

Winkler, Adalbert; Bindseil, Ulrich

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Dual liquidity crises under alternative monetary frameworks – a financial accounts perspective

U. Bindseil and A. Winkler*

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Abstract

In a dual liquidity crisis, both the government and the banking sector are under severe funding stress. By nature, dual crises have the potential of being particularly disruptive and damaging. Thus, understanding their mechanics, how they unfold and how they can be addressed under various monetary and international financial regimes, is crucial. We capture the logic of a dual crisis through a new, rigorous approach. A closed system of financial accounts allows for a systematic comparative review of underlying liquidity shocks as well as built-in liquidity buffers, including their limits beyond which a credit crunch materializes. Based on this we are able to (i) make precise the otherwise vague interpretations of liquidity flows and policy options; (ii) compare capacities to absorb shocks under alternative international financial systems; (iii) explain how various constraints interact; (iv) draw lessons for achieving higher resilience against self-fulfilling confidence crises. Most importantly, we analyze the role of a number of potential constraints to an elastic central bank liquidity provision, namely the availability of central bank eligible assets, limits deliberately imposed on the central bank's ability to lend to or purchase assets of banks and governments (including "monetary financing" prohibitions), and limits in a fixed exchange rate regime relating to the gold or foreign currency reserves of the central bank.

JEL classification: E50, E58

Key words: liquidity crisis, bank run, sovereign debt crisis, central bank co-operation, gold standard

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1. Introduction

Dual liquidity crises, i.e. funding crises which encompass both the private and the state sector of a country, typically have particularly devastating consequences for the real economy in the country concerned. Examples encompass the German crisis in the early 1930s as culminating in July 1931, the Asian crisis in 1998, and the euro area periphery crisis of 2011/2012. This paper shows how dual liquidity crises unfold and how this depends on the international financial and monetary regime in which the relevant country operates. In addition, we illustrate how the international monetary system and specific additional central bank policies define constraints on the elasticity of a central bank in providing liquidity to banks and securities markets as compensation for the original liquidity shocks. We capture the mechanics of dual liquidity crises within a closed system of financial accounts. The system provides a rigorous framework for analyzing how initial liquidity shocks feed through the financial system, and the limits of the system in absorbing those shocks before they eventually translate into forced deleveraging and asset fire sales. This systematic approach to the modeling of liquidity shocks has the advantage of making precise the otherwise vague interpretations of liquidity flows and policy options, and in particular how the various constraints interact. Thus, it provides a firm basis for a comparative analysis of the ability of central banks under alternative international financial systems and policy constraints to absorb shocks.

We illustrate the approach by applying it to four main regimes (i) a single country in a flexible exchange rate world; (ii) two countries linked by the gold standard; (iii) two countries using a paper standard but with one pegging its exchange rate towards the other; (iv) a monetary union like the euro area. Within each of these cases, we also analyze the role of additional deliberately chosen policy constraints. Those constraints relate to the availability of central bank eligible collateral, the unwillingness to do outright purchases of securities, monetary financing prohibitions, or limits to the borrowing of banks with the central bank. In all cases, we identify how, and up to which limits, built-in stabilizers and active central bank measures allow to prevent that the original liquidity shocks triggered by households/investors do not end in value destroying asset fire sales and the associated welfare losses. Comparing the behavior of various regimes in dual liquidity crises provides insights on the general nature of certain crises mechanisms and co-ordination failures, and is the starting point to search for improvements of crises resolution mechanisms.

The results of our analysis can be summarized as follows:

- The ability to address dual liquidity crises varies considerably through international financial frameworks. Moreover, it depends fundamentally on additional policy constraints imposed by law or deliberately adopted by the central bank.
- Within any international monetary system characterized by some sort of fixed exchange rate, the readiness of providing or tolerating *inter-central bank credit* is crucial to identify the exogenous elasticity constraints under which the central bank of a country facing a dual crisis operates. Indeed, in theory, the ability of all fixed exchange rate systems basically relies to the same extent on the actual elasticity of inter-central bank credit is made equal. The gold standard is most constraining to inter-central bank loans as in a crisis all central banks may start to hoard gold. The elasticity of the financial system is enhanced through international arrangements such as e.g. IMF type frameworks in a fixed exchange rate system under a paper standard, or via automatic inter-central bank lending (like through “TARGET2 balances” in a monetary union like the euro area). Comparing those systems with a central bank operating under flexible exchange rates and a paper standard, as for example the Federal Reserve in the global financial crisis, shows that even monetary union is not as resilient as a genuine single country currency area, if the absolute credibility of the integrity of the monetary area is put into doubts. Once this happens, negative feedback loops associated with cross border capital flight can gain momentum despite the theoretically infinite elasticity of central bank liquidity.
- Collateral and lending constraints to banks have been considered as tools to limit the need/potential for inter-central bank lending both in the gold standard and in a monetary

union. The reasons underlying the dislike for inter-central bank credit are partially similar across international monetary regimes, and deserve more in depth analysis.

- While elastic central bank lending to banks in a liquidity crisis is rarely questioned as an adequate policy response, typically some constraints loom in the background and exert a restrictive influence. In particular collateral constraints seem to matter systematically across all liquidity crises. The scarcity of collateral (and closeness to borrowing limits and moral suasion to rely less on the central bank) make banks engaging in efforts to reduce their funding needs through a shortening of their balance sheet, which will contribute to a credit crunch and damage growth dynamics. Banks react this way even if – eventually – the central bank usually stops short in strictly enforcing those constraints when they trigger (more) bank defaults and a deepening of the crisis.
- Outright purchases of securities in general have always been a controversial tool of central bank liquidity provision in financial crisis. They appear unlimitedly powerful for providing central bank funding, and were applied as such by a number of central banks starting in 2009. If the central bank is not allowed or unwilling to play such a role, in principle banks can act as the lender of last resort for debt securities markets. This will however be subject to additional constraints and specific drawbacks such as leading to diabolic solvency loops. At the same time, large scale central bank outright purchases may create undue financial risks to the central bank and moral hazard issues. Monetary financing prohibitions (regarding Governments) characterized Germany in 1931 and to a somewhat more moderate extent the Eurosystem in 2011/12. In both cases they played a key role in the evolution of the crisis. In Germany in 1931, they were one driver of Brüning's extreme austerity policy, while in 2010-12, they may explain why the Eurosystem was less engaged in sovereign bonds purchases than peer central banks despite facing a sovereign debt crisis.
- The pricing of the elastic provision of central bank or inter-central bank liquidity is often very simple in practice, with either flat pricing (e.g. applied to TARGET2 inter-bank liquidity or fixed rate full allotment central bank operations) or a step increase (some IMF loans, liquidity provision in the form of discount window lending / marginal lending facility / ELA). In view of the popularity to consider also strict limits, i.e. a sudden infinite increase of costs at a certain point, and the implications of limits on system stability, one wonders why not more thinking is devoted to more differentiated gradual pricing schemes of central bank liquidity.

The paper proceeds as follows. **Section 2** motivates the financial accounts framework and the underlying assumptions. It develops the general idea that the resilience of a system increases with the size of the shocks it can absorb before forced deleveraging and fire sales have to address funding stress. As larger buffers also make it less likely that a run arises and hence that the buffers are tested, the effect of buffers is twofold positive for the stability of the system. Against this background, we analyze dual liquidity crises in four different international financial frameworks. **Section 3** introduces the case of an individual country operating within a flexible exchange rate environment where the central bank plays the role of a lender of last resort either for a) the banking and the government sector or b) the banking sector only. **Sections 4 to 6** each treat one case of two countries in some sort of fixed exchange rate regime in which currencies are linked to each other through a gold parity in the gold standard (section 4), through an exchange rate peg in a paper standard (section 5), and through a monetary union in a paper standard (section 6). For the latter three cases we model an asymmetric crisis, with country 1 being perceived as the “safe haven” country, while country 2 experiences a financial crisis, as – with the exception of the gold standard regime – symmetric cases can be captured in the one country model of section 3. **Section 7** draws conclusions.

2. Dual liquidity crises and the merits of a closed financial accounts representation

2.1 The nature of a liquidity crisis

The nature of a liquidity crisis has intrigued economists for many centuries. In a *funding* liquidity crisis the willingness of potential lenders to lend evaporates, triggering funding stress on all economic agents who depend on refinancing from others. In a *market* liquidity crisis, turnover drops, bid-ask spreads go up and much higher discounts have to be accepted when selling assets, in particular if sales volumes are large and if sales have to be conducted rapidly because cash is urgently needed. A market liquidity crisis contributes to a funding crisis as the possibility of funding through asset sales is impaired (see Brunnermeier and Pedersen, 2007 for the concepts of funding and market liquidity). Liquidity crises, once under way, are characterized by vicious circles of liquidity stress, liquidity hoarding, asset fire sales and implied valuation losses and solvency problems. Economic activity shrinks not only because all agents focus more on funding survival instead of on launching new liquidity consuming investment projects, but also because actual defaults and closures of companies occur. Default, company closure or restructuring imply destruction of organizational capital and the inactivity of productive resources leads to severe output losses.

Most authors analyzing financial crises highlight the role of serious downward revisions of asset values as triggers of the crisis (from Bagehot, 1873, to e.g. Kindleberger and Aliber, 2005). In the crisis that started in August 2007, the inversion of an unsustainable trend in real estate prices and related securitizations (and associated malpractices) played a key trigger role (Gorton 2008). Other crises, like the German crisis that culminated in 1931, seem to have been triggered primarily by a reversion of capital inflows in view of debt sustainability and political issues (see e.g. Ritschel and Safarez, 2006).

Liquidity crises can be triggered by various exogenous events. It has however been argued that their consequences tend to be similar and rather independent of the initial trigger. This view is most prominently taken by Bagehot (1873, chapter VI “Why Lombard Street Is Often Very Dull, and Sometimes Extremely Excited”): “Any sudden event which creates a great demand for actual cash may cause, and will tend to cause, a panic in a country *where cash is much economised* (emphasis by UB and AW) and where debts payable on demand are large. Such accidental events are of the most various nature: a bad harvest, an apprehension of foreign invasion, the sudden failure of a great firm which everybody trusted, and many other similar events, have all caused a sudden demand for cash. And some writers have endeavored to classify panics according to the nature of the particular accidents producing them. But little, however, is, I believe, to be gained by such classifications. There is little difference in the effect of one accident and another upon our credit system. We must be prepared for all of them, and we must prepare for all of them in the same way—by keeping a large cash reserve.” The observation of the universal nature of liquidity crisis suggests that one analytical framework may be able to explain a large part of the mechanics of most liquidity crisis. Against this background, we argue that approach presented in this paper is applicable almost all liquidity crises.

It is important, in particular when analyzing dual crises, that liquidity funding crises can manifest themselves on various markets, and in particular a) the market for bank deposits, b) the interbank market and c) bonds and other security markets involving debt titles.

(a) “Runs” by investors/households. The key theoretical reference on bank runs by investors/households remains Diamond and Dybvig (1983). Basically, they model a banking sector with two equilibria, one superior and one inferior. The superior is the pre-crisis one, and the inferior is the one representing the liquidity crisis. Diamond and Dybvig (1983) are silent on the triggers that lead to a shift from the superior to the inferior equilibrium by referring to “sunspots” as crises origins. However, empirically (Calomiris and Gorton 1991) concerns about the solvency of individual banks (or debtors in general, Bagehot 1873) in an environment characterized by asymmetric information are at the heart of liquidity crises. Thus, higher credit risk changes the strategic game from one with a

unique stable superior equilibrium, to a prisoners dilemma kind of situation: if other depositors run, it is best for me to run as well. Once a run on a bank starts, it can lead to the default of the bank, confirming the individual wisdom of those who were first in the queue to withdraw their money. According to Laeven and Valencia (2008, 19), bank runs are a common feature of banking crises, with 62 percent of crises experiencing sharp and sudden reductions in total deposits.

b) Liquidity hoarding in a stable inferior equilibrium of the interbank market. Already Thornton (1802) noticed the problem of liquidity hoarding and bank runs, and how they relate to a lack of trust. “That a state of distrust causes a slowness in the circulation of guineas, and that at such time a great quantity of money will be wanted in order to effect only the same money payments, is a position that scarcely needs to be proved... When a season of extraordinary alarm arises, and the money of the country in some measure disappears, the guineas, it is commonly said, are hoarded. (p. 99)” Once a liquidity crisis has broken out, and everybody starts hoarding liquidity, this “dreadful state” (Bagehot 1873) may constitute an inferior equilibrium which is difficult to overcome. B2B (bank to bank) liquidity hoarding is a variant of the I2B (Investor to bank) bank run problem described above and at the heart of the global financial crisis in 2007/2008 (Gorton 2008).

(c) Bonds and other security markets: Fire sales spirals and the impact of liquidity stress on solvency. The mechanics of I2B and B2B types of crises can be generalized along three dimensions. First, self-fulfilling confidence crises also apply to institutional investors (pension funds, sovereign wealth funds, etc.). Second, the logic also holds for other entities with funding needs, i.e. not only to banks, but also to corporates and sovereigns. Third, it also applies to capital market instruments, i.e. debt securities (Gorton 2008), including government bonds (Winkler 2011) and not only to deposits. Thus, in a financial crisis, due to heightened uncertainty, information asymmetries and the shrinkage of the number and purchasing capacity of investors ready to buy at depressed prices, the liquidity of markets deteriorates significantly. Hence, it is no longer possible to sell significant amounts of assets without accepting a large discount relative to some perceived fair value. In this case, a vicious spiral can materialize in which asset fire sales to obtain liquidity depress market prices of assets remaining on the balance sheet of financial and non-financial firms to such an extent that, after the fire sales, solvency and liquidity problems are worse and trigger a new round of fire sales, and so on (see e.g. Brunnermeier et al 2009). Moreover, the asset fire sales of one institution may also negatively impact on the mark-to-market value of other institutions’ assets (and hence losses), leading to negative externalities (e.g. Cifuentes, Ferrucci and Shin, 2005).

These mechanics of liquidity crises imply that higher systemic liquidity buffers mean a lower probability of confidence crises leading to inferior equilibria. Thus, we aim at identifying in our system of financial accounts the system liquidity buffers that can support financial stability in the wake of shocks and identify the trigger points of a fire sales spiral, i.e. to contain a genuine liquidity crisis.

2.2 Dual liquidity crises

Dual crises are confidence and liquidity crises which involve the government and the banking sector. Given the quantitative importance of government debt in mature market economies and their financial systems respectively (Bini Smaghi 2010) – in the euro area government debt represents more than 50% of total outstanding debt securities (ECB 2010, 97-98) – they are particularly dramatic as they involve a larger part of the refinancing needs of the economy than “only” a banking/private sector funding crisis. There are important qualitative aspects as well as government debt usually plays an important role as the most secure debt in an economy. Thus, sovereign default is the ultimate disaster for the functioning of financial markets in any country, as it undermines confidence in the solvency of almost any other debtor. Moreover, it is pervasive in legal, social and economic terms. A government that is no longer able to fulfill its obligations towards its citizens and other stakeholders loses its key stabilizing functions. Only if creditors expect the Government to be able and willing to (i) recapitalize or take over insolvent financial institutions; (ii) guarantee exposures of the central bank and can take responsibility for the risk taking needed to save the financial system through exceptional liquidity

measures; (iii) maintain and possibly expand public expenditures, it can prevent the negative externalities of individual defaults, mitigate a panic and stabilize the financial system as well as economic activity, and hence prevent a depression.¹

This is why sovereign default, including so-called “private sector involvement” is so problematic (Bini-Smaghi 2011, Schnabel 2004, Ritschl and Sarfarez 2006). The euro area sovereign debt crisis of 2011 can be regarded as a dual crisis in the sense that the sovereign and the national banking systems in a number of euro area countries lost access to capital markets more or less simultaneously. As argued by Bagehot (1873) for liquidity crises in general, the origins of the crisis may vary substantially but are of limited importance for its eventual unfolding. For instance, in the case of Ireland, huge losses of a disproportionately sized banking system dragged the perceived credit quality of the sovereign down. By contrast in Greece, the banking system was seen as comparatively solid at the outset, but the poor fiscal and structural policies of the sovereign led to a government debt sustainability problem that via several contagion channels also implied a loss of funding market access and eventually solvency problems for the banking system. Once the dual crisis is in full motion, “diabolic loops” (Brunnermeier et al 2011) between the two sectors operate and drag the country into this most comprehensive form of liquidity crisis. Our approach to rely on a closed system of financial accounts encompassing all sectors is particularly suitable to analyze dual crisis as it allows fully capturing the interaction between all sectors involved.

2.3 A financial accounts presentation

We illustrate dual liquidity crises with the help of a closed financial accounts representation. The systematic use of such a representation has a number of advantages. First, it provides general discipline in thinking and ensures that transactions are captured in their entirety. Second, it can illustrate how shocks feed through the entire system. Third, it allows to thoroughly identify the constraints that determine the shock absorbing capacity of the system. Fourth, it allows measuring precisely concepts of shock absorbing capacity, such as “distance to illiquidity” or “distance to fire sales” (which can be defined as the absolute amount of short term liabilities of a debtor that can flow out before it becomes illiquid or has to start selling illiquid assets at a heavy discount) or “probability of fire sales” (taking distributional assumptions for a given distance to fire sales, the probability that fire sales become necessary). Finally, it provides a simple framework for a precise comparison between different international monetary regimes using the same language

It is important to distinguish our approach of a closed financial accounts representation from the one of Gray, Merton and Bodie (2007), who focus on *solvency* interactions between the sectors of an economy on the basis of a structural credit risk model and option pricing theory. The structural model of credit risk explains the liability structure of economic entities as options with the assets of the entity as underlyings. Starting from distributional assumptions on asset values, it thereby prices the value of liabilities as options. This allows to model how changes in asset values and volatilities impact liability values and hence asset values of other sectors, and hence allows to model how they affect the solvency of all economic sectors. Our approach is complementary to the one of Gray, Merton and Bodie (2007) in the sense that we model how funding liquidity issues, in contrast to solvency issues, unfold through the financial accounts of an economy, and how they can best be addressed through an adequate monetary framework and active central bank measures. Thereby, we ask the question what conditions on the liquidity side trigger asset fire sales and the associated downward spiral of prices. Once they are triggered, the model of Gray, Merton and Bodie becomes applicable.

Our system of financial accounts is stylized along a number of dimensions.

First, we only account for the most basic financial assets, namely banknotes, deposits at banks, sovereign bonds and bank loans. Moreover, in general we abstract from all intra-sector financial transactions. Households/investors are modeled as net creditors who have diversified their real assets into financial assets and who are not leveraged at all (i.e. their entire liability side consists in equity).

¹ The importance of the government for financial stability has been highlighted by Goodhart (1998, 1999).

Corporates and sovereigns are the real sectors that need funding. The banking sector performs intermediation services, while the central bank issues banknotes and may hold different types of financial assets.

Second, we abstract from genuine solvency problems and focus on liquidity aspects. This does not mean that we deny solvency problems - at the contrary, by focusing on the liquidity side and modeling flows in a closed system of financial accounts, we can precisely identify the conditions under which it can be precluded that liquidity shocks lead to asset fire sales or other forms of disruptive restructuring which typically is value destroying and hence has solvency implications.

Third, as already mentioned, we do not model the underlying triggers of liquidity shocks that may relate to doubts about solvency of debtors, or to any other reasons, even before the liquidity crisis has started. While these are certainly relevant and often the genuine original trigger of a liquidity crisis, as Bagehot argues they do not determine the further evolution of the liquidity crisis. The following figure captures the part of financial crises on which this paper focuses on, namely part D as highlighted, which decides on whether the initial liquidity crisis can get neutralized or not.

Figure 1: Financial stability, crises triggers, systemic buffers and financial crises

Development of a financial crisis		Part
Financial stability ↓		A
Crisis trigger (shock to actual or perceived asset values, sudden solvency problems of major economic players) ↓		B
Liquidity hoarding, funding market freeze, bank runs, capital flight ↓		C
Systemic buffers in particular associated with the central bank providing elasticity of credit to prevent default due to illiquidity ↓		D
Confidence returns, back to financial stability	Eventually constraints are hit and defaults, fire sale spirals, widespread contagion and solvency problems and a credit crunch materialize	E

Source: authors' compilation

Fourth, we capture liquidity problems by imposing that the banking, corporate and government sector perform maturity transformation, in the sense that they have partially (banks) or completely (corporates, government) illiquid assets, but relatively short term liabilities. We do not model the consequences of fire sales by banks of non-liquid assets, but investigate the conditions that the system can, through its built-in elasticity, avoid the need of fire sales and the associated intensification of financial crisis dynamics. Households/investors lend short-term and trigger a financial crisis via an instable demand for financial assets, exposing the banking and government sector to a liquidity shock. In the two country case the central bank of the distressed country can experience a liquidity shock as well. Original liquidity shocks can take in particular the following forms: (i) a withdrawal of household/investors deposits from or capital market funding to the banks (“-d”); a liquidation or non-roll over by the household/investor of sovereign debt (“-s”); (iii) the return of banknotes to the central bank, “-g”, in exchange for gold and foreign exchange respectively. In each case, households/investors substitute these assets with some other financial asset which may be considered a “save haven” assets.

Fifth, in the two country case we only model *one* household/investor sector as – due to the assumption of an open capital account – the sector is free to invest in any sector of any country. By contrast, for all other sectors we distinguish between sectors located in country 1 and country 2 because they are assumed to be asymmetrically hit by a liquidity shock.

In annex 1, we present the actual financial accounts of the Eurosystem and reflect on how they compare with our stylized accounts. Annexes 2.1 to 2.4 show the evolution of the actual balance sheets of the Federal Reserve and the Eurosystem during the global financial crisis.

2.4 The size of system liquidity buffers, system resilience, moral hazard and central bank risk taking

Financial crises can be avoided when the system is able to withstand liquidity shocks thanks to sufficient systemic liquidity buffers. Financial history has seen many attempts by the private and public sector, including central banks operating under the constraint of some form of a fixed exchange rate, to provide for such buffers (Goodhart 1988, Obstfeld, Shambaugh, Taylor 2008, Gourinchas and Obstfeld 2011). The larger the buffers the less likely a confidence crisis arises and a run takes place testing the elasticity of a system. There are at least three reasons for this proposition: *First*, if we assume that the probability distribution of liquidity shocks is exogenous to the size of buffers, larger buffers make it less likely that they will be exhausted. *Second*, the probability distribution of liquidity shocks itself may partially depend on the size of buffers, i.e. is at least partially endogenous. For instance, if depositors know that a bank will default when only few depositors withdraw, then all depositors will be nervous and at the slightest sign of withdrawals by others will start a run. If in contrast depositors know that buffers are very large anyway, they will be relaxed and will not even monitor the behavior of others. *Third*, the existence of buffers and the associated confidence will incentivate market players, who are themselves potentially constrained, to provide liquidity in an elastic way.

For a closed economic system, having a central bank has become the key institutional device to provide those buffers in case of need (Bagehot 1873, Goodhart 1988), i.e. to provide an ‘elastic currency’ (Friedman (1989) with reference to the Federal Reserve Act of 1913).² For example, well-functioning interbank markets providing additional liquidity buffers in normal time have only been forthcoming on the basis of general confidence on the existence of system buffers provided by the central bank (Miron 1986). Balderston (1989) makes a similar point with regard to the development of liquid short-government debt markets, which was hampered in interwar Germany due to the strict monetary financing prohibitions the Reichsbank was subject to. Thus, liquidity buffers substantially reduce the volatility of short-term rates. This translates into a lower degree of volatility of longer-term rates reducing noise in economic decisions, and hence supporting the economy in reaching equilibrium (Bindseil, 2005, 237). Moreover, beyond the buffering function in normal times to counter the short term exogenous changes of the inelastic demand for liquidity, the merits of the central bank to act as a lender of last resort in the case of liquidity crises have been well documented (Bagehot, 1873, King, 1936, Goodhart 1988, 1999).

At the same time, large liquidity buffers provided by central banks have also be viewed critically for a number of reasons. Very elastic central bank liquidity supply may: (i) create leeway for moral hazard as the implicit liquidity buffers provided by the central bank would invite reliance on them, and undermine the incentives of debtors to take themselves the due preparations, which are costly (see e.g. Bindseil and Lamoot 2011 for this as basis for liquidity regulation); (ii) support credit booms and asset price bubbles as investors feel confident to leverage strongly and quickly when economic opportunities arise and hence lays the foundations of the eventual burst of such bubbles and associated crisis costs (Calomiris 2009, Mishkin 2010, Schularick and Taylor forthcoming); (iii) prevent insolvent debtors to be identified early enough and be forced to default and thereby allow them to continue wasting resources; (iv) create undue financial risks for the central bank, as the elastic supply allows the weakest debtors who have most problems to fund transactions in the market to take massive recourse to the central bank.

From the latter arguments, one could in extremis conclude that private and sovereign debtors should (be forced to?) take care themselves of ensuring sufficient funding liquidity under all circumstances,

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and to forego having a central bank (Hayek 1976, 104-105). It is well known that this conclusion has not been drawn by mature economies (Goodhart 1999). However, the arguments have made an impact on central bank policies. Indeed, the issue of limiting the elasticity of central bank funding supply in normal, but even more in crisis time, has been a major topic of central banking ever since the 18th century (Bindseil 2005, Chapter 4). For example, whether access to borrowing facilities at the central bank should be regulated purely through the price mechanism (the borrowing facility rate) or, in addition, through deliberately narrowing collateral eligibility criteria, quantitative limits, administrative restrictions, or moral suasion, has been a recurrent issue debated by central bankers and academics. Those debates reflect the insight that there is a trade-off between the pros and cons of an elastic currency which can be illustrated in terms of a classic two stage problem: first, establishing the efficient frontier, and then choosing the best point on the efficient frontier. Only few specific monetary frameworks will actually be on the efficient frontier and perform well in combining the pros of elasticity in terms of making liquidity crises relatively unlikely thanks to sufficient buffers, while at the same time avoiding to the extent possible moral hazard, undue risk taking, and destabilization due to excessive leveraging. The efficient frontier is reached through an optimum combination of (i) the choice of the overall monetary framework (in particular the exchange rate regime); (ii) risk control measures on collateral in central bank credit operations (collateral eligibility criteria, valuation, haircuts, concentration limits); (iii) price incentives against the use of special liquidity facilities by applying a system of adequate interest rate surcharges; (iv) the extent of monitoring and due diligence by central bank on collateral issuers and counterparties; (v) the readiness of central banks to take proactive discretionary support measures when needed.³

3. The case of one country in a flexible exchange rate environment

We start our analysis with the case of a single country facing a dual liquidity crisis, also to introduce thoroughly the logic of the representation of the financial system in a closed accounts system. We assume that the country is linked with the international financial system through a flexible exchange rate regime with no or limited borrowing in foreign currency. We use the following balance sheet positions and notation:

- E = household equity, equal to the real assets in the system
- D = deposits of households with banks
- S = debt securities
- B = Banknotes
- G = Gold
- FX = Foreign currency reserves of central bank
- Small letters: various liquidity shocks referring to the relevant asset class (*s* a negative shock to sovereign debt demand; *g* a positive demand gold shock, *d* a negative shock to bank deposit, *y* an interbank market shock, *k* a deposit shift shock between banks of different types).

3.1 The central bank as universal lender of last resort

We follow standard macroeconomic analysis (e.g. Williamson 2010) by assuming that at the origin of the economy stands the household/investor sector. In the beginning, this sector only holds real assets of value E (equity). The household then diversifies into three financial assets, namely deposits with banks D, banknotes B, and sovereign debt *S*. To the extent that the household diversifies into financial assets, it sells real assets to the corporate and government sectors. However, households do not transact directly with corporates and the central bank but use the intermediary services of banks. Households are strictly non-leveraged i.e. their balance sheet length always remains E.

³ In Bindseil (2011, 94) a two-dimensional example is provided for establishing a concrete efficient frontier between on one side the “probability of illiquidity” of banks, on the other side the financial risk taking of the central bank.

Corporates and the sovereign finance themselves via bank loans and debt securities issuance. We treat the government and the corporates most of the time as one sector, which is an adequate and parsimonious treatment in our model. We will distinguish between them when central bank actions relate to one, but not the other, as it is the case for a strict “monetary financing prohibition” on central bank credit to sovereigns. The real resources that the corporate and the government sector can appropriate correspond to what the household wants to diversify in the form of banknotes, deposits and securities. The corporate and the government sector use the real assets for idiosyncratic illiquid projects (machines, schools, etc.). If the corporate and government sector can no longer roll over the loans obtained from banks and the debt securities issued, they would have to sell these assets at loss-making prices (e.g. a sophisticated machine being sold as old metal). As mentioned, we do not model this case explicitly as we are looking for the conditions that this case can be avoided.

Debt instruments are issued by the corporate and government sector in exchange for real assets held by households. By contrast, the provision of credit based on the diversification of household assets into banknotes and bank deposits runs via banks. The banking sector is the intermediary between the remaining sectors. First, it offers deposits D to households and invests them into loans to corporates. Second, the sector is an intermediary to the operation between the households, the corporates/government and the central bank encompassing the issuance of banknotes B . Banks use banknotes to purchase real assets from households, which they sell on to corporates who finance them through a loan from the bank. Thus, total funding and hence total assets held by banks amount to $B + D$. Finally, banknotes are issued by the **central bank** who provides them to banks through collateralized credit operations.

The resulting financial structure of the economy is reflected in the accounts below (Figure 2). The capital letters reflect the positions introduced so far. The small letters reflect the liquidity shocks in the system related to the instability of household / investor demand for specific financial assets. Households may withdraw deposits from the banks (d) or they may be unwilling to roll over (or they may sell) debt securities (s). In each case, we assume that they substitute these assets with banknotes, i.e. banknotes are seen by households/investors as the “save haven” asset.

Figure 2: A simple system of financial accounts

Households / Investors			
Real Assets	$E - D - S - B$	Household Equity	E
Deposits Bank 1	$D - d$		
Debt securities	$S - s$		
Banknotes	$B + d + s$		
Corporate / Government			
Real assets	$D + B + S$	Credits from banks	$D + B$
		Debt securities	S
Bank			
Lending to corporates	$D + B$	Household deposits / debt	$D - d$
		Credit from central bank	$B + d$
Central Bank			
Debt securities	s	Banknotes	$B + d + s$
Credit operations with banks	$B + d$		

Source: authors' compilation

Following up on the discussion in section 2, the central bank is the **built in liquidity stabilizer** in this system. The central bank is able to issue banknotes demanded by households/investors and to compose its assets in line with the need to stabilize the financial system by preventing illiquidity. It does so by

absorbing the excess supply of debt securities and deposits resulting from reduced investor demand (“ s ”, “ d ”) and by buying bonds and providing additional credit to the banking sector.

The **constraint** the central bank is subject to when performing its stabilizing function is a self-imposed one and relates to the quantity and quality of *collateral* it accepts in exchange for the issuance of banknotes. This is because the central bank applies risk control measures which reduce the borrowing potential of banks vis-à-vis the central bank. Those measures include (i) restrictive eligibility criteria (e.g. excluding certain non-transparent asset classes and setting a minimum credit quality for the collateral obligor), (ii) conservative collateral valuation (to reduce the risk of assuming too high collateral values), (iii) haircuts (to cater for losses in value during the liquidation period after a counterparty default), or (iv) quantitative limits (to address concentration and correlation risks). The need to collateralize central bank lending has been discussed already in the 19th century central banking literature (e.g. Bagehot 1873), and is one of the most sacred principle of central banking.⁴

To simplify, we assume that all loans of banks to corporates are eligible collateral, and that the central bank imposes a haircut of $h\%$ on them, implying that for one unit of collateral value, the bank can obtain a maximum of $(1-h\%)$ units of central bank funding.⁵ Thus the maximum lending of the central bank to the banking sector is determined as

$$(1) \quad (1-h)(D+B) \geq B+d$$

If the shock d exceeds $(1-h)D-hB$, the banking sector hits the collateral constraint, and banks may become illiquid and default, unless the central bank is willing to either reduce haircuts or to lend further to banks if the Government provides a financial guarantee.

Apart from collateral constraints, the central bank could in principle impose a **lending limit** on banks. In the current specification of the system of financial accounts with only one bank, such a lending constraint would be either binding and make the collateral constraint irrelevant, or vice versa. However, in the extension of the financial accounts model with more than one bank, this redundancy of one of the two constraints no longer holds as different banks may become subject to one or the other of the two constraints.

Overall, the system of accounts reflects two key features of central banking. On the one hand, there are no limits – in principle – for the central bank to provide an ‘elastic currency’. On the other hand central bank lending to banks and outright purchases may both be potentially constrained by central bank financial risk management or other policies. In case of credit operations with banks, this implies that the collateral constraint may bind, while in the case of outright operations, it may lead to a general refusal of such operations, or narrow limits to it. Example of other policies would be in the case of collateral the real bills doctrine, and in the case of outright purchases the monetary financing prohibition regarding sovereign debt.

Deposit shift shocks between individual banks and the break down of the interbank market

The simple model above is *not* able to illustrate developments in the recent financial crisis. This is because the deposit withdrawal shock d above reflects the idea of a bank run by retail depositors and the transformation of deposits into cash, i.e. banknotes being the safe haven asset. The idea of a flight from debt securities into banknotes follows a similar logic. However, as it is well known the recent financial crisis has not been characterized by bank runs, with the case of Northern Rock as an important exception. As a result, only a moderate increase of the trend growth of banknotes in circulation has been observed in the 2007/2008 crisis. Instead, households/investors shifted their investments/deposits across financial institutions/issuers. Thus, we have to extend the model by introducing two types of bank groups: safe banks and risky banks whose solvency has been put in doubt. By doing this, we can account for an interbank market freeze and a deposit shift shock.

⁴ A detailed overview of principles, tools and calibration techniques of collateral frameworks can be found in Bindseil et al (2009; in particular chapters 7 to 10 on risk management of central bank credit operations).

⁵ In this simplified setting, h also implicitly covers conservative valuation of bank assets when being submitted as collateral, and the fact that not all assets are eligible as central bank collateral.

The interbank market position between the two types of banks is set initially to Y , whereby we assume that safe banks (Bank 1) lend to risky banks (Bank 2) an amount Y . This could be the case because safe banks have comparative advantages in deposit collection, while risky banks have comparative advantages in originating and managing loans to corporates (see e.g. Bindseil and Jablecki, 2011). We introduce two new shocks. Shock k is a deposit shift shock originating from households/investors. Households hear rumors about risky banks having problems and therefore transfer deposits from risky to safe banks (from Bank 2 to Bank 1). Shock y is the interbank market shock. As safe banks hear the same rumors about risky banks, they reduce their limits to risky banks such that interbank loans decrease by an amount of y . Thus, risky banks are under double funding stress and extend their central bank borrowing until they hit their collateral constraints. As in view of the later discussion of TARGET2 balances it is interesting to note that there is a threshold for the joint shock $k + y$ beyond which safe banks (Bank 1) will have excess reserves with the central bank. Thus, instead of a liability position towards the central bank of $B/2 + d/2 - k - y$, safe banks will have a claim on the central bank of $-B/2 - d/2 + k + y$. In this case, the central bank balance sheet expands by the latter amount (Figure 3).

Figure 3: Deposit shifts and liquidity crisis on the interbank market – a financial accounts presentation

Households / Investors			
Real Assets	$E - D - S - B$	Household Equity	E
Deposits Bank 1	$D_1 - d/2 + k + s$		
Deposits Bank 2	$D_2 - d/2 - k$		
Debt securities	$S - s$		
Banknotes	$B + d$		

Bank 1			
Lending to corporates	$D_1 + B/2 - Y$	Household deposits / debt	$D_1 + k + s - d/2$
Deposits with CB	$\max(0, -B/2 + k + y + s - d/2)$	Credit from central bank	$\max(0, B/2 - k - y - s + d/2)$
Lending to Bank 2	$Y - y$		

Bank 2			
Lending to corporates	$D_2 + B/2 + Y$	Household deposits / debt	$D_2 - k - d/2$
		Credit from central bank	$B/2 + k + y + d/2$
		Liabilities to Bank 2	$Y - y$

Central Bank			
Debt securities	s	Banknotes	$B + d$
Credit oper.	$B/2 + k + y + d/2 + \max(0, B/2 - k - y - s + d/2)$	Deposits banks	$\max(0, -B/2 + k + y + s - d/2)$

Source: authors' compilation

Let us briefly note, also for historical reasons (e.g. Friedman and Schwartz 1965, Goodhart 2010), one important central bank consideration on collateral eligibility in this extended model: traditionally, central banks did not accept as collateral “financial bills” but only “real bills”, i.e. loans from banks to the real economy, i.e. corporates.⁶ This “real bills” doctrine is still alive in more or less stringent variants. Most central banks do not accept bank bonds or any other claims to banks as collateral.⁷ This puts a limit to the interbank lending Y from bank 1 to bank 2. Concretely, the (deterministic part of the) collateral constraint of safe banks (bank 1) under the “real bills doctrine” constraint is $(1 - h)(D_1 + B/2 - Y) \geq B/2 - k - y - s + d/2$. Without the real bills doctrine, and assuming that the

⁶ Securities were accepted only for Lombard loans, while interbank loans were not accepted at all.

⁷ The Eurosystem accepts bank bonds, but foresees certain limits on the use of unsecured bank bonds by other issuers to prevent issuance spirals, and it does not accept interbank loans (while it accepts loans to corporates as collateral).

interbank financing takes the form of eligible collateral (e.g. bank bonds), the constraint amounts to $(1-h)(D_1 + B/2) \geq B/2 - k - y - s + d/2$.

Central banks may also introduce a non-redundant lending constraint to banks. It could for instance set (i) an identical limit across all banks; (ii) a proportionally limit, i.e. that each bank can only finance a share of $q\%$ of its balance sheet through central bank lending; (iii) a maximum as equal to central bank lending to individual banks on a specific past date. The constraints could be non-redundant in the sense that for some banks, the collateral constraint would still be the binding constraint, while for others it could be the central bank borrowing limit.

3.2 Example: The US during the financial crisis 2007 - 2010

The model including deposit shift and interbank shocks can be used to explain the development of central bank balance sheets in a liquidity crisis. We illustrated this by the example of the Federal Reserve in the global financial crisis. Stabilizing measures by the Federal Reserve in the recent financial crisis have been analyzed extensively (Madigan 2009, Stella 2010, Hilton and McAndrews 2010), including overviews provided by the Fed itself (e.g. at <http://www.federalreserve.gov/monetarypolicy/bst.htm>).⁸ We follow the literature by distinguishing between three crisis phases. The first one covers the period from July 2007 until the Lehman default in September 2008. During the first phase the size of the Fed balance sheet basically did not change, but credit operations with banks substituted outright holdings of sovereign debt. In a second phase, from the Lehman event to around April 2009, the balance sheet of the Fed lengthened massively due to special credit operations to entities that had lost market access to US dollar funding (banks, but also insurance companies such as AIG, as well as other central banks). In a third phase (since April 2009), special credit operations have been reduced gradually, but this has been more than compensated through large scale securities purchases including both sovereign paper and agency debt / mortgage bonds. Looking at the liability side, the Lehman default is the start of the built up of massive remunerated excess deposits of banks with the central bank, reflecting the liquidity injections first due to special credit operations and then due to outright purchases.

To map the evolution of the actual Fed balance sheet into our stylized balance sheet, a number of issues need to be noted. First, we introduce another item called “other autonomous factors” that contains all sorts of positions in the balance sheet which do not fall under any of the categories introduced so far. We assume that changes to other autonomous factors (a) feed like banknote shocks (d) through the system. Second, we are aware that sovereign debt purchases by the Fed were not motivated by lender of last resort considerations but rather by “quantitative easing” in the wide sense of the term encompassing the goal of bringing down long term interest rates for the sake of softening the monetary policy stance. Third, deposits of banks with the central bank partially reflect reserve requirements. So even if the interbank market functions well and the banking system in total has a liquidity deficit towards the central bank, deposits of banks to cover reserve requirements will be held with the central bank. Having made these remarks, we can interpret the Fed balance sheet as follows in our simplified structure (Figure 4), whereby we distinguish four different dates in relation to the crisis.

Figure 4: The evolution of the Federal Reserve Balance Sheet during the financial crisis

Panel A: Fed balance sheet – pre-crisis – 30 June 2007			
Debt securities purchased	790	Banknotes	775
Credit operations banks	20	Other autonomous factors	19
		Deposits banks	16
Total	810	Total	810

⁸ The charts in annex 2.1 and 2.2 summarize how the assets and the liabilities of the Federal Reserve evolved between July 2007 and end of 2011.

Panel B: Fed balance sheet – pre-Lehman – 13 September 2008			
Debt securities purchased	479	Banknotes	795
Credit operations banks	286	Deposits banks	25
Other autonomous factors	45		
Total	765	Total	810

Panel C: Fed balance sheet – post-Lehman – 7 January 2009			
Debt securities purchased	495	Banknotes	848
Credit op. banks/others finance. inst.	852	Deposits banks	846
Other autonomous factors	344		
Total	1694	Total	1694

Panel D: Fed balance sheet – 16 November 2011			
Debt securities purchased	2625	Banknotes	1016
Credit op. banks/others finance. inst.	38	Deposits banks	1578
		Other autonomous factors	79
Total	2663	Total	2663

Sources: *Federal Reserve and authors' compilation*

Pre-crisis, 30 June 2007 (Figure 4, Panel A). The pre-crisis Fed balance sheet was characterized by a predominance of sovereign debt outright holdings on the asset side. Only around 2.5% of assets took the form of credit operations with banks. Thus, the Fed's balance sheet was "lean" in the sense that its size was hardly longer than the possible minimum, which is determined by the amount of banknotes in circulation. The large holdings of sovereign debt reveal that there is no 'Angst' at all of interaction with sovereign debt markets. In fact, the approach reflects the idea to hold sovereign debt paper as counterpart to banknotes in circulation. It should not be misinterpreted as reflecting lender of last resort action for the sovereign.

The logic of this balance sheet is as follows: Banknotes (decided by households), other autonomous factors (decided by whatever actor is behind the underlying items), and deposits of banks (equal to reserve requirements) are exogenous.⁹ The Fed at this time targeted neutral money market conditions in the sense that deposits would be close to required reserves. Hence it automatically adjusted the sum of its two policy assets (securities and credit operations) to be such as to achieve deposits equal to reserve requirements. The remaining decision of the central bank is then the composition of the asset side which has a length equal to the sum of the three exogenous liability items. The Fed decided to hold the very large share of its assets as securities.

13 September 2008 – pre Lehman (Figure 4, Panel B). In this phase of the crisis, the Fed reduced its sovereign debt holdings and provided more central bank credit to banks against less liquid collateral (it basically enlarged the collateral set for its repo open market operations to the very broad one accepted for discount window borrowing). This change was motivated by the fact that the US government whose debt titles were seen by households/investors as a "safe haven asset" (Bordo and James 2008), had no problems to place debt in the markets. By contrast, banks faced acute funding needs that they were allowed to cover through repo operations with the central bank with less liquid collateral, namely the collateral set otherwise reserved for the discount window (the TAF operations).

Again, a similar balance sheet logic applies, whereby the debt securities held by the Fed were actually the residual determined by the rest of the items. Indeed, 'credit operations with banks' were determined by the banks which had lost access to funding sources and hence needed to fund themselves by borrowing from the Fed. The Fed responded to this need by reducing its outright holdings such as to keep deposits with banks equal to reserve requirements.

⁹ With regard to the last of the three, the notion of 'exogenous' has to be understood as follows: the reserve requirements are exogenous at any specific moment in time.

Post-Lehman – 7 January 2009 (Figure 4, Panel C). In the post Lehman situation interbank market dislocation became obvious. As a result, the Fed balance sheet rapidly doubled reflecting the need to lend massively to financial institutions and close their funding gap.

The logic of this balance sheet needs to be based on a disaggregate model with – for simplicity – only two types of banks, “safe” and “risky” banks. The balance sheet of the central bank should be understood as follows (Figure 5).

Figure 5: The Federal Reserve post-Lehman balance sheet – a financial accounts perspective

Central Bank	
Debt securities	$S+s$
Credit oper.	$B/2+ A/2 - S/2 + k+y + d/2 + a/2$
$+ \max(0, B/2+A/2 - S/2 - k-y - s + d/2 + a/2)$	
Banknotes	$B+d$
Other autonomous factors	$A+a$
Deposits banks	$\max(0, -(B/2+A/2 - S/2 - k-y - s + d/2 + a/2))$

Source: authors' compilation

Safe banks (Bank 1) record liquidity inflows and as a result their access to the central bank switches balance sheet sides. As we can directly observe s , d , and a (as there are single balance sheet positions in our stylized balance sheet which only contain as change factor one of each of those), we can use the formula for the deposits of banks to identify $k+y$, and obtain USD 927 bn for the sum of these shocks. The meaning of this should not be interpreted further, since the US banking system is not strictly split in two types of banks. However, based on the two types of banks assumption we are able to identify the shock $k+y$ on the basis of the Federal Reserve balance sheet within our system of financial accounts.

Post crisis: 16 November 2011 (Figure 4, Panel D). Finally, we turn to the post crisis, post LSAP (large-scale asset purchase program) situation. Since April 2009, large scale asset purchase programs have lengthened the Fed balance sheet considerably, while lending to institutions with an impaired market access has receded, suggesting that financial institutions could regain market access. As mentioned, the securities purchases are not motivated by lender of last resort considerations. However, had they been strictly motivated in that way, one could have derived the shock s within the system of financial accounts.

When describing this phase of the crisis, we can return to an aggregate balance sheet logic, i.e. ignoring the interbank market dimension of a liquidity crisis. The key policy decision of the Fed was how much outright purchases of assets to make. Banknotes and other autonomous factors remain exogenous variables. The endogenous variable is the amount of deposits of banks with the central bank. They reflect debt securities purchased by the Fed minus the sum of banknotes and other autonomous factors.

Table 1 summarizes the evolution of the shocks (for s assuming that there would indeed have been such an underlying shock and that securities purchases would not have partially been motivated by quantitative easing).

Table 1: Liquidity shocks in the United States during the global financial crisis – a financial accounts presentation

	ASSETS		LIABILITIES			Change shocks - relative to 30 June 2007			
	Debt	Credit		Deposits	Other				
	Securities	operations	Banknotes	Banks	AF	s	d	a	$k+y$
30. June 07	790	20	775	19	16				
13. Sep 08	479	286	795	25	-45	-311	20	-61	-
07. Jan 09	495	852	848	846	-344	-295	73	-360	926,5
16. Nov 11	2625	38	1016	1578	79	1835	241	63	-

Source: Federal Reserve and authors' compilation

Overall, one may conclude that the US Federal Reserve represents the ideal type of a central bank that is in principle unconstrained in addressing a liquidity crisis with the exception of self-imposed constraints reflecting adequate risk control measures. Moreover, these constraints became endogenous in the crisis, as *collateral constraints* were adjusted by widening when necessary the collateral set in repo operations to the very broad one of discount window borrowing. No particular *lending limits* were imposed on banks. No constraints relating to *gold or foreign currency reserves* applied, as the Fed operates in a flexible exchange rate environment (and indeed the US never particularly seemed to care about defending the external purchasing power of the USD). Finally, no constraints to *outright purchases*, including Government debt, applied. In the absence of constraints, the FED acted strongly through various measures to support the funding liquidity of the economy.

3.3 The central bank as lender of last resort under the paper standard under a strict “monetary financing” prohibition

Outright purchases to address funding liquidity issues of Governments and corporates may be regarded as particularly effective as they allow to avoid collateral and other constraints that the banking system may otherwise face. However, outright purchases of securities, in particular in the case of sovereign debt, are often viewed critically. In particular, a “bail out” through outright purchases is considered to create incentive and moral hazard issues both on the side of investors and debt issuers. Investors may have earned risk premia and may have managed their risks insufficiently. Debt issuers are protected not only from taking disruptive and welfare reducing measures with negative externalities, but maybe also from taking necessary corrective measures (ex post moral hazard). Moreover, expectations of bail out may create ex ante moral hazard. In the case of sovereign debt, outright purchases have been seen as being particularly dangerous in view of the potential damage to central bank independence. While there is a rather balanced discussion of those dangers in the US (e.g. Walsh 2011), respective arguments have been used in particular by German officials and economists to prevent, limit and heavily criticize the Eurosystem’s purchase program for sovereign debt launched in May 2010 (see section 6, Bindseil and Modery 2011).¹⁰

Reluctance to outright purchases by central banks of securities is old. According to the German 19th century economist and journalist Max Wirth (1883, 528) outright purchases of distressed assets as a rescue measure in crisis times would be a particularly dangerous rescue measure for moral hazard reasons, that should always be avoided, while liberal central bank collateralised lending would be a fair compromise between moral hazard and financial stability considerations: “The committee for emergency matters was able to stay away from one danger we had particularly warned it about: the outright purchases of securities. The most extensive secured lending, the most liberal discounting, even the provision of loans against as collateral commercial goods are not as problematic as the purchase of securities. We must not recommend a medication of which the excessive consumption had itself caused the disease. Through outright purchases, one removes the responsibility of speculators, and one offers them the chance to restart playing the same game. The reasons for the crisis are not removed by that, the liquidation is only postponed to eventually return in an even more threatening form. After a while, it will appear that even this tool no longer works. In contrast, through collateralized lending, one achieves the strictly necessary, the confidence crisis and thereby the hoarding of cash is attenuated. ... Even the most liberal collateralized lending and discounting maintains that speculators are forced to put their things in order.”

The rejection of the central bank’s lender of last resort role for Governments and corporates through outright purchases modifies the financial accounts framework (Figure 6). As the central bank refuses or is not allowed by law to operate as a lender of last resort through outright purchases of securities, any liquidity shock on debt securities market (s) has to be addressed by the banking sector if stability shall be maintained. Thus, the banking sector becomes the lender of last resort for the securities

¹⁰ Against this background, it is interesting to note that the central bank with the longest tradition, the Bank of England, has been granted the status of a central bank after providing a loan to the Government when it was unable to find funding from other sources (Goodhart 1988).

markets. We assume that risky banks (bank 2) are not able or willing to expand their balance sheet. We assume that the debt securities purchases of safe banks (bank 1) increase deposits with the two banks equally. This captures the issue that banks lose liquidity when they buy assets outright.

Figure 6: Monetary financing prohibition and its implication in time of crises – a financial accounts representation

Households / Investors			
Real Assets	$E - D - S - B$	Household Equity	E
Deposits Bank 1	$D_1 - d/2 + k + s/2$		
Deposits Bank 2	$D_2 - d/2 - k + s/2$		
Debt securities	$S - s$		
Banknotes	$B + d$		

Bank 1			
Lending to corp/Gvt	$D_1 + B/2 - Y$	Household deposits / debt	$D_1 + k + s/2 - d/2$
Lending to Bank 2	$Y - y$	Credit from central bank	$B/2 - k - y + s/2 + d/2$
Debt securities	s		

Bank 2			
Lending to corp/gvt	$D_2 + B/2 + Y$	Household deposits / debt	$D_2 - k - d/2 + s/2$
		Credit from central bank	$B/2 + k + y + d/2 - s/2$
		Liabilities to Bank 2	$Y - y$

Central Bank			
Credit operations	B	Banknotes	B

Source: authors' compilation

The inability or refusal of the central bank to act as lender of last resort through outright purchases increases the risk of a liquidity crisis because stabilizing efforts will now face additional constraints.

First, the central bank will have to be willing to expand its lending to banks to allow banks to fund their additional purchases of debt securities in their function as lender of last resort. The extent will depend on the exact flow allocation, but often the entire increase of the banks' stock of securities will have to be refinanced by the central bank (in the accounts above this holds if both banks are dependent on central bank funding).

Second, like in the previous case, there are collateral constraints as the central bank applies a haircut on the collateral banks provide when demanding central bank credit. As just shown, the demand for central bank credit by banks rises when they act as lender of last resort for debt securities. Assuming that the haircut applied on debt securities h_s is lower than the haircut on loans h_L with $0 < h_s < h_L < 1$, the collateral constraint kicks in when the weighted sum of shocks exceeds a certain threshold as derived from the above balance sheet of the bank, namely:

$$(2) \quad h_s s + d > (1 - h_L)(D_1 + B) - B.$$

Third, capital constraints on banks may become relevant. For the sake of simplicity, we have refrained from including capital as a balance sheet item of the banking sector in the system of financial accounts. However, this can easily be changed by transforming a part of household deposits into holdings of bank equity E_B (Figure 7).

Figure 7: The banking system as a lender of last resort for (the government) securities market – a financial accounts presentation

Bank 1			
Lending to corporates	$D + B$	Bank equity	E_B
Debt securities	s	Household deposits / debt	$D - E_B - d/2 + k + s/2$
		Credit from central banks	$B + s/2 + d/2 - k$

Source: authors' compilation

Assume that regulatory or economic risk weights for loans is a and for debt securities is b , with $0 < a < 1$ and $0 < b < 1$. Then, the following overall capital constraint applies:

$$(3) \quad aD + bs < E_B.$$

The constraint implies that the banking sector has a limit to perform the lender of last resort for securities, and this limit is reached if s reaches $(E_B - aD)/b$, assuming that the banking sector is unwilling to reduce its exposure to the corporate sector. Put it differently: as the banking sector can expand its security purchases by shrinking their loan books, costly restructuring becomes necessary when the constraint gets binding. Of course, observers viewing outright purchase programs critically may argue that the central bank taking over the role of lender of last resort for Governments is a way to circumvent the fact that when purchasing risky assets, capital buffers should be explicitly foreseen. Proponents of central bank outright purchase programs may counter that capital scarcity is a crucial ingredient of contagion in financial crises. Against this background, it is one of the channels of effectiveness of central bank outright purchase programs that they make available the implicit capital associated with the unique privileges of the central bank (the future certain profit stream stemming from seignorage and the guaranteed liquidity, see e.g. Bindseil et al, 2004 and Stella 2002).

4. Dual liquidity crises in the two countries case (I): The gold standard

4.1 The system of financial accounts and the transmission of shocks in the gold standard

The early 1930s and in particular the case of Germany in July 1931 provide ample evidence on the mechanics of dual liquidity crises under the gold standard. The gold standard imposes the most stringent constraints on a central bank's ability to safeguard financial stability. At the same time, the gold standard is often portrayed as a smoothly functioning system as it embodies an automatic adjustment mechanism between member countries. If these adjustment mechanisms are allowed to play, financial stability could be maintained for the system as a whole. However, most observers agree that a) neither with respect to a smoothly functioning system, b) nor with regard to the play of automatic adjustment mechanisms this characterization reflected the realities of the pre- and post-WWI periods of the gold standard (e.g. Eichengreen 1985).

Under the gold standard, the central bank guarantees convertibility of banknotes against gold at a given rate. As a result, our stylized central bank balance sheet now includes gold as an asset (G_{CB}). Moreover, usually the central bank statutes require a certain minimum coverage of banknotes in the form of gold reserves. For example, in the interwar period a minimum ratio of 40% was applied by the German *Reichsbank*.¹¹ The convertibility guarantee at a given rate implies that the likelihood of a liquidity crisis increases substantially as the central bank now faces an external constraint on its ability to issue banknotes. Indeed, the central bank itself can become subject to a liquidity shock (g) because gold replaces banknotes as the ultimate "safe haven" asset. Accordingly, households/investors may want to sell banknotes and buy gold from the central bank. Another shock would be a simple increase

¹¹ In the UK, the Peel's Act allowed for a fiduciary note issue of a maximum of 14 million pounds. Any additional note issue required a 100% marginal gold cover ratio (Dornbusch and Frenkel 1984). See also Bermanke and James (1991).

of banknote demand at the expense of deposits with banks ($-d$). Both types of shocks are reflected in the financial accounts system below.¹²

We establish again a simple system of accounts to capture the basic liquidity flows (Figure 8). We ignore the lender of last resort for debt issuers, but the model can be easily expanded to have either the banking system, or the central banks being the ultimate lender of the sovereign. In terms of **shocks**, purely for presentational simplification, we assume that gold withdrawals g of the public go at the expense of central bank 2, and that they are paid with banknotes being returned to the central bank. Moreover, we assume that a deposit shift shock k occurs between the banking systems of the two countries. This shock needs to be balanced in the central bank balance sheets with corresponding gold flows. The **built-in stabilizers** are now: (i) the elasticity of central bank lending to banks to react to deposit shifts and gold demand; (ii) the elasticity of banknote supply and the readiness to provide gold at any time against banknotes; (iii) the ability of the central banks to influence the gold allocation parameter g through choosing the interest rate i ; and (iv) loans between central banks.

Figure 8: The gold standard – a financial accounts presentation

Households / Investors			
Real Assets	$E - D_1 - D_2 - B_1 - B_2$	Household Equity	$E + G$
Gold	$G - G_{1,CB} - G_{2,CB} + g$		
Banknotes 1	B_1		
Banknotes 2	$B_2 - g$		
Deposits Bank 1	$D_1 + G_{1,CB} + k$		
Deposits Bank 2	$D_2 + G_{2,CB} - k$		

Bank 1			
Lending to corporates	$D_1 + B_1$	Household deposits / debt	$D_1 + G_{1,CB} + k$
		Credit from central banks	$B_1 - G_{1,CB} - k$

Bank 2			
Lending to corporates	$D_2 + B_2$	Household deposits / debt	$D_2 + G_{2,CB} - k$
		Credit from central banks	$B_2 - G_{2,CB} + k$

Central bank 1			
Gold	$G_{1,CB} + k$	Banknotes	B_1
Credit operations with banks	$B_1 - G_{1,CB} - k$		

Central bank 2			
Gold	$G_{2,CB} - g - k$	Banknotes	$B_2 - g$
Credit operations with banks	$B_2 - G_{2,CB} + k$		

Source: authors' compilation

The constraints to those built-in stabilizers include the **collateral** constraint of the flexible exchange rate case, i.e. the post haircut collateral value needs to be at least as high as the total borrowing from

¹² In the financial accounts, it is a presentational question whether we see the household or the central banks as the original holder of gold. To maintain the idea that at the origin, there is only the household, and that the financial sector follows afterwards from scratch, we attribute the initial gold endowment to the household, and the central bank will buy the initial gold endowment via banks from households.

the central bank, $(D_2 + B_2)(1-h) > B_2 - G_{2,CB} + d$. The second constraint is particular to the gold standard, is the **central bank gold coverage ratio (GCR)**. It is binding if $(B_2 - g) < GCR(G_{2,CB} - k - g)$. If there is no gold cover ratio, gold reserves must always be non-negative, i.e. $G_{2,CB} - k - g > 0$.

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With the help of the central bank interest rate, in theory the gold coverage ratio can always be maintained by changing the relative attractiveness of gold versus deposits, i.e. inducing households/investors to forego the holding of gold in favor of deposits. However, this implies that the central bank is exposed to the impossible trinity, i.e. the setting of short term interest rates can no longer be used as an independent monetary policy tool to achieve price stability and hence the stability of economic activity (Obstfeld, Shambaugh and Taylor 2005). Most importantly, in the case that a gold outflow is due to a confidence crisis and to capital flight, the need to hike rates goes typically in the opposite direction of what would be needed in terms of achieving price stability and conjunctural stabilization. Real economic activity is likely to decline, raising or reinforcing doubts about the solvency of any borrower in the economy and hence triggering or aggravating a financial crisis.¹³ Indeed, a situation may arise in which even at very high interest rates, a central bank can no longer attract gold as the confidence crisis deepens with a higher interest rate. The perspectives for the domestic economy and hence for political stability become so poor, that households/investors suspect the likelihood of the country to give up the gold parity as too high. However, if the gold standard itself is questioned the rate of interest is unable to equilibrate supply and demand for gold (Eichengreen 1995).¹⁴ As a result, the central bank will eventually run out of gold, and the worst expectations will become self-fulfilling.

Figure 9: Current account transactions – a financial accounts presentation

Households / Investors COUNTRY 1			
Real Assets	$E_1 - D_1 - B_1 - k$	Household Equity	$E_1 + G_1$
Gold	$G_1 - G_{1,CB}$		
Banknotes 1	B_1		
Deposits Bank 1	$D_1 + G_{1,CB} + k$		

Households / Investors COUNTRY2			
Real Assets	$E_2 - D_2 - B_2 + k$	Household Equity	$E_2 + G_2$
Gold	$G_2 - G_{2,CB}$		
Banknotes 2	B_2		
Deposits Bank 2	$D_2 + G_{2,CB} - k$		

Source: authors' compilation

Before confronting our model with real data, and allow it to explain the constraints that eventually hit the Reichsbank in 1931, we may want to include a shock term for the **current account imbalance**, i.e. the net balance of trades and services. In fact, in our system of accounts, current account flows cannot be distinguished from pure capital flows as they have exactly the same representation in the accounts of the financial system. To illustrate this point, Figure 9 differentiates the household sector into two country parts, assuming, only for presentational reasons that each household deals only with the

¹³ See Dornbusch and Frenkel (1984) for an early example. In line with this argument, the gold standard period was characterised by a series of recurrent financial crises (Dornbusch and Frenkel 1984, Calomiris and Gorton 1991) that have not been observed in countries operating under the paper standard with flexible exchange rates and with no or little dollarization in terms of government, bank and private sector borrowing, i.e. avoiding „original sin“ (Eichengreen and Hausmann 1999).

¹⁴ In principle, this is the macroeconomic equivalent to the situation analyzed by Stiglitz and Weiss (1981) leading to credit rationing; see also Stiglitz (1987).

banking system in its own country. We assume a trade flow in the sense that household 1 sells a real asset to the household 2. The good is paid for by a transfer of deposits.

For the banking system, the flow k is identical to the one of a pure capital flow and hence it is also identical for all financial accounts. Thus, it is not possible within the financial accounts representation to distinguish whether a transaction of “real assets” (or goods) is behind the deposit shift, or a decision of investors to move their deposits from a bank account in one country, i.e. the risky banks, to bank accounts of another country, i.e. the safe banks. To do so an in-depth analysis of the balance of payment statistics, i.e. capital and current account flows, is needed.

The system of accounts also provides meaning to the term “global scarcity of gold”. It refers to a situation in which global gold reserves are not sufficient to ensure that *all* central banks can fulfill their gold cover ratio in a comfortable way. Thus, in case of a global scarcity of gold, households must be pushed through high interest rates to neither hold gold, nor banknotes, but mainly deposits with banks as financial asset. As households however have preferences towards holding these three types of assets, this requires a level of the rate of interest that is above the “natural” level which is neutral towards prices. This would mean that a deflationary environment would be created, which would eventually drive down prices, i.e. nominal values, and hence also the demand for banknotes in circulation. This should eventually allow to restore the gold cover ratio at lower interest rates, i.e. to reach an equilibrium with stable prices. However, the adjustment path is likely to be harsh. If the world is close to this gold-constrained state, and for instance a sudden shock of loss of confidence in banks occurs, such that deposits are substituted with gold and banknotes, then this must be counterbalanced by a strong interest rate increase and deflationary pressure – which is itself unlikely to overcome the confidence crisis vis-à-vis the banking system (as in a deflation bank balance sheets will be weakened).

As long as there is no global scarcity of gold, but only an imbalance across central banks, the gold coverage ratio of any individual central bank participating in the system can in principle be maintained by **cross-border gold loans** from central banks that hold gold reserves in excess of the minimum coverage ratio (Figure 10). In the example below, the inter-central bank gold loans correspond exactly to the deposit shift between the banks (the rest of financial accounts do not change). Central bank 1’s gold reserves will be stable as it experiences a gold inflow reflecting the deposit shift from banking sector 2 to banking sector 1 and provides lending to central bank 2. Central bank 2’s reserves suffer from the general gold drain to households. However, the outflow of gold triggered by the deposit shift gets compensated by the inter central bank loan.¹⁵

Figure 10: Inter center bank lending under the gold standard – a financial accounts presentation

Central bank 1			
Gold	$G_{1,CB}$	Banknotes	B_1
Credit operations with banks	$B_1 - G_{1,CB} - k$		
Gold loans to central bank 2	k		
Central bank 2			
Gold	$G_{2,CB} - g$	Banknotes	$B_2 - g$
Credit operations with banks	$B_2 - G_{2,CB} + k$	Gold borrowing from central bank 1	k

Source: authors’ compilation

There are five major **reasons that may constrain the willingness of central bank 1 to provide loans to central bank 2 under a gold standard**: *First*, as mentioned above, a global scarcity of gold reserves may apply and central bank 1 may itself feel uncomfortable with its gold reserves. *Second*,

¹⁵ Of course inter central bank loans could also be $d + g/2$, or $d+g$, the latter if e.g. central bank 1 was initially more distant to its gold coverage ratio constraint than central bank 2, and is willing to help also in a way that even reduces its gold holdings relative to the pre-crisis starting point.

central bank 1 may fear becoming subject to a similar crisis as country 1 in the future, i.e. it considers having a larger buffer to be appropriate. *Third*, central bank 1 may be unwilling to lend as it may feel that lending to central bank 2 runs counter to domestic stability as it could imply rising inflationary pressures in the future. Thus, central bank 1 may feel that central bank 2 should, instead of asking for a loan, raise further its discount rate, or limit its lending to banks (undertake “Credit restrictions”, or that the sovereign has to take economic policy measures (e.g. of a fiscal or structural kind) that restore confidence). *Fourth*, central bank 1 may be unwilling to lend to central bank 2 for financial risk management reasons, i.e. it may feel uncertain about whether it would ever be repaid. *Fifth*, central bank 1 may be unwilling to lend to central bank 2 for political reasons, or the gold loan may be provided only conditional on some concessions of country 2 on related or unrelated issues that country 2 may be unwilling to accept. All of these five reasons somehow played a role in the failure to agree on central bank loans to the Reichsbank in July 1931.

4.2 Application to the German dual crisis of 1931

4.2.1 Background and development of the German credit crisis of 1931

Run up: 1921 - 1929

The origin of financial instability characterizing the Weimar Republic was largely related to the reparation debt and the inability and unwillingness of Germany to deliver on it (Fleisig 1976, Ritschl 1996). The **war reparation** eventually imposed on Germany in early 1921 was 132 bn Goldmark (12 billion US dollar, or 47000 tons of Gold), i.e. an **estimated 250% of 1913 German GDP**¹⁶. The reparation bill led to an outcry and resistance in Germany, which triggered the French 1922 Ruhr occupation and hyperinflation in 1923.¹⁷

In 1924, the mark could be stabilized, and the **Dawes Plan** constituted the starting point of a number of prosperous years. The Dawes Plan foresaw “transfer protection” (“Transferschutz“) as a prioritization concept regarding the use of Reichsbank reserves. The transfer of reparations would be conditional to protection of the central bank’s reserves. Therefore, in the event of a foreign exchange shortage, commercial claims would be served first to avoid a run on the Reichsbank. In this sense, private claims had preferred creditor status relative to public claims stemming from reparations. As a consequence of the subsequent stabilization and of transfer protection, between 1924 and 1929, a total of 21 billion Reichsmark of private capital flowed to Germany.¹⁸

In 1927/28, official reparation creditors became increasingly concerned by this construction and their junior status, and started to press for abandoning transfer protection. Private investors realized in 1928 that seniority rules may be reverted. Negotiations on the Young Plan, later endorsed under the name of Hague convention of 20 January 1930, started in February 1929 in Paris. A Plan of 12 experts was presented in June 1929, but became already known in March 1929. As it foresaw the end of transfer protection, i.e. private claimants would no longer have priority in terms of the recourse to the Reichsbank’s gold reserves, it was followed by a sudden stop of capital inflows, i.e. six months before the Wall Street crash.

1929 marked the turning point in the Weimar Republic’s financial and economic development (Table 2) recording the last year without negative growth and deflation. At the same time, monetary

¹⁶ The pre 1914 Goldmark was equal in gold value to the post 1924 Reichsmark. The value of the 47000 tons of gold today would be (with a price per ounce of USD 1700) USD 25,815 Billion, i.e. 780% of German GDP today.

¹⁷ The German hyperinflation was unrelated to the kind of shocks and possible liquidity provision by the Reichsbank discussed in the paper but resulted from direct financing of government expenditures supporting the striking workers in the Ruhr area. On a more general level Bordo (1986, with reference to Capie (1986)) claims that any hyperinflation in the 20th century was associated with situations of extreme social unrest or civil war, i.e. not financial crises.

¹⁸ Ritschl (1996, 14) refers to a moral hazard issue: The more Germany would take in as commercial credit, the less reparations would probably have to be paid in the end. Private creditors felt confident to invest in Germany as long as transfer protection prevailed.

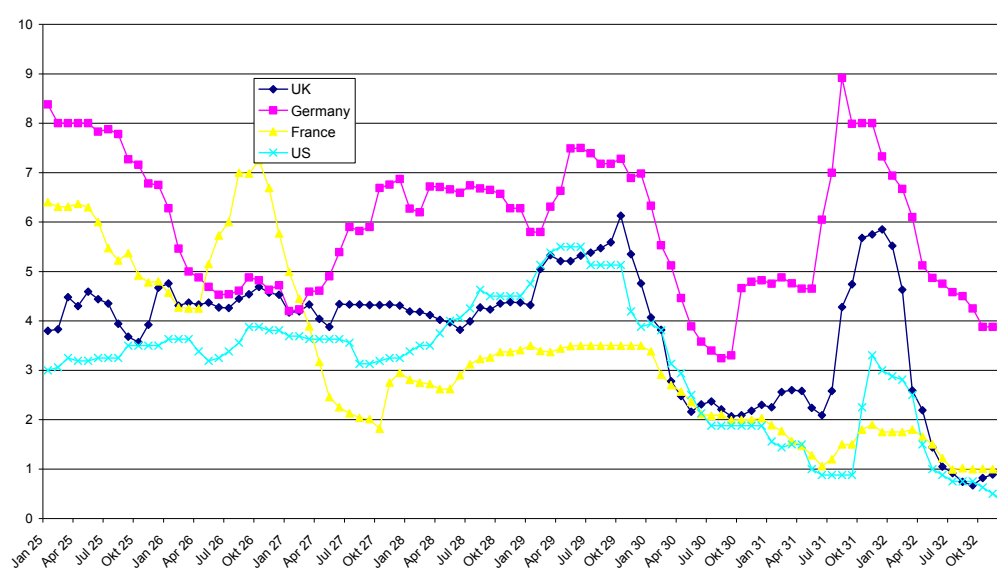
conditions tightened as shown by the development of interest rates (Table 2, Chart 1), illustrating the constraint under the gold standard for a country suffering a confidence crisis in terms of inability to use the central bank interest rates in a counter-cyclical manner.¹⁹

Table 2: Inflation, growth and key interest rates, Germany, 1926 - 1933

	Inflation	Real GNP growth	Discount rate	Lombard rate
1926			6.74%	7.90%
1927	0.9%	9.8%	5.83%	7.24%
1928	2.7%	4.5%	7.00%	8.00%
1929	0.0%	0.0%	7.11%	8.11%
1930	-5.5%	-1.4%	4.93%	5.93%
1931	-9.3%	-7.2%	6.91%	8.58%
1932	-10.4%	-7.8%	5.21%	6.21%
1933	-4.7%	6.8%	4.00%	5.00%

Source: Deutsche Bundesbank (1976)

Chart1: Short-term money rates in the UK, Germany, France and the US, 1925 - 1932



UK: Bankers' acceptances 3 months, Germany: Private discount rate, France: Private discount rate, US: Prime bankers' acceptances, 90 days
Source: Federal Reserve (1943)

The situation in 1930

Germany's total foreign indebtedness in 1930, excluding reparations, was 25 billion Reichsmark, or 35-40% of GNP (Toniolo 2005, 100). The net present value of the Young Plan, which foresaw cash flows totaling approximately 110 billion Reichsmark was, using a 3% discount rate, worth 54 billion Reichsmark in 1930, i.e. around 80% of GNP, leading to a total debt in 1930 of around 115-120%. The real debt burden obviously grew substantially in the following three years as nominal GNP shrank

¹⁹ Indeed, interest rate tightening by the Reichsbank (being a decoupling from rates set by the other major central banks) had started already in 1927. However, at this stage it was not the reflection of a confidence crisis, but more a standard tightening measure in the context of a still positive economic sentiment (Voth 2003).

by 30% in 1930-32. Therefore, in 1932, the debt/GNP ratio would have reached an order of magnitude of 150% of GNP. According to Bundesbank (1976), around one half of the 20 billion Reichsmark of foreign debt of Germany were short term. In 1930, German banks were in a relatively weak solvency situation, and partially highly dependent on short term foreign loans. Moreover, the Reichsbank's gold reserves were not very comfortable in comparison with the 40% coverage of banknotes by gold reserves (the threshold imposed by the Dawes and Young Plans).

The **Brüning Government**, which was never able to rely on a solid parliamentary majority, was established in March 1930. It would stay in power until May 1932. An extraordinary Reichstag election on 14 September 1930 sees extremist parties gain, the NSDAP becoming the second largest party, contributing further to a sense of political destabilization and further capital outflows. In the absence of a parliamentary majority, the Brüning Cabinet would impose in total 62 emergency decree laws of which four are famous in terms of imposing draconian economic austerity, such as increases of direct and indirect taxes, decreases of state employee wages, and in 1931 even with a general decrease of all employee wages, residential rents and prices. Until today, Brüning is commonly accused of having deflated the economy out of misconceived classical business cycle doctrines, or out of the desire to get rid of reparations (e.g. Ferguson and James 2001). However doing justice to Brüning requires to recognize that (i) Germany had largely lost capital market access in 1929, that (ii) at least the unconditional part of the reparation annuities had to be paid, (iii) that monetary financing of Government deficits was excluded by the restrictions imposed by the Dawes and Young Plans, and that (iv) dismissing the gold standard was not an option either, as it would also have been in contradiction with the Young plan and would possibly have created a panic in view of the fresh memories on hyperinflation. Therefore, extreme fiscal austerity and deflationary policies were probably unavoidable, if compliance with the Young plan was to be achieved for as long as possible.

The credit crisis of 1931

In March 1931, the **German – Austrian free trade agreement** was signed, which was seen by some (France in particular) as a political provocation (Ferguson and Temin 2001). It would reduce the willingness of France to agree to the Hoover moratorium and to central bank credits to the Reichsbank. In May 1931, problems of the **Österreichische Kreditanstalt** became known (namely an annual loss equal to the banks' total capital). Contagion to Germany sets in in the form of the start of an interbank run, foreign and domestic withdrawals from bank deposits and finally a retail bank run (Schnabel 2004). On 9 June 1931, Brüning announced his second emergency decree law, „Notverordnung zur Sicherung von Wirtschaft und Finanzen“, which however fails to restore confidence. From 1 to 17 June the Reichsbank lost 1.4 billion RM, more than one half of its gold reserves, and comes close to its minimum 40% coverage ratio prescribed by the Young plan, whereby the decline is in particular driven by banks' need to refund foreign sources of funding. On 13 June, the Reichsbank raises the discount rate from 5% to 7% (in a deflationary context) to stop the capital flight. On 16 June 1931, **Nordwolle**, a large textile company, announces high losses making insolvency likely, leading to a destabilization of Danat bank, which was known to be highly exposed to Nordwolle.

The **Hoover Moratorium of July 1931** was a late attempt to stop the confidence crisis by opening a perspective on restoring debt sustainability, and by relieving the Reichsbank of immediate payments that would have gone further at the expense of its gold reserves. On 20 June 1931, Hoover's plan was publicly announced. The US would forgo \$ 245 million of war debt payable soon by Britain, France, and Italy, provided that the Allies themselves suspend \$ 385 million in reparations due from Germany. Markets reacted very positive about the news and the German stock market jumped 25% on the following Monday. However, Hoover had not involved Germany's largest creditor, France, and unsurprisingly the French Government reacted negatively. On 5 July 1931, Luther writes in a letter to the BIS that the Reichsbank reserve ratio had fallen below 40% and that Germany could not meet the Young payments due on 15 July. An accord with France on the Hoover Moratorium was reached on 7

July 1931.²⁰ However, it was too late in the sense that the negative momentum could no longer be reversed. The Danat-Bank crisis was in full swing. Within one month, Danat-Bank had lost 40% of its deposits (Dresdner 11%, Deutsche 8%) (Toniolo, 2005, 101).

On 13 June, the Reichsbank raised its discount rate to 7% to stem capital flight, but with no effect. In this context, the Reichsbank announced **central bank borrowing limits for banks (“credit restrictions”)** with effect on 22 June: **the discount borrowing potential was fixed to the levels of discount borrowing as of 19 June 1931**. In addition the instruction was given that “for any central bank credit provision it is to be ensured that it is not used by the banks to finance the purchase of foreign exchange, who have no real economic foundations. In other words, beyond the strict quantitative restriction, constraints on capital mobility were imposed on banks” (James, 1998, 61). Imposing general central bank limits froze interbank and capital markets even more, as every bank became extremely concerned about its own funding. Thus, even banks with some liquidity buffer were no longer ready to lend those out of fears of being the next ones to be liquidity.

On 22 June, Reichsbank President Luther approaches Bank of England Governor Norman for a short term loan of USD 100 million, which is granted jointly by the Bank of England, The Fed New York, the Banque de France and the BIS three days later (Toniolo, 2005, 101-102; see below for further details). Conditionality was imposed on the Reichsbank to take measures to stop capital flight (James 1998). On 8 and 9 July, Luther flies to European capitals to ensure another larger central bank credit. However, “after a number of consultations, the US authorities took the position that ‘**Germany should first undertake credit restrictions**’ and ‘present a concrete proposal to the heads of the various central banks assembled in Basel’.” (Toniolo, 2005, 105).

This is confirmed by **the most detailed contemporaneous historical account of the episode, Priester (1932)** who describes the dramatic days in mid July 1931. On Saturday, 11 July 1931, the failure to find a solution becomes evident. We recollect these decisive days with some excerpt of Priester (58-62), as it illustrates the various constraints (in particular the collateral and gold constraint, and the unwillingness also of foreign central banks to help).

“To understand the future events, it is to be noted that the economic assessment of the ministerial bureaucracy [immediately preceding 11 July 1931] was in principle correct, but that it was unable to make their points towards the Chancellor and the Reichsbank. (p. 56).”

“The senior ministry officials considered the issue as being one of a liquidity crisis. A crisis of which the reasons needed to be removed quickly. This was only possible in their view if the Reichsbank would give up its restrictive policies and would declare itself again to be ready to accept any trade bill for discounting that the banks would submit.... They were aware that the available stock of eligible discount bills was largely exhausted due to the already much increased recourse to the Reichsbank. So even if the Reichsbank would declare again to discount all eligible bills, the banks would not be able to rely on this since no eligible bills were left in their portfolios. Ergo, so the senior ministry officials, one would have to find ways to create immediately new eligible trade bills. The idea of a guarantee by the Reich came up to achieve this....”

Only after the autopsy, one would be able to see what the eventual exposure – the financial risk of the Reichsbank – would be. That is why no special solution for a single bank should be thought, but instead a general guarantee in the above-mentioned form. There was consensus that one could not afford to let any major bank fail.

This plan, which was similar to the eventual solution adopted later on, did not encounter support of the ministers. One was still believing into the breakthrough of the Luther trip [to secure loans from foreign central banks]. Also the Reichsbank strongly opposed the plan. She was not ready to give up its restrictive lending policy under any circumstances, at the contrary, she was committed, with a view of expectations abroad, to become even more restrictive with regard to the provision of discount loans. According to the reports that were available to Luther, the foreign capitals were still regarding

²⁰ According to the Hoover Moratorium, Germany would pay only the unconditional part of the Young Loan which would then be immediately re-loaned to the German Railways.

the currency flows as German capital flight, which could be stopped immediately by restricting credit (p. 57-58)."

Priester summarizes the events of 11 July 1931 as follows:

"On 11 July 1931, the Government quarter, which is normally very quiet on a Saturday evening, had a very unusual appearance. Cars rushed permanently towards the Chancellery. The big conference room was full of people. Not only the leaders of the big banks, not only the members of the Government, but also anyone who had any relation with the Government or the banks felt entitled to participate to this decisive meeting. ...

After a short welcome by Chancellor Brüning, state secretary Trendelenburg summarized the situation. There would be two ways to save Danatbank: a merger or supportive solidarity by all other banks. Otherwise, only a closure of Danatbank would remain. A discussion followed. The banks unanimously rejected the idea of solidarity as the situation of Danatbank was completely non-transparent.... Eventually, the banks were ready to help Danatbank with 250 million Reichsmark, but only if the funding would come from the Reichsbank and in any case the Reichsbank would have to give up its restrictive policies.

The President of the Reichsbank Dr. Luther completely rejected this proposal, and announced to the contrary that the restrictive policies would be sharpened even further in the future. Neither him nor Brüning mentioned, that the political negotiations with France [regarding inter-central bank loans] played an important role to explain his position.

Harsh words were exchanged, including by Dr. Luther. He refused to tolerate that all of the burden was dumped on the Reichsbank, who would not be the drudge the banks seemed to perceive in it. She would not be ready to let itself be misused, as the first condition for maintaining the German economy would be that the central bank would remain faultless. If he would provide further discount loans, he would not be able to maintain the 40% gold cover ratio. ... The banks should think about the signal an under-fulfillment of the gold cover ratio would imply. Unrest would be created, which could easily be the starting point of a domestic bank run.... Also for political reasons, the Reichsbank would not be in a position to engage in such support measures before the central bank meeting in Basel next Monday....

Luther had spoken himself into a state of strong excitement. He stood there wildly gesticulating, in his hand his bible, the Reichsbank law. The representatives of the banks and the ministries were perplex, as they did not know enough about the political issues who had brought Luther towards such conclusions. ... Geheimrat Bücher of the AEG asked Luther ironically, what was the benefit of an faultless Reichsbank if the rest of the economy had broken down. He added that one should not only insist on legal articles, as unusual times also require unusual measures. The Reichsbank would be the institution that was responsible for the functioning of the German credit system. She would had the duty to do whatever was possible, to avoid the collapse of the German credit building. But Dr. Luther constantly insisted that the Reichsbank would not contribute funding in any sense to the rescue of Danatbank. (pages 60-62)"

Hopes that eventually other major central banks, and in first place the gold rich Banque de France (Eichengreen 1986), would provide emergency loans, i.e. act as an international lender of last resort did not materialize. On Saturday 11 July, France had one more time specified its conditions, which "concentrated on three points: dismantling of the customs union with Austria; renouncing to the construction of the armored cruiser "type B", and economic commitments relating to a tightening of credit restrictions and measures to stop the capital flight out of Germany" (Priester, 1932, 64). The role of political conditionality is obviously remarkable from today's perspective. However, despite the efforts of the Americans to broker a deal, eventually no new credits were granted.

As negotiations failed, the Danat-Bank was unable to open its counters on Monday 13 July. On Sunday 12 July 1931, an emergency decree had announced a guarantee on deposits with Danat-Bank, and Danat-Bank was kept closed on 13 July. However, a **run on the other banks develops on 13 July, so that also on all other banks a two days bank holiday was declared**. At the end of July 1931, the discount rate of the Reichsbank stood at 15%; the gold coverage ratio was far below 40%.

Full convertibility of the Reichsbank ended and exchange controls, never to be lifted again for decades, were imposed. Moreover, the gold reserves of the Reichsbank would never recover again, and Germany would make no further substantial reparation payments apart from some final payments in 1933 and the repayment of Dawes and Young bonds after World War II. In this sense, July 1931 marks a tragic failure of crisis management the relevance of which can be hardly exaggerated in terms of its economic and political implications.²¹

4.2.2 Application of the financial accounts model

Table 3 summarizes the evolution of the Reichsbank balance sheet between 1926 and 1934. The last three columns present time series of the relevant liability positions. It becomes obvious that the year 1931 is an exceptional one:

- Gold and FX reserves drop by more than 50% (from 2.7 to 1.2 billion Reichsmark)
- The gold cover ratio falls from 56% to 24% and thereby below the 40% minimum as laid down in the Dawes/Young plan.
- Total central bank credit provision (Discount bills and Lombard loans) increase from 2.6 to 4.4 billion Reichsmark as the Reichsbank discounts huge amounts of bills to ease the strains on banks' balance sheets (Schnabel 2002).
- Total assets of the Reichsbank rise by less than 10%, from Rm 6.25 to Rm 6.86 bn, indicating that interbank intermediation by the central bank was not a very large scale phenomenon.

By contrast, other time series, including the banknotes in circulation, remain relatively stable.

Table 3: The Reichsbank balance sheet (in RM millions), 1926-1934

	Sum of balance sheet	Assets					Liabilities		
		gold + FX	Discount Bills	Securities	Lombard loans	Other assets	Bank- notes	Deposits banks	Other Liabilities
1926	4918	2350	1829	91	84	564	3736	450	732
1927	5994	2147	3129	93	78	547	4564	550	880
1928	6451	2884	2627	92	176	672	4930	633	888
1929	6535	2687	2608	92	251	897	5044	77	1414
1930	6253	2685	2366	103	256	843	4778	525	950
1931	6868	1156	4144	161	245	1162	4776	604	1488
1932	5414	920	2805	398	176	1115	3561	460	1393
1933	5129	395	3177	581	183	793	3645	558	926
1934	5885	84	4020	763	146	872	3901	881	1103

Source: Deutsche Bundesbank 1976

²¹ On the former James (2010, 239-240) notes that 1931 has been a decisive turning point in 20th century economic history away from market economies and globalisation, demonstrating that there are no means to solve a banking and currency crisis.

Table 4 shows a number of derived measures of the Reichsbank balance sheet across the same years.

Table 4: Gold coverage ratio, central bank credit and other net liabilities – the Reichsbank, 1926 - 1934

	Resulting measures		
	Gold Cover Ratio	Total CB credit	Other net liabilities
1926	63%	1913	77
1927	47%	3207	240
1928	58%	2803	124
1929	53%	2859	425
1930	56%	2622	4
1931	24%	4389	165
1932	26%	2981	-120
1933	11%	3360	-448
1934	2%	4166	-532

Sources: Deutsche Bundesbank (1976), *authors' calculations*.

Finally, Table 5 shows the annual changes of key balance sheet items of the Reichsbank and composite items according to the stylized system of financial accounts.

Table 5: Changes of key items of the Reichsbank's balance sheet, 1927 - 1934

	Delta FX/gold	Delta CB credit	Delta Banknotes	Delta autonom. factors
1927	-203	1294	828	263
1928	737	-404	366	-33
1929	-197	56	114	-255
1930	-2	-237	-266	27
1931	-1529	1767	-2	240
1932	-236	-1408	-1215	-429
1933	-525	379	84	-230
1934	-311	806	256	239

Sources: Deutsche Bundesbank (1976), *authors' calculations*

A comparison of the end 1931 Reichsbank balance sheet to the one of end 1930 allows us to identify the shocks at work (Figure 11). We consider discount and Lombard loans as central bank credit operations and combine foreign exchange with gold reserves. Finally we treat outright holdings of securities as an autonomous factor (we could also have kept it as a separate item). We obtain the following end-1930 and end-1931 Reichsbank balance sheets.

Figure 11: The Reichsbank's balance sheet in the German crisis of 1931 – a financial account presentation

Reichsbank balance sheet end 1930			
Gold (and FX reserves)	2685 - g - k	Banknotes	4778 -g
Credit operations with banks	2622 + k - a	Other autonomous	529 - a

Reichsbank balance sheet end 1931			
Gold (and FX reserves)	1156	Banknotes	4776
Credit operations with banks	4389	Other autonomous	769

Source: authors' compilation

The financial accounts representation suggests that the change in the key balance sheet positions can be decomposed into shocks as follows:

- $\Delta \text{Credit operations} = 1767 = k - a$
- $\Delta \text{Banknotes} = 2 = g$
- $\Delta \text{other autonomous factors} = 240 = -a \Rightarrow a = -240$
- $\Delta \text{Gold} = -1529 = -g - k$

We have four equations with one linear interdependence resulting from the balance sheet identity and can easily solve for the remaining unknown $k = 1527$. The dominating shock was thus the shift of household/investor capital and/or a current account imbalance that lead gold to flow out from the Reichsbank. As Germany recorded a current account surplus in 1931 (Table 6) current account transactions cannot explain k . Thus, the shock represents a pure capital account phenomenon. It may be noted that a large non-assignable residual dominates the balance of payment in 1931. As also explained in Deutsche Bundesbank (1976), this is due to the poor capturing of capital account transactions at that time. Presumably, the large negative residual constitutes non-captured capital outflow. It is also remarkable that the current account balance of the years preceding 1931 was substantially negative and counterbalanced by large capital inflow, such that the Reichsbank's gold reserves were rather stable.

Table 6: Germany's balance of payments, 1926 – 1934 (in RM million)

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	Capital account balance	Current account balance	Non- assignable residual	Change in gold / FX reserves
1926	1523	-39	-916	568
1927	3482	-4244	310	-452
1928	3123	-3192	1000	931
1929	1425	-2469	879	-165
1930	1236	-610	-746	-120
1931	657	1040	-3350	-1653
1932	-749	257	236	-256
1933	-807	132	228	-447
1934	190	-534	-80	-424

Source: Deutsche Bundesbank, 1976 (p. 328)

Central bank loans and the gold constraint

The run on Germany in 1931 could probably have been managed without the credit restrictions of July 1931 and a credit crunch if fellow central banks would have provided intra-central bank loans in gold / foreign currency. Toniolo (2005, 101-106) summarises the negotiations and limited results between the Reichsbank and its fellow central banks in June and July 1931 to obtain central bank credit to restore its gold reserves and to be able to continue to maintain gold convertibility.

The USD 100 million loan of 26 June 1931

On 22 June 1931, Luther approached Norman for a three weeks loan to maintain the gold cover ratio. "The Bank of England, itself walking on thin ice and concerned about possible domino effects of the crisis, gave a positive response. Its only condition was the participation of the Federal Reserve Bank of New York, which in turn required that France be involved." (Toniolo 2005, p. 101) Also the BIS joined the loan consortium, and all four lenders put in an equal share. The credit agreement was signed on 24 June 1931. The difficulties in reaching the agreement are reflected by the fact that it took two days in coordinating the press communiqué to be issued by each participating central bank, eventually published on 26 June 1931 (Toniolo 2005, 102).

Attempts to secure a further central bank loan in July 1931

In July 1931 Luther fails to obtain additional central bank loans when "*the run on [German] banks intensified from the first week in July onwards, while capital flight continued. ... The Reichsbank currency / reserve ratio dropped below the 40% statutory threshold.... It is against this background that Luther undertook his well-known and well-dramatised tour of the European capitals to rally support from central banks and obtain new credit lines... Norman [the Bank of England Governor] was convinced that only negotiations between the governments could restore market confidence – leaving the impression that, as a central banker, he now felt powerless.... The French were adamant with their guest that only an improvement of the relations between the two countries could open the door to the granting of new credit lines US authorities took the position 'that Germany should first undertake credit restrictions' and 'present a concrete proposal to the heads of the various central banks assembled in Basle....*" (Toniolo 2005, 104-105)

We already mentioned the further negotiations with France on Saturday 11 July 1931 which however failed due to the political conditionality expressed by France (giving up the custom union with Austria and the project to build the armored cruiser "type B").

On Monday 13 July 1931, at a BIS meeting in Basel, "Luther made a poor showing" (Toniolo, 2005, 105), and "*his fellow central bankers were, in any case, in a gloomy mood themselves*". "*Norman felt that Germany needed 'a credit but that the situation [was] so much political that he [questioned] how it [could] be handled'. McGarrath [Fed NY Chairman], for his part, considered that there was nothing to be done at the moment but 'await developments, until we can see what is being done in Berlin'.*" Still, Luther was able to obtain a prolongation of the three weeks USD 100 million credit from the meeting in Basle.

In the days that followed 13 July, "*the Americans and the French continued to press for tighter credit controls. The Reichsbank discount rate reached as high as 15% at the end of July, while the reserve ratio was allowed to drop below the 40% threshold.... When all was over, the situation had changed, but to no-one's advantage. The Germans failed to get a credit, the French failed to get concessions, the UK Treasury failed to get revisions of the Versailles Treaty, and, one may add, the US lenders failed to get their money back.*" (Toniolo, 2005, 105)

In sum, it appears that out of (i) own fears; (ii) political tensions and political conditionality perceived to be unacceptable to either Germany or France; (iii) general feeling of uncertainty on what needs to be done, negotiations failed and credit restrictions became necessary. However, restoring *deliberately* a tight collateral policy in combination with borrowing limits in view of the approaching full depletion of gold reserves was the eventual end point of Danat-Bank's operations. The general bank run triggered by the failure of Danat-Bank finally marked the effective end of gold convertibility in Germany.

The strategy of the Reichsbank has been intensively discussed, by key actors at that time as well as economic historians (e.g. Ahamed, 2009, Born, 1967, Ferguson and Termin, 2001, James 1984, 2010, Ritschl and Safarez, 2006, Schnabel, 2002]). Most prominently Hjalmar Schacht (1956, p. 358-365), Reichsbank President from 1924 to 1930, and from 1933 to 1939, has argued that he would have advocated an early payment moratorium for foreign debt as a reaction to the outflows of foreign currencies because the very fact that gold (and fx) reserves by the Reichsbank are by definition limited aggravates the panic. Moreover, due to the weekly publication of the Reichsbank's balance sheet households/investors know exactly how large the available buffers remain, reinforcing capital outflows.. Schacht also explicitly distinguishes between the shock „ d “ and the shock „ k “ of our model, and argues, consistently with the model, that d can in principle be handled, while the handling of k has its limits (p. 359). This is why the strategy of the Reichsbank to satisfy all foreign demands as quickly as possible, which would stop the run *had to fail because* „*the more the foreigners noted that the foreign reserves of the Reichsbank were being depleted, the more they rushed to withdraw their money before that actually materialised. As suggested by an old saying, the dogs always bite the last one. The depletion of German foreign exchange reserves co-incided with the failure of a major German bank (the Danat-Bank).*“ The latter could have been avoided if the Reichsbank had just focused on d and had given up convertibility. Indeed, the main counterargument to Schacht's lines of thought is a legal, not an economic one, as maintaining convertibility was a duty of the Reichsbank that had been imposed upon it through the Dawes and Young plans. Luther probably hoped that he could still turn around the situation before exhausting gold reserves, maybe also with the help of foreign central bank loans. As long as he hoped, he probably did not want to breach this pillar of the international agreements.

Monetary financing prohibitions

The Dawes and Young plans imposed a strong monetary financing prohibition on the Reichsbank, which went beyond those foreseen in the Maastricht Treaty for the ECB. They were reflected in the Reichsbank Law of 1924, which – according to Reichsbank (1925, 161, own translation) – “*explicitly excluded, and this being of utmost importance, the previous close business relationship between the Reich and the Reichsbank, which had lead to an extensive credit recourse of the Reich. Apart from some immaterial exceptions, the Reichsbank must not, directly or indirectly, grant credit to the Reich, the Ländern, or to local public authorities.*” Moreover, (p. 163), “*the Reichsbank has lost the permission to discount treasury bills with a maximum three months maturity*”.

In 1930/31, monetary financing prohibitions played a key role in deepening the crisis (see e.g. Bordo 1986) for two reasons. First, they forced the government to do whatever is needed to minimise the recourse to monetary financing, including his draconian austerity measures, with their strong negative effects on the economy. Brüning (1970, p. 293) describes how close Germany was to default in June 1931 also because of this prohibition, and how he had to painfully convince Luther to circumvent it marginally to be able to pay salaries of state employees (25 June 31): “We had a gap of 200 million mark. We would not be in a position to pay the salaries of employees, if we would not on that date get a bridge loan of 200 million Reichsmark. At 9 pm I drove to Luther in Dahlem and after several hours obtained what I had hoped for. He was ready to grant the bridge loan, but insisted on his requirement to introduce in the coming month credit restrictions on banks.” Second, the possibility of a German default led to a further decline in confidence and hence fostered capital flight.

Finally, it has to be noted that during the crisis the prohibitions were at least partly circumvented and after the introduction of capital controls finally discarded. Brüning (1970, p. 307) describes how eventually, through a placement of sovereign debt with banks, and their use for Reichsbank credit operations, another way to circumvent the monetary financing prohibition was found: „In case the plan to obtain a foreign credit would definitely fail, the Reich would provide to banks bills in the amount of several hundred million Reichsmark that they would rediscount with the Reichsbank.” In July 1931, bank recapitalisation was eventually financed with central bank money as well: „We obtained the necessary 300 million marks for the Dresdner Bank capital injection by issuing bills, who were made

eligible for Reichsbank discounting by interposing the *Akzeptbank* and which were indeed then discounted accordingly with the Reichsbank.” (Brüning 1970, 349)

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In sum, the monetary financing prohibition was eventually to some extent circumvented by the Reich and the Reichsbank before it would itself have led to the ultimate disaster of a sovereign default. This does not mean that this constraint was not highly relevant in the sense that Brüning needed to do whatever it takes to minimise the recourse to this instrument, including his draconian austerity measures, with their strong negative effects on the economy.

Collateral constraints

In 1931 banks eventually hit their collateral / eligible assets constraints. For a while, the Reichsbank could keep banks liquid by extra liquidity provision against assets that would previously not have been eligible (Priester 1932). Luther (1960; Chapter 9, the Reichsbank’s policy within the framework of Brüning’s economic programme (*Die Politik der Reichsbank im Rahmen des Brüning’schen Programms*) p. 252/253) explains a number of tricks and exceptions that the Reichsbank tolerated in 1931. According to Luther, the Reichsbank did not “strictly stick to the trade (commodity) bill which is self-liquidating after three months. She has been forced through the July events to also accept to some extent financial bills. She also financed production by agreeing to discount for an amount up to 150 million Reichsmark bills relating to industrial exports to the Soviet Union, of which everyone knows that the true self-liquidation only arises in the course of two years, when being paid by Russia.” Moreover: “With the agricultural bills, we are also doing something that a central bank should do only extremely limitedly, namely to finance goods that have not yet been sold. Fact is that at end 1931 around one third of bills discounted by the Reichsbank would not have been accepted in normal times, in particular finance bills and Russia bills.” Furthermore, after the July disaster „the finance bills resulted mainly from the rescue measures for banks and saving associations. Being confronted with the choice between either to insist on the honourable principles of central banking or exceptionally to trespass these rules, the Reichsbank chose the second avenue. It could only be done via the described construction of the *Akzeptbank*.“

Brüning (1970, p. 350) explains that Government guarantees were used and a necessary condition in view of the lack of standard collateral to continue funding Danatbank (as had been argued by senior ministerial officials already in early July, according to Priester 1932): „In the case of Danat-Bank, the Reich, beyond the guarantee of deposits, issued a guarantee on issued bills. This allowed the Reichsbank to grant unlimited discount loans to the Danat-Bank.” Schnabel (2002, p. 28) confirms the funding of normally non-eligible paper: „Remarkably, the Reichsbank also discounted bills that were generally not acceptable for discount: banks converted illiquid advances into acceptance loans, by allowing their customers to draw a bill of exchange on them, discounting the bill, and exchanging the bill with another bank to obtain the required third signature. Then, the bill, which clearly was a pure financial bill, hence not discountable at the Reichsbank, was discounted at the Reichsbank. ... The strongest increase could again be found at Danatbank where acceptance liabilities jumped 70 percent between March and July 1931. This makes clear that banks had run out of collateral long before the Reichsbank’s denial to discount further bills in July. The proceeds from discount loans frequently were immediately exchanged into foreign currency.”²² James (1998, 63) remarks that the standard eligibility criteria for discount bills were never restored after July 1931 and that the Reichsbank should have reduced its transparency on its operations but would nevertheless have continued a liberal policy, in particular with regard to the acceptance of financial and public bills. The Reichsbank also financed a bad bank scheme, the “*Akzept und Garantiebank*” which had the task to take over impaired loans from credit institutions (with a balance sheet length of around 550 million Reichsmark in mid 1932, i.e. around 8% of the length of the Reichsbank balance sheet, see Bundesbank, 1976, 41).

In sum, the collateral constraint never became strictly binding. Confronted with the choice of enforcing those constraints implying the collapse of the system and circumventing them, in the end the

²² According to James (1998, 63) the standard eligibility criteria for discount bills were never restored after July 1931.

Reichsbank took the necessary measures of collateral enlargement to continue closing the ever increasing funding gaps. Only at the very end, confronted with the immediate perspective of a depletion of gold reserves, i.e. in the days before 13 July 1931, collateral tightening and borrowing limits forced Danat-Bank to give up. Against this background, Luther (1964, 247) argues that the Reichsbank did everything it could in terms of supportiveness, i.e. whatever was not strictly imposed as constraint on it, it tried. He quotes himself from an intervention made at a conference in [July 1931]: *“There is so much talk about active central bank policy. I would be very grateful to get a concrete answer to the question: what should the central bank do? In particular, what should she do beyond what she has already done?”* He also notes the Reichsbank went far beyond what a central bank does in normal times without making noise about it (Luther 1964, 250). He feels that he receives unjustified criticism from two opposing sides: *„While today and at that time, I was attacked from various sides because the Reichsbank would not be doing enough, also, partially by the same people, I was confronted with bitter allegations that I would not respect the sacred principles of central banking.”*

Central bank borrowing limits (credit constraints)

In June 1931, the Reichsbank limited central bank borrowing of banks to levels observed for each individual bank as of 19 June 1931. In the climax of the crisis, on 11 July 1931, Luther announced that he would tighten these restrictions further, instead of softening them, as requested by the banks (see above). The imposing of limits intensified the panic and general liquidity hoarding. Thus, instead of defusing the crisis, it played a crucial role in driving Danatbank into illiquidity and causing the bank runs and bank holidays in the week of 13 July 1931. It has to be noted, however, that the Reichsbank were pressured by its fellow central banks to introduce those limits for the sake of stopping the German capital flight and hence for preventing large borrowing needs of the Reichsbank vis-à-vis foreign central banks. At the end there seemed to have been a lack of awareness in all major capitals and central banks, not only in Berlin and the Reichsbank, of the insight already highlighted by Bagehot (1873) sixty years earlier, namely that only a “brave plan”, i.e. a courageous approach of the central bank, i.e. “to lend in a panic on every kind of current security” and take associated risks, can save the banking system, including the central bank itself (and in retrospect, in case of Germany in 1931, the state and civil society in general).

Interest rate policies

Under normal conditions interest rate changes in a fixed exchange rate environment create arbitrage opportunities for investors and thereby trigger capital inflows, or at least reverse capital outflows.²³ Unfortunately, this mechanism does not work when the fixed exchange rate has lost its medium term credibility.²⁴ If investors fear that the interest rate differential will eventually be overcompensated by a devaluation of the currency and if interest rate increases make disruptive economic and political developments more likely, then a point may be surpassed beyond which interest rate increases are no longer stabilising. This was the case for the Reichsbank in 1931. Table 7 summarises the development of Reichsbank interest rates from mid 1930 to the end of World War II.

²³ “7 percent will draw gold from the moon” was a standard saying under the pre-WWI gold standard (Dornbusch and Frenkel 1984, 254).

²⁴ Eichengreen (1995) argues that this was a key difference between the interwar and the pre-WWI gold standard, namely that for various economic and political reasons, the latter including the rise of democracy and the growing importance of employment and growth objectives for economic policy making, it lacked medium-term credibility. This lack of medium-term credibility made authorities to forego an important policy option used before 1913 to deal with financial stability challenges under the rigid constraints of the gold standard, i.e. its temporary suspension. Without credibility, investors did not believe in “temporary” suspensions, forcing authorities to stick to the gold parity as long as possible in order to demonstrate that the standard is credible and thereby caused economic and financial turmoil not seen in der pre-WWI gold standard..

Table 7: Reichsbank Discount and Lombard rate, June 1930 to end of World War II

Date	Discount rate	Lombard rate
1930		
21 June	4%	5%
9 October	5%	6%
1931		
13 June	7%	8%
16 July	10%	15%
1 August	15%	20%
12 August	10%	15%
19 August	10%	12%
2 September	8%	10%
10 December	7%	8%
1932		
9 March	6%	7%
9 April	5.5%	6.5%
28 April	5%	6%
22 September	4%	5%
1940		
9 April 1940	3.5%	4.5%

Source: Deutsche Bundesbank 1976)

The high level of central bank rates in 1931 are remarkable considering the large deflation that prevailed since 1930, leading to extremely high real interest rates at a time of extreme recession. Thus, it illustrates that the Reichsbank was unable to square external and internal stability under the gold standard in a crisis of confidence.

5. Two countries, paper standard, fixed exchange rates

A paper standard operating under a fixed exchange rate replaces the gold constraint by a foreign exchange reserve constraint. In the asymmetric case we discuss, this constraint only applies to the central bank of the distressed country. By contrast, the central bank of the safe haven country is formally unconstrained and could provide unlimited emergency lending in its own currency which – by definition – households/investors perceive as the “safe haven asset”. Thus, one major constraint of the gold standard does not apply: There is theoretically no constraint that prevents *all* central banks to expand their consolidated balance sheet, and there is no issue such as a global scarcity of reserves. However, this absence in theory does not imply that the constraint could not become binding for one of the other reasons that made central banks unconstrained by gold cover ratio hesitant in providing international loans to distressed central banks, like the Reichsbank in 1931: political reasons, inflationary fears, perceptions that the stressed central bank (and the government of the stressed country) follows inadequate policies and that lending to it will only reduce pressure to change, etc.. Indeed, they may be even more relevant when the fixed exchange rate is not agreed upon in multilateral setting, i.e. with a system of fixed exchange rates, like it was the case with the Bretton Woods System, but unilaterally decided by the distressed country with no formal involvement of the safe haven central bank and country, as it is the case for almost any fixed exchange rate policy pursued by countries since 1973, with the notable exception of the European Monetary System. However, the economics are unchanged compared to the gold standard case: fixed exchange rates are guaranteed by the central banks, and cross country flows need to be balanced by changes of FX reserves of central

banks. Against this background, various dual crises during the 1990s fall under this category, such as the Asian crisis in 1997/1998.²⁵

In illustrating the two countries, paper standard, fixed exchange rate case in the system of financial accounts (Figure 12), we assume that FX reserves (FX) take only the form of deposits of central banks with foreign banks. The initial establishment of foreign reserves by central banks derives from existing cross-border interbank claims and liabilities.²⁶ We also reintroduce sovereign debt, assuming that sovereign debt is not held cross border by central banks to keep notation simple. Deposits with banks of country 1 are considered as a safe haven asset, when capital flight arises from deposits with banks of country 2, and for sovereign debt of country 2. Finally, we assume that the central bank of country 2 performs the lender of last resort function for the banking system only. For the government, domestic banks have to act as lender of last resort.

Figure 12: A fixed exchange rate regime under a paper standard – a financial accounts presentation

Households / Investors			
Real Assets	$E - D_1 - D_2 - S_1 - S_2 - B_1 - B_2$	Household Equity	E
Banknotes 1	B_1		
Banknotes 2	B_2		
Deposits Bank 1	$D_1 + k + s$		
Deposits Bank 2	$D_2 - k$		
Sovereign debt country 1	S_1		
Sovereign debt country 2	$S_2 - s$		

Corporate			
Real assets	$D_1 + D_2 + B_1 + B_2$	Credits from banks	$D_1 + D_2 + B_1 + B_2$

Sovereign 1			
State assets	S_1	Sovereign debt	S_1

Sovereign 2			
State assets	S_2	Sovereign debt	S_2

Bank 1			
Lending to corporates	$D_1 + B_1$	Household deposits / debt	$D_1 + k$
		Deposits from foreign CB	$FR_2 - k$
Claims to foreign banks	$\text{Max}(0, -FR_1 + FR_2)$	Credit from home central bank	$B_1 - FR_1$
		Liabilities to foreign banks	$\text{Max}(0, FR_1 - FR_2)$

Bank 2			
Lending to corporates	$D_2 + B_2$	Household deposits	$D_2 - k$
Sovereign debt country 2	s	Deposits from foreign CB	FR_1
Claims to foreign banks	$\text{Max}(0, FR_1 - FR_2)$	Credit from home central banks	$B_2 - FR_2 + k + s$
		Liabilities to foreign banks	$\text{Max}(0, -FR_1 + FR_2)$

²⁵ James (2010, 227) highlights the parallels between 1931 and 1997/8, as both crises were related to a sort of fixed exchange rate and previous large capital inflows.

²⁶ An alternative way to establish an initial endowment of foreign reserves for central bank 2 would be to accumulate reserves from current account surpluses.

Central bank 1		
Credit operations with Bank 1	$B_1 - FR_1$	Banknotes B_1
Foreign reserves	FR_1	

Central bank 2		
Credit operations with banks	$B_2 - FR_2 + s + k$	Banknotes B_2
Foreign reserves	$FR_2 - k$	

Source: authors' compilation

The built-in stabilizers of the system are the foreign reserves of central bank 2. They ensure that the outflow of deposits from country 2 can be compensated. Two constraints may eventually cause a liquidity crisis. First, again the **collateral constraint**, which in this case is specified as: $h_s s + h_p (D_1 + B_2) \geq B_2 - FR_2 + k + s$. Second, **central bank 2's foreign reserves impose a limit to deposit outflows**. Any deposit shift shock k out of country 2 must not exceed the foreign reserves of the central bank, FR_2 (Obstfeld, Shambaugh and Taylor 2008). If foreign reserves are exhausted, fresh cross-border interbank credits are needed to compensate further deposit shifts without triggering asset fire sales of the banking system 2. However, under financial stress, interbank markets typically are not a source of compensating flows – if anything the contrary. Again, as in the case of the gold standard, constraints can be overcome by cross-central bank lending: bilateral, or, what has been more frequent over the past decades, multilaterally via an institution like the IMF (Corsetti et al. 2006).

The accounts representation of inter-central bank lending in the case of a fixed rate paper standard regime is similar to the one under the gold standard. Amongst the constraints that may prevent inter-central bank lending to happen, the first two no longer apply (international gold scarcity; fear of central bank 1 to be itself viewed as vulnerable and being subject to a gold run). However, other constraints still apply:

- *First*, central bank 1 may be unwilling to lend as it may feel that lending could be macro-economically destabilizing and could imply rising inflationary pressures in the future. In other words, central bank 1 may feel that central bank 2 and the Government of country 2 should first do their economic homework in order to restore confidence. The IMF as intermediary between central banks, imposing programs and conditionality, may be understood to address this concern.
- *Second*, central bank 1 may be unwilling to lend to central bank 2 for financial risk management reasons, i.e. it may feel uncertain about whether central bank 2 may be able or willing to pay back at maturity. This fear may be particularly justified if overall, country 2 is in a disastrous state and politically unstable. Again, the IMF as intermediary may address also risk management concerns.
- *Third*, central bank 1 may be unwilling to lend to central bank 2 for political reasons. This may be a less relevant constraint today than it was in the 1930s. Nevertheless, it should not be underestimated.

Some remarks on the case of flexible exchange rates and a dollarized economy

In the case of widespread unofficial dollarization, the central bank of a stressed country will care considerably about its exchange rate, as exchange rate volatility quickly leads to solvency problems of the domestic private and public sector, as some entities (corporates, banks, households, the government) will unavoidably have an asset/liability mismatch in terms of currency denomination (Eichengreen and Hausmann 1999, Chang and Velasco 2000). Therefore, devaluations lead to over-indebtedness problems of the economic agents that are funded over-proportionally in foreign currency. As a result, countries with dollarized economies will behave, despite following formally a flexible

exchange rate regime, similarly to the case of a paper standard with fixed exchange rates (Calvo and Reinhart 2000, Calvo, 2006). Thus, distressed central banks will use their foreign reserves to try to stabilize exchange rates and depend, when reserves are exhausted, on emergency loans from other central banks or the IMF to prevent asset fire sales and deleveraging.

Foreign banks that have access to funding from their parent banks in mature economies might serve as a substitute for IMF borrowing. Indeed, the massive entry of foreign banks in banking sectors of Latin American and emerging European countries observed since the mid- to late 1990s was welcomed by several observers as a contribution of financial stability in the respective countries (Mishkin 2001, 2006). Evidence on the stabilizing role of foreign banks in emerging markets from the global financial crisis is mixed and regionally different (Vogel and Winkler (2011a,b), Claessens and van Horen (2012), De Haas et al. (2011), also because the crisis had a negative impact on the ability of parent banks to provide funding and keep exposures. As a result, in emerging Europe, the IMF, together with EU institutions, other international financial institutions, home and host country governments and central banks as well as major foreign banks operating in the region established the Vienna Initiative to prevent forced deleveraging and spirals of asset fire sales (IMF 2012).²⁷

Overall, the case of a dollarized financial system implies the same constraints for lender of last resort operations by central banks as in a fixed exchange rate system where financial intermediation and assets are denominated in domestic currency, which is why we do not cover this case in more detail.

6. Two countries in a euro area style monetary union

6.1 The model of financial accounts

The case of a monetary union between two countries is constructed based on the euro area example, i.e. with a system of central banks unified by fixed exchange rates and unconstrained cross-central bank transferability of deposits of banks. We ignore the rest of the world as the currency union is embedded in the global financial system through flexible exchange rates and hence the system of monetary union central banks does not face any external constraints. In this sense, it is in a similar position as the central bank of the “safe haven” country in the fixed exchange rate case (section 5) or the central bank in the one-country paper standard case (section 3): it does not have to worry about becoming subject to a liquidity shock itself. This implies that in principle the common central bank faces only the self-set collateral constraint when engaging in stabilizing activities. However, for the concrete case of the euro area, it is well known that the ECB does not act as an unconstrained lender of last resort *to euro area governments*, in particular in view of legal constraints imposed by the monetary financing prohibition in Article 123 of the Treaty establishing the European Union. Thus, the ECB can be compared to a central bank that operates in a setting as discussed in section 3.3. In fact differences to the one country case appear to be relatively limited and only presentational as they result from the existence of two separate national central banks that together constitute the central bank of the monetary union. However, capital movements can take a more dramatic dynamic in a monetary union with separate countries, compared to a case of a fully integrated country in which only individual banks (or debt issuers) may be subject to a liquidity run. This is in particular due to the following reasons.

First, in the absence of common sovereign bond issuance (“Eurobonds”), the scope for self-fulfilling runs on the debt of Governments is much larger as debt is segregated and linked to the fate of individual member countries (Ang and Longstaff 2011, Winkler 2011).

Second, in the absence of sufficiently strong elements of a fiscal union, including a proper monitoring and sanctioning framework that involves some loss of sovereignty and the possibility of solidarity and fiscal transfers if needed, the probability rises of imprudent national governments causing national

²⁷ Chitu (2011) presents evidence suggesting that the global financial crisis was more pronounced in dollarized economies than in other emerging markets due to currency mismatches, reduced monetary policy autonomy and limited lender of last resort ability.

debt sustainability problems which subsequently cannot be addressed neither by fiscal transfers nor by currency devaluation. Hence, doubts about sustainability can create enormous challenges and, again, self-fulfilling confidence crises.

Third, the ease of cross-country capital flows in a currency union in good times, coupled with the illusion that current account imbalances do no longer matter (Giavazzi and Spaventa 2010), bears the risk of quickly emerging unsustainable imbalances. Once sufficiently bad news arise, and markets realize the extent of imbalances, a sudden stop occurs and the sovereign, banks, and corporates are trapped in negative feedback loops.

Fourth, the segregation of Government debt, combined with the absence of a common bank rescue funds – which is consistent with the absence of a common banking supervision – create the potential for “**diabolic loops**” between sovereigns and banking systems which will face common liquidity and eventually solvency issues (Brunnermeier et al 2011).

Fifth and last, populist leaders of countries subject to considerable economic stress may lead the country into default and exit from monetary union. In this case, exposures to this country would likely suffer additional losses. Investors may anticipate that and move pre-emptively, possibly in a self-fulfilling manner, also including other members of the union, giving rise to widespread contagion within the monetary union.²⁸ Monetary union may appear like marriage: once one starts to mention the possibility of separation, a Pandora’s box of uncontrollable centrifugal forces may have been opened.

We model these difficulties in the system of financial accounts by again assuming a confidence crisis in country 2 (Figure 13). There are two “national central banks” that counterbalance any cross-border deposit shifts by credits to banks. These national central bank credits are then counterbalanced by a change of intra-central bank claims and liabilities, the so-called TARGET2 balances in the Eurosystem. Finally, we assume that the banking sector of country 2 engages in stabilizing purchases of government bonds of country 2.

Figure 13: Monetary union – a financial accounts presentation

Households / Investors			
Real Assets	$E - D_1 - D_2 - S_1 - S_2 - B_1 - B_2$	Household Equity	E
Banknotes 1	B_1		
Banknotes 2	B_2		
Deposits Bank 1	$D_1 + k + s$		
Deposits Bank 2	$D_2 - k$		
Debt securities country 1	S_1		
Debt securities country 2	$S_2 - s$		

Corporates + sovereigns			
Real assets	$D_1 + D_2 + B_1 + B_2 + S_1 + S_2$	Credits from banks	$D_1 + D_2 + B_1 + B_2 + S_1 + S_2$

Bank 1			
Lending to corporates	$D_1 + B_1$	Household deposits / debt	$D_1 + k + s$
		Credit from home central bank	$B_1 - k - s$

²⁸ Contagion effects have also been features of the gold standard and fixed exchange rate systems under a paper standard, explaining why financial crises usually occur in clusters (Reinhart and Rogoff 2009). For example, the interwar gold standard basically collapsed in one year: Eight of 22 countries operating under the gold standard at end 1930 had the regime suspended in the course of 1931, five countries, including Germany, kept the gold parity but introduced exchange rate controls (Bernanke and James 1991).

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Bank 2			
Lending to corporates	$D_2 + B_2$	Household deposits	$D_2 - k$
Debt securities country 2	s	Credit from home central banks	$B_2 + k + s$

National central bank 1			
Credit operations with Bank 1	$B_1 - k$	Banknotes	B_1
Target claims	$k + s$		

National central bank 2			
Credit operations with banks	$B_2 + k + s$	Banknotes	B_2
		Target liabilities	$k + s$

Consolidated currency union central bank			
Credit op. with banks 1 and 2	$B_1 + B_2$	Banknotes	$B_1 + B_2$

Source: authors' compilation

The implications of these intra-central bank transactions for the currency union as a whole are captured in the balance sheet of the common central bank, i.e. the consolidated balance sheet of central banks 1 and 2. By definition, TARGET2 balances are netted out and the system of accounts and how shocks feed through it becomes in principle identical to the one of the one country case in section 3.

The representation above assumes that $B_1 - k - s > 0$, i.e. the liquidity flows from the banking system in country 2 to the banking system in country 1 are not exceeding the stock of banknotes in country 1. However, deposit and asset shifts may be larger, in particular given the arguments listed above (Figure 14). Once $k + s > B_1$, the banks in country 1 are in excess liquidity, and hence deposit their excess liquidity with the central bank. The affected accounts in country 1 then take the form depicted in Figure 14 (while there is no change to the accounts in country 2).

Figure 14: Banking sectors with a liquidity surplus in a monetary union – a financial accounts presentation

Bank 1			
Lending to corporates	$D_1 + B_1$	Household deposits / debt	$D_1 + k + s$
Deposit with CB 1	$-B_1 + k + s$		

National central bank 1			
Target claims	$k + s$	Banknotes	B_1
		Deposit of bank 1	$-B_1 + k + s$

Source: authors' compilation

Accordingly, the consolidated balance sheet of the system of national central banks lengthens by the amount of this excess liquidity (Figure 15). Contrary to some claims found in the literature (Sinn and Wollmershäuser (2011), Tornell and Westermann (2011)) this case does not impose any particular constraint on any of the actors, i.e. the national central banks and the common central bank (Bindseil and König (2011), Whelan (2011)). Like in the case of an individual country operating a paper standard under a flexible exchange rate, where the central bank is technically unconstrained in providing liquidity to any distressed bank, irrespective of its size, the common central bank is unconstrained in providing liquidity to any distressed banking sector of the currency area, irrespective of its size.

Figure 15: The balance sheet of a monetary union's central bank with some member countries' banking sectors showing a liquidity surplus

Consolidated currency union central bank			
Credit operations with banks	$B_2 + k + s$	Banknotes	$B_1 + B_2$
		Deposit of banks	$-B_1 + k + s$

A universal formulation of the central bank account is as follows:

Consolidated currency union central bank			
Credit op. with banks	$\text{Max}(B_1 + B_2, B_2 + k + s)$	Banknotes	$B_1 + B_2$
		Deposit of banks	$\text{Max}(0, -B_1 + k + s)$

Source: authors' compilation

This does not imply that there are no valid concerns about extremely high TARGET2 balances. However, those concerns have their correspondence in the concerns voiced towards central bank exposures to individual banks or debt issuers in a single country case (section 3), intra-central bank loans under the gold standard (section 4) or under fixed exchange rates under a paper standard (section 5).

First, extending intra-system loans in the form of TARGET2 may be felt to be macro-economically inappropriate, and that it could e.g. imply rising inflationary pressures in the future. TARGET2 balances would be interpreted as reflecting **economic imbalances that in the end must be addressed by counter-measures of the government of country 2**. Accordingly, the relevant government should do its economic homework in order to restore confidence into the banking system and into the government (fiscal consolidation, structural reforms that support growth, recapitalizing and restructuring the banking system, etc.), arguments which echo those made by the US and France when debating the request from Germany for emergency lending in the 1931 crisis. Moreover, allowing for unlimited TARGET2 claims to accumulate may be perceived as a removal of an important hard budget constraint and as creating moral hazard.²⁹ In the case of inter-central bank loans under a fixed exchange rate regime, cross border loans at least have to be taken consciously and actively. Thus, they are almost always attached to some conditions addressing the concerns of the lending central bank, or, in the case of multilateral approaches, some institution representing the interests of the international community like the IMF. Moreover, typically, the IMF loans are limited, as every country has in principle some maximum quota for drawing on IMF loans. Such a quantitative constraint does not exist in a monetary union with a TARGET2 type of automated basis for creating intra-central bank system claims and liabilities, contributing to fears that the elasticity of TARGET2 balances undermines pressure for restoring economic viability. However, evidence in the case of the euro area does not appear to validate this fear, as ambitious reform programmes have been adopted and implemented, which may as much appear too restrictive as to lax.

Second, Country 1 may again be unwilling to accept large central bank credits by the common central bank (in the form of TARGET2 claims) for **financial risk management reasons**, i.e. it may feel uncertain about whether central bank 2 may be able or willing to pay back TARGET2 liabilities one day. This fear may be based on the assessment that country 2 is in a disastrous state and that it cannot be excluded that it may eventually want to default and to quit monetary union (Sin and Wollmershäuser 2011)

Third, Country 1 may be unwilling to accept growing TARGET2 balances for **political reasons**, i.e. the threat to limit TARGET2 balances may be linked to the request of political concessions. While this may be in theory an issue (and has been key in 1931 for preventing France to be willing to provide central bank loans to Germany), it has not been articulated yet in the case of monetary union.

²⁹ Of course, similar arguments apply to any standard LOLR activities by a single country central bank in favour of individual banks and other financial institutions (Goodhart 1999).

While these concerns are understandable – and where at least implicitly raised before the adoption of European Monetary Union (Deutsche Bundesbank 1990) – it must be recognized that the unlimited and unconditional character of TARGET2 balances is at the very heart of monetary union. This is because the ability of banks to transfer deposits across national central banks *constitutes* the genuine single currency. Imposing a limit to such transfers and thus making those transfers impossible would de facto imply a reintroduction of two currencies with presumably different prices, marking the end of monetary union.

In sum, elasticity is provided by the readiness of central banks to compensate deposit shifts and runs on capital markets by providing sufficient central bank credit to banks. The consolidated system of central banks can provide credit freely, in the same way as the single central bank in the paper standard under flexible exchange rates. The decomposed two national central banks are also unconstrained as inter-central bank credits are automatically granted in the form of TARGET2 credits, a synonym of a genuine monetary union. However, large TARGET2 imbalances indicate that monetary union is characterized by a weak economic and fiscal union with substantial capital flight dynamics. Thus, TARGET2 imbalances may create concerns on the ability and willingness of stressed countries to restore confidence, and represent credit risks associated with extreme scenarios like a country leaving the union and simultaneously defaulting.

Apart from the reluctance to allow TARGET2 credits to grow to whatever level is necessary, the only constraint that applies is the **collateral constraint**: $h_s s + h_L (D_1 + B_2) \geq B_2 + k + s$. This is basically the same collateral constraint as in the case of two separate monetary areas with fixed exchange rates. Still, there may be one reason why in a monetary union, this constraint is more binding: the stressed country 2's sovereign and private debt securities issuers are likely to suffer, in the context of a “diabolic loop”, from rating and valuation losses, which reduce the total value of eligible collateral that can be used to obtain central bank. If h_s, h_L apply for the highest rating category (say AAA), while lower rated assets imply higher haircuts, once ratings decline in country 2 the collateral constraint is likely to become more and more binding. In a normal fixed exchange rate regime, the central bank would probably adapt gradually its haircut matrix to avoid that the general downgrading of the country by rating agencies leads to an ever growing scarcity of collateral. In a monetary union, this is less evident as the strong countries may feel that common risk management standards should be preserved, or that the collateral constraint is an effective way to indirectly impose hard budget constraints and limit the potential increase of TARGET2 balances.

6.2 Identification of shocks in the case of the Eurosystem

In the accounts above, it has been assumed that the banks are the only lender of last resort to the securities markets. In the euro area of 2010/2011, the situation was more complicated as the Eurosystem undertook some purchases of debt securities for monetary policy purposes in the context of its “Covered Bond Purchase Programmes” (see ECB press releases of 4 June 2009 and 3 November 2011) and “Securities Market Program” SMP (see ECB press releases dated 10 May 2010 on “ECB decides on measures to address severe tensions in financial markets”). If we assume that the central bank would be ready to take for monetary policy reasons a share q of the total flight of households/investors out of Government bonds, while banks would take the share $(1-q)$, the system of accounts takes the form depicted in Figure 16 (assuming again that both banking systems would still be in a liquidity deficit towards the central bank), whereby only those accounts that change have been restated, namely the ones of Bank 2 and Central Bank 2. The value of q chosen has no impact on the level of TARGET2 balances.

Figure 16: Monetary financing prohibition in a monetary union – a financial accounts perspective

Bank 2			
Lending to corporates	$D_2 + B_2$	Household deposits	$D_2 - k$
Debt securities country 2	$(1-q)s$	Credit from home central banks	$B_2 + k + (1-q)s$

Central bank 2			
Credit op. with banks	$B_2 + k + (1-q)s$	Banknotes	B_2
Debt securities country 2	$q+s$	Target liabilities	$k + s$

Source: authors' compilation

To identify q and s separately, the central bank balance sheet alone is not sufficient, but one would need in addition to look at the evolution of banks' balance sheets. We leave this identification to future research and treat ECB securities purchases below as falling into the residual category of other factors. Moreover, for simplicity, we reduce the system of financial accounts to three balance sheet positions (Figure 17). We merge banknotes and other factors in order to avoid a discussion of the rather complex accounting treatment of banknotes in the Eurosystem. T are the initial TARGET2 positions. The variables a_1, a_2 are innovations in other factors, encompassing also any banknote demand shock.

Figure 17: Balance sheets of national central banks in a monetary union facing asymmetric liquidity shocks

National central bank 1			
Credit operations with Bank 1	$B_1 - k + a_1$	Banknotes and other factors	$T + B_1 + a_1$
Target claims	$T+k$		

National central bank 2			
Credit operations with banks	$B_2 + k + a_2$	Banknotes	$-T + B_2 + a_2$
		Target liabilities	$T+k$

Source: authors' compilation

Table 8 provides end year figures of TARGET2 balances for selected countries during the years of the financial crisis and their changes. Moreover, we broadly distinguish between creditor countries (Germany, the Netherlands, Finland and Luxembourg) and debtor countries (all other euro area countries).

Table 8: TARGET2 balances in the euro area

	DE	ES	IT	PT	FR	GR	IE	DE-NL-FI-LU	Rest
2007	71	-3	36	-6	-12	-11	-1	70	-70
2008	115	-35	23	-19	-118	-35	-44	144	-144
2009	178	-41	55	-23	-62	-49	-54	255	-255
2010	326	-51	3	-60	-28	-87	-145	454	-454
Sep 11	450	-81	-91	-61	-58	-98	-125	608	-608

Sources: ECB and NCB data, authors' calculations

Table 9 provides for the same set of countries the change of central bank credit provision (Panel A), which are linked to TARGET2 balances as our system of financial accounts above indicates, and information on other balance sheet factors (Panel B), including banknotes. Figures for central bank credit provision include current accounts of banks with the Eurosystem, recourse to the deposit

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facility, and recourse to term deposits of the Eurosystem.³⁰ By contrast, credits under the emergency liquidity assistance (ELA), which are in principle similar to central bank credit (apart from the collateral accepted and the absence of loss sharing within the Eurosystem, see the 1999 Annual Report of the ECB, page 98, and the ECB Monthly Bulletin, February 2007, page 73) are not covered. Rather, the ELA funds are reflected in “other autonomous factors”, reflecting the non-availability of public data on ELA (i.e. not the logic of the financial accounts system). The Eurosystem credit provision figure is netted of current accounts of banks with the Eurosystem, recourse to the deposit facility, and recourse to term deposits of the Eurosystem.³¹

Table 9: Eurosystem credit provision and other balance sheet factors, 2007 – 2011

Panel A: Eurosystem credit provision (excl. ELA, netted out against absorbing operations, overnight/term deposits), all figures in EUR billion end of period.

	DE	ES	IT	PT	FR	GR	IE	DE-NL-FI-LU	Rest
2007	158	19	-15	-7	-1	2	18	199	60
2008	111	38	15	5	43	31	74	105	263
2009	111	55	-7	7	59	42	78	82	272
2010	-43	35	25	36	-10	87	121	-119	288
Sep 11	-174	50	82	42	32	74	94	-346	374

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Panel B: All other balance sheet factors (calculated as liability side residual), in EUR billion, end of period

	DE	ES	IT	PT	FR	GR	IE	DE-NL-FI-LU	Rest
2007	-229	-16	-21	13	13	9	-17	-270	10
2008	-226	-3	-38	14	74	5	-30	-249	-119
2009	-289	-14	-48	16	3	7	-24	-337	-17
2010	-282	16	-28	24	38	0	25	-334	166
Sep 11	-275	31	10	19	27	25	31	-262	234

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Sources: ECB, NCB data and authors' calculations

Based on Figures 17 and Table 9, we can identify the three shocks in our closed system of financial accounts for the two country groups (Table 10), i.e. creditor countries (DE-NL-FI-LU) and debtor countries (remaining euro area countries).

Table 10: Identification of annual shocks in assumed two monetary area sub-groups (creditor and debtor countries), in billion of euro (relative to previous year)

	k	a_1	a_2
2008	73	-21	130
2009	111	88	-102
2010	198	-3	-183
Sept. 2011	154	-73	-68

Source: authors' calculations

The identified shock k documents a systematic capital flight into the four save haven countries, out of the rest of the euro area, year after year since 2008. The interpretation of the shocks a_1 and a_2 is in view of their residual character less obvious. One would need to review carefully the disaggregate

³⁰ Holdings of required reserves could have been handled separately, but are irrelevant for the sake of identifying the respective shocks. Thus, we merge them for presentational simplification.

³¹ Holdings of required reserves could have been handled separately, but for the sake of identifying the respective shocks do not matter. Thus, we merge them for presentational simplification.

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balance sheet items behind this residual balance sheet item, and also look at the developments in individual NCBS.

Collateral constraints and the collateral policies of the Eurosystem during the financial crisis

The Eurosystem has always accepted a rather broad collateral set (see e.g. Tabakis and Weller, 2009, also for a comparison with the pre-crisis collateral frameworks of other major central banks). Most importantly, it had only *one* collateral set for both regular repo tenders and the marginal lending facility for overnight loans at a penalty rate. Thus, in contrast to other central banks (e.g. the Federal Reserve), the Eurosystem did not have to widen its collateral set in the first phase of the global crisis.³² Only in October 2008, the ECB announced a number of measures widening the set of eligible collateral (15 October 2008, Press Release “Measures to further expand the collateral framework and enhance the provision of liquidity”). In early 2009, the ECB raised its rating threshold for ABS to “two AAA ratings at issuance” from “one A rating” and lowered the rating threshold for all securities except ABS from A- to BBB-. In the subsequent years, the ECB continued to combine both tightening and loosening measures in its collateral frameworks with a view to remain on the efficient frontier in the possibility space of supportiveness towards central bank funding and financial risk taking (see section 4 of Bindseil et al 2012). Such adjustments over time during a profound financial crisis are necessary in view of the ever changing financial conditions, risk factors and bank refinancing needs. Adjustments included the suspension of the rating threshold for sovereign debt and sovereign guaranteed debt in the countries subject to an EU/IMF program, Greece, Portugal and Ireland (see e.g. press release of 3 May 2010, “ECB announces change in eligibility of debt instruments issued or guaranteed by the Greek Government”) and loosening of the rating threshold for ABS from AAA to A (December 2011). The former move was justified with a view to maintain available collateral in the respective countries, and that adjustment programs were in place in these countries which were signed off by the ECB. The latter move reflected the adjusted, more conservative rating methodologies of banks and the fact that concentration of collateral around Government exposures appeared to emerge as more relevant worry than the reliance on ABS as collateral (8 December 2011, Press release “ECB announces measures to support bank lending and money market activity”).

It may be noted that at some stage, the Eurosystem was also said to consider **addressing excessively large or persistent recourse of banks to central bank credit beyond collateral constraints**. According to the summary of an interview given by the Governor of Banca d’Italia to the Financial Times on 9 December 2010 (“Interview with Mario Draghi: Action on the addicts”³³): *“Mr Draghi says the ECB must look at how it might deal with ‘addicted’ banks – those institutions reliant on the unlimited liquidity the ECB has provided since the collapse of Lehman Brothers, the US investment bank, in September 2008. The number of ‘addicts’ unable to obtain alternative funding is not clear, but data on ECB liquidity usage suggest they are a source of widespread concern at the bank’s Frankfurt headquarters. ‘Sooner or later’, Mr Draghi explains, the ECB will want to return to the system of auctioning liquidity. The risk is that addicted banks will then send interest rates artificially higher because they will be desperate to obtain funds – again interfering with monetary policy. Analysts have suggested a possible two-tier ECB liquidity system, with special provisions for addicted banks. Without revealing details, Mr Draghi says that ‘concrete proposals’ are being discussed. ‘We want to make absolutely sure that our monetary policy is not going to be polluted by the addicted banks’ demand.’ ”*

Ways to reduce TARGET2 balances without questioning monetary union

³² Indeed, immediately before the Lehman event, in early September 2008, the ECB *tightened* collateral eligibility criteria and risk control measures by increasing haircuts on ABS and bank bonds and prohibiting certain ABS types (Press release of 4 September 2008 on “Biennial review of risk control measures in Eurosystem credit operations”). They did not prevent the Eurosystem from having to build a risk provision at year end to address possible losses from the default of Lehman, in view of the complex and eventually impaired ABS that this bank had submitted to the ECB to address its ever intensifying funding stress during 2008 (see ECB Press release of 5 March 2009 on “Eurosystem monetary policy operations in 2008”).

³³ <http://www.ft.com/intl/cms/s/0/af24be36-03ca-11e0-8c3f-00144feabdc0.html#axzz1kMDSIGJJ>

We exclude the idea of imposing limits on TARGET2 balances because it is inconsistent with the concept of monetary union. The moment the limit would be hit, deposits across central banks would no longer be perfect substitutes, and hence there would no longer be a single currency. However, two price incentive mechanisms might in theory be considered once capital market access has been restored.

First, **increasing marginal rates of remuneration on TARGET2 balances**. Marginal remuneration rates could increase, whereby the marginal rate curve would be defined e.g. in relation to GDP (it is recalled that currently, the remuneration of any TARGET2 balance is equal to the rate of the main refinancing operations – MRO). For example, for TARGET2 balances up to e.g. 25% of GDP, the normal MRO rate would apply, but then for each subsequent 25%, it would increase by say 0.5 percentage point. As the remuneration would be paid by the central bank, and hence be at the expense of the profits transferred to the Government, this would create economic incentives for the Government to address the reasons for the capital flight. A backdrop of such a measure would be that debt sustainability of the country under stress would be slightly weakened, unless a counterbalancing measure is taken.³⁴

Second, a similar framework of increasing marginal costs of borrowing could **apply to banks when borrowing from the Eurosystem**. For example, if borrowing were to exceed proportional borrowing by more than say 100%, then a surcharge of e.g. 0.5 percentage points could apply, and for each additional 100 percentage points of over-proportionality, the surcharge would increase linearly. The extra income would be monetary income and would hence have to be shared within the system of central banks.

A system of such surcharges would give to the term “elastic currency provision” a more intuitive interpretation: “Elastic” would mean that there is no hard limit (in contrast to the approach proposed by Sinn and Wollmershäuser 2011), but the more remote one is from “equilibrium”, the more some gradually increasing force (in the form of a financial incentive) emerges that pulls the system back to the equilibrium. Thus, TARGET2 balances would be built on Hooke’s law in physics, according to which strain is directly proportional to stress, or the restoring force exerted by the spring on its end is equal to a constant (the spring constant) times the displacement of the spring’s end from its equilibrium position. Elastic materials for which Hooke’s law³⁵ is a good approximation are called “linear-elastic” or “Hookean” materials. Currently, **TARGET2 balances are not Hookean** as the force exerted by the spring on its end does not increase at all. Under the approach proposed by Sinn and Wollmershäuser (2011), it would be even less Hookean as the force would switch from zero to infinite. The Bagehot principle of lending freely but at high rates may also be seen as a plea for more Hookean central banking in financial crisis.

³⁴ A similar approach applies to the IMF’s so called non-concessional facilities. All IMF non-concessional facilities are subject to the IMF’s market-related interest rate, the “rate of charge”. The rate of charge is uniform for all members, as stipulated by Article V, Section 8(d) of the Articles of Agreement. In addition, the Fund applies a system of graduated surcharges according to the amount and length of time credit is outstanding, which aim at providing the right incentives to the debtor country, i.e. to discourage large access over a prolonged period of time. The rate of charge is equal to the weekly revised SDR interest rate, plus a margin of currently 100 basis points. The surcharge has two components: first, for access to facilities above 300% of the quota, a 200 basis points surcharge is paid. In addition, for access above 300% exceeding more than 3 years, another 100 basis points surcharge is imposed.

³⁵ Hooke’s law is named after the British physicist Robert Hooke who stated this law in 1678 as “Ut tensio, sic vis”, i.e. “As the extension, so the force”.

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7. Conclusions

In this paper, we develop a closed system of financial accounts to capture the mechanics of liquidity crisis under various monetary frameworks and international financial systems. In particular, we compare the case of a single country (embedded in a flexible exchange rate context) and three variants of a two country setting with fixed exchange rates, namely the gold standard, the paper standard with fixed rates, and a monetary union as the euro area. Moreover, we distinguish the cases in which the central bank is only the lender of last resort for banks, and the one in which it is also the lender of last resort for securities issuers, including the sovereign.

In each case, we focus on understanding how a confidence crisis that involves a shift of funds from one bank to the other or from one country to the other, which in the latter case can encompass debt instruments issued by corporates and the sovereign, feeds through the accounts of the financial system. We compare the different cases with regard to the liquidity buffers available to avoid that the original liquidity shocks translate into either default or an asset fire sales spiral. The key results can be summarized as follows.

Under a paper standard and with flexible exchange rates, liquidity buffers are in principle unlimited as the domestic central bank only faces constraints set by its own risk management policy when dealing with a financial crisis. If the central bank is prohibited or refuses to be the lender of last resort to debt securities markets and in particular to its government, debt issuers have to rely on the domestic banking sector to perform this stabilizing function. This implies additional risks to financial stability as the banking sector may encounter capital and liquidity (or stigma related) limitations in acting as a lender of last resort. Moreover, even if the banking sector performs this role, the central bank has, under most scenarios, to provide the banking sector with the needed additional liquidity and allow the banks to submit securities for which they assume the role of lender of last resort as central bank collateral.

Under the gold standard and an associated fixed exchange rate regime, the domestic central bank of the distressed country is limited in its lending by its gold reserves, in particular if the drain is driven by capital flight out of the currency. If gold reserves are hitting the lower bound, the domestic central bank needs an international lender of last resort activated by international monetary cooperation. However, under the gold standard, international monetary cooperation proved difficult to organize as all central banks are exposed to the risk of a liquidity shock and may therefore themselves reach binding limits or have, preemptively, themselves incentives to hoard reserves. Thus, other central banks will be reluctant to help a central bank subject to gold outflows through loans. Overall, the gold standard is the most constraining international financial system in terms of the ability of central banks to provide the liquidity buffers needed.

Under a **paper standard with a fixed exchange rate regime** similar constraints occur, namely the problem that the central bank of the stressed country exhausts at some stage its foreign exchange reserves. However, the cases of international scarcity of gold and gold hoarding of the non-distressed central bank no longer apply. Hence, one reason for the failure of international central bank cooperation through loans is overcome. The IMF has been the main conduit of inter - central bank loan provision over the last decades. The conditionality imposed in the context of IMF loans was supposed to address one of the potential concerns that are associated with lending between central banks to address capital flight undermining the ability to sustain fixed exchange rates: that the public authorities of the stressed countries do not undertake efforts to overcome the source of the imbalance. Organizing intra central bank loans through the IMF also seems to have favourable properties from the risk management perspective, as the IMF has not recorded losses on its loans up to now.

Cross country stabilizing operations by a central bank of a **currency union** can be interpreted as an institutionalized and automatic approach to monetary cooperation. In the case of the Eurosystem, automatic TARGET2 balances take over the role of loans between central banks. The automaticity of TARGET2 claims is both an advantage (as it provides credibility to the elasticity of national liquidity supply) and a necessary condition for classifying the monetary link between the two countries as a

monetary union. Indeed, without a strict interchangeability of bank deposits with national central banks across the union system of central banks, and hence the possibility of creation of associated intra-central bank system claims and liabilities, there is no real monetary union. At the same time, the automaticity of TARGET2 balances may also be regarded as a potential weakness of a monetary union, namely in the sense that the automaticity is contrary to the idea, accepted in the case of e.g. IMF loans, of conditionality to ensure that the necessary adjustment measures to overcome the situation that created the capital outflows are undertaken. This weakness could be overcome by establishing governance structures that refer to TARGET2 balances and that implement mechanisms ensuring that corrective measures are taken. Moreover, surcharges in case of very large and protracted imbalances could be built in similarly to the case of surcharges for certain IMF loans. In this sense, monetary union would allow for the benefits of automaticity and credibility of inter-central bank liquidity provision, while imposing a framework of governance and incentives to ensure adequate policies commensurate with a mean reversion of TARGET2 balances over time.

Collateral constraints became quickly binding for many German banks in 1931 and for many euro area banks in 2010/2011. Both the Reichsbank and the Eurosystem however adjusted the collateral constraint to avoid that it would in itself be the source of bank defaults. Both central banks adjusted their collateral rules in practice in a way to allow banks to close their funding gaps through the necessary recourse to central bank credit, while still controlling central bank risk taking. At the same time, scarcity of collateral may unavoidably have contributed in both cases to a quick deleveraging of banks and hence to a credit crunch, as the fear or actual pressure associated with collateral constraints exert an influence on the behavior of stressed banks in the sense of creating a steady deleveraging / fire sales pressure. What led to the closure of Danat-Bank was a deliberate discontinuation of this flexible collateral policy combined with credit restrictions, as imposed by the gold constraint and the inability of the Reichsbank to convince its fellow central banks to grant sufficient loans. In the case of the Eurosystem, a number of changes of collateral rules supported banks, while other elements of the collateral framework reduced the borrowing potential of banks (temporary tightening of ABS rating threshold, mark-to-market valuation of securities, increase of haircuts on BBB rated instruments). In addition, emergency liquidity assistance provided by NCBs allowed closing funding gaps at a penalty rate and without intra-system loss sharing. The fact that collateral constraints were eventually not the constraints that lead themselves to bank closures reflects the facts that (i) these were not imposed strictly on central banks through their statutes or other exogenous factors, and that (ii) it can be self-defeating and probably not even financial loss minimizing for a central bank to let a bank default for that reason. In the case of a currency union with unconstrained TARGET balances, the collateral constraint can be the indirect regulator of the extension of TARGET2 balances. In this sense, collateral eligibility and risk control measures become the eventual battlefield for deciding on the degree of support to stressed countries' banking systems and debt issuers (in case of a prohibition or aversion of the central bank to buy debt securities itself, the banks will have to do so, financed by the central bank). Thus, while central banks eventually soften collateral standards in a crisis (and should do so), central bank risk remains key, and that central banks must be well equipped to apply the best possible risk management technology to their exposures in particular if, in a crisis, they find themselves forced to widen their collateral set. This ensures that they get the best possible protection also out of non-conventional collateral, while avoiding that collateral constraints are themselves not the trigger of counterparty defaults.

Borrowing limits of banks / credit constraints are constraints deliberately imposed by the central bank to limit the borrowing of banks with the central bank, as an independent further constraint beyond collateral eligibility. However, instead of containing the crisis, they may accelerate it by pushing all banks (potentially) affected by the limit into a state of fear from becoming illiquid, and hence into a state of strict liquidity hoarding. The Reichsbank, facing strong pressures from creditor countries and vanishing gold reserves, was forced to impose credit constraints and hence its decision to eventually do so was voluntarily taken. In retrospect, it seems that this measure contributed, if anything, to the disaster of July 1931, instead of preventing it from happening.

With regard to **interest rates as a tool to ensure the “elasticity” of flows**, a number of cases need to be distinguished:

- **Raising interest rates to attract funding / capital inflows**, while being the standard economic mechanism in normal times, may fail to equilibrate demand and supply in a confidence crisis as higher interest rates make it less likely that borrowers will be able to serve the debt. This mechanism applies in slightly different variants to corporates, banks, sovereigns, and central banks in a fixed exchange rate regime. It is what happened to Germany in 1931 (with the Reichsbank discount rates reaching 15% but capital outflows continuing), and to Greece, Portugal and Ireland in 2010/11 when they eventually had to request official sector loans. It has of course also happened to countless banks and corporates over time.
- **Raising central bank interest rates to make banks on aggregate refrain from borrowing with the central bank** will not work as normally, and in particular in a liquidity crisis, the aggregate demand of banks for central bank money is inelastic in the short term, as indeed the refinancing needs of banks towards the central bank depend on various factors outside the control of banks (as demonstrated in various variants in our financial accounts model). Raising central bank interest rates aggressively may then primarily put banks under additional stress, intensifying the crisis and reducing access to deposit and capital markets.
- **Raising central bank interest rates as applied to banks that are felt to have the potential to regain market access, but that prefer to rely excessively on central bank financing as it is cheap and easy**, can be an effective and non-damaging tool (Bagehot 1873). This logic could be applied first to individual banks that over-proportionally rely on the central bank although they could also access capital markets or attract more deposits with some efforts and accepting the related costs. Second, it could also apply to create incentives for individual countries within a monetary union to address large intra-central bank (TARGET2 type) balances – again provided that the confidence crisis has been overcome and the debtors in the relevant country can in principle substitute central bank funding with cross-border market funding sources, i.e. achieve capital inflows.

Monetary financing prohibitions constrained both the Reichsbank and the Eurosystem, although the former in a stricter way (as sovereign bills and bonds were not eligible for Reichsbank discount operations, the standard monetary policy instrument at that time). While the rationale of monetary financing prohibitions is clear, in both cases the prohibitions may also have contributed to the confidence crisis, although less obviously in the case of the Eurosystem. In the case of the Reichsbank, the inability to access Reichsbank funding (also indirectly via banks through the discounting of sovereign bills) and the implied lack of funds was one of the reasons for Brüning to adopt extreme austerity measures to prevent the Government from defaulting. In the case of the Eurosystem, the limited readiness of the Eurosystem to purchase sovereign bonds for supporting the monetary policy transmission mechanism (in contrast with the large scale asset purchase programs of the Fed and the BoE) has been viewed as one reason for the escalation of the crisis in the euro area, in contrast to the stabilization of the situation in the US and UK. Indeed, under a monetary financing prohibition, the banks have to take the burden to provide themselves the lender of last resort function to government (if other investors have been frightened away). This is however a less effective lender of last resort due to the collateral, liquidity, regulatory, and stigmatization constraints that limit banks, in contrast to central banks. Moreover, the additional exposure that banks load onto their books when acting as lender of last resort for Governments makes the country more vulnerable to diabolic solvency loops between the sovereign and the banks.

When **comparing specifically the case of the 1931 and the 2011 crises**, one may note the following striking parallels. In the case of both Germany in 1931 and e.g. Greece (or Portugal and Ireland) in 2010-12, a combination of similar factors led to a sudden reversal of capital flows. This led to a situation in which only the central bank was able to close the increasing funding gaps of the banking systems, while the sovereign had to be kept afloat either through the draconian measures of Brüning in 1931, or through loans from euro area Governments (today). The ingredients triggering the sudden reversal of capital flows can be summarized in five points: (i) High and possibly unsustainable public

debt; (ii) High foreign debt both of the sovereign and of the banking and corporate sector; (iii) Uncertainty about the political commitment to honor debt; (iv) sudden perceived deterioration of creditor status of private investors relatively to other debt holders: In the case of Germany in 1931 the discontinuation of transfer protection associated with the Young Plan, in the case of the euro area the emergence of the doctrine of “private sector involvement” according to which losses to private investors are to be accepted while official sector claims are in principle to be protected; and (v) loss of credibility in the integrity of the gold standard and the monetary union, respectively. The two crises were managed fundamentally differently not only in terms of loans between sovereigns, but also in terms of central bank interest rate policies and borrowing limits. In Germany, central bank rates were set at very high levels in 1931, namely up to 20%, while deflation in that year was as high as 10%, leading to real interest rates of 30% in the context of a real GDP shrinkage of 7.2%. Moreover borrowing limits were imposed on banks. In contrast, in 2011/2012, interest rates were set to 1% by the ECB (with still positive inflation rates), and the so-called fixed rate – full allotment procedure encouraged central bank borrowing of banks, instead of limiting it. In so far, despite the existence of monetary financing prohibitions and fixed exchange rates in both cases, there is no necessity that 2011 should end like 1931.

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Annex 1: Comparing the stylized system of financial accounts with the actual one – the example of the euro area

We focus on three types of actual statistical accounts.

A1.1 Euro area integrated economic and financial accounts

First, the “Integrated economic and financial accounts” of the euro area, as presented in section 3 of the ECB Monthly Bulletin (section 3.1, pages in particular page S28 in the December 2011 Monthly Bulletin). The methodology underlying these accounts has been explained in depth in a methodological document (“ECB Monthly Bulletin – Euro Area Statistics methodological notes, Chapter 3: Euro area accounts” 28 October 2010”). This is a comprehensive and consistent system of euro area financial accounts distinguishing the key institutional sectors similarly to our stylized system of financial accounts. (This and the subsequent balance sheet are in trillions of euro).

Euro area integrated economic and financial accounts						
End Q2 2011. Source: ECB Monthly bulletin, pages S28-S29						
	Households	Non-financial corporations	MFIs (banks)	Other financial institut.	Govern-ment	Rest of World
Financial assets	18,9	16,9	32,2	22,2	3,8	16,8
Currency and deposits	6,7	1,9	9,1	3,2	0,8	3,6
Debt securities	1,4	0,3	6,5	5,4	0,5	4,6
Loans	0	3,2	13,4	4,1	0,5	1,9
Shares and other equity	4,4	7,9	1,9	8,8	1,3	6,0
Other financial assets	6,4	3,6	1,3	0,7	0,7	0,7
Liabilities	18,9	16,9	32,2	22,2	3,8	16,8
Currency and deposits			22,3		0,3	2,6
Debt securities		0,9	5,2	6,4	6,7	5,9
Loans	6,1	8,6		1,9	1,4	5,6
Shares and other equity		13,4	2,6	8,8		
Other liabilities	0,6	3,9	1,2	4,6	0,8	2,7
Net financial worth	12,2	-9,9	0,9	0,5	-5,4	0

The following key observations may be made:

- **Households** have indeed a large net worth, but also have financed through loans around one third of their total financial assets. These loans are mostly mortgage loans, but also consumer loans. Their largest single asset item are deposits (and currency), while their debt securities holdings are more limited, and actually less than one half of shares and equity.
- Shares and other forms of equity are the biggest source of funding of **non-financial corporations**, followed by loans, and to a much lesser extent debt securities. In our financial accounts representation we ignore equity as the vulnerability regarding liquidity shocks comes from the the large share of funding through bank loans. Only companies financed fully through equity would be resilient against liquidity crises.
- For the **Government** the main financing source is debt issuance, as it is depicted in our financial account representation.

- **MFIs (Banks)** fund mainly through deposit collection (as assumed in our financial accounts), but also through debt issuance. Banks largest asset type are loans, but also debt securities holdings and deposits (mainly with other banks) are relevant.
- Finally, the **rest of the world** provides large scale financier in the form of shares, debt securities and loans (in this order), and vice versa.

All sectors, including households, are structurally dependent on funding if engaging in maturity transformation and hence are vulnerable to funding crises.

A2.2 MFI aggregate balance sheet

Second, we consider the aggregate balance sheet of the euro area MFI sector, as shown in section 2.1 of the Statistical annex to the ECB Monthly Bulletin (page S10 and S14 in the December 2011 Monthly Bulletin; explanatory notes can be found in <http://www.ecb.europa.eu/stats/money/aggregates/bsheets/html/index.en.html>).

MFI aggregated balance sheet			
End Q1. Source: November MB, Page S10, S14			
Assets		Liabilities	
Loans to euro area residents	17,9	Deposits	16,6
<i>to Government</i>	<i>1,2</i>	<i>from Government</i>	<i>0,3</i>
<i>to MFIs</i>	<i>5,5</i>	<i>from MFIs</i>	<i>5,7</i>
<i>to other financial intermed.</i>	<i>1,2</i>	<i>from others EA resid.</i>	<i>10,6</i>
<i>to Households</i>	<i>5,3</i>		
<i>to Non-financial corporation.</i>	<i>4,7</i>		
Securities	4,7	Securities	4,9
<i>Governments</i>	<i>1,5</i>		
<i>MFIs</i>	<i>1,5</i>	Money market funds	0,6
<i>Others</i>	<i>1,7</i>		
Shares, equity holdings	1,3	Capital and reserves	2,2
External assets	4,3	External liabilities	4,0
Other assets	3,6	Other liabilities	3,5
Total assets	31,8	Total liabilities	31,8

The following additional points from this more detailed aggregate MFI balance sheet may be highlighted in the context of our stylized financial accounts representation.

- **MFI loans** are widely split across the other sectors, whereby loans to other MFIs and to households are the biggest obligors.
- **Securities holdings** of banks is less than a third of loans, and are almost equally split across the other sectors.
- On the liability side, **household deposits predominate**, but interbank loans and debt instruments issued are also of systemic sufficient size to create a funding crisis.

A1.3 Eurosystem weekly financial statement

Finally, we look at the Eurosystem balance sheet at the same point in time, or, to be more precise, its weekly publication as of 1 July 2011 (the Eurosystem publishes a weekly financial statement (source: <http://www.ecb.int/press/pr/wfs/2011/html/fs110706.en.html>)). It should be noted that this balance sheet is presented in billions, while the previous two were in trillion.

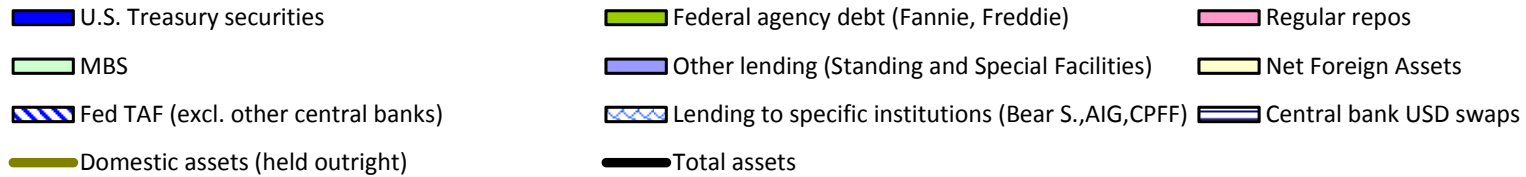
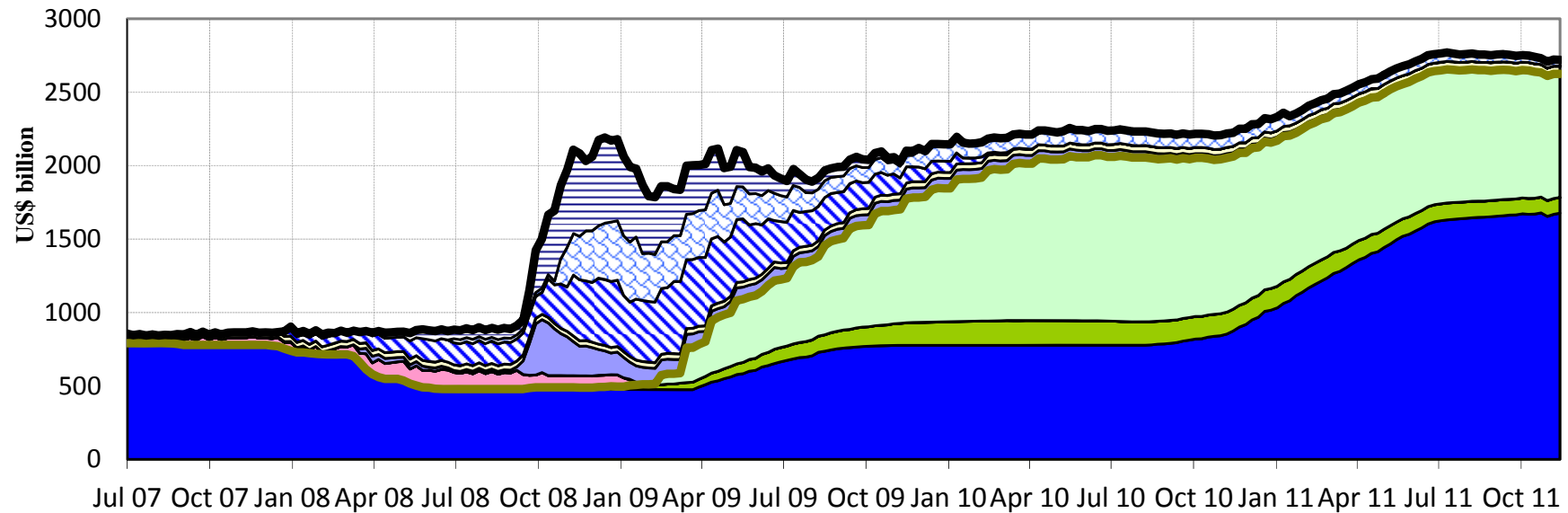
Eurosystem balance sheet			
(as of 1 July 2011)			
Assets		Liabilities	
Gold	363	Banknotes	849
Net foreign currency	229	Current accounts of banks	216
Eurosystem credit operations	455	Liquidity absorbing operations	98
<i>Marginal lending facility</i>	<i>1</i>	<i>Deposit facility</i>	<i>24</i>
<i>Main refinancing operation</i>	<i>141</i>	<i>Fixed term deposits</i>	<i>74</i>
<i>Longer term refinancing op.</i>	<i>313</i>		
Securities issued by EA resid.	485	Revaluation accounts	316
<i>Held for monetary policy purposes</i>	<i>134</i>	Capital and reserves	81
<i>Held for other purposes</i>	<i>350</i>		
Other assets	412	Other liabilities	384
Total assets	1944	Total liabilities	1944

The following points may be highlighted in the context of our stylized financial accounts representation:

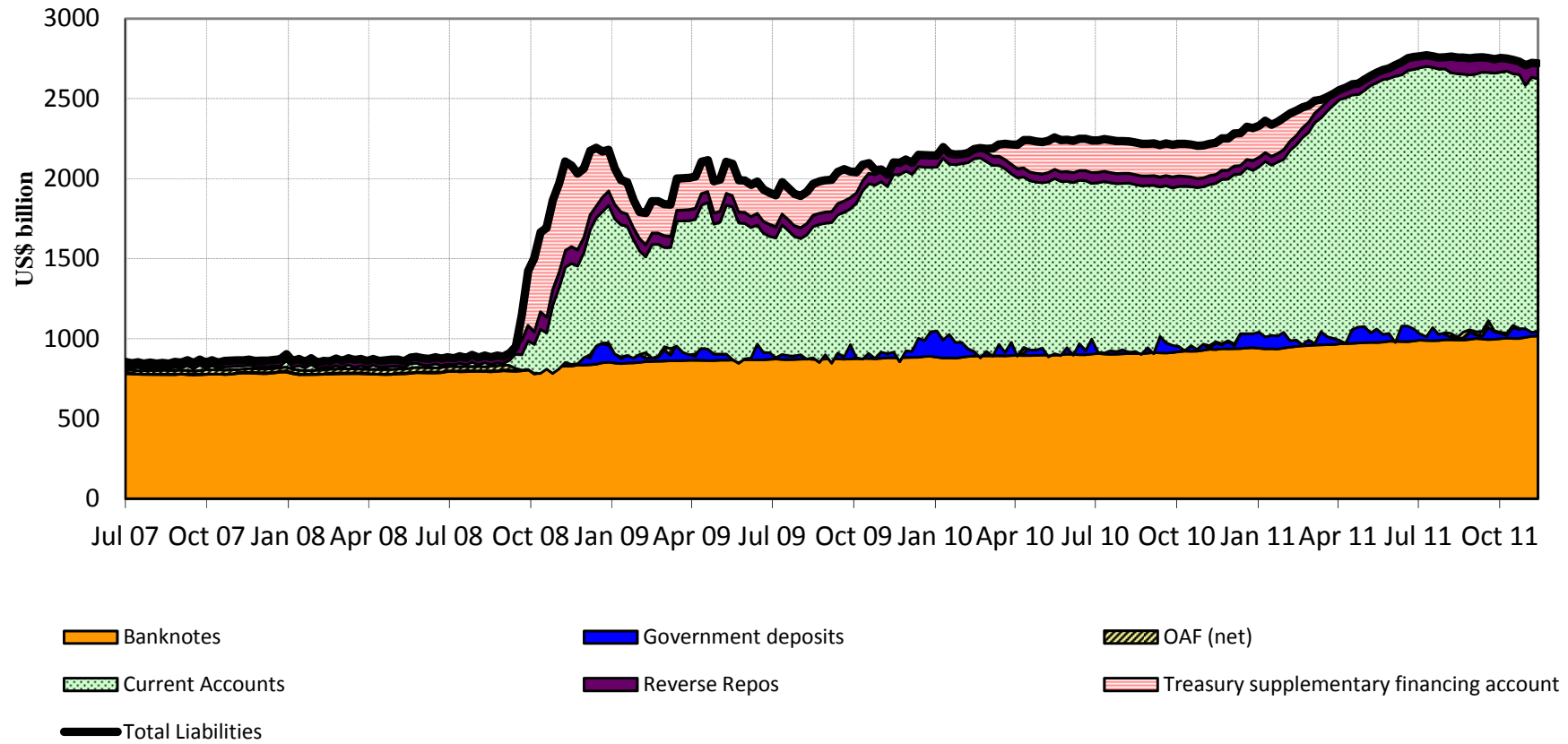
- **Gold and foreign exchange reserves** are relatively limited, reflecting that the euro area has a flexible exchange rate regime towards the rest of the world and does not need to steer its foreign exchange rate (actually the gold position is not so limited because of the large increases of gold prices over recent years – see also the size of revaluation accounts on the liability side).
- The Eurosystem held both **monetary policy portfolios** of debt securities and for investment (= “other”) purposes.
- The **total length of the balance sheet is 230% of banknotes in circulation**. It is to be recalled that in our system of financial accounts, only central bank intermediation between banks lengthened the central bank balance sheet beyond the amount of banknotes issued. However, at this point in time, the intermediation by the Eurosystem was very limited: current accounts of banks with the Eurosystem were practically equal to reserve requirements, and recourse to the Eurosystem deposit facility was below 1.5% of the balance sheet.

Since that date, the money market and deposit shocks across banks has been much stronger, and indeed currently (January 2012), the Eurosystem is heavily engaged in interbank intermediation (with cash rich banks depositing around EUR 450 billion). The figures in annex 2.3 and 2.4 show the evolution of the Eurosystem balance sheet across time.

Annex 2.1: Federal Reserve balance sheet, July 2010 –October 2011, Asset side, (Source: Federal Reserve Bank of New York)



Annex 2.2: Federal Reserve balance sheet, Liability side, July 2010 –October 2011 (Source: Fed New York)



Annex 2.3: Eurosystem balance sheet, July 2010 – October 2011, Asset side (Source: ECB)

