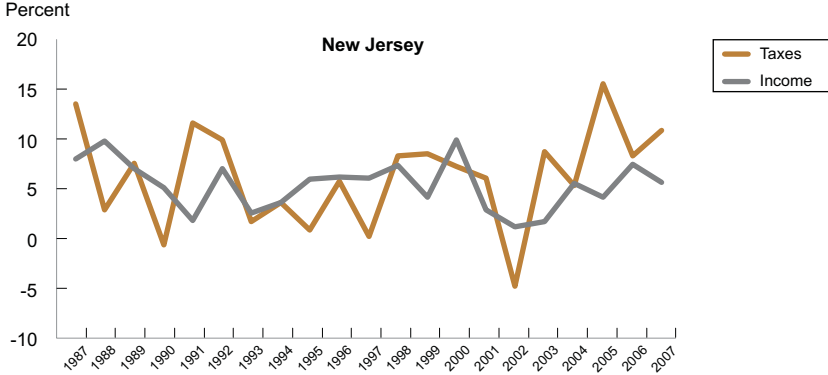
All of these ways of coping with gaps between budgeted expenditures and actual revenues were implemented among the states as they formulated budgets in 2009.<sup>12</sup> According to a

<sup>9</sup> See the article by Donald Boyd and Lucy Dadayan.

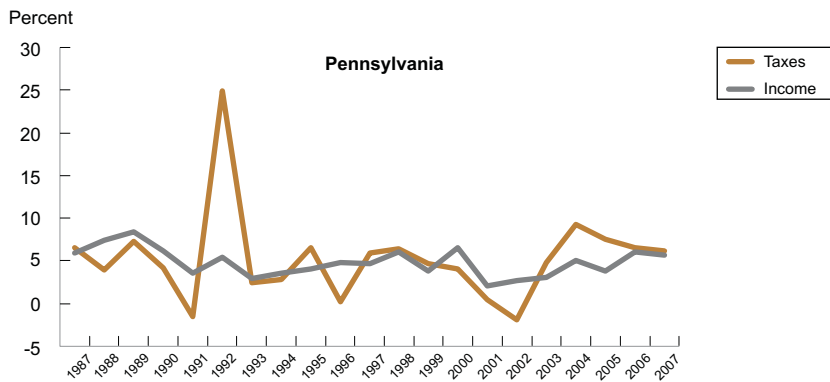
<sup>10</sup> For most states, borrowing may be used to fund capital spending projects, but borrowing cannot be used to fund operating expenditures.

<sup>11</sup> See the article by Janet Stotsky.



**FIGURE 7****Annual Change in Tax Revenue and Income**

**Source:** U.S. Bureau of Economic Analysis, State Annual Personal Income; U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

**FIGURE 8****Annual Change in Tax Revenue and Income**

**Source:** U.S. Bureau of Economic Analysis, State Annual Personal Income; U.S. Census Bureau, State Government Tax Collections.  
Data are actual tax collections not adjusted for changes in tax laws.

survey conducted at mid-year, 22 states had cut spending (including Delaware, New Jersey, and Pennsylvania), 11 had raised taxes (including Delaware, New Jersey, and Pennsylvania), 12 had raised fees (including New Jersey), 12 had used other funds to replace general revenue, and eight had tapped rainy day funds.

All of these means of coping with tax revenues that do not meet projected amounts have limitations.

<sup>12</sup> See the report by the National Conference of State Legislatures.

Tax increases and spending cuts require legislative or executive action, or both, and are usually politically difficult to accomplish. Temporary strategies are often limited in scope and, by their nature, are often insufficient to compensate for large gaps between current revenues and expenditures or long periods of low revenue. Rainy day funds are prudent and potentially adequate for emergency situations, but in most states, they have not been adequate to compensate for revenue shortfalls during economic contractions; in fact, estimates of the

amounts required for this purpose are much larger than most states have amassed heretofore.<sup>13</sup> Several strategies have been suggested for smoothing state tax revenue or otherwise coping with its fluctuations.<sup>14</sup> These could be used individually or in combination. First, states could be more conservative in planning expenditures so that they would not be left with spending programs that would require radical curtailment when tax collections decline. Second, states could assign larger amounts of revenue to rainy day funds when revenues are high, to be tapped when revenues declined. Third, states could designate tax collections from capital gains income as windfalls, not to be used to fund large ongoing spending programs. Fourth, states could expand the sales tax base in order to decrease the share of tax collections derived from other, more variable sources.

More comprehensive approaches to state government finances are also possible. For example, states could model both tax revenue and expenditure needs over the course of state-specific business cycles (that is, using economic data, such as employment and income, at the state level to chart the business cycle rather than using time frames and data related to the national cycle). Ideally, this modeling would produce a picture of how each of a state's different types of taxes varies over its business cycle and how each type of spending varies. This information could be used to calculate the amount needed for a rainy day fund. It could also be used to reorient taxes toward less variable sources. Additionally, knowledge of the cyclical variation of tax revenue and expenditure

<sup>13</sup> See the article by Gary Wagner and Erick Elder.

<sup>14</sup> See the article by Elaine Maag and David Merriman.

needs could be used to match more dependable revenue sources with those expenditure categories that are most necessary year to year and to match more variable revenue sources with programs that can be scaled back or postponed with the least adverse consequences.<sup>15</sup>


## SUMMARY

Over the past two decades or so, state tax revenue has grown, but it has become more variable, especially over the course of the business cycle.

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<sup>15</sup> See the article by Gary Cornia and Ray Nelson and the one by Russell Sobel and Gary Wagner.

In part, this has been the result of policy actions such as growing reliance on individual income taxes and the reduction in the sales tax base. Additionally, economic changes have tended to increase the variability in state tax revenue. Significant changes have been the growth of nonwage income, particularly capital gains, as a share of total taxable income, which has increased the variability of the income tax base, and the growth of service consumption relative to goods consumption, which has reduced the revenue-generating potential of state sales taxes, a relatively stable source of revenue.

States could implement tax policies to reverse some of the consequences of these changes by moving toward greater reliance on more stable revenue sources. Alternatively, they could establish procedures for managing funds in order to cope with fluctuating revenues. Or they could do both of these things. Either approach or both combined would require an effort of political will because implementing these approaches would necessitate more conservative policies on spending, higher levels of taxation, changes in the incidence of taxation (the relative share of total taxes different population groups or industries pay), or all of these. 

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# Recent Developments in Consumer Credit and Payments\*

BY MITCHELL BERLIN

**O**n September 24-25, 2009, the Research Department and the Payment Cards Center of the Federal Reserve Bank of Philadelphia held their fifth joint conference to present and discuss the latest research on consumer credit and payments. Sixty participants attended the conference, which included seven research papers on topics such as securitization and distressed loan renegotiation, consumer disclosure, data breaches and identity theft, and the effects of the U.S. financial crisis on global retail lending. In this article, Mitchell Berlin summarizes the papers presented at the conference.

In his opening remarks, Mitchell Berlin noted that the flow of high-quality papers on consumer finance and payment issues has increased steadily since the first joint conference of the Research Department and Payment Cards Center in 2001.

## SECURITIZATION AND RENEGOTIATION

In the first paper, Tomasz Piskorski of Columbia University reported the results of a study (with Amit

Seru and Vikrant Vig) that provided evidence that frictions impeded the renegotiation of certain types of distressed mortgages during the recent financial crisis.<sup>1</sup> In particular, Piskorski and his coauthors showed that loans that banks packaged into mortgage-backed securities and placed in trusts — securitized loans — were foreclosed on more often than otherwise similar mortgages that remained in bank portfolios.

<sup>1</sup>The conference agenda along with links to most of the papers presented can be found on the Philadelphia Fed's website at: <http://www.philadelphiafed.org/research-and-data/events/2009/consumer-credit-and-payments/program.cfm>.

\*The views expressed here are those of the author and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System.

The authors examined a large sample (about 327,000) of first-lien, nonagency mortgages originated between 2005 and 2006. This sample is drawn from the LPS database, which includes both loans held in the originating bank's portfolio and loans that were securitized. The sample was restricted to distressed mortgages, that is, loans that were at least 60 days' delinquent. They also considered a subsample of high-quality loans: loans with full documentation (full doc) with credit scores above 680.

First, the authors presented descriptive statistics showing that distressed portfolio loans were foreclosed less often than securitized loans. Then they used a logit model to estimate the probability of foreclosure, depending on whether the loan was securitized or held in portfolio, but also taking account of loan and borrower characteristics that might affect this probability. These included the borrower's credit score, the loan-to-value (LTV) ratio, the size of the loan at origination, the loan maturity, and the original interest rate, among other variables.

The logit results provided evidence that delinquent portfolio loans were less likely to be foreclosed and that the effect was both statistically significant and economically large. Evaluated at the mean values for all of the other variables, the probability of being foreclosed was between 3.8 and 7 percentage points lower for portfolio loans than for securitized loans, depending on the precise model specification. These corresponded to an 18 percent and 32 percent relative decline in the mean foreclosure rate.

Piskorski and his coauthors



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[www.philadelphiafed.org/research-and-data/publications/](http://www.philadelphiafed.org/research-and-data/publications/).

sought to address concerns that lenders may have learned information about borrower quality subsequent to origination but prior to delinquency. If this were true, the sample of securitized loans might disproportionately include loans that the originating bank had sold after receiving information, suggesting a higher probability of default. First, they replicated their basic results using a subsample of high-quality loans, arguably a set of loans for which it is less likely that underwriters might have subsequently learned more information about borrower quality. They also addressed this concern more directly by examining a subsample of loans for which borrowers' credit scores or LTVs at the time of delinquency were available. In these tests, the authors continued to find that portfolio loans were less likely to be foreclosed than securitized loans.

The authors also addressed concerns that their results were driven by differences in variations in state laws that affect the ease of foreclosure. Specifically, they divided states into tough and weak states, depending on whether average foreclosure times were low or high. They found that securitized loans were significantly more likely to be foreclosed in both tough and weak states, a finding inconsistent with the view that differences in state laws were the source of their results.

The authors also considered the possibility that the differences in foreclosure rates were not driven by a bias against renegotiation for securitized loans but by a bias against foreclosures by banks postponing recognizing losses on portfolio loans. Piskorski and coauthors found that delinquent borrowers resumed making payments on loans held in portfolio at a higher rate than for securitized loans, a finding inconsistent with this view.

## LIAR'S LOANS

Ashlyn Aiko Nelson of Indiana University discussed the results of a study (with Wei Jiang and Edward Vytlačil) that explored the effects on loan performance of origination channel and level of documentation for mortgage loans. Nelson and her coauthors found that loans originated by brokers and loans that required little or no documentation by the borrower (low doc loans) were particularly

**Piskorski and coauthors found that delinquent borrowers resumed making payments on loans held in portfolio at a higher rate than for securitized loans.**

prone to agency problems. Nelson argued that broker-originated loans performed badly because brokers had incentives to make loans to low-quality borrowers, while low doc loans were more likely to perform badly because borrowers overstated income.

Nelson and her coauthors examined the mortgage loans made between January 2004 and February 2009 by a large national mortgage bank. The bank's files contained a wealth of data about borrower characteristics, permitting the authors to take account of many borrower-specific factors that might affect loan performance. The authors divided their sample into four subsamples: loans originated by brokers requiring full documentation, loans originated by brokers requiring low or no documentation, loans originated by banks requiring full documentation,

and loans originated by brokers requiring low or no documentation.

Nelson explained that the loan sample was not representative of the mortgage loan market as a whole, which raised some questions about the extent to which the results could be generalized. The bank made a disproportionately large share of loans originated by brokers and a disproportionately large share of low doc loans. Nonetheless, the authors' view was that this bank represented an extreme example of tendencies that were common to many banks.

In their main econometric treatment, the authors used two models of loan delinquency: (1) a probit model, which estimates the probability of delinquency, taking into account loan and borrower characteristics; (2) a duration model, which estimates the average time to delinquency, taking into account the same characteristics. They estimated separate regressions for each of the four subsamples and found that both the origination channel and the level of documentation affected delinquency. Specifically, they found that bank-originated full doc loans had a delinquency rate of 13 percent and a five-year survival rate of 86 percent, while the comparable numbers for bank-originated low doc loans were 18 percent and 68 percent; broker-originated full doc loans were 24 percent and 65 percent; and broker-originated low doc loans were 32 percent and 36 percent.

Nelson explained that particular types of borrowers might have selected into particular types of loans. To address this issue, the authors estimated a model to explain which types of borrowers chose particular types of loans. Broadly, they found that borrowers using brokers had lower credit quality and less experience with mortgages. In contrast, in addition to self-employed borrowers, low doc borrowers were

typically more experienced and of higher credit quality.

The authors then sought to examine the separate effects of observable and unobservable differences in borrower risk on delinquency. According to the authors, many of the low doc loans looked good on paper but did poorly, suggesting that the poor performance of low doc loans was due to factors that did not appear on the loan applications. In contrast, more than half of the poor performance of broker loans was due to observable borrower characteristics.

To explain the poor performance of low doc loans, Nelson and coauthors explored the evidence for falsified loan application information. In one of their approaches to this question, they hypothesized that falsified application information would reduce the predictive power of the empirical model. To create an out-of-sample test, they estimated the model over six-month periods to predict the probability of delinquency for the subsequent six-month period. The model's predictive power was substantially lower for the low doc subsamples, a result consistent with falsified application information.

The authors also performed a more direct test for falsified application information in low doc loans. They identified the particular borrower attributes most likely to be falsified: whether the home was a primary residence, employment information, and information about income, wealth, and existing debt. The results for income provided the most striking evidence of overstatement.

In the full doc samples, income was negatively related to delinquency. However, in the low doc samples, stated income was positively related to delinquency, and the effect was strongest when the loan had been originated by brokers without an ongoing relationship with the bank. The authors also

attempted to quantify the extent of the overstatement, comparing stated income with alternative measures of the borrower's true income, for example, average income in the borrower's ZIP code. They found that the ratio of stated income to average income in the ZIP code was significantly higher for the low doc sample and estimated that income was overstated by between 15 and 20 percent.

**[Borrowers] may focus on the cost of borrowing once, even though they are likely to borrow repeatedly.**

#### DISCLOSURE AND PAYDAY LENDING

Adair Morse of the University of Chicago reported the results of a carefully designed field study (with Marianne Bertrand) that attempted to determine whether payday borrowers' decisions were affected by particular types of cognitive bias and whether their borrowing decisions might be affected by particular types of disclosures at the point of the transaction.

In a payday loan, borrowers sign over their next paycheck and pay a fee (\$15-17 for each \$100 borrowed) in exchange for a loan. Payday loans are quite expensive compared with other types of loans, with annual percentage rates (APRs) typically exceeding 400 percent, and customers typically borrowing repeatedly. According to the authors, one explanation for why borrowers use such an expensive source of borrowed funds is cognitive bias. For example, borrowers may not realize how high the APR on the payday loan is, if they don't compare it to relevant alternatives. Alternatively, they may focus on the cost of borrowing once, even though they are likely to borrow repeatedly.

The authors considered three different disclosures. In one, the APR on a payday loan was compared with the APRs on other types of loans likely to be familiar to payday borrowers. The second disclosure displayed the dollar cost of repeated borrowings up to three months and compared this with the dollar cost of repeated borrowings on a credit card. The third disclosure illustrated the likelihood that a

typical payday borrower will engage in repeated borrowings, e.g., how many borrow once, how many renew once or twice, etc.

The goal of the experiment was to determine whether a disclosure reduced either the likelihood or the amount of subsequent borrowings. Furthermore, Morse and her coauthor examined whether the disclosures worked for particular types of borrowers, for example, whether a borrower's level of education or some measure of the borrower's degree of self-control might affect the outcome of a particular disclosure.

The authors performed this experiment with the cooperation of a large payday lender operating in 10 states. They had access to all customers entering 77 stores over a two-week period. Crucially, the experiment was designed so that the disclosures (including no disclosure at all) were randomly assigned over borrowers. The goal was to minimize the possibility that factors other than the actual disclosures might affect borrower behavior; for example, the disclosures were equally distributed across different days of the week because a Monday borrower might differ from a Thursday borrower. Morse re-



ported that subsequent empirical tests by her and her coauthor verified that the experimental design had successfully randomized across customers.

The lender's records also included demographic data about each borrower, for example, level of education; financial data; and information about past and subsequent transactions with the customer, provided by the lender. In addition to these data, participating borrowers also answered survey questions about the intended use of the loan and the borrower's own view of his or her planning and spending habits. Using the survey answers, the authors designed an index of borrower self-control and a gratification index measuring whether the loan was for discretionary expenditures.

The authors' main result was that there was a statistically significant and economically large effect on subsequent borrowing behavior for the disclosure that added up the costs of subsequent borrowings *in dollars*. The effect was to reduce both the likelihood of further borrowing and the subsequent amounts borrowed. In particular, borrowers receiving this disclosure were 5.5 percentage points less likely to borrow in subsequent pay cycles (10 percent less likely to borrow compared with the control group) and they borrowed nearly \$40 less (17 percent less than the control group). Morse noted that this effect was large for this type of experimental study, especially since the disclosure was made only once.

The effects of the other disclosures on the likelihood of subsequent borrowings were relatively weaker, both statistically and economically. In particular, disclosing relative APRs seemed to have little effect. In both cases, however, there was evidence of some reduction in the amounts borrowed.

The authors also found that the effects differed across different types

of customers. The decline in the probability of borrowing occurred mainly among individuals without a college degree. The decline was also stronger for those borrowers who reported higher self-control, those who were not borrowing for discretionary purposes, and those with lower debt-to-income ratios. This last result is broadly consistent with the authors' other finding that reduced borrowing occurred only with a lag. According to Morse, borrowers may have needed time to adjust their financial situation, while others in more financially strained circumstances may simply have been unable to adjust, at least in the time frame considered in the study.

In conclusion, Morse and coauthor suggested that the success of the disclosure in the payday setting justifies further explorations of policies that might reduce consumer biases in other contexts.

## IDENTITY THEFT

William Roberds of the Federal Reserve Bank of Atlanta presented the results of a theoretical model (with Stacey Schreft) that examined the incentives for competing networks — for example, credit card networks — to adopt policies to reduce identity theft. The underlying questions were whether networks collect too much information and whether they adopt appropriate levels of security to protect that data. In general, Roberds argued that competing networks have incentives to collect too much personally identifiable information (PII)— for example, name, address, Social Security number, and so forth— while spending too few resources to protect it from theft.

In their model, many individuals are honest and joined one of two competing networks to facilitate making transactions to purchase goods. But some individuals are

fraudulent types; that is, they seek to join a network and then default on their payments.

The authors identified two types of identify theft, both involving opening new accounts, rather than stealing an existing customer's account, to purchase goods at the customer's network. First, skilled identity thieves can use sophisticated techniques — for example, hacking the network's database — to steal PII from one network to join another network (high-tech fraud). A second type of identity theft (low-tech fraud) simply requires someone to assemble enough information to create a viable identity to join a network, for example, by stealing a wallet and impersonating that person. This type of theft requires no skill, but it does require time and effort, and it is more costly for an impersonator to join a network if he or she must provide more information.

Networks have two potential security strategies. The first is to collect more PII about a customer. By keeping this information on record, the network can increase the likelihood that fraudulent customers will be detected if they attempt to impersonate a new customer applying for credit. The second security strategy is for the network to spend resources to protect its database. In particular, it can make it more difficult for skilled frauds to steal PII.

Roberds explained that data security involves an externality: By demanding a lot of PII to join, a network makes it more difficult for fraudulent customers to join. But keeping very detailed information about the network's own customers in its database makes it easier for skilled identity thieves to use stolen data to join the other network, because this tends to increase the likely overlap in the types of PII required to join each network. And a network's costly measures to secure

its own database from skilled identity thieves reduce fraud at the *competing* network.

To provide a benchmark for evaluating the choices of competing networks, the authors performed a thought experiment. They asked: How much information and data security would a benevolent social planner instruct the networks to choose? This planner would take into account all of the costs and benefits to individuals, and these hypothetical choices are termed the *optimal* outcome.<sup>2</sup> After calculating the optimal outcome, the authors examined market outcomes in successively more general examples and compared these with the optimal outcomes.

In the first example, they assume that firms do not secure their data at all. In this case, firms collect too much information. Collecting more information makes it harder for a thief to construct a viable identity to join but also makes it easier for a thief to steal data that can be used at the other network. In this example, networks collect too much information and data breaches occur more often than in the optimum, but interestingly, the prevalence of identity theft is lower than the optimal level. The more overlap between the PII collected by the competing networks, the greater the inefficiency.

In their second example, they assume that the proportions of skilled and unskilled frauds are identical. Again the basic externality arises: Networks collect too much information and invest too little in data security. The main insight from this example is that although identity theft is lower than in the optimum, it is unskilled

<sup>2</sup>It is important to note that while there are real costs to identity theft, the optimal level of identity theft is not zero. This is because it is costly to deter theft, and these costs are ultimately borne by individuals.

theft that is mainly deterred. Networks make it very difficult for unskilled thieves to join, but their excessive data collection and inadequate data security makes skilled identity theft relatively attractive.

For the most part, these insights carry over to the most general version of the model, in which security levels are freely chosen by the networks. In this setting, the authors showed that when networks require substantially similar types of information, security levels were too low and networks collected too much data. The authors argued that, in effect, competing

**Broadly, [White, Li, and Zhu] argued that the passage of the Bankruptcy Reform Act was associated with a statistically significant and economically large increase in mortgage defaults.**

networks substitute information collection for data security. As in the simpler examples, there was too much skilled identity theft and too little unskilled identity theft compared with optimal levels. Furthermore, there is less identity theft in equilibrium than in the optimum, even though networks collect too much information.

Finally, the authors examined the effects of public policies that might improve market outcomes. Since the model is quite complicated, they used simulations to evaluate the effects of these policies. One possibility is to increase civil liability for data breaches. They found that this improved incentives to increase security, but networks still collected too much information. A second approach is for some government agency to set minimum data security standards. This nearly attained the optimal outcome in their simulations. A third approach is to limit data collection. This policy did as well as

imposing civil liability but significantly increased identity theft.

## **BANKRUPTCY REFORM AND MORTGAGE DEFAULT**

Michelle White of the University of California-San Diego reported on the results of an empirical study (with Wenli Li and Ning Zhu) of the effects of the Bankruptcy Reform Act of 2005 on mortgage default. Broadly, they argued that the passage of the Bankruptcy Reform Act was associated with a statistically significant and economically large increase in mortgage defaults. According to the authors, the

act may have contributed to the severity of the subsequent crisis in housing markets.

White argued that bankruptcy law helped people save their homes, at least temporarily, but also reduced the costs of ultimately defaulting on the mortgage. Under both Chapter 7 (liquidation) and Chapter 13 (restructuring) proceedings, homeowners can protect exempted assets, in particular, homes in which a household's equity does not exceed the state-mandated homestead exemption. Both bankruptcy procedures also give a delinquent homeowner some time to pay back missed mortgage payments (*arrears*), but Chapter 13 provides a substantially longer period (three to five years) and also permits delinquent homeowners who cannot pay back arrears a significant amount of time before foreclosure.

The Bankruptcy Act of 2005 had three main effects that might affect delinquent homeowners: First,

it raised filing costs, thus making it less attractive for a household to use bankruptcy to save a home either permanently or temporarily. The act also placed a cap on the homestead exemption at \$125,000, a provision that affected 10 states with high homestead exemptions. Third, the act imposed a means test for homeowners to use Chapter 7. Specifically, it required consumers with incomes above the state median to file using Chapter 13.

The authors' empirical strategy was to use a difference-in-difference approach. In particular, the authors examined the differential effects of the change in bankruptcy law on certain households living in different states. The empirical tests exploited variation in consumers' circumstances, state median incomes, and state homestead exemptions to determine whether the act affected homeowner delinquency.

The authors used data from LPS on the performance of first-lien 30-year mortgages. These data also included information about customer credit quality, notably credit scores at the time the loan was originated. By merging the LPS data with data from the Home Mortgage Disclosure Act, the authors could also take account of information and homeowner demographic characteristics, most notably household income. The final sample included about 381,000 prime mortgages and 268,000 subprime mortgages.

Using these data, the authors examined whether mortgage defaults increased following passage of the act for those homeowners for whom the provisions of the act were actually binding, in other words, in cases in which consumers had equity in excess of the now lower exemptions or where the consumer was now required to use his or her excess cash flow to pay nonmortgage debts. Specifically, they

examined a window of three months before and after passage of the act.

Descriptive statistics showed that following passage of the act, default rates were 15 percent higher for prime loans and 9 percent higher for subprime loans. In addition, default rates increased even more for homeowners who were subject to the new cap

## The Bankruptcy Act of 2005 had three main effects that might affect delinquent homeowners: it raised filing costs, placed a cap on the homestead exemption at \$125,000, and imposed a means test.

on the homestead exemption and for prime homeowners who failed the means test. However, defaults decreased for homeowners with subprime loans who failed the means test. The authors interpreted these findings as largely consistent with the view that the act increased mortgage defaults.

The authors then estimated a logit hazard model, which estimates the probability of defaulting with the passage of time, taking into account the changes in the bankruptcy law that might affect a particular household, and controlling for a large number of demographic variables. They found that homeowners subject to the cap on the homestead exemption were more likely to default following passage of the act; specifically, White and her coauthors found that prime mortgage holders subject to the cap were 53 percent more likely to default and subprime mortgage holders were 44 percent more likely to default. Prime mortgage borrowers subject to the means test were 14 percent more likely to default, but there was no effect for subprime mortgage borrowers. White suggested that the result for subprime mortgage borrowers may have been

due to income having been overstated by these borrowers.

Results were largely the same when the authors reestimated their model using a six-month window before and after passage of the act. Thus, the authors concluded that the effects of act were not temporary.

## CONSUMER PROTECTION LAWS

Simon Gervais of Duke University presented the results of a theoretical model (with Bruce Carlin) that examined the role of the legal system when customers are poorly informed about the appropriate type of financial product to buy. In their model, households depend on brokers to match them to financial products for which they are best suited.

The main assumption of the model is that particular products are better suited for particular types of consumers. For example, a household with moderate savings and a student in high school might be better advised to invest its savings for college in a fixed income product, rather than a stock index fund, but the household might not have the sophistication to know which product is most appropriate. In Gervais and Carlin's model, both brokers and the producers of financial products must exert costly effort: At some cost, brokers can direct consumers to those products that suit them best, although there is an unavoidable probability of a mistake. Similarly, at some cost,

the producers of financial products can develop higher quality products that are suited to a wider range of consumers. Crucially, no court can observe their effort directly, nor can the court disentangle the reason why a particular product turned out poorly for a particular customer: Was it a bad match or a bad product?

In this setup, Gervais explained that product quality and effort by brokers are partial substitutes; that is, more effort by a broker reduces losses to consumers and this, in turn, reduces the producer's incentive to develop the highest quality product. In a similar fashion, when higher quality financial products are developed, there is less chance of losses to consumers, and this reduces brokers' incentives to identify the most suitable products for their customers.

The law's design must take this interaction into account. For example, while legal penalties for a broker will tend to increase broker effort, thereby increasing the probability of a good match for the customer, this will tend to decrease the provision of quality products because the firm realizes that the broker's effort will make up for the lack of quality.

First, the authors demonstrated that without legal penalties, the market leads to a serious underprovision of effort both by brokers and firms. Indeed, in their stylized setup, consumers are not willing to buy the product at all and the market breaks down altogether. Intuitively, without penalties, consumers who pay a price up-front expecting an appropriate financial product will always be disappointed because producers and brokers always have an incentive to chisel once they have been paid.

Gervais then presented their main results in a version of the model in which a customer can seek redress through the legal system only when he

or she has followed a broker's advice. In this context, the authors showed that to achieve an efficient outcome, total legal penalties can't merely be compensatory; they must be punitive. This conclusion is jointly the result of the substitutability of effort by producers and brokers and of the court's inability to assign blame to one or the other for a bad outcome. When the law seeks to push, say, the broker to increase effort by penalizing him or her when a match turns out poorly,

**[Gervais and Carlin] showed that to achieve an efficient outcome, total legal penalties can't merely be compensatory; they must be punitive.**

the producer of the financial product responds by reducing effort. Intuitively, this means that total penalties must exceed the losses imposed on the borrower for having been mismatched to induce full effort by both brokers and producers.

The authors then enriched the basic model to include the realistic possibility that the firm pays the broker for each sale. In this setting, they show that the optimal penalty structure places higher penalties on the broker than when brokers do not receive direct payments from producers.

Gervais then explained how legal penalties changed if customers were permitted to seek legal redress even when they have ignored a broker's advice. In this setting, Gervais and Carlin demonstrated that the optimal penalties were no longer punitive; customers only received compensation for having made a poor decision. Intuitive-

ly, punitive penalties reward customers for ignoring their broker's advice and then seeking redress through the courts whenever they make a bad decision. Accordingly, the optimal legal scheme can't reward customers for making bad decisions.

## GLOBAL RETAIL LENDING

In the final paper, Jörg Rocholl of the ESMT European School of Management and Technology presented the results of an empirical study (with Manju Puri and Sascha Steffen) of the effects of the crisis in U.S. mortgage markets on German banks. Rocholl and his coauthors used the unique structure of the German banking system as a natural experiment for distinguishing supply-side effects from demand-side effects.

Rocholl explained that there are 11 Landsbanken in Germany, jointly owned by state governments and the savings banks in those states. The savings banks provide financial services only for the customers in their municipality, primarily small and medium-sized firms, as well as retail customers. A key feature of the system is that the Landsbanken can rely on both formal and informal support from the savings banks with an ownership share. Thus, losses at the Landsbanken will impose losses on the savings banks, which are significant owners.

In Rocholl's account, Germany experienced growth well into 2008 and avoided the housing bubble occurring in the U.S. and other European countries. Nor did it experience the housing bust. But a number of Landsbanken were heavily exposed to risky U.S. housing assets and had experienced large losses by the third quarter of 2007.

A key feature of the German banking market provided the setting for a natural experiment. Only some of the savings banks were owners of

affected Landsbanken, while others had no exposure to U.S. real estate losses. And since the national housing market was largely homogeneous, Rocholl and his coauthors argued that troubles at a savings bank's Landsbank may be viewed as a pure shock to the supply of loans.

Using a difference-in-difference analysis, the authors compared the change in lending behavior at affected and unaffected savings banks before and after August 2007, when the U.S. housing crisis began to affect assets owned by certain Landsbanken. The authors also had information about loan applications at these banks, which made possible a clear distinction between changes in supply and demand. For example, if the authors observed that loan applications were similar across savings banks, but fewer loans were booked at affected banks post-crisis, this is strong evidence that the underlying source of the change in lending was supply driven.


The authors had data on all consumer and mortgage loans by savings banks in Germany between July 2006 and June 2008. They also had data on loan applications and the bank's risk rating of the consumer, as well as information about any preexisting financial relationships with the consumer, for example, credit lines and assets held at the bank.

In the central findings of the paper, Rocholl and his coauthors estimated a linear probability model of loan acceptance rates. They found that loan acceptance rates at affected banks declined significantly after August 2007, while acceptance rates increased insignificantly at unaffected banks. The decline at affected banks was economically large; across all types of consumer lending, acceptance rates declined 8.2 percent. The decline was strongest for customers that were assigned low credit ratings by the banks, suggesting a flight-to-quality effect. The results were consistent across loan categories, although the effects were larger for mortgage loans. The authors argued that this is because mortgage loans represent a larger commitment by the bank than other types of consumer loans.

Rocholl and his coauthors also estimated a cross-sectional regression to examine how bank characteristics affected lending behavior. They found that the declines were most dramatic for smaller banks and that for such banks the declines were particularly large for mortgage loans. They also found that the effects were greatest for banks that were relatively illiquid entering the crisis.

The authors then examined the demand for loans. In a regression framework, the authors found that loan

applications declined at both affected and unaffected banks. There was no statistically significant difference in the trend for these two groups of banks. The authors suggest that the decline in applications reflected a decline in demand, as consumers became less certain about future economic conditions, and the decline was not bank-specific. Nor did the authors find any significant difference in the amount of loan requested. This reinforced the authors' view that the declines in lending by affected banks were driven by the supply shock rather than effects on demand.

The authors then examined the effects of relationships in a linear probability model using a triple difference approach, in which loan applicants were further differentiated according to whether they had an existing relationship with the bank. Customer relationships with a bank increased acceptance rates, and the effect was strongest at affected banks after August 2007. Thus, pre-existing customer relationships mitigated the negative supply shocks at affected banks, perhaps because lenders have more information about such borrowers. 





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## IMPOSING EXCESS CASH FLOW SWEEP COVENANTS IN LOAN CONTRACTS

With free cash flows, borrowers can accumulate cash or voluntarily pay down debts. However, sometimes creditors impose a mandatory repayment covenant called “excess cash flow sweep” in loan contracts to force borrowers to repay debts ahead of schedule. About 17 percent of borrowers in the author’s sample (1995-2006) have this covenant attached to at least one of their loans. The author finds that the sweep covenant is more likely to be imposed on borrowers with higher leverage (i.e., where risk shifting by equity holders is more likely). The results are robust to including borrower fixed effects or using industry median leverage as a proxy. The covenant is more common also in borrowers where equity holders appear to have firmer control, e.g., when more shares are controlled by institutional block holders, when firms are incorporated in states with laws more favorable to hostile takeovers, or when equity holders place higher valuation on excess cash holdings. These determinants suggest that the sweep covenant may be motivated by creditor-shareholder conflicts. Finally, the author shows that the covenant has real effects: borrowers affected by the sweep covenant indeed repay more debts using excess cash flows, and they spend less in capital investment and pay out fewer dividends to shareholders.

*Working Paper 09-30, “Creditor Control of Free Cash Flow,” Rocco Huang, Federal Reserve Bank of Philadelphia*

## CORPORATE POLITICS: EFFECTS ON INTERNAL CAPITAL ALLOCATIONS AND LENDING BEHAVIOR

This study looks inside a large retail-banking group to understand how influence within the group affects internal capital allocations and lending behavior at the member bank level. The group consists of 181 member banks that jointly own a headquarters. Influence is measured by the divergence from one-share-one-vote. The authors find that more influential member banks are allocated more capital from headquarters. They are less likely to decrease lending after negative deposit growth or to increase lending following positive deposit growth. These effects are stronger in situations in which information asymmetry between banks and the headquarters seems greater. The evidence suggests that influence can be useful in overcoming information asymmetry.

*Working Paper 09-31, “Internal Capital Markets and Corporate Politics in a Banking Group,” by Martijn Cremers, Yale School of Management; Rocco Huang, Federal Reserve Bank of Philadelphia; and Zacharias Sautner, University of Amsterdam*

## CURRENCY DENOMINATIONS AND THE PRICES OF EXPORT GOODS: HOW IMPORTANT ARE THEY?

The authors show that standard alternative assumptions about the currency in which firms price export goods are virtually inconsequential for the properties of aggregate variables, other than the terms of trade, in a quantitative open-economy model. This result is in contrast to a large literature that empha-

sizes the importance of the currency denomination of exports for the properties of open-economy models.

*Working Paper 09-32, "How Important Is the Currency Denomination of Exports in Open-Economy Models?" Michael Dotsey, Federal Reserve Bank of Philadelphia, and Margarida Duarte, University of Toronto*

### **WORKER FLOWS AND JOB FLOWS: SOURCES OF DIFFERENCES OVER THE BUSINESS CYCLE**

Worker flows and job flows behave differently over the business cycle. The authors investigate the sources of the differences by studying quantitative properties of a multiple-worker version of the search/matching model that features endogenous job separation and intra-firm wage bargaining. Their calibration incorporates micro- and macro-level evidence on worker and job flows. The authors show that the dynamic stochastic equilibrium of the model replicates important cyclical features of worker flows and job flow simultaneously. In particular, the model correctly predicts that hires from unemployment move countercyclically while the job creation rate moves procyclically. The key to this result is to allow for a large hiring flow that does not go through unemployment but is part of job creation, for which procyclicality of the job finding rate dominates its cyclicity. The authors also show that the model generates large volatilities of unemployment and vacancies when a worker's outside option is at 83 percent of aggregate labor productivity.

*Working Paper 09-33, "Worker Flows and Job Flows: A Quantitative Investigation," Shigeru Fujita, Federal Reserve Bank of Philadelphia, and Makoto Nakajima, Federal Reserve Bank of Philadelphia*

### **TOO-BIG-TO-FAIL: HOW MUCH WERE BANKS WILLING TO PAY?**

This paper estimates the value of the too-big-to-fail (TBTF) subsidy. Using data from the merger boom of 1991-2004, the authors find that banking organizations were willing to pay an added premium for mergers that would put them over the asset sizes that are commonly viewed as the thresholds for being TBTF. They estimate at least \$14 billion in added premiums for the eight merger deals that brought the organizations to over \$100 billion in assets. In addition, the authors find that both the stock and bond markets reacted positively to these deals. Their estimated TBTF subsidy is large

enough to create serious concern, since recent assisted mergers have allowed TBTF organizations to become even bigger and for nonbanks to become part of TBTF banking organizations, thus extending the TBTF subsidy beyond banking.

*Working Paper 09-34, "How Much Did Banks Pay to Become Too-Big-To-Fail and to Become Systemically Important?" Elijah Brewer III, DePaul University, and Julapa Jagtiani, Federal Reserve Bank of Philadelphia*

### **CAN WE INSURE AGAINST COLLEGE-FAILURE RISK?**

Participants in student loan programs must repay loans in full regardless of whether they complete college. But many students who take out a loan do not earn a degree (the dropout rate among college students is between 33 to 50 percent). The authors examine whether insurance against college-failure risk can be offered, taking into account moral hazard and adverse selection. To do so, they develop a model that accounts for college enrollment, dropout, and completion rates among new high school graduates in the U.S. and use that model to study the feasibility and optimality of offering insurance against college failure risk. They find that optimal insurance raises the enrollment rate by 3.5 percent, the fraction acquiring a degree by 3.8 percent, and welfare by 2.7 percent. These effects are more pronounced for students with low scholastic ability (the ones with a high probability of failure).

*Working Paper 10-1, "Insuring College Failure Risk," Satyajit Chatterjee, Federal Reserve Bank of Philadelphia, and Felicia Ionescu, Colgate University*

### **WELFARE COSTS OF INFLATION**

This paper studies the steady-state and dynamic consequences of inflation in an estimated dynamic stochastic general equilibrium model of the U.S. economy. The author finds that 10 percentage points of inflation entail a steady-state welfare cost as high as 13 percent of annual consumption. This large cost is mainly driven by staggered price contracts and price indexation. The transition from high to low inflation inflicts a welfare loss equivalent to 0.53 percent. The role of nominal/real frictions as well as that of parameter uncertainty is also addressed.

*Working Paper 10-2, "The Implications of Inflation in an Estimated New-Keynesian Model," Pablo Guerron-Quintana, Federal Reserve Bank of Philadelphia*