The Weakened Transmission of Monetary Policy to Consumer Loan Rates

By Nada Mora

The economic recovery following the financial crisis and Great Recession of 2007-09 has been slow. Research has shown that recessions following banking crises are typically accompanied by large and persistent declines in output. Contributing factors include sharp declines in asset prices, such as housing prices, that damage the balance sheets of both households and financial institutions. These factors, combined often with a buildup of debt during the bubble years prior to a crisis, cause debt deleveraging to be drawn out. Demand for new credit by households is therefore depressed by the effects of reduced income and wealth, and by the debt overhang. Likewise, the supply of new credit from banks is limited by past liquidity and solvency shocks and by banks' perceptions of higher risk in future lending.

The Federal Reserve has taken steps since the financial crisis to push both short- and long-term interest rates to historically low levels. These steps have aimed to reduce financing costs generally and, more specifically, to lower the interest rates charged to finance consumer spending, which accounts for about 70 percent of all spending in the economy.

However, interest rates charged by lenders to consumers do not change automatically when the Federal Reserve alters the stance of monetary policy. The extent to which policy actions pass through to consumer interest rates determines, in part, the effectiveness of

Nada Mora is a senior economist at the Federal Reserve Bank of Kansas City. This article is on the bank's website at ***www.KansasCityFed.org.***

monetary policy. Typically, when the Federal Reserve wants to provide policy stimulus to the economy, it lowers its target for the federal funds rate—its main policy interest rate. But when the short-term rate hits the zero bound as it did in the financial crisis, there are fewer options, and the effects are less certain. Thus, it is particularly important to evaluate this pass-through from monetary policy to consumer loan rates when central banks ease policy through unconventional tools such as purchases of longer-term securities and communication to the public about the future path of policy.

This article examines the extent of pass-through to bank-reported lending rates. The data show that, since unconventional monetary policy was introduced at the end of 2008, this pass-through has weakened. The weaker response is not limited to one group of banks but characterizes both large banks and community banks. This means the effect of monetary policy on consumer spending may have declined.

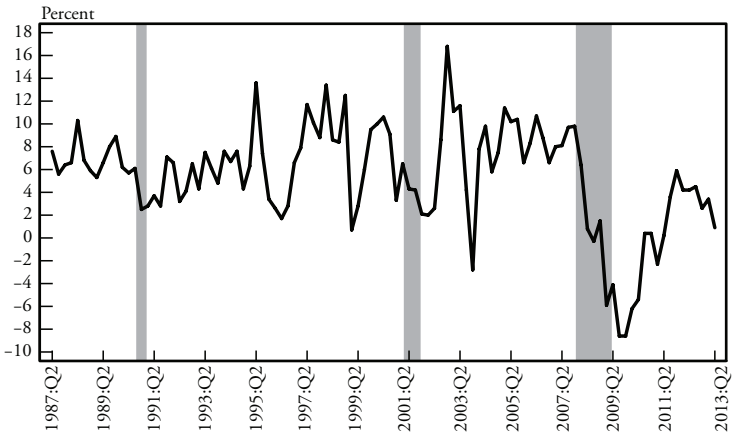
Section I reviews recent Federal Reserve policy actions and trends in interest rates on Treasuries and other securities. Section II describes banks' role in monetary policy transmission and introduces disaggregated data on consumer rates, which can be used to assess banks' rate-setting behavior. Section III examines the effectiveness of the banking channel of monetary policy transmission by estimating the response of consumer rates to market rates before and after the financial crisis.

I. MONETARY POLICY ACTIONS

In normal times, the policy instrument the Federal Reserve targets to influence economic activity is the federal funds rate, the overnight rate at which banks lend to and borrow from each other. Conventionally, the Federal Reserve eases monetary policy by lowering its target for the federal funds rate. Because markets are integrated, other interest rates—including long-term borrowing costs—also move down. By driving down borrowing rates and increasing interest-sensitive consumption and investment, the Federal Reserve stimulates economic activity.

But recent times have not been normal. The onset of the financial crisis in August 2007 led to disruptions in the normal functioning of credit markets in which financial institutions obtain and provide funding to each other. These disruptions later affected bank borrowers, visible in the sharp plunge in credit to the overall economy (Chart 1).

Chart 1
BANK CREDIT GROWTH RATE



Notes: The series is total bank credit for all commercial banks, annual growth rate (seasonally- and break-adjusted). Recessions (shaded areas) are from the National Bureau of Economic Research.
Source: Federal Reserve Board, H8 Release.

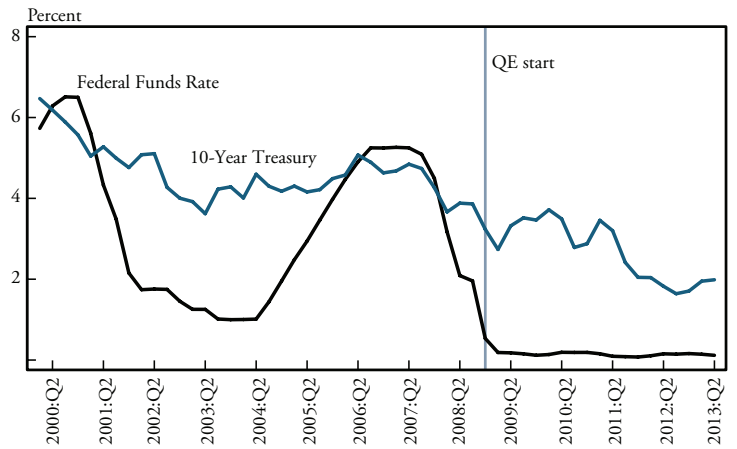
Bank credit contracted more sharply and for longer than during previous recessions in the early 1990s and early 2000s.

The Federal Reserve decreased the federal funds rate target starting in September 2007 to ease borrowing costs. The federal funds rate target was further reduced in a series of steps until it reached its effective lower bound of zero to 25 basis points in December 2008 (Chart 2). At that point, further reductions were constrained by the zero lower bound on interest rates, which arises from the option investors have to hold cash.

As rates neared their effective lower bound, the Federal Reserve turned to other, unconventional tools. In November 2008, the Federal Reserve announced and launched its first large-scale asset purchase (LSAP) program, also known as quantitative easing (QE). The action was taken to "reduce the cost and increase the availability of credit for the purchase of houses, which in turn should support housing markets and foster improved conditions in financial markets more generally."[1] This program, later known as QE1, comprised $1.7 trillion in purchases of Treasury and agency securities. Subsequent LSAP programs included purchases of $600 billion in Treasury securities (QE2, in 2010), a maturity extension program (MEP) to buy long-term Treasury securities funded by the sale of short-term notes (introduced in 2011),

Chart 2

FEDERAL FUNDS RATE AND LONG-TERM TREASURY YIELD



Note: The series are daily, aggregated to a quarterly frequency (averages).
Source: Federal Reserve Board, H8 Release.

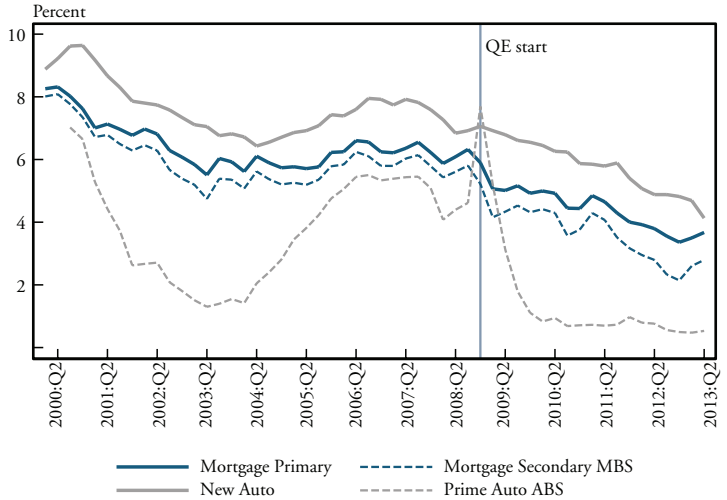
and most recently, the open-ended monthly purchase of $40 billion in MBS and $45 billion in Treasuries (QE3, in 2012).

In addition, the Federal Reserve changed its communication in December 2008 to inform the private sector about its expectations for the future path of the federal funds rate, a policy known as "forward guidance." For example, following the Federal Open Market Committee (FOMC) meeting in December 2008, the statement noted that the target rate of zero to 25 basis points would be maintained "for some time." Over time, post-meeting statements provided a stronger and more explicit commitment.

These actions—asset purchases and forward guidance—arguably helped push down rates on long-term Treasuries and other long-term assets.[2] For example, the yield on the 10-year Treasury bond steadily decreased from about 4 percent prior to QE1 in the third quarter of 2008 to 2 percent by the second quarter of 2013 (Chart 2). Likewise, conventional mortgage rates and other consumer rates, such as the finance rate for new automobiles, also declined over this period (Chart 3). The decline is apparent for both the interest rate on loans incurred by borrowing households (solid lines in Chart 3) and the market yield on asset-backed securities made up of bundles of the particular loan type and sold to investors (dashed lines in Chart 3). Market yields

Chart 3

ECONOMYWIDE MORTGAGE AND CONSUMER LOAN RATES



Notes: The primary mortgage rate is for 30-year fixed-rate first mortgages from the Freddie Mac Primary Mortgage Market Survey. The secondary mortgage rate is the representative yield on newly issued agency MBS (also from Freddie Mac). The new auto loan rate is the finance rate on new auto 48-month loans at commercial banks. The prime auto ABS yield is derived from the prime auto fixed AAA - 3-year spread-to-swap.
Sources: Federal Reserve Board, H15 Release (for Mortgage Primary) and G19 Release (for New Auto); Bloomberg for Mortgage Secondary; and JPMorgan for Prime Auto ABS.

on securitized loans link the transmission of Federal Reserve policy to consumer loan rates.[3]

Various recent studies statistically evaluate the effect of LSAPs and forward guidance. These studies find supportive evidence that the Federal Reserve's actions significantly reduced longer-term interest rates on Treasury securities, agency securities such as MBS, and other marketable securities such as corporate bonds. For example, studies suggest that QE1 reduced the yield on the 10-year Treasury note by between 40 basis points and 110 basis points and QE2 reduced the yield by an additional 15 basis points to 45 basis points (Bernanke; Gagnon and others; Krishnamurthy and Vissing-Jorgensen; D'Amico and others).[4] Moreover, QE1 was shown to reduce the spread on Baa-rated corporate borrowers by 51 basis points, leading to an increase in corporate investment by about 5 percent (Krishnamurthy and Vissing-Jorgensen; Philippon).

Nonetheless, the response of asset prices to unconventional monetary policy may be attenuated compared with the pre-crisis period. For example, Kiley finds that while private debt yields have responded to

changes in Treasury yields, the effect is weaker than before the end of 2008. A similarly weaker response to monetary policy announcements is found for stock prices (Doh and Connolly). Among the reasons offered are that 1) announcements convey information about a worse economic outlook than was previously expected, 2) greater uncertainty may accompany the use of LSAPs and forward guidance, and 3) markets may be sufficiently segmented so that purchases of Treasuries have little effect on other asset prices.[5]

II. THE ROLE OF BANKS IN MONETARY TRANSMISSION

Banks and other financial intermediaries play a key role in the transmission of monetary policy. In practice, a bond issued by a business is not a perfect substitute for a bank loan. For example, many small businesses cannot access the public debt market. Moreover, households obtain loans from banks and other financial intermediaries. This section reviews evidence that the transmission of policy rates to bank lending rates has weakened. Economists have converged on several reasons, including lender pricing power, an increase in perceived borrower riskiness, lenders' retention of liquid funds, and changes in regulation. An alternative view is that the transmission channel may have changed, thus making the instruments of Federal Reserve policy less effective.

How changes in policy rates affect bank loans

While the Federal Reserve does not directly purchase mortgage and auto loans from commercial banks, and while individual household loans are not tradable assets held by institutional investors, arbitrage works across financial markets. Consider the bank as an investor making decisions about an asset portfolio of different bonds and loans of varying substitutability. Assume for simplicity the bank can hold two assets: a mortgage loan or a marketable MBS. The bank compares the MBS market yield to its own loan yield. As the MBS yield falls relative to its current loan yield, the bank likely has incentive to increase its mortgage loan originations, thus also lowering its primary mortgage rate (conditional on loan demand and borrower creditworthiness, among other factors).[6]

The Federal Reserve's communication policy and LSAPs are also expected to push down bank lending rates. As shown in Chart 3, mortgage and auto rates declined together with MBS and ABS yields following the 2008 introduction of QE and forward guidance. While average consumer borrowing rates have trended down since the introduction of QE1—suggesting that secondary and primary credit markets are not fully segmented—the extent to which commercial banks have passed on the decline in market rates to consumer rates is unclear. For example, participants in a recent Federal Reserve Bank of New York workshop focused on the relationship of the stubbornly high primary mortgage rate and the MBS secondary rate.[7] The primary-secondary spread increased from about 40 basis points in 2007 to more than 120 basis points at the end of 2012 before declining somewhat to 90 basis points by mid-2013 (Chart 3).

Reasons offered for the higher spread between the primary and secondary mortgage rates include greater costs and risks of mortgage origination and servicing after the financial crisis. For example, mortgage put-back risk has increased while the availability of private mortgage insurance and the value of mortgage servicing rights have decreased. New regulations resulting from the Dodd-Frank Act, such as more stringent mortgage underwriting standards and increased regulatory scrutiny by the Consumer Financial Protection Bureau, also may have increased costs. Constraints on processing and servicing capacity also limit the refinancing activity existing lenders can manage, causing them to maintain higher loan rates to discourage demand. Factors that limit capacity are personnel constraints, training lags, processing technology, and MBS rules that may have led to fewer mortgage brokers.

Some workshop participants concluded these greater costs and risks of mortgage origination and servicing cannot fully explain the wedge, and therefore, the impediment might be lenders' increased pricing power (Dudley; Fuster and others). Typically, increases in originators' excess profits lead to entry by new mortgage originators, thus reducing incumbents' profits. But lenders' pricing power may have increased because industry consolidation after the crisis led to higher market concentration. New lenders may be reluctant to enter the market due to perceived high information costs about borrower risk and new regulations and rules.

How well monetary policy is transmitted through financial intermediaries is a broader question than the particulars of the current

mortgage market suggest. Reductions in the supply of bank loans affect a range of consumer loan rates, including rates on auto and personal loans because consumers have few nonbank options.[8] Conceptually, a reduced supply of banks credit increases the bank lending rate even as the market interest rate falls (Bernanke and Blinder). For example, Bernanke explains the persistence of the Great Depression as an inward shift in credit supply due to an increase in the perceived riskiness of loans and banks' liquidity concerns. Similar reasoning is offered by Williams, "[in the current environment] the opportunity cost of holding reserves is low, while the risks in lending or investing in other assets seem high … In a nutshell, the money multiplier has broken down."

To summarize, the literature suggests several bank- and borrower-related factors that affect the degree to which banks pass through lower market rates to their borrowers. These include changes in regulatory costs, lender pricing power, changes in perceived riskiness of borrowers, and lenders retaining liquid funds. However, the attenuation of the monetary transmission also may be due to factors outside the bank credit sector such as uncertain estimates of the persistence of LSAPs and a poor economic outlook.

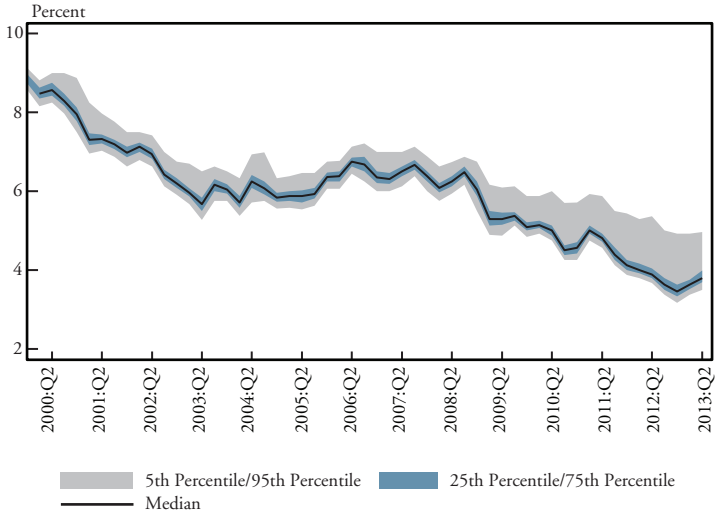
Bank-level lending rates and their relation to market rates

Based on a new analysis of bank-level consumer loan rates since 2000, evidence suggests banks have some pricing power and, therefore, might not pass through the entire decline in rates during an accommodative monetary policy episode.

Branch-level rate data are obtained from a proprietary survey conducted by RateWatch. In this analysis, branches are matched to their bank holding company (hereafter referred to as "bank").[9] RateWatch data have two main advantages. First, the data offer cross-sectional bank heterogeneity not otherwise available in the aggregate data presented in Chart 3. Second, RateWatch collects actual, not implicit, rates. This allows for cross-bank comparisons of a particular product.

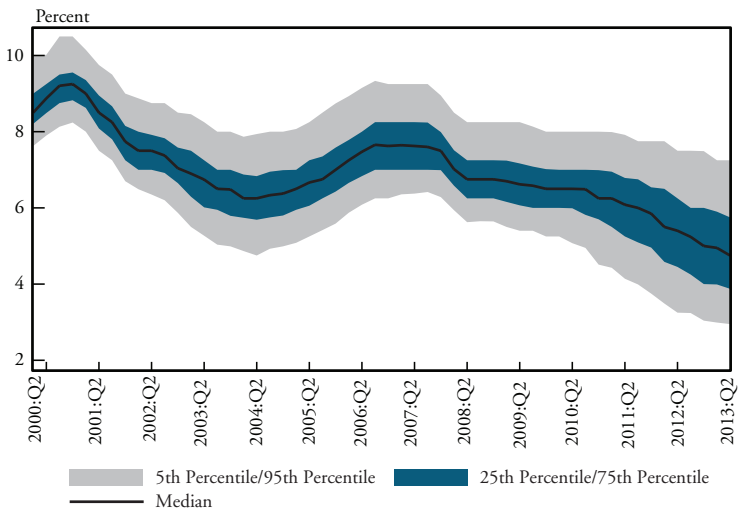
The analysis focuses on loan rates for two common and relatively homogenous products, the 30-year fixed mortgage and the 48-month loan for new autos. Trends for rates based on RateWatch data broadly match the aggregate series. Rates for mortgage loans are shown in Chart 4; rates for auto loans are shown in Chart 5. In each chart, the

Chart 4
BANK-LEVEL MORTGAGE RATES



Notes: The series is the 30-year fixed-rate mortgage rate at $175,000. The underlying data are from survey data of individual bank branches, which are matched by the author to the respective bank holding company and aggregated to a quarterly frequency (averages). The number of reporting branches fluctuates over time (on average, 1,845 branches report this series each quarter, translating to an average of 443 bank holding companies).
Sources: RateWatch and author's calculations.

Chart 5
BANK-LEVEL NEW AUTO RATES



Notes: The series is the new auto 48-month loan finance rate at $25,000. The underlying data are from survey data of individual bank branches, which are matched by the author to the respective bank holding company and aggregated to a quarterly frequency (averages). The number of reporting branches fluctuates over time (on average, 5,012 branches report this series each quarter, translating to an average of 1,158 bank holding companies).
Sources: RateWatch and author's calculations.

line plots the median rate, which is similar to the respective average rate plotted in Chart 3. For example, the median mortgage rate declined from 6.5 percent in the third quarter of 2008 to a low of 3.5 percent at year-end 2012.

As noted in the previous section, the lower rates in the secondary market have not passed through one-to-one to the average rate in the underlying mortgage market. This dispersion between the secondary and primary markets is seen in the increased primary-secondary spread from an average of 0.4 percent in the two years before the crisis to 1.2 percent at year-end 2012. Similarly, the primary-secondary spread in the auto loan market increased from 2.6 percent in the two years before the crisis to 4.3 percent by year-end 2012.

A striking feature of Charts 4 and 5 is the wide dispersion in loan rates across banks. For example, in the mortgage market at year-end 2012, the 25th to 75th percentile range was 3.33 percent to 3.63 percent and the 5th to 95th percentile range was 3.17 percent to 4.92 percent. Moreover, the dispersion of rates appears to be time varying and to have increased in recent years. For example, as measured by the difference between the 95th and 5th percentiles, the dispersion increased from 0.71 percent in the third quarter of 2008 to 1.75 percent at year-end 2012. Similar evidence for auto loans is shown in Chart 5, where dispersion increased from 2.60 percent to 4.45 percent over the same period.[10]

These dispersions, whether cross-bank or cross primary-to-secondary market, can be explained by lender pricing power. To identify systematic relationships, Table 1 shows the correlation of the dispersion of bank rates and the level of market rates over the sample period. The evidence suggests that lending-rate dispersions increase when market rates are low. All correlations are negative and statistically significant at the 1 percent level (except the correlation between the auto spread and the long-term Treasury yield). Results are not driven by the recent period as the correlations are similarly negative when computed over the pre-crisis period to the second quarter of 2007.

Dispersions thus appear to systematically increase when market rates are low. One possible reason is that lenders exploit their pricing power by not decreasing lending rates to the full extent of the decline in market rates.[11] In contrast, when markets rates are high or rising, all lenders quickly raise their loan rates. This general behavior is not

Table 1
CORRELATIONS OF MARKET RATES WITH PRIMARY-SECONDARY SPREAD AND RATE DISPERSION

	Federal Funds	10-Year Treasury
Lending Rates		
Dispersion of Bank-Level Mortgage Rates (95th - 5th percentile)	-0.52	-0.76
Spread between Primary and Secondary Mortgage Rates	-0.79	-0.92
Dispersion of Bank-Level Auto Rates (95th - 5th percentile)	-0.55	-0.82
Spread between Primary and Secondary Auto Rates	-0.52	-0.20
Deposit Rates		
Dispersion of Bank-Level 12-month CD Rates (95th - 5th percentile)	0.80	0.66

Notes: See Chart 3 for the primary and secondary mortgage (auto) rates from which the respective spread is calculated. See Charts 4 and 5 for the dispersion of bank-level lending rates. The period over which the correlations are calculated is from 2000. All correlation coefficients are statistically significant at the 1 percent level with the exception of the correlation between the auto spread and the long-term Treasury yield.

limited to particular characteristics of the current mortgage market alluded to earlier (Fuster and others). Banks' incentive to exploit any potential pricing power may also be greater when market interest rates are low and falling because of pressure on lenders' net interest income, traditionally a primary source of net income.[12]

This finding also closely relates to the literature on deposit pricing that shows retail deposit rates are more sticky upward than downward. That is, banks are less likely to pass on the benefits of higher rates to their deposit holders when market rates are increasing (Hannan and Berger; Neumark and Sharpe; Driscoll and Judson; Yankov). This hypothesis is confirmed by the RateWatch data on deposit rates shown in the bottom row of Table 1. The correlation coefficient is significantly positive, indicative of greater dispersion in 12-month CD rates when market rates are high. Some studies find rates are stickier in concentrated deposit markets so that banks with market power capture the surplus. In contrast, Yankov finds depositors face search costs in choosing a bank and concludes that many depositors can be characterized as uninformed.

III. THE PASS-THROUGH OF POLICY RATES TO BANK LENDING RATES

Changes in the pass-through of monetary policy to bank lending rates can be more thoroughly evaluated by testing the response of banks'

mortgage and auto loan rates to market rates before and after the financial crisis. The results reveal the transmission of market rates to bank rates is less robust after the crisis. This is especially apparent after the onset of unconventional monetary policy as short-term rates approached the zero lower bound at the end of 2008. The weaker transmission characterizes both large and community banks. Additional tests on the lender pricing hypothesis indicate it alone cannot explain the change in transmission.

Changes over time in the pass-through of monetary policy: All banks

The quarterly change in the bank lending rate is regressed on the change in three market rates: the effective federal funds rate, the 10-year Treasury yield, and the asset-backed security yield (agency MBS for mortgage loans and prime auto ABS for auto loans). The regressions are presented in Table 2 for mortgage rates and in Table 3 for auto rates.[13] Panel A of each table reports the pass-through coefficients from a regression that allows for different coefficients for each of four monetary policy periods. Panel B shows the results of statistical tests of structural change in the pass-through relation. Starting in 2000, the first year for which RateWatch data are available, the sample can be divided into the four periods tested: the first quarter of 2001 to the second quarter of 2004 (early 2000s benchmark easing period); the third quarter of 2007 to the third quarter of 2008 (crisis easing period); the fourth quarter of 2008 to the second quarter of 2013 (QE easing period); and the remainder of the sample, which is made up of monetary tightening periods.

The first main finding is that pass-through during the QE period is lower than in the benchmark episode for "conventional" monetary policy easing in the early 2000s. For example, the pass-through coefficient from MBS yields to mortgage rates is 0.63 in QE while it was 0.78 in the early 2000s (Table 2, Panel A, column 2). In other words, 63 percent of the change in MBS yields was passed through to the average primary mortgage rate homeowners paid since the end of 2008, while 78 percent was passed through in the early 2000s. Similar smaller effects are estimated for the response of mortgage rates to 10-year Treasury yields (0.58 compared with 0.72 earlier). The response of auto rates to ABS yields and to the federal funds rate has also diminished as shown in Table 3 (0.01 compared with 0.23 earlier for ABS yields; -0.07 compared with 0.29 earlier for the federal funds rate).[14]

Table 2

PASS-THROUGH OF MARKET RATES TO MORTGAGE LOAN RATES OVER TIME, 2000-2013

(The dependent variable is the mortgage loan rate. The market rate used respectively in each of the two columns is the 10-year Treasury yield and the MBS yield).

	10-Year Treasury	Mortgage-Backed Security Yield
	(1)	(2)
Panel A. Pass-Through Estimates		
Easing 2008:Q4 to 2013:Q2 (QE)	0.58***	0.63***
	(0.10)	(0.03)
Easing 2007:Q3 to 2008:Q3 (Crisis)	0.43***	0.86***
	(0.08)	(0.08)
Easing 2001:Q1 to 2004:Q2 (Early 2000s)	0.72***	0.78***
	(0.08)	(0.05)
Monetary Tightening Periods (Other)	0.77***	0.82***
	(0.11)	(0.05)
R^2	0.27	0.34
Panel B. Testing Structural Changes in Pass-Through Relation over Time (p-value in parantheses)		
QE = Crisis	Yes	No
	(0.24)	(0.01)
QE = Early 2000s	Yes	No
	(0.27)	(0.01)
Crisis = Early 2000s	No	Yes
	(0.01)	(0.39)
Other = Early 2000s	Yes	Yes
	(0.69)	(0.63)

Notes: This table presents regressions of the change in bank-level mortgage lending rates on the change in the market rate (at the quarterly frequency). To allow for different pass-through coefficients over time, the change in the market rate is interacted with a dummy variable equal to one for each of the four periods and zero otherwise. Monetary tightening periods within the available RateWatch sample are 2000:Q1 to 2000:Q4 and 2004:Q3 to 2007:Q2 (for more details, see *http://www.federalreserve.gov/monetarypolicy/openmarket.htm*). The regressions comprise 37,373 observations and also include a constant term. The standard errors used in calculating significance levels are robust to heteroscedasticity; clustered at both the bank and quarterly date, and are reported in parentheses. Panel B reports tests of structural changes in the pass-through relation. The null hypothesis is that the coefficients are the same in the two periods tested. The p-values of these F-tests are reported in parentheses such that a p-value < 0.1 means that the null hypothesis can be statistically rejected at the 10 percent level.
Note that ***, **, *, indicate 1, 5, and 10 percent statistical significance, respectively.

Table 3

PASS-THROUGH OF MARKET RATES TO AUTO LOAN RATES OVER TIME, 2000-2013

(The dependent variable is the auto loan rate. The market rate used respectively in each of the two columns is the federal funds rate and the auto ABS yield).

	Federal Funds	Auto Asset-Backed Security Yield
	(1)	(2)
Panel A. Pass-Through Estimates		
Easing 2008:Q4 to 2013:Q2 (QE)	-0.07***	0.01
	(0.01)	(0.01)
Easing 2007:Q3 to 2008:Q3 (Crisis)	0.20***	0.21*
	(0.02)	(0.11)
Easing 2001:Q1 to 2004:Q2 (Early 2000s)	0.29***	0.23***
	(0.03)	(0.07)
Monetary Tightening Periods (Other)	0.51***	0.45***
	(0.06)	(0.10)
R^2	0.13	0.08
Panel B. Testing Structural Changes in the Pass-Through Relation Over Time (p-value in parantheses)		
QE = Crisis	No	No
	(0.00)	(0.07)
QE = Early 2000s	No	No
	(0.00)	(0.00)
Crisis = Early 2000s	No	Yes
	(0.01)	(0.86)
Other = Early 2000s	No	No
	(0.00)	(0.00)

Notes: This table presents regressions of the change in bank-level auto lending rates on the change in the market rate (at the quarterly frequency). To allow for different pass-through coefficients over time, the change in the market rate is interacted with a dummy variable equal to one for each of the four periods and zero otherwise. Monetary tightening periods within the available RateWatch sample are 2000:Q1 to 2000:Q4 and 2004:Q3 to 2007:Q2 (for more details, see *http://www.federalreserve.gov/monetarypolicy/openmarket.htm*). The regressions comprise 100,565 observations and also include a constant term. The standard errors used in calculating significance levels are robust to heteroscedasticity; clustered at both the bank and quarterly date, and are reported in parentheses. Panel B reports tests of structural changes in the pass-through relation. The null hypothesis is that the coefficients are the same in the two periods tested. The p-values of these F-tests are reported in parentheses such that a p-value < 0.1 means that the null hypothesis can be statistically rejected at the 10 percent level.
Note that ***, **, *, indicate 1, 5, and 10 percent statistical significance, respectively.

A second, closely related finding is that the lower pass-through observed during QE is also statistically different from the early 2000s for MBS yield to mortgages and both the ABS yield and the federal funds rate to auto loans (Panel B of Tables 2 and 3). For example, the hypothesis that the response during QE is equal to that in the early 2000s is rejected at the 1 percent level (Panel B, column 2, of Table 2).

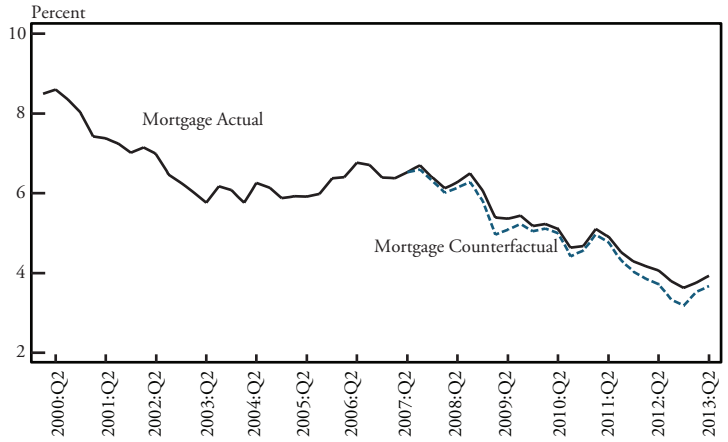
Third, monetary transmission during the crisis period was higher overall than later during QE but similar to the benchmark early 2000s. For example, 86 percent of the change in MBS yields from the third quarter of 2007 to the third quarter of 2008 passed through to the primary mortgage rate while only 63 percent passed through since the fourth quarter of 2008. This difference is statistically different at the 1 percent level (Table 2, column 2). In contrast, the hypothesis that the crisis response (0.86) was equal to that in the early 2000s (0.78) cannot be statistically rejected. Similarly, about 20 percent of the change in ABS yields and the federal funds rate passed through to finance rates on new auto purchases made by households during the crisis, significantly different from the roughly zero effect since the end of 2008 (Table 3). In contrast, the 20 percent pass-through during the crisis was not statistically different from the early 2000s for ABS yields.

Finally, a comparison of the response during periods of monetary tightening to the benchmark monetary easing period reveals a greater pass-through in tighter monetary conditions. This difference is statistically significant for auto loans (for example, 0.45 compared with 0.23 in Table 3, column 2). The generally stronger response of bank lending rates to increases in market rates is consistent with the lending pricing power evidence in Table 1 discussed previously.

The change in pass-through is illustrated in Charts 6 and 7 for mortgages and autos, respectively. A counterfactual series is constructed for each lending rate using the estimated coefficients from the pre-crisis period and actual changes in the explanatory market rate since the crisis. The pre-crisis period is the benchmark episode for monetary policy easing from the early 2000s; nonetheless, the plots are very similar if the full pre-crisis sample is used (the first quarter of 2000 to the second quarter of 2007). For example, by the end of 2012, the counterfactual primary mortgage rate based on MBS yields reached 3.18 percent, roughly 45 basis points below the average mortgage rate. Similarly, Fuster and Lucca

Chart 6

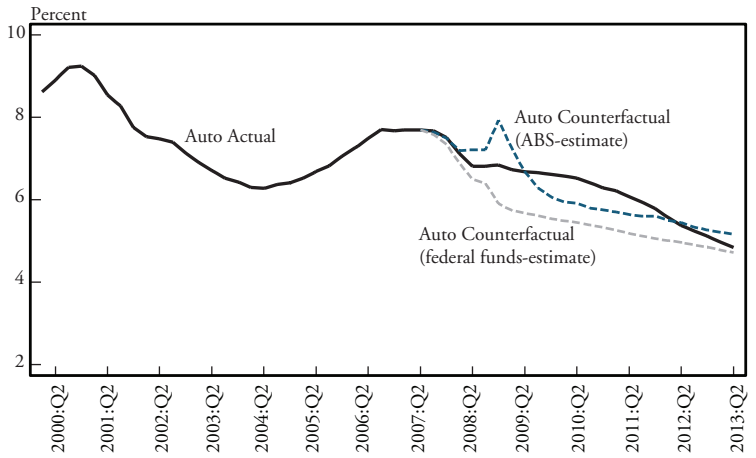
COUNTERFACTUAL PATH FOR MORTGAGE RATES BASED ON PRE-CRISIS ESTIMATES



Notes: The "Mortgage Actual" rate is the 30-year fixed-rate mortgage rate (average) computed from RateWatch, while the "Mortgage Counterfactual" is the hypothetical rate had the pass-through from the secondary mortgage rate (MBS) to the primary mortgage rate remained unchanged from the pre-crisis period from the first quarter of 2001 to the second quarter of 2004.

Chart 7

COUNTERFACTUAL PATH FOR AUTO RATES BASED ON PRE-CRISIS ESTIMATES



Notes: The "Auto Actual" rate is the new auto 48-month loan finance (average) computed from RateWatch, while the "Auto Counterfactual (ABS-estimate)" is the hypothetical rate had the pass-through from the prime auto ABS yield to the new auto loan rate remained unchanged from the pre-crisis period from the first quarter of 2001 to the second quarter of 2004. Similarly, the "Auto Counterfactual (federal funds-estimate)" is the hypothetical rate had the pass-through from the federal funds effective rate to the new auto loan rate remained unchanged.

argue that the mortgage rate should have been 70 basis points lower by the end of 2012. The larger, 70-basis point difference in their calculation is because they assume a one-to-one pass-through.

In Chart 7, two alternative counterfactual series are plotted for autos, one based on the ABS yield and one based on the federal funds rate because the auto finance rate was also sensitive to the latter short rate in the pre-crisis period. The ABS-estimated path spikes at the end of 2008 because of the spike in ABS yields as securitization markets seized up. Since early 2012, the average auto finance rate has converged to its counterfactual paths.

Changes over time in the pass-through of monetary policy: Large versus community banks

Partitioning the pass-through regressions according to size determines whether the generally weaker pass-through is confined to any group of banks (Table 4). Large banks are defined as those with $10 billion or more in assets; small banks are defined as those having less than $10 billion in assets. The regressions allow tests of pass-through differences along two dimensions: time period and bank size. For example, it is possible to test whether pass-through in large banks is different after QE than before QE. It is also possible to test whether pass-through is different in large banks than in community banks for a given time period. To limit the number of time periods analyzed, only the QE and pre-QE periods are examined. These periods were chosen because the transmission during QE was weaker overall than in the three previous periods. The regressions also focus on one regression for MBS yield to mortgage rates and one for ABS yield to auto rates.

The results document a change to a lower pass-through of monetary policy to consumer loan rates within each bank size category. This indicates the average effect estimated in Tables 2 and 3 was not driven by one type of bank. A second finding is that in the pre-QE period, pass-through was higher for large banks than for community banks, although it became similar in the QE period for mortgage rates. The pass-through to auto rates remained higher at large banks, although this finding does not apply to other measures of large banks (for example, there is no statistical difference between the pass-through at the top 10 banks and other banks in the QE period).[15]

Table 4

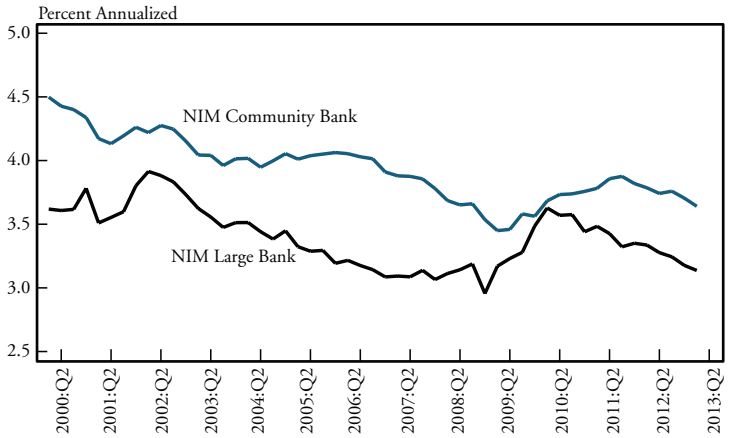
PASS-THROUGH RELATIONS BY BANK SIZE, 2000-2013

	From MBS to Mortgage Loan Rate	From Auto ABS to Auto Loan Rate
	(1)	(2)
Panel A. Pass-Through Estimates		
Large Bank QE	0.64***	0.10**
	(0.04)	(0.04)
Large Bank Pre-QE	0.86***	0.33***
	(0.04)	(0.04)
Community Bank QE	0.63***	0.01
	(0.03)	(0.01)
Community Bank Pre-QE	0.80***	0.28***
	(0.04)	(0.05)
R^2	0.34	0.07
Panel B. Testing Structural Changes in Pass-Through Relations		
Large QE = Large Pre-QE	No	No
	(0.00)	(0.00)
Community QE = Community Pre-QE	No	No
	(0.00)	(0.00)
Large QE = Community QE	Yes	No
	(0.43)	(0.02)
Large pre-QE = Community Pre-QE	No	No
	(0.03)	(0.05)

Notes: This table presents regressions of the change in bank-level lending rates on the change in the respective asset-backed security yield (at the quarterly frequency). To allow for different pass-through coefficients over time and across bank types, the change in the market rate is interacted with a dummy variable equal to one for each of Large Bank QE, Large Bank Pre-QE, Community Bank QE, Community Bank Pre-QE, and zero otherwise. An asset size of $10 billion divides a Community Bank (below) from a Large Bank (above). The regressions comprise 37,373 observations in column (1) and 100,565 observations in column (2), and also include a constant term. The standard errors used in calculating significance levels are robust to heteroscedasticity; clustered at both the bank and quarterly date, and are reported in parentheses. See notes to Table 3 for interpreting Panel B.
Note that ***, **, *, indicate 1, 5, and 10 percent statistical significance, respectively.

Chart 8

NET INTERNET MARGIN BY BANK SIZE



Notes: Net interest margin is net interest income divided by the quarterly average of interest-earning assets.
Source: Reports of Condition and Income.

One explanation for the weaker pass-through in the current low-rate environment is the use of pricing power by banks as described in Section II. Chart 8 assesses this hypothesis in more detail by plotting the net interest margins of all large and community banks over time. The net interest margin (NIM) is computed as interest income earned on loans, leases, and other investments minus interest expenses paid on deposits and other borrowing in each quarter (annualized), divided by the quarterly average of interest-earning assets. If lenders price loans higher than they typically would, with all else fixed, net interest margins should have significantly increased since the end of 2008 compared with the pre-QE era. However, while NIMs are higher than their crisis lows when the cost of deposits and wholesale funding increased sharply, NIMs for both large and community banks are on average smaller than they were pre-crisis (for example, 3.7 percent for community banks compared with 4.1 percent earlier).[16]

Therefore, chronically low NIMs and profits do not suggest that loan pricing power is the only explanatory factor. To the extent that lenders are exercising pricing power on their loans, the effect appears to be offset by other factors compressing their NIMs. Among these is the zero floor on rates they can offer depositors and the shift to relatively low-yielding assets as banks have built up reserves and Treasury securities

and decreased real estate and credit card lending. The move away from risky assets is explained by greater regulatory costs and borrower risk but also by weaker loan demand (Office of the Comptroller of the Currency).

IV. CONCLUSION

This article examined whether the Federal Reserve's actions—including targeting a near-zero federal funds rate, purchasing longer-term Treasuries and MBS on a large scale and providing forward guidance about the future path of the federal funds rate—significantly reduced the rates that matter to consumers such as rates on mortgages and auto loans. Consumer rates have indeed declined, and correspondingly, the pace of mortgage origination in the second quarter of 2013 was double the low point reached in the third quarter of 2011. The pace of new auto loans was also robust and at a six-year high.[17]

While loan rates declined significantly, the pass-through has been significantly weaker since year-end 2008 than during previous periods and the dispersion of rates across banks has been higher. Some of this attenuation can be explained by lenders exploiting their pricing power when market interest rates are low, the mirror image of the established result that deposit rates are slow to adjust upward when market rates are high. But other reasons for the attenuation include changes in lending risk, economic conditions, and the monetary policy transmission channel. As a result, the Federal Reserve may be pulling on less-effective levers.

As discussed by Philippon, economists need to acknowledge that not enough is known about the channels through which unconventional monetary policy affects the economy to prescribe definite policy recommendations. But it is clear from the analysis that central banks may be justified in introducing new policy tools outside of the conventional short-term rate in the aftermath of financial crises. It is important though to reach an appropriate balance between providing enough incentives for productive risk-taking and discouraging excessive risk-taking in credit markets (George; Stein). Current research on monetary policy transmission should help broaden understanding of the important link between financial intermediaries and the real economy.

ENDNOTES

[1]See the press release on November 25, 2008, available at *http://www.federalreserve.gov/newsevents/press/monetary/20081125b.htm*.

[2]Since the interest rate on a long-term Treasury bond can be expressed as the sum of the average level of short-term risk-free rates expected over the term to maturity plus a term premium, the transmission channel can be through 1) the expected path of future federal funds rate (forward guidance) and 2) changes to the term premium (portfolio balance effects from LSAPs). The precise channel and strength of the response compared with the pre-crisis period is open to debate. A detailed conceptual review falls outside the scope of this article. See Bernanke; Krishnamurthy and Vissing-Jorgensen; and Woodford; among others.

[3]Note also that many factors affect market yields on asset-backed securities (ABS), including investor risk appetite as shown by events at the onset of the crisis. The prime auto ABS yield, in addition to other consumer credit ABS yields such as credit card receivables, spiked in late 2008 as securitization markets froze. ABS issuance backed by autos collapsed to near zero by August 2008 (Agarwal and others). The Federal Reserve responded by introducing the Term Asset-Backed Securities Loan Facility (TALF). This temporary program helped restore the functioning of securitization markets, which are crucial for auto, student, and credit card loans (Campbell and others). In contrast, while the private-label MBS market dried up, the market for agency-issued MBS did not. This is because conforming mortgages are underwritten by government-sponsored agencies (for example, Freddie Mac and Fannie Mae).

[4]The common approach to evaluating the effect has been an event study approach, which is suitable for high frequency market data because a narrow window surrounding the event can be isolated to mitigate the effect of other news shocks. Nonetheless, the caveat applies that event studies may omit the effect of LSAPs on the expectations of financial market investors. Relying on survey and news article evidence, Foerster and Cao show that a significant effect on rates precedes the actual LSAP announcement date.

[5]For example, Krishnamurthy and Vissing-Jorgensen argue there is a unique clientele for very safe assets so that it may be inappropriate for the central bank to only focus on Treasury securities if these effects "do not carry over to mortgage and lower-grade corporate borrowing rates."

[6]In practice, arbitrage may work more directly: Since the MBS market is where securitized mortgage loans are sold to investors, higher prices in this secondary market caused by Federal Reserve actions lead mortgage packaging and warehousing firms to bid up the price of primary mortgages. The higher the price at which the originating bank can sell its loan to the packager, the higher the price it will accept in the primary market, that is, the lower the primary mortgage rate at which the bank is willing to provide a household with a mortgage loan, all else fixed.

[7]See "The Spread Between Primary and Secondary Mortgage Rates: Recent Trends and Prospects," a workshop sponsored by the Federal Reserve Banks of Boston and New York, December 3, 2012, *http://www.newyorkfed.org/research/conference/2012/Mortgage_rates.html.*

[8]Business borrowers are also affected because bank loans and corporate bonds are not easily substitutable sources of finance for a business. While corporate bond rates have decreased, easing conditions for relatively large firms, small firms have less access to public debt markets. Therefore, the investment of bank-dependent borrowers may be reduced relative to borrowers in the corporate bond market when loan supply falls.

[9]The article relies on identifier information provided by RateWatch in conjunction with identifiers from the annual Summary of Deposits survey conducted by the FDIC to link the data. The Summary of Deposits data are at the branch level, where for each branch the bank and bank holding company (BHC) identifiers are also provided. The BHC is used in this study following much of the banking literature that argues that decisions are made at the BHC level.

[10]The dispersions for auto loans are generally greater than for mortgages. This is not due to sample selection differences in the banks. Chart 5 is similar when plotted for the sample of banks reporting mortgage rates. There are many structural differences in the characteristics of the two markets, among which is the government-guaranteed nature of the conventional mortgage market. Another feature of these charts is the skewness of the rates, meaning that the distributions are asymmetric. For example, the average skew is 3.28 for mortgages and 0.53 for autos so that the "long tail" is in the positive direction. However, based on statistical tests, skewness does not appear to be systematically related to the level of market rates.

[11]Other reasons, however, such as variation in borrower credit risk over the cycle, may also be responsible.

[12]For example, recent studies have found that banks' net interest income and profitability decline when the short-term rate falls (English and others; Landier and others). Indeed, while net interest income is reduced when MBS yields fall, the response is muted in localities with a high concentration of banks (Scharfstein and Sunderam).

[13]Regressions of mortgage rates on the federal funds rate and of the auto rate on the 10-year Treasury yield were also conducted. Generally, mortgage rates are more sensitive to long-term rates while auto rates are more sensitive to short-term rates.

[14]Also note the following: 1) The -0.07 statistically significant coefficient on the federal funds rate in the auto equation should be interpreted with caution because the funds rate has been near zero for much of this period. The effect of the federal funds rate on auto rates is not statistically different from zero when evaluated for the zero-bound period beginning in the second quarter of 2009. 2) The pass-through of market rates to auto finance rates are generally lower than to

mortgage rates. The question of a different transmission to mortgage rates existed prior to the crisis and depends on various structural characteristics of each market including liquidity and government-sponsorship. The analysis in this article is interested more in the change in the response relation *within* each market because that is the primary question of interest for a central bank evaluating changes in the effectiveness of its policy. 3) The regressions, which are at the quarterly frequency, are contemporaneous; motivated by the results of event studies and the rate-setting literature that pass-through to bank rates occurs relatively quickly compared with wage-setting in labor markets. Nonetheless, lags of markets rates can be included and tested. Typically, only the first lag is significant if at all. And the economic impact from the sum of the contemporaneous and first lag of the market rate is comparable to the results shown. 4) The data sample in the regressions is pooled (without controlling for bank fixed effects). The results, if bank fixed effects are controlled for, are very similar.

[15]The caveat applies that the comparisons in Table 4 may not fully capture other differences between bank sizes. Nonetheless, results are similar when first conditioning on several bank characteristics before estimating the pass-through equations. Moreover, the weaker pass-through effect since year-end 2008 is supported by other partitions such as by geographic region, market concentration, and bank financial condition. For example, the pass-through significantly decreased from 0.86 to 0.61 in Nevada and from 0.80 to 0.57 in Texas. But there doesn't appear to be a generalizable pattern where, for example, the transmission may have become significantly weaker in states experiencing severe house price busts.

[16]The caveat applies to what the "typical" pricing behavior should be. Here, the average pre-crisis NIM is applied. If instead the NIMs are detrended based on the pre-crisis downward trend, the average QE-era NIM for community banks is similar to pre-crisis (roughly zero detrended) while it is 0.5 for large banks, suggestive of an increase in their pricing power. On the other hand, the downward trend itself reflects changes in pricing power pre-crisis and therefore should not be included in the all-else-fixed assumption. Also, the recent levels of NIMs are even lower when adjusted for the FAS 167 accounting change effective in early 2010 that required the consolidation of variable interest entities. The main type of entity consolidated on bank balance sheets were securitization entities for credit cards and receivables.

[17]See the Federal Reserve Bank of New York's (FRBNY) Quarterly Reports on Household Debt and Credit available at *http://www.newyorkfed.org/regional/householdcredit.html.* The FRBNY Consumer Credit Panel is a nationally representative sample from Equifax credit-report data.

REFERENCES

Agarwal, Sumit, Jacqueline Barrett, Crystal Cun, and Mariacristina De Nardi. 2010. "The Asset-Backed Securities Markets, the Crisis, and TALF," Federal Reserve Bank of Chicago, *Economic Perspectives*, Fourth Quarter.

Bernanke, Ben S., and Alan S. Blinder. 1988. "Credit, Money, and Aggregate Demand," *The American Economic Review Papers and Proceedings*, May.

_____. 2010. "The Economic Outlook and Monetary Policy," speech, August 27.

Campbell, Sean, Daniel Covitz, William Nelson, and Karen Pence. 2011. "Securitization Markets and Central Banking: An Evaluation of the Term Asset-Backed Securities Loan Facility," *Journal of Monetary Economics*, July.

D'Amico, Stefania, William English, David López-Salido, and Edward Nelson. 2012. "The Federal Reserve's Large-Scale Asset Purchase Programs: Rationale and Effects," *Economic Journal*, November.

Doh, Taeyoung, and Michael Connolly. 2013. "Has the Effect of Monetary Policy Announcements on Asset Prices Changed?" Federal Reserve Bank of Kansas City, *Economic Review*, Third Quarter.

Driscoll, John C., and Ruth A. Judson. 2013. "Sticky Deposit Rates," Federal Reserve Board of Governors, working paper.

Dudley, William C. 2012. Opening Remarks at "The Spread between Primary and Secondary Mortgage Rates: Recent Trends and Prospects Workshop," December 3.

English, William B., Skander J. Van den Heuvel, and Egon Zakrajsek. 2012. "Interest Rate Risk and Bank Equity Valuations," Federal Reserve Board, Finance and Economic Discussion Series, no. 2012-26.

Foerster, Andrew, and Guangye Cao. 2013. "Expectations of Large-Scale Asset Purchases," Federal Reserve Bank of Kansas City, *Economic Review*, Second Quarter.

Fuster, Andreas, Laurie Goodman, David Lucca, Laurel Madar, Linsey Molloy, and Paul Willen. 2012. "The Rising Gap between Primary and Secondary Mortgage Rates," Federal Reserve Bank of New York, White Paper, November.

Gagnon, Joseph, Matthew Raskin, Julie Remache, and Brian Sack. 2011. "Large-Scale Asset Purchases by the Federal Reserve: Did They Work?" *International Journal of Central Banking*, March.

George, Esther. 2013. "Central Bank Patience," speech, April 4.

Hannan, Timothy H., and Allen N. Berger. 1991. "The Rigidity of Prices: Evidence from the Banking Industry," *American Economic Review*, September.

Kiley, Michael T. 2013. "Monetary Policy Statements, Treasury Yields, and Private Yields: Before and After the Zero Lower Bound," Federal Reserve Board Finance and Economic Discussion Series, no. 2013-16.

Krishnamurthy, Arvind, and Annette Vissing-Jorgensen. 2011. "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy," *Brookings Papers on Economic Activity*, Fall.

Landier, Augustin, David Sraer, and David Thesmar. 2013. "Banks Exposure to Interest Rate Risk and the Transmission of Monetary Policy," NBER, working paper, no. 18857.

Neumark, David, and Steven A. Sharpe. 1992. "Market Structure and the Nature of Price Rigidity: Evidence from the Market for Consumer Deposits," *Quarterly Journal of Economics*, May.

Office of the Comptroller of the Currency. 2013. *Seminannual Risk Perspective*. Washington, D.C., Spring.

Philippon, Thomas. 2011. Comment on "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy," *Brookings Papers on Economic Activity*, Fall.

Scharfstein, David S., and Adi Sunderam. 2013. "Concentration in Mortgage Lending, Refinancing Activity and Mortgage Rates," NBER, working paper, no. 19156, June.

Stein, Jeremy C. 2013. "Overheating in Credit Markets: Origins, Measurements and Policy Response," speech, February 7.

Williams, John C. 2012. "Monetary Policy, Money, and Inflation," speech, July 2.

Woodford, Michael. 2012. "Methods of Policy Accommodation at the Interest-Rate Lower Bound," *The Changing Policy Landscape*, symposium sponsored by the Federal Reserve Bank of Kansas City, August 30-September 1.

Yankov, Vladimir. 2012. "In Search of a Risk-Free Asset," Federal Reserve Board of Governors, working paper.