TUTORIAL – U. Bindseil, TU Berlin SS 2019 **[updated version as of 13 July 2019. As discussed in the last lecture block, this version (i) amends few of the exercises which were ambiguous (notably Q16; it beautifies the presentation of solutions (notably for Q36) and (iii) it strikes out few questions that will not be relevant)]**

Financial Accounts, central banks and money creation

Q1 Consider the following system of financial accounts.

A. What monetary policy implementation technique does the central bank seem to apply?

B. How are the following events reflected in this system of financial accounts? You may want to distinguish immediate effects and possible subsequent effects reflecting the reactions of economic actors (in particular of the central bank) to the initial event.

   a. The central bank buys new headquarters for 1

   b. Due to progress in electronic payment technologies, banknote demand shrinks by 80%

   c. Because of a financial panic, the households substitute all bank deposits with banknotes.

   d. The CB decides to substitute all its securities holdings with reverse open market operations (as it decided to change its monetary policy implementation technique)

   e. The real assets of the corporate sector lose 50% of their value due to an earthquake

Households			
Real assets	60	Equity	100
Banknotes	10		
Deposits banks	10		
Bank equity	10		
Corporate equity	2		
Corporate bond	1		
Government bond	7		
Total assets	100	Total liabilities	100
Government			
Real assets	20	Debt	20
Total assets	20	Total liabilities	20
Corporations			
Real assets	20	Equity	2
		Debt	18
Total assets	20	Total liabilities	20
Banks			
Corporate bonds	7	Deposits of HH	10
Government bonds	8	Equity	10
Deposits with CB	5	Central bank credit	0
CB Deposit facility	0		
Total assets	20	Total liabilities	20
Central bank			
Corporate bonds	10	Banknotes	10
Government bonds	5	Deposits of banks (RR=0)	5
Central bank credit	0	CB Deposit facility	0
Total assets	15	Total liabilities	15

Q2 Consider the following balance sheet of the Reichsbank of 1900 and 1922, Deutsche Bundesbank as of December 1998, and of the Bank of Latvia as of December 2001

Reichsbank, average weekly financial statements in 1900, in billion RM

Gold and silver	817	Banknotes	1139
Banknotes of other issuing banks	14	Other liabilities (net)	150
Government bills	23		
Discounted trade bills	800		
Lombard lending	80	Current accounts of banks	513
Residual	68		
Total assets	1802	Total liabilities	1802

Reichsbank, end 1922, in billion RM

Net foreign assets incl. gold	1	Banknotes	1280
Government bills	1184	Other liabilities (net)	36
Discounted trade bills	660		
Lombard lending	1	Current accounts of banks	530
Total assets	1846	Total liabilities	1846

Bundesbank, end 1998, in billion DM

Net foreign assets incl. gold	112	Banknotes	260
		Other liabilities (net)	33
Credit operations with domestic banks	235	CB bills issued	5
		Current accounts of banks	49
Total assets	347	Total liabilities	347

Bank of Latvia, Dec 2001, in million Lats

Net foreign assets incl. gold	563	Banknotes	484
		Other liabilities (net)	55
Credit operations with domestic banks	39	Current accounts of banks	63
Total assets	602	Total liabilities	602

(a) For each of these central bank balance sheets, please provide:
   (i) The level of total autonomous factors;
   (ii) the total liquidity provision through monetary policy operations;
   (iii) the original liquidity deficit of the banking system;
   (iv) the liquidity deficit after outright monetary policy operations;

(b) What do you find striking with regard to each the four balance sheet structures?

Q2b: Illustrate the concepts of "100% reserve money", "plain money" and "central bank digital currency" in a financial account system, and in particular how these innovations would change today's structure of the financial system. How do you assess these different proposals?

Q2c: What is the difference between "illiquidity" and "specificity" of an asset? Provide examples for both.

The short-term interest rate as the operational target of monetary policy

Q3 What are desirable properties of an operational target of monetary policy?

Q4 Verify that short term interbank interest rates are a suitable operational target of monetary policy. Why is the overnight interest rate preferable to say the three months interest rate?

Q5 Derive the "non-accelerating" nominal interest rate from an arbitrage relationship between the four goods "money today" and "wheat today", "money tomorrow" and "wheat tomorrow". What are important simplifying assumptions of this arbitrage logic, that require to be refined when applying it in central bank practice?

Basic techniques of controlling short term interest rates

Q6 What is the basic idea behind the "fundamental equation" of controlling the overnight interest rate in a corridor system? What explicit or implicit assumptions does this equation depend on?

Q7 A corridor system with two facilities that are both liquidity providing or absorbing. The classical approach of the Reichsbank up to at least 1914 consisted to steer short term interbank rates in a corridor set by two liquidity providing standing facilities: a discount facility (in which banks could submit trade bills satisfying certain criteria) and a Lombard facility, priced at 100 basis points above the discount facility, which provided collateralised lending against a very broad collateral set. In 2015, the Fed announced a system after lifting off from the zero lower bound which Potter (Money Markets and Monetary Policy Normalization, April 15, 2015, speech by Simon Potter, Executive Vice President, FRBNY, "Remarks at the Money Marketeers of New York University", New York City) describes as follows:

"Specifically, the Federal Reserve intends to target a range for the federal funds rate that is 25 basis points wide, and to set the IOER [Interest on excess reserves] rate and the offering rate associated with an ON RRP [overnight reverse repo] facility equal to the top and bottom of the target range, respectively. It intends to allow aggregate capacity of the ON RRP facility to be temporarily elevated to support policy implementation. It can also adjust the IOER rate and parameters of the ON RRP facility, and to use other tools such as term operations, as necessary for appropriate monetary control….The Federal Reserve intends to use adjustments to the IOER rate—a rate it directly administers—as the main tool for moving the fed funds rate and other short-term interest rates into its target range…. The IOER rate is essentially the rate of return earned by a bank on a riskless overnight deposit held at the Fed, thus representing the opportunity cost to a bank of using its funds in an alternative manner, such as making a loan or purchasing a security. In principle, no bank would want to deploy its funds in a way that earned less than what can be earned from its balances maintained at the Fed. Even though banks are the only institutions eligible to earn IOER, arbitrage should lift market rates up to the level of the IOER rate. In practice, however, with the large levels of excess reserves in the system, certain institutional aspects of money markets—including bank-only access to IOER, credit limits imposed by cash lenders and other impediments to market competition, and the costs of balance sheet expansion associated with arbitrage activity—appear to create frictions that have made IOER act more like a magnet that pulls up short-term interest rates than a firm floor beneath them. …The FOMC will supplement the magnetic pull of changes in the IOER rate with an ON RRP facility to help control the federal funds rate. Under the facility, the Desk will offer general collateral reverse repurchase agreements at a specified offering rate to a broad set of counterparties—including several types of nonbank financial institutions that are significant lenders in U.S. money markets."

(a) How do such techniques generally insure that the interbank rates are kept with a corridor of same-sided standing facilities?

(b) Do you believe that this technique allows for a very precise control of overnight rates?

Collateral

Q8 Why should a central bank refrain from providing uncollateralized credit?

Q9 What are desirable properties of central bank collateral (and why)? What are the differences to the desirable properties of collateral for interbank repo operations?

Q10 Under what circumstances can losses arise even in collateralised lending? What risk control measures can be designed to address this? Against what can these protect, and against what can they not?

Q11 Why would assets with lower credit quality tend to deserve higher haircuts, even after adjusting valuation? Why would assets with longer duration deserve higher haircuts?

The nature of a liquidity crisis

~~**Q12** Assume the following balance sheet of an indebted company. (You can use excel to approximate some of the answers).~~

~~Company x~~			
~~Assets~~	~~100+e~~	~~Senior debt~~ ~~Equity~~	~~80 –max(0,e-20)~~ ~~20+min(e,20)~~

~~(a) What is the probability of default for senior debt, assuming that e is normally distributed and has an expected value of -5% and a standard deviation of (i) 5%, (ii) 15%, (iii) 25%? Assume that default occurs when equity is negative.~~

~~(b) Assuming that investors are risk neutral and that the required remuneration rate for risk free assets (established by the central bank) is 4%, what is the remuneration rate of debt for the three alternative values of the standard deviation of e which compensates for the expected losses?~~

~~(c) Assume now that there is a one off realised shock of e=-10. In the next period, asset value uncertainty is again an identically independently distributed e being N(-5, σ^2). What is now the remuneration rate of debt that compensates for expected losses, again depending on the standard deviation of asset value shocks?~~

~~(d) In how far does the profitability of the corporate depend on asset price volatility (even with risk neutral investors)?~~

Q13 Assume the lemons market model of section 5.3 and that before the outbreak of a financial crisis, the following parameter values apply: δ =0.4, p=0.9, and V_G=1.2.

(a) Will an active credit market prevail under such circumstances?

(b) On the basis of the three parameters, explain why a financial crisis can lead to a break-down of credit markets. Provide illustrations from the current financial crisis.

(c) Starting from the values above and varying each parameter individually: what are the critical values of each of the parameters?

Q14 Why would you expect haircuts to increase in a financial crisis? What is the effect on leverage? When could some collateral type become ineligible in interbank repos?

Q15 Why do bid ask spreads posted by market makers typically increase in a financial crisis?

Q16 Assume the following bank balance sheet. [note that parts of this have been modified]

Assets		Liabilities	
Assets	D+1	Short term funding from Investor 1 Short term funding from Investor 2 Equity	D/2 D/2 1

Assume that a share Lambda, Λ ($0<\Lambda<1$) of assets is fully liquid (i.e. it can be sold without any fire sale losses). Assume also that the other assets, i.e. a share $(1-\Lambda)$ of assets, are totally illiquid, i.e. if one would try to fire sell them, one would not generate a cent of liquidity, but only generate losses. Assume also that the central bank applies a homogeneous haircut h on all assets, and that all assets are eligible as central bank collateral.

(a) Is funding stability ensured if Λ=0.4, h = 0.8, and D=2?

(b) What is the maximum sustainable amount of short-term funding for Λ=0.2, h = 0.8?
(c) Assume now that in a liquidity crisis, asset liquidity deteriorates and Λ=0. What would the central bank need to do to maintain a unique no-run equilibrium (starting from h=0.8 and D=2)?
(d) How can central banks justify that they continue to lend, or even lower haircuts or expand collateral eligibility in a financial crisis, when all other lenders become more restrictive?

Q17 What measures can central banks take to address the risks of the economy falling into a deflationary trap in a financial crisis? (a) ex ante; (b) ex post

Q18 Assume the following representative bank balance sheet. In normal (crisis) times, fire sale discounts of credit claims is 100% (100%) and of corporate bonds 25% (50%). Central bank haircuts are set in normal times to be 100% on credit claims (i.e. credit claims are not eligible central bank collateral) and 50% on corporate bonds.

(a) What is the maximum sustainable level of d in normal times (assuming that the banks are myopic and do not anticipate crisis times)?

(b) Assume that banks indeed chose to maximise their funding through short term deposits. How would the central bank need to adjust its collateral framework in crisis times to preserve a stable funding structure of banks and to prevent bank runs?

Assets		Liabilities	
Credit claims	(d+2)/2	Short term funding from Investor 1	d/2
Corporate bonds	(d+2)/2	Short term funding from Investor 2	d/2
		Long term debt	1
		Equity	1

Q19 on 15 October 2008, the ECB announced that it would "lower the credit threshold for marketable and non-marketable assets from A- to BBB-, with the exception of asset-backed securities (ABS), and impose a haircut add-on of 5% on all assets rated BBB-". How would you explain these decisions?

Q20 Consider briefly **another example in which now three types of assets are distinguished**: those which are always liquid (share $\Lambda \geq 0$), those which are mostly liquid, but may become non-liquid in case of a crisis (share $\Pi \geq 0$) and those which are never liquid (rest), with $\Pi+\Lambda \leq 1$. Recall that liquid assets can be sold at zero losses, while illiquid ones cannot be sold at all. The central bank applies a homogeneous haircut h on all assets. Assume now also a somewhat different notation of the liability structure, as shown below. We assume absence of long term debt (which here simply reflects that equity and debt are the same in this simple setting).

A bank threatened by a bank run

Bank A			
Liquid assets	$\Lambda(2+e)$	Depositor 1	1
Mostly liquid assets	$\Pi(2+e)$	Depositor 2	1
Non-liquid assets	$(1-\Pi-\Lambda)(2+e)$	Central bank credit	0
		Equity	e

a) What is in good time the liquidity the bank can generate? What is the condition for a single no-run equilibrium? What is the minimal amount of equity to achieve this?
b) Assume now that initially: (i) h = 0.8, similar to the effective average haircut that the ECB applies; (ii) Λ=20%; (iii) Π=20%. Assume that we are in good times and that the bank is myopic, i.e. it goes for the currently cheapest stable funding structure. What equity will it hold?

c) Assume now that the mood in the market turns bad and the mostly liquid assets stop being liquid. What will happen? Distinguish the cases that a run materializes or not. If it does not, what should the bank do?

d) assume that the equity funding premia (relative to short term deposits) is 10%. What is the increase of average bank funding costs due to the asset liquidity deterioration? How can the central bank react?

Q21 In particular German economists have warned repeatedly that the crisis response of the ECB would be inflationary. Examples (I wish to thank Adalbert Winkler for collecting these quotes): J. Starbatty, 22 April 2010: „I think that the inflation rate will increase strongly: to above 5%. All evidence shows that countries that have high debt levels tend to inflation"; H-O Henkel, 25 Mai 2010: "An increase of inflation is in front of the door"; S. Homburg, 18 December 2011, answering to a journalist's question "Is a higher inflation rate unavoidable in the future?" S. Homburg: "Yes. So far, the ECB has purchases sovereign bonds while at the same time absorbing the money supply elsewhere. But when Italy gets stressed, then the ECB will no longer be able to sterilize the bond purchases which would then be necessary. And if she is no longer able to do so, then unavoidably the monetary base, the quantity of money, and eventually prices will increase. Currently the inflation rate is 2.8%, so clearly above the target level of 2%. In principle the ECB would have to tighten its interest rate policy already now". J. Stark, 23 March 2012: "History has shown that any particularly strong increase of central bank balance sheets has lead in the medium term to inflation" J. Starbatty, 10 September 2012: "In the long term there is only one reason for inflation: financing of fiscal deficits by central banks. Current recessionary tendencies may still hide that. But that this creates inflation is as certain as the Amen in the church". MJM Neumann, 6 November 2012: expects a "creeping inflation rate of up to 6%". R. Vaubel, 11 October 2012: "I expect that we will get in coming years inflation rates of up to 5% and more. This is because the monetary base has been increased since 2010 by more than 50%. I do not believe that the ECB will be able to turn this back in time".

At least so far these economists were wrong, as inflation rates in the euro area trended down and both headline and core inflation reached new lows in early 2015 (core at 0.6%, headline negative).

(a) What may explain that the inflation fears of these economists have not (yet) materialized?
(b) How would you rank their different arguments in terms of merits?
(c) Could they still be right in the long term with their inflation worries?

Open market operations and standing facilities in a financial crisis

Q22 Besides improving collateral availability, how can central banks adjust their credit operations in financial crises to make them more convenient?

Q23 What purposes can outright purchase programmes pursue in a financial crisis?

Q24 What are suitable operational targets for outright purchase programmes?

Q25 How would you measure the success of outright purchase programmes? Distinguish between operational, intermediate, and ultimate targets. What are the main difficulties?

~~**Q26** Should the success of outright purchase programme depend on whether the securities purchased come from the holdings of banks or from of the holdings of households? What if banks are subject to leveraging constraints? Draw the financial accounts of the economy and show what difference it makes where the securities come from.~~

~~**Q27** Various LSAPs aimed at overcoming low inflation in the context of the ZLB (e.g. the Government bond purchase programmes of the FED, BOE, BoJ and ECB). What effects on yields do you expect~~

~~from such programmes? Distinguish between a "stock", a "flow", and a fair value effect, and elaborate also on the time path of interest rates that you expect to materialise.~~

The lender of last resort (LOLR) role of the central bank

Q28 What are the fundamental reasons for central banks to act as lender of last resort?

Q29 Explain why the LOLR role is also to some extent effective under central bank inertia, i.e. without the CB taking active LOLR measures. What determines the limits of this built-in LOLR?

Q30 What are key "active" LOLR measures?

Q31 What are the distinct features of ELA, compared with normal central bank credit operations? What are generally accepted central bank principles applied to ELA?

~~**Q32** How would you assess the merits of "constructive ambiguity" regarding the provision of ELA?~~

Q33 On 14 September 2007, Northern Rock requested liquidity support facility from the Bank of England. According to the Financial Times of that day: "It will lift the uncertainty that has been hanging over Northern Rock's future for much of the past month because it could not access the wholesale funding upon which it is heavily dependent. It will also allow Northern Rock to reassure thousands of customers that their deposits are secure." However, actually these announcements triggered a bank run with people queuing in front of branches to withdraw cash, i.e. the announcement to provide ELA contributed to worsen a panic, instead of stabilising the situation. How can this be explained? Under what scenario is it a rational reaction?

Q34 Bagehot claimed in 1873 that "only the brave plan [of the Bank of England] is the safe plan". Why would this be the case, and under what circumstances?

Q35 On 5 Mach 2009, the ECB issued a press release on its end 2008 Annual accounts and a note on Monetary Policy Operations in 2008, in, which also explained the following. "In autumn 2008, five counterparties defaulted on refinancing operations undertaken by the Eurosystem, namely Lehman Brothers Bankhaus AG, three subsidiaries of Icelandic banks, and Indover NL. The total nominal value of the Eurosystem's claims on these credit institutions amounted to some €10.3 billion at end-2008. The monetary policy operations in question were executed on behalf of the Eurosystem by three NCBs, namely the Deutsche Bundesbank, the Banque centrale du Luxembourg and de Nederlandsche Bank. The Governing Council has confirmed that the monetary policy operations in question were carried out by these NCBs in full compliance with the Eurosystem's rules and procedures, and that these NCBs had taken all the necessary precautions, in full consultation with the ECB and the other NCBs, to maximise the recovery of funds from the collateral held. The counterparties in question submitted eligible collateral in compliance with the Eurosystem's rules and procedures. This collateral, which mainly consisted of asset-backed securities (ABSs), is of limited liquidity under the present exceptional market conditions and some of the ABSs need to be restructured in order to allow for efficient recovery. Under current market conditions, it is difficult to assess when the eventual resolution will be achieved by the Eurosystem. The Governing Council decided that any shortfall, if it were to materialise, should eventually be shared in full by the Eurosystem NCBs in accordance with Article 32.4 of the Statute of the ESCB, in proportion to the prevailing ECB capital key shares of these NCBs in 2008. The Governing Council also decided, as a matter of prudence, that the NCBs should establish their respective shares of an appropriate total provision in their annual accounts for 2008 as a buffer against risks arising from the monetary policy operations which were conducted with the counterparties mentioned above. The size of the total provision will amount to € 5.7 billion, and it is already accounted for in the net result figures stated above. The level of the provision will be reviewed annually pending the eventual disposal of the collateral and in line with the prospect of recovery."

On 20 February 2013, the Bundesbank issued a press release on the same subject: "Since autumn 2008 the Bundesbank has gradually resolved the pledged securities, in some cases having to restructure them. In 2012, Diversity and Excalibur, the two largest positions in the LBB collateral

portfolio, were sold, amongst other assets. The process of winding down the pledged securities is now complete. The situation after more than four years of resolving collateral is as follows. With proceeds from sales as well as interest and redemption payments totalling €7.4 billion, a considerable percentage of the original claims against LBB have been covered. After subtracting these €7.4 billion from the original claim of €8.5 billion, a difference of €1.1 billion is left over. After accounting for interest claims and costs totalling €0.8 billion, a residual claim of €1.9 billion is left over and will go into the German LBB bankruptcy proceedings. In addition, the Bundesbank is a creditor in the US LBHI bankruptcy proceedings; it has a nominal guaranteed claim of $3.5 billion against LBHI. Payments are expected from both bankruptcy proceedings. For this reason, the Eurosystem's provisions for counterparties in default, calculated according to the principle of prudence, and of which LBB is the largest position, were able to be reduced from €5.6 billion at end-2008 to €0.3 billion at end-2012." What are the ley lessons from this episode for central bank collateral frameworks?

The international lender of last resort

Q36 Consider the case of a monetary area such as the euro area, with a system of national central banks (NCBs) and the ECB. The following accounts represent this case, whereby only two NCBs are distinguished (A and B)

a) Comment on these initial financial accounts. How could one explain the main asymmetries between the two countries?
b) Assume now that doubts arise on the solvency of the banking system of one country (or people realise that the deposit insurance in one country is less good than in other countries etc.). Represent the following five shocks in the system of financial accounts:
   i. households shift deposits of 5 from A to B banks
   ii. household shifts deposits from B to A banks amounting to 32
   iii. decline on interbank -lending to A banks to zero
   iv. households withdraw banknotes from A banks for 6
   v. NCB A injects reserves into the A banks by purchases of corporate claims of 4
c) How would you represent a current account transaction in this system of financial accounts (hint: you need to split the household account into an A country and a B country household)? Assume a surplus of country B of 10.

Euro area households

Deposits with A banks	10	Equity	100
Deposits with B banks	40		
Banknotes	10		
Real assets	40		

A country banking system

Loans	20	HH Deposits	10
Deposits with NCB A (RR)	5	Eurosystem refinancing	5
		Net interbank liability	10

B country banking system

Loans	40	HH Deposits	40
Net interbank claims	10	Eurosystem refinancing	20
Deposits with NCB B (RR)	10		

NCB A

Eurosystem credit	5	Banknotes	3
Loans to A-corporates	4	Deposits of banks (RR=5)	5
Net intra –Eurosystem claims	3		

NCB B

Eurosystem credit	20	Banknotes	7
		Current accounts of banks (RR=10)	10
		Net intra – Eurosystem liabilities	3

Q37 Consider the case of a monetary area such as the euro area, with a system of two national central banks (but no ECB). The accounts below represent this case, with two stylised countries "Greece" and "Germany" which are initially identical. Assume that this represents the situation at end of 2009.

"Greek" households

Deposits with Greek banks	10	Equity	50
Deposits with German banks	10		
Banknotes	5		
Real assets	25		

"German" households

Deposits with Greek banks	10	Equity	50
Deposits with German banks	10		
Banknotes	5		
Real assets	25		

Euro area corporate sector

Real assets	50	Real assets	50

"Greek" banking system

Loans	25	HH Deposits	20
Deposits with NCB A (RR=5)	5	Eurosystem refinancing	10

"German" banking system

Loans	25	HH Deposits	20
Deposits with NCB B (RR=5)	5	Eurosystem refinancing	10

"Bank of Greece"

Eurosystem credit	10	Banknotes	5
		Deposits of banks	5
Intra –Eurosystem claims	0	Intra –Eurosystem liabilities	0

"Deutsche Bundesbank"

Eurosystem credit	10	Banknotes	5
		Deposits of banks	5
Intra –Eurosystem claims	0	Intra – Eurosystem liabilities	

"Eurosystem"

Eurosystem credit	20	Banknotes	10
		Deposits of banks	10

(a) Assume now that Greece has in 2010 a current account deficit of 2 and a capital account deficit of 4. The current account deficit results from real asset transactions between households (whereby the Greek household uses his account with the Greek bank to pay for the net import of real assets), while the capital account deficit results from deposit transfers of which one half is done by the Greek, and one half by the German households (i.e. each household transfers 2 deposit units from one bank account to the other). How do the accounts look like at end 2010?

(b) Assume that the central bank accepts Loans of banks to corporates as collateral but imposes a haircut of h. What is the critical level of the haircut h at which the flows above become constrained by the collateral scarcity of the Greek banking system?

(c) Assume that after 2010, the same capital and current account flows continue. When will the consolidated Eurosystem balance sheet start to lengthen (i.e. when will the Eurosystem start to do "absolute" central bank intermediation, instead of only "relative" one)? How does the BBK balance sheet look like on 31 December 2011.

Q38 Some observers have criticised that the TARGET2 system (which is the cross border payment system in the euro area) and the associated creation of Intra-Eurosystem claims and liabilities (Target2 balances) is problematic as it undermines "hard" budget constraints. The conclusion is drawn by these observers that the intra-Eurosystem claims should be capped (i.e. a maximum limit should be imposed). What international monetary framework would apply to the euro area after such a change? How do you assess this proposal?

Solutions

Solution to Q1 Consider the following system of financial accounts.

A. **What monetary policy implementation technique does the central bank seem to apply? The** central bank has created excess liquidity in the banking system through outright purchases of securities that exceed the banks' liquidity needs. Therefore the overnight interest rate in the interbank market will be equal to the rate of remuneration of excess reserves, It may be remarked that the banks do not use the deposit facility. This suggests that the deposit facility may be subject to an even lower remuneration than the remuneration of excess reserves (maybe excess reserves have a remuneration of 0 and the deposit facility is subject to a – 10 basis points remuneration.

B. **How are the following events reflected in this system of financial accounts?** Distinguish immediate effects and subsequent effects reflecting reactions of economic subjects (e.g. the central bank) to the initial event.

a. The central bank buys new headquarters for 1. We show this transaction in two steps: first the part where the corporate obtains a cash payment from the central bank (in the form of a deposit with its bank); second the decision of the corporate to issue less debt at the next occasion (as the corporate has no interest to have excess cash while having to pay interest for the corresponding debt amount).

b. Due to progress in electronic payment technologies, banknote demand shrinks by 80%

c. Because of a financial panic, the households substitute all bank deposits with banknotes.

Households			
Real assets	60	Equity	100
Banknotes	10 - 8 + 18		
Deposits banks	10 + 8 - 18		
Bank equity	10		
Corporate equity	2		
Corporate bond	1		
Government bond	7		
Government			
Real assets	20	Debt	20
Corporations			
Real assets	20 - 1	Equity	2
Cash with bank	1-1	Debt	18 - 1
Banks			
Corporate bonds	7 -1	Deposits of HH	10 +8-18
Government bonds	8	Deposit from corporate	1-1
Deposits with CB	5 +1 + 8 -14	Equity	10
CB Deposit facility	0	Central bank credit	0 +4
Central bank			
Real assets	1	Banknotes	10 -8 + 18
Corporate bonds	10	Deposits of banks (RR=0)	5 +1+8 - 14
Government bonds	5	CB Deposit facility	0
Central bank credit	0 + 4		

d. **The CB decides to substitute all its securities holdings with reverse open market operations (as it decided to change its monetary policy implementation technique).** We need to take an assumption on who purchases the securities that the central bank no longer wants to hold. We assume that the banks are willing to do so, at least initially (maybe because the central bank is ready to sell the securities at any price). Moreover, probably the central bank will not be able to maintain the amount of excess reserves of 5, because it is not obvious to force banks to take an amount of credit from the central bank that creates excess reserves. We therefore accept that only 10 out of 15 of the former outright securities are substituted by credit operations, and the excess reserves shrink from 5 to 0.

Households			
Real assets	60	Equity	100
Banknotes	10		
Deposits banks	10		
Bank equity	10		
Corporate equity	2		
Corporate bond	1		
Government bond	7		
Government			
Real assets	20	Debt	20
Corporations			
Real assets	20	Equity	2
		Debt	18
Banks			
Corporate bonds	7 + 10	Deposits of HH	10
Government bonds	8 + 5	Equity	10
Deposits with CB	5 - 5	Central bank credit	0 + 10
CB Deposit facility	0		
Central bank			
Corporate bonds	10 – 10	Banknotes	10
Government bonds	5 - 5	Deposits of banks (RR=0)	5 - 5
Central bank credit	0 + 10	CB Deposit facility	0

e. **Corporations see their asset value being reduced from 20 to 10, and see their equity being wiped out and also the value of debt has to decline from 18 to 10 (write-offs applied to the holders of these securities).** For banks that means that corporate bonds decline from 7 to 7*10/18 = 3.89, i.e. by 3.11. Their equity declines accordingly from 10 to 6.89. The central banks' corporate bonds decline from 10 to 10*10/18 = 5.56 and CB equity becomes negative (having been zero before), namely an asset side equity of 4.44. Finally, also the household suffers a shrinkage of corporate bond values by a factor 10/18 (i.e. by 0.445 to 0.555) on its corporate bonds and experiences the same drop of its equity. Moreover, the households has large losses on corporate and bank equity (as he is the only holder of this equity). In fact the only loss that does not end up directly with the household is the central bank loss. This will however end later on with it, in the form of higher taxes to compensate for the absence of seignorage disbursements to the government for some years. The financial accounts look as follows after the changes.

Households			
Real assets	60	Equity	100 **-2 -3.11 -0.445** -4.44
Banknotes	10		
Deposits banks	10 -4.44		
Bank equity	10 **- 3.11**		
Corporate equity	2 **- 2**		
Corporate bond	1 **- 0.445**		
Government bond	7		
Corporations			
Real assets	20 **– 10**	Equity	2 **- 2**
		Debt	18 **- 8**
Banks			
Corporate bonds	7 **- 3.11**	Deposits of HH	10 -4.44
Government bonds	8	Equity	10 **- 3.11**
Deposits with CB	5 -4.44	Central bank credit	0
CB Deposit facility	0		
Central bank			
Corporate bonds	10 **-4.44**	Banknotes	10
Government bonds	5	Deposits of banks (RR=0)	5-4.44
Central bank credit	0	CB Deposit facility	0
Equity gap	**4.44 -4.44**		

Solution to Q2

(a) The definitions of the various CB balance sheet concepts can be found in Chapter 2. In short:

(i) The level of total autonomous factors = total net sum of all balance sheet items that are not under the control of the monetary policy function, i.e. all items except monetary policy items and sight deposits of domestic banks with the central bank; netted typically on the liability side of the balance sheet;

(ii) the total liquidity provision through monetary policy operations = the (net asset) sum of monetary policy operations, i.e. both outright and reverse;

(iii) the original liquidity deficit of the banking system = autonomous factors + reserve requirements = liquidity that needs to be provided through MPI including outright operations; In historical central bank balance sheets, one should also account for a large demand for working balances by banks, which one may regard as a component of the liquidity deficit that needs to be satisfied through monetary policy operations.

(iv) the liquidity deficit post outright monetary policy operations = liquidity needs that need to be covered by central bank credit operations, i.e. after outright monetary policy operations = AF + RR – outright MPOs;

(v) the "leanness" of the balance sheet = total length of BS / banknotes

Be aware that assigning certain balance sheet items to either "autonomous factors" or "monetary policy" is not necessarily trivial. For example, "government bonds" can reflect (i) an investment portfolio; (ii) a facility granted to the Government; (iii) a monetary policy portfolio. In the first two cases it would be classified as autonomous factor, in the last case obviously as monetary policy item. A classification can normally be achieved by reading in e.g. the annual report of the central bank its further explanations. Below we solved these ambiguous cases in one way or the other, as it can be seen in the calculus provided within the matrix. Another issue is that in principle one would need to know reserve requirements (which itself is not a balance sheet item) to calculate the liquidity deficit. Again ideally one can find out the level of reserve requirements from publications of central banks.

The following table provides the results for the five central banks and the five measures:

Measure → Central bank ↓	Total autonomous factors	Total liquidity provision through MPOs	Original liquidity deficit	Liquidity deficit post outright operations	Leanness of balance sheet
Reichsbank 1900	1139+150-817-14-23 -68 = 367	800+ 80 = 880	376 + 513 = 889*	889	1802/1139 = 1.58
Reichsbank 1922	1280 + 36 – 1 – 1184 = 131**	660+1 = 661	131+530 = 681	681	1846/1280 = 1.44
Bundesbank 1998	260+ 33—112 = 181	235 – 5 = 230	181 + 49 = 230***	230	347/260 = 1.33
Latvia, 2001	484+55-563 = -24	39	-24+63 = 39	39	602/484 = 1.24

* We interpret current accounts in the case of the Reichsbank as inevitable demand for reserve balances and therefore as a component of the liquidity deficit.

** We interpret the large outright holdings of T-bill as result of a funding facility offered to the Government by the Reichsbank – this implies the classification as autonomous factor

*** In these cases we interpret current account as being equal to reserve requirements

(b) Striking features of balance sheets

Reichsbank 1900: large size of voluntary reserves, suggesting a not so efficient payment system and/or a high number of small depositors with the central bank. Large precious metal reserves relative to the monetary base, and reliance on discounting as monetary policy tool.

Reichsbank 1922: depleted precious metal reserves, instead lots of Government bills of a presumably not so healthy sovereign, implying that in reality the Reichsbank may have had negative capital. Still reliance on discounting of trade bills as tool to provide liquidity.

Bundesbank 1998: Lean balance sheet, reliance on central bank credit operations for MPI.

Bank of Latvia, 2001: More foreign reserves than banknotes, compatible with currency board framework. Very small liquidity deficit.

Solution to Q12

(a) The formula to be applied is PD = 1-Φ((20-5)/σ), with Φ being the cumulative standard normal distribution. The resulting PDs are (i) 0.13%, (ii) 16%, and (iii) 27%.

(b) This depends on the damage done by the default and the implied "loss given default" (LGD). Assume that the LGD is 50%. The expected loss is then PD*LGD, and a risk neutral investor wants to be compensated exactly for this, i.e. the senior debt interest rate must be higher by 0.07%, 8%, 13.5%, respectively.

stdev(e)	5	15	25
P(Equity<0)	0,13%	15,87%	27,43%
Eloss for LGD = 0.5	0,07%	7,93%	13,71%

(c) Starting from a lower level of equity, PDs and Expected losses will obviously be higher.

stdev(e)	5	15	25
P(Equity<0)	15,9%	36,9%	42,1%
Eloss for LGD = 0.5	7,9%	18,5%	21,0%

(d) Volatility of asset prices could matter since the example above illustrated that a higher volatility means a higher PD, which means higher funding costs for senior debt. Of course, one could argue that higher volatility should be neutral when looking at equity and debt as a whole, as higher loss rates on debt are compensated by higher expected returns on equity. However, such full compensation does not apply if we assume, as suggested by the empirical corporate finance literature, that default of companies is costly in itself. Above, we reflected the wealth destructive effects of default in an LDG of 50%. Therefore, higher asset volatility eventually means higher total funding costs and lower profitability.

Solution to Q13

(a) It is shown in section 5.3 that in order to make no losses, the bank needs to demand an interest rate of: $i^*=(1- \delta)(1-p)/(\delta p)$. The condition for the existence of a credit market is that good companies (with good projects yielding returns of V_G on one dollar invested) can afford to pay this interest rate, i.e. $i^* < V_G-1$. For the given parameter values, one obtains $i^*=16\%$, i.e. lower than the return of good projects which is 20%. Therefore a credit market will exist.

(b) In a financial/economic crisis, the share of good projects, the quality of the monitoring technology, and the returns of good projects, all likely deteriorate and therefore may lead to a credit market breakdown. For example, any of the following three changes alone $\delta =0.3$, $p=0.8$, or $V_G =1.1$ is sufficient to lead to a credit market stand still.

(c) The exact critical values can be calculated with the equation above. For example, the critical value δ^* can be derived as follows: $(1- \delta^*)(1-0.9)/(\delta^*0.9)=0.2 \Rightarrow \delta^* = 0.357$

Solution to Q16

(a) The bank can generate in good times a total liquidity of L = Λ(D+1)+(1-h)(1- Λ)(D+1). It can be shown that the condition for a unique no run Nash equilibrium is that L is at least equal to the deposits of one of the two depositor, i.e. L ≥ D/2. The condition for financial stability in good times is thus: Λ(D+1)+(1-h)(1- Λ)(D+1) ≥ D/2. Inserting the proposed values into the equilibrium condition shows that indeed it is fulfilled:

0.4*(2+1)+(1-0.8)(1-0.4)(2+1) ≥ 2/2 ⇔ 1.2 + 0.2*0.6*3 ≥ 1 ⇔ 1.56 ≥ 1

*(b) The Bank can generate liquidity of (0.2+0.2*0.8)(D+1) = 0.36(D+1), which needs to exceed D/2. 0.36(D+1)≥0.5D ↔ 1 ≥ 0.14D ↔ 7.143 ≥ D*

(c) Now it is assumed that a crisis breaks out and Λ'=0. Therefore: L'= (1-h)(D+1). For h=0.8 and D=2, we obtain L'=0.6, which is below D/2, and therefore financial stability is lost – unless the central bank decreases its haircut sufficiently. We can calculate the maximum collateral haircut that restores funding stability as follows: L'= (1-h)(D+1) ≥ D/2 ⇔ (1-h)3 ≥ 1 ⇔ h ≤ 2/3

Solution to Q18 (a) What is the maximum sustainable level of d in normal times? Let us summarise first in a table the fire sale discounts and the haircuts on the two types of bank assets.

	Fire sale discounts in good times: f	Fire sale discounts in bad times: f'	Central bank collateral haircuts h
Credit claims	100%	100%	100%
Corporate bonds	25%	50%	50%

Consider two liquidity strategies of the bank, first to fire sell corporate bonds (strategy I) and second to pledge them (strategy II). Starting with strategy I, the condition that liquidity generated is at least equal to the deposits of one depositor means that: (3/4)(d+2)/2 ≥ d/2 ⇔ 3(d+2) ≥4d ⇔ 6 ≥ d

We also have to verify that with this strategy, fire sale losses to not exceed equity. If d=6, then deposits of one depositor are 3, and to generate liquidity of 3 the bank will incur fire sales losses of 3*0.25 = 0.75. This is below equity.

The alternative strategy (strategy 2), to pledge the corporate bonds, obviously allows to generate less liquidity as the liquidity condition is 0.5(d+2)/2 ≥ d/2 ⇔ 0.25d + 0.5 ≥ 0.5d ⇔ d ≤ 2, i.e. the maximum sustainable amount of deposits is only 2. Therefore, the answer to question (a) is 6.

(b) If haircuts are 50%, then the banks have no advantage in fire selling corporate bonds relative to borrowing from the central bank. Therefore, they will borrow from the central bank, but that under the prevailing haircut scheme allows only to sustain a level of deposits of 2, i.e. much less than the actual 6. Therefore, the only way to restore funding stability of banks is to lower the haircut on corporate bonds to 25%, implying that the deposits of 6 can exactly be supported.

Solution to Q20

Bank A			
Liquid assets	Λ(2+e)	Depositor 1	1
Mostly liquid assets	Π(2+e)	Depositor 2	1
Non-liquid assets	(1-Π-Λ)(2+e)	Central bank credit	0
		Equity	e [0.8]

a) What is in good time the liquidity the bank can generate? What is the condition for a single no-run equilibrium? What is the minimal amount of equity to achieve this?

Suppose for the time being that we are in "good" times in the sense that the mostly liquid assets are indeed fully liquid (and in fact no-one has in mind that they could turn illiquid). The bank can now generate a maximum liquidity in case of a run of L=(Λ+Π)(2+e) + (1-h)(1-Λ-Π)(2+e). It can be shown that a single no-run deposit equilibrium exists if (Λ+Π)(2+e)+(1-h)(1-Λ-Π)(2+e)≥1 and e≥0. The decision problem for the bank is: how much equity e is needed to sustain short term funding of 2, depending on Λ, Π and h? And, related, how high will the average funding costs be, depending on these variables? One can transform the equilibrium condition as follows:

$(\Lambda+\Pi)(2+e)+(1-h)(1-\Lambda-\Pi)(2+e)\geq 1$

$\Leftrightarrow (\Lambda+\Pi+(1-h)(1-\Lambda-\Pi))E + (\Lambda+\Pi)2 +(1-h)(1-\Lambda-\Pi)2 \geq 1$

$\Leftrightarrow e + 2 \geq 1/(\Lambda+\Pi+(1-h)(1-\Lambda-\Pi))$

$\Leftrightarrow e \geq 1/(1-h+h(\Lambda+\Pi)) - 2$

It is clear from this formula that the critical value $e^*= 1/(1-h+h(\Lambda+\Pi))-2$ increases with h and decreases with (Λ+Π).

b) Assume now that initially: (i) h = 0.8, similar to the effective average haircut that the ECB applies; (ii) Λ=20%; (iii) Π=20%. Assume that we are in good times and that the bank is myopic, i.e. it goes for the currently cheapest stable funding structure. What equity will it hold?

If the banks do not take into account that the mostly liquid assets may become illiquid one day, then the banks will not hold any equity and the effective funding costs of the bank are equal to the rate of remuneration of deposits, which we assumed to be equal to the policy rate. Indeed, without any equity, the liquidity L that the bank can generate is equal to (0.4*2+0.6*2*0.2)=1.04≥1 and hence sufficient to sustain a unique no-run equilibrium.

c) Assume now that the mood in the market turns bad and the mostly liquid assets stop being liquid. What will happen? Distinguish the cases that a run materializes or not. If it does not, what should the bank do?

If now, however a (non-anticipated) crisis breaks out and the mostly liquid assets stop being liquid, then L drops to L=(0.2*2+0.8*2*0.2)=0.72 < 1, and therefore, there is no longer a single no-run equilibrium, but there are now two equilibria, one characterized by a run and the default of the bank. Two cases can then distinguished: first, that immediately a run starts, and indeed the bank defaults, with all the serious consequences for the depositors (who face losses) and the real economy, which no longer obtains loans. Here we assume the favourable case that for some times no immediate bank run destroys the bank (i.e. the favourable of the two equilibria prevails). Still, in this case, the bank will have to adjust its funding structure in order to restore the uniqueness of the no-run equilibrium. The bank should certainly not do nothing and simply hope that the superior equilibrium continues to hold. The minimum equity holdings of the bank are now $e \geq 1/(1-h+h\Lambda) - 2 = 0.8$.

d) assume that the equity funding premia (relative to short term deposits) is 10%. What is the increase of average bank funding costs due to the asset liquidity deterioration? How can the central bank react?

The need to hold equity in the new environment leads to an increase of average funding costs of the bank by 28.6% of the equity funding spread. If this spread is 10%, then average funding costs of the bank increase by 2.8%. The bank lending rates to the real economy need in principle to increase by the same amount, which means a significant tightening of the effective stance of monetary policy. The central bank could neutralise this effect by reducing the average haircut to 60%, as then, once again, no equity would be needed to sustain the stable no-run equilibrium. If the central bank has not yet reached the zero lower bound, it could as an alternative, from the monetary policy perspective, lower its policy rate instead of changing haircuts. Once the zero-lower bound is reached, a compromise between the two conflicting targets is likely to be optimal. Acting also on the collateral side could be decisive to prevent a deflationary spiral. At the same time, it may create moral hazard if being anticipated. Also Diamond and Rajan (2012, 4) note this effect, as well as Chapman et al (2010,

4) who conclude that "if the central bank can commit not to repeat [it] in the future, a temporary surprise cut in the haircut can be welfare improving."

Solution to Q21

(a) These German economists may have overlooked that financing conditions for the euro area real economy were tight since the financial crisis and later on due to the euro area sovereign debt crisis. Moreover, fundamental economic and political uncertainty creeped in after the debt crisis spread to Spain and Italy in 2011. Also, banks were not only traumatized by their loss experiences of 2007-2012 and the recession of 2009 and therefore tended to restrict lending, but also a wave of new regulation to prevent a repeat of the 2007-2008 episode restricted banks in various ways and supported deleveraging. Finally, the structural reforms in program countries strengthened competition and lead to a positive supply side shock which tended to be dis-inflationary, and the fiscal austerity contributed a negative demand shock. In sum: financing conditions remained tight despite the significant and effective contributions of the central bank to ease them (which at least prevented even more tightening) while economic developments were subdue. This was not an inflationary environment at all and the ECB was right to worry about disinflation.

(b) That "countries with high debt levels tend to inflation" seems to have been invalidated as a general statement by the Japanese experience. The statements of S. Homburg and R. Vaubel which seem to focus on the monetary base and the money multiplier seem to rely on a reserve position doctrine view of the world that for the reasons indicated in chapter 3 we would reject. That "Financing of fiscal gaps by the central bank" always leads to high inflation seems to find little empirical support from the cases of the US and Bank of England, in which indeed massive purchases of Government debt took place in phases of high fiscal deficits (in 2009 and 2010). Even in those countries inflationary pressures seem to remain low, years after the launch of these very large programs. In contrast, in the euro area fiscal adjustment was frontloaded and the purchases of sovereign bonds by the Eurosystem remained small compared to the US and UK (at least until including 2014). The main legitimate worry on these programs may relate to the challenges of exit and possible moral hazard issues when Governments have high debt-GDP ratios and will also in the future be potentially vulnerable to impaired capital market access. Reducing again the Central Bank's stocks of sovereign bonds will contribute to increase capital market yields and financing costs of Governments. Therefore it seems key that Government address their structural and fiscal challenges so as to ensure that an orderly exit of the Eurosystem from purchase programs and acquired sovereign debt stocks will be possible in the future, so that the central bank is not stuck with very high Government bond exposures and related possible pressures by the Government in the long term.

(c) It is always right to be also worried about inflation in the medium to long term. The fact that inflation has been trending down for decades and that also recently, surprises of inflation in major economies tended to be on the downside does not mean that this could not change again. Also, as mentioned, it is true that large scale purchase programs may be difficult to exit and at that stage could create undue political pressures and possible conflicts of interest.

Solution to Q36

(a) Country A is a smaller country than country B in terms of size of the financial system. More interestingly, in country A, the banking system has provided relatively more loans to the real economy, and finances a part of these through interbank credit from country B. In other words, capital imports from country B to country A took place. This probably reflected that there was a belief that capital productivity in country A was larger than in country B, and it was therefore considered welfare improving (for all) to export some capital from country B to country A.

(b) We represent the following five shocks in the system of financial accounts – they can be traced thanks to the different amounts (and they are shown in the order of appearance). For (ii), to allow easy identification we underline the related changes:

i. Households shift deposits of 5 from A to B banks. What is important to note in this case is that the net Eurosystem claims change sign, and therefore shift the side in the national central banks' balance sheet (which is not explicitly shown in the financial accounts)

Changes below in red

Euro area households

Deposits with A banks	10 -5	Equity	100
Deposits with B banks	40 +5		
Banknotes	10		
Real assets	40		

A country banking system

Loans	20 -	HH Deposits	10-5
Deposits with NCB A (RR=5)	5	Eurosystem refinancing	5 +5
		Net interbank liability	10

B country banking system

Loans	40	HH Deposits	40+5
Net interbank claims	10	Eurosystem refinancing	20 -5
Deposits with NCB B (RR=10)	10		

NCB A

Eurosystem credit	5 +5	Banknotes	3
Intrasystem claims	3 -5*	Deposits of banks	5

NCB B

Eurosystem credit	20 -5	Banknotes	7
		Deposits of banks	10
		Intrasystem liabilities	3-5*

*position shifts side in balance sheet

ii. Household shift deposits from B to A bank amounting to 32 – all changes underlined. We assume here that the deposit shift leads to a closing of the interbank position, as the A-bank becomes thanks to the capital inflow very cash rich now and it would be counterintuitive that still they receive interbank credit from bank B. Therefore, the central bank credit provision does not need to be adjusted by the same amount as the deposit shift, but by 10 less, and also the effect on intra-central bank claims is only 22. Note that collateral in the form of bank loans is insufficient in this case, even if the central bank imposes zero haircuts on bank loans as collateral. The central bank would have to accept an ELA solution. For example, it could require as additional collateral and indeed block the required reserves held in the central bank

Changes below in <u>underline</u>

Euro area households

Deposits with A banks	10 <u>+32</u>	Equity	100
Deposits with B banks	40 <u>-32</u>		
Banknotes	10		
Real assets	40		

A country banking system

Loans	20	HH Deposits	10 <u>+32</u>
Deposits with NCB A (RR=5)	5 <u>+17</u>	Eurosystem refinancing	5 <u>-5</u>
		Net interbank liability	10 <u>-10</u>

B country banking system

Loans	40	HH Deposits	40 <u>-32</u>
Net interbank claims	10<u>-10</u>	Eurosystem refinancing	20 <u>+22</u>
Deposits with NCB B (RR=10)	10		

NCB A

Eurosystem credit	5 -5	Banknotes	3
Intrasystem claims	3 +22	Deposits of banks	5 +17

NCB B

Eurosystem credit	20 +22	Banknotes	7
		Deposits of banks	10
		Intrasystem liabilities	3+22

*position shifts side in balance sheet

iii. Decline of interbank lending to A bank to zero (i.e. by 10). Again in this case intra-system claims switch sign. Changes below in red

iv. Households withdraw banknotes from A bank for 6 (we assume that each central bank accounts for its banknotes separately). Changes below in green.

v. NCB A injects reserves into the A bank by purchases of corporate claims of 4. Changes below in blue.

Euro area households

Deposits with A banks	10 -6	Equity	100
Deposits with B bans	40		
Banknotes	10 +6		
Real assets	40		

A country banking system

Loans	20 -4	HH Deposits	10 -6
Deposits with NCB A (RR=5)	5	Eurosystem refinancing	5 +10 +6 -4
		Net interbank liability	10 -10

B country banking system

Loans	40	HH Deposits	40
Net interbank claims	10 -10	Eurosystem refinancing	20 -10
Deposits with NCB B (RR=10)	10		

NCB A

Eurosystem credit	5 +10 +6 -4	Banknotes	3 +6
Claims on corporates	+4	Deposits of banks	5
Intrasystem claims	3 -10*		

NCB B

Eurosystem credit	20 -10	Banknotes	7
		Deposits of banks	10
		Intrasystem liabilities	3 -10*

*position shifts side in balance sheet

(c) This is the system of financial accounts after we split the household accounts into two parts. The accounts below show the current account transaction.

A households

Deposits with A banks	10	-10	Equity		30
Deposits with B banks					
Banknotes	3				
Real assets	17	+10			

B households

Deposits with B banks	40	+10	Equity		70
Banknotes	7				
Real assets	23	-10			

A country banking system

Loans	20		HH Deposits	10	-10
Deposits with NCB A (RR)	5		Eurosystem refinancing	5	+10
			Net interbank liability	10	

B country banking system

Loans	40	HH Deposits	40 +10
Net interbank claims	10	Eurosystem refinancining	20 - 10
Deposits with NCB B (RR	10		

NCB A

Eurosystem credit	5 +10	Banknotes	3
		Deposits of banks	5
Intrasystem claims	3 -10*		

NCB B

Eurosystem credit	20 -10	Banknotes	7
		Current accounts of banks	10
		Intrasystem liabilities	3 -10*

* Position switches side of balance sheet.

Solution to Q37

(a) At end 2010 the accounts look as follows (current account transactions in red, capital account transactions in green)

"Greek" households

Deposits with Greek banks	10 -2 -2	Equity	50
Deposits with German banks	10 +2		
Banknotes	5		
Real assets	25+2		

"German" households

Deposits with Greek banks	10 -2	Equity	50
Deposits with German banks	10 +2 +2		
Banknotes	5		
Real assets	25 -2		

Euro area corporate sector

Real assets	50	Real assets	50

"Greek" banking system

Loans	25	HH Deposits	20 -2 -4
Deposits with NCB A (RR=5)	5	Eurosystem refinancing	10 +2 +4

"German" banking system

Loans	25	HH Deposits	20 +2 +4
Deposits with NCB B (RR=5)	5	Eurosystem refinancing	max(0, 10 -2 -4)

"Bank of Greece"

Eurosystem credit	10 +2 +4	Banknotes	5
		Deposits of banks	5
Intra –Eurosystem claims	0	Intra –Eurosystem liabilities	+2 +4

"Deutsche Bundesbank"

Eurosystem credit	max(0, 10 -2 -4)	Banknotes	5
		Deposits of banks	5
Intra –Eurosystem claims	+2 +4	Intra – Eurosystem liabilities	

"Eurosystem"

Eurosystem credit	20	Banknotes	10
		Deposits of banks	10

(b) Eurosystem credit of 16 needs to be collateralised with collateral value after haircuts of (1-h)25. The critical value of h can therefore be calculated by equating 16 = (1-h)25 => h = 1 – 16/25

(c) The German banking system will be in excess liquidity (relative to required reserves) after further inflows of 4. If annual inflows are 6 and they are spread regularly over time, then after the first 8 months of 2011, the Eurosystem balance sheet starts to lengthen (i.e. it starts to lengthen on 1 September 2011). The Bundesbank balance sheet on 31 December 2011 should look as follows:

"Deutsche Bundesbank" at end December 2011

Eurosystem credit	0	Banknotes	5
		Deposits of banks	7
Intrasystem claims	12	Intrasystem liabilities	0