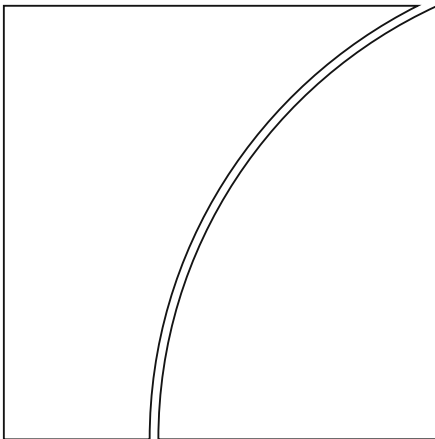# BIS Working Papers
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The 2011 FDIC assessment on banks' managed liabilities: interest rate and balance-sheet responses

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The 2011 FDIC assessment on banks' managed liabilities: interest rate and balance sheet responses

Lawrence L Kreicher, Robert N McCauley and Patrick McGuire[1]

Abstract

The global financial crisis led to discussion of corrective bank taxes to promote financial stability. This paper interprets the widening of the FDIC assessment base from deposits to assets less equity for US-chartered banks in April 2011 as such a corrective or Pigovian tax. In terms of yields, banks shifted its cost to wholesale funders, benefiting floating-rate borrowers, while the linkage between onshore and offshore dollar money markets weakened. In terms of quantities, US-chartered banks shifted funding to more stable deposits. At the same time, the US branches of non-US banks, which were unaffected by the widened assessment base, increased US assets, funding their take-up of most of the Fed's reserve injection of $600 billion offshore. Thus, a new internationally uncoordinated policy had the expected effect on US banks' funding structure, but also redistributed dollar intermediation to non-US banks that continue to rely on wholesale funding. The implication for global financial stability is at best ambiguous.

Keywords: Deposit insurance, reserve balances, money markets, federal funds, repo, eurodollars, wholesale funding, flow of funds, large-scale asset purchases, Dodd-Frank.

JEL classification: E43, E52, E65, G01, G15, G21, G28.

Contents

1. Introduction

The global financial crisis led to a variety of proposals to levy taxes on the financial sector (Alworth and Arachi (2012), Hemmelgarn and Nicodeme (2012) and Lloyd (2012)). Some proposed *corrective or Pigovian taxes* which would raise the private cost of financial choices that impose broader social costs. By analogy, economists have long proposed to curb air pollution efficiently by imposing taxes that make the polluter pay the social costs of sulphur emissions (Schultze (1977)). In addition to regulating banks to limit leverage or dependence on short-term funding, the government can tax borrowing or short-term debt (Masciandaro and Passarelli (2012)).

Proposals for corrective taxes on the financial sector have focused either on big *institutions* or on fragile *balance-sheet structures*. Acharya et al (2009) argued for a systemic risk tax on individual banks with large market equity capitalisation losses during big market sell-offs. Shin (2010) urged a tax on non-core liabilities and Weder di Mauro (2010a, 2010b) proposed a hybrid. While the Basel Committee on Banking Supervision (2012) reports post-crisis international cooperation on higher required capital for systemically important banks, new taxes on banks have been national. Some European countries have taxed bonuses (IMF (2010), Alworth and Arachi (2012)). Similarly, while not explicitly a tax, Dodd-Frank's widening of the FDIC assessment (in effect, tax) base from domestic deposits to assets less tangible equity affected only US-chartered banks and not even all banks in the United States.

This widening of the FDIC base had a rapid effect on prices *and* quantities. The price effect is easily stated: banks passed the cost of the new assessment on to lenders of short-term funds, and lowered the cost of short-term US dollar debt. And linkages between onshore and offshore money market yields weakened. The quantity effects differ because the policy change only affected a subset of banks. It bound banks in the United States holding a US charter and these shifted their funding, repaying wholesale funding from abroad and relying more on domestic deposits. With few exceptions the policy change did not bind foreign bank branches in the United States and they drew in massive net wholesale funding from abroad.

Viewed as a corrective policy, the policy can be seen as a partial success. US-chartered banks now rely more on stable domestic deposits and less on volatile wholesale funds. But, thanks to the massive injection of bank reserves that financed the Federal Reserve's large purchases of bonds, the risk of a unilateral policy, in the sense that it affects one particular category of banks, is already evident.[2] The policy has had the unintended side effect of increasing the share of US banking assets on the books of US branches of foreign-chartered banks.

A world in which banks headquartered outside the United States intermediate a larger share of dollars may not prove more financially stable, despite more stable funding for US-chartered banks. Banks *without* a US charter have much of their

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[2] In this case, the polluter does not even have to move across the border. Proponents of a such a tax well understood the risks of a narrowly applied measure. Shin (2010) cautioned: "A globally coordinated introduction of a non-core liabilities tax (perhaps through the G20 process) would maximize its effectiveness and minimize the distortions through possible circumvention or shifts in the pattern of capital flows". McDonald and Johnson (2010) noted that "Taxing the domestic financial sector may actually encourage instability by providing more incentive to use [the] external finance sector". See also Perotti and Suarez (2010) and Ostry et al (2012).

dollar assets outside the United States, which cannot readily be discounted at the Federal Reserve. Their ongoing reliance on wholesale dollar funding could leave them more vulnerable to runs. To be sure, this concern remains hypothetical as long as foreign banks are flush with reserves at the Fed. However, we interpret foreign banks' disproportionate take-up of Fed reserves as merely the *initial manifestation* of the reconfiguration of global dollar banking to which the new incentives lead.[3]

The rest of this paper is in four parts. In Section 2, we describe the change in the FDIC assessment. In Section 3 we examine its impact on overnight and term interest rates. In Section 4 we analyse banks' balance-sheet responses using quarterly call reports and flow of funds data. We conclude in Section 5.

2. The FDIC assessment change

The Banking Act of 1933 created the Federal Deposit Insurance Corporation (FDIC) as an independent agency of the US government in response to widespread banking failures, depositor losses and bank runs. The FDIC currently insures deposits at US-chartered banks up to a limit of $250,000 per account. In addition, it has primary or backup supervisory responsibility for all insured banks and acts as the receiver for failed banks. Assessments paid by insured banks and earnings on its investment portfolio fund the FDIC's Deposit Insurance Fund.

Signed into law on 21 July 2010, Dodd-Frank mandated the FDIC to widen its assessments base (on which charges are levied to build up the FDIC insurance fund) from adjusted domestic deposits to total assets less tangible shareholders' equity (see Hein et al (2012)). The FDIC issued proposals in November 2010 and published final rules and regulations in February 2011 (FDIC (2011)).

Before the FDIC published the proposed rules in November, market participants hoped that reserve holdings at the Federal Reserve might be excluded from the asset base (Smedley (2010)). Apart from a partial exemption for custodian banks, the FDIC generally included reserve holdings in the FDIC assessment base.

This inclusion would disturb the so-called arbitrage in which banks borrowed overnight from non-banks unable to place at the Fed at its going rate of 25 basis points. If banks were going to have to pay the FDIC to borrow from wholesale lenders, then they would have to offer fewer basis points for overnight funds.

How many fewer basis points would depend on the rate paid to the FDIC on the newly assessed liabilities. This is not easily ascertained from the FDIC schedule, especially for large and highly complex institutions (Table 1). The rate depends on a bank's riskiness, as summarised by its regulatory (CAMELS) rating, with adjustments for more long-term unsecured debt (downward) and more brokered deposits (upward). Whalen (2011, p 7) cites an estimate from the specialist *IRA Bank Monitor* for JPMorgan Chase of $1.4 billion on an assessment base of $1.785 trillion, for an estimated 8-basis point rate. Given market estimates of CAMELS, mega-bank Wells Fargo is generally considered to pay a lower rate, and Citigroup a higher rate.

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[3]   Dodd-Frank in some way takes us back to 1990, when reserve requirements provided an incentive for intermediation to occur in foreign banks outside the United States (He and McCauley (2012)).

FDIC insurance schedule as of 1 April 2011

(basis points)   Table 1

	Risk category I	Risk category II	Risk category III	Risk category IV	Large and highly complex institutions
Initial base assessment rate	5–9	14	23	35	5–35
Unsecured debt adjustment	–4.5–0	–5–0	–5–0	–5–0	–5–0
Brokered deposit adjustment	....	0–10	0–10	0–10	0–10
Total base assessment rate	2.5–9	9–24	18–33	30–45	2.5–45

Note: Total base assessment rates exclude the depository institution debt adjustment. Risk categories range from low (I) to high (IV).

Source: FDIC (2011, p 10717).

The clear intention of the wider assessment and lower rate on deposits was to shift the burden of FDIC assessments from small to big banks. "Aggregate premiums paid by institutions with less than $10 billion in assets will decline by approximately 30 percent, primarily due to the assessment base change," testified the FDIC's Gruenberg (2011).[4] Whalen (2011) cites estimates of a 33% to 576% rise for the top 10 banks (Table 2). "The result will be a sharing of the assessment burden that better reflects each group's share of industry assets" (Bair (2011)).

When would one expect banks to begin to respond to the policy change? Until the November 2010 FDIC proposal, bankers had hoped that holdings of reserves would be excluded the FDIC's definition of the assessment base. By the end of the year 2010, bankers could foresee the new regime in April 2011.

Therefore, we interpret the first quarter of 2011 as the beginning of the adjustment period to the new FDIC policy. To the extent that the policy change gave incentives for an altered flow of short-term funds, new channels would require the arrangement of new credit lines and increases in existing lines. Since the assessment

Estimated change in FDIC assessment base for top 10 US banks

Table 2

	2010 base (billion dollars)	2011 base (billion dollars)	Percent change
JPMorgan Chase	670	1,785	167%
Bank of America	943	1,737	84%
Citigroup	336	1,317	291%
Wells Fargo & Co.	786	1,155	47%
US Bancorp	178	308	74%
PNC Financial	182	272	50%
Capital One Financial	122	199	64%
Bank of New York Mellon	76	196	156%
SunTrust Banks	122	163	33%
State Street Corp	23	156	576%

Source: Whalen (2011, p 7), citing FDIC(RIS)/*The IRA Bank Monitor*.

[4]   Ely (2011) notes that, while in the 2007–10 period the FDIC had no losses on banks with assets in excess of $25 billion, these stood to pay 72% of assessments in 2011.

for the second quarter would depend on the average balance sheet in that quarter, bankers needed to start rearranging their balance sheets before the end of the first quarter. Thus in what follows, we take calendar 2010 as the *before* period, and 1 April 2011 to 31 March 2012 as the *after* period.

This timing means that the adjustment to the new FDIC policy coincided with the forced increase in bank reserves that resulted from the Federal Reserve's decision in its early November 2010 meeting to increase its holdings of Treasury securities by some $600 billion (the so-called QE2 or second phase of quantitative easing), or 5% of bank assets in the United States, over the months through June 2011.

The coincidence of the FDIC assessment change and the Fed's injection of assets that only banks in the United States can hold presented challenges to the US-chartered banks, including US subsidiaries of foreign-headquartered banks, that dominate US commercial banking. They funded only two thirds of their assets of $10 trillion at end-September 2010 with deposits, and large banks even less (see below); most of the rest was funded by managed liabilities such as interbank borrowings, repos and funds borrowed from their overseas affiliates (so-called eurodollars). Since these wholesale funding sources would now be part of their FDIC assessment base, US-chartered banks had every reason to drop their bids for such funds and to take on as little of the new claims on the Fed as possible.

For their part, US branches and agencies of foreign banks could hold more reserves at the Fed without paying the FDIC assessment on any wholesale funding. That is because they are not generally covered by deposit insurance.[5]

3. Money market rates, onshore and offshore

This section analyses the effect the change in the FDIC assessment base on money market rates, the primary channels through which the Fed communicated and implemented its monetary policy. We have two questions in mind. First, what happened to the *level* of money market rates? We find that overnight and term money market rates fell by 5–10 basis points, which suggests that banks largely passed on the tax to providers of wholesale funding.[6] Second, what happened to the *linkage* between onshore and offshore rates in the global dollar money market? Falling only on some banks in the United States, the new assessment loosened this linkage, suggesting an unintended consequence of a less immediate monetary transmission. A looser linkage between onshore and offshore rates also provides perspective on the disparate balance-sheet responses examined in the next section.

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[5]   Total assets at insured branches and agencies stood at $28.7 billion out of a total of $1.5 trillion in September 2010. On the FDIC's list of insured banks with $10 billion or more of assets, there is only one branch of a foreign-chartered institution, namely Bank of China, with $12 billion in assets.

[6]   Kreicher (1982) and McCauley and Seth (1992) found that Libid tended to trade at the all-in cost of US CDs, paying a premium to offshore depositors roughly equal to the cost of the reserve requirement and FDIC insurance on a domestic deposit. Put otherwise, a domestic depositor in effect paid the cost to the bank of reserve requirements and deposit insurance. Reserve requirements on large deposits were reduced to zero in 1990, and FDIC assessments fell effectively to zero in the mid-1990s (FDIC (2011)), so the two studies covered most of the relevant data.

We analyse not two, but three overnight rates because the financial crisis of 2007–08 disrupted the normal functioning of uncollateralised overnight dollar money markets.[7] As providers of funds became more wary about taking on credit risk in lending to banks, unsecured markets (fed funds, eurodollars) dried up, while transactions in secured markets such as repurchase agreements (repos) held up.[8] While previous analyses of the relationship between onshore and offshore overnight rates have focused on federal funds and eurodollars, we also include overnight repos to reflect the shift in liquidity to that secured market during the crisis. The federal funds market, the eurodollar market, and the Treasury general collateral finance repo market serve as key funding sources for global banks. Numerous large non-bank entities are also active participants in these markets, including securities firms, money market mutual funds, and government agencies (Table 3).

The source for our price data on overnight eurodollar and Treasury repo transactions is ICAP, one of the premier inter-dealer brokers in the global marketplace. We make use of their daily effective rates for eurodollars and Treasury repo, which are based on transactions occurring during the New York City trading day.[9] For consistency, we also use ICAP's measure of the effective fed funds rate.

Major US dollar money market participants			Table 3
	(1) Federal funds market	(2) Eurodollar market	(3) Repo market
Borrowers	Depository institutions	Depository institutions	Depository institutions Broker-dealers
Lenders	Depository institutions Broker-dealers Government-sponsored enterprises	Money market funds Financial and non-financial lenders	Money market funds Securities lenders Government-sponsored enterprises

Source: Marquez et al (2012).

3.1 The overnight market for unsecured funds in the post-crisis period

When the Federal Reserve began paying interest on required and excess bank reserve balances in October 2008, it thought that "[p]aying interest on excess balances should help to establish a lower bound on the federal funds rate."[10] At the outset, however, this expectation turned out to be incorrect as the effective fed funds rate (and its closely aligned sister rate on overnight eurodollars) both traded below the interest-on-excess-reserves rate. In December 2008, the Fed accepted

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[7] Stigum and Crescenzi (2007) describe these markets. Before the crisis, Lee (2003) and Demiralp et al (2006) found small unexploited arbitrage opportunities between federal funds and eurodollars, but they used the Board of Governors' overnight eurodollar rate, which is known to have limitations. Bartolini et al (2008) found these markets very well integrated pre-crisis.

[8] ECB (2011) reports that unsecured transactions remained a third to a half below their 2007 peak in 2010 and 2011, while secured transactions had recovered to 2007 levels. The survey also finds that unsecured transactions were more than ever extended only overnight.

[9] These are known respectively as HEDDR (eurodollars) and i-Repo (Treasury repo). ICAP's measure of the effective fed funds rate is known as HEFFR. This last series is an important component in the NY Fed's benchmark calculation for the effective fed funds rate and is virtually identical to that benchmark in the post-December 2008 period (details available from authors upon request).

[10] Federal Reserve Board of Governors, *Press Release*, 6 October 2008.

this outcome by setting the interest rate on excess reserves equal to 25 basis points, and establishing a target range for the fed funds rate of 0 to 25 basis points.[11]

Overnight rates trading below the Fed's interest rate on excess reserves leaves an arbitrage opportunity – depository institutions with accounts at the Fed (eg US-chartered banks and US branches and agencies of foreign banks) could borrow cheap funds in the market and then take delivery of those funds at the Fed, earning a risk-free profit. Why did it persist? Following Bech and Klee (2011), it persisted because banks that could receive the 25 basis points were unwilling to leverage their balance sheets without earning a spread, even though the excess reserves are seen as risk-free. Cash-rich non-banks such as the government-sponsored enterprises (Fannie Mae and Freddie Mac), and money market mutual funds were at the same time *not* able to receive the 25 basis points from the Fed.

This equilibrium in the market for overnight, unsecured funds is illustrated in the right-hand panel of Graph 1. Total demand for overnight unsecured funds (here we combine the fed funds and Eurodollar markets for ease of exposition) is shown by the downward-sloping solid black line in the right-hand panel. Government-sponsored enterprises, money market funds and others supply overnight funds along the upward sloping red line. Their intersection illustrates the market equilibrium with quantity T_0 of funds changing hands at an overnight rate equal to r_0. In the left-hand panel we have decomposed the demand for overnight funds between that of US-chartered banks and that of US branches and agencies of foreign banks. These schedules are downward sloping because banks are assumed to require ever larger concessions to the rate received on excess reserves to expand their balance sheets by borrowing. Since branches and agencies have an aggregate balance sheet that is much smaller than that of US-chartered banks, their demand for funds is assumed to be less – shifted to the left – at every interest rate, while again for ease of exposition, we assume that the average minimum concession for all banks with access to the Fed's 25 basis points is [25 - R^0]. The initial equilibrium uptakes are D_0 for US-chartered banks and F_0 for foreign branches and agencies.

The new FDIC balance-sheet assessment raised the all-in cost of funds for US-chartered banks performing this arbitrage, leaving them at a disadvantage relative to branches of foreign banks. The size of this disadvantage, that is, the FDIC assessment *rate*, is particular to each US-chartered bank, risk-related, and not made public by the FDIC, as described in Section 2. Clearly, US-chartered banks, paying the new assessment on wholesale funding, could not pay 18 basis points for overnight funding and 10 basis points to the FDIC only to receive 25 basis points from the Fed.

An insured bank necessarily must lower its bid for overnight funding, shown as a leftward shift in the demand schedule for US-chartered banks to the blue dashed line in Graph 1, left-hand panel. A new equilibrium for overnight unsecured funds is predictably found at a smaller quantity T_1 and lower interest rate r_1, in the right-hand panel of Graph 1, where the size of the changes depend on the interest rate elasticities of the total supply and demand schedules. Notice that the uptake of overnight funds by US-chartered banks falls to D_1 from D_0, in the left-hand panel of Graph 1, but the uptake by now more competitive branches and agencies of foreign banks actually rises from F_0 to F_1.


Supply of and demand for overnight unsecured funds
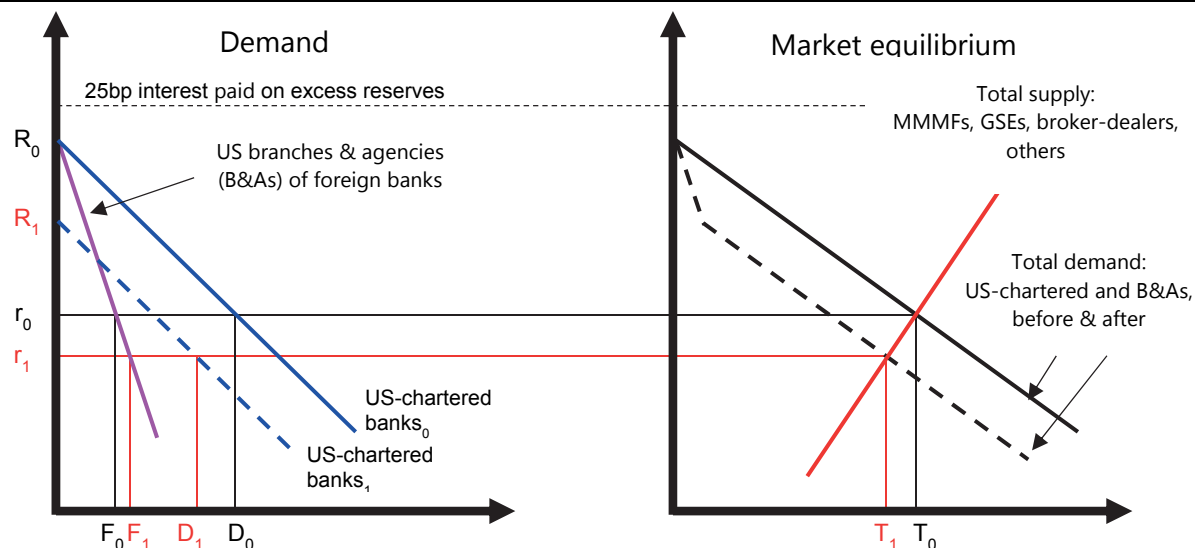
Graph 1

The price and quantity predictions of this simple model of US dollar overnight rates are readily confirmed. In Graph 2, the red and blue lines for the effective fed funds and overnight Eurodollar both declined in the lead-up to the 1 April 2011 widening of the FDIC assessment base. Unlike the pre-crisis targeting of a single rate for the effective federal funds, the Fed's target of a 25-basis point range allowed new balance-sheet constraints on market participants to change overnight rates without Fed resistance.

The aggregate quantity of fed funds sold also dropped. Call report data indicate that, across all banks in the United States, the amount of "fed funds sold", or Fed reserves lent out by one bank to another (mostly overnight), stood at $255 billion at end-2008 (Graph 3, left-hand panel). This stock fell to $89 billion by end-Q1 2010, when the Fed's first round of bond-buying with excess reserves
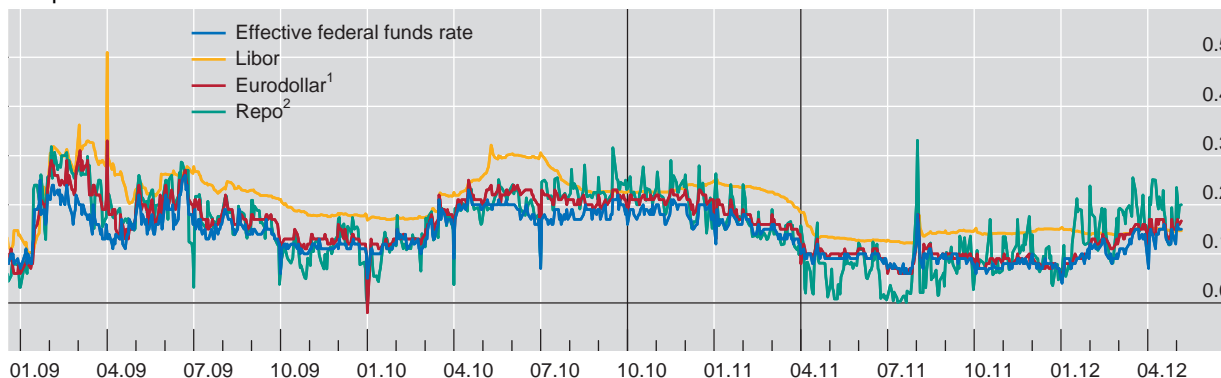
US dollar overnight money market rates

Graph 2

In per cent

Note: The vertical lines indicate the announcement of the change to the FDIC assessment base and its implementation (1 April 2011).
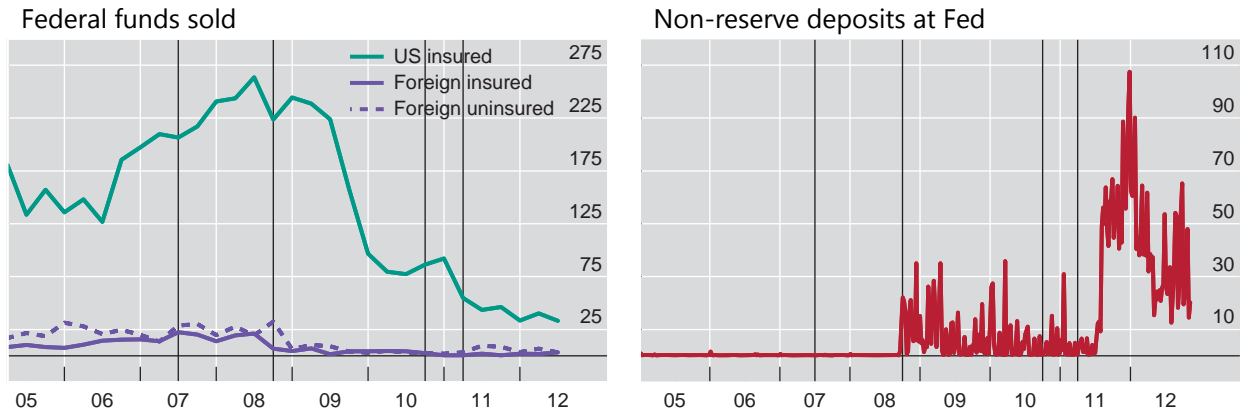
[1] Uncollateralised, HEDDR . [2] Collateralised with Treasury securities, i-Repo.

Sources: ICAP, British Bankers' Association, Bloomberg.

Activity and friction in the federal funds market

In billions of US dollars Graph 3

Federal funds sold

US insured	
Foreign insured	
Foreign uninsured	

Non-reserve deposits at Fed

Note: The vertical lines indicate the start of the financial crisis (end-Q2 2007), the collapse of Lehman Brothers (end-Q3 2008), the announcement of the change to the FDIC assessment base (end-Q3 2010) and its implementation (1 April 2011).

Sources: Federal Financial Institutions Examination Council, Call Reports (form FFIEC 002); Federal Reserve H.4.1 release.

("quantitative easing") came to a close. As predicted, it fell further, to $54 billion by end-Q4 2011, after the change in the FDIC assessment as well as the Fed's second round of quantitative easing. The right-hand panel of Graph 2 shows that non-banks with accounts at the Fed like Fannie and Freddie (Wall (2011)) often failed to sell their holdings at the Fed, suggesting credit and strategic (Bech and Klee (2011)) frictions.

3.2 The new FDIC assessment, overnight yields and who pays

Insured banks were quick to anticipate the FDIC change. Their balance-sheet adjustments were well under way in the weeks and months leading up to the April 2011 changeover even though many banks did not learn of their new individual FDIC assessment rates until the summer of 2011. Conversations with informed observers indicated that the FDIC change cut overnight rates at the margin by 5–10 basis points. The lenders of short-term funds appear to have borne the brunt of this reduction.

Trading on the day of 1 April 2011 was especially turbulent, and some overnight instruments briefly traded with negative yields. One anecdote had FDIC staffers calling money market dealers that day, asking why rates had cratered. Stepping back, a review of average rates during the four quarters before and since the FDIC change tells a clear story.

Table 4 confirms that a transition in the level of overnight dollar interest rates occurred around 1 April 2011, with rates falling from already low levels (near 20 basis points on average) to ultra-low levels below 10 basis points. Marginal bank borrowers lowered their bids not only in the fed funds market but in the offshore (eurodollar) market and the (secured) repo market. The new FDIC assessment affected every type of bank borrowing so that, as lenders scrambled to place their funds, the entire overnight rate complex was squeezed down towards zero. The evidence in Table 4 is consistent with the prevailing market wisdom: the FDIC

FDIC assessment change and overnight yields

Average levels of overnight interest rates in per cent before and after 1 April 2011   Table 4

Quarterly period	Effective federal funds	Eurodollars	Treasury repo	*Memo: Three-month OIS*
1 Jan 2010–31 Mar 2010	0.1321	0.1438	0.1289	*0.1653*
1 Apr 2010–30 Jun 2010	0.1923	0.2168	0.2006	*0.2214*
1 Jul 2010–30 Sep 2010	0.1822	0.2094	0.2296	*0.1852*
1 Oct 2010–31 Dec 2010	0.1852	0.2115	0.2174	*0.1797*
1 Jan 2011–31 Mar 2011	0.1510	0.1676	0.1566	*0.1535*
1 Apr 2011–30 Jun 2011	0.0928	0.0994	0.0630	*0.1123*
1 Jul 2011–30 Sep 2011	0.0883	0.0909	0.0674	*0.0931*
1 Oct 2011–31 Dec 2011	0.0761	0.0818	0.0940	*0.0897*
1 Jan 2012–31 Mar 2012	0.1074	0.1205	0.1537	*0.1109*

Sources: ICAP and authors' calculations.

change pushed down already low overnight rates by an additional 5–10 basis points.

The box shows that the lower overnight rate carried over to the key benchmark short-term rate, three month Libor. As a result, a host of payers of floating interest rates, ranging from non-financial firms, through households with floating-rate mortgages, to young people with student loans, benefited from the wider FDIC assessment.

3.3 The FDIC assessment change and money market integration

Because the wider FDIC assessment bound US-chartered banks but not US branches and agencies of foreign banks, any overnight interest rate makes for different all-in costs for these two groups of potential borrowers. These circumstances could only weaken the linkages between market segments, especially if the composition of participants differs across market segments. In this section, we consider various cross-market statistics that show that overnight dollar money markets indeed became less integrated after the FDIC assessment change.

Table 5 shows in the simplest terms how the relationships among our three key overnight rates have weakened, both in level terms and in terms of day-to-day changes. The tightness of every market link, as measured by its correlation coefficient, was weaker in the 12-month period after the widening of the FDIC assessment base than before. Links were looser not only for pairs involving eurodollars, which might have been particularly affected by sovereign strains in Europe, but also for the federal funds-repo pair.

Box: The FDIC assessment and term lending rates

The key to linking the FDIC assessment to term lending rates like Libor or the now defunct New York funding rate (NYFR) is a third term rate, the dollar overnight index swap (OIS) rate. This is a fixed rate quoted by brokers that can be swapped against the average value of the effective fed funds rate over a contracted term, say three months (Wheatley (2012, pp 47-48)). Libor is simply the sum of this OIS rate and a bank credit-risk premium. Therefore, the impact of the FDIC assessment on Libor operating through its impact on current and expected overnight fed funds rates is reflected in the OIS rate.

US dollar three-month money market rates

In per cent   Graph A
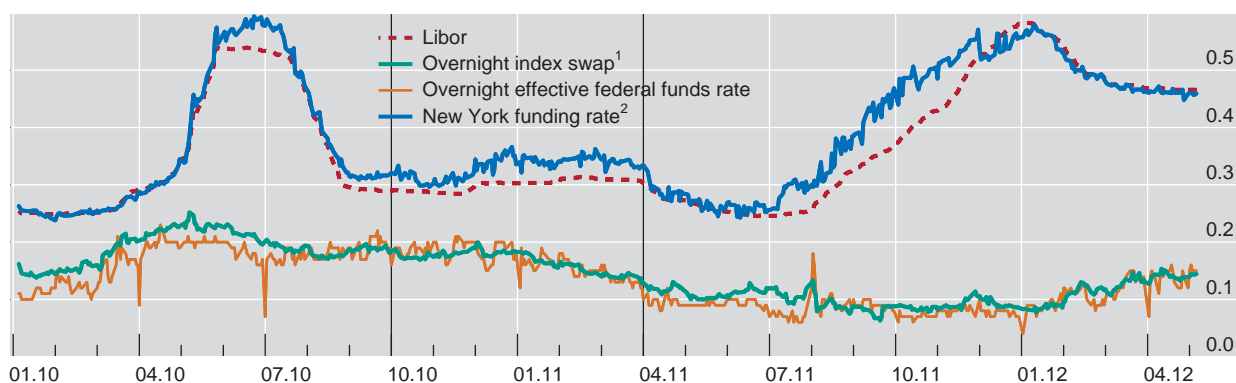
Note: The vertical lines indicate the announcement of the change to the FDIC assessment base and its implementation (1 April 2011).

[1] The dollar overnight index swap is a rate for three months that can be swapped against the average effective federal funds rate for the same three months.   [2] The New York funding rate is a mid-market three-month rate reported by anonymous survey participants in the New York morning. ICAP ceased its publication in August 2012 as bank participation declined.

Sources: British Bankers Association, ICAP.

As overnight rates dropped in the first quarter of 2011, the three-month overnight index swap rate also began to fall (Graph A, green line), averaging roughly 15 basis points during this transition quarter, down from 18 basis points during the fourth quarter of 2010 (Table 4, memo column). That is, market participants treated the declines in overnight rates as lasting ones. The three-month overnight index swap rate continued to track overnight rates lower in the two quarters after 1 April, eventually matching the average decline of 9 basis points in the effective federal funds rate. After 1 April, both the three-month Libor (red dashed line) and the NYFR (blue line) moved lower, substantially restoring their respective pre-FDIC spreads with the OIS rate mid-year. Although European events led to wider credit risk premia in the summer of 2011 (as well as credit frictions in the overnight market in Graph 3, right-hand panel), the OIS rate allows us to conclude that the FDIC-induced decline in overnight rates during the first half of 2011 was substantially passed through to three-month Libor, benefiting borrowers and floating rate payers in derivative contracts.

A more precise regression-based analysis that focuses on the interest rate spreads between markets (Table 6) allows us to measure the speed with which each pair of markets returns to equilibrium following a shock. The half-life of a deviation is measured as $-\ln(2)/\ln(1+ ß)$. This analysis suggests that the FDIC assessment change has slowed arbitrage across dollar overnight money markets. For example, in the key overnight fed funds and eurodollar markets during the pre-FDIC period, we observe that half of any disturbance to their rate spread away from its centre of gravity is retraced in roughly two (2.16) days. Following the FDIC assessment change, that half-life lengthens to nearly three (2.83) days, an increase of more than

FDIC assessment and correlations among overnight yields and their changes   Table 5

Rate series or change pair	Time period	
	Pre-FDIC 1 Jan 2010–31 Dec 2010	Post-FDIC 1 Apr 2011–31 Mar 2012
Fed funds vs Eurodollar	0.9259	0.8837
Fed funds vs repo	0.8341	0.6570
Eurodollar vs repo	0.8384	0.6854
ΔFed funds vs ΔEurodollar	0.7477	0.5719
ΔFed funds vs Δrepo	0.6361	0.4838
ΔEurodollar vs Δrepo	0.5876	0.4990

Sources: ICAP and authors' calculations.

30%. Similarly, the half-lives for the fed funds/repo and eurodollar/repo linkages increase by 26% and 48%, respectively. Clearly, the results suggest that the wider FDIC assessment loosened the integration of overnight money market segments. When the Federal Reserve again starts to change the federal funds target to signal its policy, it will have to contend with money markets that spread its policy across those markets with less immediacy.

The rate effects discussed in this section are associated with sizeable adjustments in the balance sheets of US-chartered and foreign-headquartered banks, adjustments made to avoid or to exploit the widening of the FDIC assessment base. In the next section, we discuss what we might expect to happen, and what actually happened, in the way of balance-sheet adjustments. It turns out that the weakening of arbitrage between onshore and offshore money markets happened during a period of unwinding of cross-border funding positions.

Pre- and post-FDIC overnight rate convergence

Estimation of $\Delta\, Spread_{i-j,t} = \alpha_{i-j} + \beta_{i-j} \times Spread_{i-j,t-1} + \sum \theta_n \times \Delta\, Spread_{i-j,t-n} + \varepsilon_{i-j,t}$ Table 6

Rate series spread	Time period	
	Pre-FDIC assessment change 1 Jan 2010–31 Dec 2010	Post-FDIC assessment change 1 Apr 2011–31 Mar 2012
Eurodollar minus fed funds (lag=2):		
beta	−0.2771	−0.2172
half-life	2.16	2.83
Repo minus fed funds (lag=1):		
beta	−0.2597	−0.2133
half-life	2.30	2.89
Eurodollar minus repo (lag=1):		
beta	−0.3271	−0.2352
half-life	1.75	2.59

Sources: ICAP and authors' calculations.

4. Balance-sheet response to the FDIC assessment and QE2

In this section, we analyse how US-chartered banks altered their funding mix in response to the change in the FDIC assessment base. We also examine its interaction with the expansion of bank reserves at the Fed (QE2) using both aggregate flows of funds and bank-level data. The Federal Reserve's injection of a large sum of excess reserves acted like time-lapse photography by compressing what might have been longer-term adjustments into several quarters. The Fed forced US commercial banks to add 5% to their $12 trillion in assets in seven months in the form of excess reserves yielding 25 basis points.

Such an assessment on *non-deposit* liabilities held by *some* banks in the United States in an environment of forced asset growth would justify three expectations, which we explore below. First, the affected entities should rely less on the newly assessed liabilities. The data confirm that the funding model of the affected US-chartered banks responded strongly to the change in the relative cost of deposits and wholesale funding. In particular, these banks bid for more deposits and at the same time repaid newly assessed liabilities to their foreign affiliates. This behaviour was most marked among the biggest banks that relied more on wholesale funding and that must pay a premium for complexity in the FDIC assessment matrix.

Second, unaffected foreign bank branches and agencies could be expected to take up a disproportionate share of the excess reserves at the Fed since the all-in cost of their more elastic source of funds had not risen. The data again confirm this, notwithstanding the deterioration in the credit standing of banks from the euro area, which had some of the largest US branches and agencies.

And third, the non-affected banks would have no reason to avoid funding with the liabilities on which other banks are now paying assessments. Again, the bank-level data confirm this; foreign branches and agencies funded the new claims on the Fed by reducing their net claims on their foreign affiliates.

4.1 US-chartered banks' change in funding model

A tax on the *non-deposit* liabilities of US-chartered banks operating in the United States can be expected to set in train important changes on the liability side of these banks' balance sheets. Specifically, the banks should economise on the newly assessed wholesale funds. The only way that they can do that is to raise more equity, which is likely to be expensive, or to gather more deposits. Indeed, banks should now favour deposit over non-deposit liabilities because the (relative) regulatory cost of deposits has gone down, owing to a lower assessment on deposits (to leave the measure revenue-neutral) and a new assessment on other liabilities. For example, say a big bank was paying a 10-basis point premium to the FDIC on its domestic deposits before, and afterwards has to pay 8 basis points on both deposit and non-deposit liabilities. Before the wider assessment base, the regulatory costs of the two funding sources differed by 10 basis points, and afterwards by zero basis points. Particularly in an environment of very low rates, one would expect banks to change their funding habits in the face of such a shift in relative costs.

This is illustrated in Graph 4, which shows how a representative bank would respond to the all-in cost of deposits falling and the all-in cost of wholesale liabilities rising (ie the shift from the solid black line to the dashed red line). Here we

make the assumption that the marginal cost of deposits is lower than the cost of wholesale funding up to a point (D_0), after which wholesale funding is cheaper. The upward shift rise in the all-in cost of wholesale funds leads to a higher loan rate, r_1. At the same time, a downward shift in the all-in cost of deposits leads to an increase in deposits from D_0 to D_1, and thus a rise in the of deposits to loans (D_0/L_0 to D_1/L_1).

Bank quality would figure in the response of US-chartered banks to the FDIC move, and affect the take-up of the Federal Reserve excess reserves. Higher-quality banks with relatively low FDIC assessments would experience a smaller shift in the regulatory cost of deposit and non-deposit liabilities. In particular, an 8-basis point assessment of a good bank would represent a smaller wedge in the gap between the Federal funds rate and the 25 basis points on excess reserves received from the Federal Reserve, leaving more incentive to do the intermediation.

To some extent, the Fed's purchase of Treasury bonds from non-bank investors produced an inflow of domestic deposits. In the first instance, an investor selling a bond to the Fed receives a credit to her bank account equal to the sales proceeds. In fact, households reduced their holdings of Treasury securities by $330 billion between September 2010 and June 2011, and increased their holdings of bank deposits by $240 billion. However, institutional investors continued to accumulate Treasury securities and did not much increase their holdings of bank deposits.[12]

On balance, US-chartered banks have come to rely much more on deposit funding. They took in almost $500 billion in deposits from households and firms

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Change in the FDIC assessment base and reliance on deposits[1] Graph 4
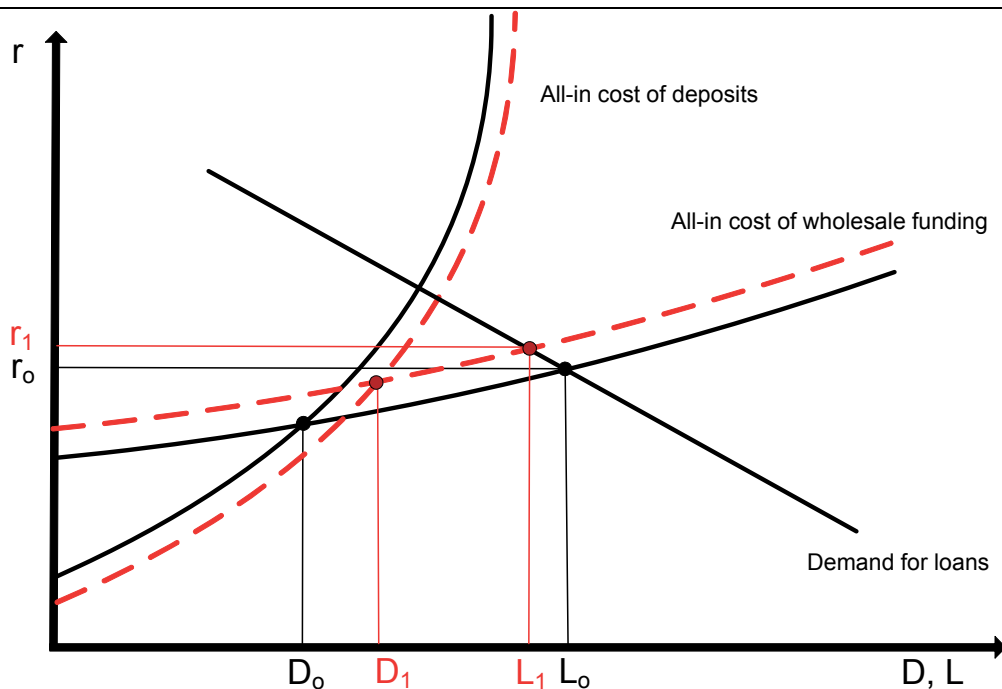
[1] The graph shows how the change in the FDIC assessment base affects the all-in cost of deposit and wholesale funding sources (shift from the solid black lines to the red dashed lines) for FDIC-insured banks. The widening of the assessment base from domestic deposits to total assets less equity increases the relative cost of wholesale funding. The equilibrium level of deposits shifts from D_0 to D_1.

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[12]   US-chartered banks slightly reduced their holdings of Treasury securities during QE2, while pension funds, insurance companies, mutual funds and foreign investors increased their holdings.

Reliance on deposits by US-chartered banks

In billions of US dollars   Table 7

|	Q3 2010	Q4 2010	Q1 2011	Q2 2011	Q3 2011	Q4 2011	Q1 2012	2012 Q2
Checkable	838	941	978	1,060	1,155	1,261	1,220	1,230
Small time	5,790	5,889	5,980	6,131	6,293	6,426	6,599	6,639
Large time	901	849	824	819	802	814	743	778
Total	7,530	7,679	7,782	8,010	8,250	8,500	8,562	8,646
Memo:								
Total assets	11,293	11,291	11,309	11,453	11,557	11,706	11,656	11,748
Deposits/ assets	*66.67%*	*68.01%*	*68.81%*	*69.94%*	*71.38%*	*72.61%*	*73.45%*	*73.60%*

Source: Federal Reserve Flow of Funds.

from September 2010 to mid-2011 (Table 7), more than double their incremental holding of reserves at the Fed. As a result of deposits growing faster than assets, US-chartered banks raised their reliance on deposits from 66.7% of total assets in September 2010 to 69.9% in June 2011 and 72.6% by end-2011 (Table 7).[13]

From a longer-term perspective, a 7 percentage point rise in the deposit-to-asset ratio in the seven quarters through mid-2012 has no precedent (Graph 6, lower left-hand panel). To be sure, the turning point came when dependence on wholesale funding created the greatest vulnerability, namely in the fourth quarter of 2008. However, the subsequent rise owes all to the increase in deposits (Table 7).

Digging into the cross section, the left-hand panel of Graph 5 shows that US-chartered banks, whether US- or foreign-owned, raised their reliance on deposits. (In contrast, foreign bank branches in the United States, discussed in the next section, did not.) The right-hand panel of Graph 5 shows that the change in the funding structure was most pronounced among large banks. Indeed, the top five banks raised their ratio of deposits to assets by almost 20 percentage points. With their prior reliance on wholesale funding, these banks stood to pay up with the new FDIC assessment base (Table 2). To avoid paying more, they sought to bring their funding model into alignment with that of smaller banks.

The wholesale funding that the big banks let run off comprised not only fed funds (Graph 3, left-hand panel) but also eurodollar funding sourced from their affiliates offshore (Graph 6, lower right-hand panel, red line). Liabilities to affiliates abroad declined by about $100 billion during the three quarters of QE2 and by another $300 billion into 2012. A strong force was at work to reduce to zero in very short order a stock of liabilities that had taken years to build up.

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[13]   Admittedly, the FDIC assessment on managed liabilities was not the only feature of Dodd-Frank in play. The legislation also extended blanket, unlimited FDIC insurance on non-interest bearing deposits, which expired on schedule at the end of 2012. In the event, there was surprisingly little response by bank deposits to the expiration of this guarantee.
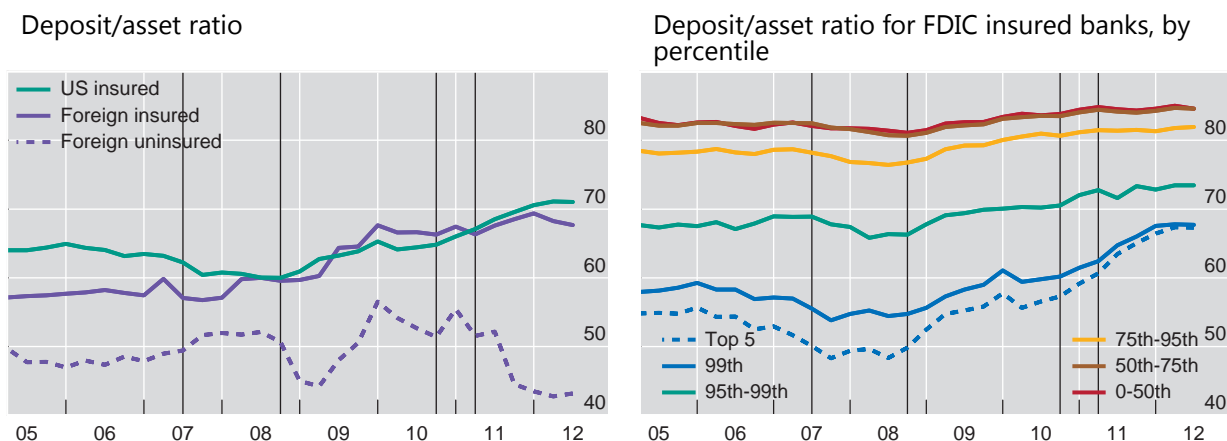
Graph 5

Deposit/asset ratio

Deposit/asset ratio for FDIC insured banks, by percentile

Note: The vertical lines indicate the start of the financial crisis (end-Q2 2007), the collapse of Lehman Brothers (end-Q3 2008), the announcement of the change to the FDIC assessment base (end-Q3 2010) and its implementation (1 April 2011).

Sources: Federal Financial Institutions Examination Council, Call Reports.

4.2 US branches of foreign banks and holdings of reserves at the Fed

Our second prediction shifts the focus from the liabilities of the banks affected by the wider FDIC assessment to the assets of the unaffected US branches of foreign banks. Unconstrained by a rise in the cost of their liabilities, foreign branches took on a disproportionate share of the reserves used by the Fed to pay for Treasury securities in QE2 (Graph 6, upper left-hand panel, solid lines). In particular, they took roughly two thirds of the cumulative change in reserves at the Fed from the end of September 2010 to the middle of 2012. Recall that foreign branches and agencies had about $1.5 trillion of assets, while US-chartered banks had over $10 trillion.

Not only was the share of foreign branches disproportionate, but it was *more disproportionate* than during QE1 (dashed lines) from late 2008 to early 2010. Then, foreign branches claimed a share of only a quarter to a third of the overall increase.

We use regression analysis on bank-level data taken from the US call reports to formally investigate this asymmetric uptake of excess reserves. As in Graph 6, upper left-hand panel, we exploit the natural experiment represented by the Fed's two episodes of large-scale bond purchases by separately examining the determinants of banks' increases in holdings of reserves during QE1 and QE2. Our regressions aim to measure the partial effect of the FDIC change in the assessment base on changes in banks' holdings of reserves after controlling for other bank characteristics that may have affected them as well.

We define three alternative dependent variables, each of which captures individual banks' changes in reserve holdings during the quantitative easing window. The first is ΔFRB_i, which is simply the dollar change in bank i's holdings of reserves from the beginning to the end of the quantitative easing operation. The second is $\Delta FRB_i / TA_i$, where, again, the numerator is the change in bank i's holding of reserves over the quantitative easing period, and the denominator is bank i's total assets measured at the end of the quarter before the operation. The third is
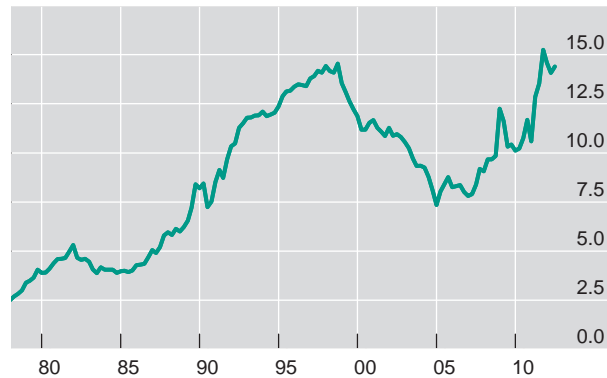
Balance-sheet responses to quantitative easing and the FDIC assessment change
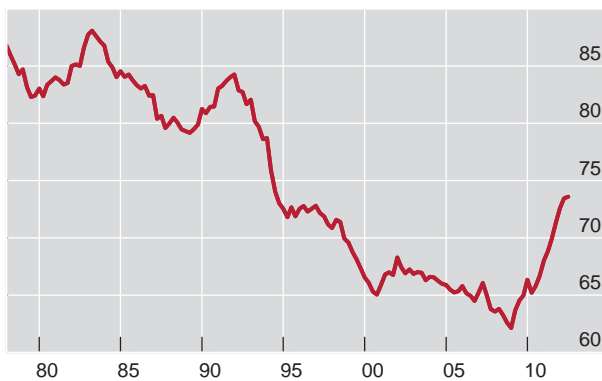
Graph 6
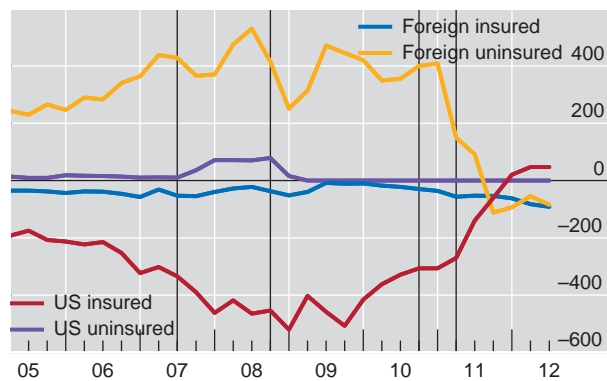
Cumulative change in reserves at the Federal Reserve[1,2]
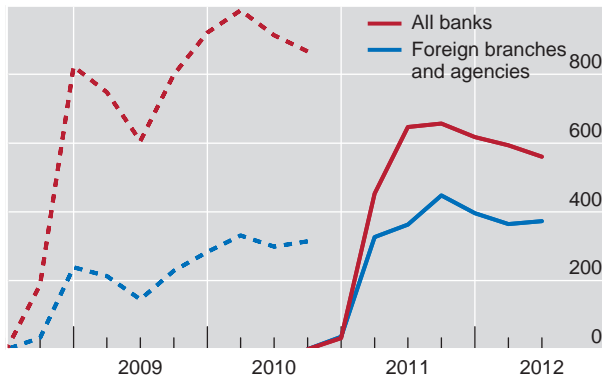
Asset share of foreign branches and agencies[3]

Deposit-to-asset ratio for US-chartered banks[1]

Inter-office claims by bank nationality and FDIC status[1,4]

Note: The vertical lines indicate the start of the financial crisis (end-Q2 2007), the collapse of Lehman Brothers (end-Q3 2008), the announcement of the change to the FDIC assessment base (end-Q3 2010) and the implementation of the change (1 April 2011).

[1] In billions of US dollars.   [2] Cumulative change in balances due from Federal Reserve banks during the first round of Fed bond-buying (QE1, dashed lines) and the second round (QE2, solid lines).   [3] Sum of total assets of foreign branches and agencies (Flow of funds Table L.111) in total bank assets in the United States (Tables L.110 plus Table L.111, excluding credit unions), in per cent.   [4] Sum across banks of net due from (asset side) and net due to (liabilities side) related depository institutions .

Sources: Federal Reserve *Flow of funds statistics*, Federal Financial Institutions Examination Council, Call Reports.

$\Delta(FRB_i/TA_i)$, which is the change in the *share* of bank *i*'s reserve holdings in its total assets during the quantitative easing period. While we are agnostic about which of these dependent variables is most appropriate, $\Delta(FRB_i/TA_i)$ interests us most because it indicates a shift in balance-sheet composition towards reserve holdings.

We choose independent variables to isolate the effect of FDIC insurance from other bank characteristics that may have affected the uptake of reserves. These include bank size, measured by total assets (and total assets squared), and the level of reserve holdings prior to the quantitative easing operations. The independent variables of interest are: (i) a dummy that takes the value of 1 for FDIC-insured entities (0 otherwise); and (ii) bank nationality dummies, which control for home-country fixed effects. For instance, when money market funds cut deposits in

German banks in 2011, the dummy for German banks would soak up the average effect.[14]

As described above, the change in the FDIC assessment should be evident in two ways. First, we test for whether FDIC insurance exerted a different effect in the two periods of quantitative easing. If indeed the change in the FDIC assessment led to the outsized uptake of reserves during QE2, we should see a negative and statistically significant coefficient on the FDIC dummy during QE2, but not during QE1. Second, this coefficient should remain significant even after the inclusion of our control variables. Specifically, the sample of banks is asymmetric in the sense that (virtually) all US-headquartered banks are insured by the FDIC whereas non-US banking entities are mixed. If it was other factors (eg credit risk concerns because of a bank's exposure to troubled European sovereigns) that drove the increase in reserve holdings, we should find a statistically insignificant coefficient on the FDIC dummy since bank nationality dummies should proxy for these other factors.

Table 8 shows the result of this analysis of the full sample of banks in the United States with positive reserve holdings at the Federal Reserve just before the quantitative easing operations.[15] The first three columns of Table 8 show the results of regressions for the QE1 period, while the last three columns show the results of similar regressions for QE2. Note that even these simple regressions account for

Change in reserve holdings during QE1 and QE2 and FDIC insurance

US-chartered banks and foreign branches and agencies   Table 8

	QE1: Q3 2008–Q1 2010			QE2: Q3 2010–Q4 2011		
Dependent variables[1]	ΔFRB_i	$\Delta FRB_i/TA_i$	$\Delta(FRB_i/TA_i)$	ΔFRB_i	$\Delta FRB_i/TA_i$	$\Delta(FRB_i/TA_i)$
FDIC dummy	-0.460	-2.516	-1.979	-2.314	-11.036	-4.98
	(-0.96)	(-1.07)	(-1.35)	(-5.11)	(-2.68)	(-4.17)
Total assets	0.092	0.024	0.012	0.083	0.045	0.037
	(20.87)	(1.10)	(0.87)	(22.34)	(1.33)	(3.77)
Total assets squared	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(-7.10)	(-0.78)	(-0.61)	(-22.36)	(-1.40)	(-3.95)
Due from FRB[2]	-1.066	-0.586	-0.277	0.001	0.07	0.053
	(-24.71)	(-2.77)	(-2.10)	(0.06)	(0.30)	(0.78)
Constant	0.09	284.94	81.821	0.919	478.587	3.082
	(0.03)	(21.19)	(9.76)	(0.49)	(28.03)	(0.62)
Bank nationality dummies[3]	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.543	0.449	0.328	0.312	0.374	0.221
Observation number	1780	1780	1780	1957	1957	1956

[1] The table shows the coefficients from OLS regressions of the change in individual banks' holdings of reserves at the Federal Reserve on a dummy for FDIC insurance and various controls. ΔFRB_i is the change in bank i's absolute reserve holdings from the beginning to the end of the respective period of quantitative easing. $\Delta FRB_i/TA_i$ is the change in bank i's reserves expressed as a share of total assets measured prior to the quantitative easing operations. $\Delta(FRB_i/TA_i)$ is the change in bank i's share of reserve holdings in total assets during the quantitative easing operation. t-statistics are shown in parentheses under each coefficient. [2] Level of bank i's reserve holdings measured at the beginning of the quantitative easing operations. [3] Dummies for the headquarter country of each bank.

[14] For the long-standing dependence of European banks on US money market funds for US dollar funding, see Baba et al (2009); for the money market funds' reduction of exposure to European banks, see Fitch Ratings (2011).

[15] Of the 7,000 banks in the United States covered by the call reports, only about 2,000 held positive reserves at the Federal Reserve in early 2009. Smaller banks tend to hold reserves in larger banks.

much of the cross-sectional variation in the change in reserve holdings (the R-squared statistics are quite high). Not surprisingly, bank size is positively related to the change in reserve holdings, regardless of the dependent variable.

The results point to the change in the FDIC assessment base, rather than any country-specific factors, as the explanation of the changes in banks' holdings of reserves. This is demonstrated by the negative and very statistically significant coefficient on the FDIC dummy for the QE2 period regressions. Using the change in the share of reserves in total assets as a baseline case (last column), the estimated coefficient implies that uninsured banks' share of reserves in total assets increased by 5 percentage points more than that of insured banks. Note that this result is robust to the inclusion of a full set of bank nationality dummies. Importantly, in contrast to the QE2 regressions, the coefficient on the FDIC insurance dummy is negative but statistically insignificant in all specifications for the QE1 period.

In ending up with a disproportionate share of QE2 reserves, foreign bank branches gained asset share in US commercial banking (Graph 6, upper right-hand panel). Their share reached an all-time high, surpassing the levels seen in the mid-1990s. We contend that the new FDIC assessment on wholesale funding, which does not apply to branches and agencies, explains this observation.

Other accounts emphasise European sovereign strains and their effect on the balance sheets of foreign branches in the United States.[16] Indeed, when we break down the assets of foreign branches and agencies by nationality, it is evident that euro area bank assets did behave differently from others in a manner consistent with recurrent credit problems (Graph 7). Whereas the aggregate of branches and agencies increased their US assets (upper left-hand panel), those from the euro area (lower left-hand panel) shrank their assets since the onset of the global financial crisis and since the worsening of sovereign strains in Europe.

However, the disproportionate uptake of reserves at the Fed was not particular to European banks. Their build-up of reserves at the Fed in QE2 was, if anything, *less* than that by Japanese, Swiss and UK banks (upper right-hand panel) or other banks, including Canadian, Australian and Swedish banks, that have retained their strong credit standing in recent years (lower right-hand panel). All foreign branches in the United States might well have ended up with an even higher fraction of the new reserves at the Federal Reserve had it not been for the European sovereign strains.

To investigate more formally, we return to regression analysis, but this time we focus on a restricted sample of non-US-headquartered banks' entities located in the United States. Some of them are subsidiaries insured by the FDIC and others are uninsured branches or agencies (Table 9). Here, we carry over the dependent variables and time periods (QE1 and QE2) from the regressions reported in Table 8, but we now introduce holding company dummies to control for individual foreign bank parents that own more than one US banking entity. In these cross-sectional regressions, these bank-holding company dummies control for much of the credit risk of individual institutions (eg as would be picked up by credit default swap

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[16]   Allen and Moessner (2013) hold that European banks exposed to troubled sovereigns hoarded liquidity to reassure investors or to satisfy supervisors. Correa et al (2012) find that European branches and agencies that lost wholesale US funding reduced their US loans.

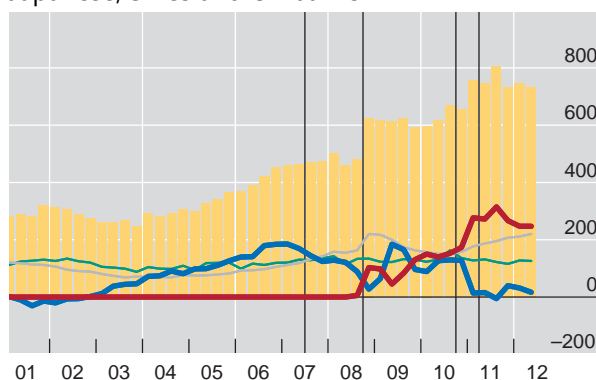## Foreign banks' uninsured branches and agencies in the United States[1]
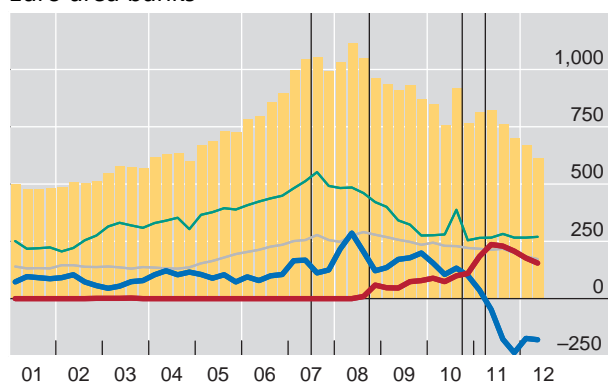
In billions of US dollars

Graph 7
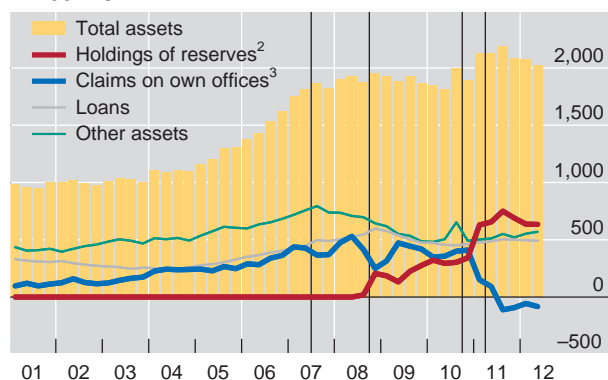
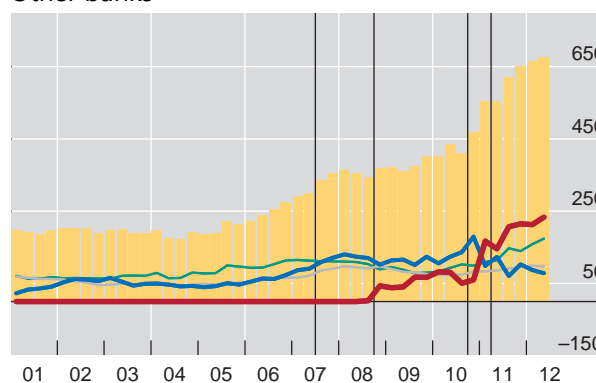
Note: The vertical lines indicate the start of the financial crisis (end-Q2 2007), the collapse of Lehman Brothers (end-Q3 2008), the announcement of the change to the FDIC assessment base (end-Q3 2010) and the implementation of the change (1 April 2011).

[1] Graph shows the balance sheets of foreign banks' uninsured branches and agencies aggregated by bank nationality.   [2] Balances due from Federal Reserve banks .   [3] Sum of net due from (asset side) and net due to (liabilities side) related depository institutions.

Sources: Federal Financial Institutions Examination Council, Call Reports.

spreads or ratings). This set of regressions thereby most precisely measures the partial role of FDIC insurance independent of these credit risk factors.[17]

Some simple sample statistics offer a preview of the regression results. Of the 241 foreign banking institutions in the United States that reported positive reserve holdings just prior to the start of QE2, 58 were FDIC insured and 183 were not. Their combined holdings of reserves increased by $414 billion during QE2. FDIC-insured banks increased the share of reserve holdings in total assets by less than 1 percentage point; uninsured banks increased their share by almost 6 percentage points. W*ithin each banking organisation,* asset growth was skewed toward branches able to increase managed liabilities assessment-free, and away from subsidiaries.

[17]   Note that this is more restrictive than necessary. Similar regressions which include all non-US institutions but do not include bank holding company dummies also yield similar results in that the FDIC insurance dummy is negative and statistically significant in the QE2 period.

Change in reserve holdings during QE1 and QE2 and FDIC insurance

Non-US-chartered banks[1]   Table 9

Dependent variables[2]	QE1: 2008Q3 – 2010Q1			QE2: 2010Q3–2011Q4		
	ΔFRB_i	$\Delta FRB_i/TA_i$	$\Delta(FRB_i/TA_i)$	ΔFRB_i	$\Delta FRB_i/TA_i$	$\Delta(FRB_i/TA_i)$
FDIC dummy	−0.655	−0.798	−0.049	−4.522	−20.551	−6.525
	(−0.41)	(−0.16)	(−0.01)	(−3.28)	(−1.44)	(−1.83)
Total assets	0.198	0.171	0.161	0.185	0.526	0.304
	(2.88)	(0.79)	(0.91)	(2.91)	(0.73)	(1.83)
Total assets squared	−0.000	−0.001	−0.001	−0.000	−0.003	−0.001
	(−0.56)	(−0.39)	(−0.52)	(−0.88)	(−0.60)	(−1.30)
Due from FRB[3]	−0.890	1.857	−0.188	−0.265	−0.612	0.045
	(−1.70)	(1.14)	(0.14)	(−2.18)	(−0.45)	(0.14)
Constant	−0.011	−0.011	−0.061	8.97	−39.903	−0.047
	(−0.00)	(−0.00)	(−0.00)	(1.36)	(−0.54)	(−0.00)
Bank nationality dummies[4]	Yes	Yes	Yes	Yes	Yes	Yes
Holding company dummies[5]	Yes	Yes	Yes	Yes	Yes	Yes
R–squared	0.595	0.744	0.8	0.585	0.325	0.382
Observation number	138	138	116	155	155	154

[1] The sample includes only those foreign-owned banking entities that are part of a larger banking group that has at least two entities operating in the United States.   [2] The table shows the coefficients from OLS regressions of the change in individual banks' holdings of reserves at the Federal Reserve on a dummy for FDIC insurance and various controls. ΔFRB_i is the change in bank i's absolute reserve holdings from the beginning to the end of the respective period of quantitative easing. $\Delta FRB_i/TA_i$ is the change in bank i's reserves expressed as a share of total assets measured prior to the quantitative easing operations. $\Delta(FRB_i/TA_i)$ is the change in bank i's share of reserve holdings in total assets during the quantitative easing operation. t-statistics are shown in parentheses under each coefficient.   [3] Level of bank i's reserve holdings measured at the beginning of the quantitative easing operations.   [4] Dummies for the headquarter country of each bank.   [5] Dummies for individual holding companies of banking entities.

This result survives the regression analysis that includes controls for the parent group (Table 9). The coefficients on the FDIC dummy variable during the QE2 operations exceed those during QE1, and are statistically significant in all but the second specification. These findings further confirm that it is non-US banks' advantage in having uninsured branches that explains their asymmetric uptake of Fed reserves, not some other characteristic specific to them.[18]

In summary, aggregate and bank-level analysis both point to the importance of the new FDIC assessment in explaining the distribution of the asset growth forced by the Fed's financing of its bond purchases. In aggregate, foreign branches took up more of QE2 after the FDIC change than they had taken up of QE1 before this change. Precautionary demand for reserves would suggest that euro area banks should have taken more than their fair share of the Fed reserves, but the reverse is

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[18]   Correa et al (2012, p 18) argue that investors focused on the sovereign risk "in a somewhat indiscriminate way", and capture this notion with dummies for the bank country of origin. If so, our inclusion of bank nationality dummies above should ensure that the FDIC result is not an artefact of European sovereign strains, but here we include dummies for bank group as well.

the case. Instead, the banks least affected by losses in US housing and Europe took most of the new Fed reserves. And regression analysis confirms the importance of FDIC coverage in explaining the scale of acquisition of Fed reserves, even across subsidiaries and branches of individual foreign banks in the United States.

4.3 Foreign branches and agencies' funding

Consistent with our hypothesis, foreign branches in the United States funded their holdings of Fed reserves with the sort of wholesale funds that would have attracted an FDIC assessment if used by US-chartered banks. Rather than domestic sources such as federal funds or repo, however, the particular source of funds that the US branches and agencies of foreign banks drew on makes this a global banking story. Specifically, they drew on their own affiliates outside the United States to fund their asset growth. The flow of funds data show that their claims on all banks outside the United States of $359 billion in September 2010 had been worked down to a net liability by June 2011 that had mounted to $166 billion by September 2011, a swing of $525 billion in four quarters. The similar decline in Graph 6 (lower right-hand panel, yellow line) implies that the sizeable change took place against own offices outside the United States.

Indeed, for each nationality group of foreign branches in Graph 7, a close relationship emerges between the increase in its holdings at the Fed and the drawdown of its claims on its affiliates abroad. The upper left-hand panel juxtaposes net inter-office claims to other assets. In aggregate, as claims on the Fed became the largest category of assets, foreign branches repatriated dollars that they had previously advanced to affiliates abroad. A regression of the change in reserve holdings at the Fed by a sample of 130 branches and agencies on the change in their net claims on own offices abroad (and other controls) indicates a very tight relationship: for every dollar increase in holdings at the Fed, net due to own offices rose by 44 cents.[19] The lower left-hand panel of Graph 7 shows that this relationship held even for banks in the euro area whose funding was squeezed in mid-2011 by credit concerns. The upper right-hand panel shows that it held as well for the well established Japanese, Swiss and UK banks, whose assets levelled off. And the lower right-hand panel shows that it held as well for the Australian, Canadian, Swedish and other banks of unimpaired creditworthiness which attracted local deposits as well as reduced claims on foreign affiliates.

These observations suggest that a powerful force was at work. After all, as noted by Shin (2012), foreign banks in the United States had built up their claims on their foreign offices from the turn of the century. Yet the net claims were run down and turned into a liability in a matter of quarters.

They also provide perspective on the finding above that the onshore and offshore money markets have become less tightly linked in the period since 1 April 2011. Previously, foreign banks had sourced dollars onshore in the United States, while US banks had sourced dollars offshore, and these two-way flows had accumulated into offsetting stocks (Graph 6, lower right-hand panel). The widening of the FDIC assessment base to eurodollar liabilities led US banks to repay them. For

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[19]   The regression described here contains all control variables used in Table 9, except the FDIC dummy. The R squared from this regression is 0.617, and the t statistics on the net due to own offices is 9.62.

their part, foreign banks' US branches drew down their net advances of dollars to their affiliates abroad, which in effect funded their disproportionate share of the new claims on the Federal Reserve. In short, rather than US-chartered banks' funding themselves extensively from abroad and foreign branches lending dollars extensively to affiliates abroad, both reduced their intragroup cross-border positions towards zero. This reduced interpenetration of funding was associated with a marked lengthening of the time taken for the onshore and offshore money market rates to converge.

The opposite movement of dollars, with foreign banks repaying funds raised in the United States and US-chartered banks repaying funds raised outside the United States, makes no sense when viewed from a macroeconomic perspective. But it makes good sense as a response to the US-chartered banks having to pay the FDIC assessment on funds raised outside the United States.

5. Conclusions

The widening of the FDIC assessment base for US-chartered banks from domestic deposits to total assets less tangible equity in effect imposed a corrective or Pigovian tax on wholesale liabilities such as federal funds, repos and eurodollars. Such funding comes with an externality, namely a risk to financial stability because of the potential for contagious runs. The observed response in both prices and quantities allows us to draw four conclusions.

First, it appears that US-chartered banks shifted the cost of the widened FDIC assessment base onto providers of wholesale funding around 1 April 2011. Moreover, arbitrage relationships between US dollar federal funds rates targeted by the Federal Reserve and eurodollars became looser: the estimated half-life of any divergence between them lengthened from two to three days. The decline in the structure of overnight rates seemed to have been transmitted to three-month Libor and thereby to the stock of floating-rate dollar liabilities and derivatives.

Second, US-chartered banks responded by changing their funding model to rely more on deposits. This is precisely what an environmental engineer imposing a Pigovian tax would wish for: firms avoided paying by cleaning up their act.

Third, unaffected by the wider FDIC assessment, US branches and agencies of foreign-chartered banks ended up with a disproportionate share of the new excess reserves from the Fed's QE2. In a regression of changes in holdings of claims on the Fed in this period, a dummy for FDIC insurance has an economically large and statistically significant negative effect. In contrast, there was no such effect during QE1, before the change in the FDIC assessment. When we narrow the analysis to US subsidiaries (holding a US charter and so subject to the FDIC assessment) and branches of the same foreign-headquartered bank, we find that the branch, not subject to the FDIC assessment, accounts for most of increased holdings of Fed reserves (even after controlling for the creditworthiness of the parent organisation). Foreign banks' branches took up the bulk of QE2's reserves notwithstanding the strains in the creditworthiness of European banks in 2011.

Fourth, global dollar funding flowed in a counterintuitive fashion during what is called QE2. Fears that QE2 would flood the global interbank market with dollars proved unfounded. True, US-chartered banks lowered the cost of the wider FDIC assessment base by paying back a large stock of eurodollars borrowed abroad. But

at the same time, foreign banks repatriated hundreds of billions of dollars back into the United States to finance their disproportionate take-up of the new claims on the Federal Reserve. On balance, dollars flowed into the United States.[20]

Viewed as a Pigovian tax on unstable managed liabilities, this policy has only partially contributed to financial stability. Doubtless the funding structure of US-chartered banks shifted away from wholesale funding. If managed liabilities are more prone to runs than deposits, then these banks now fund themselves in a way that is more conducive to financial stability. The benefit is all the greater since it was systemically important big banks that most improved their funding models.

However, US-chartered banks compete globally with foreign-chartered banks, including their branches in the United States. Since these were not affected by the wider FDIC assessment, they could take market share from US-chartered banks.[21] Thus the effectiveness of a tax on financial pollution produced by institutions chartered in only one jurisdiction can be undermined by competition from those chartered in another. Thanks to the coincidence of the Fed's QE2, amounting to some 4% of commercial bank assets in the United States, we have witnessed a fast-forwarding of the effect of the wider FDIC assessment on the market share of foreign-chartered banks. BIS statistics show that banks outside the United States held $2.6 trillion in claims on US non-banks in September 2012. This sum could grow larger as foreign banks put to work their advantage in raising wholesale funds.

This is not simply a case of wholesale funding moving from one set of institutions to another, with no implication for financial stability. US-chartered banks book most of their dollar credit in the United States, where it can readily serve as collateral at the Fed's discount window. Foreign-chartered banks, by contrast, book most of their dollar credit outside the United States.[22] The Federal Reserve extended dollar swaps to major central banks in 2008–09 to allow them to fund foreign banks that needed dollars but had no or limited access to its discount window (Committee on the Global Financial System (2010a)). Ironically, a unilateral levy on bank managed liabilities, by shifting dollar intermediation away from US-owned banks, may make international cooperation in liquidity regulation and provision more important.

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[20]   See Martin et al (2011) for the argument that the Federal Reserve introduced assets into the banking system that compete with other dollar assets in bank portfolios.

[21]   Korinek (2012) might regard the FDIC assessment as an imperfect instrument. We would suggest that the instrument may be fine but that its uncoordinated application can have perverse results. See Goodhart (2012) on the genesis of Basel I.

[22]   The contrast between the dollar funding of Canadian as compared to European banks in late 2008 is instructive. Canadian banks, with subsidiaries chartered in the United States, were able to draw on the Federal Reserve's discount window facilities. In contrast, many European banks were only able to obtain sufficient dollar funding by providing collateral to their home central banks, which in turn obtained dollars through swaps with the Federal Reserve.

References

Acharya, V, L Pedersen, T Philippon and M Richardson (2009): "Regulating systemic risk", Chapter 13 of *Restoring financial stability: how to repair a failed system*, V Acharya and M Richardson (eds), New York University Stern School of Business, John Wiley and Sons, March.

Allen, W and R Moessner (2013): "The liquidity consequences of the euro area sovereign debt crisis", *BIS Working Papers,* no 390, March.

Alworth, J and G Arachi (2012): "Introduction", in J Alworth and G Arachi, (eds), *Taxation and the financial crisis,* Oxford University Press, pp 1–27.

Baba, N, R McCauley and S Ramaswamy (2009): "US dollar money market funds and non-US banks", *BIS Quarterly Review*, March, pp 65–81.

Bair, S (2011): Testimony to hearing on "State of the FDIC: deposit insurance, consumer protection, and financial stability", before the Committee on Banking, Housing and Urban Affairs; United States Senate, 30 June.

Bartolini, L, S Hilton and A Prati (2008): "Money market integration", *Journal of Money Credit and Banking*, vol 40, no 1 (February), pp 193–213.

Basel Committee on Banking Supervision (2012): *Report to G20 Finance Ministers and Central Bank Governors on Basel III implementation*, October.

Bech, M and E Klee (2011): "The mechanics of a graceful exit: interest on reserves and segmentation in the federal funds market", *Journal of Monetary Economics*, vol 5, issue 5, July, p 415–31.

Committee on the Global Financial System (2010a): *The functioning and resilience of cross-border funding markets, CGFS Publications,* no 37, Basel, March.

____ (2010b): *Funding patterns and liquidity management of internationally active banks, CGFS Publications,* no 39, Basel, May.

____ (2011): *The impact of sovereign credit risk on bank funding conditions, CGFS Publications,* no 43, Basel, July.

Correa, R, H Sapriza and A Zlate (2012): "Liquidity shocks, dollar funding costs and the bank lending channel during the European sovereign crisis", *Board of Governors of the Federal Reserve System International Finance Discussion Papers,* no 1059, November.

Demiralp, S, B Preslopsky and W Whitesell (2006): "Overnight interbank loan markets", *Journal of Economics and Business*, vol 58, pp 67–83.

Ely, B (2011): "Re RIN number 3064-AD66; assessments, large bank pricing NPR; assessments, assessment base and rates NPR", comment letter to FDIC, 3 January.

Ennis, H and A L Wolman (2011): "Large excess reserves in the US: a view from the cross-section of banks", *Federal Reserve Bank of Richmond Working Paper*, 13 September.

ECB (2011): *Euro money market survey*, September.

Federal Deposit Insurance Corporation (2011): "12 CFR Part 327, RIN 3064–AD66: assessments, large bank pricing", *Federal register*, vol 76, no 38, 25 February, pp 10672–733.

Fitch Ratings (2011): "US money funds and European banks: exposures down, maturities shorter", *Fitch macro credit research,* 22 August.

Goodhart, C (2012): *The Basel Committee on Banking Supervision: a history of the early years 1974–1997,*Cambridge University Press.

Gruenberg, M (2011): Testimony at hearing on "Enhanced oversight after the financial crisis: Wall Street reform at one year", before the Committee on Banking, Housing and Urban Affairs, United States Senate, 21 July.

Hein, S, T Koch and C Nounamo (2012): "Moving FDIC insurance to an asset-based assessment system: evidence from the special assessment of 2009", *Journal of Economics and Business,* vol 64, no 1, January/February, pp 7–23.

Hemmelgarn, T and G Nicodeme (2012): "Can tax policy help to prevent financial crisis?", in J Alworth and G Arachi (eds), *Taxation and the financial crisis*, Oxford University Press, pp 116–47.

International Monetary Fund (2010): *A fair and substantial contribution by the financial sector: final report for the G20*, June.

Korinek, A (2012): "Capital controls and currency wars", manuscript, University of Maryland, November.

Kreicher, L (1982): "Eurodollar arbitrage", *Federal Reserve Bank of New York Quarterly Review*, summer, pp 10–22.

Lee, Y-S (2003): "The Federal funds market and the overnight eurodollar market", *Journal of Banking and Finance*, vol 27, pp 749–771.

Lloyd, G (2012): "Moving beyond the crisis: strengthening understanding of how tax policies affect the soundness of financial markets", in J Alworth and G Arachi (eds), *Taxation and the financial crisis*, Oxford university Press, pp 190–213.

Marquez, J, A Morse and B Schlusche (2012): "The Federal Reserve's balance sheet and overnight interest rates and reserve balances: econometric modeling of exit strategies", Federal Reserve Board, *Finance and Economics Discussion Series*, 2012-66, September.

Martin, A, J McAndrews and D Skeie (2011): "A note on bank lending in times of large bank reserves", *Federal Reserve Bank of New York Staff Reports*, no 497, May.

Masciandaro, D and F Passarelli (2012): "Regulation and taxation: economics and politics", in J Alworth and G Arachi (eds), *Taxation and the financial crisis*, Oxford University Press, pp 247–69.

McCauley, R (2001): "Benchmark tipping in the money and bond markets", *BIS Quarterly Review*, March, pp 39–45.

McCauley, R and R Seth (1992): "Foreign bank credit to US corporations: the implications of offshore loans", *Federal Reserve Bank of New York Quarterly Review*, vol 17, pp 52–65.

McDonald, J and S Johnson (2010): "Tax policies to improve the stability of financial markets", paper presented at the Bank of Italy workshop, "Fiscal policy: lessons from the crisis", Perugia, 25–27 May.

Ostry, J, A Ghosh and A Korinek (2012): "Multilateral aspects of managing the capital account", *IMF Staff Discussion Note*, SDN/12/10, 7 September.

Perotti, E and J Suarez (2011): "A Pigovian approach to liquidity regulation", working paper, April.

Schultze, C L (1977): *The public use of private interest*, Brookings University Press.

Shin, H S (2010): "Non-core liabilities tax as a tool for prudential regulation", mimeo, 19 February.

____ (2012): "Global banking glut and loan risk premium", *IMF Review*, vol 60, no 2, pp 155–92.

Smedley, B (2010): "FDIC proposal should lead to lower rates", Bank of America Merrill Lynch *US rates* weekly, 12 November.

Stigum, M and A Crescenzi (2007): *Stigum's money market*, 4th edition, Dow Jones-Irwin.

Wall, L (2011): "Three individually reasonable decisions, one unintended consequence, and a solution", Federal Reserve Bank of Atlanta, *Notes from the Vault*, May/June.

Weder di Mauro, B (2010a): "Taxing systemic risk: proposal for a systemic risk charge and a systemic risk fund," mimeo, University of Mainz.

Weder di Mauro, B (2010b): "Quantitative impact of taxing or regulating systemic risk", Chapter 5 in S Claessens, M Keen and C Pazarbasioglu (eds), *Financial sector taxation: the IMF's report to the G-20 and background material*, IMF publication, September.

Whalen, C (2011): "What is a core deposit and why does it matter? Legislative and regulatory actions regarding FDIC-insured bank deposits pursuant to the Dodd-Frank Act", Network Financial Institute, *Indiana University Working Paper*, no 14, June.

Wheatley review of LIBOR: final report (2012): UK Treasury, September.