The credit channel of monetary policy:
Evidence from the housing market

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Abstract

This paper tests a credit channel of monetary policy (especially a bank-lending channel) in the housing market. We argue that the relevance of the credit channel depends on the structural features of the housing finance system, in particular efficiency and institutional organisation. We employ a VAR approach to analyse this issue in four housing markets (Finland, Germany, Norway and the UK). Our findings show across countries a clear-cut relationship between presence of the credit channel, efficiency of housing finance and type of institutions active in mortgage provision.
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1. Introduction

Since Bernanke and Blinder (1988), the literature has shown a renewed interest in the credit channel of monetary policy. According to this view, widespread imperfections in the credit market, such as asymmetric information or imperfect contract enforceability, result for consumers and firms in a wedge between the opportunity cost of internal funds and the cost of external funds. In turn, this *external finance premium* depends on monetary

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policy. Tight monetary policy not only raises market rates of interest but also the external finance premium, thus discouraging investment and consumption. The explanations of this link are twofold. The *balance-sheet* view argues that the bridge between monetary policy and the external finance premium is represented by the financial position of borrowers. Tight money affects borrowers' net worth, either reducing their current cash flows (increasing interest on debt burdens) or the value of their pledgeable assets. This feeds back on the external finance premium required by external lenders. The *bank-lending channel* view, on the other hand, focuses on lenders' financial status. Tight money drains reserves and retail deposits on the liability side of banks' balance-sheets. Faced with this deposit drain, banks can react by increasing their funding through managed liabilities (such as certificates of deposit) or shrinking assets (loans and securities). In the presence of an upward sloping supply for managed liabilities, banks may find too costly to fully offset the reduction in retail deposits and opt to reduce their assets. The lending view argues that the impact is relatively stronger on loans than on securities. In fact loans and securities are imperfect substitutes because loans are riskier and less liquid. Therefore tight money causes an inward shift of credit supply that especially affects borrowers with limited access to non-bank sources of external funding.

The credit channel literature has produced mixed results (see Bernanke and Gertler, 1995; Baum et al., 2003). A strong focus has been placed on identifying contractions in credit aggregates resulting from inward shifts in the demand for funds (fully consistent with the traditional monetary transmission mechanism) from shifts in supply resulting from a credit channel. A second crucial issue of this empirical literature has been to disentangle the bank-lending from the balance-sheet channel (Kashyap et al., 1993). In this sense, much work has been done on the relative impact of monetary policy on firms with different dependence on bank funds, such as small and big firms (see Gertler and Gilchrist, 1994).[1]

This paper analyses the credit channel of monetary transmission on the households' demand side focusing on the housing market. Our aim is twofold. One the one hand, we want to assess the presence of such a channel in the housing market, possibly disentangling a bank-lending from a balance-sheet channel. On the other hand, we want to relate its presence to the structural characteristics of the housing finance system, especially its institutional organisation and its efficiency. Clearly, the paper has implications that go beyond the housing market. Housing plays an important role in the business cycle, not only because housing investment is a very volatile component of demand (Bernanke and Gertler, 1995), but also because changes in house prices can have important wealth effects on consumption (International Monetary Fund, 2000) and investment (Topel and Rosen, 1988).

There are three main motivations for our paper. First, housing markets feature puzzles in terms of quantity and price dynamics hard to reconcile with the traditional monetary

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[1] Other studies use microeconomic data and exploit cross-sectional differences among banks or firms to disentangle a bank-lending channel. Using data from the Call Reports submitted by insured banks to the Federal Reserve, Kashyap and Stein (2000) find that small and illiquid banks react more strongly to monetary shocks, concluding that these banks cannot protect their loan portfolios by shrinking their stock of securities. Baum et al. (2003) show that the results of Kashyap and Stein (2000) can be explained by a different behaviour of banks in the presence of financial sector uncertainty rather than by a bank-lending channel. Ashcraft (2006) argues that the result that small banks react to monetary shocks more strongly than big ones could be driven by the fact that large banks fund mainly large firms. In general, a shortcoming of these studies using microeconomic data is that they do not ascertain whether the bank-lending channel affects aggregate economic activity.

transmission mechanism. For instance, as Bernanke and Gertler (1995) observe, the response of residential investment to innovations in short-term rates is generally sharp and persistent. This feature does not match the dynamic response of long-term rates (those that mainly drive residential expenditure) that traditionally under-react to innovations in short-term rates and revert fast to their initial level. Second, as argued in Section 2, there are reasons to expect that the housing market is particularly exposed to the credit channel, hence representing a better environment to capture its presence than the broader economy. Finally, by exploiting the cross-country heterogeneity in housing finance systems, we can verify whether there exists a ''reasonable'' link between institutional context and evidence of a credit channel, thus offering an important robustness check for our findings.

The paper is organised as follows. Section 2 analyses the credit channel in the housing market emphasising the role of the structural features of the housing finance system, especially its institutional framework and its efficiency. Section 3 presents the empirical methodology while Section 4 presents the results. In Section 5, we perform robustness checks. Finally, Section 6 concludes.

2. Institutional background

The credit channel of monetary policy can be expected to be relatively effective in the housing market. Starting from the balance-sheet channel, ''housing demand is linked directly to consumer balance-sheets by features like down-payment requirements, up-front transaction costs, like closing costs and 'points' and minimum income-to-interest-payment ratios'' (Bernanke and Gertler, 1995, p. 45).[2] The lending channel is also likely to be relatively strong both at the source (depository institutions) and at the destination (households). At the source, in countries where mortgage standardisation and securitisation are not widespread, the relative illiquidity of mortgages could matter. If banks want to keep a buffer against liquidity shocks, they might be encouraged to shift from less to more liquid loans or to securities. At the destination a fall in bank mortgages will probably result in actual lack of funds for house purchases whenever mortgage funding from specialist mortgage lenders or from the State is not a sufficient buffer. In fact, households have less financing opportunities than firms.

2.1. Credit channel and the institutions for housing finance

The first structural aspect that can affect the credit channel in the housing market (especially the bank-lending channel) is the institutional organisation of the housing finance system. The bank model is characterised by a strong presence of depository institutions (e.g., banks) in mortgage provision. The bank model is the strongest candidate for a bank-lending channel: the dependence of borrowers on depository institutions is generally high; moreover, the amount of loanable funds is likely to depend strongly on monetary policy, because of the reliance of banks on reservable retail deposits. In particular, as stressed by Guiso et al. (1999), banking systems with low concentration are more exposed to a bank-lending channel, given the traditional difficulty of small banks in accessing

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[2] In countries where equity withdrawal is not widespread, we can also expect that homeowners' housing demand is strongly tied to their housing wealth.

wholesale funding (however, see the analysis of Germany in Section 4.2. for a qualification of this argument when small banks can form networks).

The mortgage bond model is characterised by the strong role of specialist mortgage institutions (mortgage banks) which fund themselves mainly through the wholesale market. Because of this funding mechanism, the mortgage bond model is less likely to be characterised by a bank-lending channel. In fact, monetary policy is likely to have limited credit supply effects if specialist mortgage lenders with easy access to wholesale funding are major players and offer contracts highly substitutable with those of depository institutions. Finally, the State model is characterised by a relevant State involvement (directly or indirectly trough public banks). Whether the State model is exposed to a bank-lending channel depends on the substitutability between State mortgages and mortgages from depository institutions. State mortgages are often restricted to social housing or to funding particular types of house purchases; this implies low substitutability and, possibly, the presence of a bank-lending channel.

2.2. Credit channel and the efficiency of housing finance

The second structural aspect that can affect the credit channel is the efficiency of the housing finance system. In particular, three aspects are relevant for the presence of a credit channel: (i) depth of the funding system for housing finance institutions; (ii) presence of a diversified range of mortgage lenders; and (iii) sharing of credit risk. A deep market for wholesale funding can undermine at the source the effectiveness of a bank-lending channel by reducing the dependence of housing finance institutions on retail deposits. A wide, diversified range of mortgage finance institutions can weaken at the destination the bank-lending channel by reducing the dependence of households' house purchases on bank credit. The sharing of credit risk, instead, is mainly reflected in the level of minimum income-to-interest-payment ratios and down-payment requirements. These quantitative controls affect the link between borrowers' net worth and the availability of funds from bank and non-bank intermediaries, determining the strength of the balance-sheet channel.

The efficiency of a housing finance system is the result of the historical evolution of the system and of regulatory constraints. After tight money, a regulatory ceiling on deposit rates can prevent banks from offsetting the drain in deposits by increasing the return paid to depositors. Similar arguments apply for restrictions on market funding. In the past, depository institutions in some countries have been prevented from issuing bonds in the open market, which has implied a strong link between retail deposits and assets. Entry restrictions are again likely to strengthen the bank-lending channel by allowing a small range of lenders alternative to depository institutions. For these reasons, the lending channel is likely to have become weaker after the financial liberalisation that occurred in many countries during the 1980s.[3] It is instead unclear whether financial liberalisation has significantly altered the strength of balance-sheet effects (see Bernanke and Gertler, 1995; for a discussion).

Table 1 classifies the housing finance systems of Finland, Germany, Norway, and the UK according to the institutional framework and the level of efficiency, in the three

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[3] The abolition of interest rate ceilings and of portfolio and entry restrictions would have respectively deepened the market for banks' liabilities and reduced the dependence of households on banks for mortgage funding.

Table 1
Structural features of housing finance systems

Country	Institutional framework	Efficiency		
		Funding market*	Mortgage market	Risk-bearing
Finland	Bank model • Strong role of banks • State funding restricted in scope and beneficiaries	• Strong reliance of banks on retail deposits and limited use of general wholesale funding (like bank bonds) • Limited use of mortgage bonds; no use of mortgage backed securities (EMF)	• Limited possibility of diversifying away from banks • State funding limited to particular types of mortgages/borrowers (BGMR)	• LTV ratios around 70–80%
UK	Bank model • Strong role of depository institutions (banks and building societies)	Competitive (DL) • Good access of depository institutions to wholesale general funding • Building societies can issue mortgage backed securities Sources of inefficiency • Limits on building societies unsecured debt • Capital requirements unfavourable to issuing mortgage-backed securities (DL and EMF)	• Weak role of non-depository mortgage lenders • Integrated and competitive system • No restrictions on contracts (DL)	• LTV ratios up to 80% (without insurance) and 100% with insurance
Germany	Bank and mortgage bond system • Low concentration in banking system	Segmented (DL) • Strong reliance of banks on retail deposits (mortgage backed securities issued at a very small rate) Sources of inefficiency • Deposit rates sluggish below market rates • Banks cannot issue mortgage bonds • Only Bausparkassen can issue contract savings • Limits on insurers favour mortgage bonds (DL and EMF)	• Strongly competitive • Well diversified range of alternative mortgage-lenders • Commercial and savings banks have overcome the funding segmentation through ownership of the specialised institutional funding sources (DL)	• LTV ratios > 80% restricted only to repeat buyers • Regulator constrains LTV ratio below 80% for mortgage bank and Bausparkassen mortgages
Norway	Bank and state model	• Good access of commercial and savings banks to wholesale market (bank bonds and other general funding) (EMF)	• Strong and increasing competition in market for mortgage loans (LWD)	LTV ratios around 80%

Note: DL refers to Diamond and Lea (1992); LWD refers to Lea et al. (1997); BGMR refers to Booth et al. (1994), EMF refers to European Mortgage Federation (2000).

aspects indicated above.[4] For this purpose, we refer mainly to the works by Diamond and Lea (1992), Booth et al. (1994), Lea et al. (1997) and European Mortgage Federation (2000). As the Table shows, we choose these countries because they display strongly diverse housing finance systems, hence fulfilling the heterogeneity criterion mentioned among the motivations of the paper. In Appendix A, we provide additional evidence in support of this argument. In Section 4, we discuss the institutional features of the countries under exam and draw empirical predictions about the presence of a balance-sheet or bank-lending channel.

3. Empirical methodology

3.1. Overview

Several studies provide a theoretical background for our econometric analysis. Aoki et al. (2004) and Iacoviello (2005) analyse the transmission of monetary policy in a general equilibrium framework in which the strength of borrowers' balance-sheets affects their debt capacity. Bernanke and Blinder (1988) provide a theoretical analysis of the bank-lending channel in an extended IS-LM framework.

For each country, we run four VARs in order to assess the presence of a credit channel of monetary transmission and to disentangle a balance-sheet from a bank-lending channel (see Table 2).[5] As explained in the next subsection, we follow Gali (1992), Gerlach and Smets (1995) and Angeloni et al. (2003) in identifying periods of tight money using a combination of long-run restrictions (corresponding to the long-run neutrality of monetary shocks) and of the more widely used short-run restrictions, namely delays in the effects of interest rate shocks on GDP and prices.[6]

(1) The first VAR includes: *GDP, CPI inflation, short-term interest rate, real house prices, housing loans by banks and other depository institutions, and total loans by banks and other depository institutions.* This VAR is substantially uninformative for detecting a credit channel. A reduction in loans after tight money could reflect a fall in loan demand, thus being consistent with the traditional monetary transmission mechanism.[7] Yet, the change in housing loans can give a clue on the quantitative relevance of a possible credit channel.

(2) The second VAR includes: *GDP, CPI inflation, short-term interest rate, real house prices and the Spread between a mortgage interest rate on housing loans and a benchmark interest rate.* A rise in the Spread between the mortgage rate and a safe rate of comparable maturity (e.g., a government bond yield) could capture the increase in

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[4] Given the impossibility of determining, even at a qualitative level, whether the presence of the state affects the effectiveness of the bank-lending channel, state and bank model are bundled together.

[5] The variables used and the identification scheme are summarised in Table 2. Appendix B describes data sources and time periods used in the regressions.

[6] See Christiano et al. (1998) and Rotemberg and Woodford (1997) for models that generate long-run monetary neutrality while being consistent with the assumption that contemporaneous output and the price level do not respond to a monetary policy shock.

[7] A reduction in loans is not even a necessary condition for a credit channel: households could try to compensate a reduction in wealth by borrowing more from external sources. Hence, tight money could elicit an increase in loan demand that, if strong enough, could overwhelm any contraction in loan supply resulting from a credit channel.

Table 2
Overview of the econometric specifications

VAR	Variables (regression)	Identification of	Identification scheme
1	Y, DP, R, HP, HL, BL (Loans regression)	Monetary policy shock	Combinations of short and long-run restrictions; monetary shock does not affect contemporaneously
2	Y, DP, R, HP, SP (Spread regression)		Y and DP and has zero impact on all the variables in the long run
3	Y, DP, R, HP, MIX (Mix regression)		
4	Y, DP, MIX, HP	Mix shock	Recursive. The MIX shock does not affect contemporaneously Y and DP

Variables: Y (real GDP), DP (consumer price inflation), R (money market rate), HP (real house prices), HL (real housing loans from banks), BL (real total loans from banks), SP (mortgage rate, RM, *minus* benchmark safe rate, RL), MIX (ratio of housing loans from "non-banks" to total housing loans).

the external finance premium associated with a credit channel. However, the analysis of the Spread encounters three problems. First, the price is only one of the terms of mortgage contracts: for instance, an increase in the default probability of the borrower could result in higher required collateral rather than higher mortgage rate. Second, if quantity rationing were pervasive in the credit market, the Spread would fail to capture an increase in non-price rationing of mortgage demand. Finally, in the 1980s some of the analysed countries experienced a progressive shift from long-term, fixed mortgage rates to variable, reviewable and renegotiable rates. The Spread between a variable mortgage rate and a long-term benchmark rate could also reflect a liquidity premium (possibly time-varying) not associated with agency or monitoring costs. We tackle this issue by matching the maturity of the benchmark safe rate with the actual length of fixity of the mortgage rate. For this purpose, for all the countries we reviewed the extant studies (Diamond and Lea, 1992; Lea et al., 1997; Booth et al., 1994; European Mortgage Federation, 2000) and identified the typical duration of mortgage contracts and the nature – fixed or renegotiable – of the mortgage rates. For example, for Finland we found that mortgage loans have typically adjustable rates with adjustment periods of 3–5 years and therefore we considered a 3-year benchmarking interest rate.

Finally, note that the unavailability of detailed data on mortgage rates charged by different lenders prevents us from using the analysis of the Spread to disentangle a bank-lending from a balance-sheet channel – for instance detecting whether the Spread on bank mortgages increases more than that on mortgages from non-depository institutions. Hence, we generally focus on the spread on mortgages by depository institutions or the spread on an average mortgage rate (Germany) inferring from its behaviour only information on the existence of a broad credit channel (balance-sheet and/or bank-lending).

(3) The third VAR includes: *GDP, consumer price inflation, short-term nominal interest rate, real house prices, and the ratio of housing loans by all "non-depository" financial institutions and the State to all housing loans*. We argue that the analysis of the external finance Mix – that is, the fraction of housing loans by "non-banks" – is the best way to disentangle a lending channel. If managed liabilities are not a perfect substitute for deposits, a drain in reserves and deposits will lead to a *relatively* strong

contraction in bank mortgages and to an increase in the Mix. The Mix will plausibly increase also as households try to compensate the reduction in bank mortgages with mortgages by other institutions. However, in the presence of imperfect substitutability between bank and other mortgages, this compensation is only partial and the reduction in bank supply affects housing demand. Therefore the analysis of the Mix requires two steps: to analyse whether monetary policy affects the Mix (VAR 3) and if so to analyse whether changes in the Mix affect the housing market (VAR 4).

(4) If monetary policy affects the Mix, we run a fourth VAR with *GDP, CPI inflation, external finance Mix and real house prices*. We look at the effects of an exogenous Mix increase, what we call *external finance shock*. If the Mix has any explanatory power in a house price reduced form equation that already includes income and inflation as controls, its incremental explanatory power supports the existence of an independent bank-lending channel.[8]

The analysis of the finance Mix was first proposed by Kashyap et al. (1993) (who analysed the response of the Mix between *bank loans* and *commercial paper* to innovations in the Fed Funds rate) and has been used in the analysis of a lending channel in the automobile market (Ludvigson, 1998). As stressed by Oliner and Rudebusch (1996) the Mix does not completely solve the endogeneity problem because a change of the Mix could capture a change in the quality composition of borrowers. Suppose that banks specialize in funding households with a weak financial position. An increase of the Mix after tight money could reflect a "flight to quality" from risky households to households with a stronger financial position. In this case, the increase of the Mix would be the result of the working of a households' balance-sheet channel rather than a bank-lending channel. Therefore, whenever the combined evidence from the third and the fourth VARs hints at the presence of a bank-lending channel, we will carry out a robustness analysis to rule out this alternative explanation. In particular, in order to assess whether depository institutions fund riskier households than non-depository ones, we will use evidence on the risk of mortgages, as proxied, for example, by the default ratio of mortgages, by the number of repossessions, or by the amount of loan loss provisions made by mortgage financiers. Note that we can also exclude that changes in the Mix reflect the heterogeneous demand pattern of different cohorts of households. In fact, for all the countries the extant studies (Diamond and Lea, 1992; Lea et al., 1997; Booth et al., 1994; European Mortgage Federation, 2000) indicate that depository and non-depository institutions have no systematic tendency to finance groups of households with different structural characteristics.

In all the specifications we use house prices as a cyclical indicator in the housing market. In principle, another way to test for the presence of a credit channel in the housing market would be to analyse the behaviour of housing investment. There are reasons to believe that

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[8] Following Ludvigson (1998), we do not include the interest rate in this equation. If the interest rate indicates monetary policy, then including it would mean that changes in the Mix marginally reflect non-monetary effects. If the bank-lending channel is operative, then monetary policy should affect the Mix, and the Mix should affect house prices, but there should be no reason to expect that the Mix affects house prices when some variable that captures monetary policy stance is included in the VAR. Therefore the innovation in the Mix captures both monetary policy shocks and non-policy induced shocks, like, for instance, credit crunch episodes.

house prices are more suitable to our analysis. First, since in the housing market quantities adjust sluggishly, prices could be more informative in capturing changes in housing demand in the short run. Second, house prices can play a crucial role in the transmission of monetary policy through credit supply shifts. On the one hand, house prices affect borrowers' wealth and credit capacity (for theoretical models see Aoki et al., 2004 and Iacoviello, 2005). On the other hand, they influence lenders' net worth and, potentially, the amount of credit they extend. Specifying the VARs using quantities rather than prices would omit these interactions.

3.2. Identifying the shocks

We identify the monetary shocks in VARs 1–3 using a combination of short and long-run restrictions. In particular, we adopt the common trends approach as developed by King et al. (1991). The approach uses the cointegration properties of the data to achieve identification using both short and long-run restrictions. When a group of variables in a VAR is cointegrated, a useful specification for their dynamics is a vector–error–correction model (VECM). A VECM places reduced rank restrictions on the matrix of long-run impacts from a VAR. KPSW distinguish between structural shocks with permanent effects on the level of the variables from shocks with only temporary effects. The permanent shocks are the sources of the so-called common stochastic trends among the series. The number of these shocks equals the number of variables in the system less the cointegrating relationships between them. The remaining transitory shocks equal the number of cointegrating relationships (intuitively, a cointegrating vector identifies a linear combination of the variables that is stationary, so that shocks to it do not eliminate the steady state in such a system).

The VAR model needs not to be fully identified: partial identification of either the transitory or permanent shocks is possible. Furthermore, one can separate the transitory shocks by adding some untested restriction on their impact effect. We identify the monetary shock as the transitory innovation that does not affect contemporaneously GDP and CPI inflation, but that can have impact effects on all the other variables. In addition, the shock has also to satisfy long-run neutrality, both by having zero long-run effect on GDP (and the other real variables) and by keeping relative prices of houses and consumer goods constant.[9] Therefore, GDP, inflation, real house prices and all other variables will revert back to their initial steady state once the effects of the shock die out.

We run augmented Dickey–Fuller unit root tests on the levels of the series.[10] The tests suggest that the variables are integrated of order 1. The results from the cointegration tests are mixed, but tend to indicate, in the first three VARs, at least three cointegrating vectors: one vector could correspond to a long-run stationary real interest rate (cointegration between nominal interest rate and inflation), another to a long-run housing supply curve (cointegration between house prices and GDP). The third cointegrating vector could hint, depending on the VAR, at a stable long-run ratio between housing loans and total loans (VAR 1), stationary spread (VAR 2), stationary Mix (VAR 3). For this reason in our

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[9] The monetary shock will not affect the relative prices of the two goods in the long run, but the permanent shocks in the VAR (which we do not focus upon here) in general will. However, it can affect the CPI and house price index (by the same amount), since we impose the zero long-run restriction on CPI changes, not on levels.
[10] More details on this and on the cointegration tests are available from the authors upon request.
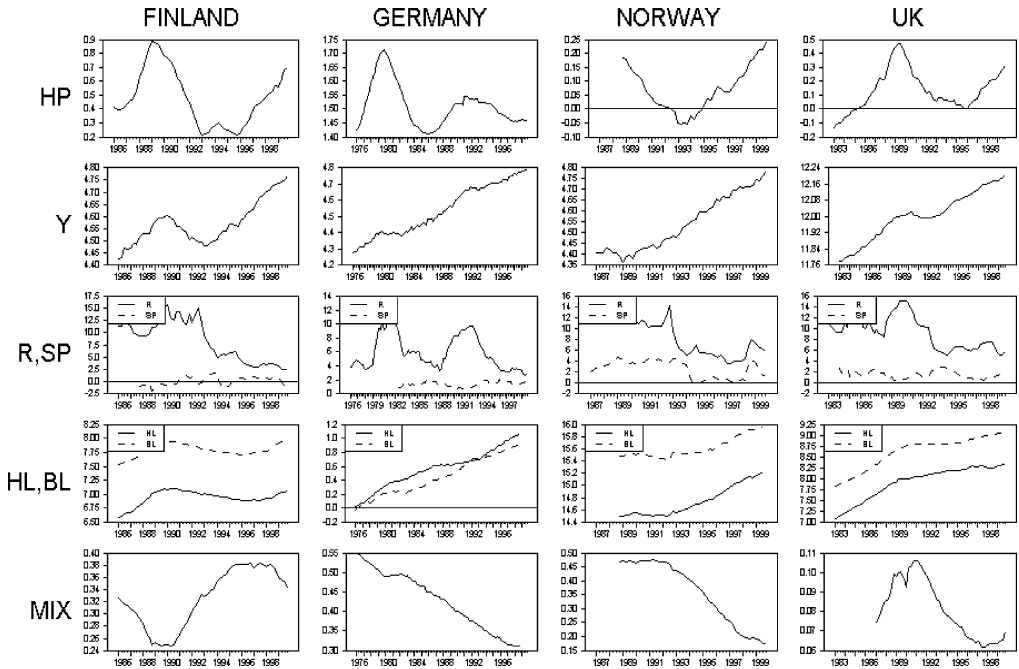
Fig. 1. The data used. HP: log of real house prices; *Y*: log of GDP; *R*: short-term interest rate, percentage. SP: Spread between mortgage rate and a safe rate of same maturity, percentage. HL: log of real loans from banks for housing; BL: log of real loans from banks for all other purposes. MIX: ratio between housing loans from State and non-depository institutions versus total housing loans.

specifications we opt for a common rank of 3, with the exception of Norway, where the tests indicate four cointegrating vectors.[11]

On the basis of this, we specify the first three VARs in the form of a vector error correction model (VECM).[12] In all specifications, our way of identifying tight money by use of short and long-run restrictions turns out to be successful, as the contractionary monetary shock elicits a rise in the interest rate and a negative response of GDP and inflation, which are all suggestive of a tight monetary policy stance. As is well known (see Christiano et al., 2000), this is evidence per se of the success of our selection scheme, since our impulse responses can account for the qualitative features of a wide range of monetary business cycle models in which money shocks have delayed, transitory effects on economic activity.[13]

In VAR 4, we use a recursive scheme to identify a Mix shock, ordering the Mix after GDP and consumer price inflation and before real house prices. Economic theory is in fact silent about the permanent effects of a Mix innovation.

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[11] The identification restrictions imposed on the monetary shock are similar to all other cases.

[12] Each model is estimated with a lag length of 2–4 in order to get serially uncorrelated residuals.

[13] As a robustness check, we also estimated the impulse response without imposing the long-run zero restrictions using a Choleski decomposition of the residuals and ordering the interest rate after GDP and CPI inflation. The results of this specification were similar to those reported here.

4. Results

4.1. Finland

Finland has the characteristics of a bank model. In the early 1990s, banks provided about 80% of mortgage loans while the State Housing Fund provided about 15%; the rest was accounted for by minor non-depository institutions (Nordic Council, 1992). The efficiency of the funding market is low: Finnish banks rely strongly on retail sight deposits (European Mortgage Federation, 2000) and can access wholesale funding at a higher cost than mortgage credit institutions in other Nordic countries (Kosonen, 1993; Booth et al., 1994). Analogous considerations hold for the efficiency of the mortgage market: the bulk of mortgages from non-depository institutions come from the State. State mortgages can buffer shocks to bank funding only to a limited extent because state funding is restricted to social housing (rental, cooperative and owner occupied) and to financing the construction of single-family houses. As a result, the substitutability between private-bank and alternative funding is imperfect, implying the relevance of mortgage distribution for households' house purchases. Finally, the LTV ratios are medium–low (70–80%). All in all, these features render Finland a natural candidate for the presence of a bank-lending channel and possibly a balance-sheet channel.

The evidence supports indeed a bank-lending channel and leaves room for a balance-sheet channel. Fig. 2A shows the responses of real housing and total loans to a monetary contraction, using quarterly data from 1978Q4 to 1999Q4, along with one standard error asymptotic confidence bands. Both housing and total loans fall after tight money. Fig. 2B shows the response of the Spread between mortgage rate on new housing loans by banks and 3-year benchmarking interest rate to a negative monetary shock.[14] As anticipated, the maturity of the benchmark rate reflects the fact that in Finland mortgages have typically adjustable rates with adjustment periods of 3–5 years (Kosonen, 1993). The Spread increases significantly about three periods after the contraction hinting at the presence of a broad credit channel.

The analysis of the finance Mix supports the workings of a bank-lending channel. We construct the Mix as the sum of housing loans by the State plus other minor non-depository lenders over housing loans by all institutions (including commercial, savings and cooperative banks) and analyse its behaviour in two steps. First, using data from 1987Q1 to 1999Q4 (that is after the liberalisation of interest rates) we find a significant, persistent increase in the Mix following tight money (Fig. 2C). This result is consistent with the low efficiency of the market for bank funding and suggests that financial liberalisation could have had a minor role in weakening a bank-lending channel *at the source* (i.e. increasing the substitutability between retail deposits and wholesale funding). We then analyse the impact of the Mix shock (Fig. 2D) and find that real house prices fall significantly after an increase in the Mix. This suggests that the composition of mortgage finance can play an important role in affecting housing demand and appears consistent with the low efficiency of the mortgage market (i.e. the low substitutability between private-bank and alternative funding).

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[14] Here the sample includes quarterly data from 1988Q1 to 1999Q4. Therefore the sample extends entirely after the abolition of interest rate ceilings (occurred in 1987).
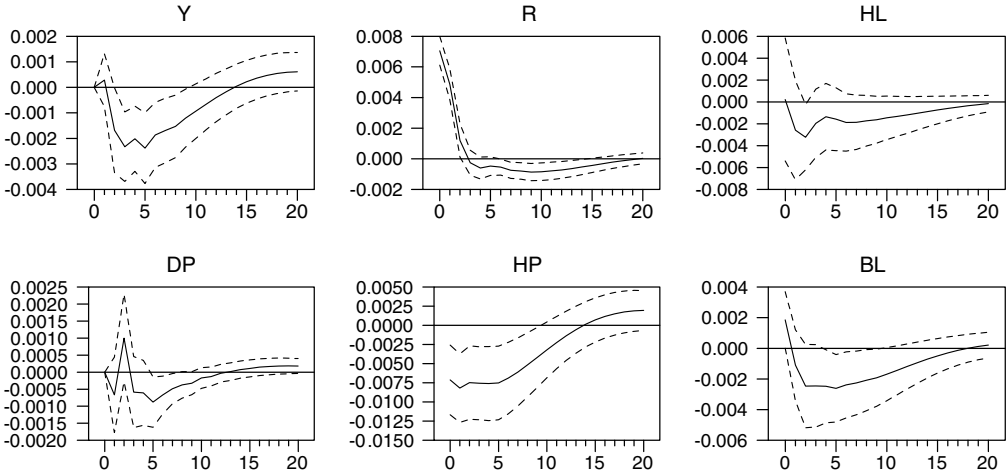
Fig. 2A. Finland: Response ±1 S.E. bands to a monetary shock, loans regression (Impulse responses of the VAR. Response of total real bank loans, bank housing loans and other macro variables to a monetary contraction).
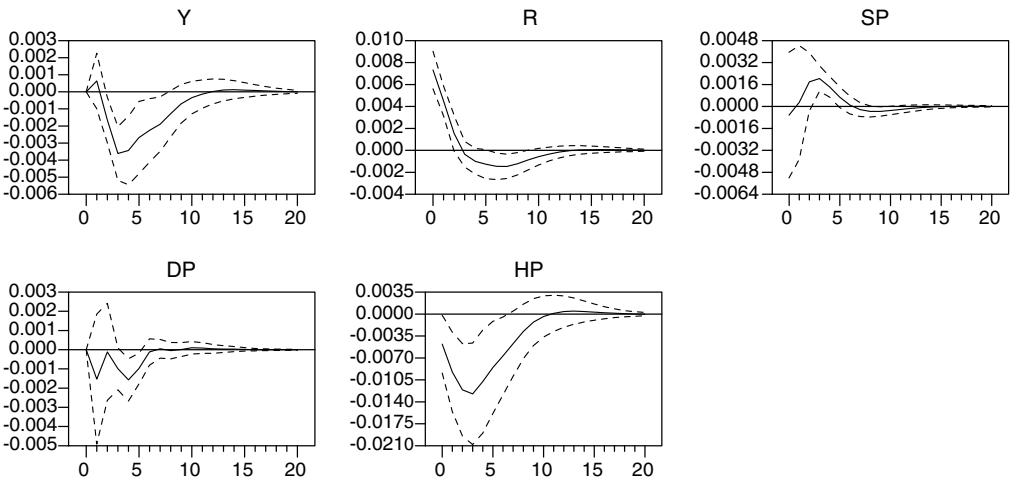

Fig. 2B. Finland: Response ±1 S.E. bands to a monetary shock, Spread regression (Impulse responses of the VAR. Response of the Spread between mortgage rate and long-term safe rate of equal maturity to a monetary contraction).

As argued previously, an alternative explanation for the response of the Mix to a monetary shock could be that this response reflects a change in the quality composition of borrowers. A strategy for disentangling a "flight to quality" is analyzing whether depository institutions fund riskier borrowers than non-depository institutions. Unlike for the UK (see below), data on mortgage defaults in Finland are not available. Therefore, we test this hypothesis indirectly. We obtained annual data on loan loss provisions of Finnish credit institutions for the period 1996–2000 from the international rating agency Fitch-IBCA.
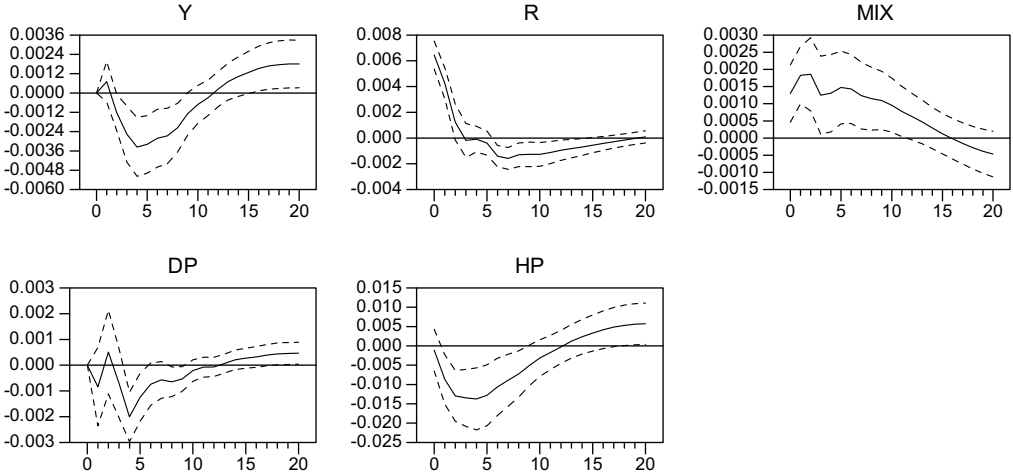
Fig. 2C. Finland: Response ±1 S.E. bands to a monetary shock, Mix regression (Impulse responses of the VAR. Response of Mix (housing loans from non-banks over total housing loans) to a monetary contraction).
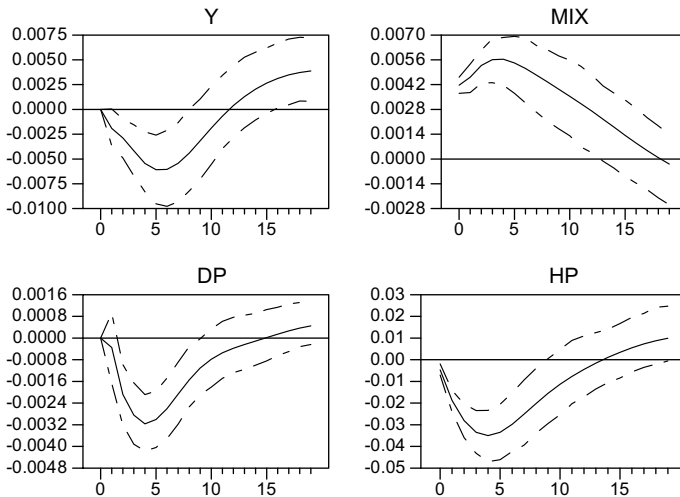

Fig. 2D. Finland: Responses ±1 S.E. bands to a shock in the Mix variable (Impulse responses of the VAR. Response of house prices to a positive Mix innovation).

The data include loan loss provisions of a major non-depository housing finance institution (Municipality Housing Finance) and of the wide majority of Finnish depository institutions.[15] We then compared the ratio (loan loss provisions/total loans) of the Municipality Housing Finance with the average ratio of the depository institutions in the sample. Since data on loss provisions for depository institutions bundle together

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[15] Data on alternative measures of the risk of loans, such as loan loss reserves and amount of non-performing loans, were not available for many institutions, including the Municipality Housing Finance.

mortgages with other types of loans and, hence, can imperfectly capture the risk of mortgages, we also compared the ratio of the Municipality Housing Finance with that of a major depository institution specialized in mortgage financing (Oko Mortgage Bank Ltd.). If depository institutions specialize in financing mortgages with high probability of default, we would expect them to have a higher ratio (loan-loss provisions/total loans). Instead, in both comparisons, this ratio was lower for the Municipality Housing Finance.[16] Clearly, this evidence should be interpreted with caution because it is limited to one non-depository institution, though a major one, and it refers to a sub-period of the Mix analysis. However, it suggests that depository institutions have no systematic tendency to fund riskier borrowers than non-depository ones.

4.2. Germany

Germany constitutes partly a bank model and partly a mortgage bond model. Commercial and savings banks and credit cooperatives account for about 45% of total mortgages, with savings banks and credit cooperatives being the main financiers of house purchases (approximately two thirds of bank housing loans). Banks compete mainly with mortgage banks, which fund themselves issuing mortgage and municipal bonds to institutional investors, and Bausparkassen, which rely on savings generated from long-term (6–18 years) housing linked contracts and on government subsidies. The efficiency of the funding market for banks is low. According to Diamond and Lea (1992), German funding markets are segmented. First, they feature *sluggishness of market deposit rates*. More important is the *segmentation of the bond market*: commercial and savings banks can issue unsecured debt but cannot issue mortgage bonds (unlike mortgage banks) and are also strongly discouraged by the regulator from issuing derivative securities. As a result, banks rely mainly on retail general funding and especially on savings deposits (European Mortgage Federation, 2000). The mortgage market is instead well diversified and competitive (Diamond and Lea, 1992): although depository and non-depository institutions offer contracts which are not entirely homogeneous, especially in the length and in the rate (fixed or renegotiable), these differences do not imply a strong non-substitutability. Finally, Germany has medium–low LTV ratios (around 60–80%). These characteristics of the German system leave room for the presence of a balance-sheet channel but tend to exclude the presence of a bank-lending channel (especially because of the high efficiency of the mortgage market).

We find evidence of a balance-sheet channel but no evidence of a bank-lending channel. Fig. 3A shows responses of total loans and housing loans by banks, using data from 1974Q2 to 1998Q4.[17] A monetary contraction leads to a significant decline in total bank loans while housing loans are virtually unchanged. This could be due to long-term relationships between banks and customers that induce banks to insulate their loan portfolios from monetary disturbances. The Spread between the average 10 year fixed mortgage rate and the government 10 year bond yield widens after a monetary contraction and stays

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[16] In particular, the ratio equals 0.28% for the Municipality Housing Finance, 0.28% for the depository institutions and 0.06% for the Oko Mortgage Bank Ltd.

[17] The availability of relatively long time-series and the absence of significant structural changes in the regulation of the housing finance system led us to use relatively long time periods in the analyses. The regression for the Spread starts in 1982, as we found consistent time series for the interest rates only after that date.
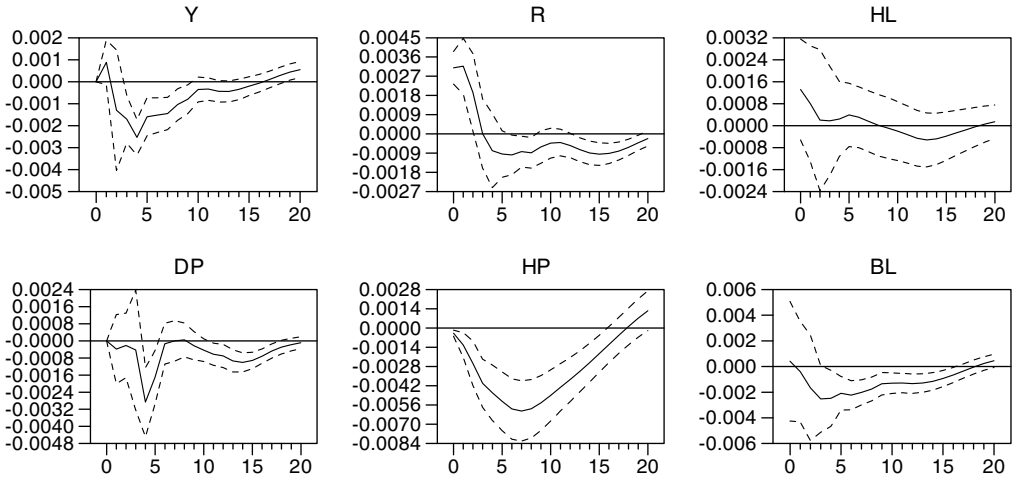
Fig. 3A. Germany: Response ±1 S.E. bands to a monetary shock, loans regression (Impulse responses of the VAR. Response of total real bank loans, bank housing loans and other macro variables to a monetary contraction).
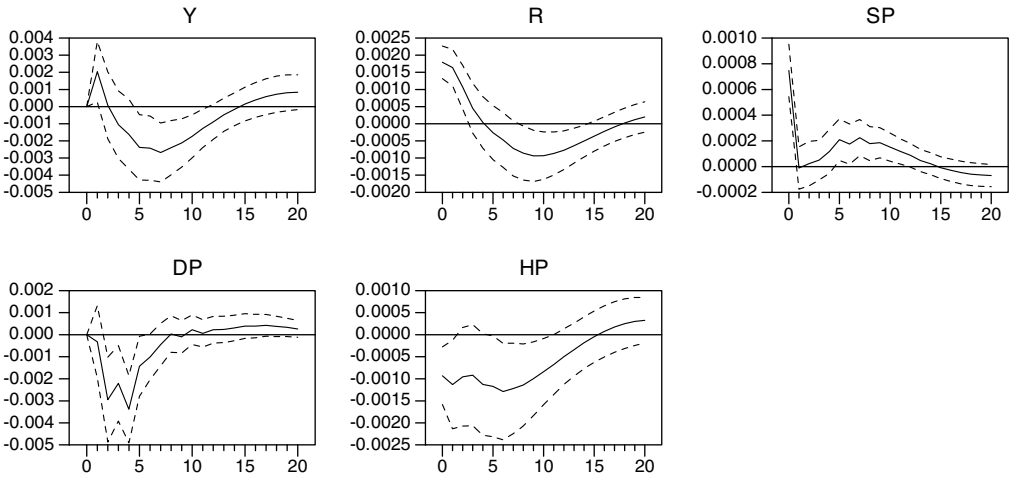

Fig. 3B. Germany: Response ±1 S.E. bands to a monetary shock, Spread regression (Impulse responses of the VAR. Response of the Spread between mortgage rate and long-term safe rate of equal maturity to a monetary contraction).

positive for about 3 years (Fig. 3B). Even if in the 1990s mortgages with fixed rate have also been originated by commercial and savings banks, they are more typical of non-depository institutions, such as mortgage banks or Bausparkassen. The latter are shielded from fluctuations in reservable deposits, so that the increase in the Spread could reflect the impact of a deterioration in borrowers' net worth on the external finance premium (i.e. a balance-sheet channel).
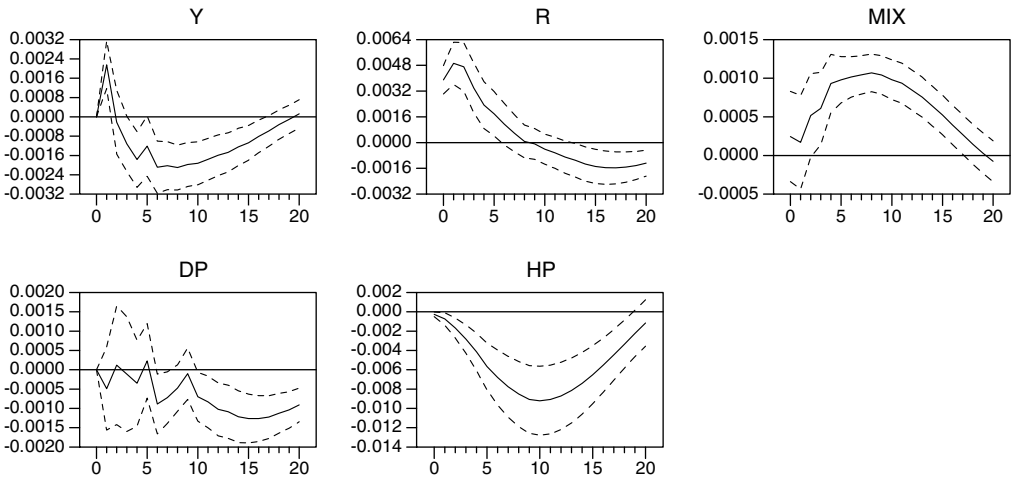
Fig. 3C. Germany: Response ±1 S.E. bands to a monetary shock, Mix regression (Impulse responses of the VAR. Response of Mix (housing loans from non-banks over total housing loans) to a monetary contraction).

Next, we analyse the Mix using data from 1974Q2 to 1998Q4. To obtain the Mix, we consolidate all the institutions traditionally relying on reservable, short-term retail deposits. We then construct the Mix as the sum of housing loans from Bausparkassen and Mortgage Banks over total housing loans from all financial institutions.[18] Tight money (Fig. 3C) leads to a rise in the Mix, which displays a hump-shaped response, peaking after two years and returning to the baseline after four. This finding seems consistent with the low efficiency of the funding market. Note that the behaviour of the Mix could also reflect the low degree of concentration of the banking system which, except for the three big banks, is made by a network of small banks with difficult access to wholesale funding. However, especially for Germany, this argument should be qualified. In fact, small German banks tend to be organized in networks (acting as a *hausbank*) and this type of organization can offset their small size and insulate their lending from monetary policy shocks, at least for some time.

Finally, Fig. 3D shows that the Mix shock does not affect real house prices significantly, indicating the absence of a bank-lending channel. This finding is in line with expectations given the good substitutability of mortgages from depository institutions with mortgages from other institutions.

4.3. Norway

Norway has the characteristics of a state model. Over the sample period, Government Lending Institutions have originated an important fraction of mortgages (on average about 40% in the 1990s), although at the end of the 1990s the market share of

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[18] The denominator includes, besides mortgages from the two mentioned institutions, mortgages from commercial, savings, and regional banks and from credit cooperatives. The definition of housing loans includes mortgages secured by real estate (about 90% of the aggregate) and a residual category of other housing loans (for redevelopment etc.).
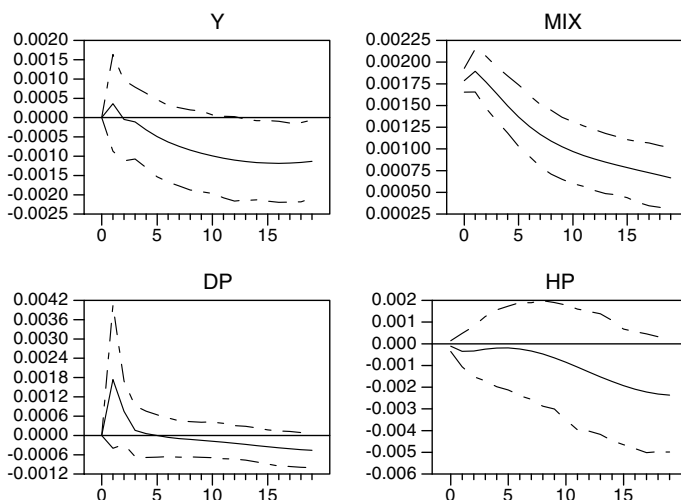
Fig. 3D. Germany: Response ±1 S.E. bands to a shock in the Mix variable (Impulse responses of the VAR. Response of house prices to a positive Mix innovation).

commercial and savings banks had risen to about 80%. Finally, finance and credit companies that fund themselves mainly through the wholesale market have a minor share. Norway has experienced a remarkable increase in the efficiency of the funding market for banks. According to Lea et al. (1997), the access of depository institutions to the wholesale market improved during the 1990s, reducing banks' dependence on retail deposits (even if deposits still represent banks' main source of funding, with an approximate share of 60% of banks' liabilities). The International Monetary Fund (2000) reports that banks have increasingly enjoyed easy access to wholesale general funding, in the form of bank bonds, loans from other monetary financial institutions and other general funding. Finally, Norway has medium LTV ratios (around 80%). All in all, these features imply that in Norway we should find no evidence of a balance-sheet or bank-lending channel.

Indeed, we find lack of evidence of a credit channel. Fig. 4A shows total loans and housing loans by banks in response to a monetary shock, using data from 1988Q3 to 1999Q4. Loans and real house prices fall significantly. The response of the Spread between the mortgage rate[19] and the 5-year government bond yield provides weak evidence for the credit channel hypothesis: the Spread (Fig. 4B) is not significantly affected by a monetary contraction. Further evidence comes from the analysis of the Mix (Fig. 1, bottom row). We construct the Mix as the sum of loans from state and non-depository financial institutions over total housing loans.[20] Fig. 4C shows its response to a negative monetary

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[19] Interest rates on mortgage loans from banks were available for Norway starting only in 1995. Before that date, we used the interest rate on long and medium-term loans. The bulk of mortgage loans in Norway have reviewable rates, but a non-marginal fraction has renegotiable rates. For this reason, and for the likely pooling with loans with medium-long-term fixed rates, we opted for a medium-term rate as benchmark.

[20] As shown in Fig. 1, because of the declining importance of public funding, the Mix exhibits a strong decline over the sample, passing from 45% in the late 1980s to a value of little more than 15% at the end of the 1990s.
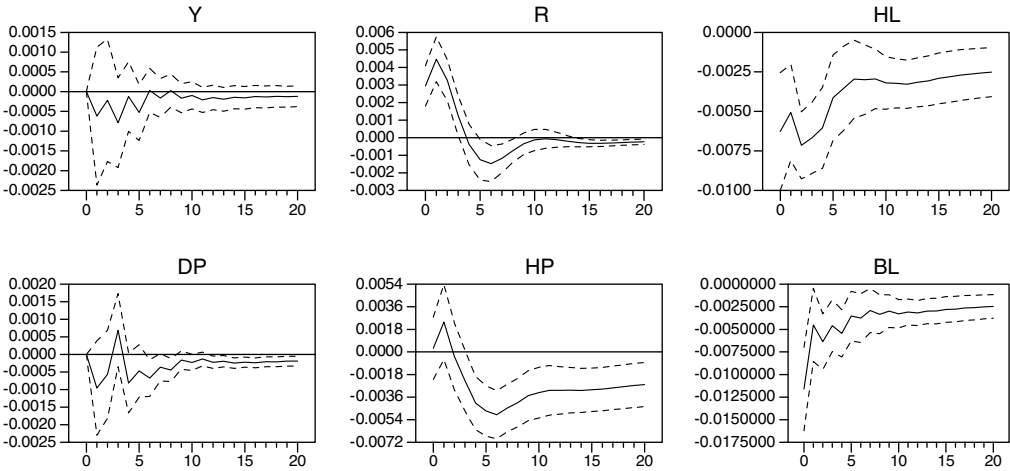
Fig. 4A. Norway: Response ±1 S.E. bands to a monetary shock, loans regression (Impulse responses of the VAR. Response of total real bank loans, bank housing loans and other macro variables to a monetary contraction).
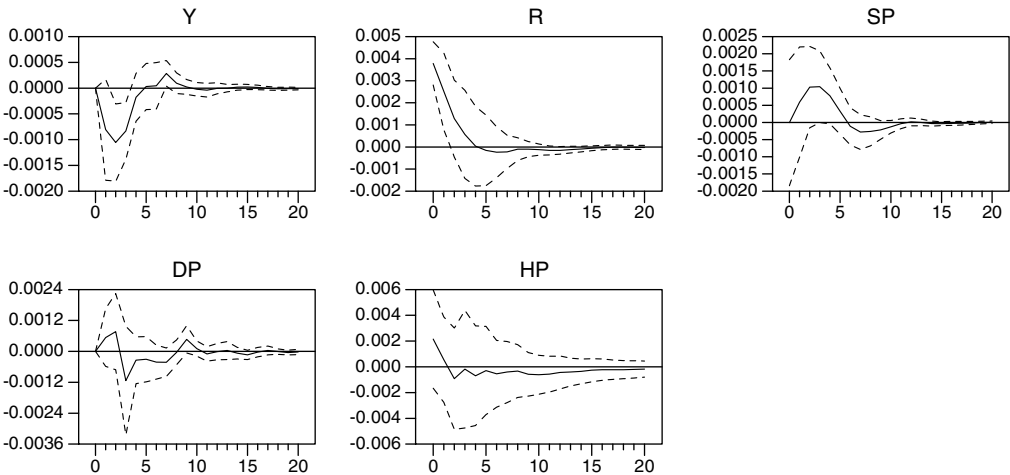

Fig. 4B. Norway: Response ±1 S.E. bands to a monetary shock, Spread regression (Impulse responses of the VAR. Response of the Spread between mortgage rate and long-term safe rate of equal maturity to a monetary contraction).

shock: the response appears insignificantly different from zero; if anything, the Mix seems to drop. This result can reflect the deepening of the market for bank funding we mentioned above while arguments related to the average size of Norwegian banks are not of help. In fact, the concentration of the banking system is quite low with the strong presence of a myriad of small savings banks alongside a few medium-sized commercial banks.
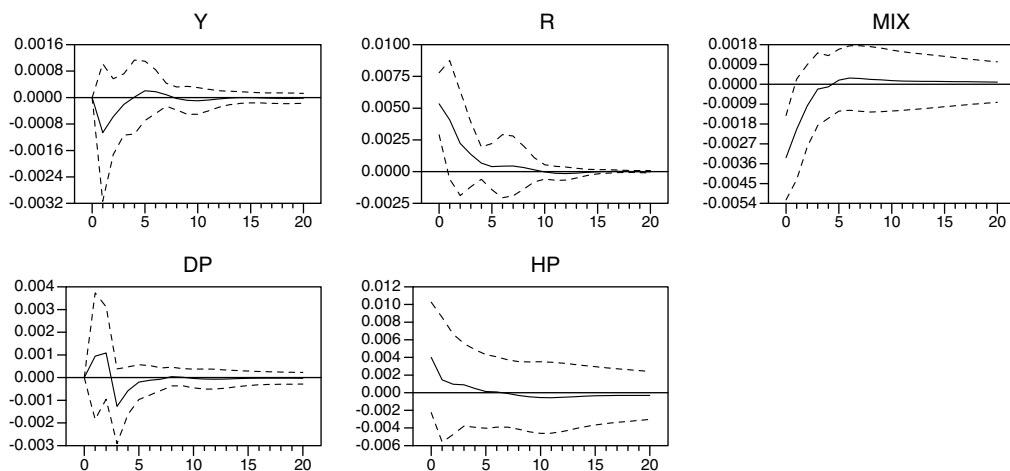
Fig. 4C. Norway: Response ±1 S.E. bands to a monetary shock, Mix regression (Impulse responses of the VAR. Response of Mix (housing loans from non-banks over total housing loans) to a monetary contraction).

4.4. The United Kingdom

The UK has the characteristics of a bank model: banks and building societies have a market share of around 90%. From the late 1980s, real estate agents and centralised mortgage lenders have competed with depository institutions in mortgage provision. However, after aggressively entering the mortgage market in the late 1980s, these non-depository institutions have seen their market share decline in the 1990s (Fig. 1, bottom row[21]). The bulk of funds of these non-depository institutions (and of insurance companies) come from the wholesale market, shielding them from fluctuations in retail deposits. Several studies (see Diamond and Lea, 1992) report that the UK has a fully integrated and developed funding market: banks have relatively easy access to the wholesale market and the constraint imposed on the wholesale funding of Building Societies is not binding. Diamond and Lea (1992) report the limit on the issuance of unsecured debt by Building Societies as the only major inefficiency. The mortgage market has instead a low efficiency:[22] with a market share of less than 10%, non-depository institutions probably represent a too small buffer to effectively shield households from a reduction in mortgages from banks and building societies.

The evidence supports the existence of a bank-lending channel and leaves room for a balance-sheet channel. The first VAR runs from 1978Q1 to 1999Q4. Tight money reduces on impact mortgages of depository institutions while total loans decline only slightly and with some lag (Fig. 5A). Real house prices react with the expected negative sign. We construct the Spread as the difference between the average mortgage rate on mortgages by building

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[21] The figure also includes a negligible, declining market share of the Government.

[22] According to Lea et al. (1997), following the sharp rise of market rates in 1988, centralised lenders were hit both financially and in originations with heavy pre-payments as they had to adjust their rates when the funding rate index (Libor) changed. Banks and building societies could avoid this adjustment because retail savings rates sluggishly responded to market rates.
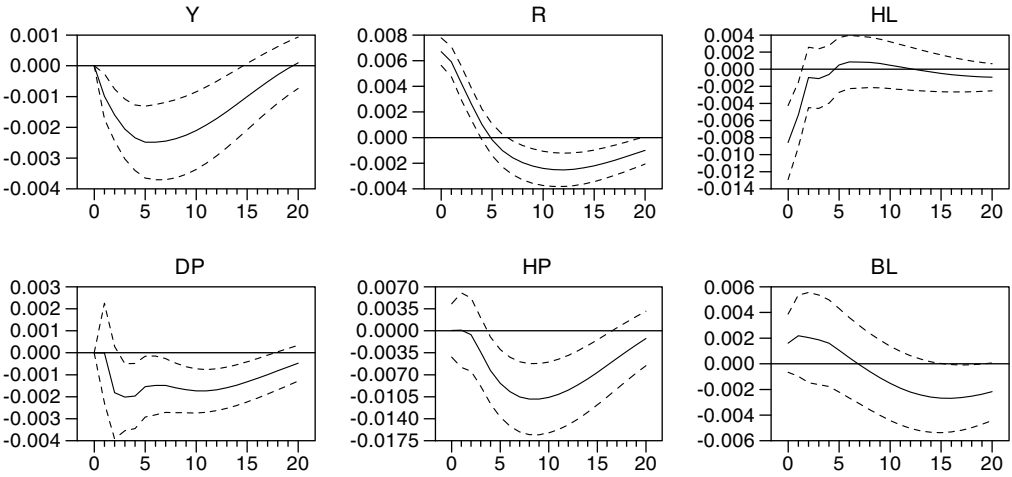
Fig. 5A. UK: Response ±1 S.E. bands to a monetary shock, loans regression (Impulse responses of the VAR. Response of total real bank loans, bank housing loans and other macro variables to a monetary contraction).
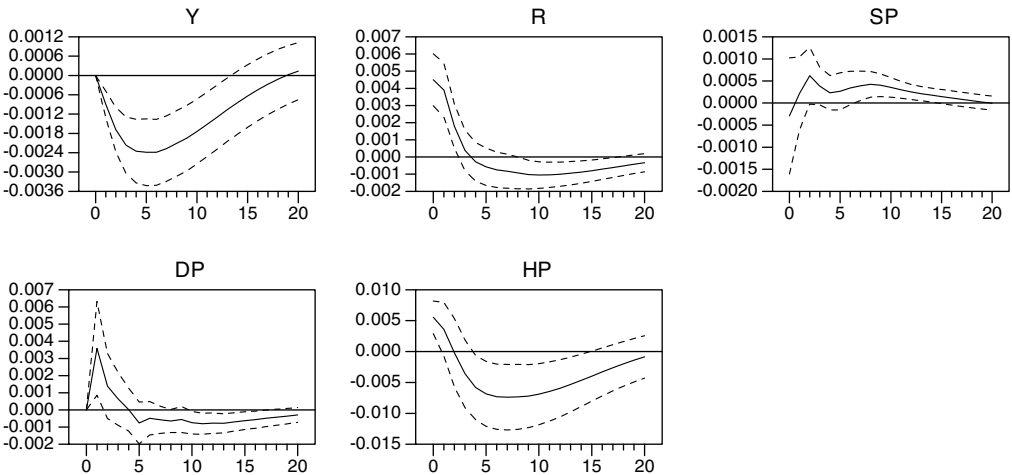
Fig. 5B. UK: Response ±1 S.E. bands to a monetary shock, Spread regression (Impulse responses of the VAR. Response of the Spread between mortgage rate and long-term safe rate of equal maturity to a monetary contraction).

societies and the 3-months Treasury bill rate. We choose a three-month rate as benchmark because the majority of mortgages in the UK have a rate reviewable at the discretion of the lender. The response of the Spread offers tentative evidence of a broad credit channel (Fig. 5B).[23] The Spread stays marginally positive for about 3 years. Next, we construct the Mix as housing loans of non-depository financial institutions, insurance companies,

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[23] Here the VAR runs from 1985Q1 to 1999Q4 (a period that extends after the reforms of the UK housing finance system of the 1980s, including the 1986 Building Societies Act).
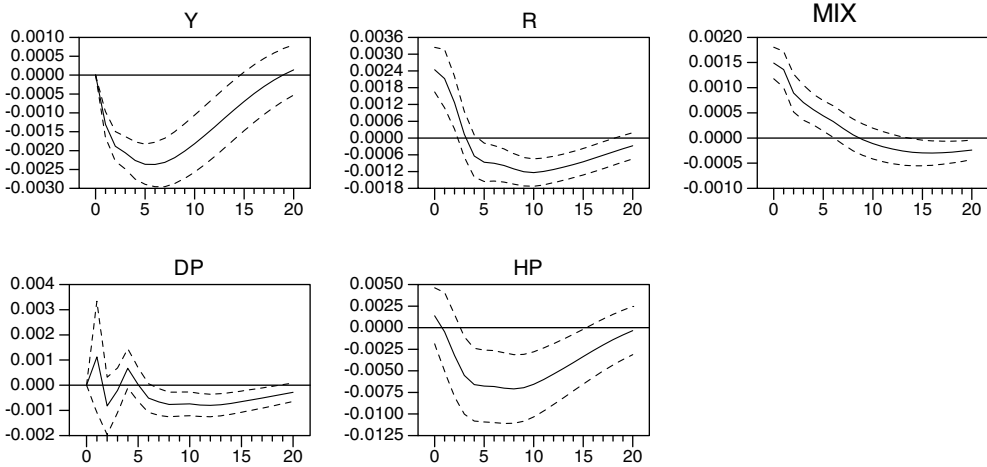
Fig. 5C. UK: Response ±1 S.E. bands to a monetary shock, Mix regression (Impulse responses of the VAR. Response of Mix (housing loans from non-banks over total housing loans) to a monetary contraction).
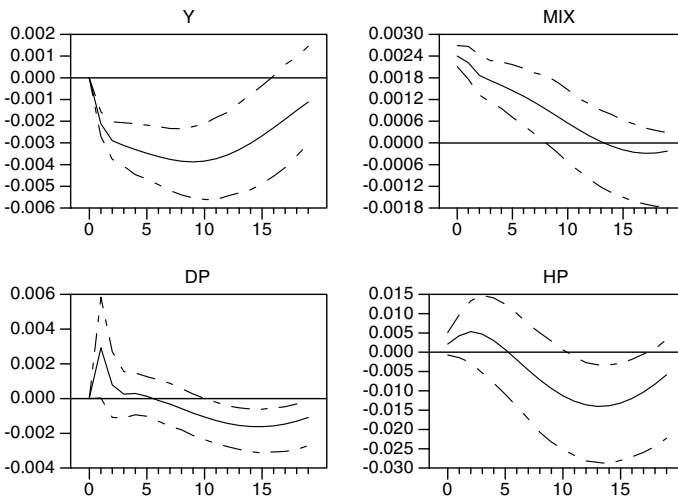
Fig. 5D. UK: Response ±1 S.E. bands to a shock in the Mix variable (Impulse responses of the VAR. Response of house prices to a positive Mix innovation).

pension funds and the State (excluding banks and building societies) over total housing loans by all institutions. The Mix increases following a negative monetary innovation (Fig. 5C), showing evidence of a fall in the mortgage supply of banks and building societies stronger than the fall in the mortgage supply of non-depository institutions. In turn, a positive innovation in the Mix reduces significantly real house prices that are below the baseline around eight quarters after the shock (Fig. 5D). The results from the third and fourth VAR tend therefore *to support the hypothesis of a bank-lending channel*. On the one hand, the causality from monetary actions to the Mix shows that monetary policy

can affect the composition of mortgage supply. On the other hand, the good marginal explanatory power of the Mix hints at the relevance of the composition of external finance for housing demand.

As in the case of Finland, an alternative explanation for the response of the Mix to a monetary shock could be a change in the quality composition of borrowers. To assess this alternative hypothesis, we obtained data on property repossessions and mortgage arrears.[24] Under the hypothesis that non-depository institutions fund less risky borrowers, the number of repossessions and mortgage arrears should fall when the Mix increases. We regressed the number of repossessions[25] as a fraction of mortgage loans on the Mix and on cyclical indicators of the housing market (house prices) and the economy (GDP and inflation). We found that an increase of the Mix positively affects the ratio repossessions over mortgage loans. This would suggest that in the UK, contrarily to the "flight to quality" argument, non-depository mortgage financiers tend to fund riskier borrowers than depository institutions.

Given the high efficiency of the funding market, the relevance of monetary policy for the Mix would appear controversial: in such a context it would have been equally plausible to find a weak link between monetary policy and the composition of finance. Given the low efficiency of the mortgage market, the effect of the Mix on house prices is instead in line with reasonable expectations. After entering the mortgage market in the 1980s, non-depository institutions have seen their market share decline. As argued by Kashyap and Stein (1994), in the presence of non-negligible costs for switching from one lender to another the argument of the "marginal" lender could fail, and the relative sizes of the bank and non-bank intermediary sectors could matter.

5. Robustness

In the analysis above, we run different VARs for the four countries under exam. Ideally, one would like to throw in a single specification combining all four countries together. This is not difficult to do, and would take into account all interdependencies across countries while providing a way to nest in a single econometric specification all the regression results we present in the paper. In practice, however, this is really only feasible for small systems: with four countries and eight variables for each country to look at, and assuming two lags of each variable, a constant, and a trend, this would call for a VAR model in which the right-hand side of each of the 32 equations would feature 66 regressors, and quickly exhaust all degrees of freedom.

An alternative to a large VAR would be to consider a fixed-effects panel VAR, as commonly done in cross-country investment or growth regressions. This would be tantamount to imposing common coefficients and/or identical responses to, say, a monetary shock for the countries that we consider. However, the key premise of our analysis is that the housing and mortgage markets of the countries under exam feature sharply different structural characteristics (efficiency and institutional organization) and that, in turn, these differences affect the presence of a broad credit channel and of a bank-lending channel in the housing market (in fact, these differences are the key reason why we choose these countries). Fur-

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[24] The data are from the Council of Mortgage Lenders (CML). They are half-annual from 1991H1 to 2001H2 on mortgages in arrear between 3 and 6 months, between 6 and 12 months and beyond 12 months.
[25] We did a similar exercise for mortgage arrears, obtaining similar results.

thermore, over the sample in question, the countries had different monetary policy strategies, different exchange rate regimes, different legal systems and financial institutions, different degrees of openness. For all these reasons, we prefer to keep as a working assumption the hypothesis that the countries are indeed different.[26]

Of course, it is still conceivable that, despite potential institutional differences, the countries in question might exhibit similar sensitivity to economic shocks. We used a simple test to verify and disprove the latter claim. Because we uncover differences across countries in the response of, say, the Mix variable to a change in the interest rate, we can impose the restriction that the elasticity of the Mix to the interest rate is similar across countries, and formally test whether the restriction is supported by the data.[27] To this purpose, we regress the Mix variable on a constant, trend, two lags of itself, inflation, GDP and interest rate. We run this regression (1) separately for each country, and (2) jointly for all countries using a fixed-effect panel approach, imposing the condition that the sensitivity of the Mix to interest rate changes is the same across countries. We then use a standard *F*-test to check whether the restrictions of the pooled regression (the one where we impose equal sensitivity of the Mix variable across countries) are rejected or not by the data. Our *F*-statistic[28] has a value of 3.96, and a *p*-value of 0.00431%. The tabled critical value is 2.24 for 1% significance, so we overwhelmingly reject the null hypothesis that the coefficient vectors are the same across countries. Obviously, once we reject the null hypothesis that the response of the Mix is identical across countries, it becomes irrelevant to test whether the effects of a shock to the Mix are different across countries. In fact, the heterogeneous sensitivity of the Mix to interest rate changes already implies that the structure of the four economies under exam is not the same.

One question that this robustness check leaves open is whether we can bundle together countries for which, ex post, we obtain roughly similar results. Take for instance Finland and the UK. In both countries, the Mix responds positively to an adverse monetary shock. It might be the case that efficiency would be gained if we use a panel VAR for Finland and the UK. We redo the same exercise we performed above, this time bundling together the two countries. The *p*-value for the *F*-statistic we calculate is 0.56%. The hypothesis of homogeneity is again rejected, although, judging from the regression's *p*-value, the differences are not huge (though it would still be rejected at the 99% confidence level).

Finally, one might wonder whether it would be preferable to run a single regression for each country (while analyzing countries separately). There are three main reasons why we choose not to do so. First, data availability: some series are only available for a short period of time. Second, clarity: we find more natural to look at each potential story behind the credit channel in isolation. Third, and most importantly, parameter

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[26] In fact, most studies that compare the transmission mechanism of monetary policy across countries use an approach similar to ours, specifying separate VARs for each country: see, for instance, Gerlach and Smets (1995).

[27] We run a similar experiment for all the other regressions of our paper. The results we report here are similar, in that we reject homogeneous responses across countries.

[28] The *F*-statistic is constructed as follows. We estimate 40 parameters altogether in the unrestricted regressions (four regressions for the four countries with 10 parameters for each country two lags of interest rate, inflation, GDP and the Mix, a trend and a constant) and 13 parameters altogether in the pooled regression (lagged variables, a trend and four constant terms). We use 245 observations in total. The random variable $\frac{(\text{RSSR}-\text{RSSU})/R}{\text{RSSU}/(T-K)}$ is distributed as an $F(R,K)$ statistic under the null hypothesis, where $R = 40 - 13 = 27$, $K = 40$, RSSR is the residual sum of squares of the restricted regression, and RSSU is the sum of the residual sum of squares of the four unrestricted regressions.

stability. Take Finland for instance: while it is acceptable to run a VAR with bank and housing loans beginning with data from the late 1970s, it would be unwise to use the same sample in the Spread regression, since interest rates were only liberalized in the mid 1980s. Clearly, one could use a minimum common denominator and run a single VAR with 8 variables for each country. However, we did so and found results similar to those that we report in the main body of the paper; moreover, such a VAR was clearly overparameterized, and we were left with too few degrees of freedom to conduct proper inference.

6. Conclusions

We have analysed and tested the presence of a bank-lending channel and more generally of a credit channel in four European housing markets characterised by different institutional frameworks and different levels of efficiency in the funding and mortgage systems. The results suggest that, despite the process of integration, residual heterogeneity characterises European housing markets and eventually the transmission mechanism of monetary policy. Table 3 summarises the econometric evidence. While robust evidence of a bank-lending channel emerges for Finland and the UK, we find at most evidence of a balance-sheet channel for Germany, and lack of evidence of a credit channel for Norway.

As discussed in Section 1, housing plays a key role in the aggregate economy. House prices appear to have important wealth effects on consumption (International Monetary Fund (2000)) and investment (Topel and Rosen, 1988). Indeed, Case et al. (2005) analyse a panel of US states and estimate long-run elasticities of consumption to house prices of about 0.06 while Davis and Palumbo (2001) find an elasticity of consumption to housing wealth of 0.08. Moreover, as noted by Bernanke and Gertler (1995), housing investment is highly volatile and, in the aftermath of a monetary tightening, it accounts for a large part of the decline in aggregate demand. On the basis of these considerations, we believe that our results provide useful insights into the transmission mechanism of monetary policy. A thornier issue is instead to evaluate to what extent in the economies we have investigated our findings extend to non-housing markets. Interestingly, in all the four countries small firms account for an important share of total employment and production. For example, in the 1990–1999 period, in Finland and the UK, i.e. the countries where we found

Table 3
Summary of the empirical findings

Country	Response to a negative monetary shock			Response to Mix increase	Credit channel?	
	Bank loans and housing loans	Spread = bank mortgage − benchmark rate	Mix (Housing loans non-bank/Total Housing loans)	Real house prices	Balance-sheet	Bank-lending
Finland	BL⇓HL⇓	Spread⇑	Mix⇑	HP⇓	Possible	Yes
Germany	BL⇓HL ⟺	Spread⇑	Mix⇑	HP ⟺	Yes	No
Norway	BL⇓HL⇓	Spread ⟺	Mix ⟺		No	No
UK	BL ⟺ ⇓HL⇓	Spread ⟺ ⇑	Mix⇑	HP⇓	Possible	Yes

evidence of a bank-lending channel, small firms (defined as those with less than 250 employees) accounted for 59.15% and 56.42% of total employment, respectively (Ayyagari et al., 2003). In conjunction with the fact that banks typically constitute the main source of external finance of small firms, this suggests that the results we have obtained for the housing market are likely to be also relevant for the small business sector.

Appendix A. Structural features of the housing markets

A.1. Institutional framework

Main mortgage lenders and recent percent market share

Finland — Deposit banks and Bank of Finland (78), State and other specialist lenders (22) (source: Statistics Finland).

UK — Banks (68.6), building societies (24.9), other specialist lenders (6.5) (source: Lea et al., 1997).

Norway — Savings banks (40.8), commercial banks (33), mortgage institutions (1.5), State banks (16.1), insurance companies (8.2), other (0.4) (source: Lea et al., 1997).

Germany — Private commercial banks (21), mortgage banks (16), credit co-operatives (14), savings banks (25), Bausparkassen (11), regional banks (13) (source: Lea et al., 1997).

A.2. Funding methods (depository institutions)

Sources of funds for banks and other depository institutions (retail deposits: accounts and savings deposits; wholesale funding: bank bonds, loans from other monetary institutions and other minor techniques)

Finland — *Banks*: retail deposits (90%), wholesale general funding (10%) (source: European Mortgage Federation, 2000).

UK — *Banks* (exact figures not available); *building societies*: retail deposits (75%), wholesale general funding (25%) (source: European Mortgage Federation, 2000).

Norway — *Commercial banks*: retail deposits (50%), wholesale general funding (47%); *savings banks*: retail deposits (61%), wholesale general funding (37%); (source: European Mortgage Federation, 2000).

Germany — Mortgage bonds, mortgage backed securities, deposits (exact figures not available).

A.3. Maximum loan to value ratios (source: OECD, 2000)

Finland: 70–80%; UK: 100%; Norway: 80%; Germany: 60–80%.

A.4. Degree of liberalisation

Set 1: Ceilings on deposit and lending interest rates; funding restrictions

Finland   Abolition of ceilings on loan rates in 1987.
UK   End of collusive interest rate cartel with the abolition of the Corset (direct incremental control on the growth rate of interest bearing deposits, time deposits and CDs) in 1980. Relaxation of constraints on funding of Building Societies in 1986 (Building Societies Act).
Norway   Abolition of ceilings on bank-lending rates in 1985.
Germany   Abolition of "the regulation on interest rate adjustment (Zinsverordnung)" in 1967.
           Persisting collusive mortgage rates.

Set 2: Entry and portfolio restrictions

UK   Abolition of the Corset in 1980.

Appendix B. Data description

Summary tables of time periods and variables used in the regressions (source in brackets).

Loan regressions

Country	Years	Variables
Finland	78Q4–99Q4	$\underline{HP}$ = Residential property prices (source: *BIS*) R = Money market rate (*Datastream (DS)*) HL = Banks' outstanding housing loans (*Statistics Finland*) BL = Banks' lending outstanding (*Statistics Finland*)
Germany	74Q2–98Q4	$\underline{HP}$ = Residential real house price index (*Aufina/ERA; the original annual series was made quarterly through interpolation assuming an ARIMA(0,2,0) in the original series*) R = 3 months Money market lending rate (DS) HL = Private commercial banks housing loans (DS) BL = Private commercial banks total loans (DS)
Norway	88Q3–99Q4	$\underline{HP}$ = New Detached Houses, Price Index (DS) R = 3 months forward rate (DS) HL = Housing loans commercial bank + Savings banks (*Statistics Norway*) BL = Total loans commercial bank + Savings banks (*Statistics Norway*)
UK	78Q1–99Q4	$\underline{HP}$ = Nationwide East Anglia house price index (DS) R = Inter-bank 3 months interest rate (DS) HL = Building societies loans for house purchase + Bank-lending secured on dwellings (DS) BL = Total loans, banks and building societies (DS)

Spread (SP = RM − RL) regressions

Country	Years	Variables
Finland	88Q1–99Q4	RM = Interest rate on banks new housing loans (*Bank of Finland*) RL = Long benchmarking interest rate, 3 years (*Bank of Finland*)
Germany	82Q4–99Q4	*Industrial production and producer price inflation were used instead of Y and DP* RM = Mortgage rate, 10 year fixed average (DS) RL = 10 year Government bond yield (DS)
Norway	88Q3–98Q4	RM = Interest rate on long-term and medium-term loans until 95Q4; Interest rate on mortgage loans from banks from 96Q1 (Statistics Norway) RL = Interest rate on 5 year bonds (Statistics Norway)
UK	85Q1–00Q2	RM = Building societies, mortgage average rate (DS) RL = Treasury bill rate (Office for National Statistics)

Mix regressions

Country	Years	Variables
Finland	87Q1–99Q4	MIX = Housing loans from all other lenders/(Housing loans from all other lenders + Housing Loans from Depository Banks and Central Bank)
	74Q2–98Q4	MIX = Housing loans from Bausparkassen and Mortgage Banks/Total housing loans from all the financial institutions
Norway	88Q3–99Q4	MIX = Housing loans from state and non-depository fin. institutions/Total housing loans
	87Q1–00Q2	MIX = General Govt + Insurance companies & Pension funds + Other financial intermediaries loans secured on dwellings/total loans secured

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