Chapter 7
International Monetary Frameworks

In this chapter we turn to representing flows of funds in alternative international monetary frameworks, and what global liquidity these different frameworks provide. We first recall some arguments in favour of and against fixed exchange rate systems. We then introduce two international monetary arrangements of the past which imply fixed exchange rates, namely the gold standard and the Bretton Woods system, and recall why both eventually failed. We then turn to three international monetary frameworks in the context of the current paper standard, i.e. fixed exchange rate systems, flexible exchange rate systems, and the European monetary union. We explain the role of an international lender of last resort and related solutions, and how these allow for more leeway in running fixed exchange rate systems. We also show how banks and central bank balance sheets are affected by international flows of funds and the balance of payments. Finally, we briefly review recent developments of foreign currency reserves, being the key central bank balance sheet position in this context.

7.1 Why Do Fixed Exchange Rates Persist?

This chapter introduces the flow of funds mechanics of various international monetary frameworks. It will be shown how the frameworks absorb capital and current account imbalances and see what limits the systems may encounter. Most of the sections of this chapter are devoted to forms of fixed exchange rate systems. International monetary frameworks often aimed at supporting fixed exchange rate systems, or they imply by construction fixed rates, like the international gold standard. Under fixed exchange rates, the central bank loses its otherwise unconstrained LOLR powers in its domestic currency. In addition, with fixed exchange rates, central banks lose the power to do independent monetary policy, as monetary policy will be determined by the need to be consistent with the fixed exchange rate. Obstfeld and Rogoff (1995) have therefore concluded that "for most countries, it is folly to recapture the lost innocence of fixed

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exchange rates". Why do countries or central banks want to have fixed exchange rates at all, or bind themselves to gold so as to lose parts of their freedom and power, both in terms of monetary policy, and as a lender-of-last resort? For example, why has the EU launched the euro project and why has China shown so much commitment over the last decades to keep its exchange rates relatively stable by allowing its foreign reserves to fluctuate considerably?

Mainly four reasons for fixed exchange rates are still sometimes considered valid:

- Effective fixed exchange rates make it possible to achieve **the network benefits from a more universal money**. Exchange rate stability contributes to reduce uncertainty and transaction costs (as currency dealers do not need to be compensated for risk taking or for being occasionally exploited by insiders). In particular, for a small country, it can be welfare improving to give up its own monetary freedom and to link its currencies to make its own economy benefit from a larger de facto monetary area.
- Binding a currency to gold or to another stable currency may make it possible to obtain credibility as it provides a commitment that can be monitored and that anchors expectations. A commitment to a certain inflation rate is not observable on a day-by-day basis as inflation is linked to policy measures only in a noisy and lagged way. The success of binding a currency to another one (or to gold) can be monitored on a continuous basis.
- Establish an order to **prevent "beggar my neighbour" foreign exchange policies or "exchange rate wars"**. For some episodes, observers have felt that exchange rate policies in flexible exchange rate systems have been used to achieve devaluations of their own currencies to make domestic industries more competitive and thereby stimulate domestic growth—at the expense of trading partners who experience exactly opposite effects in a sort of zero-sum game. A fixed exchange rate system, in particular with some agreed rules and a governance framework, could be seen as a way to overcome incentives for such non-cooperative behaviour which at the end makes everybody worse off.
- **Variable exchange rate systems may have a tendency to "overshoot"**, i.e. volatility of exchange rates is not just reflecting changing real factors, but additional, endogenously created volatility, not only related to speculation and panics, but also with sticky prices, as Dornbush (1976) noticed a few years after the breakdown of the Bretton Woods System.

For these reasons, countries have often chosen to try to fix their currency to a precious metal or to other currencies. Different forms of fixed currencies systems exist, as will be explained below (e.g. peg to metal; unilateral peg to another currency; multilateral agreement like the Bretton woods framework; EMS; monetary union). In the following sections, four international monetary arrangements will be introduced. First, frameworks of the past: the gold standard, which had its height from around 1875 to 1914, and second the Bretton Woods System, which regulated the international monetary relation from 1945 to 1971 and was officially dissolved in 1976.

Then, arrangements that are still in place today: fixed exchange rates and flexible exchange rates in the context of a paper standard.

7.2 Past International Monetary Frameworks

7.2.1 The Gold Standard

To represent the flow of funds under an international gold standard, assume two countries $i = \{1,2\}$, and the following for each sector:

- **Households** are not leveraged, they initially held all real assets of the economy, including gold, but they were ready to give up a part of it, "$\mathbf{G_i}$", and hold instead extra deposits with their home bank. Therefore, their initial deposits with their home bank are $D_i + G_i$. Households hold banknotes equal to B in their domestic currency.
- **Corporates** are identical across the two countries and financed exclusively through bank loans. They hold the real assets given up by the household (with the exception of gold).
- The two **banking systems** are also identical initially. Each banking system has assets of $D_i + B_i$ and is financed through bank deposits ($D_i + G_i$) and through central bank credit ($B_i - G_i$).
- Each of the **central banks** has a balance sheet length of B_i, equal to banknotes issued. In terms of assets, this is matched partially by the gold holdings (G_i) and partially credited to banks ($B_i - G_i$).

Cross border economic flows (financial flows and those relating to trade) are captured in the balance of payment, which records the economic transactions of a country within the international context. For a detailed description of the international accounting standards of the balance of payment, see the IMF Balance of Payments Manual (IMF 2009). Here, the flow of funds analysis will be limited to basic trade and financial flow transactions. For example, the following two events, which also affect the international accounts of a country, will not be captured:

- ***Changes of asset valuation.*** Changes of values of cross border asset and liability positions affects the international accounts of a country. In a flexible exchange rate system, many such valuation changes stem from exchange rate adjustments, but they will not be limited to them: for example, a cross border claim in the form of equity fluctuates in value even if exchange rates do not change. The net foreign wealth position of a country will be affected as well.
- ***Transfers, remittances, indemnities.*** Transactions of this type are international transfers through donations (e.g. a rich country provides development aid to a poor country by giving real goods or money), remittances (a Pakistani accountant working in Abu Dhabi transfers money every month to his family in Pakistan); a

country winning a war imposes an indemnity to the country that lost it; a country grants debt relief to another.

Table 7.1 shows basic capital and current account transactions defined as follows.

Capital transactions (ca): We define a capital transaction as one in which net financial claims between sectors of countries change without transfer of real goods (other than gold). In the gold standard, they are settled in central bank gold. We assume that household 2 is behind the capital move, namely that household 2 opens an account with bank 1 and then shifts a part of her bank deposit from country 2 into country 1. There are different ways of imagining how these transfers can concretely take place. Capital account transactions do not change the net foreign position of a country, i.e. having a net credit or a net debt towards the rest of the world. But in a fixed exchange rate system, they typically change the net cross-border position of the private sector, with opposite changes of the public sector as represented by the central bank.

Current account transactions (cu): Here we assume that household 1 sells a real asset to household B (alternatively, the transaction could also take place between corporates). Household 2 instructs her bank to credit the account of household 1 with bank 1. Again, this transaction can be implemented in different ways. At the end, it will impact on accounts as shown in Table 7.1. Current account transactions normally change the **net foreign position** of a country, i.e. the difference between foreign assets and foreign liabilities of a country.

Table 7.2 shows these accounts in the form of an asset liability matrix (see Table 7.2), such as introduced in Sect. 2.2.1.

If for example ca = – cu, then under fixed exchange rates (including the gold standard), the central bank gold (or foreign exchange) reserves do not change. This means that in net terms, capital flows exactly finance the net transfer of goods. There are single transactions that represent both types of transactions at once, for example: a machine is exported from corporate 1 to corporate 2, but not paid yet, such that a financial claim from corporate 1 to corporate 2 is created at the same time when the real good passes the border. This transaction takes place entirely in the corporate sector balance sheets. In the accounts below (Table 7.3), the value of the transaction is denoted by X, with $\mathbf{X = cu = - ca}$.

Capital and current account balances can have various reasons:

- **Smoothing the consumption path of households**: for example, one country may have a particularly low birth rate, and its households could partially invest their savings abroad, allowing it to transfer consumption into the future.
- Growth rates, and hence **real rates of return, may be higher in one country than in another**. Therefore, the rates of return on capital investments should also be higher in that country. Real assets are likely to move into this country for production purposes, and the flow of real goods could be financed by capital inflows. In this case (and similarly in the previous one), the balance of payment may be balanced as capital and current accounts tend to compensate each other. But the net foreign position of the country would change, as the country would become indebted towards the rest of the world.

Table 7.1 Two countries' financial accounts, gold standard

Household 1			
Deposits Bank 1	$D_1 + G_1 + cu$	Household Equity	E_1
Banknotes	B_1		
Real Assets	$E_1 - D_1 - B_1 - G_1 - cu$		
Corporate 1			
Real assets	$D_1 + B_1$	Loans Bank 1	$D_1 + B_1$
Bank 1			
Loans corporate 1	$D_1 + B_1$	Deposits household 1	$D_1 + G_1 + cu$
		Deposits household 2	+ ca
		Credit central bank 1	$B_1 - G_1 - ca - cu$
Central Bank 1			
Credit Bank	$B_1 - G_1 - ca - cu$	Banknotes issued	B_1
Gold reserves	$G + ca + cu$		
Household 2			
Deposits Bank 2	$D_2 + G_2 - ca - cu$	Household Equity	E_2
Deposits Bank 1	+ ca		
Banknotes 2	B_2		
Real Assets	$E_2 - D_2 - B_2 - G_2 + cu$		
Corporate 2			
Real assets	$D_2 + B_2$	Loans Bank 2	$D_2 + B_2$
Bank 2			
Loans corporate 2	$D_2 + B_2$	Deposits household 2	$D_2 + G_2 - ca - cu$
		Credit central bank 2	$B_2 - G_2 + ca + cu$
Central Bank 2			
Credit Bank	$B_2 - G_2 + ca + cu$	Banknotes issued	B_2
Gold reserves	$G_2 - ca - cu$		

- There is also the case where **capital and current account imbalances both have the same sign and therefore contribute jointly to a payment imbalance**. For example, although not under a gold standard, emerging market economies like China in the first decade of 2000 had both large capital inflows and large current account surpluses. Capital goods were imported to China, but exports in consumer goods were so strong that the current account was in surplus. Foreign reserves ballooned in China during this period (under the gold standard its gold reserves would have ballooned). Greece in 2010 seems to have represented the opposite case, i.e. it had both a capital account and a current account deficit.
- **Capital accounts can be driven by capital flight and then the amplitude of the capital account easily exceeds that of the current account**. This was illustrated

Table 7.2 Two countries' financial accounts, gold standard, matrix representation

Asset of: →			Liability of: ↓								
	Real assets ↓	HH A	HH B	Corp 1	Corp 2	Bank 1	Bank 2	CB 1	CB 2	*Tot Financial Assets*	*Tot Assets*
Real Equity→	$E_1 + E_2$	**E**	**E**								
Household 1	$(E_1 - D_1 - B_1)$ **$- G_1 -$ cu**					**$D_1 + G_1 +$ cu**		**B_1**		**$D_1 + B_1 + G_1 +$ cu**	E_1
Household 2	$(E_2 - D_2 - B_2)$ **$- G_2 +$ cu**					**+ ca**	**$D_2 + G_2 -$ ca $-$ cu**		**B_2**	**$D_1 + B_1 + G_1$ $-$ cu**	E_1
Corporate 1	$(D_1 + B_1)$										$D_1 + B_1$
Corporate 2	$(D_1 + B_1)$										
Bank 1				**$D_1 + B_1$**						**$D_1 + B_1$**	$D_1 + B_1$
Bank 2					**$D_2 + B_2$**					**$D_2 + B_2$**	$D_2 + B_2$
CB 1	**$G_1 +$ ca + cu**					**$B_1 - G_1 -$ ca $-$ cu**				**B_1**	B_1
CB 2	**$G_2 -$ ca $-$ cu**						**$B_2 - G_2 +$ ca + cu**			**B_2**	B_2
Tot. Fin. Liabs				**$D_1 + B_1$**	**$D_2 + B_2$**	**$B_1 + D_1$**	**$B_2 + D_2$**	**B_1**	**B_2**		
Tot. Liabs		**E_1**	**E_2**	**$D_1 + B_1$**	**$D_2 + B_2$**	**$B_1 + D_1$**	**$B_2 + D_2$**	**B_1**	**B_2**		

Table 7.3 A balance of payment equilibrium within the corporate sectors of two countries

Corporate 1			
Real assets	$D_1 + B - X$	Loans Bank 1	$D_1 + B_1$
Claim to Corporate 2	+ X		
Corporate 2			
Real assets	$D_2 + B_2 + X$	Loans Bank 2	$D_2 + B_2$
		Liability to Corporate 1	+ X

by numerous emerging market crises (Mexico in the 1980s, Thailand, Indonesia and Russia in the late 1990s), and also in the euro area crisis.

Generally, observers may find current and capital accounts of specific countries in specific periods, as well as cumulated external positions of these countries, as something economically sensible and welfare improving, or as reflecting undesirable imbalances with the potential for financial destabilisation and corresponding welfare damage. For example, the large short-term foreign indebtedness of Germany that built up in the second half of the 1920s and that created the subsequent run on Germany in 1931 was assessed early as problematic (see e.g. annual reports of the Reichsbank in the 1920s). Similar cases were often observed until recently with emerging market economies. During his entire Presidency, US President Trump criticised German current account surpluses as unnatural and problematic, while the Bundesbank defended them as reflecting the German age pyramid and hence the need for the German society as a whole to save through the temporary accumulation of a net external claim.

Alternatives to settlement in gold

Returning now to the initial case in which the balance of payment is not balanced, i.e. $ca \neq -cu$, it should be noted that the resulting **net claim does not necessarily need to be settled through a physical gold transfer**, but it can also be settled through the creation of a foreign reserves claim of central bank 1 towards central bank 2. One could for example imagine that also under the gold standard, the two central banks have a settlement agreement in which cross border bank transfers are settled through a counterbalancing central bank position, up to a certain limit beyond which settlement in gold is required. This case is illustrated in the accounts in Table 7.4.

Table 7.5 shows still another alternative, namely that a claim of central bank 1 towards commercial bank 2 is created. For both central banks, this could make a difference: from the perspective of central bank 1, it could mean problems in case of a need to liquidate these claims when they are needed for interventions. For central bank 2, it could cause domestic financial stability issues, requiring it to act as LOLR to its domestic debtors when central bank 1 liquidates its foreign reserves for intervention purposes.

Returning to the base case that the international transactions are settled in gold and affect central bank gold reserves, two limits may eventually become binding:

Table 7.4 Central banks' accounts in gold standard with claims on gold instead of shipments

Central Bank 1			
Credit Bank	$B_1 - G_1 - ca - cu$	Banknotes	B_1
Gold reserves	G		
Gold Claim to CB 2	$+ ca + cu$		
Central Bank 2			
Credit Bank	$B_2 - G + ca + cu$	Banknotes issued	B_2
Gold reserves	G	Gold liability to CB 1	$+ ca + cu$

Table 7.5 Accounts of financial sectors if deposits with foreign banks replace gold shipment

Bank 1			
Loans corporate 1	$D_1 + B_1$	Deposits household 1	$D_1 + G_1 + cu$
		Deposits household 2	$+ ca$
		Credit central bank 1	$B_1 - G_1 - ca - cu$
Central Bank 1			
Credit Bank	$B_1 - G_1 - ca - cu$	Banknotes	B_1
Gold reserves	G		
Deposits Bank 2	$+ ca + cu$		
Bank 2			
Loans corporate 2	$D_2 + B_2$	Deposits household 2	$D_2 + G - ca - cu$
		Credit central bank 2	$B_2 - G$
		Deposit Central Bank 1	$+ ca + cu$
Central Bank 2			
Credit Bank 2	$B_2 - G$	Banknotes	B_2
Gold reserves	G		

first, the **limit with regard to the share of banknotes that needs to be covered by gold reserves**, according to the central bank law. For example, the Reichsbank was subject, according to its mandate established by the Dawes Plan in 1924, to a 40% gold coverage ratio for banknotes. Second, assuming that gold coverage ratios have been given up, when **gold reserves are fully exhausted**, such as in the case of the Reichsbank in July 1931. Then, eventually the gold convertibility has to be given up.

Performance of the gold standard

The gold standard worked fine during the period 1876–1914, but poorly in the interwar period. The poor interwar performance of the gold standard is explained by Eichengreen (1995) with the global scarcity of gold and non-collaborative international behaviour in the context of larger capital flow volatility due to the political and financial instabilities. The interwar gold standard came after the WWI experience that one cannot rely on a universal commitment of Governments to maintain

a gold parity. For example, Germany devalued in 1924 by a factor of 10^9, and only very few like the US and the UK did not. Similarly, the belief in Governments to repay their debt was shaken (e.g. the Russian mega-default of 1917); moreover, the inter-war period was characterised by unsolved problems of international debt imbalances (war and reparation debt) and political instability, materialising in the rise of fascism and communism. Finally, the willingness of central banks to collaborate, e.g. through inter-central bank loans, was insufficient (while an international LOLR like the IMF was still missing). With increasing uncertainties after the outbreak of the global financial crisis in 1929, central banks were even keener to each hold sufficient gold reserves to be protected against future outflows, implying that on average central banks kept interest rates too high in their competition for the global gold stock, triggering deflation and depression.

7.2.2 The Bretton Woods System

The Bretton Woods system was set up in 1944 and included establishing the IMF and the World Bank. The related convertibility promises were given up in 1971 and 1974, although the role of the IMF as international LOLR has continued until today. The Bretton Woods system was a fixed exchange rate system in which the US committed to fix the value of the USD in gold (and to ensure convertibility), while the others promised to fix the price of their currency in USD (and to defend these fixed exchange rates). Therefore, in principle the US Fed needed gold as a reserve asset, while the other members needed USD. The accounts shown in Table 7.6 illustrates this situation, focusing on the case of flows handled through the foreign reserves of a non-US country. If country 2 is Germany, then in the Bretton Woods era $(ca + cu) < 0$, i.e. Germany had balance of payment surpluses and the Bundesbank accumulated foreign reserves.

Bordo (1993) notes that a fixed rate system of the **Bretton Woods type was subject to the following three problems**:

- **Adjustment**: "Under the classical gold standard, balance of payments adjustment worked automatically through the price specie flow mechanism, aided by short-term capital flows. …. Under Bretton Woods, concern over the unemployment consequences of wage rigidity delayed the deflationary adjustment required by a deficit country and, together with the use of short-term capital controls, considerably muted the automatic mechanism. …. The adjustment problem concerned the burden of adjustment between deficit and surplus countries and the choice of policy tools."
- **Liquidity**: "The perceived liquidity problem in the Bretton Woods system was that the various sources of liquidity were not adequate or reliable enough to finance the growth of output and trade. The world's monetary gold stock was insufficient by the late 1950s, IMF unconditional drawing rights were meagre, and the supply

Table 7.6 Two countries' financial accounts under the Bretton Woods system

Household 1			
Deposits Bank 1	$D_1 + G_1 + cu$	Household Equity	E_1
Banknotes	B_1		
Real Assets	$E_1 - D_1 - B_1 - G_1 - cu$		
Corporate 1 (USA)			
Real assets	$D_1 + B_1$	Loans Bank 1	$D_1 + B_1$
Bank 1 (USA)			
Loans corporate 1	$D_1 + B_1$	Deposits household 1	$D_1 + G_1 + cu$
Loans corporate 2	F	Deposits household 2	$D_{21} + ca$
		Credit central bank 1	$B_1 - G_1$
		Deposits Central Bank 2	F – ca – cu
Central Bank 1 (USA)			
Credit Bank 1	$B_1 - G_1$	Banknotes	B_1
Gold reserves	G_1		
Household 2			
Deposits Bank 2	$D_2 - ca - cu$	Household Equity	E_2
Deposits Bank 1	$D_{21} + ca$		
Banknotes	B_2		
Real Assets	$E_2 - D_2 - B_2 + cu$		
Corporate 2			
Real assets	$D_2 + B_2$	Loans Bank 2	$D_2 + B_2$ **– F**
		Loans Bank 1	**F**
Bank 2			
Loans corporate 2	$D_2 + B$ **– F**	Deposits household 2	D_2 **– ca – cu**
		Credit central bank 2	B_2 **– F + ca + cu**
Central Bank 2			
Credit Bank	B_2 **– F + ca + cu**	Banknotes issued	B_2
Foreign reserves	**F – ca – cu**		

of U.S. dollars depended on the U.S. balance of payments, which in turn was related to the vagaries of government policy and the confidence problem."

- **Confidence**: "as in the interwar period, involved a portfolio shift between dollars and gold. As outstanding dollar liabilities held by the rest of the world monetary authorities increased relative to the U.S. monetary gold stock, the likelihood of a run on the "bank" increased. The probability of all dollar holders being able to convert their dollars into gold at the fixed price declined."

This led surplus countries to prefer hoarding gold instead of holding USD, i.e. a run on the US Fed's gold holdings took place by the surplus countries who made use of

the US Fed's obligation to convert the surplus countries' USD into gold. Another way to describe the Bretton Woods problem is the **Triffin Dilemma** (Triffin 1960). In the words of the IMF (IMF 2020b):

> If the United States stopped running balance of payments deficits, the international community would lose its largest source of additions to reserves. The resulting shortage of liquidity could pull the world economy into a contractionary spiral, leading to instability. If U.S. deficits continued, a steady stream of dollars would continue to fuel world economic growth. However, excessive U.S. deficits (dollar glut) would erode confidence in the value of the U.S. dollar. Without confidence in the dollar, it would no longer be accepted as the world's reserve currency. The fixed exchange rate system could break down, leading to instability.

In principle, the solution of this problem was supposed to be the "SDR", the special drawing rights of the IMF, which created additional international liquidity.

Table 7.7 shows the case if the other country experiences balance of payment surpluses and the central banks prefer to accumulate gold instead of USD

The accounts in Table 7.6 had suggested that the US Fed's balance sheet was not really affected by the balance of payment deficits of the US—however this was not true, as highlighted by the Triffin Dilemma: Central bank 2 can also exchange its foreign reserves against gold, and this is indeed what central banks of balance of payment surplus countries tended to do. For example, the Bundesbank (until 1957 its predecessor, the Bank Deutscher Länder) had no gold reserves in 1949, but more than 3000 tons at the end of the Bretton Woods era in 1974. The desire to accumulate not only US dollars, but also gold, may have been understandable, since holding very large amounts of US dollars exposed a central bank to risks that the US eventually devalues—which it actually did. A bank run logic applies. The mechanics of the self-fulfilling prophecy works as follows in this case: if surplus countries start to doubt the ability or willingness of the US to defend the peg of the USD to gold, they are incentivized to start hoarding gold instead of USD, and eventually this leads the US to run out of gold reserves, forcing it to devalue the USD against gold, validating the fears of the countries who "ran" on the USD. Of course, at an early stage, the US could have tried to defend the peg by restrictive monetary policies which would have triggered capital inflows exceeding the negative effects of current accounts. But this would have had significant economic costs in the view of the responsible policy makers, and therefore did not take place. In the financial accounts, the tendency of surplus countries to hoard gold is reflected as follows, assuming the case that country 2 (Germany) has surpluses and converts these completely into gold (Table 7.7).

In retrospect, it appears that the Bretton Woods system could have worked if:

- balance of payment imbalances would have been limited;
- commitment of countries to defend the pegs had been very strong, even if this would require domestic adjustments. In view of its exposed role, the related commitment and credibility of the US was of overwhelming importance;
- the other countries accepted to mirror US monetary policies, including, for example, to import inflation, so as not to build up appreciation pressures, as e.g. the DM constantly did;

Table 7.7 Bretton Woods financial accounts if surplus countries hoard gold instead of USD

Bank 1 (USA)			
Loans corporate1	$D_1 + B_1$	Deposits household 1	$D_1 + G_1 - cu$
Loans corporate 2	FR	Deposits household 2	$D_{21} - ca$
		Credit central bank 1	$B_1 - G_1 + ca + cu$
		Deposits Central Bank 2	FR
Central Bank 1 (USA)			
Credit Bank	$B_1 - G_1 + ca + cu$	Banknotes issued	B_1
Gold	$G_1 - ca - cu$		
Bank 2 (Germany)			
Loans corporate 2	$D_2 + B_2 - FR$	Deposits household 2	$D + ca + cu_2$
		Credit central bank 2	$B_2 - FR - ca - cu$
Central Bank 2 (Germany)			
Credit Bank	$B_2 - FR - ca - cu$	Banknotes	B_2
Foreign reserves	FR		
Gold	$+ ca + cu$		

- the other countries accepted to accumulate USD as foreign exchange reserves, i.e. did not insist on accumulating gold, in case the US ran balance of payment deficits;
- an international LOLR (like the IMF) had given enough confidence to non-US countries about available liquidity in case of need, so that central banks would not have been tempted to build up excessively large foreign exchange reserves and thereby contribute to international imbalances.

There were several changes of pegs before the eventual dismissal of the Bretton Woods system in 1974.

7.3 International Monetary Frameworks of the Present

After the collapse of the Bretton Woods system in 1971, and its official dissolution with the Jamaica Accords of 1976, a "paper standard" emerged in which currencies were no longer pegged to gold. While the biggest economies opted for flexible, floating exchange rates, the smaller economies mostly fixed their exchange rate to that of the US or of the nearest large economy. The western European countries tried to develop arrangements for limiting the fluctuations of the currencies between each other, whereas the German Mark emerged as the anchor. Thereafter these agreements led to the creation of the euro.

7.3.1 *Fixed Exchange Rate System—Paper Standard*

The following financial accounts show a fixed exchange rate system in a paper standard. Country 1 is a large country, which does not care about the exchange rate, while country 2 is a smaller country that does care and that ensures that its currency is pegged 1:1. For example, country 1 could be the euro area and country 2 Bulgaria. To be able to defend the currency peg, the central bank of country 2 needs foreign reserves. In the accounts below, we assume that these have a level **FR** and are held in the form of deposits in currency 1 with Bank 1, and that they originated in the past from capital account inflows into country 2, which still materialize in the accounts in the form of lending of Bank 1 to corporate 2 of FR.

Table 7.8 illustrates the example of a **current account transaction in which a household in country 1 sells a car and exports it to a household in country 2**.

- Household 1 requires payment on its account at bank 1 and household 2 requests his Bank 2 to make an international payment to the account of household 1 at Bank 1.
- To do this, bank 2 needs deposits in country 1. If it has none, it will go to the foreign exchange (FX) market and offer deposits with itself, and demand deposits with some bank in country 1, so that it can then transfer funds to the account of household 1 in country 1.
- If the market was otherwise in equilibrium, this FX market transaction of bank 2 increases demand of currency 1 and supply of currency 2. This will bring the FX market into disequilibrium and push up the price of currency 1 measured in units of currency 2. Central bank 2 committed to a fixed exchange rate, and must therefore compensate the disequilibrium by increasing supply of currency 1 and demand of currency 2. It does this by selling deposits with bank 1 to bank 2 and debiting the current account of bank 2 with itself.
- Since bank 2 needs to restore zero deposits with central bank 2, it will increase its credit from central bank 2 by taking recourse to central bank 2 credit operations.

Exhausted central bank foreign reserves and the ILOLR

What if central bank 2's foreign reserves are exhausted, i.e. if ca + cu > FR? Eventually, the central bank and the government of country 2 have to restore macroeconomic conditions that stop and revert the flows that led to this situation (e.g. increase interest rates, strengthen the competitiveness through supply side reforms, etc.). However, such measures typically require some time to be effective. There are two short term options: either **Central bank 2 finds an *international* LOLR to replenish its foreign reserves**, or central bank 2 "defaults" on its promise to fix the exchange rate. In the latter case, the system moves towards a variable exchange rate system.

An international LOLR can take two forms: a direct lending between central banks, or through an intermediary like the IMF. Table 7.9 shows the latter case in a stylized way. **The intermediary (which we call "IMF") takes a loan from central**

Table 7.8 Two countries' financial accounts in paper standard with fixed exchange rates

Household 1			
Deposits Bank 1	$D_1 + cu$	Household Equity	E_1
Banknotes 1	B_1		
Real Assets	$E_1 - D_1 - B_1 - cu$		
Corporate 1			
Real assets	$D_1 + B_1$	Loans Bank 1	$D_1 + B_1$
Bank 1			
Loans corporate 1	$D_1 + B_1$	Deposits household 1	$D_1 + cu$
Loans corporate 2	FR	Deposits household 2	+ ca
		Credit central bank 1	B_1
		Deposits central bank 2	FR – ca – cu
Central Bank 1			
Credit Bank 1	$B_1 - G_1$	Banknotes 1	B_1
Household 2			
Deposits Bank 2	D_2 – ca – cu	Household Equity	E_2
Deposits Bank 1	+ ca		
Banknotes 2	B_2		
Real Assets	$E_2 - D_2 - B_2 + cu$		
Corporate 2			
Real assets	$D_2 + B_2$	Loans $Bank_2$	$D_2 + B_2$ – FR
		Loans Bank 1	FR
Bank 2			
Loans corporate 2	$D_2 + B_2$ – FR	Deposits household 2	D_2 – ca – cu
		Credit central bank 2	B_2 – FR + ca + cu
Central Bank 2			
Credit Bank	B_2 – FR + ca + cu	Banknotes 2	B_2
Deposits bank 1	FR – ca – cu		

bank 1 to obtain currency 1 and provides this as credit to central bank 2. The loan is assumed here to exactly close the gap of missing foreign reserves to stem the outflow due to current and capital account deficits.

The intermediary could also have initially, when founded as an international institution, created a sufficient balance sheet to accommodate such loans. This is displayed in Table 7.10, where the IMF balance sheet is initially based on paid-in capital. This paid in capital is "invested" by the IMF in the form of deposits with the central banks.

Table 7.9 Financial accounts, fixed exchange rate, with IMF providing additional foreign reserves obtained by credit line

Bank 1			
Loans corporate 1	$D_1 + B_1$	Deposits household 1	$D_1 + cu$
Loans corporate 2	FR	Deposits household 2	+ ca
		Credit CB_1	$B_1 - \max(0, -FR + ca + cu)$
		Deposits CB_2	$FR + \max(0, -FR + ca + cu)$
Central Bank 1			
Credit to banks	$B_1 - \max(0, -FR + ca + cu)$	Banknotes 1	B_1
Credit to IMF	$+ \max(0, -FR + ca + cu)$		
Bank 2			
Loans corporate 2	$D_2 + B_2 - FR$	Deposits household 2	$D_2 - ca - cu$
		Credit central bank 2	$B_2 - FR + ca + cu$
Central Bank 2			
Credit Bank 2	$B_2 - FR + ca + cu$	Banknotes 2	B_2
Deposits bank 1	$\max(0, FR - ca - cu)$	IMF Credit	$\max(0, -FR + ca + cu)$
IMF			
Credit to CB B	$\max(0, -FR + ca + cu)$	Credit from CB A	$\max(0, -FR + ca + cu)$

Table 7.10 Financial accounts, fixed exchange rate, with IMF providing additional foreign reserves obtained by pre-paid capital

Central Bank 1			
Credit to banks	$B_1 - \max(0, -FR + ca + cu)$	Banknotes 1	B_1
Paid-in Capital IMF	IMFC/2	IMF deposit	$IMFC/2 - \max(0, -FR + ca + cu)$
Central Bank 2			
Credit Bank 2	$B_2 - FR + ca + cu$	Banknotes 2	B_2
Paid-in Capital IMF	IMFC/2	IMF deposit	IMFC/2
Deposits bank 1	$\max(0, FR - ca - cu)$	IMF credit	$\max(0, -FR + ca + cu)$
IMF			
Deposit CB 1	$IMFC - \max(0, -FR + ca + cu)$	Paid-in capital	IMFC
Deposit CB 2	IMFC		
Credit to CB 2	$\max(0, -FR + ca + cu)$		

Devaluation and settlement of the implied negative central bank capital

A devaluation by a central bank under a fixed exchange rate system could in some sense be compared to a default of a commercial bank when it is no longer able to pay back deposits when these are withdrawn, as developed in Chap. 6. Based on this analogy, one could also aim at a model of runs on currencies, in which the no-run conditions would depend both on liquidity (quantity and liquidity of foreign exchange reserves of the central bank) and on "fundamentals" being the (maybe somewhat less obvious) analogue to solvency in the bank run model.

Table 7.11 Central bank accounts when currency 2 is devalued

Central Bank 1 (denominated in currency 1)			
Credit to banks	B_1	Banknotes 1	B_1
Central Bank 2 (denominated in currency 2)			
Credit Bank 2	$B_2 - FR$	Banknotes 2	B_2
Foreign reserves	0.5FR		
Negative equity	0.5FR		

Table 7.11 shows the case of an appreciation of currency 2. This is what happened to Germany during Bretton Woods (but it would be similar in a paper standard).

If currency 2 would depreciate, typically no profits (nor losses) occur for central bank 2 as this scenario most likely occurs when central bank 2 has exhausted its foreign reserves. If it had foreign currency reserves, then it would book a profit, or, if it were prudent and conservative, it would book instead revaluation reserves on its liability side. Returning to the case of an appreciation of currency 2: the accounts of country 1 are not affected, but the country 2 central bank books a loss and negative equity. If the Government of country 2 wants to repair this negative equity, then it may issue additional debt (or impose extra taxes on households) and recapitalize the central bank. At the end, the appreciation is at the expense of the wealth of household 2. One could say that the household 2 sold real assets to country 1, but was only paid for half of the value—retroactively because of the devaluation of currency 1 (USD).

7.3.2 Flexible Exchange Rate Systems

In Table 7.12, we denominate the accounts of country 1 in currency 1, and those of country 2 in currency 2, and introduce the exchange rate α, i.e. α units of currency 2 are worth one unit of currency 1. Now, **the central bank balance sheet is no longer available for counterbalancing private balance of payment flows**. Instead, the private market participants have to equilibrate the balance of payment on its own. Below, this takes place by letting banks create cross border claims and liabilities between each other, so that eventually the foreign exchange market is in equilibrium. Now call *ca* the capital account imbalance contributed by the household. The total capital account balance will be $ca + ca_B$, if we call ca_B the capital account contribution of the banking system. Necessarily, $ca + ca_B = cu$, i.e. the total capital account exactly balances the current account. This obviously implies that $ca_B = cu - ca$, i.e. the capital account contribution of the banking system will have to equal the difference between the current account imbalance and the capital account imbalance contributed by the households. If banks are less willing to provide some elasticity be entering cross-border exposures, then the adjustment of the exchange rate to imbalances of payment flows stemming from households will be more violent. In other words, the readiness

of the financial system to look through short-term fluctuations of payment flows and to take temporarily cross border exposures is essential in this system to be relatively stable (in conjunction of course with adequate central bank and fiscal policies of the public authorities in both countries). If the private financial sector is only limitedly willing to provide elastic cross-currency liquidity services, this will imply more volatile foreign exchange rates, and possibly require a more activist central bank (through more frequent interest rate adjustments, or even sporadic foreign exchange interventions). This could also be a consequence of tight regulations of banks' risk taking, or a lack of economic capital of banks that makes them unwilling to take risks anyway. Bank 1 has accepted to export capital into country 2 by depositing foreign currency in bank 2, while bank 2 has accepted to import capital by getting indebted towards bank 1.

The net foreign position of the countries has evolved as it would have done under any other international monetary regime—according to the current account imbalance. **The net foreign position is also impacted by the exchange rate**. If the claim is denominated in currency 2, then a devaluation of currency 2 (i.e. an increase in α) implies that the net foreign position of country 1 (in currency 1) declines (while it did not change for country 2), etc. The central bank foreign reserves do not change, i.e. the central bank is neither involved in current account nor capital account flows.

7.3.3 The European Monetary Union

A monetary union like the euro area can be interpreted as a fixed exchange rate system in which the automatic creation of intra-central bank claims and liabilities plays the role of gold/foreign reserves/IMF loans in standard fixed exchange rate systems. The intra-central bank claims and liabilities are in the case of the euro area the so-called TARGET2 balances, which have found some attention starting in 2011 (e.g. Sinn and Wollmershäuser 2012; Bindseil and König 2012; Buiter and Rabhari 2012). The capital flow mechanics in the years up to 2012 are reviewed in more detail in Lane (2013). A recent comprehensive treatment is Hellwig (2019). The system of financial accounts in Table 7.13 assumes that country 1 has a balance of payment surplus and country 2 a balance of payment deficit. We assume that both current account and capital account imbalances originate from the household. The two households contribute to capital flight to the same extent by shifting bank deposits from country 2 to country 1. The payment matching the current account transaction is assumed to be from the account of household 2 with bank 2 to the account of household 1 with bank 1.

The Eurosystem consolidated balance sheet will look as follows is shown in Table 7.14.

Table 7.13 made a number of simplifications: for example, there are no cross-border loans of banks to corporates, and the Eurosystem does not invest into securities. These additional elements could be integrated of course.

Table 7.12 Two countries' accounts in a flexible exchange rate system

Household 1			
Deposits Bank 1	$D_1 + cu$	Household Equity	E_1
Banknotes	B_1		
Real Assets	$E_1 - D_1 - B_1 - cu$		
Corporate 1			
Real assets	$D_1 + B_1$	Loans Bank 1	$D_1 + B_1$
Bank 1			
Loans corporate 1	$D_1 + B_1$	Deposits household 1	$D_1 + cu$
Deposit Bank 2	$ca + cu$	Deposits household 2	$+ ca$
		Central bank credit	B_1
Central Bank 1			
Credit Bank	B_1	Banknotes 1	B_1
Household 2			
Deposits Bank 2	$D_2 - \alpha{\cdot}ca - \alpha{\cdot}cu$	Household Equity	E_2
Deposits Bank 1	$+ \alpha{\cdot}ca$		
Banknotes 2	B_2		
Real Assets	$E_2 - D_2 - B_2 + \alpha{\cdot}cu$		
Corporate 2			
Real assets	$D_2 + B_2$	Loans Bank 2	$D_2 + B_2$
Bank 2			
Loans corporate 2	$D_2 + B_2$	Deposits household 2	$D_2 - \alpha{\cdot}ca - \alpha{\cdot}cu$
		Deposit Bank 1	$+ \alpha{\cdot}ca + \alpha{\cdot}cu$
Central Bank 2			
Credit Bank	B_2	Banknotes issued	B_2

In contrast to foreign reserves, T2 balances are not limited. However, one constraint is the central bank collateral framework and to what extent banks can close the funding gap created by the Balance of Payment deficits through additional central bank credit. This is why Hans-Werner Sinn and other ECB critics have identified the **ECB collateral framework** as one key factors that allowed the Eurosystem to contribute to overcoming the balance of payment crisis associated with the sovereign debt crisis of 2009–2012. Once the cumulated Balance of Payment deficits exceed the initial level of banknotes circulating in country 1, the banking system would be in a liquidity surplus and the Eurosystem consolidated balance sheet would start to lengthen one-to-one with further surpluses of country 1.

Table 7.13 Two countries' accounts in the European Monetary Union exchange rate system

Household 1			
Deposits Bank 1	$D_1 + ca/2 + cu$	Household Equity	E_1
Deposits Bank 2	$D_{12} - ca/2$		
Banknotes	B_1		
Real Assets	$E_1 - D_1 - D_{12} - B_1 - cu$		
Corporate 1			
Real assets	$D_1 + D_{21} + B_1$	Loans Bank1	$D_1 + D_{21} + B_1$
Bank 1			
Loans corporate1	$D_1 + D_{21} + B_1$	Deposits Hh 1	$D_1 + cu + ca/2$
		Deposits Hh 2	$D_{21} + ca/2$
Deposits NCB 1	$\text{Max}(0, -(B_1 - ca - cu))$	Credit NCB 1	$\text{Max}(0, (B_1 - ca - cu))$
National Central Bank 1 (NCB1)			
Credit Bank 1	$\text{Max}(0, (B_1 - ca - cu))$	Banknotes issued	B_1
T2 claims	$\text{Max}(0, ca + cu)$	Deposits bank 1	$\text{Max}(0, -(B1 - ca - cu))$
		T2 liabilities	$\text{Max}(0, -(ca + cu))$
Household 2			
Deposits Bank 2	$D_2 - ca/2 - cu$	Household Equity	E_2
Deposits Bank 1	$D_{21} + ca/2$		
Banknotes	B_2		
Real Assets	$E_2 - D_2 - D_{21} - B_2 + cu$		
Corporate 2			
Real assets	$D_2 + B_2$	Loans Bank 2	$D_2 + B_2$
Bank 2			
Loans corporate 2	$D_2 + D_{12} + B_2$	Deposit household 2	$D_2 - ca/2 - cu$
		Deposit household 1	$D_{12} - ca/2$
Deposit NCB 2	$\text{Max}(0, -(B_2 + ca + cu))$	Credit NCB 2	$\text{Max}(0, B_2 + ca + cu)$
National Central Bank 2 (NCB2)			
Credit to bank 1	$\text{Max}(0, B2 + ca + cu)$	Banknotes	B2
T2 claims	$\text{max}(0, -(ca + cu))$	Deposits bank 2	$\text{Max}(0, -(B2 + ca + cu))$
		T2 liabilities	$\text{Max}(0, (ca + cu))$
ECB			
T2 claims	$ca + cu$	T2 liabilities	$ca + cu$

Table 7.14 Eurosystem consolidated balance sheet

Eurosystem			
Eurosystem credit	$B_1 + B_2 + \text{max}(0, -(B_1 - ca - cu)) + \text{max}(0, -(B_2 + ca + cu))$	Banknotes	$B_1 + B_2$
		Deposits of banks	$\text{max}(0, -(B_1 - ca - cu)) + \text{max}(0, -(B_2 + ca + cu))$

7.3.4 Foreign Reserves

Although in principle the time of universal fixed exchange rates ended in the 1970s, many central banks continue to manage their exchange rate by letting their foreign reserves fluctuate accordingly. From 2000 to 2013 foreign reserves increased in an unprecedented manner, with China overtaking Japan as the largest holder of official foreign reserves in 2005 and reaching in 2013 close to 4 trillion USD equivalent of foreign reserves. During the same period, the Eurosystem was also surpassed by a number of emerging economies. Switzerland is unique in terms of being a small advanced economy and nevertheless ranking third—reflecting its combat against appreciation in view of safe-haven flows in the context of the euro area sovereign debt crisis. How can one explain this rapid build-up of unprecedented foreign reserves in the years until 2014? IMF (2011, 9) reports the following most frequent answers to the question about the reasons for holding (high) reserves: 80%: "Buffer for liquidity needs"; 60%: "Smoothing of exchange rate volatility"; 30%: "Management of exchange rate level". One might speculate that the frequency of answers also reflect how potentially controversial different explanations are. In reality, the management of the exchange rate level, i.e. preventing appreciation, has likely been the most important reason for the very steep trend of reserve accumulation, which goes beyond needed liquidity buffers.

What do foreign reserves consist of?
As the IMF annual report for 2014 (appendix I, page 1) reveals, foreign reserves at the end of 2014 consisted to a very large extent of **foreign currency** (86%), while **gold** came second (10%) and **IMF related reserves** (including SDRs) were third (4%). The **currency composition of foreign reserves** at the end of 2013 was (according to the IMF annual report for 2014) dominated by USD holdings (66%), followed by the EUR (24%) and the GBP (6%). **In which form were the foreign exchange reserves held?** McCauley and Fung 2003 (see also Borio et al. 2008) report that in the year 2000, 75% were held in the form of securities, and 25% in the form of deposits with banks and money market instruments. The majority of deposits is offshore, i.e. not deposits in USD with US banks, but with banks located in other jurisdictions (mainly London, or other global foreign exchange centres).

Foreign reserves may be built-up in particular in four ways: (i) Accumulated balance of payment surpluses under a fixed exchange rate system (or managed float). (ii) Creation of mutual foreign reserves through a currency swap, possibly including the involvement of an international organisation like the IMF. This neither requires Balance of Payment surpluses, nor will it put pressure on the exchange rate. (iii) Obtaining the foreign claims without counter-flow through e.g. a war indemnity, or a grant. (iv) Acquiring reserves in the market without corresponding balance of payment surpluses, assuming variable exchange rates. Banks will, with some elasticity, finance this, i.e. will accept the corresponding capital account flows. However, the exchange rate of the country accumulating foreign reserves in this way will likely decline to some extent. Eventually balance of payment surpluses may then kick in as a consequence of the devaluation.