

Recent findings on monetary policy transmission in the euro area

This article draws on new Eurosystem research to provide a summary of recent findings on the transmission of monetary policy in the euro area. The article is structured around three main questions: What are the estimated effects of monetary policy changes on prices and output in the euro area? How are these effects channelled? How do the effects of monetary policy differ over time or across individual sectors or countries in the euro area?

The main results of the research into each of these questions can be summarised as follows. Monetary policy changes have a temporary effect on aggregate euro area output; over time, output tends to return to close to its original level. Although more muted at the start, the effect on consumer prices is long-lasting. Whereas these general results are clearly supported by the evidence discussed in this article, the more specific patterns of the transmission lags of monetary policy are subject to considerable uncertainty. This is due partly to the fact that the analysis is, by necessity, based predominantly on data from the period before the introduction of the euro. The existence of long and uncertain lags confirms that monetary policy should be focused on medium-term developments and should avoid attempting to fine-tune output or prices in the short term.

Investment appears to be an important driving force behind output changes in the wake of a monetary policy shock. The results confirm that business investment is sensitive both to changes in the user cost of capital and, to a more limited extent, to liquidity or cash-flow effects. Financial and credit constraints seem to play a role in explaining the response to monetary policy in some countries and for specific groups of firms or banks, but do not appear to be of central importance for the euro area as a whole.

The empirical evidence does not suggest that there are systematic differences between countries in policy transmission that are robust across different studies and methodologies. There is, however, evidence of a differential impact on economic sectors and also evidence that the effects of monetary policy on output may be stronger in periods when the balance sheets of households and firms are weak, such as during a downturn.

I Introduction

Drawing on new analyses conducted by the ECB in co-operation with the Eurosystem's research areas, this article provides a summary of recent findings on the transmission of monetary policy in the euro area. The Eurosystem's work was carried out by two different groups, namely the "Monetary Transmission Network", which focused on aggregate time series models and on microeconomic data, and the Monetary Policy Committee's "Working Group on Econometric Modelling", which concentrated on structural area-wide and national econometric models.¹ This article follows another on the same subject which appeared in the July 2000 issue of the ECB's Monthly Bulletin, and is a progress report that extends and updates these earlier findings.

The article is structured around three main questions: What is the estimated effect of monetary policy on prices and output in the euro area? How are these effects channelled? Are there differences in how monetary policy is transmitted throughout the euro area? The main results of research on each of these questions are examined in the three following sections of this article. The last section contains the overall conclusions of the research and discusses the links and implications for the ECB's monetary policy strategy.

¹ The complete research results have been published in ECB Working Papers Nos. 91-114.

2 Aggregate effects of monetary policy on prices and output

There is a general consensus on the *direction* of the effects of changes in policy-controlled interest rates on output and prices: an increase (decrease) in interest rates is thought, *ceteris paribus*, to have a downward (upward) effect on prices and output. However, there is far less agreement about the *magnitude* and *timing* of these effects. Obtaining updated estimates of the effect of monetary policy on the aggregate price level and economic activity in the euro area as a whole is of prime importance for policy-making. In order to attain its statutory goal of maintaining price stability in the medium term, the Governing Council needs to be aware of the size and the timing of the adjustments in the policy-controlled interest rate that are necessary at each time. This requires estimates of the effects of policy rate adjustments on prices at different time lags. In addition, since the ECB aims to attain price stability over the medium term, thereby avoiding the introduction of unnecessary fluctuations in other relevant macroeconomic variables, in particular economic activity, evidence about the effects of monetary policy on output is also important.

In order to create a comprehensive body of evidence, Eurosystem researchers have produced several estimates of the effects on prices and output using a variety of models and data. The results presented in this article were found to be fairly robust across different methodologies and are also consistent with indications from economic theory. It remains important to note, however, that despite their robustness, all these estimates are surrounded by a significant degree of uncertainty. This is partly due to the fact that the analysis is, by necessity, based predominantly on data from the period before the introduction of the euro. Hence the results may be subject to change as a consequence of the introduction of the new currency and the related change in the “monetary policy regime”.

As an illustration of the results obtained for the euro area as a whole, Table I shows the

simulation results of a temporary increase of 100 basis points (lasting for two years) in policy-controlled interest rates within three different macroeconomic models of the euro area: the ECB’s area-wide model (AWM), the aggregations of simulations of the individual national central bank country models (NCB) and of the NiGEM multi-country model, developed by the National Institute of Economic and Social Research (NIESR) in the United Kingdom. In line with the academic literature, the monetary policy changes are assumed to be *unexpected*, although policy moves are usually anticipated to a certain extent. Hence, the simulations lump together the *overall* effects of the policy change, including those stemming from any early signals or other information that may precede it. In these simulations, it is assumed that the long-term interest rate and the exchange rate respond in line with the expectations theory of the term structure of interest rates and the uncovered interest rate parity theory respectively. The long-term interest rate is assumed to increase by 20 basis points on impact, while the exchange rate is assumed to appreciate by 2%. In all cases, the maximum effect on real output occurs in the second year. The size of the effect after one year lies within a relatively narrow range of -0.2 to -0.4%. Moreover, all model results suggest that output eventually tends to return to the original value after the temporary monetary policy shock. For prices, the adjustment in response to the same shock is slower; the level of consumer prices decreases gradually. By contrast with the effects on output, the effects of monetary policy on the price level are long-lasting. According to Table I, the drop in the price level after three years lies in a range of -0.2 to -0.4%.

There are some differences in the persistence of the output and price effects across different models. Notably, models differ in how long it takes for output to return to baseline. For example, in the aggregation of the simulations calculated from the national models, euro area output returns to baseline

Table 1**Responses to a 1% increase in the policy-controlled interest rates of the euro area**

	Real GDP			Consumer prices		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
AWM	-0.34	-0.71	-0.71	-0.15	-0.30	-0.38
NCB	-0.22	-0.38	-0.31	-0.09	-0.21	-0.31
NiGEM	-0.34	-0.47	-0.37	-0.06	-0.10	-0.19

Sources: McAdam, P. and J. Morgan, ECB Working Paper No. 93; Van Els et al., ECB Working Paper No. 94.

Notes: The table shows responses of real GDP and consumer prices to a two-year increase of 100 basis points in the policy-controlled interest rates of the euro area. Figures are expressed in per cent from baseline. Simulations are performed using the ECB's area-wide model (AWM), the NCBs' macroeconomic models (NCB) and the multi-country model of the NIESR (NiGEM).

after about five years, while the return occurs later, after seven years, in the NiGEM multi-country model. Overall, the detailed timing of the effects of monetary policy are subject to greater uncertainty than the evidence on the overall size of the effects.

The broad profiles of the output and price responses to monetary policy are robust across econometric models and methodologies. Using vector-autoregression (VAR) models, for example, the typical pattern over time of the response of euro area output after a monetary contraction is characterised by an inverted hump shape. Output begins to decline significantly roughly two quarters after the initial increase in the interest rate and returns to close to its original value after around two years (see the article entitled "Monetary policy transmission in the euro area" in the July 2000 issue of the ECB's Monthly Bulletin).

Overall, the results show that the effect of monetary policy on prices is very slow, but long-lasting, whereas the effect on output is significant in the short run, but temporary. These results are both qualitatively and

quantitatively comparable with those in the large body of empirical literature on the effects of monetary policy in other countries, notably the United States. They highlight two robust features of monetary policy transmission. First, the impact of monetary policy is neutral in the long run, i.e. a permanent change in the money supply (associated here with a temporary change, in the opposite direction, in the central bank instrument, the policy-controlled interest rate) has no significant long-run effect on real GDP, but does lead to a permanent change in the price level. This evidence is consistent with that given in the large body of theoretical and empirical literature on money neutrality. Second, monetary policy changes do have a temporary impact on output. This short-run non-neutrality is attributable to nominal and real rigidities in the goods and labour markets, which prevent prices from quickly adjusting after a change in monetary policy. This highlights the importance of the structural characteristics of the wage and price setting mechanisms in terms of enhancing the effectiveness of monetary policy on prices and reducing its costs in terms of output fluctuations.

3 Channels of monetary transmission

Monetary policy decisions are transmitted through the economy in a variety of ways, all of which eventually affect the evolution of prices and output. The monetary transmission mechanism is a combination of all the economic channels through which, over time, monetary policy affects the

economy.² There are two approaches to determining the importance of the different channels in affecting the evolution of prices

2 A more detailed overview of these mechanisms of monetary transmission can be found in the article published in the July 2000 issue of the ECB's Monthly Bulletin and in the volume entitled "The Monetary Policy of the ECB"; ECB, August 2001.

and output in the euro area. On the one hand, structural econometric models can be used to try to disentangle some of the channels and identify their relative quantitative importance at the macroeconomic level. One drawback in doing this is that the analysis is model-dependent, and the result can be driven partly by modelling choices. On the other hand, disaggregated data from balance sheets of non-financial firms and banks can be used to analyse specific key links in the transmission mechanism, such as the role of financial factors and the supply of bank credit. This approach is particularly promising given the importance of bank lending as a source of finance in the euro area. With this type of research, however, it is not always easy to deduce the macroeconomic importance of evidence in favour of financial factors playing a role. Hence, the pieces of evidence gathered by the two approaches are complementary and are best considered together.

In the following sections, these two pieces of evidence are discussed in turn. It should be noted, however, that this analysis is not exhaustive. In particular, important channels such as the direct effect of monetary policy on inflation expectations are not explicitly discussed. The Eurosystem's monetary policy strategy, with its emphasis on price stability over the medium term, plays an important role in anchoring inflation expectations at low levels and thereby contributing to the stability of the economy. Indirect evidence (e.g. the analysis of bond yields) supports the view that since the start of Stage Three of Economic and Monetary Union (EMU), expectations of inflation over the medium term have been well anchored by the Eurosystem's commitment to price stability. However, the effects induced by the credibility of the ECB's strategy are by their nature limited to the post-1999 period and therefore not easily captured by the econometric models used to analyse monetary transmission.

Macroeconometric evidence: decomposing the interest rate channels

Changes in the policy-controlled interest rate usually have a prompt impact on market interest rates and on prices of financial assets, such as bonds, equity and foreign exchange. As nominal prices and wages are sticky, a change in nominal short-term interest rates affects real interest rates and asset prices. The latter in turn influence real spending decisions and, through the ensuing imbalance between the demand and the supply for goods and services, also alter wages and prices with a delay. Changes in market expectations can speed up this stage of the transmission.

In a relatively closed economy such as the euro area, the "domestic channels" (primarily consumer and investment expenditure, including construction and inventories) are likely to be the most important. A temporary increase in real interest rates makes it more rewarding for households to delay consumption and increase saving. As households are willing to postpone consumption, current domestic demand for consumer goods and services is reduced (substitution channel). Price adjustments in domestic asset markets – for bonds, equities and real estate – affect the value of households' wealth and, therefore, spending (wealth channel). Interest rate changes can also have an impact on disposable income directly by affecting the proceeds from holding or borrowing via short-term and variable-coupon securities (income channel). Finally, changes in interest rates also change the cost of acquiring new capital and thereby affect the demand for fixed and inventory investment goods (cost-of-capital channel).

By modifying the relative return on assets denominated in domestic and foreign currency or by influencing expectations regarding future economic developments inside the euro area, an increase in domestic interest rates may also affect the exchange rate. An appreciation, for example, tends to put downward pressure on the domestic

price level through cheaper imported goods used in domestic consumption and production. Since domestic goods become more expensive relative to foreign goods, domestic and foreign demand for such goods is also likely to decrease, with a negative effect on GDP (exchange rate channel). It should be stressed, however, that most economic literature argues that the effects of interest rate changes on exchange rates are particularly difficult to predict in practice.

Goods prices can be expected to respond relatively quickly to any given change in the nominal effective exchange rate. By contrast, the transmission of monetary policy through the domestic substitution, income, wealth and cost-of-capital channels is likely to be slow in the short term, but more powerful and reliable in the medium term, in particular in a relatively closed economy such as the euro area. The importance of domestic demand in the transmission mechanism is illustrated in Table 2, which shows the percentage contributed by changes in consumption, fixed investment and the other components of aggregate demand to the change in GDP following a tightening of monetary policy. These contributions are calculated by weighting the response of each component according to its share in GDP. Consumption and investment together cover almost the totality of the effect on domestic demand and output (the remainder being accounted for by government consumption, changes in inventories and net exports). In particular,

the results show that investment is a main driving force, with a contribution of more than 80 percent to the total response of GDP after three years. Moreover, the importance of investment gradually increases over time, suggesting the existence of accelerator effects that build up gradually. The important role of investment in the transmission process is confirmed by country-level analyses and by the microeconomic evidence on the cost-of-capital channel discussed in the next section. The effect of consumption as a percentage of the total response to GDP remains quite steady over time and is estimated to be between one-third and one-half of the total response of GDP.

Microeconomic evidence and the credit channel

Households and firms may be constrained in their spending behaviour if desired spending exceeds currently available funds or the amount of credit that they can obtain. This mechanism, which arises under imperfect financial markets and gives rise to what is often referred to as the credit channel, operates in a number of different ways. The first is through the supply of bank lending, as firms and households often depend on banks as their main providers of external finance (bank-lending channel). Another is through the availability and value of collateral necessary for borrowing operations (balance sheet channel) or the availability of liquid

Table 2
Contributions of aggregate demand components to the GDP effect of an increase in the policy-controlled interest rates of the euro area

	NCB			AWM		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Consumption	33	37	37	48	50	46
Investment	32	57	83	50	70	88
Other	34	6	-20	2	-20	-34
Total	100	100	100	100	100	100

Source: ECB calculations based on Van Els et al., ECB Working Paper No. 94.

Note: The table shows the contributions of the components of aggregate demand to the effect of a two-year increase of 100 basis points in the policy-controlled interest rates of the euro area. Figures are expressed as a percentage of the total effect on real GDP. Simulations are performed using the NCBs' macroeconomic models (NCB) and the ECB's area-wide model (AWM).

funds (cash-flow channel). The credit channel depends on the level of interest rates and other asset prices and normally plays a role in addition to the more traditional interest rate channel, typically strengthening the effects generated through substitution, cost-of-capital and wealth effects. On the whole, the importance of the credit channel depends on the financial structure and the financial stability of the economy concerned (“financial accelerator” effects). The high degree of bank dependence and the limited breadth of the stock and other financial markets in the euro area are conducive to the existence of possible credit channel effects. As a consequence, attention to the importance of such channels, in particular the role of banks, in the transmission mechanism is warranted.

Empirical evidence on the behaviour of individual firms collected by the Eurosystem groups shows that the effects of changes in the cost of capital on firms’ investment decisions are significant (see the box). Cost-of-capital changes therefore seem to represent a significant element in the monetary transmission process. However, in most euro area countries cash-flow considerations also play a role in investment decisions, pointing to the possibility that firms are to some extent subject to liquidity constraints. In these circumstances, firms may not be able to fully fund all positive net-present-value projects because of the unavailability of internal or external finance.

Empirical evidence on the behaviour of individual banks shows that bank loans decline significantly after a tightening of monetary policy (see the box). Evidence from macroeconomic time series clearly confirms this effect. Moreover, the results for the euro area show that banks that hold relatively less liquid assets generally adjust their lending to changes in the short-term interest rate by

more than banks that hold more liquid assets. This suggests that the response of loans to monetary policy changes depends on the characteristics of banks, i.e. the *suppliers* of loans, as opposed to the economic units that *demand* them (households and non-financial firms). This indirect evidence supports the existence of loan supply effects for at least some categories of banks. However, the direct quantitative effects of the liquidity differences do not appear to be large. In addition, contrary to what has been observed in the United States, small banks or less capitalised banks do not seem to react differently to other banks in most countries. Possible reasons for this are the existence of relationship banking, foreign ownership, membership of bank networks, explicit or implicit deposit insurance schemes or other forms of guarantee.

While the results show that a bank-lending channel of monetary policy transmission is likely to be operative in at least some euro area countries, the evidence does not suggest an overwhelming role for such a channel in the euro area as a whole. This could be due to the fact that, in the past, the euro area has been characterised by a rather high degree of financial stability (as indicated by the very small incidence of bankruptcies in the banking sector). In fact, the banks for which the credit channel is important appear to account for a relatively small fraction of total bank lending. However, there could be differential effects of monetary policy among particular classes of banks or borrowers in those euro area countries where the bank-lending channel is found to operate more strongly.³

3 Details on the effects of monetary policy in individual countries can be found in ECB Working Papers Nos. 91-114.

4 Differences in monetary policy effects

This section examines whether the effects on prices and output are homogeneous within the euro area and over time. Asymmetries across countries or regions can arise for a variety of reasons, and can take many forms. First, different cyclical positions may cause different policy effects. Second, differences in the nature of output and in the production techniques can generate differences in the impact of monetary policy across sectors. Third, cross-border differences may result from a variety of factors, such as the legal and institutional framework, the sectoral decomposition of output, etc. Given the area-wide nature of the ECB's price stability objective, cross-country differences cannot be of direct relevance for monetary policy-making. However, an understanding of the factors which determine asymmetries in the transmission of monetary policy is important as it may make it easier to assess the overall policy transmission process, to select the best indicators, and – most importantly – to highlight areas where structural reform in goods, labour and financial markets may be necessary.

Differences according to the business cycle

One of the main reasons why the cyclical position of the economy may be of relevance for monetary policy is that the balance sheet position of households and firms is typically weaker in a downturn than in a boom. A weaker balance sheet of firms and households may accentuate a number of channels of monetary policy transmission, including the “cost-of-capital channel” and the “credit channel.” Evidence based on VAR analysis suggests that the effects of monetary policy on output are indeed larger in a recession (when balance sheets are weaker) than in a boom. This has been found to hold for most countries in the euro area, as well as for the United States.

The chart below illustrates the above by comparing the estimated effects of a common euro area interest rate tightening on industrial

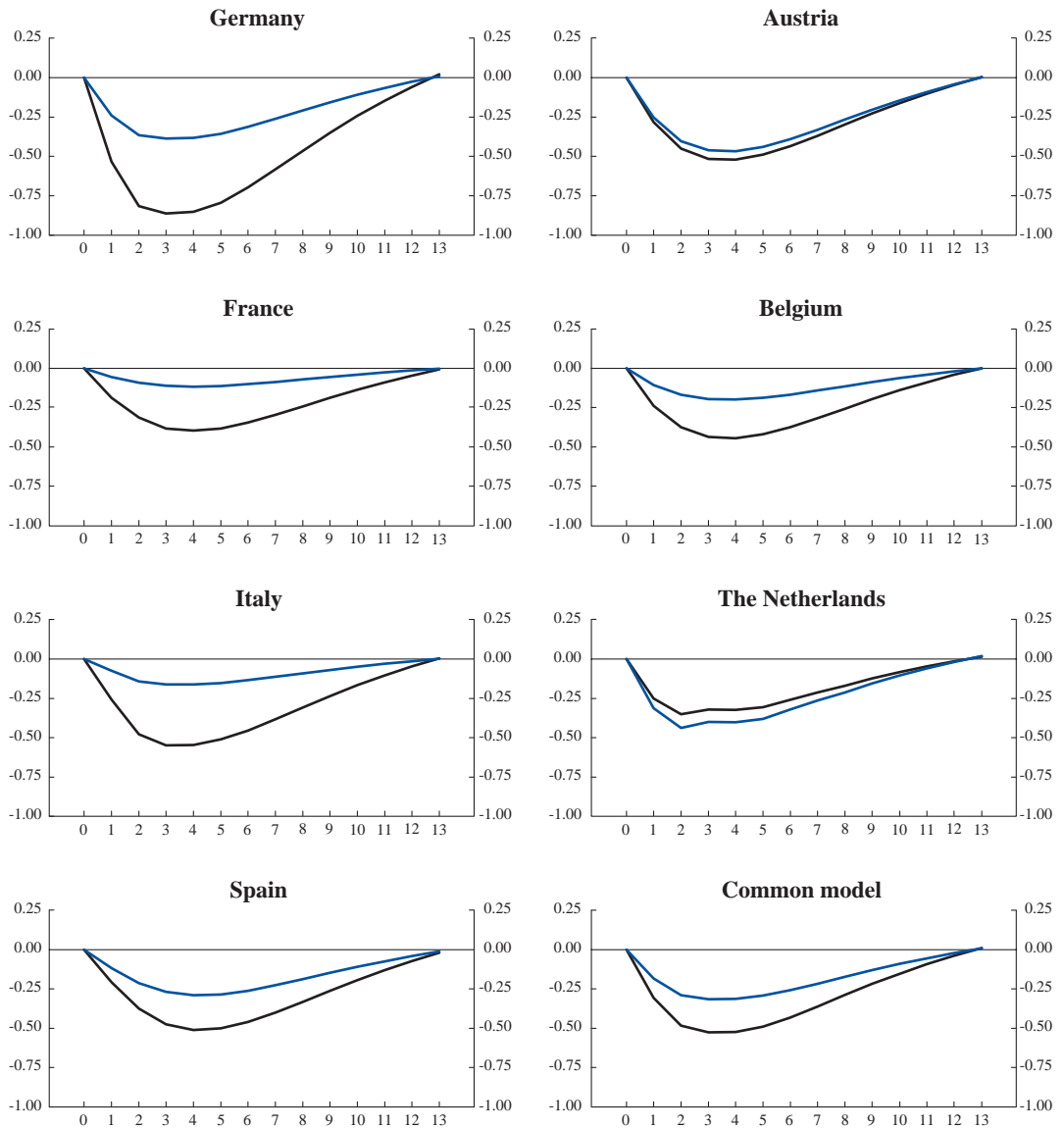
output in the seven largest countries of the euro area in a boom (blue line) and in a downturn (black line). The temporary increase in the policy-controlled interest rate is assumed to be the same in all cases, regardless of the state of the cycle. The simulations show that the *shape* and the *timing* of the effect in a boom and in a recession are similar; however the maximum *size* of the effect is on average larger in a downturn. It is assumed that, given the business cycle position, the effects of a tightening of monetary policy are the same as those of an easing of similar magnitude. The simulation therefore implies that the effect on output of a tightening in a boom is weaker than the effect of an easing in a downturn. Sectoral analysis has shown that those differences are typically larger in industries with weaker balance sheets.

Differences across sectors

Monetary policy changes can affect sectors differently for a number of reasons. First, demand for the respective products can be more or less interest-sensitive. For example, durable items such as investment goods, construction and durable consumption goods are likely to respond more strongly to monetary policy, as their acquisition can be shifted more easily over time. Second, if interest rate changes affect the exchange rate, industries producing tradable goods will be affected more strongly than the services industries. Third, sectors characterised by more capital-intensive production might display higher interest rate sensitivity, since changes in the cost of capital tend to have a greater impact on them. Fourth, monetary policy may affect firms' financing through its effect on collateral values, and the availability of collateral is to some extent sector-specific. Finally, interest rate changes might affect industries at different times depending on their position in the production chain: producers of final goods are likely to be affected earlier than producers of intermediate or primary goods.

Chart

Effects of monetary policy on euro area output in booms (blue line) and in downturns (black line)



Source: G. Peersman and F. Smets, "Are the effects of monetary policy in the euro area greater in recessions than in booms?", ECB Working Paper No. 52.

Notes: The table shows the effects of a temporary increase in the policy-controlled interest rates of the euro area on industrial output in booms (blue line) and in downturns (black line). The policy experiment concerns a temporary increase in short-term interest rates in the euro area of around 35 basis points. The horizontal axis refers to quarters following the increase.

The findings on cross-sectoral differences in monetary transmission in the euro area are still limited, but they are indicative.⁴ First, there seems to be significant cross-sectoral heterogeneity in the reaction of output to monetary policy. Monetary policy effects are greater for producers of durable goods. This holds true, for example, for the construction industry. Second, industries that use more capital in their production technology (e.g. petroleum refineries, iron and steel and non-ferrous metals) are more sensitive to monetary policy changes. Finally, there is also evidence that financial factors play a role in explaining cross-sectoral differences. However, given the relative homogeneity in the sectoral composition of output across the euro area countries (compared, for example, with the regional diversity in the United States), any degree of differential response of output across sectors is unlikely to lead to large cross-country differences in the overall transmission process.

Differences across countries

It should be stressed that it is very difficult to compare the effects of monetary policy changes across countries on the basis of largely pre-1999 data and to draw conclusions on the likely effect of the single monetary policy on the national economies; thus the results of such an exercise should be treated with caution. The effects of monetary policy

changes depend, to a large extent, on the monetary policy regime itself, as perceived by market agents who form expectations and react to monetary policy changes on the basis of such expectations. Hence, the change in policy regime due to the introduction of the euro is likely both to be particularly relevant in this case and to invalidate part of the inference that one can draw with regard to the effectiveness of monetary policy.

Despite these caveats, the fairly extensive literature on transmission mechanisms in individual economies and the results of the research recently conducted in the Eurosystem⁵ make it possible to draw a number of broad conclusions. A number of studies have used econometric models of individual countries to compare the effects of monetary policy. The rankings in terms of the magnitude of the policy effects established in these studies are normally not robust across different studies. In addition, confidence bands around those effects are generally wide so that ranking relative magnitudes becomes difficult. Overall, a comparison of different research findings points to the conclusion that differences in the estimated impact of monetary policy on output and prices across countries do not tend to be robust across different methodologies, data and models. Although differences may be detected in individual studies, they are often not statistically significant and moreover inconsistent across studies.

5 Conclusions

This article has presented an overview of recent research on monetary policy transmission in the euro area, focusing on aspects relevant for the conduct of the single monetary policy. Most of the analytical results were assembled in the course of recent research projects conducted jointly by the research areas of the Eurosystem central banks.

The findings concerning the response of prices to monetary policy confirm that the

ECB can use monetary policy effectively to maintain price stability in the euro area in the

4 See Dedola, L. and F. Lippi, "The monetary transmission mechanism: evidence from the industries of five OECD countries", Banca d'Italia Temi di Discussione No. 389; and Peersman, G. and F. Smets (2002), "The industry effects of monetary policy in the euro area", ECB Working Paper No. 165.

5 For further arguments and evidence on this issue see Majon, B. and G. Peersman, "A VAR description of the effects of monetary policy in the individual countries of the euro area", ECB Working paper No. 92; van Els, P., A. Locarno, J. Morgan and J.-P. Villetelle, "Monetary policy transmission in the euro area: what do aggregate and national structural models tell us?", ECB Working Paper No. 94; Angeloni, I., A. Kashyap, B. Mojon and D. Terlizzese, "Monetary transmission in the euro area: where do we stand?", ECB Working Paper No. 114.

medium term, thereby fulfilling its statutory objective. Consumer prices are affected gradually but permanently by monetary policy. By contrast, real output is affected by monetary policy only temporarily, and not in the medium to long term.

Empirical evidence points towards a large role for investment in the transmission of monetary policy. Investment responds to changes in the user cost of capital and, albeit to a lesser extent, to cash flow or liquidity effects. Loan supply effects, although present in some countries, do not appear to be of central importance in shaping the transmission of monetary policy in the euro area as a whole.

Monetary policy appears to have a different impact on the various economic sectors, depending on the nature of the goods or the services produced, on the sector's capital

intensity, and on the financial structure of the firms operating in it. Monetary policy effects are also found to be different according to the state of the economic cycle. By contrast, it is difficult to detect systematic differences across countries.

Whereas these general results are supported by sufficiently robust analysis, the more specific patterns of the transmission lags of monetary policy are subject to considerable uncertainty. The existence of long and uncertain lags to both prices and output in the transmission of monetary policy suggest that monetary policy decisions should, as laid down in the ECB's monetary policy strategy, have a medium-term orientation and refrain from attempting to stabilise short-run economic developments, thus avoiding causing undue fluctuations in output and other economic variables.

Box

Microeconomic analyses of firms' and banks' behaviour in the euro area

Eurosystem research groups have analysed corporate investment behaviour and bank lending patterns in the euro area using individual firm-level and bank-level data, applying both country-specific approaches (that facilitate accounting for national specificities) and a harmonised approach (that allows for easier cross-country comparisons). The results are presented in detail in a series of working papers published by the ECB.¹

The analytical framework for the analysis of non-financial firms was provided by the standard neo-classical theory of investment, expressing investment (as a ratio to the capital stock) as a function of firm sales and of the cost of capital to the firm. In addition to these variables, the availability of funds within the firm (expressed by the cash-flow-to-capital ratio) was also included to measure the existence of liquidity or capital constraints. The cash-flow-to-capital ratio becomes relevant if capital markets are not completely efficient. The estimated model also allows for firm-specific effects and aggregate shocks, as well as lagged investment. The inclusion of lagged variables attempts to capture the effects of delays in expectation building, investment decisions and the installation of capital goods.

The results² show that the user cost of capital (itself indirectly affected by the policy-controlled interest rates) is a main driver of fixed investment expenditures in most euro area countries. Expected demand developments (approximated by sales growth) and cash flow are also significant. The effects are well distributed within the population of non-financial firms, and there are no systematic differences according to firm size. These results, which have been confirmed by both the harmonised and the country-specific analyses, would suggest that, through corporate spending, monetary policy has a significant influence on the euro area economy.

The analysis of bank lending was aimed at identifying and measuring loan supply responses to monetary policy. Individual bank data were used to identify loan supply effects and to verify whether certain types of bank show a distinct reaction to monetary policy. Analyses of the US economy have shown that smaller, less liquid or less capitalised banks tend to display a comparatively stronger loan supply response to monetary policy restrictions (and the opposite for expansions). This has been interpreted as evidence that the supply of bank loans is responsive to monetary policy changes, to an extent that depends on the specific characteristics of the individual bank. Taken in conjunction with a sensitivity of non-financial firms to the availability of cash flow or liquidity, this may indicate that a "credit channel" of monetary policy is at work.

Again, both country-specific and harmonised analyses were carried out by Eurosystem researchers. The analytical framework was provided by a simple model whereby loans by each bank are explained by short-term interest rate changes, taken as a proxy of monetary policy shifts, as well as developments in real output and prices that express the main variables driving aggregate loan demand in the medium to long term. In addition, the model includes specific characteristics that identify each bank.

The results³ confirmed that monetary policy changes, together with GDP and prices, have a sizeable and rapid effect on bank loan developments. Of the three criteria suggested above, only asset liquidity (measured as the ratio of cash, interbank lending and securities to total assets) seems to be relevant for explaining the differential responses of banks to monetary policy changes. Conversely, bank size and the degree of bank capitalisation do not seem to influence the pattern of individual bank lending responses. This could be due both to banks' tendencies (observed in several euro area countries) to operate in co-operative networks and to the breadth and coverage of the (often implicit) safety schemes provided by public authorities. Both these factors would help to mitigate the effect of individual balance sheet characteristics on lending behaviour and, more generally, to reduce the potency of any "lending channel" of monetary policy.

1 ECB Working Papers Nos. 96-114.

2 See, in particular, Chatelain et al., "Firm investment and monetary transmission in the euro area", ECB Working Paper No. 112.

3 See, for a summary, Ehrmann et al., "Financial systems and the role of banks in monetary policy transmission in the euro area", ECB Working Paper No. 105.