

The dollar swap lines and the financial dilemma: The Federal Reserve and European Central Bank in the 2007–2009 crisis

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ABSTRACT: The General Accountability Office of the US Congress reported in 2011 how the Federal Reserve massively provided liquidity to several Eurozone commercial banks as well as to the European Central Bank during the global financial crisis from 2007 to 2009. Although the literature has analyzed the role of the Federal Reserve as the global lender of last resort, many aspects of the Dollar Swap Lines to the European Central Bank need further exploration. We provide original evidence – using data from both central banks and transcripts of the Federal Open Market Committee’s meetings – about allotted amounts and interest rates on dollar provision by the Federal Reserve and the European Central Bank.

KEYWORDS: Financial globalization; International lender of last resort; Federal Reserve; European Central Bank; Currency swap arrangements

JEL CODES: E44, E58, F33, F36, F42, F55, F65

1. INTRODUCTION

The Dodd-Frank Act adopted in May 2010 forced the Federal Reserve exceptionally to lift the confidentiality on its credit facility programs (General Accountability Office, 2011). The Federal Reserve was thus accountable to Congress for the counterparties and the corresponding amounts. And most of the emblematic operations performed by the Federal Reserve helped out the majority non-US commercial banks and especially the

European banks. Moreover, the dollar swap lines granted to fourteen central banks, notably to the European Central Bank, were the most important program representing almost a quarter of the Federal Reserve's total assets between October 2008 and January 2009. Any attempt to narrow the intervention of the Federal Reserve with respect to the US banking system alone may, however, conflict with the effects of financial globalization. Actually, the international activities of the US financial institutions partly required the Federal Reserve during the 2007–2009 financial crisis to extend its responsibilities not only beyond its ordinary operations, but also beyond the banking system's national borders. So there is a new dilemma – defined here as a financial dilemma – with which the US political and monetary authorities are now confronted: either Congress enforces the mandate given to the Federal Reserve in which case the Federal Reserve cannot fully respond to the needs of the global banking institutions and systemic instability worsens; or the Federal Reserve provides dollar liquidity liberally to foreign global banks and central banks in which case Congress *de facto* slackens the terms of the mandate it gives to the Federal Reserve and moral hazard problem worsens. We find evidence that the financial dilemma created tension in dollar liquidity needed and the interest rate set by the European Central Bank, and that the Federal Reserve's announcement on October 13, 2008 turned dramatically from one horn of the financial dilemma to the other.

Notwithstanding the huge amount of liquidity created through the Federal Reserve's Dollar Swap Lines, the related literature remains relatively scarce. Allen and Moessner (2010), and Allen (2013) study currency swap arrangements and international liquidity in the financial crisis of 2008–2009 with an emphasis on central bank cooperation. Aizenman and Pasricha (2010) analyze the impact of the dollar swap arrangements on the exchange rate in emerging market economies. Fleming and Klagge (2010), Goldberg, Kennedy, and Miu (2011) examine the disruptions in the dollar funding markets, the initial structure of the dollar swap line program, and the changes in breadth and volume of the funding conditions in response to the worsening financial crisis. McDowell (2012), Helleiner (2014, pp. 6-7, 43-4), Morelli, Pittaluga, and Seghezza (2015) examine the intervention of the Federal Reserve through the analytical lens of international political economy. Broz (2015) explores the motivations behind the Federal Reserve's global lending and the response of the US Congress in 2010 and the proposal for a

Federal Reserve Transparency Act in 2012. Bordo, Humpage, and Schwartz (2015) offer an overview of the Federal Reserve's swap lines from 1962 to 2009. In the paper, we go beyond this literature and we find original evidence about the operations, amounts, and interest rates with regard to the Federal Reserve's dollar swaps and the European Central Bank's dollar provision.

The phrase global lender of last resort (Obstfeld, 2009) tends to replace that of international lender of last resort (Hawtrey, 1932). In the context of the gold standard regime, characterized both by the free movement of capital and the fixed exchange rate, international lending in last resort meant making emergency loans by transferring metallic reserve. In the context of the Bretton Woods system, the controls of international capital movements circumscribed the function of the lender of last resort at the national level and temporary funding was reserved to the International Monetary Fund. In the context of the financial liberalization and the fixed exchange rate adopted by emerging countries in the 1990s, the function of the lender of last resort returned to its international level. One view was to consider that the International Monetary Fund should ensure the role of international lender of last resort (Calomiris, 1998; Fischer, 1999; Goodhart, 1999) and, the other view, that the Federal Reserve should do so (Keleher, 1999). We shall not retrace this debate. Instead, we explore the new scope of the lender of last resort and the ensuing dilemma in light of the global financial crisis of 2007–2009.

The remainder of this paper proceeds as follows. In the second section, we outline the effects of the financial globalization, and the unprecedented policy of the Federal Reserve from 2008 to 2009 in supporting non-US banks. In the third section, we examine the Federal Reserve's dollar swap operations with the other central banks (hereafter, we shall use the term "central banks" to designate central banks other than, and in relation with, the Federal Reserve). In the fourth section, we offer original evidence about the relations between the Federal Reserve and the European Central Bank and, in the fifth section, about the respective interest rate policies. We also rely on all transcripts of the meetings and conference calls of the Federal Open Market Committee from August 2007 to December 2008 (FOMC, 2007, 2008) in order to discern the Federal Reserve's guidelines. In the sixth section, we analyze the financial

dilemma that we distinguish from the monetary dilemma formulated by Triffin (1960) at the onset of the Bretton Woods period and, in the seventh section, we conclude.

2. THE FEDERAL RESERVE AND FINANCIAL GLOBALIZATION

The Federal Reserve's global lending results from a twofold evolution of the international monetary and financial system. The first evolution is related to the international status that the US dollar has retained since the end of the Bretton Woods system (Goldberg, 2010; Eichengreen, 2011). In the meantime, deposits and credits in dollars outside the United States – the Euromarkets – have grown tremendously, especially in Europe. The development of the Euromarkets and the concomitant indebtedness of the non-US banks from the 1970s onwards has not yet put the Federal Reserve in the position of the global lender of last resort. The foregoing leads to the second evolution and the crucial role of financial globalization. Financial innovations such as securitization and structured credit have emerged and grown in the United States (Ashcraft and Schuermann, 2008; Pozsar, Adrian, Ashcraft and Boesky, 2010). These financial products have then attracted European banks, which invested in mortgage-backed securities in US markets through the shadow banking system, and financed long-term securities with short-term funding *vis-à-vis* US banking institutions in the repurchase agreement or commercial paper markets (McGuire and von Peter, 2009; Acharya and Schnabl, 2010; Shin, 2012).

One measure of the dollar shortage is the increase in the spread between the term interbank (Libor) rate and the overnight-index-swap (OIS) rate (Taylor and Williams, 2008). Another measure is the increase in the euro-dollar swap spread, which ordinarily converges to zero once arbitrage in foreign exchange markets can take place, but remains positive in stressed conditions, when arbitragers cannot borrow enough dollars (Baba and Packer, 2009; Coffey, Hrungr, and Sarker, 2009). However, these two measures of liquidity shortage do not take into account the effect related to the commercial banks' jurisdiction (US and non-US). To capture the jurisdiction effect, Fleming and Klagge (2010, p. 5) examine the spread between the average borrowing rate of the thirteen non-US banks and the average borrowing rate of the three US banks among the sixteen banks of the dollar Libor panel. The spread rose at the onset of the

financial crisis in August 2007 and soared in the wake of the Lehman brothers collapse in September 2008. European banks and their subsidiaries mainly funded their long-term assets purchases by the intermediary of the repurchase agreement and commercial paper markets (wholesale funding), whereas US banks could rely to a greater extent on their liabilities in the form of deposits (retail funding) covered by supervisory authorities. Insofar as runs took place in the wholesale markets (Gorton and Metrick, 2012), European banks rolled over their short-term debts in dollars with difficulty (Baba, McCauley, and Ramaswamy, 2009).

The twofold evolution of the international monetary and financial system respectively created both a “supply” of (owing to the dollar internationalization), and a “demand” for (owing to financial globalization) the global lender of last resort whenever the dollar funding markets collapsed. In this respect, the Federal Reserve’s policy moved toward the enlargement of the spectrum of collateral, and for a broader range of counterparties (US and non-US). Non-US primary dealers could obtain dollars via the Term Securities Lending Facility (TSLF) and the Primary Dealers Credit Facility (PDCF). Moreover, non-US banks received almost 65% of the amounts allotted via the Term Auction Facility (TAF) and 60% of those allotted via the Commercial Paper Funding Facility (CPFF) (Table 1). The Term Auction Facilities and the Commercial Paper Funding Facilities were the most substantial of the Federal Reserve’s main facility programs between 2007 and 2010 (Government Accountability Office, 2011, p. 137). It may be pointed out that the interest rate set by the Federal Reserve under these facility programs followed auction or market format, and was similar (single price) for all banking institutions (US or non-US).¹

[Table 1]

¹On the Federal Reserve’s facility programs, Armentier, Krieger, and McAndrews (2008), Adrian, Burke, and McAndrews (2009), Fleming, Hrungr, and Keane (2010), Cecchetti and Disyatat (2010), Adrian, Kimbrough, and Marchioni (2011), General Accountability Office (2011), and Acharya, Fleming, Hrungr, and Sarkar (2014). The Government Accountability Office (2011, pp. 196, 231) mentions most principal non-US banks that get dollar liquidity through the TAF and the CPFF and also through the discount window. Also Shin (2012, p. 168) for amounts outstanding. Although all of the facility programs were publicly announced when they were initiated from 2007 to 2009, the names of the counterparties were disclosed to Congress only in December 2010, that is, two years after the height of the financial turmoil. According to the Board of Governors of the Federal Reserve (2011, p. 1), the confidentiality about the names of the counterparties and borrowers remained consistent with the central banks’ practice: “Releasing the names of these institutions in real-time, in the midst of the financial crisis, would have seriously undermined the effectiveness of the emergency lending and the of investors and borrowers.”

Since the onset of financial crisis in 2007, the members of the Federal Open Market Committee were aware that European banks met growing difficulties in the dollar funding markets: “Every morning the European banks need dollars” (FOMC, 2007: Dudley, Aug. 16, p. 15; also Bernanke, Aug. 10, p. 11; Bernanke, Sep. 18, p. 14; Dudley, Dec. 6, p. 4; Dudley, Dec. 11, p. 8), and that many of them consequently asked for and obtained liquidity at the discount window of the Federal Reserve (FOMC, 2007: Rosenberg, Sep. 18, p. 55; Lacker, Sep. 18, p. 146). Then, once they were implemented, the Term Auction Facilities were “dominated by European institutions” (FOMC, 2008: Lacker, Apr. 29-30, p. 13). The Dollar Swap Lines (DSL) program was therefore considered as a better operational design, whereby the Federal Reserve could transfer counterparty and asset risks to other central banks.

3. THE FEDERAL RESERVE AND THE DOLLAR SWAP LINES

Until the 1990s the currency swap agreements between central banks were put in place to circumvent tension on the foreign exchange market (Bordo, Humpage, and Schwartz, 2015). During the 2007–2009 experience, foreign exchange swap lines were different both in degree (unprecedented in monetary history) and in nature (mainly depending on financial globalization). Their aim was henceforth to allay pressure in the dollar funding markets, and they became an important source of dollar funding and accounted for almost 25% of the Federal Reserve’s total assets over the period from October 2008 to January 2009 (Figure 1). The temporary currency swap line agreement was decided on December 6, 2007 and it was designed as follows. At the contract date, currency swaps were set at the prevailing market exchange rate and, at maturity, dollars were repurchased at the same exchange rate, so that the Federal Reserve did not bear the exchange risk. Furthermore, the Federal Reserve provided dollars to central banks, which loaned them in determining the eligible counterparties and collateral, so that the Federal Reserve did not bear credit and asset risks (FOMC, 2007: Johnson, Sep. 18, p. 133; Geithner, Sep. 18, p. 139; Sheets, Dec. 6, p. 7; Bernanke, Dec. 11, p. 4; Board of Governors of the Federal Reserve System, 2007). Ultimately, the Federal Reserve defined the dollar swap line format and ensuing amounts and interest rate.

[Figure 1]

With regard to the nature of the relations between the Federal Reserve and other the central banks, especially in Europe, the literature suggests two approaches. The first approach claims that the currency swap arrangements corresponded to an international cooperative regime based on reciprocity (Allen and Moessner, 2010; European Central Bank, 2014, 2016). This cooperation approach suggests that the Federal Reserve was not so much a lender of last resort as a participant among others in organizing the global safety network notably around reciprocal swap line agreements. However, evidence for 2008–2009 shows that the currency swap arrangements went in one direction only: the Federal Reserve widely granted dollar swap lines, while the other central banks did not grant swap lines in their own currency to the Federal Reserve. Furthermore, the Federal Reserve’s policy was not more cooperative towards the central banks via the Dollar Swap Line program than it was towards non-US banking institutions via the Term Auction Facility or the Commercial Paper Facility programs: in both cases, the market format initially prevailed. The Federal Reserve’s policy was even more liberal for commercial banks than for central banks: in effect, the central banks swapped their own currency at a fixed rate, while the non-US banks posted private and risky securities as collateral. In fact, the cooperation argument had been made so as to avoid the stigma associated with the *de facto* unilateral swap lines. As the Federal Open Market Committee stated, the response of the Federal Reserve to the European Central Bank’s proposition was to pursue “*some sort of a cooperative arrangement*” (FOMC, 2007: Sheets, Dec. 6, p. 18, added italics), a response “*which symbolizes the cooperation and coordination of the two central banks*” (FOMC, 2008: Bernanke, Sep. 16, p. 13, added italics).

The second approach considers that the currency swap arrangements were not the result of a cooperative regime, but that the Federal Reserve’s intervention was motivated by defensive reasons and concerns about the interest of the major US banking institutions (McDowell, 2012; Broz, 2015). This approach mainly claims that the appearance of *ad hoc* cooperation among central banks was in fact possible only because of the convergence of participants’ interests, without characterizing however the central banking relation between the United States and Europe. All these approaches or interpretations do not scrutinize the procedures and their timing, the allotted amounts, and the interest rates between the Federal Reserve and the European Central Bank. So,

further investigations are necessary, from empirical and analytical points of view, in order to discern *in fine* the nature of the relationship between the Federal Reserve and the European Central Bank. In the following sections, we provide original evidence about the Federal Reserve's dollar swaps and the European Central Bank's dollar provision, and we hence shed light on the international relationship of central banking.

4. THE FEDERAL RESERVE AND THE EUROPEAN CENTRAL BANK

Among the fourteen central banks participating in the currency swap arrangements, the European Central Bank received in 2008–2009 almost 80% of the dollar swap lines from the Federal Reserve (Government Accountability Office, 2011, Table 24, p. 205). The Federal Reserve could choose two auction formats to carry out its facility programs in general and the dollar swap lines in particular (Goldberg, Kennedy, and Miu, 2011). The first is the market format auctioning limited dollar amounts: within this market format, pricing can be either at a single interest rate (single price) and all allocations are made at the lowest bid interest rate, or at multiple interest rates and all allocations are made at the respective bid interest rate of subscribers (multiple price). The second is the full-allotment format: there is simply a fixed interest rate and all bids are satisfied.

Until October 10, 2008 the Federal Reserve adopted the market format with multiple prices so that each central bank paid a different interest rate on dollar swap lines (Figure 2).² There was a significant difference from September 30 to October 13 between the interest rate paid by the European Central Bank on the one side, and the Bank of England, the Bank of Japan, and the Swiss National Bank on the other side. On September 30 and October 10, the interest rate paid by the European Central Bank became exorbitant, soaring above 10%. In accordance with its announcement on October 13, and in order to stabilize the swap interest rate, the Federal Reserve radically modified the auction format to the European Central Bank and also the Bank of England, the Bank of Japan, and the Swiss National Bank. Then, the dollar swap lines corresponded to the full-allotment format at a fixed interest rate equal to the

² The Dollar Swap Line program prior to October 13, 2008 has been likened to Term Auction Facilities. There was indeed a common feature, namely, the auction format. The two programs differed, however, with regard to the way interest rates were set: there was a multiple-price format under the Dollar Swap Line program and a single-price format under the Term Auction Facility program.

overnight-index-swap rate plus 100 basis points (Board of Governors of the Federal Reserve System, 2008). The change in the Federal Reserve's policy contributed to reducing the volatility of the interest rates, which declined by around 2% on October 14, and below that in the following days and weeks. Notwithstanding the importance of the action taken after October 13, a complete examination and systematic analysis is still lacking.

[Figure 2]

The very high interest rate and the reaction delay of the Federal Reserve raise the question of the Federal Open Market Committee's guidelines. The Federal Open Market Committee's discussion prior to the announcement on October 13, 2008 was not so significant as it had been prior to the decision of December 6, 2007. The resolution was passed unanimously on September 16: that is, "to provide to the Foreign Currency Subcommittee [that consists of the Chairman of the Board, the Vice Chairman of the FOMC, and the Vice Chairman of the Board] the authority to enter into swap agreements with the foreign central banks as needed to address strains in money markets in other jurisdictions. [...] *The amounts are unlimited in principle, but the decisions will be made by the Foreign Currency Subcommittee as needed and as appropriate for the particular circumstances*" (FOMC, 2008: Bernanke, Sep. 16, p. 18, added italics, also p. 3). A similar resolution was passed unanimously on September 29: the Federal Open Market Committee "authorizes the Federal Reserve Bank of New York to take the following actions to *amend* the existing temporary swap arrangements with foreign central banks" and "extends the current delegation of authority to Foreign Currency Subcommittee until April 30, 2009" (FOMC, 2008: Madigan, Sep. 29, pp. 9-10, added italics). As paradoxical as it may appear, the Federal Open Market Committee undertook a short discussion on October 28-29 about the change in the Federal Reserve's swap lines policy for the European Central Bank, the Bank of England, the Bank of Japan, and the Swiss National Bank.³ What can be found is the information that the "fixed-rate tender dollar auctions were implemented [...]. The ECB swap size is currently about \$280 billion, more than half the total amount of swaps outstanding", which "led to rapid

³The Federal Open Market Committee (FOMC, 2008, Oct. 28-29, pp. 10-35) however spent a long time discussing the dollar swap lines for central banks in emerging market economies and the role of the International Monetary Fund.

expansion of [the Federal Reserve's] balance sheet" (FOMC, 2008: Dudley, Oct. 28-29, pp. 4-6). Again, it was recommended that "the FOMC delegate to its Foreign Currency Subcommittee the authority to approve these drawings" (FOMC, 2008: Sheets, Oct. 29-30, p. 10).

So the outstanding question concerns the rule governing the Federal Reserve's interest rate policy. Regarding the liquidity facilities granted directly to the primary dealers and commercial banks, the Federal Reserve implemented a single price and did not strictly practice the rule of the penalty interest rate (Hogan, Le, Salter, 2015). Regarding the dollar swap lines granted to central banks, we compute the spread between the swap interest rate paid by the European Central Bank and other interest rates set by the Federal Reserve (primary rate, TAF rate, TSLF rate) or interbank market rates (one-month Libor rate and overnight Libor rate) (Figure 3). One interpretation is that the Federal Reserve allegedly applied Bagehot's dictum of the very high interest rate in order to discourage central banks from demanding dollars at its desk too promptly. Another interpretation is that it supposedly attempted to counter moral hazard by applying a penalty rate.⁴ Had that been the case, we can then point out a threefold inconsistency in the Federal Reserve's policy. First, the rule confining moral hazard by means of a penalty rate would have been applied to central banks only (through the Dollar Swap Line program), and not to commercial banks (through the Term Auction Facility program). Second, such discrimination would have been all the more paradoxical because central banks swapped their own currency against dollars (with no exchange risk), whereas the commercial banks posted private and risky securities against liquidity in dollars (with high asset risks). Third, unlike central banks, commercial banks can be insolvent (with higher counterparties risks concerning non-US banks and their subsidiaries).

[Figure 3]

All things considered, the interest rate set by the Federal Reserve was so chaotic over the period from September 30 to October 15, 2008 that Bagehot's dictum or penalty-

⁴ We stress here that the rule of the very high interest rate formulated by Bagehot (1873, p. 197) aims at discouraging banks from demanding liquidity in first resort at the central bank's desk, while the penalty rate formulated by the contemporary analysis aims at confining moral hazard. See Humphrey and Keleher (1984, pp. 301-2), Meltzer (1986, p. 83), Keleher (1999, p. 3), Martin (2009, p. 399). Also Bernanke (FOMC, 2007: Sept. 18, p. 147, 162), Fisher (FOMC, 2007: Sept. 18, p. 154), Bernanke (2008), Madigan (2009).

rate argument must be handled with care. Prior to October 13, the auction format and the delay during which the Federal Reserve decided to switch toward the full-allotment and fixed-rate format contributed to triggering the very high interest rate. After October 13, the interest rate paid by the European Central Bank remained higher than the market overnight rate and the TAF rate paid by commercial banks at the discount window, and similar to the TSLF rate paid by the primary dealers. Put differently, the Federal Reserve took time to recognize that the market format applied to dollar swap lines did not address the difficulties met by the European Central Bank.

5. THE EUROPEAN CENTRAL BANK AND EMERGENCY DOLLAR PROVISION

An important issue, not explored in the literature, is to ascertain how the European Central Bank loaned in its jurisdiction dollars received from the Federal Reserve. Data about dollars subscribed by the European Central Bank at the Federal Reserve's desk are not publicly available over the period. In order to gauge the European Central Bank's trouble, we compute the differential between the dollar amount allotted by the Federal Reserve to the European Central Bank and the dollar amount allotted by the European Central Bank to Eurozone banks (Figure 4). The differential indicates that dollar funding pressure met by the Eurozone banks worsened from March 2008 onwards. After stopping dollar funding auctions from late January to late March, the European Central Bank restarted them and even requested a rise in the dollar swap lines, to which the Federal Reserve responded but sparingly (FOMC, 2008: Bernanke, Mar. 10, pp. 3, 36; Dudley, Apr. 29-30, p. 7-8; Dudley, Jun. 24-25, pp. 6, 8; Dudley, Jul. 24, p. 6). The differential thus indicates dollar rationing (from March 2008 to September 2008) followed by dollar abundance (from October 2008 to March 2009), with a very unstable transitory period. The negative differential did not result from the interest rate that would not have been high enough to induce Eurozone banks to revert to the dollar funding markets: over-subscriptions showed rather how they met a severe coordination problem in the dollar funding markets, and very high rates thus showed how the European Central Bank did not handle dollar shortage. The positive differential resulted from the application of the full-allotment and fixed-rate format by the Federal Reserve, and the Eurozone banks received all the dollar liquidity they demanded from

the European Central Bank: over-liquidity finally indicated how the Federal Reserve dramatically changed the terms of the financial dilemma.

[Figure 4]

The sequence from dollar rationing to dollar abundance impacted the ratio of the subscribed amounts by the Eurozone banks to the offered amounts by the European Central Bank (the ECB bid-to-cover ratio). The conjunction of the dollar shortage in Europe and the European Central Bank's impossibility to get more dollars at the Federal Reserve's desk triggered a dramatic increase in the ECB bid-to-cover ratio, which climbed from 2 in March to 4.5 in August 2008 (Figure 5). Although it remained at around 2 during the transitory period from September 30 to October 10, 2008, the ECB bid-to-cover ratio was rather unstable because the European Central Bank attempted to respond to dollar demands but at high interest rates. Then, the Federal Reserve massively allotted on October 15 a total amount of 310 billion dollars to the European Central Bank, which in turn immediately supplied the same amount to Eurozone banks, so that the ECB bid-to-cover ratio rapidly converged to 1.

These findings over the period from March to August 2008 are consistent with data that the Federal Open Market Committee authorized for public release about the ratio of the subscribed amounts by the European Central Bank to the offered amounts by the Federal Reserve (the FED bid-to-cover ratio). Indeed, the FED bid-to-cover ratio of the Dollar Swap Lines climbed from 2 in March to 4 in August.⁵ For comparison, over the same period of time, the bid-to-cover ratio of the Term Auction Facility declined from 2.2 to 1.1 (calculation from Federal Reserve Bank of New York, "Markets"). Notwithstanding Eurozone banks' difficulty, the Federal Open Market Committee worried that the European Central Bank's auction on dollar provision was "noncompetitive": "The bids are prorated, and the banks pay the US stop-out rate. Larger bids by European banks in the ECB auction do not affect the interest rate they pay for such funding, and that encourages more-aggressive bidding. Conversations with the ECB staff indicate that they are concerned that the outcome could be a bidding spiral. Individual banks could keep raising the size of their bid submissions to ensure a

⁵ The corresponding chart (FOMC, 2008: Materials, Aug. 5, , Figure 18, p. 136) plots the FED bid-to-cover ratio of the Dollar Swap Lines from March and August 2008, but the full series over the Dollar Swap Line period are not publicly available.

stable amount of dollar funding” (FOMC, 2008: Dudley, August 5, p. 6). Thus, until its resolution passed on September 16, the Federal Open Market Committee did not recognize that amounts allotted through the dollar swap lines were not sufficient to mitigate the problems that the European Central Bank faced in dealing the Eurozone banks’ need for dollar funding. Furthermore, between September 18 and October 10, the Federal Reserve maintained the market format with limited amounts and, despite that it accelerated the provision of dollar to the European Central Bank, the swap interest rate climbed to very high level.

[Figure 5]

The sequence from dollar rationing to dollar abundance thus impacted the evolution of the interest rate set by the European Central Bank. Until October 3, as point out by the Federal Open Market Committee (FOMC, 2008: Dudley, August 5, p. 6), and without a dialogue with the Federal Reserve, the European Central Bank implemented a “noncompetitive” format for providing dollars, that is, applied the same interest rate as was paid to the Federal Reserve. In other words, the European Central Bank worked as the conveyor belt of the Federal Reserve’s policy. Then, the mechanism failed: the margin, here defined as the difference between the interest rate on dollar provision set by the European Central Bank and the interest rate on the dollar swap lines set by the Federal Reserve, became negative (Table 2). The difference in maturity of the dollar provision does not explain the negative margin insofar as the European Central Bank applied the same maturity as the Federal Reserve (except on October 6). Because the interest rate paid to the Federal Reserve was exorbitant, the European Central Bank oddly accepted to bear a negative margin so as to allocate a larger dollar amount. And because the European Central Bank provided dollar funding at a loss, there are reasons to think that it put pressure on the Federal Reserve in order to offer dollars in accordance with the Eurozone banks’ bids – but there is no readily available evidence. One observation is that the full-allotment and fixed rate format was an European Central Bank’s concept that the Governing Council implemented several times in the euro funding markets and especially from October 8 onwards (European Central Bank, “Communication”). In any case, the change in the Federal Reserve’s policy from October 13 onwards contributed to lowering the swap interest rate and the

European Central Bank resumed its work as the conveyor belt.

[Table 2]

In sum, the currency swap arrangements placed the Federal Reserve at a higher level with respect to the other central banks: at the apex, it is the Federal Reserve that determines at discretion the dollar swap line format and the ensuing allocated amounts and interest rates; in an intermediate position, the other central banks, the primary dealers, and commercial banks that have access to the Federal Reserve's desk; at the base, the other non-US banks that revert to the central banks of their jurisdiction to obtain dollar funding. The hierarchical structure we analyze rests notably on the institutional criterion of access (or not) to the Federal Reserve's desk. However, it does not strictly take into account the different levels of interest rate set by the Federal Reserve for central banks or for commercial banks. So it might be stressed that the interest rate on Dollar Swap Lines charged to central banks (with multiple prices) was higher than the interest rate on Term Auction Facility charged to non-US banks (with a single price). Moreover, the collateral posted by non-US banks or primary dealers was riskier (the private and risky securities, sometimes with no market valuation) than that swapped by the central banks (their own currency, with no exchange rate risk). All things considered, the hierarchical structure departs from any cooperative regime – *ad hoc* cooperation or institutionalized cooperation – and is rather the adjustment whereby the US monetary authorities cope with the financial dilemma.

6. FROM THE TRIFFIN DILEMMA TO THE FINANCIAL DILEMMA?

The dilemma that Robert Triffin (1960) examined arose under the Bretton Woods regime featured by fixed exchange rates with the US dollar as the key-currency, and by international capital flow controls. In the present day, the floating exchange rate system and financial globalization have transformed the nature of the dilemma, which is no longer a *monetary* question (how to ensure international monetary stability in accordance with multilateral exchange rate agreements and dollar parity?) but a *financial* one (how to ensure global financial stability in accordance with the Federal Reserve's mandate as the

national lender of last resort?) The financial dilemma we discern may be hence formulated as follows: either the Federal Reserve decides to ration its dollar provision in order to conform to its mandate and to contain moral hazard, but it may thereby worsen systemic instability; or the Federal Reserve provides dollar liquidity liberally during financial crises in order to maintain global banks under perfusion, but it thereby departs from its mandate and deeply encourages risk taking.

Analyzed in this light, the financial dilemma clearly appeared before and after the Federal Reserve's decision on October 13, 2008. The underlying tension was at its height between September 30 and October 6, 2008, and was partly absorbed by the European Central Bank with negative margins. Inasmuch as the dollar shortage met by the Eurozone banks and the very high interest rates paid by the European Central Bank became unsustainable, the Federal Reserve decided at its discretion to implement the full-allotment format with fixed interest rate. In other words, as the Federal Reserve passed from one horn of the financial dilemma to the other, the dollar funding in the Eurozone passed from scarcity to abundance.

Interestingly, the Federal Open Market Committee early and implicitly expounded the financial dilemma: on the one hand, it worried that "we're subsidizing foreign banks without really doing anything to mitigate [moral] hazard" and it was not sure that "the public understands that"; on the other hand, it was recognized that "we all understand that we have systemic responsibilities" (FOMC, 2007: Fisher, Sep. 18, p. 154). The first option of the financial dilemma could operate in two ways: the extreme way was to let foreign central banks manage dollar shortages with their own dollar reserve holdings (FOMC, 2007: Poole, Dec. 6, p. 16; Dec. 11, p. 8); the moderate way was to implement dollar swap lines to central banks with limited amounts and market auction format (FOMC, 2007: Resolutions, Dec. 6, p. 18; Dec. 11, p. 14).

The second option of the financial dilemma decided by the Federal Reserve's Foreign Currency Subcommittee in October 13, 2008 was the full-allotment format with fixed rate. And the reason for the second option was clearly exposed with regard to the emerging market economies and the European countries as well: "the privilege of being the reserve currency of the world comes with some burdens. Not that we have an obligation in this sense, but we have an interest in helping these guys mitigate the

problems they face in dealing with currency mismatches in their financial systems. We have an interest in helping them meet that in some sense. It's not our obligation. We have the same basic interest that led us to be responsive to the European need in some cases" (FOMC, 2008: Geithner, Oct. 28-29, p. 21).

7. CONCLUSION

The institutional response of the Federal Reserve in 2008–2009 to the global dollar shortage relied on the emergency lending programs, notably some facility programs that non-US banks benefited from in their majority, and the dollar swap line program with full-allotment and fixed rate when the European Central Bank met serious difficulties in distributing dollars in its jurisdiction. We have explored in this paper the relation between the Federal Reserve's dollar swap lines and the European Central Bank's dollar provision with regard to the auction formats, the allotted amounts, and the interest rates. We have found that relations between the two central banks seemed rather hierarchical: the Federal Reserve changed at discretion the auction format of the dollar swap lines and the European Central Bank deeply depended on its global lending policy. We have also found that, when the European Central Bank paid very high swap interest rates and distributed dollars to Eurozone banks at a loss, the Federal Reserve finally decided on October 13, 2008 to implement the full-allotment and fixed-rate format. Although the institutional response positioned the Federal Reserve as the global lender of last resort, it also placed the US political and monetary authorities before a new dilemma –the financial dilemma. While the monetary dilemma that Triffin (1960) analyzed under the Bretton Woods system was related to the exchange rate agreements and the balance of payment disequilibrium, the financial dilemma that we discern is henceforth related to the global financial markets and large commercial banks' indebtedness in dollars.

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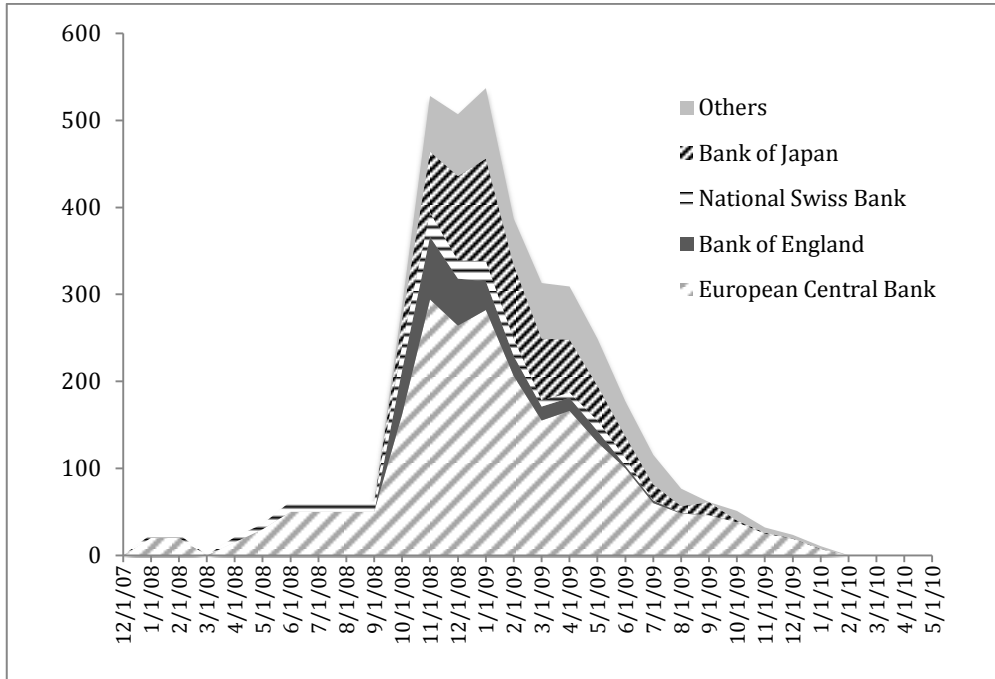
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Table 1: Total amount by parent banks' domiciliation for TAF and CPFF (in percent)

TAF		CPFF	
United States	35	United States	41
United Kingdom	17	United Kingdom	18
Germany	16	Belgium	10
Japan	8	Germany	9
France	7	Switzerland	9
Others	16	Others	13
Total	100		100

Source: Government Accountability Office (2011, figure 10, p. 134)

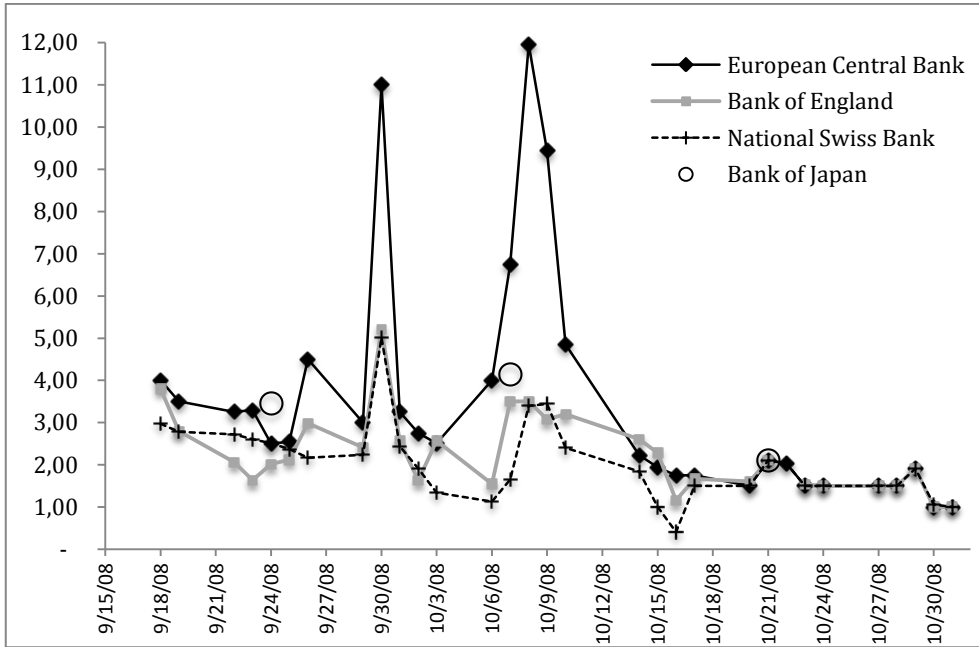
**Figure 1: Dollar swap lines with central banks
(December 2007 – May 2010, in billion dollars)**



Source: Government Accountability Office (2011, figure 25, p. 201)

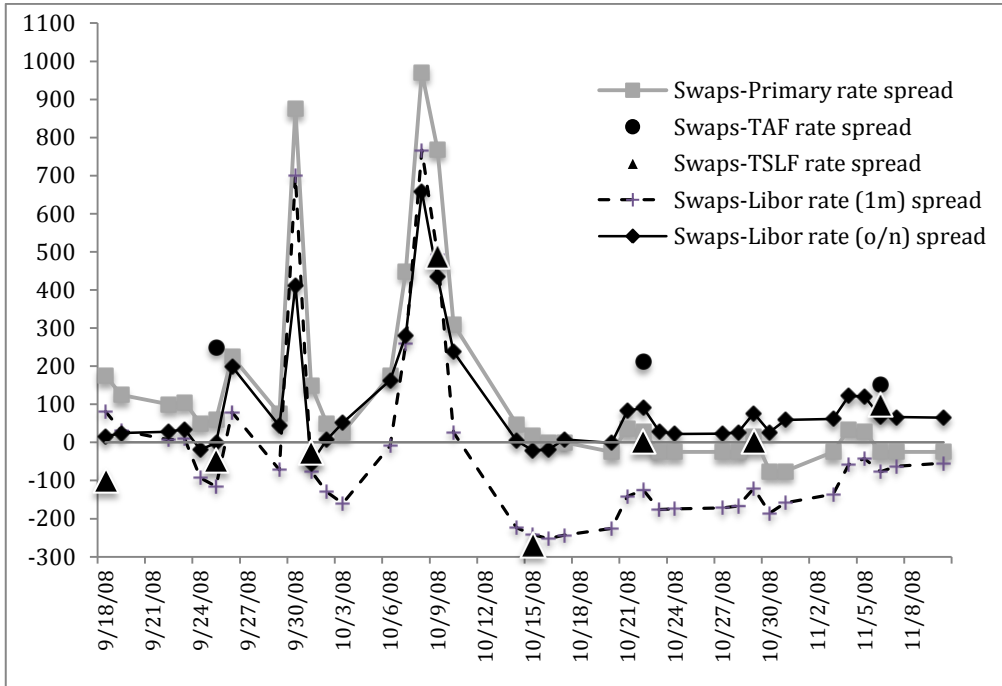
Note: Dollar Swap Lines (DSL) were implemented from December 17, 2007 to February 1, 2010. Fourteen central banks progressively participated in the program, namely (by date of announcement): the European Central Bank and the Swiss National Bank (December 12, 2007), the Bank of Canada, the Bank of England, and the Bank of Japan (September 18, 2008), the *Danmarks Nationalbank*, the *Norges Bank*, the Reserve Bank of Australia, and the *Sveriges Riksbank* (September 24, 2008), the Reserve Bank of New Zealand (October 28, 2008), the *Banco Central do Brasil*, the *Banco de Mexico*, the Bank of Korea, and the Monetary Authority of Singapore (October 29, 2008).

Figure 2: Interest rate set by the Federal Reserve on dollar swap lines (September 18 – October 30, 2008, in percent)



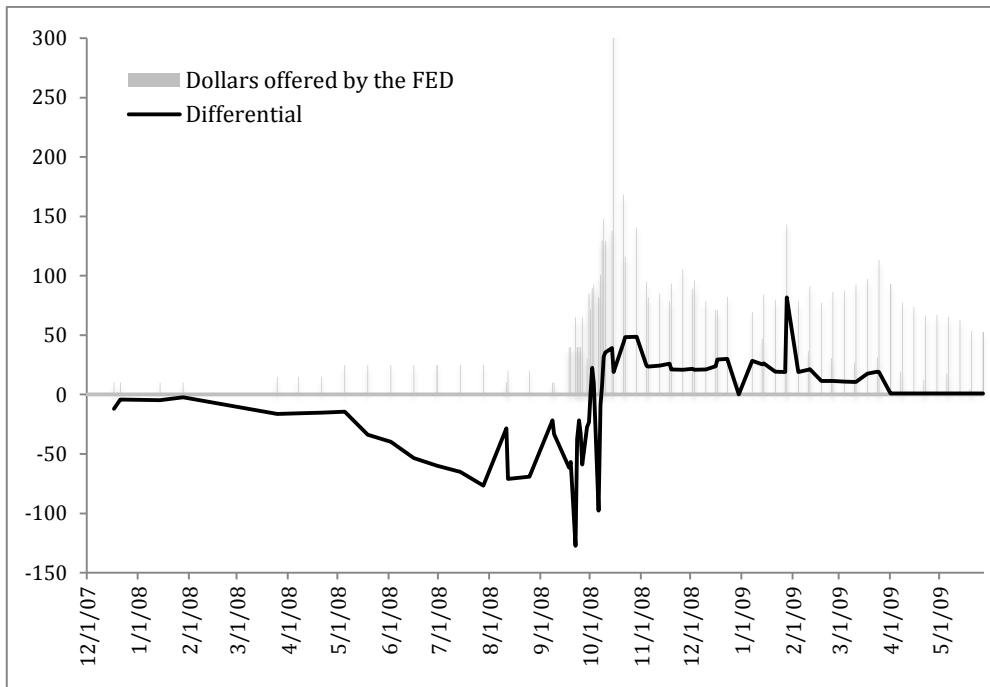
Source: Board of Governors of the Federal Reserve System, "Central Bank Swap Lines."

Figure 3: Spread between the swap interest rate and other interest rates set by the Federal Reserve (primary rate, TAF rate and TSLF rate), and by the funding market (Libor rate) (September 18 – November 9, 2008, in basis points)



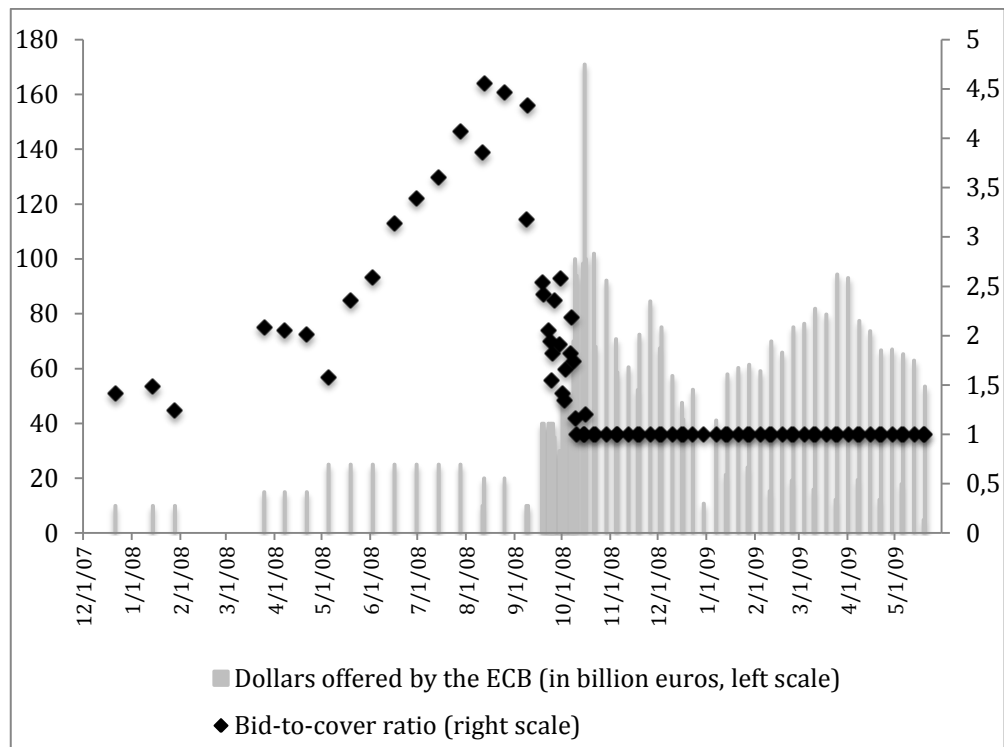
Source: Authors' calculation based on Board of Governors of the Federal Reserve System, "Central Bank Swap Lines", Federal Reserve Bank of New York, "Markets", Datastream.

Figure 4: Dollars provided by the Federal Reserve to European Central Bank and differential with dollars provided by the European Central Bank to Eurozone banks (December 2007 – May 2009, in billion dollars)



Source: Authors' calculation based on Board of Governors of the Federal Reserve System, "Central Bank Swap Lines", and European Central Bank, "History of all ECB Open Markets Operations."

Figure 5: Dollars provided by the European Central Bank to Eurozone banks and ECB bid-to-cover ratio (December 2007 – May 2008)



Source: Authors' calculation based on European central bank, "History of all ECB Open Markets Operations."

Table 2: Interest rate on dollar swap lines set by the Federal Reserve, the interest rate on dollar provision set by the European Central Bank, and the margin (October 3 – October 21, 2008, in percent)

Date	Federal Reserve		European Central Bank		Margin (2)–(1) (%)
	Maturity (days)	Rate (1) (%)	Maturity (days)	Rate (2) (%)	
<i>October 3</i>	3	2,51	3	2,51	0
<i>October 6</i>	1	4,0	85	1,39	–2,61
<i>October 8</i>	1	11,96	1	9,5	–2,46
<i>October 9</i>	1	9,44	1	5,0	–4,44
<i>October 10</i>	4	4,85	4	0,5	–4,35
<i>October 14</i>	1	2,23	1	0,2	–2,03
<i>October 15</i>	1	1,94	1	0,5	–1,44
<i>October 21</i>	28	2,11	28	2,11	0

Source: Authors' calculation based on Board of Governors of the Federal Reserve System, "Central Bank Swap Lines", and European Central Bank, "History of all ECB Open Markets Operations."