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BANK OF FINLAND DISCUSSION PAPERS

15 • 2003

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13.5.2003

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Bank of Finland Discussion Papers 15/2003

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Abstract

Since 1 January 1999 the ECB has conducted a single monetary policy in the euro area, but the mechanisms by which and the extent to which monetary shocks are transmitted into prices and real economic activity may vary from country to country. This paper investigates how and to what extent the impact of monetary policy depends on national features of financial systems. The main interest is in examining whether the bank lending channel of monetary policy results in asymmetric loan supply reactions on the aggregate level across countries.

The variety of transmission mechanisms suggests that the potency of monetary policy may depend on several country-specific factors. On the basis of descriptive analysis, the present Member States seem to differ considerably in terms of their financial systems. The econometric analysis using aggregate data on a panel of twelve countries supports the view that some of these differences may lead to cross-country asymmetries in responses to the common monetary policy. In particular, a larger size and a lower degree of capitalisation of a banking sector are found to strengthen the bank lending channel on the aggregate level.

Key words: EMU, monetary transmission, bank lending channel, panel data analysis

Kansallisten rahoitusjärjestelmien vaikutus maiden välisiin eroihin euroalueen rahapolitiikan välittymisessä

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Tiivistelmä

Voimakkuus ja mekanismit, joilla EKP:n harjoittama euroalueen yhteinen rahapolitiikka välittyy hintoihin ja reaalitalouteen, voivat vaihdella maittain. Tässä tutkimuksessa tarkastellaan, missä määrin rahapolitiikan vaikutukset riippuvat kansallisten rahoitusjärjestelmien ominaisuuksista. Mielenkiinto kohdistuu erityisesti kysymykseen, johtaako rahapolitiikan pankkiluottokanava maakohtaisiin eroihin aggregaattitason luotontarjontareaktioissa.

Rahapolitiikan välittymiskanavien moninaisuuden vuoksi rahapolitiikan teho voi riippua useista maakohtaisista tekijöistä. Kuvailevan tilastoaineiston vertailun perusteella euromaiden rahoitusjärjestelmissä on huomattavia eroja. Paneeliaineistoon perustuva ekonometrinen analyysi tukee käsitystä, että osa näistä eroista voi johtaa maakohtaisiin eroihin rahapolitiikan vaikutuksissa. Tulosten mukaan pankkisektorin suuri koko ja huono pääomitus vahvistavat luotonantokanavaa aggregaattitasolla.

Avainsanat: EMU, rahapolitiikan välittyminen, pankkiluottokanava, paneeliaineisto

Contents

1   Introduction

Since 1 January 1999, along with Stage Three of Economic and Monetary Union (EMU), the European Central Bank (ECB) has conducted a single monetary policy in the Member States[1]. Nevertheless, despite common monetary policy actions, the mechanisms through which the actions are transmitted into the real economy and the extent to which they affect output and prices may vary from one country to another, and even over time within the same country. Countries with diverse business cycles and different economic and financial structures tend to respond asymmetrically to monetary policy shocks of a given type and size. Thereby, to be able to optimise the timing and magnitude of intended monetary policy actions, the monetary authorities should be aware of the extent to which the present twelve Member States differ from each other. Since considerable distributional differences in output costs of lowering inflation would impose adjustment requirements on other economic policies and could ultimately create political tensions between countries among the Union, the degree of asymmetry is a matter of key importance for the future success of the common euro area monetary policy.

Monetary transmission has long been a research topic of great interest in macroeconomics and the origins of the basic theoretical framework date back to times of Hicks and Keynes in the 1930s. However, since then both the theories and empirical methods have widened and deepened considerably, and it is only recently that the focus has been rather on uniform monetary shocks and different transmission mechanisms than on asymmetric shocks and their final effects across countries. In particular, after the outset of Stage Three of EMU, there has been a wave of extensive empirical research in Europe and many papers dealing with the pros and cons of the common monetary policy have emphasised differences in transmission channels across the Member States. For example, within the ECB and the national central banks, plenty of research has lately been conducted using different data and various methodologies, including structural and VAR macro models for the euro area and the national economies and panel micro data analyses of bank and nonfinancial corporate sector behaviour.

In many of the past studies concerning EMU, differences in financial structures across the Member States contribute to explaining cross-country differences in the monetary transmission mechanisms. A common conclusion is

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[1] Throughout this study, the term 'Member State' refers to an EMU member country, ie to an European Union (EU) member country which has adopted the single currency, euro. At present, EMU – also referred to as the euro area – consists of twelve of the fifteen EU countries: Austria, Belgium, Finland, France, Germany, Greece (as from 1 January 2001), Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. EU member countries outside EMU comprise Denmark, Sweden and the United Kingdom.

that the national institutional environment, in which finance – both intermediated and direct – takes place, does matter for the monetary transmission process, and that so does also the household and nonfinancial corporate sector behaviour within the specific environment. The country-specific financial system has thus been found to have a significant effect on the channels through which and ultimately on the extent to which the national real economy responses to monetary policy shocks.[2]

My view in the present study is close to that of Schmidt (1999), for example. In accordance with his study, I address three issues as follows. First, I describe how monetary policy is currently conducted in the euro area and how it, in theory, should affect prices and the real economic activity. Second, I discuss how and to what extent the impact of monetary policy depends on specific features of an economy and, in particular, which features of a financial system are most significant for the monetary transmission process. Finally, I aim at comparing the current euro area countries and at discussing what kind of consequences differences between them have for how the single monetary policy should and can be conducted in a common currency framework.

I thus treat the issue from both theoretical and empirical perspectives by first laying a broad theoretical foundation, on the basis of which the euro area national financial systems are then being compared. I aim at widening the view of the previous descriptive studies by exploiting data and findings from various different sources. Moreover, Finland is of special interest, since so far it has commonly been neglected in the euro area cross-country comparisons.

Despite aiming at a broad perspective, throughout the study the main focus is, however, on the recent credit view of monetary transmission and, in particular, on the operation of the bank lending channel. Thereby, also the econometric analysis aims at providing empirical evidence on the impact of monetary policy on lending and particularly on the asymmetry of the supply shifts depending on country-specific financial system characteristics. Using aggregate national data on a panel of twelve EU countries, I estimate a dynamic reduced-form model of the bank loan market. The main purpose is to examine the effect of size, liquidity and capitalisation of the national banking sectors on the way in which the total lending is adjusted to changes in national money market interest rates.

The remainder of the study proceeds as follows. Section two describes briefly the ESCB's present monetary policy strategy, its objectives and the main

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[2] The term 'financial sector' is used for institutions, which provide financial services to the nonfinancial sectors of the economy, whereas the term 'financial system' comprises the demand for and supply of financial services and the financial intermediaries and markets by which, and the way in which, they are provided, as defined also in Schmidt (1999). 'Financial structure' in turn refers to the complete organisation of the financial system, ie the interdependence of financial markets, institutions and instruments in a given place at a given time (Goldsmith 1987).

instruments used, and then discusses experiences from the first three and a half years of the common monetary policy. Section three moves on by going through the various channels through which monetary policy should in theory affect inflation and the real economic activity. Section four presents findings of existing econometric research on the euro area monetary transmission. In section five, I present descriptive comparative statistics for a set of national financial systems, with the objective of exploring for concrete differences in factors found relevant in the preceding sections. On the basis of a previously developed model, section six carries out a dynamic panel estimation for the national bank lending channels. In the end, section seven gathers up the main findings and draws the final conclusions.

2   The ESCB monetary policy strategy

The European System of Central Banks (ESCB), which consists of the European Central Bank and the national central banks of the fifteen EU Member States[3], constitutes the institutional and operational framework for the ECB's monetary policy. The formulation and implementation of the common monetary policy are separated in the sense that the Governing Council of the ECB is responsible for the former and the Executive Board for the latter[4]. (ECB 2001) This section describes briefly the conduct of the common monetary policy by presenting its objectives and the instruments and procedures used in the light of past financial and economic developments.

2.1   Objectives

The objectives of the ESCB are defined in the consolidated version of the Treaty establishing the European Community (1997)[5]. According to Article 105 in the Treaty, the primary objective of the ESCB and its monetary policy is to maintain price stability. A more precise definition in quantitative terms has been introduced in an ECB press release on 13 October 1998, stating that price stability refers to a

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[3] The three EU Member States outside EMU retain their powers in the field of monetary policy and are thus not involved in the conduct of the euro area monetary policy.

[4] The Executive Board comprises the President, the Vice-President and four other members chosen from among persons of recognised standing and professional experience in monetary or banking matters. The Governing Council in turn consists of all the members of the Executive Board and the governors of the National Central Banks of the Member States, each with one vote.

[5] The consolidated version of the Treaty establishing the European Community incorporates changes made by the Treaty of Amsterdam, signed on 2 October 1997.

year-on-year *increase* in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2%[6]. Thereby, it is noteworthy that the focus is on the euro area as a whole instead of a country-specific or other regional perspective. Furthermore, price stability is to be maintained specifically over the medium term, since short-term volatility in prices cannot be controlled by means of monetary policy. In fact, excessive short-term inference might rather cause unnecessary, self-sustaining volatility into the real economy.

The quantitative definition of the objective of price stability is important for the success of the monetary policy strategy, since it guides future price developments by providing an anchor for the public's expectations. Moreover, the exact definition makes monetary policy more transparent and sets a benchmark against which the public can hold the ECB accountable for its performance, thus enhancing the credibility and effectiveness of the common monetary policy.

Having price stability as the ECB's primary objective is based on the argument that maintaining price stability is the best contribution that monetary policy can make in the long run to economic stability and growth. According to the ECB (2001), there are several ways in which price stability contributes to achieving higher levels of economic activity and employment. First, it improves the transparency of relative prices, thus helping the market to allocate resources more efficiently and thereby raising the productive potential of the economy. Second, the credible maintenance of price stability reduces the inflation risk premium, which the investors demand in real interest rates to compensate them for the loss of purchasing power in the long term. Third, maintaining price stability credibly in the long run reduces also unnecessary hedging activities against inflation. These second and third impacts as well should strengthen the economic growth by enhancing efficient investment. Fourth, price stability reduces the distortionary effect of tax and social security systems and, fifth, prevents arbitrary redistribution of wealth and income, thus increasing social and political stability. All in all, it is argued that, on average, economies with lower inflation tend to grow more rapidly in real terms in the long run than countries with faster rising prices. Nevertheless, despite the ECB's primary interest on inflation, also the short-run impact of monetary policy on output is considered in the course of this study.

Since national inflation rates vary across countries for example due to differences in productivity and growth and also depending on in which point the countries are in their inflation cycles, it can be difficult for the monetary authorities to assess the appropriate stance of the common monetary policy. In fact, the European Economic Advisory Group (2002, 55–56), consisting of seven European economists, has criticised the ECB's inflation target for being possibly too tight. The Group argues that as it is impossible to reach the target inflation rate

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[6] Both zero inflation and deflation contradict the ECB's definition of price stability.

simultaneously in each euro area country, a considerable amount of inflation has to be accepted in some countries in order to avoid the risk of pushing others into deflation. As prices typically rise more rapidly in fast growing less developed countries than in countries of higher development but slower economic growth, the inflation ceiling of 2% may put deflationary pressure on slow-growth countries in particular. According to Sinn and Reutter (2001), keeping average inflation below 2% could imply inflation rates as high as 3.5% in fast growing countries, such as Finland and Ireland for the time being, but as low as 1% in Germany, where both productivity growth and inflation have recently been the lowest in Europe.

Monetary policy actions affect inflation in an uncertain, variable magnitude and typically after a time lag of 1–2 years. It is therefore highly important that the monetary authorities follow inflationary expectations continuously, since they can be seen as a prediction for future inflation. Moreover, since inflationary expectations affect pricing decisions and thus actual future inflation, it is important that the expectations match the central bank's inflation target[7]. Inflationary expectations are based on the expectations of future economic developments and the future course of monetary policy but they can be influenced also by announcements and implementation of the current monetary policy, if the public considers the central bank credible.

The Governing Council of the ECB uses an analytical framework for assessing risks to price stability in a systematic and organised manner. It has thus adopted a forward-looking lasting strategy to ensure consistency and stability over time. Consequently, there are two well-defined pillars, which are used to guide the decision-making on monetary policy actions. The first pillar gives a prominent role for money by stating a reference value of 4.5% for the annual growth of the broad money aggregate M3. The reference value is consistent with the definition of price stability, a stable annual growth rate of 2–2.5% of the euro area GDP, and a decline of M3 velocity in the range of 0.5–1% per annum. Under normal circumstances, deviations of actual monetary growth from the reference value signal a threat to price stability, but the ECB is not committed to making any mechanistic corrections over the short term. The first pillar focuses thus on permanent rather than temporary changes in the velocity of circulation and thereby on the monetary origins of inflation over the medium to long term.

The second pillar in turn emphasises the importance of monitoring and analysing a wider range of economic and financial indicators to assess the risks to price stability. For example, changes between demand and supply in goods and

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[7] Inflation reduces the purchasing power of money but also inflation lower than expected results in costs as ex post real interest rates turn out to be higher than expected. Moreover, if inflationary expectations have led to higher nominal wages, also ex post real labour costs are higher than expected. (Kettunen 1995, ECB 2001)

labour markets as well as conditions in financial markets are expected to affect price developments over the short to medium term. Although decisions are made from the viewpoint of the euro area aggregate level, the national central banks contribute to the assessment by preparing background analyses and economic forecasts on an individual country level.

According to the Treaty, without prejudice to the primary objective, the ESCB should also support general economic policies in order to contribute to the achievement of the objectives of the European Community. According to Article 2 in the Treaty, broader aims of the European Community comprise the promotion of a harmonious, balanced and sustainable development of economic activities, a higher level of employment and social protection, equality between men and women, sustainable and non-inflationary growth, a higher degree of competitiveness and convergence of economic performance, a high level of protection and improvement of the quality of the environment, the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among the Member States. In all of its activities the ESCB should follow the principle of an open market economy with free competition, favouring an efficient allocation of resources.

2.2   Instruments

In order to achieve its above-mentioned objectives, the Eurosystem[8] has available three types of monetary policy instruments; it executes open market operations, offers standing facilities and requires minimum reserves. The purpose and conduct of each are described briefly below on the basis of *Monetary Policy of the ECB* (2001) and *The Single Monetary Policy in Stage Three* (2000) by the ECB, unless stated otherwise.

2.2.1   Open market operations

Open market operations are conducted in financial markets, usually in the money market, by the national central banks on the initiative of the ECB for the purposes of steering interest rates, managing the liquidity situation in the market and signalling the stance of the current monetary policy. With respect to their aim, maturity, frequency and the procedures followed, open market operations are divided into four categories of main refinancing operations, longer-term refinancing operations, fine-tuning operations and structural operations. Each

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[8] The term 'Eurosystem' refers to arrangement whereby the ECB and the NCBs carry out the tasks of the ESCB within the euro area (ECB 2001).

operation is executed through a transaction, which either provides or absorbs liquidity in the market. Transactions available are of following five types: reverse transactions, outright transactions, the issuance of debt certificates, foreign exchange swaps and the collection of fixed-term deposits.

The main refinancing operations are the most important open market operations and the ESCB's principal monetary policy instrument. They are liquidity-providing operations, which are executed by the national central banks through weekly standard tenders in the form of reverse transactions with maturity of two weeks. In a reverse transaction a central bank provides funds to its counterparties for a pre-specified limited period by buying assets under a repurchase agreement or by granting loans against collateral.

From the beginning of 1999 to June 2000, the main refinancing operations were executed via fixed rate tenders. Starting with the operation settled on 28 June 2000, they were switched into variable rate tenders with a multiple rate auction procedure. The Governing Council of the ECB determines a minimum bid rate for the operations approximately every two weeks. It is the key ECB interest rate, since changes in it signal the stance of the ECB's monetary policy and affect short-term interest rates in the euro area money market. Furthermore, since the ECB has a monopoly over the issuance of base money, it can efficiently influence the overall conditions in the money market.

According to Estrella and Mishkin (1997), monetary tightening raises not only money market rates but typically also long-term interest rates but less than the short ones. Thus, a rise in the official central bank rate usually not only raises the yield curve but also makes the curve flatter by narrowing the spread between short- and long-term interest rates. The rise in the short-term market interest rates results from the tightening of credit conditions, whereas the effect on long-term interest rates depends also on long-term ex ante real interest rates and the credibility of the central bank's monetary policy, ie on the effect on inflationary expectations. Basically, the more credible is monetary policy, the less long-term interest rates should rise due to a rise in the central bank rate. However, if the rise in the policy rate is considered insufficient to control the future inflation, the yield curve may even become steeper as long-term interest rates rise more than the short ones.

The effect of interest rates on inflation and inflationary expectations is based on the pure expectations theory of the term structure of interest rates and the Fisher equation. According to the former, any long-term interest rate can technically be thought of as a geometric average of present and expected future short-term interest rates[9]. Consequently, the short-term interest rates, on which the

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[9] For example $1 + r_{t,t+n} = \sqrt[n]{(1 + r_{t,t+1})(1 + f_{t+1,t+2})...(1 + f_{t+n-1,t+n})}$, where a n-year spot rate $1 + r_{t,t+n}$ equals the geometric average of a 1-year spot rate $1 + r_{t,t+1}$ and expected future 1-year rates $1 + f_{t+1,t+2},..., 1 + f_{t+n-1,t+n}$ for the following n – 1 years.

monetary authorities have the greatest impact through the central bank rates, affect also the overall level of interest rates in the financial markets. Moreover, long-term interest rates can be seen as reflecting present expectations of the future development of short-term interest rates. The Fisher equation in turn is based on the idea that nominal and real capital are perfect substitutes as investments but the nominal capital must yield in addition to the real rate of return also a compensation for the expected loss in the purchasing power of money[10]. Combining the two theories results finally in the idea that the expected future nominal interest rate implied by the nominal term structure of interest rates reflects expectations of the sum of the future inflation and real interest rate.[11]

Open market operations are considered to have several advantages over the other tools of monetary policy. First, open market operations occur at the initiative of the ECB, which thus has a complete control over their volume. Second, they are both flexible and precise, since they can be used to any desired extent. The suitable change in reserves or the monetary base can be achieved with a purchase or sell of securities in any specific magnitude. Third, open market operations are easily reversed, so if a mistake has been made concerning the optimal volume, it can be easily corrected by conducting a reverse transaction. Fourth, open market operations can be implemented quickly for the absence of administrative delays. (Mishkin and Eakins 2000, 220–221)

2.2.2 Standing facilities

The national central banks offer for their counterparties two types of standing facilities, marginal lending and deposit facilities, with the following three aims. First, the former provides and the latter absorbs overnight liquidity in the markets. Second, they signal the general stance of monetary policy and, third, bound the overnight market interest rates – the former from above and the latter from beneath. Thus, by setting the two rates at which the loans are granted and the deposits remunerated by the national central banks, the Governing Council of the ECB restricts the excessive volatility of short-term market interest rates and thereby contributes to the overall money market stability. Under normal circumstances, counterparties can take overnight loans and make overnight deposits on their own initiative without a limit or other restrictions apart from the requirement to present sufficient underlying assets for a loan collateral. In practise, due to high borrowing costs and a low rate of return on deposits, credit

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[10] By Fisher equation, $1 + i_t = (1 + r_t)(1 + E_t(\pi_t)) = 1 + r_t + E_t(\pi_t) + r_t E_t(\pi_t) \approx 1 + r_t + E_t(\pi_t)$. (Eg Copeland and Weston 1988)

[11] For further details, see eg Browne and Manasse (1989), or Kettunen (1995) which provides some empirical evidence for Finland.

institutions use the standing facilities only if there are no other alternatives available.

2.2.3 Minimum reserves

Minimum reserve system aims at stabilising money market interest rates and creating or enlarging a structural liquidity shortage. It thus contributes to the ability of the Eurosystem to operate efficiently. Within the minimum reserve system, the ECB requires euro area credit institutions to hold minimum reserves on accounts with the national central banks at the interest rate of the main refinancing operations. The reserve requirement of an institution depends on its reserve base, ie deposits, debt securities issued and money market papers on the liability side of its balance sheet. Compliance with the reserve requirement is determined on the basis of an institution's average end-of-calendar-day reserve holdings over a one-month maintenance period. The averaging provision aims at contributing to the stabilisation of money market interest rates by giving institutions an incentive to smooth temporary liquidity fluctuations.

2.3   Past developments

This section discusses the ECB's monetary policy decisions in the first three and a half years of the common monetary policy on the basis of the ECB (2001) and Bank of Finland (2002a). In particular, changes in the key ECB interest rates are assessed with respect to past developments in inflation and monetary growth. The role of the general economic development in interest rate decisions is also considered. Moreover, the focus is on EMU-wide aggregates in accordance with the ESCB's monetary policy strategy.

Figure 1 below shows past euro area interest rates daily from 2 January 1999 to 28 June 2002. Changes – both anticipated and actual – in the three key ECB interest rates are reflected rapidly in the euro area money market rates. In particular, both the overnight interest rate Eonia and the 1-month Euribor seem to follow the ECB's main refinancing rate very closely. Moreover, since 8 April 1999, the two interest rates on standing facilities have provided symmetrically an upper and lower limit for the short-term market interest rates. In the short run, the ECB interest rates seem to have been highly autocorrelated in the sense that they were first raised seven times in a row between 14 April 1999 and 14 May 2001, and since then they have been lowered four times so far (situation in the beginning of December 2002).

Figure 1.   **The key Eurosystem interest rates,
                2 January 1999 – 28 June 2002**

Source: ECB and Reuters.
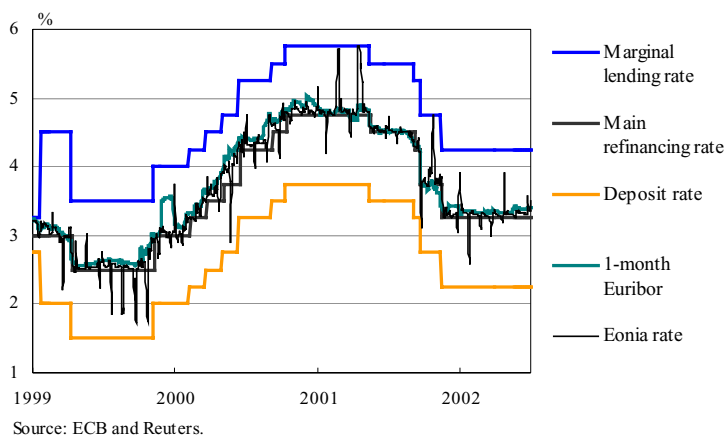
The Harmonised Index of Consumer Prices for the euro area (see figures 2 and 3) is calculated as a weighted arithmetic average of the twelve national HICPs, using private domestic consumption expenditures for the year $t-2$ as weights. Table 1 below shows the distribution of the euro area GDP and the HICP country weights as reported in the Eurostat's NewCronos database. Both figures indicate that Germany dominates the euro area aggregates rather clearly, accounting for nearly a third of the totals. Also France and Italy stand out by these measures, whereas even Spain and the Netherlands are considerably smaller. The rest of the countries account together for less than 15% of the totals, so the individual contribution of each of the seven smallest economies seems somewhat insignificant.

Table 1.   **(1) Distribution (%) of the euro area GDP in 2000
                and (2) HICP country weights in 2002**

	AU	BE	FI	FR	DE	GR	IE	IT	LU	NL	PT	ES
1	3.1	3.8	2.0	21.4	30.9	1.9	1.6	17.8	0.3	6.1	1.8	9.3
2	3.2	3.4	1.6	20.4	30.6	2.5	1.2	19.3	0.3	5.2	2.0	10.3

Source: Eurostat, NewCronos.

Figure 2 below depicts the national annual inflation rates and the euro area weighted average for the years 1999–2001. In 2001 all but France exceeded the 2% target rate, but since also in the other two large countries, Germany and Italy, prices have risen rather moderately through the years, the average has remained bearable. As shown in figure 3, also money growth has exceeded its reference value rather constantly.

Figure 2.   **Annual euro area inflation and inflation rates of the Member States, 1999–2001**

Source: Eurostat, NewCronos.   □ 1999 ▨ 2000 ▨ 2001
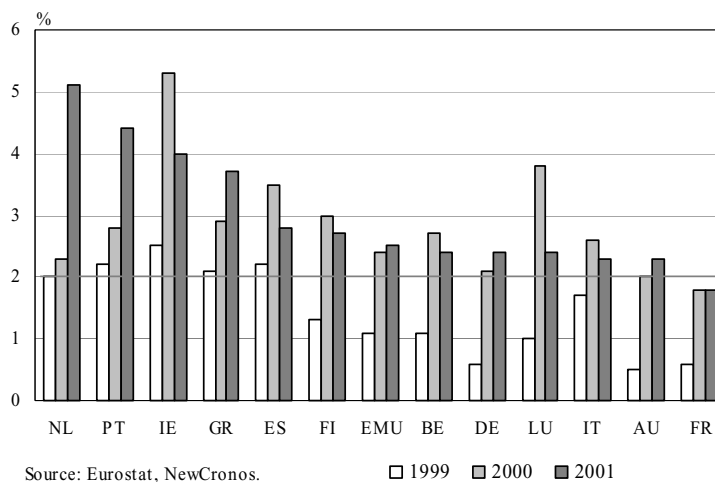
Figure 3.   **Monthly euro area inflation and M3 growth, 1999M1–2002M6**

Source: ECB and Eurostat.
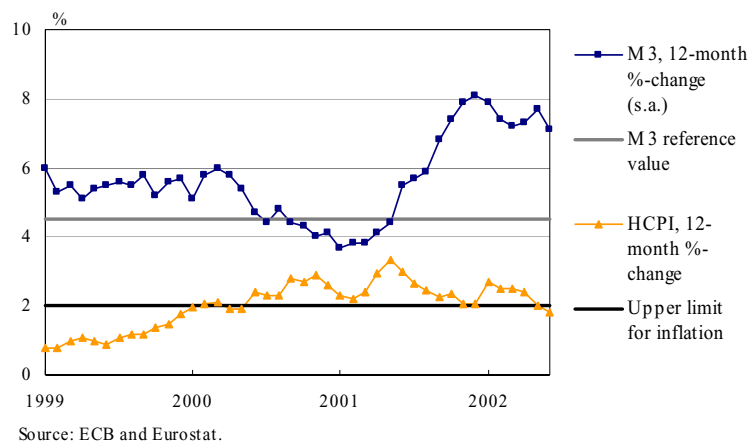
In early 1999, there was both upward and downward pressures to the euro area price stability. Downside risks were mainly due to weaker consumer confidence and decreased external demand as a result of the recent Asian and Russian crises. On the other hand, money growth was strong (see figure 3 above) and credit to the private sector growing fast, which suppressed the downside pressures. Also higher oil prices and the depreciation of the euro against the US dollar (see figure 4 below) aroused some risks rather on the upside. However, inflation remained relatively low, around 1% (figure 3), which gave the Governing Council of the ECB an opportunity to lower the interest rates in order to boost the economic growth and to reduce the anticipated future downward pressures on prices. On 8 April 1999 the ECB Governing Council decided to reduce the main refinancing

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rate by 50 basis points to 2.5%. At the same time, the interest rates on marginal lending and deposit facilities were set at 1.5% and 3.5%, respectively.

In the second half of 1999, the external environment continued to improve and also the euro area monetary and credit developments contributed to the recovery of economic growth. Moreover, the exchange rate of the euro kept weakening and oil prices continued to rise. It became evident that the risks, which led to the precautionary interest rate reduction in April, were no longer present. Consequently, on 4 November 1999 the policy interest rates were raised symmetrically by 50 basis points each. The rise was aimed primarily at preventing the prolonged high money and credit growth from pressuring prices upward and to restrain inflationary expectations and uncertainty in the financial markets.

Figure 4.   **Euro exchange rate against the US dollar and the yen, 1999M1–2002M6**

Source: ECB and Reuters.
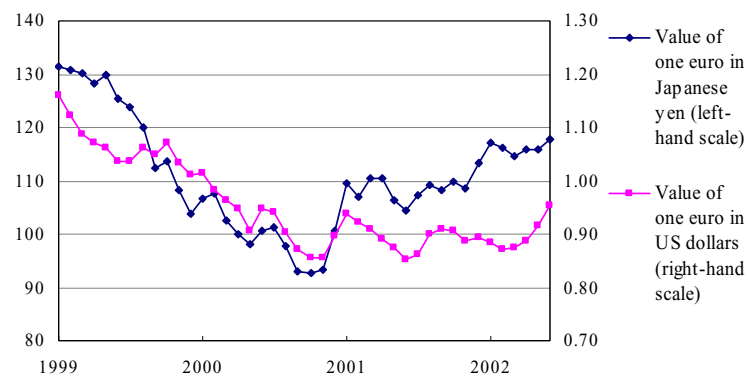
Developments in the first half of 2000 implied again increasing upward risks to price stability in the euro area. Strong M3 growth and further economic recovery combined with higher import prices due to the protracted depreciation of the euro indicated significant price pressures. Moreover, low inflation in the past suggested that ample liquidity had been progressively accumulated since the late 1999. To suppress medium-term upward price pressures, the ECB interest rates were raised by a total of 75 basis points on 3 February, 16 March and 27 April and further by 50 basis points on 8 June 2000.

In late 2000, upward risks to price stability continued to prevail despite the past monetary tightenings. Both M3 and credit growth slowed down but rising oil prices and the renewed depreciation of the euro pushed inflation above 2%. Furthermore, expectations of greater economic activity and higher inflation in the future increased the risk of second-round effects on consumer prices through wage increases. As a result, the ECB interest rates were raised by 25 basis points on 31 August and again on 5 October 2000. In addition, the ECB intervened in the

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foreign exchange markets in September and November in order to reduce the risks, which the depreciation of the euro posed to the euro area price stability.

Figure 5. **Total output, nominal change (%) on a year earlier, 1999Q1–2002Q2**
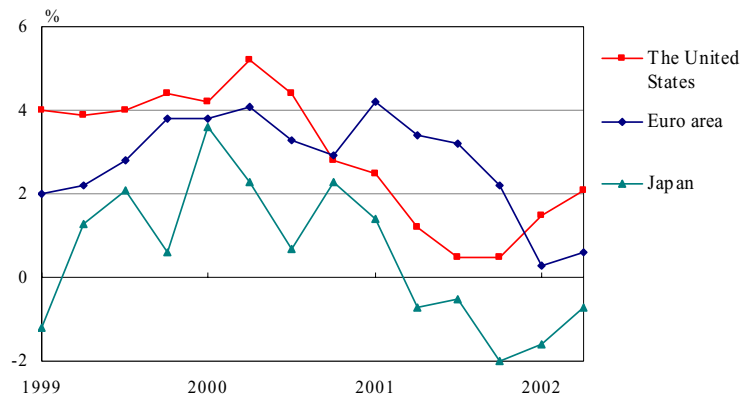
Source: Eurostat.

In early 2001, prospects for the world economy started to weaken considerably. Growth slowed down simultaneously in the United States, the euro area and Japan (figure 5). Consequently, both national domestic demands in the euro area and exports to non-euro countries were dampened and investments declined. Moreover, money growth had started to decelerate along with the past interest rate increases. Also oil prices started to trend downward, but inflation still accelerated mainly due to higher food prices. However, since the slower economic growth eased medium-term upward pressures on prices, the Governing Council decided to lower the minimum bid rate by 25 basis points to 4.50% in 15 May 2001, despite the inflation being above its 2% target ceiling.

In late 2001, the inflation outlook improved and inflationary expectations started to decline due to the slowing of energy and food price increases and a modest appreciation of the euro against the US dollar. To strengthen the consumer and industry confidence, the interest rates were cut by 25 basis points in 5 September and further by 50 basis points 19 September in the aftermath of the New York terrorist attack. Also several liquidity-providing fine-tuning operation were conducted in order to support the vulnerable financial markets. Since economic growth continued to slower in the euro area due to diminishing exports and investments, the Governing Council decided to lower the interest rates again by 50 basis points in 14 November, decreases thus summing to a total 1.50 percentage points in 2001.

In the first half of 2002, growth was still slow and inflation near the upper limit. Moreover, the public budget deficits of the major Member States were further increasing, threatening to violate a maximum of 3% of GDP, mutually

agreed on in the Growth and Stability Pact in 1997. Consequently, there was no room for either expansionary monetary or national fiscal policies. The slow US growth coupled with the strong appreciation of the euro made the picture even gloomier, since it further dampened the already weak exports. Also the near-future anxiety is related primarily to the further prolongation of the sluggish economic growth, for example as a result of oil price increases.

All in all, the Eurosystem's operational framework has been functioning rather well since the beginning of 1999, contributing thus to the stability of the euro area financial markets and thereby to the general economic growth. Liquidity conditions and short-term interest rates have been steered in a smoothed fashion using mainly open market operations and the minimum reserve system. It is seems that, so far, despite the high money growth in the past, the ECB has managed to prevent short-term price fluctuations from translating into severe medium-term inflationary expectations. Moreover, developments in long-term interest rates imply that the financial markets have considered the ECB's commitment to price stability credible.

The past policy rate reductions indicate that in times of both moderate inflation and low inflationary expectations, the ECB has been rather active also in accelerating economic growth by means of expansionary monetary policy. However, due to the ECB's strong commitment to its strategy of price stability, remedies against the sluggish economic growth are very limited when inflation is above the target. As it has been the case in the late 2002, the presence of upward pressures on prices leaves the ECB totally unequipped to increase the growth prospects of the area, let alone to stimulate the sinking world economy.

3 Channels of monetary transmission

By a broad definition, monetary transmission refers to the process through which changes in monetary variables such as money supply, interest rates, exchange rates and credit are transmitted into the real economic activity (eg Fase and de Bondt 2000). Since the final impact of monetary shocks on economy is difficult to forecast due to long and variable lags, understanding the different phases of various monetary transmission mechanisms is crucial for the planning and implementation of successful monetary policy actions. In accordance with its strategy, the ECB focuses on how its monetary policy actions affect the euro area economy in general and the price level in particular. Since – if there are no risks to price stability – the ECB uses its monetary policy also for stimulating economic growth in the short run, in what follows, the effects of monetary policy on inflation and output are both discussed.

Although the various transmission channels are described one by one in greater detail below, it is important to acknowledge that they are inter-linked and affect one another. The mechanisms may also change over time and differ from one country to another, as is emphasised in later sections of this study. Figure 6 below summarises the discussion that follows.

Figure 6. **Channels of monetary transmission**
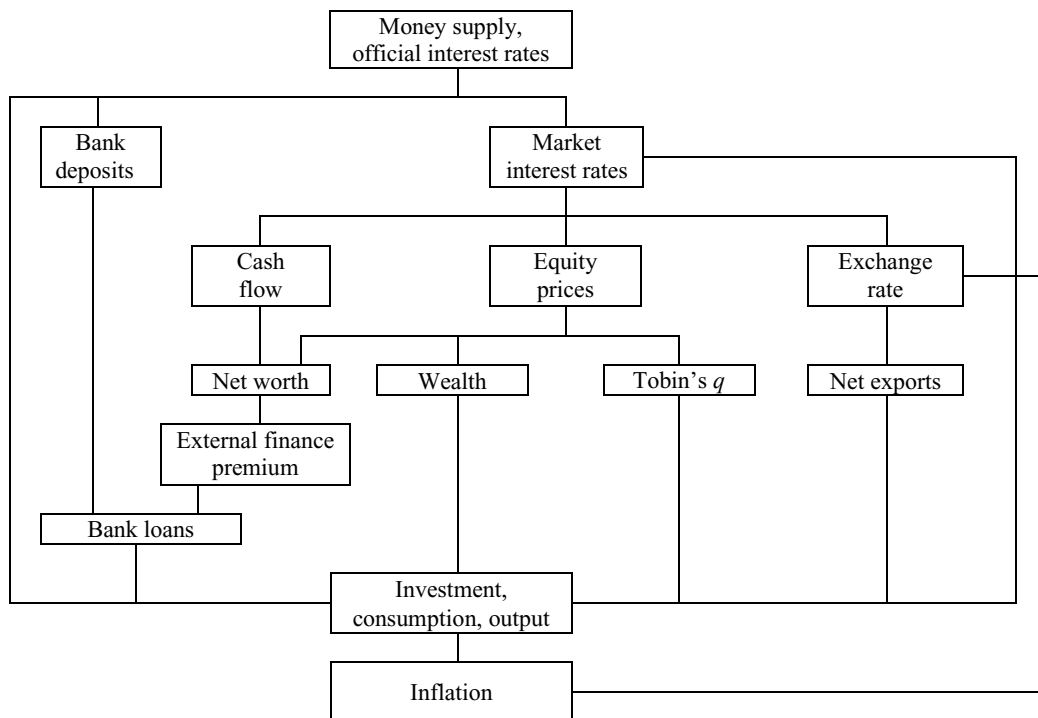
Source: Peersman (2001).

According to Fisher's quantity theory of money, a change in money stock has also a *direct* impact on real economic activity. It is generally argued, however, that monetary policy actions can affect real variables only in the short run, whereas in the long run the effect of monetary policy on real output, employment and real interest rates ceases to exist due to the so-called neutrality of money. Since a rise in the money supply leads to excessive holdings of money, it also increases demand for goods and thus raises their prices. Moreover, the general price level rises due to higher inflationary expectations, since they affect asset prices and price setting in product and labour markets. The higher monetary growth is thus typically associated with higher inflation, leading to lower purchasing power of money and thereby neutralising economic growth in real terms.

According to the monetarist view, real income is in the long run determined primarily by supply-side factors, such as technology, population growth, the flexibility of markets and the efficiency of the institutional framework of the

economy. According to the ECB, it is in fact the task of fiscal and structural policies to enhance the growth potential of the economy, whereas monetary policy contributes to long-run growth only by maintaining price stability over the medium term. (ECB 2001)

The *indirect* mechanisms through which monetary policy actions affect the real economy can be divided into three types of channels and further into six sub-channels: interest rate channel, three other equity price channels and two credit channels. The interest rate channel and, in part, other equity price channels represent the so-called money view, whereas credit channels are often referred to as the credit view of the monetary transmission process. The two confronting views differ in particular in respect to the role they give to the financial intermediary sector. In the following, key assumptions behind the two views are compared on the basis of Cecchetti (1995), Hubbard (1995), Kashyap and Stein (1997) and de Bondt (1999).

3.1   Money vs credit view

In the traditional money view, interest rate and exchange rate movements are assumed to affect directly the components of aggregate demand, which in turn is considered to determine output in the short term under fixed prices. All in all, the money view focuses on how output responses to monetary policy actions on the aggregate level. Moreover, according to the view, capital markets are perfect and there exist only two types of financial assets: 'money', which serves as a medium of exchange, and 'bonds', which for the sake of simplicity are assumed to cover all other assets, such as bonds, bank loans and other debt instruments, not used for transaction purposes. Monetary authorities control the supply of money and by adjusting the quantity of money relative to other financial assets they affect also relative asset prices. Money is thus seen as the key financial variable affecting the real economic activity in the monetary transmission process. Thereby, besides issuing demand deposits, ie creating money through the liability side of their balance sheets, banks have no special role in the money view monetary transmission mechanism.

The more recent credit view, on the contrary, assumes that monetary policy works through the asset side of banks' balance sheets. Capital markets are seen as imperfect due to information-related financial frictions and financial markets are considered to incorporate at least three types of assets: money, bonds and bank loans. The functioning of the channel is based on the idea of supply of bank loans being sensitive to monetary policy actions. Furthermore, it is assumed that bank loans do not have any perfect substitutes, for which reason some corporate investment and consumer spending, which are to be financed with credit, decrease

if the supply of loans is reduced. In contrast to the money view, the credit view of monetary transmission leads to distributional differences across borrowers due to asymmetries in their financial positions and in their degree of bank-dependency.

3.2   Interest rate channel

The interest rate channel is conventionally presented on the basis of the simple textbook version of the Keynesian IS-LM model. In the model, monetary policy actions are transmitted into the real economy through the effect of interest rate changes on spending and investment decisions. The functioning of the channel relies thus on the interest rate sensitivity of demand.

In the IS-LM framework was introduced first by Hicks in 1937, but the theory has its origins in Keynes' fixed-price model of output determination presented a year before. The model is based on a set of simplifying assumptions, the most important of which is the key Keynesian assumption stating that prices are fixed in the short run. Consequently, aggregate supply is assumed to be infinitely elastic at a given price level and output demand-determined. In the short run, the general macroeconomic equilibrium is thus to be achieved by adjusting quantities demanded instead of changing prices.

In the following, the formulation of a basic mainstream model is presented briefly in accordance with Stevenson et al (1988, 2–12). After setting out the basics, the money view monetary transmission process is described in this simplified framework.

The IS-LM model

In the IS-LM model the economy is divided into two markets, the product market for the current flow of real output and the money market for stocks of money and other financial assets. Through interrelationships between the two markets monetary and real factors affect one another. The IS curve is determined by the product market and the LM curve by the money market, and together they determine the general macroeconomic equilibrium.

In the product market, aggregate real expenditure AE consists of four components: consumption C, investment I, government expenditure G and net exports NX. With the exception of government expenditure, which is treated as totally exogenous, each of the components of aggregate real expenditure can be divided into two sub-components: to an autonomous sub-component and to a one that depends on other factors in the economy. Thereby, besides its autonomous component C_0, consumption depends partly on the current flow of real disposable

income $Y - T_0$, where Y denotes real income and T_0 a direct tax payment. The marginal propensity to consume out of disposable income is assumed to be positive and less than one. Similarly, in addition to their autonomous components I_0 and NX_0, investment and net exports are assumed to be negative functions of interest rate r and real income Y, respectively. By grouping together all exogenous components into AE_0 and endogenous variables into $AE(Y, r, T_0)$, the model results in aggregate real expenditure of the form:

$$\begin{aligned}
AE &= C + I + G + NX \\
&= C_0 + C(Y - T_0) + I_0 + I(r) + G_0 + NX_0 + NX(Y) \\
&= AE_0 + AE(Y, r, T_0),
\end{aligned} \tag{3.1}$$

with the properties $0 < AE_Y < 1$, $AE_r < 0$ and $-1 < AE_T < 0$, the lower-case letter denoting the first partial derivative. The product market reaches its equilibrium when the flow of real expenditures equals the flow of real income or output. The equilibrium condition gives the equation

$$Y = AE_0 + AE(Y, r, T_0) \tag{3.2}$$

for the IS curve, defining thus the relationship between the level of real output and the interest rate consistent with the product market equilibrium.

Components of aggregate demand, such as consumer durables, housing, business fixed investment and inventory investment respond typically to changes in medium and long-term interest rates (Hubbard 1995). Moreover, reasons for which a fall in the interest rate tends to increase spending can be divided into three distinctive mechanisms of cost-of-capital effect, substitution effect and income effect. A reduction in the cost of capital increases firms' optimal investment by lowering the marginal cost of adding new capital to production. Likewise, a lower rate of return on saving enhances investment through the substitution effect, whereas income effect influences through wealth and depends on whether the firm is a net saver or borrower.

In the money market, individual wealth holders allocate their portfolios between two assets: money and bonds[12]. The demand for real money balances L depends on real income Y (reflecting both transactions demand and precautionary motives for holding money) and the rate of interest on bonds r[13] (speculative motive). The nominal money stock M_0 is exogenously determined by the

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[12] The simplest version of the basic IS-LM model assumes that there is no banking system in the economy. Consequently, all money is considered high-powered outside money. Bonds in turn refer to risky assets, which bear a rate of return and cannot be used as a medium of exchange. The value of the bond stock B is assumed to be independent of interest rate changes.

[13] Since inflation is assumed to be zero, nominal and real interest rates are equal.

monetary authorities. Under fixed prices, a change in nominal money stock is associated with a change in real money balances and thus in real wealth.

In the money market equilibrium, the demand for real money balances equals the outstanding real money stock. This condition determines the LM curve, which, for a given money stock, gives the interest rate that is required at different income levels for money market equilibrium:

$$L(Y,r) = \frac{M_0}{P},$$
(3.3)

where $L_Y > 0$ and $L_r < 0$.

Monetary policy and the IS-LM equilibrium

In the general macroeconomic equilibrium product and money markets are in equilibrium simultaneously:

$$\begin{cases} Y = AE_0 + AE(Y,r,T_0) \\ \dfrac{M_0}{P} = L(Y,r) \end{cases}$$
(3.4)

Taking total differentials of the above equilibrium equations gives:

$$\begin{cases} dY = dAE_0 + \dfrac{\partial AE(Y,r,T_0)}{\partial Y}dY + \dfrac{\partial AE(Y,r,T_0)}{\partial r}dr + \dfrac{\partial AE(Y,r,T_0)}{\partial T_0}dT_0 \\ d\dfrac{M_0}{P} = \dfrac{\partial L(Y,r)}{\partial Y}dY + \dfrac{\partial L(Y,r)}{\partial r}dr \end{cases}$$
(3.5)

$$\Leftrightarrow \begin{cases} dY = \dfrac{dAE_0 + AE_r dr + AE_{T_0} dT_0}{1 - AE_Y} \\ d\dfrac{M_0}{P} = L_Y dY + L_r dr \end{cases}$$
(3.6)

In the equilibrium, the income level Y* clearing the product market is associated with an interest rate r* clearing the money market (point A in figure 7 below).

25

Figure 7.   **Monetary expansion in the IS-LM framework**
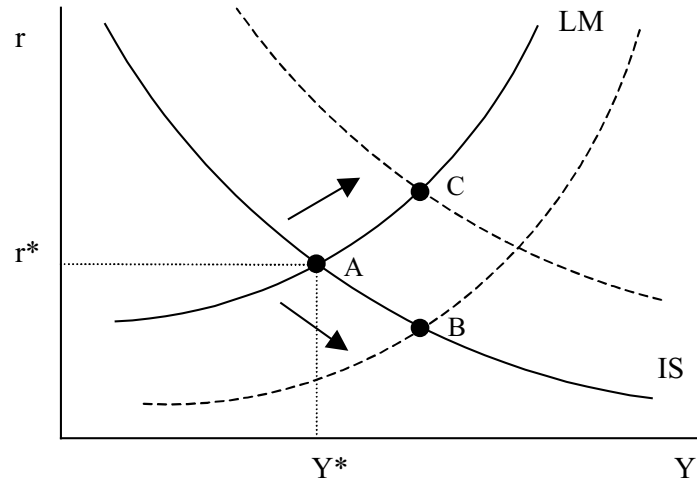
Solving for dY* and dr* provides the basis for the model's comparative static properties:

$$dY^* = \frac{L_r}{(1 - AE_Y)L_r + L_Y AE_r}\left(dAE_0 - C_Y dT_0\right)$$

$$+ \frac{AE_r}{(1 - AE_Y)L_r + L_Y AE_r} d(M_0/P) \tag{3.7}$$

$$= a_1\left(dAE_0 - C_Y dT_0\right) + b_1 d(M_0/P)$$

$$dr^* = \frac{-L_Y}{(1 - AE_Y)L_r + L_Y AE_r}\left(dAE_0 - C_Y dT_0\right)$$

$$+ \frac{1 - AE_Y}{(1 - AE_Y)L_r + L_Y AE_r} d(M_0/P) \tag{3.8}$$

$$= a_2\left(dAE_0 - C_Y dT_0\right) + b_2 d(M_0/P),$$

where parameters a_1, b_1, $a_2 > 0$ and $b_2 > 0$ unambiguously. Consequently, the higher the autonomous aggregate expenditure AE_0, whether in the form of consumption, investment, government expenditure or net exports, and the higher the real money supply $\dfrac{M_0}{P}$, the higher should be the equilibrium level of income (points B and C, respectively). The equilibrium interest rate in turn varies positively with exogenous expenditure but inversely with money supply.

As already discussed, the monetary authorities can affect interest rates also directly by raising or reducing the official central bank rates. Since for any single country in the euro area the short-term interest rate is given by the ECB, in this

context the LM curve can be thought of as being flat at any given point in time. Consequently, the equilibrium level of output is determined by the IS-curve.

To outline the role of interest rate changes in the monetary transmission process further, the basic mechanism of the IS-LM model can be simplified into the following schematic by Mishkin (1996):

$$M \uparrow \Rightarrow r \downarrow \Rightarrow I \uparrow \Rightarrow Y \uparrow, \tag{3.9}$$

where expansionary monetary policy leads to a fall in the real interest rate, which in turn causes a rise in investment and in part in consumption (consumer durables), thereby leading to an increased aggregate expenditure and output in real terms in the short run. In the long run as prices adjust, increased demand for goods due to excessive holdings of money leads to higher prices in the product market. Thus, in the long run the increased real output is reduced by the inflationary effect of expansionary monetary policy. Correspondingly, monetary tightening restrains demand and contributes to price stability.

In theory, interest rate changes should have greater impact in countries with high investment requirements. Consequently, Guiso et al (1999) use investment per GDP as a proxy for the national interest rate sensitivity. As shown in table 2 below, by this measure, monetary policy should have strongest output effects in Portugal and Austria and the slightest in Sweden, the United Kingdom and Finland. However, since the ratio varies only from 17% to 24% in the euro area, differences between most of the countries seem rather small.

Table 2. **Gross fixed capital formation as a % of GDP, averaged from 1994 to 1998**

AU	BE	FI	FR	DE	GR	IE	IT	LU	NL	PT	ES	DK	SE	UK
23	20	17	19	22	20	19	18	22	19	24	21	19	15	17

Source: Calculations based on the IMF's International Financial Statistics.

As discussed above, the IS-LM model assumes imperfect price adjustment. According to Guiso et al (1999), cross-country differences in the degree of price rigidity may lead to different patterns of output adjustment to common monetary shocks. Moreover, they argue that, since legislation governing the firing and hiring of employees in Europe makes wages rather rigid and since labour costs account for a major portion of total costs, labour market frictions can be used as a measure of the rigidity. Table 3 below reports a summary indicator of strictness of employment protection in the EU countries and in parenthesis rankings among 26 OECD countries, the score and the ranking both increasing with the strictness.

Table 3.   **A summary indicator* of the overall strictness of employment protection legislation**

AU	BE	FI	FR	DE	GR	IE	IT	NL	PT	ES	DK	SE	UK
2.3	2.5	2.1	2.8	2.6	3.5	1.1	3.4	2.2	3.7	3.1	1.5	2.6	0.9
(15)	(16)	(11)	(21)	(20)	(24)	(5)	(23)	(13)	(26)	(22)	(8)	(18)	(2)

* A weighted average of indicators for regular labour contracts, temporary contracts and collective dismissals in the late 1990s.
Source: OECD (1999).

Figures indicate that the strictest employment protection is offered in the southern Europe, whereas the United Kingdom, Ireland and Denmark are the least regulated countries. The remaining countries seem fairly similar, so if labour market frictions are considered to be the key determinant of future cross-country differences in price and wage flexibility, differences between continental economies appear rather small. According to Guiso et al, the move to a single currency should not directly or immediately change the contractual framework governing the labour market.

The traditional interest rate channel is criticised for its several omissions. First, it neglects the adjustment of other asset prices. Second, it does not take into account the accumulation of financial assets. Third, the model operates with one interest rate only, while in practise demand for money is typically associated with a short-term interest rate and investment with a long-term interest rate. Fourth, the model does not give any role for financial intermediaries. Fifth, all financial assets other than money are treated as perfect substitutes for each other, and sixth, the model does not distinguish between transitory and permanent disturbances. (Meltzer 1995) In what follows, these simplifications are somewhat relaxed, in particular by broadening the range of assets available.

3.3   Other asset price channels

Instead of focusing on one asset price only, namely the interest rate, the other asset price channels take into account the effect of changes in exchange rates, equity prices and land and housing prices.

3.3.1   Exchange rate channel

Changes in exchange rates influence the real economy due to their effect on net exports through import and export prices. When the domestic real interest rate r falls relative to foreign rates due to an increase in domestic money supply M,

domestic deposits become less attractive relative to deposits denominated in foreign currencies. This leads to a fall in the value of domestic deposits relative to other currency deposits, that is, to a depreciation of the domestic currency. The lower value of the domestic currency makes domestic goods cheaper than the foreign ones, thus increasing exports and decreasing imports. A rise in net exports NX in turn results in a rise in domestic output Y. In accordance with Mishkin (1996), the mechanism can be presented in the form of the following schematic:

$$M \uparrow \Rightarrow r \downarrow \Rightarrow E \downarrow \Rightarrow NX \uparrow \Rightarrow Y \uparrow, \tag{3.10}$$

where E denotes the exchange rate expressed in terms of domestic currency (euro) per foreign currency.

According to the ECB (2001), changes in exchange rates affect inflation in three ways. First, for example depreciation of euro tends to raise prices of consumption goods imported from outside EMU, thus accelerating inflation directly. Second, higher prices of imported inputs lead to higher prices for final goods as well. Third, depreciation of euro makes the domestically produced goods more competitive in terms of their prices on world markets. Since this tends to increase the external demand from outside EMU, also the aggregate demand and overall inflationary pressures are consequently increased in the euro area economies.

Since the exposure to exchange rate changes depends on the degree of openness of the economy, the channel is more effective for small open economies than for large closed currency areas. Basically, countries which are more open face more of the loss in competitiveness in times of tight money, but benefit more from a terms-of-trade improvement along a monetary expansion. Thus, the strength of the exchange rate channel depends on one hand on the distribution of external trade across countries and, on the other, on the volume of net exports relative to GDP.

Schmidt (1999) argues that the exchange rate channel plays a rather small role in the euro area, since there a considerable share of foreign trade is carried on between the Member States. For the entire euro area, both exports to and imports from countries outside EMU amounted to 16% of GDP in 2000. However, as shown in the first column of table 4 below, the relative importance of extra-EMU trade differs greatly from one country to another. For example in Ireland exports to outside EMU accounted for nearly a half and in Austria almost a third of GDP, whereas in France, Germany and Spain the share was less than 10%.

Furthermore, there are considerably cross-country differences as to the distribution of exports and imports and thereby in the degree of exposure to foreign currencies. The euro exchange rates against the US dollar, the yen and the British pound are usually the ones most closely followed, but as shown by the last column in table 4, the share of trade with the rest of the world – classified here as

the 'other' – is also far from being negligible. For example a half of total exports from France are directed to outside EU, the United States and Japan. Trade with Japan plays in fact a minor role in all Member States, whereas the United States is an important importer at least from Ireland, Italy and Finland.

Table 4.   **Openness of EU countries in 2000**

	Exports (imports) to (from) outside EMU as % of GDP	Distribution (%) of exports (imports) by trading partner				
		inside EMU	DK, SE, and the UK	the United States	Japan	Other
AU	29 (30)	62 (59)	13 (11)	6 (7)	1 (3)	18 (20)
BE-LU*	18 (15)	44 (47)	23 (21)	6 (4)	3 (1)	23 (26)
FI	17 (15)	44 (44)	13 (11)	10 (7)	2 (4)	31 (34)
FR	6 (12)	35 (50)	8 (8)	5 (3)	1 (3)	50 (35)
DE	8 (12)	59 (57)	11 (10)	5 (4)	1 (2)	24 (27)
GR	13 (12)	48 (54)	13 (10)	9 (7)	2 (2)	28 (26)
IE	48 (40)	40 (26)	23 (36)	17 (16)	4 (4)	16 (18)
IT	12 (11)	44 (48)	11 (8)	10 (5)	2 (3)	33 (36)
NL	23 (37)	63 (38)	15 (12)	4 (12)	1 (5)	16 (33)
PT	16 (14)	55 (64)	7 (5)	5 (4)	1 (2)	32 (26)
ES	8 (12)	66 (67)	14 (8)	6 (3)	0 (2)	13 (19)
DK	25 (18)	34 (36)	22 (26)	8 (5)	2 (4)	35 (30)
SE	23 (16)	41 (49)	15 (16)	9 (7)	3 (3)	32 (25)
UK	9 (13)	53 (46)	4 (3)	16 (13)	2 (5)	25 (33)

* Belgo-Luxembourg Economic Union
Source: Calculations based on Eurostat, NewCronos.

3.3.2   Equity price channels

Equity price channels are based on the sensitivity of equity prices to interest rate changes in the financial markets. Channels through which changes in equity prices affect the real economy can be divided into three distinctive mechanisms: Tobin's q theory of investment, wealth effects on consumption, and housing and land price channels. Each mechanism is described in greater detail below.

Tobin's q theory of investment

Tobin's q theory of investment describes a channel by means of which monetary policy actions affect the real economy through changes in share prices. By adjusting monetary policy, the monetary authorities are able to influence the allocation and amount of private spending. According to the monetarist view, after a monetary expansion, increased holdings of money are reduced by the private sector through increased investments in alternative financial assets, such

as publicly traded shares. Alternatively, in accordance with the Keynesian view, a similar effect can be achieved through the substitution effect by reducing interest rates directly and thereby making bonds less attractive investments relative to buying and holding shares. (Mishkin 1996) In any case, relative prices are changed and the increased demand for equities raises share prices, which according to the theory affects investment decisions.

In his money-capital model, Tobin (1969) defines q as the ratio of the market value of existing capital assets to their current replacement or reproduction cost. This is equal to comparing a firm's total market value to the replacement cost of its total physical capital stock. The market value of a firm refers to the total market value of its outstanding shares, which depends on the firm's tangible and intangible assets. It can also be thought of as the market's best estimate of the present value of the firm's current and future profits. The physical capital stock in turn comprises only the firm's existing tangible assets, the value of which is seen as the production cost of similar newly produced commodities.

The role of q in the investment theory is discussed further in Tobin and Brainard (1977), which states that the two prices of the same physical asset, the market value and the reproduction cost, can diverge significantly for extended periods of time. Moreover, the market values of existing assets are more volatile than the production costs of their newly produced counterparts. According to the theory, investment decisions are made on the basis of the comparison of the two prices, with the objective of maximising the present net value of the firm's outstanding shares.

Basically, an investment project is undertaken if and only if it increases the value of the firm's shares. Values of q above 1 stimulate investment in excess of requirements for replacement and normal growth, because the firm then profits from issuing equity for the purpose of buying new capital. Since the market values installed capital over the cost of purchasing capital, the firm is better off after investing the proceeds in new physical assets. The incentive is clearly the gain to be made by the excess of market price over the replacement cost. Given the diminishing marginal productivity, the firm continues to invest until the increment market value gained from the investment is equal to its cost. (Tobin and Brainard 1977)

In equilibrium marginal q, the ratio of the market value of an additional unit of capital to its replacement cost, is equal to 1. Hayashi (1982) has pointed out that under certain conditions the average q as defined above equals marginal q. These conditions are met when the firm is a price-taker in the output market with constant returns to scale in both production and installation. If the firm is a price-maker, average q is higher than marginal q by the amount of a so-called monopoly rent. Since marginal q is not directly observable, average q is usually used as an estimate for it. In general, however, it is marginal q that is critical when making an investment decision.

Mishkin (1996) has simplified the mechanism into the following schematic indicating that higher money supply leads to higher equity prices P_e and thus to higher q, which in turn increases investment and finally total output:

$$M \uparrow \Rightarrow P_e \uparrow \Rightarrow q \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow. \qquad (3.11)$$

On the contrary, values of q below 1 encourage selling off capital or buying used capital instead of new. On the other hand, firms with low q's are attractive takeover targets themselves.

Wealth channel

The second equity channel functions through the effect of equity prices on wealth and further on consumption. The idea is based on Modigliani's (1971) life-cycle model, according to which consumer spending depends on the lifetime resources of consumers, consisting of financial wealth and human and real capital. Thus, as equity prices rise, share-owning households become wealthier and increase their current consumption. (Lettau et al 2001) In the short run, this increases the aggregate real expenditure and further real output (Mishkin 1996):

$$M \uparrow \Rightarrow P_e \uparrow \Rightarrow \text{wealth} \uparrow \Rightarrow \text{consumption} \uparrow \Rightarrow Y \uparrow. \qquad (3.12)$$

In the long run, however, increased consumer demand may fuel the inflationary pressures in the markets and result in the higher price level in general, offsetting thus the expansionary effect in real terms (ECB 2001).

Housing and land price channels

Both the Tobin's q theory and the wealth channel described above apply also to housing and land markets, where housing and land are considered equity. Housing and land prices respond to monetary policy actions in the same way as share prices through the effect of interest rates on relative asset prices. A fall in interest rates leads to increased investments in assets other than money, such as land and houses, thus raising their prices. In accordance with the Tobin's q theory, an increase in house prices raises their prices relative to their replacement cost, which in turn raises the q for housing. A higher q stimulates housing production and results thus in higher aggregate demand and finally in greater output. On the other hand, since housing and land account for a large amount of private sector

wealth, rises in their prices increase wealth and therefore also consumption, aggregate demand and finally output. (Mishkin 1996)

3.4 Credit channels

Gurley and Shaw (1955) were among the first to advocate the overall interaction of financial and real activity and, in particular, the role of financial intermediaries as creditors as opposed to the conventional view of the money supply process. Gurley and Shaw argued that developed and well-functioning financial markets contribute to the general economic growth by enhancing investment through extending borrowers' financial capacity.[14]

Credit channel theories are based on the idea that the monetary transmission process is influenced by imperfections in the financial markets. Basically, credit market frictions arise from asymmetric information between borrowers and lenders and lead to problems of adverse selection and moral hazard. Akerlof (1970) introduced the adverse selection problem in his model of used cars market. The general idea applies also to financial markets, since borrowers with the greatest default risks seek loans most actively and therefore are the ones most likely selected. Moral hazard in turn takes place after credit has been granted, since the borrowers may then have incentives to engage in activities, which increase their credit risks. Consequently, for fear of credit losses lenders may choose to either cut their lending or to treat all borrowers as equally risky and therefore to raise their overall return requirements. Both adverse selection and moral hazard can thus lead to credit rationing. Likewise, when investors have difficulties in distinguishing between profitable and unprofitable investments, they may choose to invest less.

According to the credit channel theory, market imperfections result in an external finance premium, a spread between the cost of raising funds externally through an issuance of equity or debt and the opportunity cost of internal funds generated through retained corporate earnings. The size of the external finance premium reflects the cost to the borrowers due to both credit market frictions and the principal-agent problem which leads to a spread between the expected return received by the lenders and the cost faced by the borrowers.

Monetary transmission through credit markets is based on the effect of monetary policy on the external finance premium. According to the theory, any monetary policy action that raises or lowers open-market interest rates tends to change also the external finance premium in the same direction. Thereby, a monetary expansion that lowers short-term market interest rates tends to reduce

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[14] For a comprehensive literature survey on the evolution of credit channel theories, see Gertler (1988).

the wedge between self-financing and credit, whereas a monetary tightening increases it.

Monetary policy actions affect the external finance premium through bank lending and balance sheet channels. The bank lending channel focuses on the effect of monetary policy on the supply of loans by banks, whereas the balance sheet channel emphasises the impact of monetary policy on borrowers' net worth through the effect on their balance sheets and income statements. (Bernanke and Gertler 1995, de Bondt 1997 and 1999) Both channels are considered in greater detail below.

3.4.1   Bank lending channel

The bank lending channel is based on the effect of monetary policy on the external finance premium through changes in the supply of bank loans, or more generally, in the supply of intermediated finance. Despite the recent structural change, with the banking sector losing its market share to non-bank financial intermediaries, banks still remain the dominant source of finance in most of the developed countries. Moreover, since banks have specialised in overcoming informational problems and other frictions in the markets, they are expected to have an important role in the credit view of monetary transmission process. (Bernanke and Gertler 1995)

In order for the bank lending channel to operate, two assumptions must hold. First, it is assumed that there are not any perfect substitutes to bank loans neither for banks nor for borrowers. Consequently, if bank loans are reduced relative to other sources of finance, bank-dependent borrowers face higher costs of borrowing due to costs associated with finding a new lender and establishing a solid credit relationship. In particular, households as well as small and medium-sized firms depend on bank loans due to their lack of access to other forms of finance. Large firms on the contrary often have the alternative to obtain direct finance by selling bonds or issuing equity. Basically, the greater the degree of bank-dependency of consumers and firms, the greater should be the effect of bank lending on the real economic activity.

The second assumption states that monetary policy actions have a direct effect on the supply or relative pricing of bank loans. According to the theory, monetary tightening that drains reserves and hence deposits from the banking system, limits banks' access to loanable funds and thus forces them to reduce their lending. Thereby, the potency of monetary contraction depends on the degree to which banks are able to raise alternative funds to offset reserve fluctuations. Given the informational frictions between banks and their providers of funds and the imperfect substitutability of loans and other assets on the liability side of banks'

balance sheets, the mechanism relies on the assumption that banks cannot easily replace lost retail deposits with certificates of deposits or new equity issues.

Reduced loan supply leads to a rise in interest rates on lending, which in turn raises the external finance premium for bank-dependent borrowers, as a result of which their real activity is reduced. (de Bondt 1997, Bernanke and Gertler 1995) Correspondingly, expansionary monetary policy increases bank reserves and deposits, which in turn makes it possible for the banks to increase their lending. The increase in bank loans leads to a rise in investment and to a lesser extent in consumption and finally in output in accordance with the following schematic by Mishkin (1996):

$$M \uparrow \Rightarrow \text{bank deposits} \uparrow \Rightarrow \text{bank loans} \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow. \qquad (3.13)$$

However, according to Bernanke and Gertler (1995), the traditional bank lending channel has and most likely will lose some of its importance over time due to financial deregulation and innovation.

Next, two formal models by Bernanke and Blinder (1988) and Stein (1995) are presented for the bank lending channel. They both work through the effect of monetary policy on bank balance sheets. The former is a simple extension of the Keynesian IS-LM model, while the latter provides more micro foundations and develops a framework for the bank asset and liability management in the presence of adverse selection problem between banks and borrowers. The two models differ in terms of their asset sets and thereby in the way in which they assume banks to react to exogenous outflows of reserves and deposits in the aftermath of a monetary tightening.

The key distinction between the models is that according to Stein, the monetary authorities can directly affect both bond market interest rates and the spread between bonds and bank loans even if households are indifferent between holding deposits and bonds. This suggests that monetary policy can affect not only firms that rely on bank loans but also those that finance themselves in the open market. According to Stein monetary policy remains effective due to banks' preferences for their balance sheet compositions, whereas in the Bernanke-Blinder model the impact of monetary policy on bond market interest rates depends only on household preferences and bond market interest rates become insensitive to monetary policy if households are indifferent between assets.

Bernanke-Blinder model

The Bernanke-Blinder (1988) model expands the conventional IS-LM model into an IS-LM-CC model by taking into account the bank loan market in addition to

the money and goods markets. Consequently, the model operates with three assets – money (or deposits) D, bonds B and bank loans L^s – between which borrowers and lenders choose on the basis of interest rates on bonds and bank loans, i and ρ respectively. As a distinction to the IS-LM model where bonds and bank loans are implicitly seen as perfect substitutes, the Bernanke-Blinder model is based on the assumption that customer-market credit and auction-market credit are imperfect substitutes for both borrowers and banks. Imperfect substitutability between the assets may arise for example from informational asymmetries, differences in liquidity and higher transaction costs of raising funds in the open market.

Ignoring the net worth, the model simplifies bank balance sheets into the form:

Assets	Liabilities
Reserves, R	Deposits, D
Bonds, B	
Loans, L^s	

where reserves R consist of required reserves τD, τ denoting the required reserve-to-deposit ratio, and excess reserves E. The adding-up constraint, equalising banks' assets and liabilities, states the portfolio equation as follows:

$$\tau D + E + B + L^s = D \Leftrightarrow B + L^s + E = D(1-\tau). \tag{3.14}$$

Desired proportions of loans, bonds and excess reserves on bank balance sheets depend on the rates of return on loans and bonds[15], with positive own interest elasticities and negative cross elasticities. The bond stock, supply of loans and the stock of excess reserves can thus be denoted as:

$$B = \varphi(\rho,i)D(1-\tau), \quad L^s = \lambda(\rho,i)D(1-\tau) \quad \text{and} \quad E = \varepsilon(i)D(1-\tau), \tag{3.15}$$

where $\varphi_\rho < 0$, $\varphi_i > 0$, $\lambda_\rho > 0$, $\lambda_i < 0$ and $\varepsilon_i < 0$.

Demand for bank loans by borrowers is assumed to depend negatively on the interest rate on loans, $L_\rho < 0$, and positively on the rate of return on bonds, $L_i > 0$, and the gross national product, $L_y > 0$:

$$L^d = L(\rho,i,y). \tag{3.16}$$

---

[15] The rate of return on excess reserves is considered to be zero. For simplicity, the model assumes also that banks' demand for excess reserves depends only on the rate of return on bank loans, not on the interest rate on bonds.

The loan market equilibrium exists when loan demand and supply are equal:

$$L^d = L^s \Leftrightarrow L(\rho, i, y) = \lambda(\rho, i)D(1 - \tau).$$ (3.17)

The money market in turn is described by a conventional LM curve. Ignoring cash, the money market establishes, in fact, the market for deposits. The supply of deposits can be derived from the equation for bank reserves:

$$R = \tau D + E = \tau D + \varepsilon(i)D(1 - \tau) \Leftrightarrow D = \frac{R}{\varepsilon(i)(1 - \tau) + \tau} = m(i)R,$$ (3.18)

where m(i) denotes the so-called money multiplier by which deposits increase for every one-unit increase in reserves.

The demand for deposits results from the transactions motive and is assumed to depend on the interest rate on bonds, GNP and total wealth. Total wealth is, however, treated as constant and therefore ignored in the model. Equating demand for and supply of deposits gives the condition for the money market equilibrium:

$$D(i, y) = m(i)R,$$ (3.19)

where $D_i < 0$, $D_y > 0$ and $m_i > 0$.

By Walras' law, demand for money and bonds must equal the total wealth minus demand for bank loans. Consequently, $L(\rho, i, y)$ and $D(i, y)$ determine implicitly also the non-bank private sector's demand function for bonds, but it needs not to be considered in this context.

In the goods market, the equilibrium condition is characterised by the conventional IS curve:

$$y = Y(i, \rho),$$ (3.20)

where $Y_i < 0$ and $Y_\rho < 0$, stating that output varies negatively with the interest rates on both bonds and bank loans.

Using money market equation (3.19) to replace D by m(i)R on the right-hand side of the loan market equation (3.17) results in:

$$L(\rho, i, y) = \lambda(\rho, i)(1 - \tau)m(i)R.$$ (3.21)

Solving this for the interest rate on loans gives:

$$\rho = \delta(i, y, R),$$ (3.22)

where $\delta_i > 0$ assuming the money multiplier is not too inelastic, $\delta_y > 0$ and $\delta_R < 0$.

Rewriting the LM curve (3.19) and modifying the IS curve by substituting (3.22) into (3.20) gives finally the equations for the model's LM and CC (commodities and credit) curves:

$$y = M(i, R) \qquad \text{LM} \qquad (3.23)$$

$$y = Y(i, \delta(i, y, R)) \quad \text{CC} \qquad (3.24)$$

As shown in figure 8 below, the CC curve is downward-sloping and the LM curve upward-sloping in the i,y space. Relationships between the two functions establish the framework, in which monetary policy operates through the interest rate and bank lending channels.

Table 5 below summarises the model's comparative static properties, '+' denoting an increase and '−' a decrease in the variable considered. Changes in both money stock and outstanding credit seem to be good qualitative indicators of future output movements except in times of significant shocks to either money or credit demand (highlighted with a darkened background).

Table 5.   **Effect of different types of shocks on output and monetary variables**

		Output	Money	Credit	Interest rate on bonds	Interest rate on loans
Bank reserves	+	+	+	+	−	−
Money demand	+	−	+	−	+	+
Loan supply	+	+	+	+	+	−
Loan demand	+	−	−	+	−	+
Commodity demand	+	+	+	+	+	+

Source: Bernanke and Blinder (1988) (apart from the last column).

The model regards bank reserves R as the central bank's monetary policy instrument. Since a rise in bank reserves increases supply for both money and credit and thus shifts both the CC and LM curves to the right, the final effect on interest rates is ambiguous. The outcome depends on the extent to which the two curves shift relative to each other; see figure 8 below. This ambiguity can, however, be removed by making the following assumptions. First, the income elasticities of the demand functions for money and loans are not too different. Second, the absolute elasticities of loan supply and loan demand with respect to the interest rates on bonds and bank loans are not too different and, third, the interest elasticity of the money multiplier is not too large. Consequently, an increase in bank reserves can be assumed to increase output and to reduce the rate

of return on bonds unambiguously. Likewise, monetary tightening decreases output and raises the interest rate on bonds.

Figure 8. **Monetary expansion in the CC-LM model**
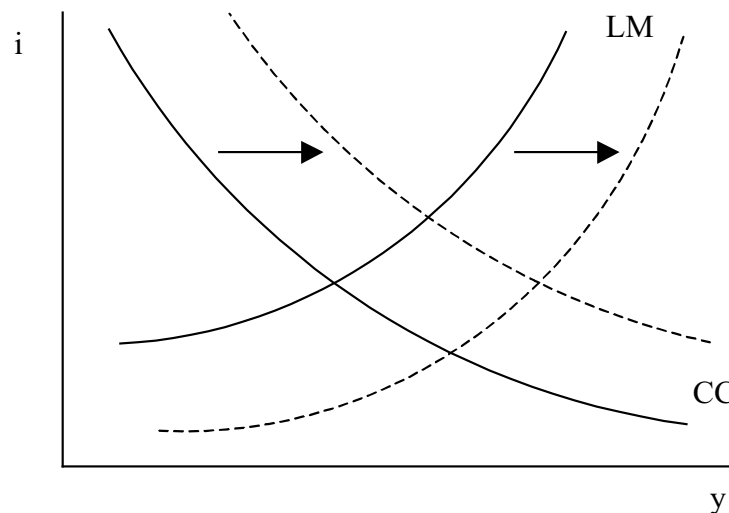
A rise in money demand shifts the LM curve upward and to the left along a fixed CC curve. Similarly, negative money demand shocks shift the LM curve downward but keep the CC curve in place. Thereby, the rate of return on bonds varies positively and output negatively with changes in demand for money.

An increase in the proportion of loans in total bank assets, $\lambda(\ )$, shifts the CC curve upward and to the right along a fixed LM curve. A positive credit supply shock leads thus to greater output and to a higher rate of return on bonds. A decrease in loan supply on the contrary reduces both output and the interest rate on bonds.

A rise in demand for bank loans, $L(\ )$, lowers money supply and increases the amount of credit. It shifts the CC curve downward and to the left along a fixed LM curve, thus reducing both output and the rate of return on bonds. A negative credit demand shock leads to opposite reactions. Positive and negative expenditure shocks through changes in commodity demand result in similar effects, shifting the CC curve like the IS curve in the conventional IS-LM model.

According to the model, the CC curve reduces to the conventional IS curve and the bank lending channel ceases to exist if bonds and bank loans are regarded as perfect substitutes either for borrowers or lenders. The former occurs when the demand for loans is perfectly elastic with respect to the interest rate on loans, ie when $L_\rho^d \to -\infty$, or when demand for commodities is insensitive to the loan rate, $Y_\rho = 0$. The latter in turn requires that bonds and loans are perfect substitutes in banks' portfolios, ie that the credit supply is perfectly elastic with respect to the

interest rate on loans, $L^s_\rho \to \infty$. Moreover, if money and bonds are perfect substitutes, the LM curve becomes horizontal resulting in a liquidity trap but monetary policy remains effective in the CC curve.

Adverse selection model

Also Stein (1995) has presented a formal model for the bank lending channel by considering the bank portfolio choice under the potential for adverse selection[16]. His two-period partial-equilibrium model of bank asset and liability management is based on the idea that asymmetric information between banks and outside investors about the value of banks' existing assets distorts the lending behaviour by making it difficult for banks to raise funds with instruments other than government-insured deposits. Stein thus contrasts the Romer and Romer (1990) view which – by applying the Modigliani-Miller theorem[17] to banking firms – states that banks can always insulate their lending decisions from deposit shocks by raising funds from non-deposit sources of finance.

According to Stein, an adverse selection problem arises when banks are for some reason forced to find non-insured sources of finance instead of issuing insured deposits, the value of which does not depend on investors' perceptions about the banks' assets and thereby on the perceived bank type. Thus, the model relies on the idea that to the extent that the monetary authorities are able to control the aggregate level of real insured deposits available to banks, they can affect also the supply of loans.

The model simplifies bank balance sheets into the form:

Assets	Liabilities
Reserves, R	Deposits, M
New loans, L	Equity, E
Old assets, K	
Securities, S	

Basically, the functioning of the model is based on banks' decisions on their optimal holdings of assets and liabilities at two points in time. The amount of new loans granted (L), a buffer stock of securities held (S) and the amount of new equity raised (E) are banks' choice variables, whereas deposits (D) and therefore required reserves (R) are determined exogenously by the monetary authorities.

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[16] The Stein (1995) study does not comprise the intermediary calculations presented in this work. An alternative one-period version of the model is presented in Kashyap and Stein (1994).

[17] For more details, see Modigliani and Miller (1958), who argue that the market value of a firm is independent of the firm's financial structure.

New loans are assumed to bear a rate of return r, which can be interpreted also as a spread between interest rates on loans and securities, since the rates of return on instruments other than loans can all be fixed and normalised to zero.

According to the model, any securities held at time 1 can be liquidated costlessly at time 2, whereas loans can be liquidated prematurely only to the amount J and for a net cost of θJ^2. Since the costs are of the quadratic form, the marginal costs are increasing ($2\theta J > 0$). Furthermore, since of key interest in this model is the way in which banks respond to a monetary contraction in the form of a decrease in deposits, it is assumed that no new lending opportunities arise at time 2, ie $L_2 = 0$. To emphasise this, loans granted at time 1 are denoted by L instead of L_1. Thus, loans held at time 2 amount to L at the most.

Old assets refer to loans, which have been granted at some earlier point of time but are still booked on banks' balance sheets. The value of these assets is assumed to follow a simple binomial process:

$$
\begin{array}{ccc}
& & u^2 K_0 \\
& uK_0 & \\
K_0 & & udK_0 \\
& dK_0 & \\
& & d^2 K_0 \\
t = 1 & & t = 2
\end{array}
$$
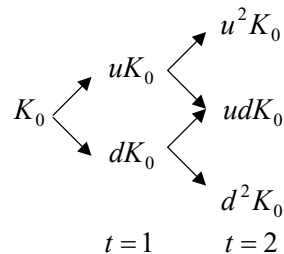
Before there is any new information available, the value of the assets is denoted by K_0. An initial public signal, which reaches outside investors at time 1, can be either 'good' or 'bad' and consequently either raise or lower the value of the assets, respectively. Similarly, the second public signal arrives at time 2, again either increasing or reducing the value. Throughout the process, the up move factor $u > 1$ is assumed to have a probability p and the down move factor $d < 1$ a probability $1 - p$.

Asymmetric information about the value of the old assets arises from the fact that the bank management is always one step ahead of outside investors in terms of their respective information sets. At both points in time, the bank management observes the signal before the outside investors and before making their lending and financing decisions for the present period. On the basis of the signals banks are divided into good and bad ones. A 'type G' (for good) refers to any bank whose private information either at time 1 or 2 leads its managers to expect an increase in the value of the bank's old assets when the next public signal is released in public. Conversely, the management in a 'type B' (bad) bank expects the bank's asset values to decrease.

The magnitude of the informational asymmetry is measured by a constant

$$A = \left(1 - \frac{d}{u}\right), \tag{3.25}$$

implying that the greater the up move factor is relative to the down move factor, the stronger is the degree of informational asymmetry.

On the liability side of their balance sheets, banks have two sources of finance: insured deposits and uninsured, non-deposit external finance. There are several forms of uninsured external finance available to banks, all of which are for simplicity assumed to be of the same priority in the model and therefore treated as equity as a whole. Since E_1 and E_2 refer to incremental amounts of equity raised at times 1 and 2 respectively, the total of $E_1 + E_2$ is raised by time 2.

M_1 and M_2 in turn denote banks' stocks of deposits at times 1 and 2 respectively, so in the case of a monetary expansion the incremental amount of deposits available to banks at time 2 would equal the difference of the two, $M_2 - M_1$. Time-2 deposits are stochastic but after M_1 is realised it is common knowledge that they are uniformly distributed on $\left[M_2^{min}, M_2^{max}\right] = \left[\rho M_1 + (1-\rho)M - \gamma/2, \rho M_1 + (1-\rho)M + \gamma/2\right]$, where the parameter ρ measures the persistence of deposit shocks and γ their variance. Thereby, the expected value of time-2 deposits is equal to $\rho M_1 + (1-\rho)M$, with M denoting the long-term mean of deposits. Though stochastic, the amount of deposits is assumed to be completely determined by the central bank's monetary policy. Moreover, in what follows, it is assumed that at time 2 all banks face an equal exogenous outflow of deposits, ie $M_2 < M_1$, which tightens their financing constraints[18]. The model is thus used for describing the banking sector behaviour under a monetary tightening.

To find a low-cost separating equilibrium, ie an equilibrium where the quantity of external financed chosen by a bank reveals its type, the two-period model is solved backwards, starting with time 2 and 'type B' banks. Type B's raise an amount of external finance that is large enough for them to avoid the costly liquidation of loans, given their time-1 lending and financing decisions. The model assumes that old assets do not require any new external funding, for they have already been financed with non-deposit sources of finance. Therefore, the financing constraint for type B's at time 2 states that the sum of time-2 deposits and the new equity raised at times 1 and 2 must equal time-2 reserve requirements, loans granted at time 1 and the adjustable securities holdings:

$$M_2 + E_1^B + E_2^B = R_2 + L^B + S_2^B. \tag{3.26}$$

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[18] Since the inter-bank competition for deposits is not allowed in the model, there is nothing the banks can do in order to offset the fall.

The bank enters time 2 with loans of L^B, securities of S_1^B and equity raised E_1^B. When the value of time-2 deposits M_2 is realised, the bank faces one of the two alternative situations. If equity raised at time 1 and time-2 deposits together exceed the time-2 requirements, that is if $E_1^B + M_2 > R_2 + L^B$, type B's can continue to fund their loans without raising any new external finance at time 2, simply by drawing down their buffer stock of securities: $S_2^B < S_1^B$. On the other hand, if $E_1^B + M_2 < R_2 + L^B$, banks are still short of funds even after selling off all of their existing securities S_1^B. Thus, at time 2 type B's are forced to raise an amount of equity:

$$E_2^B = \max\left(0, L^B - E_1^B - M_2(1 - \phi)\right). \tag{3.27}$$

where ϕ denotes the required reserve ratio, with $\phi M_2 = R_2$.

Due to an adverse selection problem, type G's choose to raise a lesser amount of external finance:

$$E_2^G = E_2^B - J, \tag{3.28}$$

implying that type G's are forced to liquidate loans by the amount J in order to keep their time-2 financing constraint in balance. Consequently, profits of type B's exceed those of type G's by the amount of the liquidation costs θJ^2.

Type B's may, however, choose to mimic type G's and raise equity only by the amount E_2^G, if the profit that can be gained by selling overpriced equity exceeds the costs of liquidating loans. Since the equity of a type B bank pretending to be G is overpriced by a factor $\dfrac{u}{d}$, the gain at time 2 equals the difference between the perceived and true value:

$$E_2^G - \frac{d}{u}E_2^G = \left(1 - \frac{d}{u}\right)E_2^G = AE_2^G. \tag{3.29}$$

In the equilibrium, profits from switching to the type-G strategy are equal to the loss due to liquidation. Thereby, the incentive constraint of type B's not mimic G's is of the form:

$$AE_2^G = \theta J^2 \Leftrightarrow E_2^G = \frac{\theta J^2}{A}, \tag{3.30}$$

which gives also the amount J by which type G's 'underlend':

$$J^2 = \frac{AE_2^G}{\theta} = \frac{A\left(E_2^B - J\right)}{\theta} \Leftrightarrow \theta J^2 + AJ - AE_2^B = 0$$

$$\Leftrightarrow J = \frac{-A \pm \sqrt{A^2 + 4\theta AE_2^B}}{2\theta}.$$

(3.31)

Due to the potential adverse selection problem in time-2 external finance markets, both types of banks face ex ante expected liquidation costs X at time 1, which depend on the time-2 financing shortfall. Since at time 2 type B's raise enough external finance so as not to have to liquidate any loans at all, only G's will incur costs. Calculating with the minimum amount of deposits available at time 2, the expected costs are of the form:

$$X = p * C\left(L - E_1 - M_2^{\min}(1 - \phi)\right) + (1 - p) * C(0)$$

$$= pC\left(L - E_1 - (1 - \phi)\left(\rho M_1 + (1 - \rho)M - \gamma/2\right)\right),$$

(3.32)

where p is the time-1 probability of a bank being of type G at time 2 and C( ) is an increasing convex function, with $C(0) = 0$. For a given M_1, the expected costs can be reduced by raising E_1 relative to L, ie by holding a greater buffer stock of securities S_1 at time 1. In fact, by making the buffer stock large enough, the expected liquidation costs can be ultimately driven to zero. Consequently, banks choose to hold securities in their portfolios despite their lower (risk-adjusted) rate of return compared to loans, since the loss in the yield is compensated by their greater liquidity at time 2. As a result, there is a tradeoff between the two assets and, since cutting loans is costly, the optimal time-1 response to a given financing shortfall is to reduce both the securities holdings and lending.

Next, the model is solved at time 1. Banks are assumed to be monopolists in the loan market and to face the following demand function for loans:

$$L^D = a - br,$$

(3.33)

where r is, as before, the rate charged to borrowers and b (> 0) a measure of the elasticity of loan demand[19].

In the low-cost separating equilibrium, type B's choose r^B so as to maximise their interest income, ie the amount lent multiplied by the rate of return on loans:

$$\max_{r^B} r^B L^B = \max_{r^B} r\left(a - br^B\right) = \max_{r^B}\left(ar^B - b\left(r^B\right)^2\right).$$

(3.34)

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[19] This sort of loan demand schedule can be derived from optimisation on the part of borrowers by assuming that they are price-takers and have output that is a quadratic function of the amount invested.

Taking the first and second derivatives gives the first- and second-order conditions for the maximum:

$$\frac{d\left(ar^B - b\left(r^B\right)^2\right)}{dr^B} = a - 2br^B = 0 \Leftrightarrow br^B = \frac{a}{2} \Leftrightarrow r^B = \frac{a}{2b} \quad \text{and} \tag{3.35}$$

$$\frac{d^2\left(ar^B - b\left(r^B\right)^2\right)}{d\left(r^B\right)^2} = -2b < 0 \rightarrow \max. \tag{3.36}$$

Substituting $br^B = \frac{a}{2}$ into (3.33) gives type B's optimal lending decision at time 1:

$$L^D = L^B = a - br^B = a - \frac{a}{2} = \frac{a}{2}. \tag{3.37}$$

At time 1, type B's choose to raise an amount of external finance that is with certainty enough also for the time-2 requirements regardless of whether the deposits decline or increase:

$$E_2^B = \max\left(0, L^B - E_1^B - M_2(1-\phi)\right) = 0 \tag{3.38}$$

$$\begin{aligned}\Rightarrow E_1^B &= L^B - M_2(1-\phi) = \max\left(0, L^B - M_2^{\min}(1-\phi)\right)\\ &= \max\left(0, a/2 - (1-\phi)\left(\rho M_1 + (1-\rho)M - \gamma/2\right)\right).\end{aligned} \tag{3.39}$$

Consequently, securities holdings must satisfy

$$\begin{aligned}S_1^B &= M_1 - R_1 - (M_2 - R_2) = (1-\phi)(M_1 - M_2)\\ &\geq (1-\phi)\left(M_1 - M_2^{\min}\right) = (1-\phi)\left(M_1 - \left(\rho M_1 + (1-\rho)M - \gamma/2\right)\right)\\ &= (1-\phi)\left((1-\rho)(M_1 - M) + \gamma/2\right),\end{aligned} \tag{3.40}$$

ensuring that $X^B = 0$.

When E_1^B is strictly positive, (3.40) holds with equality. Then, the greater is the variance of the time-2 deposit shock, ie the greater is γ, the larger the buffer stock of securities should be for type B's at time 1. Moreover, the more transitory the time-1 deposit shocks are in nature, ie the closer ρ is to zero, the more sensitively the securities holdings should react to those shocks. In the case of relatively permanent shocks, type B's react by raising more external finance E_1^B instead of reducing securities. Banks can thus use their buffer stocks of securities for smoothing the use of uninsured external finance over time.

Type G's raise less external finance than type B's at time 1 as well. As a result, they invest less in both loans and securities and are therefore forced to liquidate a part of the loans at time 2. The net costs of this to type G's are equal to the difference between the profits of type B's and G's and consist of liquidation costs and losses in yield owing to a smaller stock of loans:

$$W\left(E_1^G\right) = \pi_1^B - \pi_1^G = r^B L^B - \max\left(r^G L^G - X\right). \tag{3.41}$$

$W(\ )$ is a decreasing function, with $W\left(E_1^B\right) = 0$. For type G's their rate of return on loans, r^G, can be calculated from the equilibrium:

$$L^D = L^G \Leftrightarrow a - br^G = L^G \Leftrightarrow r^G = \frac{a - L^G}{b}. \tag{3.42}$$

Since type B's lending is given by (3.37), for them the rate of return on loans is given by:

$$a - br^B = \frac{a}{2} \Leftrightarrow r^B = \frac{a}{2b}. \tag{3.43}$$

Thereby, (3.41) can be rewritten into the form:

$$\begin{aligned} W\left(E_1^G\right) &= \frac{a}{2b}\frac{a}{2} - \max\left\{\frac{a - L^G}{b}L^G - pC\left(L^G - E_1^G - (1-\phi)\left(\rho M_1 - (1-\rho)M - \frac{\gamma}{2}\right)\right)\right\} \\ &= \frac{a^2}{4b} - \max\left\{\frac{\left(aL^G - \left(L^G\right)^2\right)}{b} - pC\left(L^G - E_1^G - (1-\phi)\left(\rho M_1 - (1-\rho)M - \frac{\gamma}{2}\right)\right)\right\}. \end{aligned} \tag{3.44}$$

Analogous to time 2, the incentive constraint for type B's to mimic type G's states the time-1 low-cost separating equilibrium:

$$W\left(E_1^G\right) = AE_1^G \Leftrightarrow E_1^G = \frac{W\left(E_1^G\right)}{A}. \tag{3.45}$$

Finally, conclusions can be drawn about banks' portfolio behaviour in the case of a monetary contraction at time 1. Again, banks have three possibilities to cope with the tightening. They can either reduce the supply of loans, raise non-deposit external finance or sell off securities. The model has two important implications. First, type G's react to deposit outflows by cutting the lending. Thus, even the presence of buffer stocks of securities on type G's balance sheets does not lead to loans being fully insulated from deposit shocks at time 1. Basically, the stronger

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the degree of informational asymmetry, the larger should be the effect of deposit shocks on lending, ie for type G's $dL/dM_1 < 0$ and $d^2L/dM_1dA > 0$.

Second, both type G's and B's react to a decrease in deposits by cutting their securities holdings, ie $dS/dM_1 < 0$. For type G's, the impact of deposit shocks on securities holdings can become either stronger or weaker when the informational asymmetry A increases in magnitude. On the one hand, due to an adverse selection problem at time 2, it is more attractive for high-A banks to hold large buffer stocks of securities, since they are the ones most eager to avoid raising external funds at time 2. This suggests that high-A banks value securities more highly and are less willing to cut them as M_1 falls.

On the other hand, the model implies that high-A banks cut their loans more at time 1 than those facing less informational asymmetry. This in turn means that the loan-security spread r rises by more for high-A banks, thereby making them to rebalance their portfolios so as to put more weight on loans at the expense of securities, ie to cut securities by more in response to a given deposit outflow. With relatively inelastic loan demand, the movement in r is substantial, making the latter effect dominant.

When the interest elasticity of loan demand b is high, it is more likely that securities are more sensitive to deposit shocks in banks facing low informational asymmetry, ie $d^2S/dM_1dA < 0$. Conversely, when loan demand is relatively inelastic, it is more likely that banks facing higher informational asymmetry are less sensitive to deposit outflows.

Extending the model to allow for inter-bank competition for deposits gives rise to a situation where firms using direct finance are also affected by the monetary tightening. Within perfectly competitive deposit markets, it is possible for type G's, who are more reluctant to raise uninsured external finance, to bid deposits away from type B's. With a common interest rate on deposits and bonds, households are indifferent between holding them, so the only distinction between the two comes from banks' preferences due to the adverse selection problem. In the extent to which the monetary authorities can drain reserves form the system, they are also able to contract the supply of deposits to banks. Thereby, the relative price of deposits rises, raising also the bond market rate. Type G's, who are now short of deposits, choose to lend less, which in turn raises the interest rate on loans r faced by their customers. Consequently, both the rate of return on bonds and the loan-bond spread are sensitive to monetary policy.

3.4.2   Balance sheet channels

The balance sheet channel operates through the effect of monetary policy on borrowers' net worth, determined on the basis of their balance sheets and income statements. The functioning of the channel is based on the idea that any shock

affecting borrowers' financial position influences also their external finance premium and the overall terms of credit the borrowers face in the markets. Basically, the lower the net worth of borrowers, the greater is the degree of adverse selection and moral hazard in lending to these borrowers and therefore the greater is the external finance premium. Changes in credit conditions in turn affect both lending and borrowing decisions and further borrowers' investment and spending decisions.

There are several ways in which monetary policy actions can affect borrowers' financial position, both directly and indirectly. In what follows, these different channels are described in greater detail in accordance with Bernanke and Gertler (1995) and Mishkin (1996).

Cash flow channel

A monetary contraction leading to higher short-term nominal interest rates i increases interest expenses from borrowers' outstanding short-term and floating-rate debt. Increased interest payments in turn reduce borrowers' net cash flow and thus lower their net worth. Higher losses from adverse selection are due to lower collateral values, whereas greater moral hazard results from borrowers' lower equity stakes. Moreover, the degree of adverse selection increases, since economic agents who are willing to take the biggest risks are the ones most anxious to borrow. Consequently, reduced lending by banks leads to lower investment spending and thereby to lower aggregate demand and output. Correspondingly, expansionary monetary policy with opposite effects can be simplified into the following schematic:

$$M \uparrow \Rightarrow i \downarrow \Rightarrow \text{net cash flow} \uparrow \Rightarrow \text{net worth} \uparrow$$
$$\Rightarrow \text{adverse selection \& moral hazard} \downarrow \Rightarrow \text{lending} \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow, \tag{3.46}$$

reflecting the fact that a greater net worth enables borrowers to reduce conflicts with lenders by offering more collateral to guarantee their loans or by financing a greater share of their investments internally.

Asset price channel

Rising interest rates typically lower asset prices P_e and thus directly weaken the borrowers' net worth. A fall in asset prices reduces also the value of borrowers' collateral and thus their creditworthiness. Similarly, declining interest rates tend to

raise asset prices and strengthen borrowers' financial position, thereby leading to similar effects as above:

$$M \uparrow \Rightarrow P_e \uparrow \Rightarrow \text{adverse selection \& moral hazard} \downarrow \Rightarrow \text{lending} \uparrow \Rightarrow I \uparrow \Rightarrow Y \uparrow \quad (3.47)$$

Debt deflation

Also an unanticipated decrease in the price level P reduces borrowers' net worth through debt deflation by increasing the real burden of debt payments fixed in nominal terms. Likewise, an unanticipated rise in the price level increases borrowers' net worth:

$$M \uparrow \Rightarrow \text{unanticipated } P \uparrow \Rightarrow \text{adverse selection \& moral hazard} \downarrow \Rightarrow \text{lending} \uparrow \\ \Rightarrow I \uparrow \Rightarrow Y \uparrow. \quad (3.48)$$

This effect of unanticipated price fluctuations on output supports further the view that the ECB should keep the price level as stable as possible in the medium term. Moreover, it implies that deviations from the inflation target are undesirable in both directions.

Financial gap

Monetary tightening can affect borrowers' net worth also indirectly by increasing the financial gap, ie the difference between borrowers' uses and sources of funds. If a firm's customers reduce their spending for cost-of-capital or balance sheet reasons, the firm's revenues decline, while various fixed payments remain the same in the short run. This weakens the firm's financial position and creditworthiness over time.

Household liquidity effect

The balance sheet channel applies equally to both households and nonfinancial corporations. When stock prices P_e rise, share-owning households' financial position becomes more secure since the value of their financial assets rises relative to their liabilities. Thus, the probability of financial distress decreases, which in turn increases the willingness to purchase consumer durables and housing C:

$$M \uparrow \Rightarrow P_e \uparrow \Rightarrow \text{financial assets} \uparrow \Rightarrow \text{likelihood of financial distress} \downarrow$$
$$\Rightarrow C \uparrow \Rightarrow Y \uparrow . \tag{3.49}$$

On the contrary, a higher likelihood of financial distress after a monetary tightening reduces spending on illiquid real assets. Instead, consumers increase their holdings in liquid financial assets, such as deposits, stocks and bonds, which can be sold easily for their full market value in the case of a financial distress. Exceptionally, the fall in output results here from households' unwillingness to consume, not from the credit rationing by banks.

4 Prior econometric evidence

This section provides an overview of the existing macro- and microeconometric evidence, whereas descriptive empirical research is discussed in section five. To begin with, some general issues are raised concerning the reliability and comparability of studies, since for several reasons, knowledge of differences between countries does not easily translate into robust conclusions about the likely impact of monetary policy. For one thing, eg Kieler and Saarenheimo (1998) have addressed the problem of identifying the causal effect of monetary policy actions. As they point out, changes in the economy following a shift in the stance of monetary policy may stem from the policy action itself or be due to the underlying factors that spurred the action in the first place.

The results of different types of studies are difficult to compare due to differences in methods and assumptions under which they have been conducted, since models with dissimilar structures leave it unclear whether the results differ only due to arbitrary modelling decisions. As Kieler and Saarenheimo (1998) state, results for the same country can differ considerably depending on the model used and, moreover, these differences tend to be larger than asymmetries found across countries using a given model and method. Furthermore, models with a uniform structure tend to yield smaller differences between countries than those with a more idiosyncratic structure (Guiso et al 1999). In addition, even the ranking of countries with respect to the impact of monetary policy has turned out to be inconsistent across different types of studies, as is shown in table 6 in section 4.1.

In particular, much of the existing empirical evidence is subject to differences between national monetary and exchange rate regimes under which the countries have operated in the past. According to Guiso et al (1999), to study properly the impacts of a common monetary policy it is necessary to formulate a monetary policy reaction function, which is uniform across countries and holds the exchange rates fixed. Furthermore, Guiso et al emphasise that the statistical

significance of the differences found between countries should be able to be tested in order to judge the reliability and uncertainty of the results.

In addition to differences between countries, cross-sectional time-series data can be problematic also with respect to the time dimension. In the case of EMU, it is possible that the transition to a common monetary policy framework and thereby the adoption of a new exchange rate mechanism and changes in the regulatory environment have resulted in such a striking regime switch that it has made the past evidence irrelevant. For example Guiso et al (1999) argue, however, that although beliefs about policy may have changed with the outset of the ESCB, it is unlikely that this institutional change has caused changes in economic agents' behaviour in a sharp or discontinuous fashion. Rather, behaviour is likely to adjust gradually, thereby not leading to any significant structural breaks in the data.

According to the ECB (1999), in the medium to long term EMU is likely to reinforce trends, which were already prevailing in the EU banking systems before the beginning of Stage Three. Due to increased competition within the euro area, existing excess capacity is expected to be reduced further and the pressure for the better profitability is assumed to still strengthen. Also internationalisation and geographical diversification are expect to increase along with new conglomerations, mergers and acquisitions in the banking sector. Moreover, for example Dornbusch et al (1998a) claim that the introduction of the euro may speed the rate at which financial relationships within Europe start to resemble those in the United States. Nevertheless, it seems reasonable enough to expect the past empirical evidence to retain some of its predicting value also for the near future.

4.1   Macroeconometric models

The existing macroeconometric analysis of monetary transmission is commonly divided into five categories on the basis of the models used: (1) large-scale single-country and (2) multi-country models, (3) small-scale structural models, (4) single-equation models and (5) structural vector autoregressions. Somewhat contradictory results of representative studies of each type are summarised in table 6 below for the four largest European countries, following the example of Kieler and Saarenheimo (1998). Figures indicate the estimated impact of a 100 basis point increase in short-term interest rates on real GDP 4 to 8 quarters after the initial monetary shock.

Table 6.			Estimated output responses (%) to a uniform monetary shock in different types of models		

Study	DE	FR	IT	UK	Ranking
(1) BIS (1995)[1]	−0.4	−0.4	−0.5	−0.9	DE=FR<IT<UK
(2) BIS (1995)[2]	−0.7	−0.7	−0.3	−1.2	IT<DE=FR<UK
(3) Britton and Whitley (1997)[3]	−0.5	−0.5	−	−0.3	UK<DE=FR
(4) Dornbusch et al (1999b)	−1.4	−1.5	−2.1	−0.9	UK<DE<FR<IT
(5) Ramaswamy and Sløk (1997)	−0.6	−0.4	−0.5	−0.5	FR<IT=UK<DE

(1) fixed ERM rates for Germany, France and Italy, and an endogenous exchange rate (ie determined by the open interest-parity condition) for the United Kingdom
(2) endogenous exchange rates
(3) each country estimated separately

In what follows, these and few other studies most often quoted in the literature are briefly discussed in the light of critique they have been given.

4.1.1 Large-scale single-country models

The BIS study (1995, 225–266) comprises a set of large-scale single-country macroeconometric models simulated independently by the national central banks. The simulations are conducted both under fixed exchange rates and allowing the exchange rates to change either independently or assuming fixed intra-ERM exchange rates against the rest of the world. The results for twelve industrialised countries[20] indicate the simulated responses of real GDP to a common monetary shock of a temporary one-percentage point increase in the monetary policy rate.

According to the results, in Europe at a two-year horizon, the output effects are found to be by far the greatest in the United Kingdom (–0.89%) for an endogenous exchange rate. Among the present euro area countries, the effects are largest and approximately of the same size in Germany, France and Italy (–0.37, –0.36 and –0.53%, respectively) under fixed ERM rates. Considerably smaller effects are found in the Netherlands, Austria, Belgium and Spain (–0.18, –0.14, –0.12 and –0.02%, respectively). On the basis of these results, the extent to which the real economic activity is affected by monetary policy seems to be related to the size of the economy, in the sense that effects are larger in larger economies.

One of the goals of the BIS study was to explore whether cross-country differences in monetary policy effectiveness could be related to cross-country differences in the underlying financial structures. However, in most cases financial structure is only indirectly modelled, as it influences the modelling mainly through decisions as to which interest rates and asset prices are included in

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[20] The BIS study includes the central bank models of the United States, Japan, Germany, France, Italy, the United Kingdom, Canada, the Netherlands, Belgium, Spain, Austria and Switzerland.

each country-specific model. Consequently, critique on these single-country models focuses mainly on their lack of common structure. According to Kieler and Saarenheimo (1998), variant assumptions under which the models have been specified may at worst dominate any genuine differences in economic agents' behaviour and in the underlying national economic and financial structures. Moreover, as Guiso et al (1999) point out, estimating the models independently of each other does not allow for formal statistical testing of differences found between countries.

Another source of criticism is the size and structure of large-scale models as such. Guiso et al (1999) argue that many of the equations within the models would fail statistical tests assessing their specification. Furthermore, since equations are estimated one at a time, the simultaneous nature of changes in a wide range of macroeconomic variables is being ignored (Kieler and Saarenheimo 1998).

4.1.2 Large-scale multi-country models

The above-mentioned BIS study (1995, 582–603) reports results also from simulating the rational-expectations version of the Federal Reserves Bank's Multi-Country Model for the G7 countries[21]. Multi-country models impose a similar structure across countries, which, on one hand, may reduce the potential biases underlying the use of national models, but on the other hand, it can also make the models less able to capture the specific features of individual economies (Kieler and Saarenheimo 1998).

In the multi-country BIS study, the structure of the model is intended to be used primarily to compare the channels of monetary transmission across countries. Results for endogenous exchange rates indicate that output responses to a temporary increase in the policy-controlled short-term interest rate of 100 basis points, lasting for two years, are the largest in the United Kingdom (–1.20%) and the second greatest in France and Germany (–0.70% and –0.65%, respectively), whereas in Italy the reaction is found to be considerably smaller (–0.30%). According to the results, almost all the effect on GDP is transmitted through the cost-of-capital and exchange rate channels, whereas the cash flow and direct consumption channels are found almost negligible.

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[21] The G7 countries include the United States, Canada, France, Germany, Italy, Japan and the United Kingdom.

4.1.3 Small-scale structural models

Small-scale structural models impose a common structure across countries considered, but the criticism against them focuses primarily on their over-simplified form and the high degree of aggregation hindering the capture of cross-country differences in underlying economic structures. (Kieler and Saarenheimo 1998)

A small-scale structural model estimated by Britton and Whitley (1997) applies the Mundell-Fleming model incorporating the Dornbusch overshooting mechanism. The study finds that when the country-specific models are estimated separately, output is less interest rate sensitive in the United Kingdom than in Germany and France, but the difference is not large enough to be statistically significant. On the other hand, when the models are estimated jointly, the responses are found to be the same in all three countries.

On the basis of their own estimations and the prior empirical evidence, Britton and Whitley conclude that some of the commonly cited differences between countries are not really structural. And even when they are, Britton and Whitley argue that they do not automatically imply that one economy is more sensitive than another to a change in the stance of monetary policy.

4.1.4 Single-equation models

Compared to the models described above, studies based on single-equation models are ideal in the sense that they allow both the exchange rate developments and monetary policy shocks to be identical across countries. That is, the specification of this form allows one to control for the intra-European exchange rate channel, and thereby to simulate a common monetary shock under a fixed exchange-rate framework, as it has been the case within EMU since the adoption of the common currency. Furthermore, since estimations can be made jointly for a set of countries, the statistical significance of differences found between countries can be tested formally. On the other hand, in addition to the usual identification problems, Guiso et al (1998) raise some doubts about the interpretability of the results due to the ad-hoc nature of the equations.

Dornbusch et al (1998b) have estimated an equation for output growth for a set of six European countries. Equations predict output growth in each country as a function of past output growth in that country, past output growth in the other countries, present and past values of expected and unexpected components of interest rates, and present and past values of bilateral exchange rates against the US dollar and the deutschemark (DM). Thereby, the method allows for simultaneity in the determination of output across countries, but not for the simultaneous determination of output, prices and monetary policy in each country.

Findings on the effect after two years imply that the impact of monetary policy on output is virtually the same in Germany (–1.40%), France (–1.54%) and Spain (–1.54%) but considerably stronger in Italy (–2.14%) and Sweden (–2.36%). The United Kingdom stands out with a notable smaller effect (–0.9%), which is explained by smaller spill-over effects from other countries and by the fact that the UK is more weakly related to the European economic cycle than the other countries considered.

4.1.5   Structural vector autoregressions

Structural vector autoregressions (SVARs) aim at determining how a change in one variable affects the others under consideration by relating a set of variables to their lagged values. According to estimates based on a vector autoregression model by Ramaswamy and Sløk (1998), the full effects of a contractionary monetary shock on real activity in one group of EU countries (Austria, Belgium, Finland, Germany, the Netherlands, and the United Kingdom) take roughly twice as long to occur, but the resulting decline in output is almost twice as large as in the other group (Denmark, France, Italy, Portugal, Spain, and Sweden). Also Ehrmann (1998) has used SVARs in modelling responses to monetary shocks in thirteen European countries. According to his findings, reactions of macroeconomic variables are weak on average but major heterogeneity exists in their magnitude across countries, with effects being larger in larger economies.

According to Guiso et al (1999), models using SVARs run into problems of asymmetric shocks and distinctive exchange rate changes. The former refers to a situation where shocks to the models differ across countries either in terms of their size or time path or both, making it difficult to draw comparisons between countries. Furthermore, as Kieler and Saarenheimo (1998) note, the black-box nature of SVARs makes it difficult to relate the estimated parameters and impulse responses to structural differences between economies. Moreover, since assumptions about the way in which the monetary authorities react to new developments in the economy tend to differ across models, different economic responses could result even if the underlying structures of the economies were similar.

The second problem in turn arises when the lock-in of the euro area currencies is neglected in the model, since changing parities makes it difficult to distinguish a given monetary policy shock from the other simultaneous shocks in the economy, including the endogenous response to exchange rate movements. Consequently, Guiso et al (1999) conclude that much of the evidence based on SVARs is likely to be irrelevant in the common monetary policy framework.

4.2   Microeconometric models

This section presents evidence from the prior microeconometric analysis on bank- and firm-specific data. The importance of using micro level data is emphasised eg by Guiso et al (1999), who state that it enables identifying behavioural differences both between different groups of agents in the same country and between similar groups of agents across different countries. The disaggregation of data may thus reveal that observed aggregate differences in responses to common monetary policy actions arise in fact for various different reasons. They can either result from cross-country differences in household and corporate sector behaviour or only from the fact that the mix of different types of households and firms differs across countries.

In 1999, the ECB and the euro area national central banks established a group of economists, called the Monetary Transmission Network (MTN), to work on the euro area monetary transmission in a consistent and harmonious manner. The Network is, in particular, aimed to examine empirically how monetary policy decisions affect the national private sectors on a micro level. Working papers written under this objective haven taken three different perspectives: (1) structural and VAR macro models for the euro area and the national economies, (2) panel micro data analyses of bank behaviour and (3) panel micro data analyses of corporate investment behaviour. The two latter groups of studies are discussed in greater detail below.

4.2.1   Models on bank-specific panel data

A total of ten studies, using national bank-specific cross-sectional time series data, have been published in the ECB working paper series[22]. Research on micro-level bank data has contributed, in particular, to the study on the bank lending channel of the euro area monetary transmission. The main focus has been on testing a hypothesis that bank-specific characteristics affect the extent to which changes in money market interest rates are transmitted into either credit expansion or rationing by banks. Each country-specific paper contains also some descriptive analysis of the structure of the national banking sector and the past macroeconomic developments, which are considered to have a bearing in the econometric analysis.

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[22] Evidence from bank level data is available for nine countries – Germany, Austria, the Netherlands, Spain, Finland, France, Portugal, Italy and Greece – in the ECB Working Papers No.'s 96–104, respectively. In addition, Paper No. 105 (Ehrmann et al) provides some evidence on the aggregate euro area level and, in particular, compares the results for the four largest EMU countries.

The main results from the studies are collected in the following on the basis of a brief summary by Angeloni et al (2002). According to estimations, loan supply effects were found to be present in France, Germany, Greece, Italy, the Netherlands and Portugal, ie in these countries either smaller, less liquid or less capitalised banks were found to adjust their loans more than their larger, more liquid and better capitalised counterparts[23]. In Austria, effects were found only limited in the sense that supply shifts were observed only during recessions. In Portugal in turn the effects seem to be totally absent, as no evidence of supply shifts was found, even after an institutional reform that squeezed bank deposits considerably.

For Finland the evidence is doubtful. According to Topi and Vilmunen (2001), bank lending responses positively to changes in GDP growth and inflation and negatively to contractionary monetary policy shocks, but the evidence in favour of the bank lending channel is weak. As to the bank-specific variables, both the linear effects and those through interaction with the policy rate are signed as expected, but the statistical significance of the interaction terms is poor. Consequently, the writers tentatively conclude that the bank heterogeneity is not irrelevant for the way in which changes in interest rates affect lending, but that the data used is too noisy for any definite signals to be identified.

According to Ehrmann et al (2001), an aggregate level cross-country comparison can be drawn by estimating the model country by country using bank-specific micro level data and then by weighting the banks in the sample with their respective market shares when calculating the overall loan responses of banks in a given country. Ehrmann et al have performed such an analysis for four countries, the results implying that the magnitude of lending reactions is similar in France and Spain, and similar in Germany and Italy but much weaker than in France and Spain.

All in all, based on their own estimations and the above-described country-specific papers, Ehrmann et al (2001) conclude that monetary policy has a significant effect on bank lending both on the country and aggregate euro area level. In general, Ehrmann et al find that less liquid banks tend to react more strongly to monetary policy actions than more liquid banks do, whereas size and the degree of capitalisation of the bank are not that relevant for the way in which it adjusts its lending to interest rate changes. Moreover, on the basis of descriptive cross-country comparisons between euro area banking systems, Ehrmann et al state that the way in which banks respond to monetary policy actions can be explained partly by the structure of the national banking system.

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[23] In the estimated models, size is measured as a log of total bank assets, whereas liquidity and capitalisation are given, respectively, by the ratio of liquid assets and the sum of capital and reserves to total bank assets.

4.2.2   Models on firm-specific panel data

Within the MTN, the transmission of monetary policy has been investigated also using micro-level data on firms[24], with the main purpose in analysing the existence of the credit channel. More specifically, papers generated under this objective aim at testing whether firms' investment is sensitive to the user cost of capital and further at examining to what extent the costs are affected by monetary policy actions. In addition, also sales and cash flow are used in explaining investment dynamics. Furthermore, a distinction between small and large firms is made in order to explore whether significant differences exist between them in terms of their investment behaviour.

Results for Germany, France, Italy and Spain imply an operative interest rate channel in all four countries, as investments are found to be sensitive to policy-induced changes in the user cost of capital. Moreover, investment is found to be quite sensitive also to movements in sales and cash flow, but only in Italy reactions are found to differ across firms depending on their size. Consequently, the paper concludes that the firm size may not be the right indicator in all countries to investigate the functioning of the broad credit channel. (Chatelain et al 2001)

On the Finnish financial statement data, the firm-level estimates do not provide any evidence for the existence of binding financing constraints in firms' investment spending, but both the sales accelerator and user-cost effects are found to be significant. However, according to Vilmunen (2002), the effects are surprisingly weak, for which a plausible explanation might the sample being biased to large firms. In fact, findings on the aggregate-level data suggest much stronger responses.

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[24] Evidence on investment dynamics is available for France, Belgium, Austria, Germany, Italy and Luxembourg in ECB Working Papers No.'s 106–111. In addition, Paper No. 112 is conducted for the four largest EMU countries. Results for Finland have been published as a BoF discussion paper.

5   Descriptive statistics on financial systems

Financial structure is commonly considered important to monetary transmission and, in fact, a major determinant of the monetary transmission mechanisms. It affects the process, in particular, by influencing the speed at which monetary policy actions affect the market interest rates[25] and the extent to which the interest rate changes are transmitted into the real economy. Hoogduin and Huisman (1998) divide the mechanisms through which interest rate changes affect the real economic activity into four complementary channels: through short- and long-term market interest rates on *new financing*, through adjustable interest rates on *outstanding loans*, through the implied *revaluation of assets* and through *exchange rate changes*. Thus, the overall interest rate sensitivity of banks, firms and households depends on the level and composition of their wealth and indebtedness, as well as on many other structural characteristics of the respective financial system.

This section presents descriptive statistics for a set of European countries on factors commonly considered relevant to the monetary transmission process, and specifically, to the operation of the bank lending channel. The main purpose here is to explore significant structural differences between financial systems across the present and potential future Member States and to shed some light to the microeconomic heterogeneity between countries. However, since the comparison of countries rests mainly on a simple description of data, the statistical deficiencies and discrepancies of which cannot be fully discovered, conclusions should be considered somewhat tentative.

Recently, similar comparative analyses for different sets of countries have been drawn for example by Favero and Giavazzi (1999) and Fase and de Bondt (2000).[26] Favero and Giavazzi address the issue of asymmetries in monetary transmission by discussing theoretical transmission mechanisms in respect to the relevant institutional and empirical evidence for the United States and a set European countries. Fase and de Bondt in turn provide an extensive survey of theories of credit to the private sector and present relevant stylized facts for six EU countries. The view of the prior studies is broadened here by taking additional countries and indicators into consideration. Moreover, Finland is of key interest, since so far it has commonly been neglected in EMU-wide cross-country comparisons.

To begin with, the securities markets are compared across countries. After discussing the importance of direct finance, financial intermediaries are brought

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[25] See, for example, Cottarelli and Kourelis (1994) for empirical evidence for a strong relation between the degree of interest rate stickiness and the structure of the financial system.

[26] See also Peersman (2001), Cecchetti (1999), de Bondt (1998) and BIS (1995), among others.

into focus. The size and structure of financial intermediary markets are examined across countries and differences in various banking sector characteristics are considered in greater detail. The two opposite roles of financial intermediaries as creditors and debtors are discussed by comparing the two most important banking customer sectors, households and nonfinancial corporations, across countries. The focus is on examining how their financial assets and liabilities differ from one country to another in terms of their structure and amount relative to GDP.

5.1   Securities market

The securities markets comprise markets for direct finance, which on the basis of maturity of instruments can be divided into money and capital markets, with the latter divided further into stock and bond markets. In Europe, bank loans have historically had a more prominent role in corporate finance than equity and bonds, but there are, however, considerable differences in overall bank dependence across countries.

The degree of bank dependence is an important factor determining the strength and effectiveness of the bank lending channel. Basically, the larger the securities market in the economy, the less heavily the nonfinancial corporate sector should depend on intermediated finance. Moreover, since large firms have a better access to capital markets, countries with many small firms should react more strongly to monetary policy shocks than countries where firms are larger on average.

Table 7 below illustrates the relative importance of national direct and indirect credit markets across the EU countries. The first column shows the value of domestic companies' shares as a % of GDP at the year-end 2000. Since shares are valued at prevailing market prices, the total market capitalisation responds to changes in both number and value of shares. Thereby, since rises in share prices in the secondary market do not lead to any additional flows of finance to the listed companies, the capitalisation figures exaggerate the importance of actual equity finance especially during the boom in the late 1990s. Thereby, the amount of new capital raised by domestic companies relative to a country's gross fixed capital formation, shown in the second column of the table, reflects more realistically the use of direct finance.

Table 7.   **Direct vs indirect credit markets**

Country	Market value / GDP (%)[a]	New capital / GFCF (%)[a]	Private credit / GDP (%)[a]	Bond emissions / GDP (%)[b]
AT	16	5	105	0.18
BE	81	–	81	0.29
FI	242	48	54	1.05
FR	112	–	89	2.32
DE	68	6	123	1.08
GR	96	36	54	1.02
IE	86	24	109	0.38
IT	72	5	78	1.13
LU	179	49	111	1.91
NL	174	–	143	2.51
PT	58	50	144	1.52
ES	90	–	104	1.32
DK	69	18	35	0.54
SE	144	29	45	2.20
UK	184	14	132	2.58

(a) in 2000
(b) corporate bond emissions; average for the years 1998–2001, or for those available
Source: FIBV, calculations based on the IMF's International Financial Statistics, Eurostat, Sampo Oyj and Dealogic Bondware.

The first measure indicates that at the year-end 2000 stock markets were particularly large – the value exceeding the GDP for the year – in Finland, France, Luxembourg, the Netherlands, Sweden and the United Kingdom. Nevertheless, in most countries stock indices reached their peaks during the year 2000 and were exceptionally high still at the end of December. Since the high around the turn of the century, the stock market values have, however, declined considerably in many of the euro area countries, for example in Finland as low as near to the late-1998 level[27]. Consequently, a comparison between countries is more relevant here than the past values as such. The second measure implies that also in Portugal equity finance was increasing in importance, whereas in Austria, Germany and Italy new capital issues were rather minor at the time.

The third column shows the value of outstanding credits by domestic financial intermediaries to the private sector in the country as a % of GDP. The indicator measures the relative size of the financial intermediary sector from the assets' point of view and it is often interpreted as indicating the level of financial services and the financial intermediary development. Economies are often categorised as

[27] The Finnish stock market was very small until the late 1990s, but since then the number of both investors and listed companies has increased considerably.

being either bank- or market-based, for example Austria, Germany and Italy falling into the former and the United Kingdom to the latter group of countries[28].

The last column shows the value of corporate bond emissions relative to GDP. The use of bonds has increased rather steadily through the late 1990s but their role is still small compared to the other forms of finance. Consequently, differences between countries are also less striking. For example, in Finland the growth of bond markets, beginning in the early 1990s, was mainly due to the increased government borrowing, but as a source of corporate finance bonds are still of a minor importance.

According to de Bondt (1998), the loan-deposit spread, ie the difference between the lending rate charged by the financial intermediaries and the deposit rate paid, can be used as a rough proxy for direct credit market imperfections. Basically, an increase in transaction costs and informational asymmetries increases also the spread. Moreover, the spread is typically lower for nonfinancial corporations than for households, implying that, in general, transaction costs and informational asymmetries form less a problem for firms than for households. In the de Bondt study, the corporate sector spread was found to be the lowest in the United Kingdom and Netherlands (as compared to Germany, France, Italy and Belgium), where stock markets were at the time the largest relative to GDP.

5.2   Financial Intermediaries

Since financial intermediaries play an important role in the credit view of monetary transmission, cross-country differences between financial intermediary sectors may give rise to considerable asymmetries across EMU. This section starts by viewing recent developments in financial intermediary markets and then compares the size and structure of the present national financial sectors, with the main focus on the euro area banking systems.

Financial intermediaries can be divided into deposit banks and non-bank financial institutions, with the latter comprising typically insurance institutions, credit card and finance companies, mortgage banks and special credit institutions. (The Finnish Bankers' Association 2001) The growing importance of non-bank financial intermediaries relative to banks seems to be a common structural change, taking place in most of the developed countries[29]. In many countries depository institutions have had for many years a falling share of total financial intermediary

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[28] For further discussion, see eg Demirgüc-Kunt and Levine (1999).

[29] See, for example, Allen and Santomero (2001) for a more detailed description of recent developments in the US financial intermediary market, which is a pioneer in this development. Compared to the United States, many countries are still in their very early stages.

assets, whereas financial assets held indirectly in the form of pension and mutual funds have continuously increased in importance.

Nevertheless, when comparing their assets to GDP, banking sectors have in general managed to maintain their position by innovating and switching from the traditional banking business to fee-producing activities, such as trusts, annuities, mutual funds, mortgage banking, insurance brokerage and transaction services. Consequently, to an increasing degree deposit banks belong to business groups, which offer a broad range of financial services, typically insurance policies, investment services, capital financing and transfer of payments. The traditional banking business of accepting deposits and admitting loans is thus in transition.

Schmidt et al (1999) have explored the role of banks as compared to securities markets. Based on data comprising France, Germany and the United Kingdom, they did not find any general trend towards disintermediation with the banking sector losing importance to the capital markets. Likewise, Allen and Santomero (2001) see the new markets for futures and options mainly as markets for intermediaries rather than for individuals or firms. Instead, according to Schmidt et al there seems to be another common pattern of change as deposit banks are specialising more in lending operations and non-bank financial intermediaries are taking over a more important role in mobilising capital from the savers.

In Europe, the national financial sectors differ quite tremendously in terms of their size relative to the respective total economy. To draw a comparison between a set of EU countries, figures 9 and 10 below present the financial sector financial assets and liabilities by balance sheet items as a % of GDP in 2000[30].

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[30] The data is derived from the Eurostat Financial Accounts and the classification of the financial balance sheet items corresponds to the standards of the 1995 European System of Accounts (ESA 1995). In this context, the financial sector comprises all corporations principally engaged in financial intermediation and/or in auxiliary financial activities. Due to ignoring the balancing item 'net financial assets', assets and liabilities do not equal in the figures. To calculate the ratios depicted in figures 9, 10 and 12–15, nominal end-of year assets and liabilities for the years 1999 and 2000 are deflated by the end-of-year consumer price indices for the respective years, and then the average of the two is divided by the real GDP for the latter year.

Figure 9.   **Financial sector financial assets as a % of GDP in 2000**
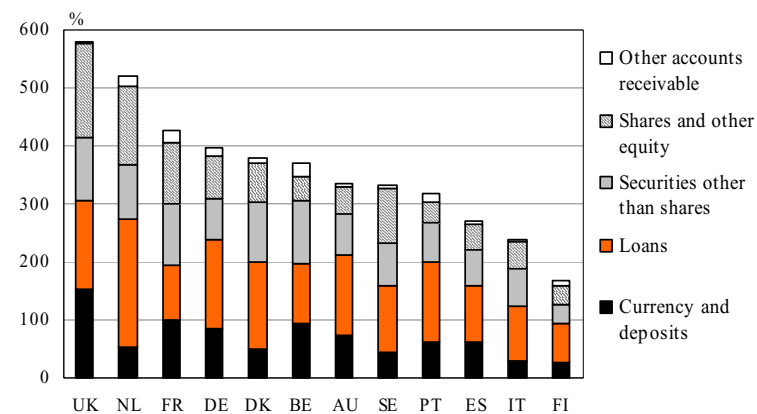
Source: calculations based on Eurostat Financial Accounts.

As shown in figure 9 above, in most of the countries considered, outstanding loans make up the largest individual item among the financial sector financial assets, but there is, however, great variance between countries when comparing the amount of loans to GDP or to the other financial assets. Based on data in 2000, the share of loans in total financial assets varies from 27% in the United Kingdom to 44% in Portugal, whereas relative to GDP the most loans are in the Netherlands and the least in Finland, with the shares of 219% and 69% respectively. In Finland loans account for 41% of the total financial sector financial assets, so despite their small amount in terms of the total economy they constitute a considerable share of the assets.

The proportion of securities in financial sector financial assets is also considerable in all sample countries. Shares and securities other than shares account together for 32% to 50% of the total financial assets, Portugal having the least and France and Sweden the most security-intensive financial sector. Other accounts receivable – comprising here monetary gold and special drawing rights, insurance technical reserves and trade credits and advances – are rather insignificant in most of the countries considered.

Figure 10.   **Financial sector liabilities as a % of GDP in 2000**
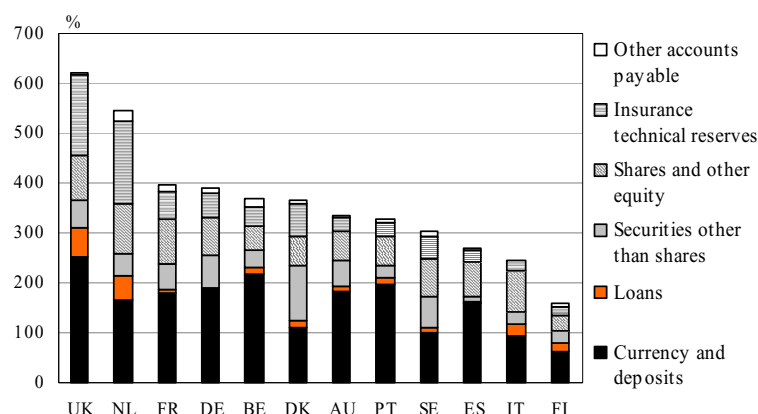
Source: calculations based on Eurostat Financial Accounts.

As shown in figure 10 above, currency and deposits account for a major share of the total financial sector liabilities in all sample countries, varying from a high of 60% in Portugal to a low of 30% in the Netherlands and Denmark in 2000. In Finland currency and deposits account for 40% of the total liabilities but are with 64% the least as compared to GDP across countries. In contrast, in the United Kingdom and Belgium, currency and deposits amount to over twice the GDP. The high proportion of insurance technical reserves[31] in the United Kingdom and Netherlands reflects their large pension funds and insurance companies (see also figure 11 below).

Interestingly, financial sectors differ greatly also when the value of loans on the asset side of their balance sheets is compared to the amount of currency and deposits on the liability side, see table 8. In the Netherlands, Italy and the Nordic countries, the value of loans exceeds that of deposits, whereas in Belgium and France deposits are nearly twice as high as the loans granted.

Table 8.   **Loans outstanding as a % of currency and deposits**
                             in the financial sector financial balance sheets
                             at the year-end 2000

AU	BE	FI	FR	DE	IT	NL	PT	ES	DK	SE	UK
76	51	108	53	81	102	130	76	63	134	115	61

Source: calculations based on the Eurostat's Financial Accounts.

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[31] Insurance technical reserves comprise provisions established by insurance corporations and pension funds for prepayments of insurance premiums and reserves for outstanding claims; see ESA 1995 for a more detailed definition.

The small amount of shares and other securities, as compared to deposits, in the financial sector liabilities coincides with the fact that financial intermediaries do not tend to raise funds by issuing shares or bonds.

The United Kingdom and Netherlands stand out with very large financial sectors in terms of their financial assets and liabilities relative to GDP. Financial sectors in France, Germany, Denmark and Belgium are considerably smaller than in the United Kingdom and Netherlands, but nevertheless larger than in Sweden, Spain and Italy. By these measures, Finland has, somewhat surprisingly, clearly the smallest financial intermediary sector among the countries considered. Consequently, the commonly held view of Finland being a particularly bank-based economy holds only when comparing banks to non-bank financial intermediaries – not relative to the size of the total economy. Moreover, the same holds also historically, as is evidenced by the IMF's International Financial Statistics time series (see eg figure A9 in appendix 2), so the current situation is not due to any recent courses of development. The gradual deregulation of the Finnish financial markets in the late 1980s together with the economic depression and the subsequent banking crisis in the early 1990s resulted in a peak in the ratio of credit to GDP, but besides these rather exceptional years the relative size of the financial sector has evolved rather steadily.

There are significant differences also in the institutional structures of the national financial sectors. In the Netherlands and United Kingdom insurance corporations and pensions funds account for a considerable share of financial sector total financial assets, as was already suggested by the large amount insurance technical reserves. Monetary financial institutions, other than the central bank,[32] are however dominant in all sample countries, accounting for more than half of the sector's total financial assets.

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[32] Other monetary financial institutions (other MFIs) are defined in ESA 1995 as comprising (a) commercial banks, 'universal' banks, 'all-purpose' banks (b) savings banks (c) post office giro institutions, post banks, giro banks (d) rural credit banks, agricultural credit banks, co-operative credit banks, credit unions, and (f) specialised banks.

Figure 11.   **Distribution of financial sector financial assets
                at the year-end 2000**
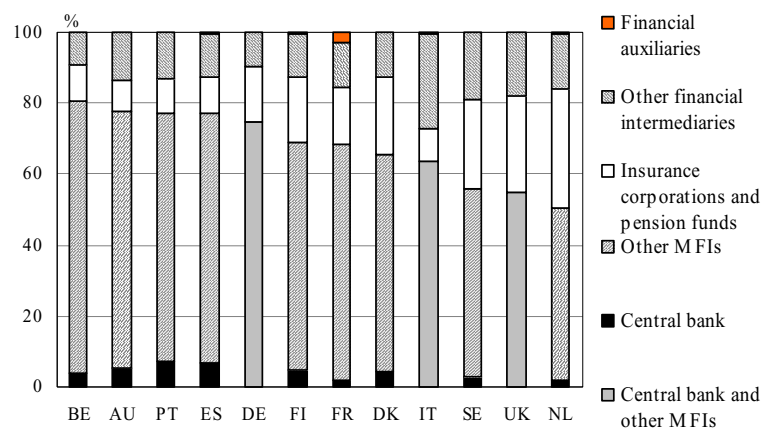
Source: calculations based on Eurostat Financial Accounts.

To further compare the size of the EU financial sector, table 9 below shows the credit institutions' balance sheet totals and loans to customers as a % of GDP, calculated on the basis of Eurostat's *Special Feature on Banking* (2001). Also the share of loans in the balance sheet total is depicted in order to assess the importance of lending activities from the banks' point of view. The table is in line with figures 9 and 10, and further emphasises the role of loans in Germany and the Netherlands, and outside EMU, in the United Kingdom and Denmark. The Finnish credit institutions are among the smallest lenders relative to GDP, but when compared to the sector's balance sheet total, the ratio is the second highest.

Table 9. **Size and structure of the EU credit institution sectors**

	Balance sheet total / GDP[a]	Loans to customers / GDP[a]	Loans / balance sheet total[a]	Number of credit institutions[a]	– per mio. inhabitants[a]	Concent-ration ratio: top five[b]
AU	262	128	49	870	108	39
BE	313	110	35	89	9	66
FI	106	75	71	361	70	56
FR	212	70	33	1148	19	48
DE	328	161	49	3055	37	14
GR	114	45	39	41	4	77
IE	189	94	50	53	15	47
IT	155	76	49	876	15	26
LU	3325	651	20	210	489	29
NL	242	140	58	169	11	81
PT	283	115	41	219	22	75
ES	179	94	53	387	10	42
DK	233	146	63	201	38	75
SE	174	109	63	212	24	88
UK	313	259	83	492	8	26

(a) in 1999 except in 1998 for Finland and in 1997 for Ireland
(b) loans of the five biggest credit institution as a % of total in 1997
Source: ECB (1999) and Eurostat (2001).

According to prior econometric evidence, lending is more closely tied to monetary policy shocks in small banks than in large banking conglomerates (see eg Kashyap and Stein 2000). Larger banks are less sensitive to changes in reserves, since they have better access to non-deposit sources of finance and more and better information with respect to capital markets (Fase and de Bondt 2000). Thereby, in countries where the banking system consists of small rather large banks, bank lending is expected to react more strongly to interest rate changes.

As shown in table 10 below, most banks are small in Austria, Finland, Portugal, Denmark and Sweden, whereas in Belgium, Greece, Luxembourg and the United Kingdom the share of large banks is considerable. The four largest euro area countries fall in the middle with mostly medium-sized banks. In general, the recent trend has been towards larger conglomerates through mergers within the banking sector and between banks and insurance companies. Austria and Finland have also considerably more banks per capita than the other EU countries, which for Finland is explained by the large amount of small co-operative banks. Greece, the United Kingdom, Belgium, Spain and the Netherlands have the least banks per capita, while the rest fall in between.

One additional way of measuring the structure of the banking system is to look at the share of the five largest creditors in total bank loans. Countries with the most banks per capita are typically among the ones with the least concentrated

systems. Interestingly, geographically small countries tend towards a high concentration of the banking industry and vice versa, which according to de Bondt (1998) suggests that banks may need a particular minimum size in order to benefit from the economies of scale.

Table 10. **Size and health of credit institutions**

	Breakdown (%) by size classes in terms of the balance sheet total (Mio. euro)[a]				Return on assets[a], %
	< 100	100–999	1 000–9 999	> 10 000	
AU	62.2	32.5	4.4	0.9	0.36
BE	16.9	43.8	31.5	7.8	0.40
FI	80.6	16.3	2.5	0.6	1.07
FR	33.6	39.8	23.2	3.4	0.48
DE	29.0	53.0	15.7	2.3	0.50
GR	34.1	26.8	29.3	9.8	1.77
IE	–	–	–	–	1.00
IT	37.0	42.1	16.6	4.3	0.45
LU	13.8	45.7	33.3	7.1	0.50
NL	–	–	–	–	0.81
PT	69.4	15.5	11.9	3.2	0.47
ES	34.6	34.1	26.6	4.7	0.60
DK	60.7	29.4	5.0	5.0	0.59
SE	51.4	32.5	10.8	5.2	0.73
UK	12.8	36.2	34.6	16.4	1.10

(a) in 1999 except in 1998 for Finland, in 1997 for Ireland, Luxembourg and the United Kingdom, and in 1996 for Germany
Source: ECB (1999) and Eurostat (2001).

A common argument is also that large, healthy banks are less sensitive to monetary policy, since they can offset reserve contractions more readily with other forms of finance, on which reserves are not required. Table ttt reports the rate of return on assets as a measure of the banking sector profitability.

5.3 Households

In most countries, households are the most important banking customer sector. Their dependence on bank loans is high due to very limited access to other forms of finance[33]. On the other hand, households are also an important source of finance as they save primarily by depositing money in banks. The financial assets

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[33] For example in Finland, the domestic deposit banks have granted nearly 90% of the household sector's outstanding credit stock, whereas at least in Sweden and Denmark also mortgage banks have an important role, in particular, in financing housing loans.

and liabilities of twelve EU household sectors are compared below on the basis of Eurostat Financial Accounts[34]. Findings rely partly on Elomaa's (2001) 11-country comparison with the similar but prior data. Nevertheless, before drawing the cross-country comparison, the Allen and Santomero (henceforth AS) study (2001) is briefly discussed in order to relate the household behaviour to certain specific banking sector activities.

In the AS study, cross-country differences in portfolio allocations of household financial assets are used for assessing the role of banks in risk management. AS classify equity and real estate as risky assets, the proportion of which of total household financial assets indicates the relative amount of risk borne by the respective household sector. Furthermore, in countries where the amount of risky assets held by households is high not only relative to their total financial assets but also to GDP, the absolute amount of risk is high as well. Based on these findings and statistics for a set of five countries, AS state that the US and UK households are exposed to a substantially greater amount of risk than their counterparts in Japan, France and Germany, both in terms of total household financial assets and relative to GDP.

AS explain these differences by the Allen and Gale theory of efficient risk sharing[35]. The theory states that in market-based financial systems, such as those in the United States and United Kingdom, competition from financial markets weakens the intertemporal smoothing of risks, since in economically good times households tend to transfer their investments from banks to money and capital markets. By buying assets that allow the immediate consumption of current payoffs, they aim at avoiding the otherwise apparent unprofitable accumulation of reserves.[36] As a result, cross-sectional risk sharing becomes correspondingly more important, meaning that risks are exchanged between more and less risk-averse individuals at any given point in time. Consequently, banks have to manage risk by using derivatives and other similar techniques instead of adjusting reserves. On

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[34] Due to a lack of disaggregation in the available data, figures for households include also non-profit institutions, which serve households by providing non-market goods and services. Their principal resources, apart from those derived from occasional sales, are derived from voluntary household contributions, from payments made by the government and from property income (ESA 1995). Moreover, it should be noted that a lot of wealth is ignored in the financial accounts data, as for example car stock, pay as you go -pensions and a part of real estates are totally left out. This, of course, distorts the comparison between countries the more, the higher the share of these assets is in total household wealth.

[35] See Allen and Gale (1997, 2000) for details.

[36] The US and UK households not only hold much higher proportions in risky assets but also own more financial assets per capita. For this reason, Elomaa (2001) sees the differences in proportions of risky assets primarily as a proof of marginal risk aversion being a decreasing function of wealth. This is not the whole picture though, since part of the real wealth is being ignored in the context of the mere financial assets, as was discussed above.

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the other hand, in bank-based systems, as in Japan, France and Germany, risks can still be managed over time in connection with the traditional banking business by investing in securities of varied maturities.

Figure 12 below presents the household financial assets relative to GDP across countries in 2000. Variation across countries is considerable, concerning both the amount and composition of the assets. Some underlying factors, discussed in Elomaa (2001), are also briefly presented here as tentative explanations for the main differences between countries.

Figure 12.   **Household financial assets as a % of GDP in 2000**
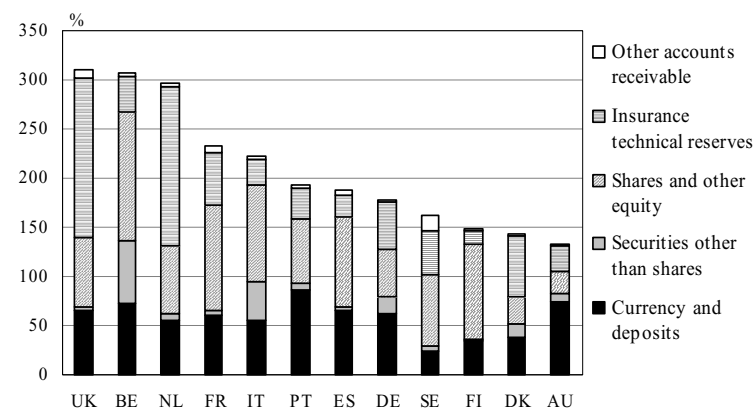
Source: calculations based on Eurostat Financial Accounts.

Households in the United Kingdom, Belgium and the Netherlands have the highest financial assets when compared to GDP, amounting to approximately twice the ratios in Finland, Denmark and Austria. The value of currency and deposits relative to GDP is the highest in Portugal and Austria and the lowest in the three Nordic countries in the sample. Moreover, in Portugal currency and deposits account for almost a half of the total household financial assets and in Austria as much as 56%, indicating that in both countries bank deposits provide the main form of saving.

In the United Kingdom and Netherlands, the value of insurance technical reserves, comprising net equity of households in life insurance and pension funds, is exceptionally high, reflecting the fact that the Dutch and the British save through pension funds and insurance companies, rather than through banks (Hoogduin and Huisman 1998). The insurance technical reserves are, however, the most variant item across countries and the differences between country-specific social security systems make the valid cross-country comparison somewhat difficult.

Shares and other equity comprise both quoted and unquoted shares, with the latter referring to shares of non-listed companies including the housing stock[37]. In Finland the proportion of unquoted shares in total household-owned shares is considerably larger than that of quoted, and the same holds also for at least France, Spain and Belgium (for whom the disaggregation is available in the underlying data at the year-end 2000). In particular, in Finland approximately two-thirds of the housing stock consists of owner-occupied homes, half of which is in the form of housing companies (Elomaa 2001), whose shares are treated as personal financial property[38]. Also here the comparability of the data is, however, somewhat questionable across countries so, if available, the use of more disaggregated data would be necessary to clarify the picture further.

As shown in figure 13 below, relative to GDP also the value of household liabilities differs quite significantly across countries. According to the data, the Finnish and Italian households are the least indebted in the sample, whereas the Danish and Dutch are the ones with the most debt as compared to GDP. Accounts payable other than loans play a minor role in all sample countries. Elomaa (2001) sees the differences in household indebtedness as resulting primarily from differences in housing loan and mortgage maturities. In Finland the loan maturities are relatively short, which is reflected as a low level of debt. Nevertheless, data separating loans on the basis of their uses would make the cross-country comparison more relevant.

Figure 13.   **Household liabilities as a % of GDP in 2000**
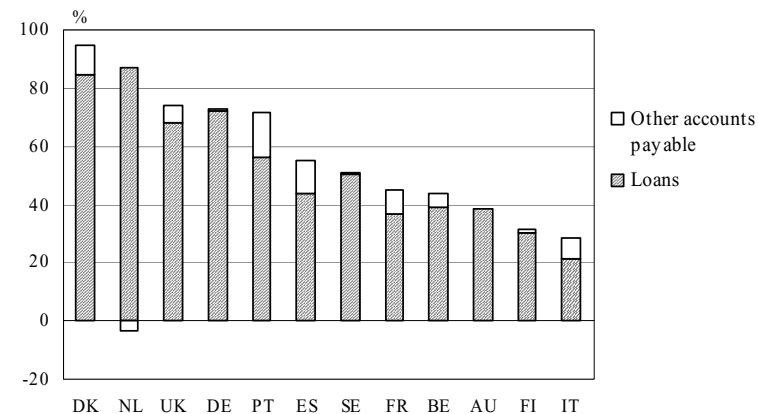
Source: calculations based on Eurostat Financial Accounts.

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[37] Unquoted shares are valued at nominal values, except for the housing stock, which is valued at (approximated) market values.

[38] Housing shares give their owner the right of physical control and occupancy of a specific apartment, whereas the building and real estate remain the property of the housing company. The housing shares can be sold or used as collateral for a loan, as any other financial property.

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As to the potency of monetary policy, an increase in an official central bank rate tends to affect economic activity more strongly in countries, where households are more heavily indebted and hold a larger part of their wealth in the form of assets, such as equity and real estate, whose price is highly interest rate sensitive. Consequently, countries with highly indebted household sectors are more likely to face depressed consumption in the aftermath of interest rate increases. On the contrary, in countries, where households have high net assets and large amount of variable-rate claims, changes in interest rates may in part be offset by a fiscal impact on household disposable income. (Hoogduin and Huisman 1998)

Moreover, also the proportion of adjustable rate credit and mortgages as well as the share of loans backed by real estate collateral should affect the potency of monetary policy through household sector behaviour. Basically, in countries, where the majority of loans is backed by collateral, a change in interest rates should have a stronger effect on real economic activity due to changes in collateral values. (Favero and Giavazzi 1999)

Table 11 below depicts the household liabilities as % of financial assets at the year-end 2000. Figures indicate that Belgian, French and Finnish households are considerable more indebted relative to their financial assets than for example German and Danish households.

Table 11.   **Household liabilities as % of financial assets at the year-end 2000**

AU	BE	FI	FR	DE	IT	NL	PT	ES	DK	SE	UK
70	86	78	80	59	87	71	61	69	33	67	74

Source: Calculations based on the Eurostat's Financial Accounts.

5.4   Nonfinancial corporations

Nonfinancial corporations have a wider range of sources of finance at their disposal than the household sector. Thereby, the proportion of bank loans in total corporate sector finance may vary over time, whereas in the case of households the role of bank loans is more pronounced. Furthermore, retained earnings are often the most important source of finance for firms, but it is more difficult to compile statistics on them than on intermediated and direct finance.

As shown in figure 14 below, corporate sector financial assets consist mainly of shares and other equity. There are, however, considerable differences across countries both in terms of the amount and structure of the assets, but their relevance and reasons for them are not that easily detected without more disaggregated data.

Figure 14.   **Nonfinancial corporate sector financial assets in 2000**
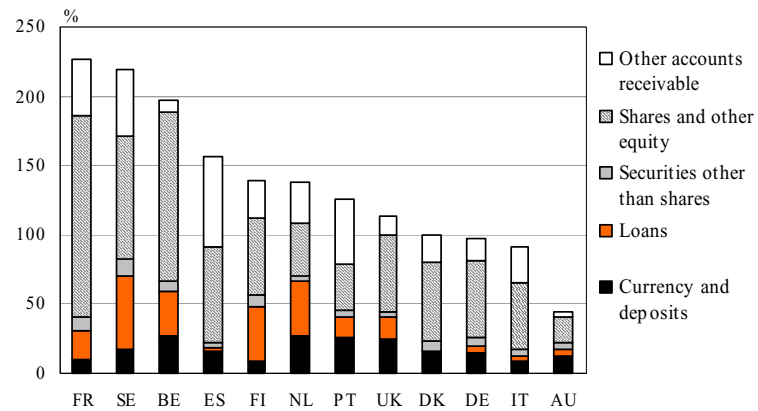
Source: calculations based on Eurostat Financial Accounts.

Figure 15.   **Nonfinancial corporate sector liabilities as a % of GDP in 2000**
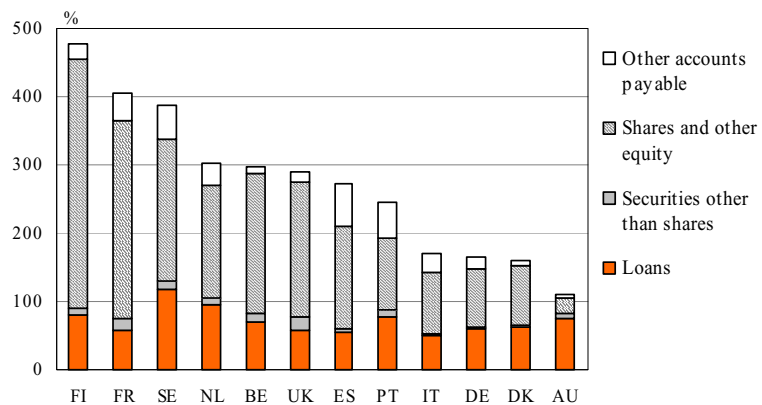
Source: calculations based on Eurostat Financial Accounts.

According to figure 15 above, in proportion to GDP the Finnish and French nonfinancial corporate sectors have the largest liabilities in the sample. Again, it should be noted, however, that share prices rose vigorously during the late 1990s, thus explaining the high proportion of shares and other equity in the total

liabilities[39]. In terms of the value of outstanding loans, Finland is placed slightly below the average. The proportion of securities other than shares is strikingly low in all sample countries, reflecting the minor development of markets for corporate bonds in Europe.

Comparing loans to shares and other equity in the liability side of the balance sheets (table 12) reveals that there are considerable cross-country differences between nonfinancial corporate sectors with respect to their leverage ratios. Austrian firms are financed mainly by loans, whereas in other countries equity dominates clearly. However, despite the high value of equities booked in the balance sheets, on a net basis shares account for a minor share of flows of external corporate finance in most countries.

Table 12. **Loans as a % of shares and other equity in the nonfinancial corporate sector liabilities at the year-end 2000**

AU	BE	FI	FR	DE	IT	NL	PT	ES	DK	SE	UK
337	33	25	20	77	58	61	79	39	69	58	32

Source: Calculations based on the Eurostat Financial Accounts.

Guiso et al (1999) use the share of firms with only one banking relationship as an indicator for the strength of the bank lending channel. Table 13 below reports the figures for the EU countries, indicating that approximately a fourth of firms has only one bank relationship in Ireland, Luxembourg, Sweden and the United Kingdom, whereas in France, Italy and Portugal the majority of firms has at least as many as seven.

Table 13. **% of firms with n bank relationships**

n	AU	BE	FI	FR	DE	GR	IE	IT	LU	NL	PT	ES	DK	SE	UK
1	19	0	1	4	16	0	24	3	29	15	5	2	10	23	23
2	14	25	29	4	8	8	35	3	0	25	3	7	27	33	28
3–7	44	25	67	33	40	51	32	23	57	58	31	44	61	44	46
>7	22	50	2	58	37	41	10	70	14	2	62	47	2	0	4

Source: Ongena and Smith (2000).

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[39] At the year-end 1999, among the countries considered, the stock market capitalisation was the highest in Finland relative to GDP. Since then, share prices have generally fallen significantly, so the data for the years 1999 and 2000 is rather exceptional for most of the countries considered. Moreover, in Finland a few large companies, such as the telecommunications and forest companies, affect greatly the nonfinancial corporate sector data, making it sensitive to fluctuations in certain lines of business. For annual *flows* of external corporate finance in Finland, see Bank of Finland (2002b).

6 Econometric analysis of the role of the financial system in the bank lending channel

Financial intermediation, and bank lending in particular, has clearly an important role in the economy. On one hand, changes in loan demand influence returns and profitability of the banking industry and, on the other, shifts in loan supply affect the general economic growth through private consumption and investment. This section performs a twelve-country panel data analysis with the purpose of investigating whether the impact of monetary policy on bank lending depends on country-specific financial system characteristics. Thus, in contrast to prior microeconomic studies on bank-specific data, here the aim is at comparing countries and at examining the role of the national financial system in the monetary transmission process.

6.1 Model specification

The model relies heavily on Ehrmann et al (2001), which in turn has its origins in a simple version of the Bernanke-Blinder (1988) model presented in section 3.4.1[40]. In what follows, the Ehrmann et al model is modified from a micro to a macro perspective by focusing on aggregate bank loan markets instead of individual banks. Consequently, the model used here incorporates national financial (or banking) system characteristics in place of micro-level bank variables. Therefore, the analysis basically answers to a question, whether the effects found on a micro level cancel each other out when each country is considered as an aggregate. If not, responses to monetary policy actions are likely to be asymmetric across countries.

According to the model, in the money market equilibrium in a country i in quarter t money m_{it} equals deposits d_{it}, which depend on the monetary policy interest rate r_{it} according to a relationship

$$m_{it} = d_{it} = -\psi r_{it} + \chi,\qquad\qquad(6.1)$$

where parameters ψ and χ are assumed to be positive and, more importantly, equal across countries, implying that the effect on deposits (or money) of a one unit change in the interest rate is of the same size in all countries. A central bank is thus considered to have a direct control over the amount of deposits available to

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[40] Also Kashyap and Stein (1994, 2000) have performed a similar analysis on the US bank-level data, with the main focus on the effect of size and liquidity of banks.

banks. Basically, the higher the national monetary policy interest rate, the less liquid the money markets should be in that country.

In the bank loan markets, demand for loans l_{it}^d faced by the banking sector in a country i at time t is assumed to depend positively on real GDP y_{it} and the price level p_{it} and negatively on the interest rate on loans i_{it}:

$$l_{it}^d = \phi_1 y_{it} + \phi_2 p_{it} - \phi_3 i_{it} \,. \tag{6.2}$$

Again the parameters (ϕ_1, ϕ_2 and ϕ_3) are assumed to be the same across countries, ie the demand for loans is considered to be independent of any national financial system characteristics. The assumption of homogenous reaction of loan demand to interest rate changes is important for the identification of loan supply effects of monetary policy actions.[41]

The supply of loans l_{it}^s by the banking sector in a country i at time t is assumed to depend positively on the amount of deposits available and the interest rate on loans and negatively on the monetary policy interest rate according to a relationship

$$l_{it}^s = \mu_{it} d_{it} + \phi_4 i_{it} - \phi_5 r_{it} \,, \tag{6.3}$$

where μ_{it}, ϕ_4 and $\phi_5 > 0$. Thus, the higher is the monetary policy interest rate, the lower the supply of bank loans should be. This direct effect of monetary policy on loan supply is based on opportunity costs for banks. Costs arise when banks are forced to use the interbank market to finance their loans, or when the mark-up pricing by banks passes on increases in deposit rates further to interest rates on loans.

The indirect impact of monetary policy on bank lending operates through changes in the amount of deposits available for banks. Banking sectors in different countries are modelled to be unequally dependent on deposits, with the effect varying over time depending on a national financial system characteristic x_{it} as follows:

$$\mu_{it} = \mu_0 - \mu_1 x_{it} \,, \tag{6.4}$$

where $\mu_0 > 0$, while the sign of μ_1 depends on the direction of the influence of the variable x_{it}. If a higher value of the variable makes the banking sector less dependent on deposits, then $\mu_1 > 0$, and vice versa. Thus, with positive μ_1, the

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[41] Asymmetric responses of bank lending to GDP and prices are allowed if, as in equation (6.11), the interaction terms of these variables with the national financial system characteristics are included in the model.

higher the value of x_{it} (ceteris paribus), the less a decrease in deposits should decrease the supply of loans. The model thus allows for asymmetric supply shifts across countries to an equal monetary-policy-induced change in deposits.

The loan market equilibrium occurs when the demand for and supply of bank loans are equal, $l_{it}^d = l_{it}^s = l_{it}$:

$$\begin{cases} l_{it} = \phi_1 y_{it} + \phi_2 p_{it} - \phi_3 i_{it} \\ l_{it} = \mu_{it} d_{it} + \phi_4 i_{it} - \phi_5 r_{it} \end{cases}$$

(6.5)

By solving the pair of equations for the equilibrium lending l_{it} by eliminating the lending rate i_{it}, the equations can be combined into a reduced-form model of the bank loan market:

$$\begin{cases} \phi_4 l_{it} = \phi_1 \phi_4 y_{it} + \phi_2 \phi_4 p_{it} - \phi_3 \phi_4 i_{it} \\ \phi_3 l_{it} = \mu_{it} \phi_3 d_{it} + \phi_3 \phi_4 i_{it} - \phi_3 \phi_5 r_{it} \end{cases}$$

$$\Leftrightarrow \phi_3 l_{it} + \phi_4 l_{it} = \phi_1 \phi_4 y_{it} + \phi_2 \phi_4 p_{it} - \phi_3 \phi_4 i_{it} + \phi_3 \phi_4 i_{it} + \mu_{it} \phi_3 d_{it} - \phi_3 \phi_5 r_{it}$$

(6.6)

$$\Leftrightarrow l_{it} = \frac{\phi_1 \phi_4 y_{it} + \phi_2 \phi_4 p_{it} + \mu_{it} \phi_3 d_{it} - \phi_3 \phi_5 r_{it}}{\phi_3 + \phi_4}.$$

Substituting for d_{it} from (6.1) and for μ_{it} from (6.4) leads then to an equation

$$\begin{aligned} l_{it} &= \frac{\phi_1 \phi_4 y_{it} + \phi_2 \phi_4 p_{it} + (\mu_0 - \mu_1 x_{it}) \phi_3 (-\psi r_{it} + \chi) - \phi_3 \phi_5 r_{it}}{\phi_3 + \phi_4} \\ &= \frac{\phi_1 \phi_4 y_{it} + \phi_2 \phi_4 p_{it} - (\phi_5 + \mu_0 \psi) \phi_3 r_{it} + \mu_1 \psi \phi_3 r_{it} x_{it} + \mu_0 \phi_3 \chi - \mu_1 \phi_3 \chi x_{it}}{\phi_3 + \phi_4}, \end{aligned}$$

(6.7)

which can be simplified further into the form

$$l_{it} = \alpha + \beta_1 y_{it} + \beta_2 p_{it} - \beta_3 r_{it} + \beta_4 r_{it} x_{it} + \beta_5 x_{it}$$

(6.8)

by denoting $\alpha = \dfrac{\mu_0 \phi_3 \chi}{\phi_3 + \phi_4}$, $\beta_1 = \dfrac{\phi_1 \phi_4}{\phi_3 + \phi_4}$, $\beta_2 = \dfrac{\phi_2 \phi_4}{\phi_3 + \phi_4}$, $\beta_3 = \dfrac{(\phi_5 + \mu_0 \psi) \phi_3}{\phi_3 + \phi_4}$,

$\beta_4 = \dfrac{\mu_1 \psi \phi_3}{\phi_3 + \phi_4}$ and $\beta_5 = -\dfrac{\mu_1 \phi_3 \chi}{\phi_3 + \phi_4}$.

The coefficient β_4 relates the reaction of bank lending to a monetary policy indicator r_{it} to the national financial system characteristic x_{it}. It thus reflects the heterogeneity of loan supply responses across countries, with a significant positive (negative) coefficient implying that the impact of monetary policy on

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bank lending decreases (increases) if the value of the country-specific characteristic increases.

The relationship of loans to real GDP and the price level can also be thought of as being loglinear. Consequently, the model can be rewritten as

$$\ln(L_{it}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(CPI_{it}) - \beta_3 r_{it} + \beta_4 r_{it} x_{it} + \beta_5 x_{it}, \tag{6.9}$$

where $l_{it} = \ln(L_{it})$, $y_{it} = \ln(GDP_{it})$ and $p_{it} = \ln(CPI_{it})$, and the respective coefficients β_1 and β_2 can now be interpreted as elasticities.

Rewriting equation (6.9) further in first differences introduces an difference operator Δ in the model. Since $\Delta \ln(L_{it}) = \ln(L_{it}) - \ln(L_{it-1}) = \ln\left(\dfrac{L_{it}}{L_{it-1}}\right)$

$= \ln\left(1 + \dfrac{L_{it} - L_{it-1}}{L_{it-1}}\right) \approx \dfrac{L_{it} - L_{it-1}}{L_{it}}$, the first difference of the natural logarithm of the dependent variable approximates the quarterly growth rate of bank loans to the nonfinancial private sector in country i in quarter t. The model is then of the form

$$\Delta \ln(L_{it}) = \beta_1 \ln(GDP_{it}) + \beta_2 \ln(CPI_{it}) - \beta_3 \Delta r_{it} + \beta_4 \Delta r_{it} x_{it} + \beta_5 \Delta r_{it} x_{it}, \tag{6.10}$$

where variable x_{it} has been left unchanged, since depending on the case, it can be of any chosen form in the final model. In what follows, equation (6.10) is extended by adding two other financial system characteristics y_{it} and z_{it} in the model.

A dynamic version of the model includes also lagged dependent variables as explanatory variables, and furthermore, by adding lags to other variables as well, long-run dynamics of the model can be examined. Consequently, the model estimated in the Ehrmann et al study regresses the growth rate of loans on lagged loan growth, quarterly GDP growth, quarterly inflation rate, quarterly interest rate change and three unit-specific characteristics (denoted here by x_{it-1}, y_{it-1} and z_{it-1}) and their interactions terms: (equation 6.11)

$$\Delta \ln(L_{it}) = a_i + \sum_{j=1}^{s} b_j \Delta \ln(L_{it-j}) + \sum_{j=0}^{s} c_j \Delta r_{it-j} + \sum_{j=0}^{s} d_j \Delta \ln(GDP_{it-j}) + \sum_{j=0}^{s} e_j \Delta \ln(CPI_{it-j})$$

$$+ fx_{it-1} + \sum_{j=0}^{s} g_{1j} x_{it-1} \Delta r_{it-j} + \sum_{j=0}^{s} g_{2j} x_{it-1} \Delta \ln(GDP_{it-j}) + \sum_{j=0}^{s} g_{3j} x_{it-1} \Delta \ln(CPI_{it-j})$$

$$+ hy_{it-1} + \sum_{j=0}^{s} k_{1j} y_{it-1} \Delta r_{it-j} + \sum_{j=0}^{s} k_{2j} y_{it-1} \Delta \ln(GDP_{it-j}) + \sum_{j=0}^{s} k_{3j} y_{it-1} \Delta \ln(CPI_{it-j})$$

$$+ mz_{it-1} + \sum_{j=0}^{s} n_{1j} z_{it-1} \Delta r_{it-j} + \sum_{j=0}^{s} n_{2j} z_{it-1} \Delta \ln(GDP_{it-j}) + \sum_{j=0}^{s} n_{3j} z_{it-1} \Delta \ln(CPI_{it-j})$$

$$+ \varepsilon_{it},$$

$i = 1,\dots,N$, $t = 1,\dots,T$ and $j = 0,\dots,s$ denote countries, time periods (quarters) and the number of lags, respectively. Alternatively, all explanatory variables could be lagged, ie $j = 1,\dots,s$, in order to avoid the potential endogeneity problem of contemporaneous changes in the dependent and explanatory variables[42]. Δr_{it-j} refers to the first difference of a nominal short-term interest rate and indicates changes in the stance of monetary policy. Similarly to loans, $\Delta \ln(GDP_{it-j})$ represents the growth rate of real GDP. $\Delta \ln(CPI_{it-j})$ in turn denotes the quarterly inflation rate calculated as the growth rate of the consumer price index. The model allows also for fixed effects, as indicated by the country-specific intercept a_i, whereas ε_{it} refers to the time-varying residual. b_j, c_j, d_j, e_j, f_j, g_{1j}, g_{2j}, g_{3j}, h_j, k_{1j}, k_{2j}, k_{3j}, m_j, n_{1j}, n_{2j} and n_{3j} are the parameter coefficients to be estimated from the model.

The inclusion of GDP growth and inflation in the model is assumed to capture loan demand effects by reflecting changes in the general macroeconomic environment. That is, the inclusion of macroeconomic variables in the model is assumed to account for the relevant time effects, whereas the distributional effects across countries should be reflected in significant coefficients on the interaction terms of the country-specific characteristics with the monetary policy indicator.

For the sake of simplicity, the model estimated here is reduced and modified further into a form (6.12)

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[42] The so-called endogeneity problem arises when the values of the explanatory variables are affected by the mechanism described by the model. This may be the case eg when a change in the price of an object is used in explaining a contemporary change in the quantity demanded. In order to avoid the problem, the explanatory variables must be either exogenous (ie variables whose values are completely determined outside the model) or lagged endogenous variables (ie variables whose values are represented by the past values of the endogenous variable of the model). (Kmenta 1986, 651–653)

$$\Delta \ln(L_{it}) = a_i + \sum_{j=1}^{s} b_j \Delta \ln(L_{it-j}) + \sum_{j=1}^{s} c_j r_{it-j} + \sum_{j=1}^{s} d_j \Delta \ln(GDP_{it-j}) + \sum_{j=1}^{s} e_j \Delta \ln(CPI_{it-j})$$

$$+ \sum_{j=1}^{s} g_{1j} x_{it-j} r_{it-j} + h y_{it-1} + \sum_{j=1}^{s} k_{1j} y_{it-j} r_{it-j} + \sum_{j=1}^{s} n_{1j} z_{it-j} r_{it-j} + \varepsilon_{it},$$

where other interaction terms than those including the interest rate are being ignored. Inclusion of all interactions could create a multicollinearity problem of correlated explanatory variables and thus lead to a lack of statistical significance of the coefficient estimates. In addition, the interest rate is entered into the model as a level variable instead of a change in order to further simplify the mechanisms.

In the long run, both the endogenous variable and the exogenous variables are assumed to grow steadily, so that $\Delta_t = \Delta_{t+1} = \Delta_{t+2}$ ... etc. That is, in the long run, loan supply and real GDP are assumed to be growing at a constant rate from one quarter to another and, likewise, prices to be rising steadily. Since the interest rate is entered as a level variable, it is assumed to be constant in the long term. Consequently, the long-run coefficients can be calculated as the sum of the estimated coefficients of the lags of the exogenous variables, divided by one minus the sum of the coefficients b_j on the lagged endogenous variables. Therefore, for example for c_j's, the estimated long-run coefficient c is of the form:

$$c = \frac{\sum_{j=1}^{s} c_j}{1 - \sum_{j=1}^{s} b_j}. \tag{6.13}$$

Finally, the basic interpretation of the model can be stated as follows:

- Other things being equal, the *higher* the interest rate *level*, the *slower* should be the *growth rate* of lending, provided that the long-run coefficient c is negative[43].
- *Statistically significant coefficients g, k* and *n* on interaction terms imply that the effect of an interest rate change on the growth rate of lending does depend on the country-specific variables.
- *Signs* of the coefficients *g, k* and *n* tell whether an increase in the respective characteristic variable increases or decreases the effect of an interest rate change.

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[43] In the Ehrmann et al model, the *greater* the *increase* in the interest rate, the slower the growth rate of lending, when c < 0.

6.2   Estimation method

To begin with, a basic model with neither lagged dependent variables nor characteristic variables and their interaction terms is estimated as a fixed-effects (within) model by the ordinary least squares (OLS) method.[44] The lagged dependent variables are dropped from the equation, since their presence would bias the OLS estimators due to the correlation with the country-specific effects. Furthermore, the model is estimated in four lags but the contemporaneous variables are ignored in order to avoid the potential endogeneity problem. Thereby, the goal is to first clarify the fundamental dynamics of the data in the simplified model of the form:

$$\Delta \ln(L_{it}) = a_i + \sum_{j=1}^{4} c_j r_{it-j} + \sum_{j=1}^{4} d_j \Delta \ln(GDP_{it-j}) + \sum_{j=1}^{4} e_j \Delta \ln(CPI_{it-j}) + \varepsilon_{it}. \tag{6.14}$$

In the model, $a_i + \varepsilon_{it}$ ($i = 1,\ldots,12$) is the residual in the sense that the main interest is in estimating the coefficients c_j, d_j and e_j ($j = 1,\ldots,4$). a_i is the country-specific time-invariant residual, so its value varies across countries but is constant over time for any given country. ε_{it} in turn is the standard residual assumed to satisfy the four Gaus-Markov conditions[45]. Then from (6.14), it follows that

$$\overline{\Delta \ln(L_i)} = a_i + \sum_{j=1}^{4} c_j \overline{r_i} + \sum_{j=1}^{4} \overline{\Delta \ln(GDP_i)} + \sum_{j=1}^{4} e_j \overline{\Delta \ln(CPI_i)} + \overline{\varepsilon_i}, \tag{6.15}$$

where the 'upper bar' refers to the value of the variable being equal to its mean over the time period considered. Subtracting (6.15) from (6.14) yields a transformation

$$\Delta \ln(L_{it}) - \overline{\Delta \ln(L_i)} = \sum_{j=1}^{4} c_j \left(r_{it-j} - \overline{r_i} \right) + \sum_{j=1}^{4} d_j \left(\Delta \ln(GDP_{it-j}) - \overline{\Delta \ln(GDP_i)} \right)$$
$$+ \sum_{j=1}^{4} e_j \left(\Delta \ln(CPI_{it-j}) - \overline{\Delta \ln(CPI_i)} \right) + \left(\varepsilon_{it} - \overline{\varepsilon_i} \right), \tag{6.16}$$

which is the final form of the model to be estimated by OLS. In (6.16) each variable is expressed in terms of its deviation from the country-specific mean over

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[44] The discussion on estimation methods is based on Bond (2002) and the *Reference Manual* (2001) for the statistical software package Stata.

[45] According to the Gaus-Markov conditions, the error term should have an expected value of zero and constant variance for all observations. Moreover, error terms of any two observations should be uncorrelated and the explanatory variables nonstochastic.

time, as a result of which the individual fixed effects a_i are wiped out from the equation. Estimating this fixed-effects model by OLS produces the within estimates for the regression coefficients reported in the next section (model 1 in table 16).

Even in the transformed model, from which the country-specific effects have been removed, the presence of lagged dependent variables causes bias, now due to negative correlation with the transformed error terms. A model of this form (equation 6.17, model 2 in table 16) is estimated, however, in order to allow for the comparison between the results.

$$\Delta \ln(L_{it}) - \overline{\Delta \ln(L_i)} = \sum_{j=1}^{4} b_j \left(\Delta \ln(L_{it-j}) - \overline{\Delta \ln(L_i)} \right) + \sum_{j=1}^{4} c_j \left(r_{it-j} - \overline{r_i} \right)$$

$$+ \sum_{j=1}^{4} d_j \left(\Delta \ln(GDP_{it-j}) - \overline{\Delta \ln(GDP_i)} \right) \qquad (6.17)$$

$$+ \sum_{j=1}^{4} e_j \left(\Delta \ln(CPI_{it-j}) - \overline{\Delta \ln(CPI_i)} \right) + \left(\varepsilon_{it} - \overline{\varepsilon_i} \right).$$

Since the inclusion of lagged dependent variables as explanatory variables makes the OLS estimators biased, the model is estimated also by the generalised method of moments (GMM) for panel data analysis. The method suggested by Arellano and Bond (1991) is often used in estimating dynamic panel data models, since it gives efficient and consistent estimates, provided that the serial correlation properties of the model are taken into account properly.

The Arellano-Bond method takes first differences of the original model, so like the fixed-effects OLS, it eliminates the country-specific effects from the model. An important distinction between the two methods is, however, that unlike the within transformation where the average error, $\overline{\varepsilon_{it}}$, is in the error term of the transformed equation for quarter t, first-differencing does not introduce all realisations of the errors $(\varepsilon_{it}, \ldots, \varepsilon_{iT})$ into the transformed error term:

$$\Delta \ln(L_{it}) - \Delta \ln(L_{it-1}) = \sum_{j=1}^{4} b_j \left(\Delta \ln(L_{it-j}) - \Delta \ln(L_{i-j-1}) \right) + \sum_{j=1}^{4} c_j \left(r_{it-j} - r_{it-j-1} \right)$$

$$+ \sum_{j=1}^{4} d_j \left(\Delta \ln(GDP_{it-j}) - \Delta \ln(GDP_{it-j-1}) \right) \qquad (6.18)$$

$$+ \sum_{j=1}^{4} e_j \left(\Delta \ln(CPI_{it-j}) - \Delta \ln(CPI_{it-j-1}) \right) + \left(\varepsilon_{it} - \varepsilon_{it-1} \right).$$

After differencing the equation into the form (6.18), lagged values of endogenous variables can be used as instruments in the estimation. If the error term in (growth) levels is serially uncorrelated, then the error term in first differences is

MA(1), so that instruments dated t–2 and earlier should be valid in the differenced equation. Under this assumption consistent parameter estimates can be obtained. On the other hand, if the error term in (growth) levels is itself MA(1), then only instruments dated t–3 and earlier will be valid, and so on.[46] Models 3–7 are estimated using this Arellano-Bond method varying the set of explanatory variables.

One further note must be made, however, concerning the method and data used. The Arellano-Bond method is best suited to panels where typically a large number of individuals, eg banks or firms, is observed for a small number of time periods, whereas the data used here is of quite the opposite form, as is described below. However, since lengthening the estimation period increases the number of valid instruments and thus leads to better estimates, it is mainly the small number of cross-sectional observations that may give rise to concern from the methodological point of view.

6.3   Data and construction of variables

The models are estimated using data derived from the IMF's International Financial Statistics database, ETLA's Economic Database (containing OECD time series), and Reuters.[47] The unbalanced panel covers twelve countries, seven variables and, at most, the years 1975–1998 on a quarterly basis, ie the sample size differs across countries, as shown in table 14[48]. Owing to the inclusion of lagged values as explanatory variables, estimation periods are slightly shorter than the initial data coverage. The sample countries comprise Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal and Spain and, outside EMU, the three EU countries Denmark, Sweden and the United Kingdom. Greece, Ireland and Luxembourg had to be dropped due to lack of adequate data. The three non-EMU countries were included in order to make the size of the sample larger but also since they are viewed as likely future members.

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[46] Reasons for the use of the Arellano-Bond method are similar to those given in Topi and Vilmunen (2001), for example.

[47] For a more detailed description of data sources and variable definitions, see appendix 1. Variables are presented in figures in appendix 2.

[48] For many countries, the time dimension of the data is limited primarily due to shortness of the interest rate series available. The post-1999 data is ignored due to a break in the comparability of figures. The definition of banking institutions was changed in the IMF's IFS along with Stage Three of EMU, in addition to which the potential regime shift in the macroeconomic environment could make a difference.

Table 14.   **Initial data coverage by country**

Country	Initial data coverage
AT	1982Q1–1998Q3
BE	1993Q1–1998Q3
FI	1975Q2–1998Q4
FR	1978Q2–1998Q2
DE	1975Q2–1998Q4
IT	1982Q1–1998Q4
NL	1978Q1–1997Q4
PT	1991Q2–1998Q4
ES	1989Q1–1998Q4
DK	1988Q2–1998Q4
SE	1980Q2–1998Q4
UK	1986Q4–1998Q4

Variables are defined as in table 15, where the first column gives the ex ante expected signs (+ or −) of the coefficient estimates. Loans refer to loans of domestic banking institutions (deposit banks) to private nonfinancial sector of the economy. The seasonally adjusted real GDP is used, since there is no clear seasonality in the dependent variable either. Moreover, the volume index is used instead of real values, since the former is more readily available. Thus the GDP volume index accounts for the growth in real terms, while the CPI reflects changes in prices.

3-month money market interest rates are quarterly averages of daily observations of country-specific nominal 3-month money market rates and they are used as monetary policy indicators[49]. This raises some concerns, however, in particular when considering the length of the estimation period. It is highly unlikely that in the course of decades the short-term interest rates have always reflected the stance of prevailing monetary policies. Nevertheless, they are the only relevant indicators available for the periods and countries considered.

When the long-run coefficients are calculated, coefficients for the lags of GDP growth and inflation should both sum to a positive number, whereas the interest rate should enter negatively.

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[49] For example for Finland, the money market rate used is the 3-month Helibor in 1987–1998, and prior to that the markka (FIM) forward interest rate.

Table 15. **Definitions of variables and the ex ante assumptions on the signs of their coefficients**

Expected sign	Variable	Definition
	$\Delta\ln(L)$	First difference of logs of loans of domestic banking institutions to the domestic private sector
+	$\Delta\ln(GDP)$	First difference of logs of real GDP volume, seasonally adjusted
–	r	A 3-month nominal money market rate
+	$\Delta\ln(CPI)$	First difference of logs of CPI
+/–	x	Total bank assets divided by GDP, 'size'
+/–	xr	Interaction term of 'size' and the interest rate
+	y	Deposits divided by total bank assets, 'liquidity'
+	yr	Interaction term of 'liquidity' and the interest rate
+	z	Capital and reserves divided by total bank assets, 'capitalisation'
+	zr	Interaction term of 'capitalisation' and the interest rate

National financial systems are characterised with three banking sector ratios. The first describes the size of the banking sector relative to the size of the total economy. The former is measured by total banking sector assets (claims for the private sector and the central government) and the latter by GDP. The underlying assumption made is that large banks should have fewer difficulties – due to lower information costs and a lower external finance premium – in raising funds than small banks. Thus the size of the bank is often used as a proxy for the informational asymmetry that it faces.

However, in the aggregate, a large banking sector could follow from either a large number of small banks or from few large banks. Thereby, it is not clear whether a country with a large banking sector should be better able to offset contractionary monetary policy actions than a country with a smaller banking sector. Therefore, the ex ante assumption on the sign of the interaction coefficient is not that obvious either. On one hand, if the banking sector is assumed to be better able to insulate the changes in interest rates when the size of the sector is larger, then the sign should be expected to be positive. But on the other hand, if the reverse is true, then the sign should be negative reflecting the fact that the size getting higher (ie x↑) adds to the initial negative effect of an interest rate increase.

In the case of the other two indicators, the mechanism is expected to be less obscure. The second indicator is calculated by dividing the sum of demand, time and savings deposits by the total bank assets. The idea is simply that the more banks have loanable funds relative to their outstanding claims, the better they should be able to insulate the supply of loans from contractionary monetary shocks. The third variable in turn characterises the degree of capitalisation by comparing the amount of capital and reserves to total banking sector assets. Again, the higher the ratio, the more readily banks should be able to draw on

additional finance, ie reserves and other non-deposits. Consequently, the expected signs are positive, ie the more liquid and better capitalised the banking system, the better it should be able to absorb the shocks.

Variables x_{it}, y_{it} and z_{it} used in estimations are constructed by calculating for each initial value X_{it}, Y_{it} and Z_{it} of the characteristic variables, the deviation from the respective cross sectional mean, ie from the mean at time t over countries $i = 1,...,N_t$[50]:

$$x_{it-j} = X_{it-j} - \frac{1}{N_t} \sum_{i=1}^{N} X_{it-j} \,. \tag{6.19}$$

This normalisation of variables with respect to their averages across countries results in indicators that sum to zero over all observations. Then the average of each interaction term equals zero as well, and consequently, the parameters c_j can directly be interpreted as the overall monetary policy effects on lending. (Ehrmann et al 2001)

6.4 Estimation results

The estimated coefficients from seven slightly different models are depicted in table 16 below[51], indicating the long-run effects for a country with the average characteristics of the sample. Models 1–2 have been estimated as fixed-effects (within) models using OLS, whereas in models 3–7 the Arellano-Bond method has been used. Model 1 has no lagged dependent variables and it is therefore referred to as 'static' in contrast to 'dynamic' models 2–7 in which also lagged values of the endogenous variable are used as explanatory variables.

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[50] Since the panel is unbalanced, the number of countries in the sample may vary from a quarter to another.

[51] Estimations are conducted using the statistical analysis package Intercooled Stata 7.0, which incorporates commands for both the fixed-effects and Arellano-Bond methods. For detailed test results and other statistical diagnostics, see appendix 3.

Table 16.   **Estimated long-run coefficients**

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
r	−0.115**	−0.378***	−0.309***	−0.249***	−0.294***	−0.143***	−0.128***
Δln(CPI)	0.941***	1.197**	0.249	0.047	0.218	0.423*	0.379*
Δln(GDP)	0.974***	1.701***	0.749***	0.720***	0.759***	0.689***	0.705***
xr				−0.882***			−0.325**
yr					0.004		
zr						0.719***	0.738***
Sargan: p			0.9261	0.9416	0.9416	0.4748	0.5356
MA(1): p			0.0000	0.0000	0.0000	0.0000	0.0000
MA(2): p			0.0116	0.0199	0.0182	0.0000	0.0000

*   significant at 90% confidence level
**   significant at 95% confidence level
***   significant at 99% confidence level
Model 1: fixed-effects (within) regression on a static model by OLS, lags 1–4
Model 2: fixed-effects (within) regression on a dynamic model by OLS, lags 1–4
Model 3: dynamic panel data estimation by Arellano-Bond method, lags 1–4
Model 4: dynamic panel data estimation by Arellano-Bond method, lags 1–4
Model 5: dynamic panel data estimation by Arellano-Bond method, lags 1–4
Model 6: dynamic panel data estimation by Arellano-Bond method, lags 1–3
Model 7: dynamic panel data estimation by Arellano-Bond method, lags 1–3

As shown in appendix 3, in model 1 only the fourth lag of the interest rate has a statistically significant coefficient at a 95% confidence level. For the CPI change, lags of 2 to 3 quarters have significant coefficients, whereas for the GDP growth all four short-run coefficients turn out to be significant. Nevertheless, as shown in table 16, the corresponding long-run coefficients are all satisfactorily significant, so in the long term the underlying data seems to suit the model rather well. The fact that the long-run coefficients are quite small suggests, however, that the effects are somewhat weak. According to model 1, an increase of 100 basis points in the interest rate reduces lending by –0.115%, whereas a 1% growth in GDP and an equal rise in prices increase lending by 0.974% and 0.941%, respectively. The interpretation is virtually the same in all seven models.

As to the signs of the long-run coefficients, the results seem to be robust to small changes in model specifications. In all estimated models, an average banking sector reacts to a monetary tightening by reducing loans, but the size of the adjustment varies slightly between the models. The coefficient of the interest rate variable is highly significant in all models, indicating that despite a priori concerns about the explanatory power of the variable, it is seems to fit to the model rather well.

The models seem to capture also the loan demand effects as the coefficient estimates for GDP growth and inflation are signed as expected, with the significance of the former being higher in all seven models. In fact, the CPI growth is the only macroeconomic variable suffering from a considerable lack of significance. In models 2–7, the high statistical significance of the coefficients on

the lagged dependent variables reflects in turn the steady behaviour of lending. That is, in most of the countries considered the loan stock has grown rather steadily throughout the years.

The interaction terms of the interest rate and the country-specific variables are included in models 4–7. In model 4, the sign of the interaction term for 'size' is negative and highly significant, implying that a larger size of a banking sector, as compared to the size of the respective total economy, strengthens the impact of a monetary tightening. The effect of 'liquidity' in model 5 is instead negligible, both in terms of its magnitude and in terms of its statistical significance. Consequently, model 5 implies that the ratio of deposits to total outstanding claims does not affect the extent to which lending reacts to changes in money market rates. In model 6 in turn, the ratio of capital and reserves to total banking sector assets is found to influence the supply of loans in the sense that the higher the ratio, the better a banking sector is able to insulate its lending from monetary policy shocks. Finally, model 7 incorporates the effect of both size and capitalisation, with the estimates having the same signs as before. The effect of the size of a banking sector is, however, considerably smaller than in model 4, whereas the degree of capitalisation impacts slightly more as compared to model 6. Nevertheless, the fact that both size and capitalisation are significant in model 7 may imply that models incorporating only one the variables might suffer from an omitted variable bias.

As shown in appendix 3, the more detailed estimation results report also the value of a constant for each estimated model, unless it is explicitly set to zero. In the models estimated using the Arellano-Bond method, the presence of a statistically significant constant implies that the underlying non-differenced data has a linear trend, ie a time variable running from quarter to another ($t = t_i + 1, t_i + 2,…,T_i$) depending on the estimation period is question. Thereby, in the first-differenced model the variable has a constant value of 1. For consistency between models, a time variable has thus been added also to the fixed-effects models to capture the underlying trend, which, in fact, turns out to be highly significant.

A Wald test of the null hypothesis that all coefficients – except for the constant – are zero is rejected in all specifications. For any of the dynamic models estimated by the Arellano-Bond method, the Sargan test of over-identifying restrictions cannot reject the null hypothesis that the restrictions are valid (see the probabilities in table 16). However, the Arellano-Bond tests for the presence of first- and second-order autocorrelation in first-differenced residuals, MA(1) and MA(2) respectively (see the two bottom rows in table 16), seem to suggest that the assumption of serially uncorrelated errors in the level specification is not entirely borne by the data. This may point to specification problems with the model, although both the estimated dynamic short-run as well as the static long-run coefficients are reasonable and of the expected sign and the model performs

well otherwise. In conclusion, however, it is noted that the over-identifying restrictions hold and the model specifications are found acceptable.

7   Conclusions

Understanding the mechanisms through which monetary shocks – particularly changes in the key ECB interest rates – affect prices and the real economic activity in the euro area is highly important for the successful conduct of the common monetary policy. Since cross-country differences in output cost of lowering inflation might require compensatory measures on the part of national fiscal policies, considerable asymmetries in monetary transmission could ultimately create political tensions within the Union.

Monetary transmission has long been a research topic of great interest in macroeconomics, but it is only recently that the established theoretical framework has been complemented by extensive empirical evidence for the main European countries. Moreover, along with the adoption of the common currency, the focus has being moving from differing shocks and their final effects within countries to detecting cross-country asymmetries in responses to uniform monetary shocks.

Common to all theories of monetary transmission is the argument that policy-induced changes in money supply influence the real economic activity, but the specific channel through which the shocks are assumed to be transmitted varies depending on the view. The traditional money view of monetary transmission focuses on the direct impact of *interest rates* on consumption and investment behaviour. Although considering a wider range of asset prices, such as *exchange rates* and *equity prices*, has broadened this conventional view, it is still commonly criticised for being overly simplistic, since it ignores banks as creditors.

The more recent lines of research have adopted the so-called credit view, which in contrast to the money view emphasises the role of bank loans in the monetary transmission process. Since the banking sector serves as the main source of finance for both households and the majority of firms, changes in lending should, according to this view, have consequences for total output through the private sector spending. The channel divides further into two separate mechanisms, of which the *bank lending channel* is based on the impact of monetary policy on banks' balance sheets, whereas the *balance sheet channel* operates through changes in borrowers' financial positions. Thereby, the former is related to banks' ability and the latter to their willingness to supply loans for the nonfinancial private sector.

The variety of transmission mechanisms suggests that the potency of monetary policy may depend on several country-specific factors. On the basis of descriptive cross-country comparisons, the current Member States seem to differ

quite considerably in terms of their financial systems, but the knowledge of differences between countries does not easily translate into robust conclusions about the likely impact of monetary policy. It is likely, however, that structural differences between economies result in asymmetries in their responses to monetary policy actions. In particular, differences in the amount and composition of the assets and liabilities of banks, households and firms may have a bearing in the degree of their interest rate sensitivity.

Most econometric analyses support the view that the prevailing differences between countries have some impact on the extent to which the ECB's monetary policy influences the individual euro area countries. The evidence is mixed, however, in the sense that the estimated magnitude of the effect of a given monetary shock varies considerably depending on the models and methods used, and even the ranking of countries with respect to their responses is inconsistent between different types of studies. Furthermore, since the economic and financial structures are constantly in a gradual change, the underlying dynamics within the Eurosystem are also changing continuously, making the past evidence less relevant.

In this thesis, a reduced-form model of the bank loan market was estimated on the macro-level cross-country data, with the purpose of examining whether characteristics of national financial systems affect the extent to which banks in the aggregate are able to insulate their lending from interest rate changes. Results on a panel of twelve EU countries indicate some support in favour of the bank lending channel and asymmetric responses across countries. A larger size of the domestic banking sector, as compared to the size of the total economy, was found to strengthen the impact of interest rate changes on lending, whereas the reverse was implied for the ratio of capital and reserves to total banking sector assets. In other words, according to the results, the smaller and better capitalised the banking system, the better it should be able to absorb policy-induced monetary shocks. On the other hand, as to the value of deposits with respect to the banking sector's outstanding claims, there was no impact on lending observable.

In addition to supply side factors, demand effects were captured in the model through inflation and real GDP growth, with the latter having a considerably greater significance. All in all, the estimated long-run coefficients were, however, rather small reflecting thereby either weakness of the effects or shortcomings in the underlying data. One plausible explanation might be the use of aggregated cross-country data, since the lack of micro-level disaggregation may suppress some of the asymmetries found within countries.

Despite the huge differences in the relative importance of Member States in terms of their impact on the weighted-average inflation and other euro area aggregates, each member in the ECB's Governing Council has an equal opportunity to influence the interest rate decisions. Due to its strong commitment to aggregate-level objectives, the Council will continuously have to trade off

between the asymmetric consequences of its decisions on the individual Member States. The research on the area may give some guidelines for how the weighting between consequences should be done, but the final outcome remains always uncertain. All in all, the Eurosystem's operational framework has been functioning rather well, although the sluggish economic growth has recently questioned the chosen strategy of focusing only on inflation.

Since the existing empirical evidence is mostly based on data prior to 1999, it has been yet too early for assessing whether the national transmission mechanisms have changed or will change due to the adoption of the common currency. It is expected, however, that countries become more and more alike in terms of their economic and financial structures, the longer they operate within the Union. Nevertheless, for example the potential eastern enlargement of EMU in the near future would clearly result in an enormous increase in the degree of heterogeneity among members. Moreover, it would further strengthen the dominance of small economies in the ECB's decision making body, unless, as is planned, the present 'one member – one vote' principle is changed. It thereby remains to be seen how changes in the euro area will reciprocally affect the conduct of monetary policy.

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Appendix 1

Data sources and description

Tables A1.1 and A1.2 below show the series codes and a more detailed description of the variables derived from the IMF's International Financial Statistics database, OECD's Main Economic Indicators, and Reuters.

Table A1.1 **Detailed data sources**

Variable	Country	Source (Series code)
Credit to the domestic private sector by domestic banking institutions	Euro area countries (excl. ES), DK, SE, UK	IMF / IFS (22D..ZF…)
	ES	IMF / IFS (32D..ZF…)
3-month money market rate	All countries	Reuters / BoF database
GDP volume index 1995 = 100, seasonally adjusted	All countries	OECD. Main Economic Indicators / Etla database
Consumer price index	All countries	IMF / IFS (64…ZF…)
Total assets (size) – Claims on central government	All countries (excl. UK)	IMF / IFS (22A..ZF..)
– –"– (net)	UK	IMF / IFS (22AN.ZF…)
– Claims on private sector	All countries	(22D..ZF… / 32D..ZF…)
Deposits (liquidity) – Demand deposits	All countries (excl. SE, UK)	IMF / IFS (24…ZF…)
– Time and saving deposits	All countries (excl. SE, UK)	IMF / IFS (25…ZF…)
– Total deposits	SE, UK	IMF / IFS (25L…ZF…)
Capital and reserves (capitalisation) – Reserves	All countries	IMF / IFS (20…ZF…)
– Capital accounts	All countries (missing for UK)	IMF / IFS (27A..ZF…)
GDP	AU, BE, FI, PT, SE, DK	IMF / IFS (99B..ZF…)
GDP s.a.	FR, DE, IT, NL, ES, UK	IMF / IFS (99B.CZF…)

Table A1.2 **Classification of banking institutions by country, prior to 1999**

Country	Banking institutions (Deposit banks)
AU	Joint stock, private, savings, and mortgage banks, agricultural credit associations, industrial credit corporations, post office savings banks, miscellaneous other credit institutions, and branches of Austrian banks resident outside Austria
BE	Commercial banks
DK	Commercial banks and other monetary institutions, ie the major savings bank and accounts of the postal checking system – December 1987 → the accounts of the deposit money banks exclude the accounts of their non-resident branches – 1990 → deposit money banks' claims on other banking institutions and local governments are included in claims on private sector (22d) – The accounts of the deposit money banks were completely restructured from January 1991 – June 1991 → the accounts of the deposit money banks include the postal giro system
FI	Commercial banks, co-operative banks, savings banks, and branches of foreign credit institutions engaged in deposit-taking activities in Finland
FR	The accounts of the commercial banks, the specialised banks, and the private sector deposits with the Postal System and Treasury of Metropolitan France and Monaco
DE	The consolidated accounts of commercial banks, specialised banks, savings banks, commercial and agricultural credit co-operatives, private and public mortgage banks, the postal banking system, and private and public building societies
IT	Commercial banks
NL	Postbank, the Bank for Netherlands Municipalities, the Netherlands Polder Boards Banks, and the universal banks, as well as security credit institutions, savings banks, and mortgage banks that are subsidiaries of universal banks
PT	All banks except saving banks and mutual agricultural credit banks, which are classified as non-bank financial institutions
ES	All resident units classified as other monetary financial institutions (MFIs), defined in accordance with 1995 ESA standards, including money market funds
SE	Commercial banks, large savings banks, co-operative banks, and deposit liabilities to the private sector of the postal giro system – Break in comparability with figures prior to 1996 due to the adoption of the European Union accounting system
UK	UK banks authorised under the Banking Act of 1987, and, beginning in January 1987, building societies as defined by the Building Societies Act of 1986 – Break in comparability with figures prior to September 1992 due to the introduction of a new balance sheet report form for the building society sector – Break in comparability with figures prior to September 1997 due to the inclusion of the accounts of certain institutions in Channel Islands and the Isle of Man to the UK banking institutions sector

Source: IMF's International Financial Statistics.

Appendix 2

Graphics

Figure A2.1   **Loans to the domestic private sector by domestic banking institutions (in national currencies), 1970Q1–1998Q4**
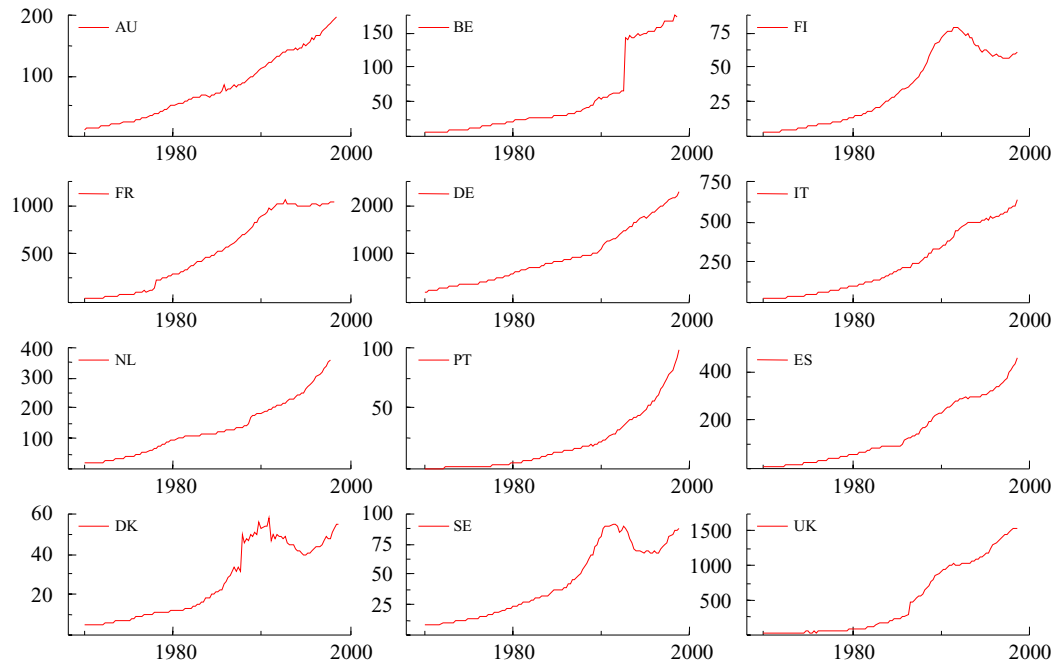
Source: IMF's International Financial Statistics.

Figure A2.2 **Quarterly growth rate of loans, 1970Q2–1998Q4**
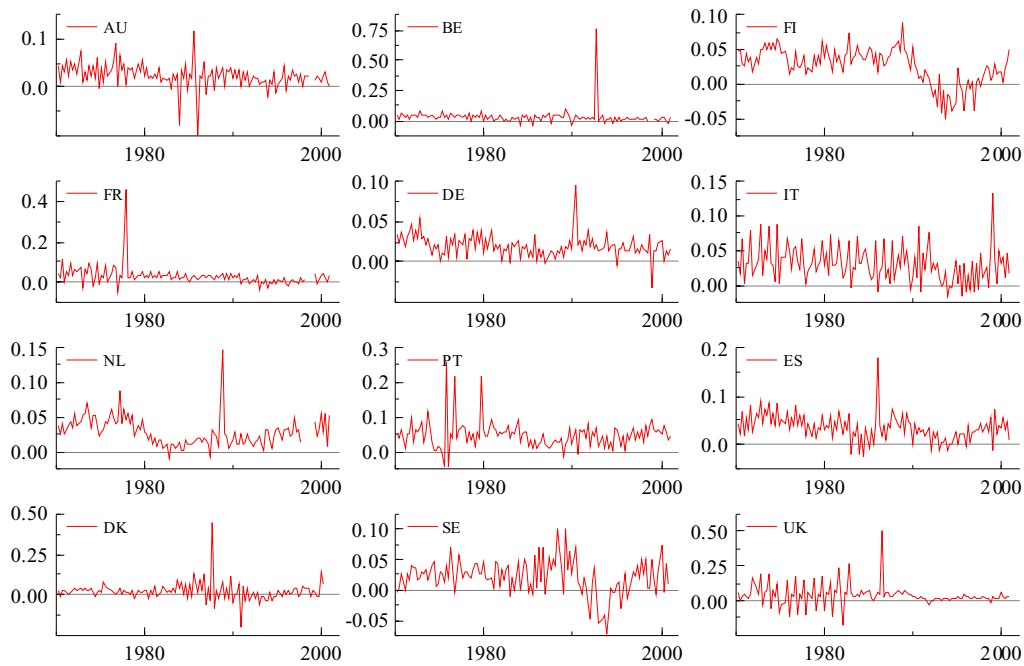
Source: Calculations based on the IMF's International Financial Statistics.

Figure A2.3 **Quarterly average of a 3-month nominal money market rate (%), 1972Q1–1998Q4**
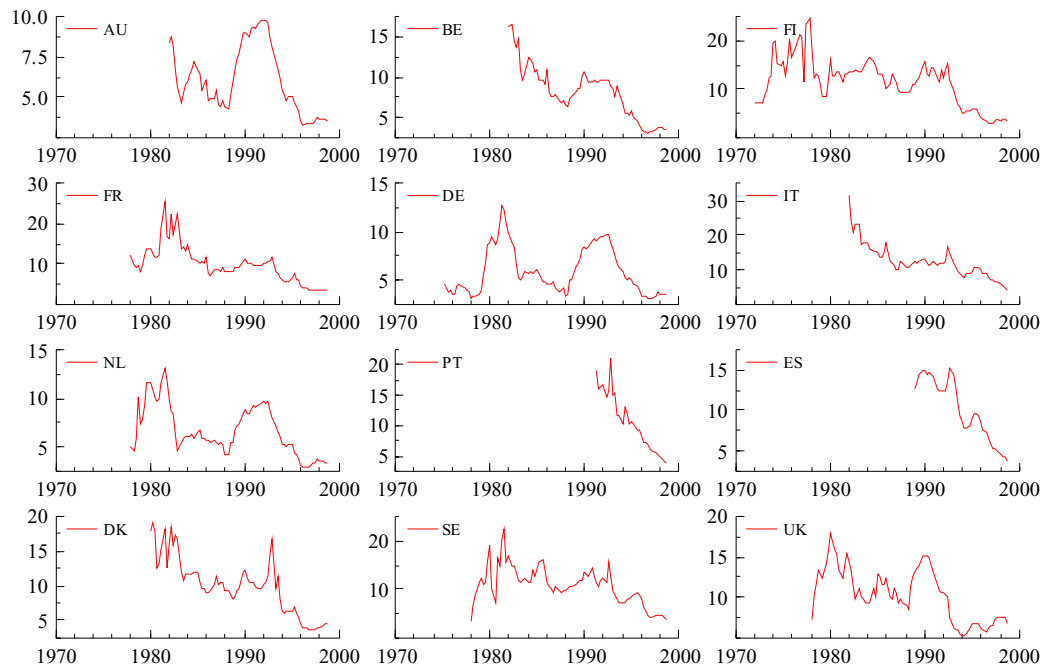
Source: Reuters.

Figure A2.4   **Quarterly change of a 3-month nominal money market rate, 1972Q2–1998Q4**
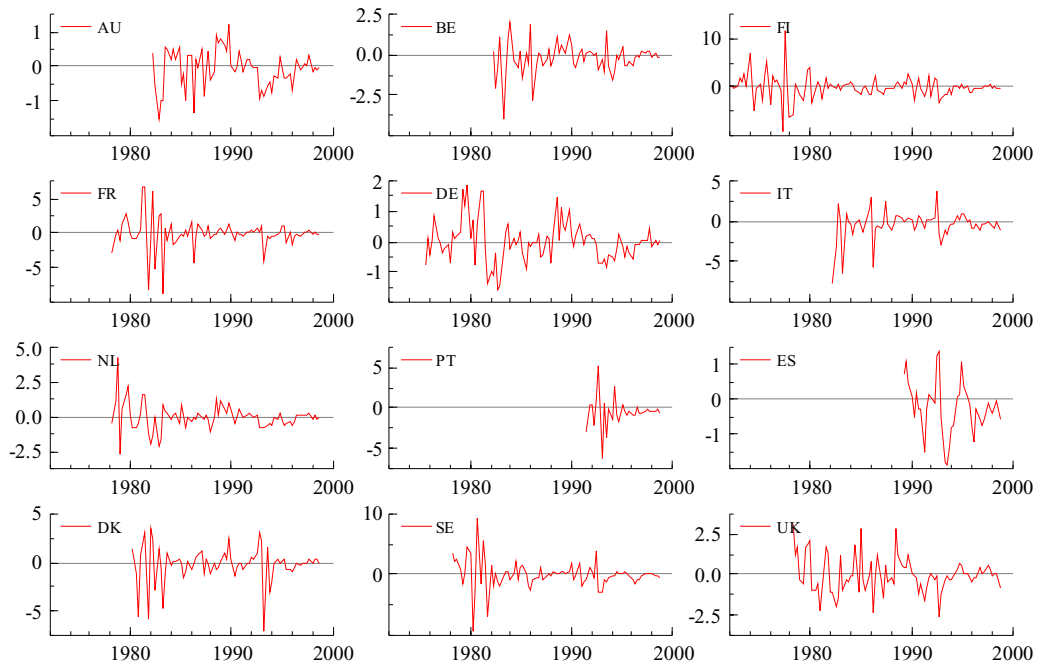
Source: Reuters.

Figure A2.5   **GDP volume index (1995=100), seasonally adjusted, 1970Q1–1998Q4**
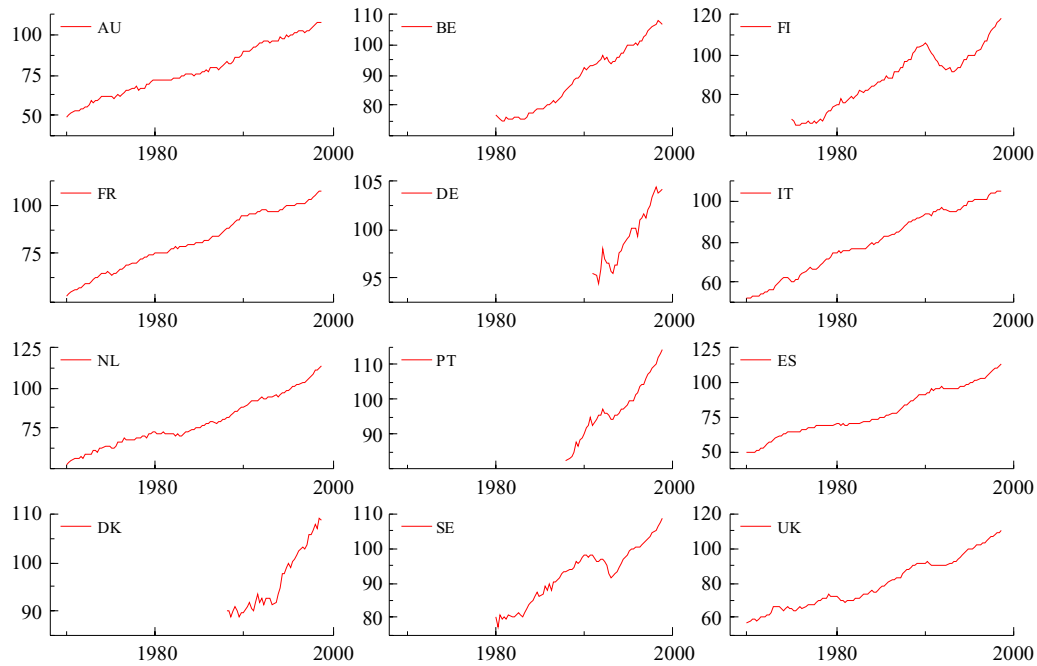
Source: OECD's Main Economic Indicators.

Figure A2.6   **Quarterly growth rate of GDP volume index, 1970Q2–1998Q4**
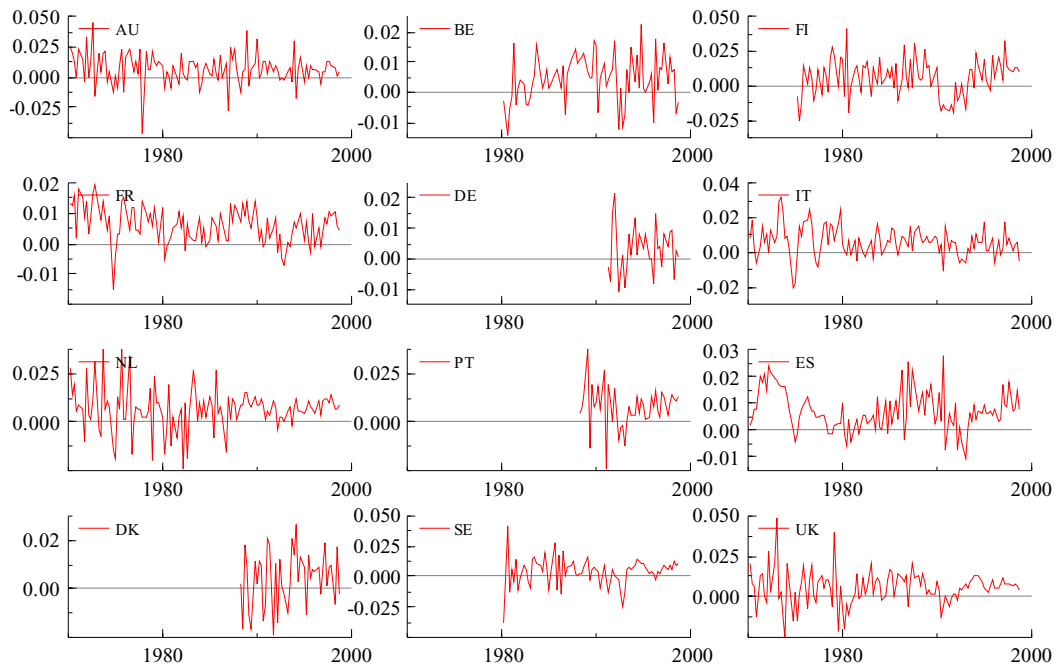
Source: Calculations based on OECD's Main Economic Indicators.

Figure A2.7   **Consumer price index (1995=100), 1970Q1–1998Q4**
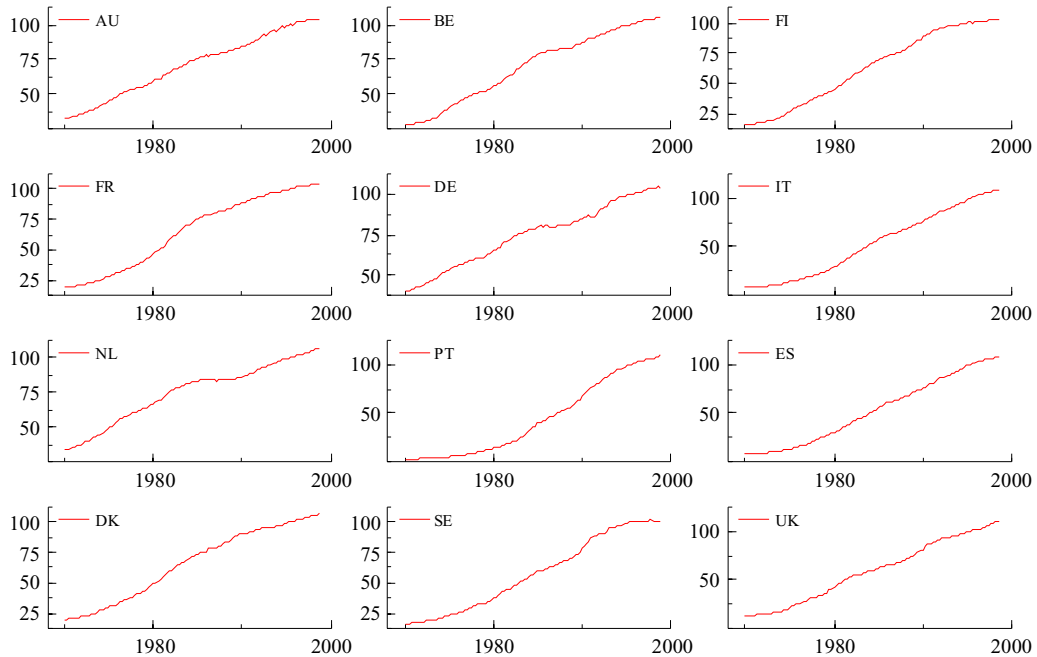
Source: IMF's International Financial Statistics.

Figure A2.8   **Quarterly growth rate of CPI, 1970Q1–1998Q4**
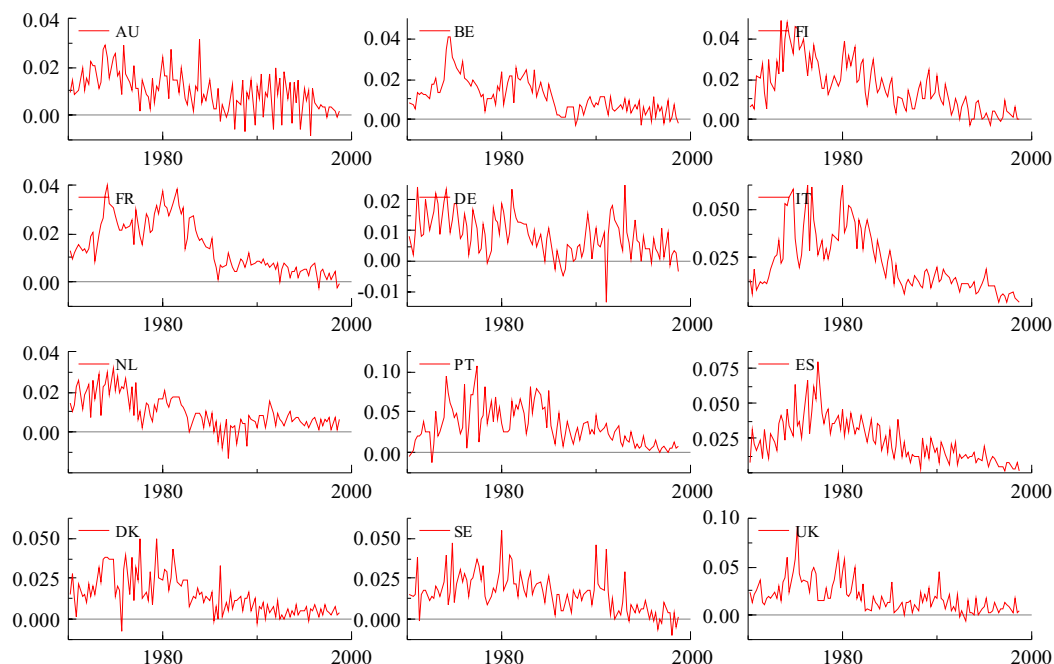
Source: Calculations based on the IMF's International Financial Statistics.

Figure A2.9   **Total bank assets divided by GDP,
                               1970Q1–1998Q4**
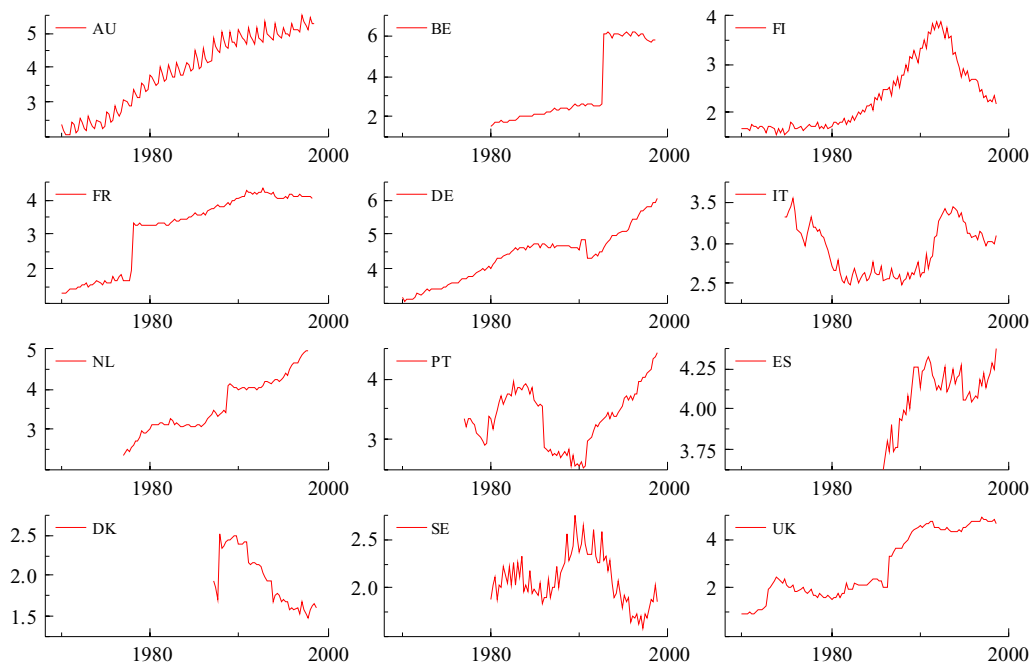
Source: Calculations based on the IMF's International Financial Statistics.

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Figure A2.10 **Deposits divided by total bank assets, 1970Q1–1998Q4**
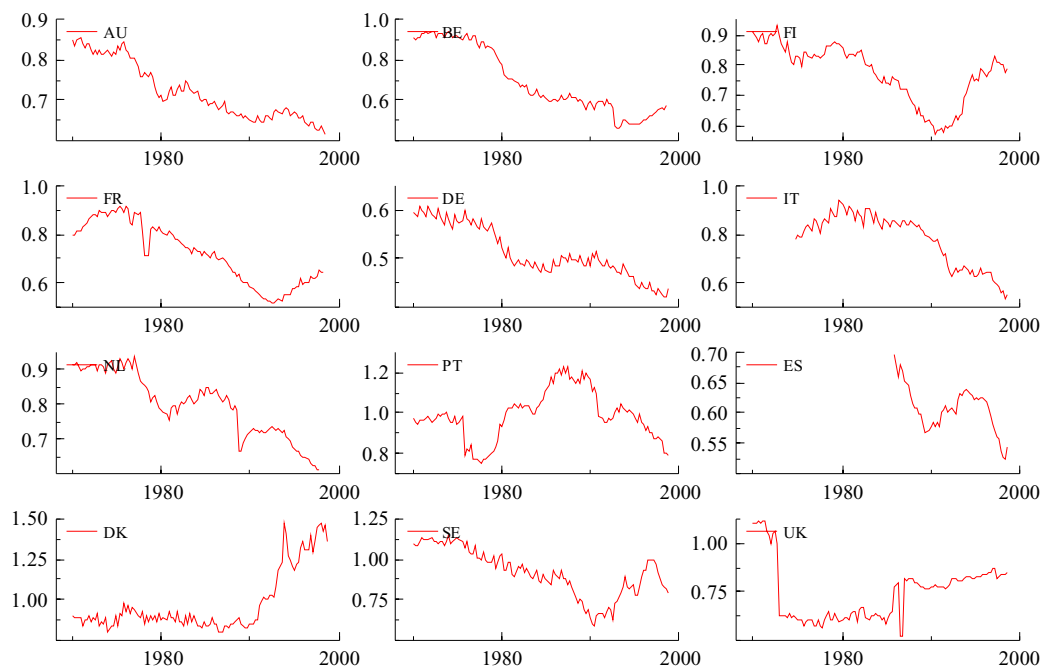
Source: Calculations based on the IMF's International Financial Statistics.

Figure A2.11 **Capital and reserves divided by total bank assets, 1970Q1–1998Q4**
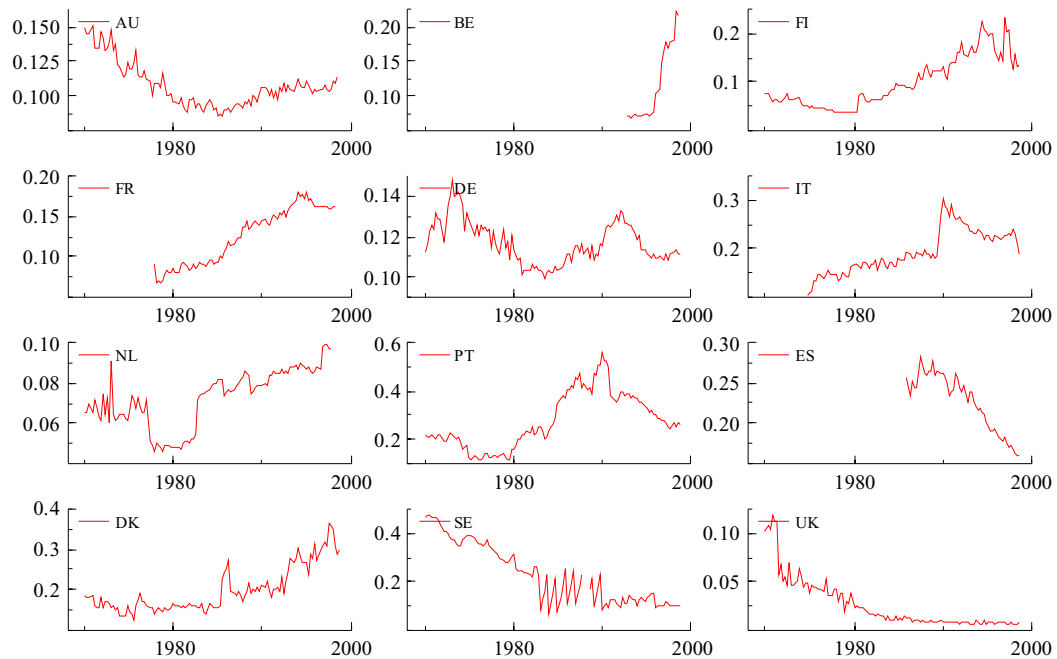
Source: Calculations based on the IMF's International Financial Statistics.

Appendix 3

Detailed estimation results

All estimations have been carried out using Stata 7 procedures.

Model 1 (The basic model as an OLS fixed-effects model estimated using *xtreg, fe* procedure)

```
. xtreg d1lnl r_1 r_2 r_3 r_4 d1lncpi_1 d1lncpi_2 d1lncpi_3 d1lncpi_4 d1lngdp_1
d1lngdp_2 d1lngdp_3 d1lngdp_4 trend, fe

Fixed-effects (within) regression          Number of obs      =        699
Group variable (i) : i                     Number of groups   =         12

R-sq:  within  = 0.1406                     Obs per group: min =         19
       between = 0.0216                                    avg =       58.3
       overall = 0.1312                                    max =         91

                                            F(13,674)          =       8.48
corr(u_i, Xb)  = -0.0679                    Prob > F           =     0.0000

------------------------------------------------------------------------------
   d1lnloans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         r_1 |  -.0023287   .0663332    -0.04   0.972    -.1325734    .1279159
         r_2 |  -.0273701   .0802121    -0.34   0.733    -.1848656    .1301255
         r_3 |   .0644963   .0777988     0.83   0.407    -.0882608    .2172535
         r_4 |  -.1497077    .059887    -2.50   0.013    -.2672951   -.0321202
    d1lncpi_1 |   .2413014   .1478111     1.63   0.103    -.0489241    .5315269
    d1lncpi_2 |   .3470377   .1483908     2.34   0.020     .0556739    .6384014
    d1lncpi_3 |    .320581   .1504986     2.13   0.034     .0250784    .6160835
    d1lncpi_4 |   .0319488   .1491494     0.21   0.830    -.2609045    .3248022
    d1lngdp_1 |   .2367469    .086744     2.73   0.007     .0664258    .4070679
    d1lngdp_2 |   .1720764   .0862592     1.99   0.046     .0027074    .3414454
    d1lngdp_3 |   .3014185   .0855007     3.53   0.000     .1335388    .4692982
    d1lngdp_4 |   .2637977    .083493     3.16   0.002      .09986    .4277355
       trend |  -.0001652   .0000634    -2.61   0.009    -.0002897   -.0000407
       _cons |   .0349301   .0103052     3.39   0.001     .0146961    .0551642
-------------+----------------------------------------------------------------
     sigma_u |  .00913908
     sigma_e |  .02367418
         rho |  .12969579   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(11, 674) =      3.83           Prob > F = 0.0000
```

Long-run coefficients and their standard errors with *lincom* procedure:

```
------------------------------------------------------------------------------
       d1lnl |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _cons |   .0349301   .0103052     3.39   0.001     .0146961    .0551642
-------------+----------------------------------------------------------------
           r |  -.1149101   .0453653    -2.53   0.012    -.2039845   -.0258357
-------------+----------------------------------------------------------------
     d1lncpi |   .9408689   .2360363     3.99   0.000      .477414    1.404324
-------------+----------------------------------------------------------------
     d1lngdp |   .9740395   .1651648     5.90   0.000      .64974    1.298339
-------------+----------------------------------------------------------------
       trend |  -.0001652   .0000634    -2.61   0.009    -.0002897   -.0000407
------------------------------------------------------------------------------
```

Model 2 (A dynamic version of the basic model estimated using *xtreg, fe* procedure)

```
. xtreg d1lnl d1lnl_1 d1lnl_2 d1lnl_3 d1lnl_4 r_1 r_2 r_3 r_4 d1lncpi_1 d1lncpi_2
d1lncpi_3 d1lncpi_4 d1lngdp_1 d1lngdp_2 d1lngdp_3 d1lngdp_4 trend, fe

Fixed-effects (within) regression        Number of obs    =       699
Group variable (i) : i                   Number of groups =        12

R-sq:  within  = 0.4228                  Obs per group: min =        19
       between = 0.7515                                 avg =      58.3
       overall = 0.4349                                 max =        91

                                         F(17,670)        =     28.87
corr(u_i, Xb)  = 0.0288                   Prob > F         =    0.0000

------------------------------------------------------------------------------
   d1lnloans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     d1lnl_1 |  -.0075631   .0341967    -0.22   0.825    -.0747087    .0595824
     d1lnl_2 |   .1884066   .0338878     5.56   0.000     .1218676    .2549457
     d1lnl_3 |  -.0283922   .0339523    -0.84   0.403    -.0950578    .0382734
     d1lnl_4 |   .4637613   .0341875    13.57   0.000     .3966338    .5308889
         r_1 |  -.1105306   .0551524    -2.00   0.045    -.2188229   -.0022382
         r_2 |   .0479665   .0666653     0.72   0.472    -.0829316    .1788646
         r_3 |  -.0180212   .0646243    -0.28   0.780    -.1449116    .1088693
         r_4 |  -.0644846   .0497574    -1.30   0.195    -.1621837    .0332146
   d1lncpi_1 |   .0337921   .1230347     0.27   0.784    -.2077878     .275372
   d1lncpi_2 |   .1903506   .1231247     1.55   0.123    -.0514061    .4321073
   d1lncpi_3 |   .2011059     .12453     1.61   0.107    -.0434102    .4456219
   d1lncpi_4 |   .0339873   .1235992     0.27   0.783    -.2087011    .2766757
   d1lngdp_1 |   .1003141   .0721546     1.39   0.165    -.0413624    .2419905
   d1lngdp_2 |   .1252569   .0717796     1.75   0.081    -.0156831    .2661969
   d1lngdp_3 |   .2582073   .0711305     3.63   0.000     .1185419    .3978728
   d1lngdp_4 |   .1690122   .0697306     2.42   0.016     .0320953    .3059291
       trend |  -.0001214   .0000524    -2.32   0.021    -.0002242   -.0000185
       _cons |    .026623   .0085411     3.12   0.002     .0098525    .0433935
-------------+----------------------------------------------------------------
     sigma_u |  .0049588
     sigma_e |  .01945968
         rho |  .0609759   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(11, 670) =     1.38             Prob > F = 0.1754
```

Long-run coefficients and their standard errors with *testnl* procedure:

Variable	Long-run coefficient	$\chi^2(1)$	Prob $> \chi^2$	Standard error
constant	0.06936914	48.01	0.0000	0.01001153
r	−0.37799523	11.36	0.0008	−0.11214945
$\Delta \ln CPI$	1.1965894	5.54	0.0189	0.50838212
$\Delta \ln GDP$	1.7009174	19.32	0.0000	0.38697211
trend	−0.00031632	47.96	0.0000	−0.00004568

Model 3 (A dynamic version of the basic model estimated using *xtabond* procedure)

```
. xtabond d1lnl l(1/4).(r d1lncpi d1lngdp), lags(4) maxldep(8) maxlags(8)

Arellano-Bond dynamic panel data              Number of obs     =        687
Group variable (i): i                         Number of groups  =         12

                                              Wald chi2(16)     =     381.45

Time variable (t): t                          min number of obs =         18
                                              max number of obs =         90
                                              mean number of obs =      57.25

One-step results
------------------------------------------------------------------------------
d1lnloans   |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
d1lnl       |
        LD  | -.0690659   .0344195    -2.01   0.045    -.1365268   -.0016049
       L2D  |  .1324007   .0338399     3.91   0.000     .0660757    .1987257
       L3D  | -.0702894   .0334648    -2.10   0.036    -.1358793   -.0046995
       L4D  |  .4253175   .0335726    12.67   0.000     .3595164    .4911186
r           |
        LD  | -.0760708   .0535479    -1.42   0.155    -.1810229    .0288812
       L2D  |  .034282    .0635084     0.54   0.589    -.0901921    .1587562
       L3D  | -.0214802   .061538     -0.35   0.727    -.1420925    .0991322
       L4D  | -.1161679   .0486565    -2.39   0.017    -.2115329   -.0208028
d1lncpi     |
        LD  | -.0452801   .1205246    -0.38   0.707    -.2815041    .1909439
       L2D  |  .1174356   .1197694     0.98   0.327    -.1173081    .3521794
       L3D  |  .1208462   .1215577     0.99   0.320    -.1174025    .3590949
       L4D  | -.0483862   .121829     -0.40   0.691    -.2871666    .1903942
d1lngdp     |
        LD  |  .0917289   .0718931     1.28   0.202     -.049179    .2326368
       L2D  |  .1264373   .071891      1.76   0.079    -.0144665    .267341
       L3D  |  .2656741   .0708811     3.75   0.000     .1267498    .4045985
       L4D  |  .203044    .0687982     2.95   0.003     .068202     .337886
_cons       | -.000292    .0000727    -4.02   0.000    -.0004345   -.0001496
------------------------------------------------------------------------------
Sargan test of over-identifying restrictions:
        chi2(706) =   652.37     Prob > chi2 = 0.9261

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
        H0: no autocorrelation   z = -16.26   Pr > z = 0.0000
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
        H0: no autocorrelation   z =  -2.53   Pr > z = 0.0116
```

Long-run coefficients and their standard errors with *testnl* procedure:

Variable	Long-run coefficient	$\chi^2(1)$	Prob $> \chi^2$	Standard error
constant	–0.00050203	79.67	0.0000	–0.00005624
r	–0.30850309	16.87	0.0000	–0.07511073
$\Delta \ln CPI$	0.24863538	0.44	0.5068	0.37483194
$\Delta \ln GDP$	0.74866981	18.01	0.0000	.18227738

Model 4 (Interaction term of the interest rate and 'size' included, lags 1–4)

```
. xtabond d1lnl l(1/4).(r d1lncpi d1lngdp xr), lags(4) maxldep(8) maxlags(8)

Arellano-Bond dynamic panel data              Number of obs     =        687
Group variable (i): i                         Number of groups  =         12

                                              Wald chi2(20)     =     402.09

Time variable (t): t                          min number of obs =         18
                                              max number of obs =         90
                                              mean number of obs =     57.25

One-step results
------------------------------------------------------------------------------
d1lnloans   |    Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
d1lnl       |
         LD | -.0779818   .0345003    -2.26   0.024    -.1456012   -.0103624
        L2D |  .1240565   .0339561     3.65   0.000     .0575037    .1906093
        L3D | -.0599524   .0338805    -1.77   0.077     -.126357    .0064521
        L4D |  .4412589     .03392    13.01   0.000      .374777    .5077407
r           |
         LD |  -.058281   .0535101    -1.09   0.276    -.1631589    .0465969
        L2D |  .0431104   .0634175     0.68   0.497    -.0811857    .1674065
        L3D | -.0182801   .0613853    -0.30   0.766    -.1385931    .1020329
        L4D | -.1089061   .0485205    -2.24   0.025    -.2040045   -.0138076
d1lncpi     |
         LD | -.0668293   .1208237    -0.55   0.580    -.3036395    .1699808
        L2D |  .0929729   .1199555     0.78   0.438    -.1421356    .3280814
        L3D |  .0748155   .1217668     0.61   0.539     -.163843    .3134741
        L4D | -.0742713   .1221884    -0.61   0.543    -.3137563    .1652136
d1lngdp     |
         LD |  .0876051   .0721207     1.21   0.224    -.0537488     .228959
        L2D |  .1285841    .072017     1.79   0.074    -.0125666    .2697347
        L3D |  .2706324   .0708518     3.82   0.000     .1317654    .4094993
        L4D |  .1901863   .0689479     2.76   0.006     .0550508    .3253218
xr          |
         LD | -.0516504   .0674985    -0.77   0.444     -.183945    .0806443
        L2D | -.1085921   .0672277    -1.62   0.106     -.240356    .0231717
        L3D | -.2243581   .0659655    -3.40   0.001    -.3536482    -.095068
        L4D | -.1204952   .0649756    -1.85   0.064     -.247845    .0068547
_cons       | -.0002826   .0000722    -3.91   0.000    -.0004242    -.000141
------------------------------------------------------------------------------
Sargan test of over-identifying restrictions:
        chi2(706) =   648.07    Prob > chi2 = 0.9416

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
        H0: no autocorrelation   z = -16.13   Pr > z = 0.0000
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
        H0: no autocorrelation   z =  -2.33   Pr > z = 0.0199
```

Long-run coefficients and their standard errors with *testnl* procedure:

Variable	Long-run coefficient	$\chi^2(1)$	Prob > χ^2	Standard error
constant	–0.00049352	76.59	0.0000	–0.00003229
r	–0.24860641	10.86	0.0010	–0.07543926
$\Delta \ln CPI$	0.04660646	0.01	0.9035	0.4660646
$\Delta \ln GDP$	0.72046202	17.60	0.0000	0.1717334
xr	–0.88208013	10.64	0.0011	–0.27041901

Model 5 (Interaction term of the interest rate and 'liquidity' included, lags 1–4)

```
. xtabond d1lnl l(1/4).(r d1lncpi d1lngdp yr), lags(4) maxldep(8) maxlags(8)

Arellano-Bond dynamic panel data              Number of obs      =        687
Group variable (i): i                         Number of groups   =         12

                                              Wald chi2(20)      =     384.05

Time variable (t): t                          min number of obs  =         18
                                              max number of obs  =         90
                                              mean number of obs =      57.25

One-step results
-------------------------------------------------------------------------------
d1lnloans   |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------+------------------------------------------------------------------
d1lnl       |
        LD  |  -.0747429    .034872    -2.14   0.032    -.1430907   -.0063951
        L2D |   .1355865   .0342887     3.95   0.000     .0683819    .2027911
        L3D |  -.0728068   .0339425    -2.15   0.032    -.1393328   -.0062807
        L4D |   .4218724    .034059    12.39   0.000     .3551181    .4886268
r           |
        LD  |  -.0446519   .0568331    -0.79   0.432    -.1560428    .0667391
        L2D |  -.0162911   .0693071    -0.24   0.814    -.1521304    .1195483
        L3D |   .0008435   .0681886     0.01   0.990    -.1328038    .1344908
        L4D |  -.1131951   .0527564    -2.15   0.032    -.2165958   -.0097944
d1lncpi     |
        LD  |  -.0672665   .1220662    -0.55   0.582    -.3065119    .1719788
        L2D |   .1170693   .1207437     0.97   0.332    -.1195841    .3537227
        L3D |   .1201537   .1221719     0.98   0.325    -.1192989    .3596063
        L4D |  -.0414523   .1223099    -0.34   0.735    -.2811753    .1982707
d1lngdp     |
        LD  |   .0960427   .0736335     1.30   0.192    -.0482764    .2403618
        L2D |   .1275778   .0735197     1.74   0.083    -.0165183    .2716738
        L3D |   .2655982    .072697     3.65   0.000     .1231147    .4080817
        L4D |   .2161451   .0703016     3.07   0.002     .0783564    .3539337
yr          |
        LD  |  -.3948789   .2832618    -1.39   0.163    -.9500618     .160304
        L2D |   .6535021   .3480857     1.88   0.060    -.0287334    1.335738
        L3D |  -.3548516   .3339386    -1.06   0.288    -1.009359    .2996559
        L4D |   .0985013   .2511782     0.39   0.695    -.3937989    .5908015
_cons       |  -.0002904   .0000785    -3.70   0.000    -.0004443   -.0001366
-------------------------------------------------------------------------------
Sargan test of over-identifying restrictions:
        chi2(706) =   648.05    Prob > chi2 = 0.9416

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
        H0: no autocorrelation   z = -16.40   Pr > z = 0.0000
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
        H0: no autocorrelation   z =  -2.36   Pr > z = 0.0182
```

Variable	Long-run coefficient	$\chi^2(1)$	Prob $> \chi^2$	Standard error
constant	–0.00049213	77.24	0.0000	–0.000056
r	–0.29367435	15.44	0.0001	–0.07473815
$\Delta \ln CPI$	0.21777013	0.34	0.5587	0.37347269
$\Delta \ln GDP$	0.75880932	17.23	0.0000	0.18280582
yr	0.00385181	0.00	0.9866	n.a.

Model 6 (Interaction term of the interest rate and 'capitalisation' included, lags 1–3)

```
. xtabond d1lnl l(1/3).(r d1lncpi d1lngdp zr), lags(3) maxldep(8) maxlags(8)

Arellano-Bond dynamic panel data              Number of obs     =        694
Group variable (i): i                         Number of groups  =         12

                                              Wald chi2(15)     =     226.92

Time variable (t): t                          min number of obs =         19
                                              max number of obs =         91
                                              mean number of obs =  57.83333

One-step results
------------------------------------------------------------------------------
d1lnloans   |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
d1lnl       |
         LD | -.1596299   .0362093    -4.41   0.000    -.2305989   -.0886609
        L2D |  .2588931   .0359073     7.21   0.000     .1885161    .3292701
        L3D | -.0723963    .036418    -1.99   0.047    -.1437743   -.0010184
r           |
         LD | -.0481092   .0559771    -0.86   0.390    -.1578223    .0616039
        L2D | -.0142326   .0680602    -0.21   0.834    -.1476282     .119163
        L3D | -.0771023   .0531422    -1.45   0.147    -.1812591    .0270544
d1lncpi     |
         LD |  .0265896   .1303376     0.20   0.838    -.2288675    .2820466
        L2D |  .1767122   .1294872     1.36   0.172    -.0770779    .4305024
        L3D |  .2081997   .1327754     1.57   0.117    -.0520353    .4684346
d1lngdp     |
         LD |  .2833838   .0770912     3.68   0.000     .1322878    .4344798
        L2D |  .1472253   .0774888     1.90   0.057    -.0046499    .2991005
        L3D |  .2396836   .0752695     3.18   0.001     .0921582    .3872091
zr          |
         LD | -1.262733   .3030946    -4.17   0.000    -1.856787   -.6686783
        L2D |  1.11092    .3630763     3.06   0.002     .3993035    1.822536
        L3D |  .851572    .3356018     2.54   0.011     .1938046    1.509339
_cons       | -.0002891   .0000804    -3.59   0.000    -.0004467   -.0001314
------------------------------------------------------------------------------
Sargan test of over-identifying restrictions:
        chi2(710) =   711.72     Prob > chi2 = 0.4748

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
        H0: no autocorrelation   z = -17.62   Pr > z = 0.0000
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
        H0: no autocorrelation   z =  -9.05   Pr > z = 0.0000
```

Long-run coefficients and their standard errors with *testnl* procedure:

Variable	Long-run coefficient	$\chi^2(1)$	Prob > χ^2	Standard error
constant	−0.00029708	234.97	0.0000	−0.00001938
r	−0.14329399	11.39	0.0007	−0.04245864
$\Delta \ln CPI$	0.42286243	3.83	0.0503	0.21607261
$\Delta \ln GDP$	0.68879866	21.12	0.0000	0.14988057
zr	0.7190784	7.07	0.0078	0.27043727

Model 7 (Interaction with 'size' and 'capitalisation' included, lags 1–3)

```
. xtabond d1lnl l(1/3).(r d1lncpi d1lngdp xr zr), lags(3) maxldep(8) maxlags(8)

Arellano-Bond dynamic panel data                Number of obs     =        694
Group variable (i): i                           Number of groups  =         12

                                                Wald chi2(18)     =     237.53

Time variable (t): t                            min number of obs =         19
                                                max number of obs =         91
                                                mean number of obs =  57.83333

One-step results
------------------------------------------------------------------------------
d1lnloans   |    Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
d1lnl       |
        LD  | -.1598328    .036355    -4.40   0.000    -.2310873   -.0885783
        L2D |  .2606295   .0360861     7.22   0.000     .189902    .3313571
        L3D | -.0578903   .0368456    -1.57   0.116    -.1301063    .0143258
r           |
        LD  | -.0410271   .0562396    -0.73   0.466    -.1512546    .0692004
        L2D | -.0057926   .0681389    -0.09   0.932    -.1393424    .1277571
        L3D | -.0753234    .053167    -1.42   0.157    -.1795289    .028882
d1lncpi     |
        LD  |  .0008265    .130868     0.01   0.995     -.25567    .2573231
        L2D |  .1666674   .1301852     1.28   0.200    -.0884909   .4218257
        L3D |  .1951239   .1333656     1.46   0.143    -.066268    .4565157
d1lngdp     |
        LD  |  .2989188   .0772634     3.87   0.000     .1474854   .4503522
        L2D |  .1419726   .0776811     1.83   0.068    -.0102795   .2942248
        L3D |  .2341911   .0753978     3.11   0.002     .086414    .3819681
xr          |
        LD  | -.1919251   .0716109    -2.68   0.007    -.3322799   -.0515704
        L2D | -.0336147   .0717515    -0.47   0.639    -.1742451    .1070157
        L3D | -.0852346   .0704398    -1.21   0.226     -.223294    .0528248
zr          |
        LD  | -1.187052   .3040391    -3.90   0.000    -1.782958   -.5911462
        L2D |  1.004942   .3646565     2.76   0.006     .2902285   1.719656
        L3D |  .8885994   .3358107     2.65   0.008     .2304225   1.546776
_cons       | -.0002748   .0000804    -3.42   0.001    -.0004323   -.0001172
------------------------------------------------------------------------------
Sargan test of over-identifying restrictions:
        chi2(710) =   705.98    Prob > chi2 = 0.5356

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
        H0: no autocorrelation   z = -17.76   Pr > z = 0.0000
Arellano-Bond test that average autocovariance in residuals of order 2 is 0:
        H0: no autocorrelation   z =  -8.77   Pr > z = 0.0000
```

Long-run coefficients and their standard errors with *testnl* procedure:

Variable	Long-run coefficient	$\chi^2(1)$	Prob > χ^2	Standard error
constant	−0.00028712	223.49	0.0000	−0.00001921
r	−0.12761887	8.48	0.0036	−0.0438245
$\Delta \ln CPI$	0.37887399	2.94	0.0864	0.2209638
$\Delta \ln GDP$	0.70534649	21.37	0.0000	0.15258093
xr	−0.32470642	5.28	0.0215	−0.14131033
zr	0.73816153	7.23	0.0072	0.27452523

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