Should Policymakers be Concerned with Asset Prices?

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Abstract
This paper examines the response of the economies of 11 EU countries plus Japan to shocks in housing and equity prices. The effects are assessed with a Structural Vector Auto Regressive (SVAR) model, and we find that housing price shocks generally have a substantial positive impact on output, while equity price shocks have a very modest effect. Housing price shocks affect real activity through consumption, and are related to cross-country homeownership patterns. Variance decompositions indicate that monetary policy reacts to equity price shocks but not to housing price shocks. These results suggest that the task of choosing an appropriate monetary policy for several countries with differing institutional characteristics is complicated by asset shocks and their impact on the real sectors of the aggregate economy.

Keywords: Monetary policy, Asset prices, structural VAR
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Table of Contents

Thus, understanding how monetary policy affects the broader economy necessarily entails understanding both how policy actions affect key financial markets, as well as how changes in asset prices and returns in these markets in turn affect the behavior of households, firms, and other decision makers.

Bernanke (2003)

As societies accumulate wealth, asset prices will have a growing influence on economic developments. The problem of how to design monetary policy under such circumstances is probably the biggest challenge for central banks in our times.

Otmar Issing (*Wall Street Journal*, 2004-02-18)

1. Introduction

Popular accounts suggest that asset prices have played a prominent role in recent macroeconomic fluctuations. According to *The Economist* (2002), the recent mild downturn was due in good part to "The Houses that Saved the World." The run-up in equity prices in Japan, Sweden, the U.K., and the U.S. arguably fuelled rapid growth. The subsequent sharp declines in equity prices in Japan and the U.S. have been linked by several observers to the subsequent recessions. These recessions have been marked by sizeable contractions in business fixed investment. *The Economist* (2003), for example, reports that, "One reason for the current doldrums [in IT spending] is that many firms still regret binge-buying during the bubble."

While these casual observations are provocative, economic theory indicates asset prices impact real activity and hence the monetary transmission mechanism through several channels that, on balance, have ambiguous effects. Here we confine ourselves to considering housing and equity prices on households and firms, and examine four channels. Asset prices are directly linked by a *wealth channel* to consumption according to the life-cycle/permanent income model. However, there are a number of reasons why the response of consumption to variations in wealth may differ by asset.[1] Given the volatility of asset prices, consumers may have difficulty separating temporary from permanent changes. If asset price movements are viewed as largely temporary, then the impact on consumption will be minimal. The degree of recognition of wealth changes may differ by asset because financial portfolios are priced daily while housing assets are traded and hence valued infrequently.

[1] This list of factors is drawn from Case, Quigley and Shiller (2001, Section II).

Moreover, some assets such as housing provide both wealth and a service flow. Tax laws impact the ultimately realizable change in wealth, and may differ by asset and across countries. If wealth directly enters the utility function and is a sufficiently strong substitute for consumption, then increases in wealth may lead rational consumers to lower consumption and raise leisure. The assumption of a rationally calculating consumer may not be appropriate with regard to asset prices and the emotions that are engendered by price movements. With behavioral heuristics such as "mental accounts," certain assets are viewed as vehicles for saving for retirement or other long-term goals, and hence these assets have little effect on consumption. In sum, the wealth channel may be small, perhaps negative, and likely differs between housing and equity assets.

Recent work on finance constraints faced by household and firms links asset prices to spending patterns via a *balance sheet channel*.[2] This literature highlights the critical role played by asymmetric information in capital markets in disrupting the financial flows supporting consumption by households and investment by firms. A key element is that a wedge exists between the costs of external and internal finance that is sensitive to the ability of lenders to recover funds in the case of bankruptcy. Hence, a critical role exists for collateral in particular and financial structure in general. An increase in the value of collateral such as housing and equities lowers the financing wedge, and stimulates consumption and investment spending.[3]

Rising equity prices may lower the cost of equity to firms. Whether managers truly believe that the cost of equity has fallen depends on the relation between the current stock price and the fundamental stock price that managers presumably are in a better position to evaluate than outside investors. If such a perceived misevaluation exists, then there exists an *equity finance channel.* However, as noted by Blanchard, Rhee and Summers (1993), the existence of cheap equity does not necessarily imply that firms will increase investment in physical capital. Rather, managers may sell overvalued equity, and place the proceeds in cash and marketable securities. Thus an equity finance channel may be operative, but have no effect on investment spending.

[2] Regarding the voluminous finance constraints literature, see Carroll (2001) on household consumption and Hubbard (1998) on business investment.

[3] This version of the balance sheet channel is likely to be more important for consumers, though it will also affect firms insofar as they hold equity assets of other companies. Such cross-shareholdings are important in Japan and several Western European countries.

Most studies of the relation between asset prices and real activity have focused on either consumption or investment behavior in isolation.[4] This focus is useful for studying the above three channels, but may miss the *allocation channel* that directs scarce resources via asset prices. More generally, as in the general equilibrium model of Brainard and Tobin (1968), an asset price shock affects the returns to a spectrum of imperfectly substitutable assets so that asset/liability composition matters and revaluations of assets have direct consequences for real expenditures. For example, a rise in equity prices may stimulate investment spending via the balance sheet or equity finance channels discussed above. However, this flow of resources may result in an inefficient allocation if the asset price signal reflects a non-fundamental movement. GDP will be lowered further by non-trivial adjustment costs for increasing and ultimately decreasing capital in specific sectors (as occurred dramatically with IT and biotechnology investments in the US). On balance, the allocation channel may dominate, and GDP will be lower as a result of an asset price increase.

The wealth, balance sheet, equity finance, and allocation channels suggest that the impacts of asset prices -- directly on real activity and indirectly on the monetary transmission mechanism -- are ambiguous. Whether policymakers should be concerned about asset prices thus remains uncertain. Of additional concern is that the strength of several of these channels may depend on country specific characteristics such as homeownership, indebtedness, and equity market capitalization.

To begin to address some of these issues, this paper examines the response of 12 highly industrialized economies to shocks to housing and equity prices. The examination of asset price effects is still at a relatively early stage in the literature, and hence there is little consensus on a detailed structural model.[5] Consequently, we estimate VARs that allow us to impose a relatively limited amount of structure in order to characterize the responses in the aggregate data and to examine the impact of cross-country variation in equity market capitalization and homeownership.

Section 2 begins with a discussion of our dataset and the variables in the VAR. We use the EUROMON database constructed at the Dutch National Bank (DNB,

[4] Several of these studies will be discussed in the next draft.
[5] Examples are Ludvigson et al. (2002) on the wealth effects in the US, Iacoviello (2000) on housing price effects in the UK, and Giuliodori (2003) on housing price effects in eight European countries.

2000) that contains quarterly data for 12 countries -- Austria, Belgium, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, and the UK -- for the period, 1979:4 to 1998:4. This period covers the two decades of the European Exchange Rate Mechanism (ERM), and thus allows us to avoid major structural breaks due to changes in the exchange rate system. The EUROMON panel database is supplemented with several variables describing country specific financial and economic characteristics. We include four variables used frequently to describe open economies -- real GDP, CPI, an exchange rate, and the three-month money market rate as an indicator of monetary policy.[6] Additionally, we include (selectively among countries) several exogenous variables. The role of asset prices is captured by the nominal asset values for houses and equities.

Section 3 reexamines the role of asset price shocks in a structural VAR. In order to isolate the effects of hypothetical shocks, we need to impose some structure on the contemporaneous relations among the shocks. A Choleski decomposition is not appropriate because we wish to allow monetary policy to affect and be affected by asset prices. The assumptions that underlie our identification of the structural shocks are discussed in this section.

Section 4 examines the effects of asset prices on real GDP and three components -- consumption, residential investment, and business investment. Based on cumulative impulse responses over 4, 8, and 12 quarters, we find that housing price shocks have a much larger effect on real variables than equity price shocks and that the response is heterogeneous across countries.

Section 5 uses this heterogeneity to study the relation between the CIRs and institutional characteristics that measure either the exposure to asset price movements or the "noise" in the environment. We find that the impact of housing price shocks on consumption is positively related to the extent of home ownership, an important result given the wide variations in homeownership among industrialized countries.

Section 6 uses the structural VAR to ask whether policymakers are concerned about asset prices. We find little evidence that housing prices affect monetary policy.

[6] At the onset, the VAR literature followed the basic IS-LM modeling framework and hence introduced the mentioned four endogenous variables into the models (for an overview, see Christiano et al., 1998; for an application to the euro area, see Peersman and Smets, 2003, and Mojon and Peersman, 2003).

However, monetary policy makers in half of the countries appear to have responded to equity prices.

Section 7 summarizes and concludes.

2. Model Variables and Pre-testing

2.1. Model Variables

The empirical results in this paper are based on a VAR analysis (to be discussed in Section 3) of 12 highly industrialized countries: Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (GE), Italy (IT), Japan (JP), Netherlands (NL), Spain (SP), Sweden (SW), and the United Kingdom (UK). The basic data source is the EUROMON database constructed at the Dutch National Bank (DNB, 2000) that contains quarterly macroeconomic data. (Details can be found in the Appendix A.) The sample period is 1979:4 to 1998:4, which covers the two decades of the European Exchange Rate Mechanism (ERM) and thus allows us to avoid major structural breaks due to changes in the exchange rate system.

Our VAR contains seven endogenous and four exogenous variables. Five of the endogenous variables are used frequently in VAR studies to represent the aggregate economy. Output and prices are measured by real GDP and a price index for consumption (PC), respectively. All of the economies in this study are heavily influenced by foreign trade, and we include a nominal effective exchange rate (EX) based on trade weights. Since the work of Bernanke and Blinder (1992), a short-term interest rate variable has been used frequently as an indicator of monetary policy and in the present cross-country study a three-month money market rate (RS) is available for all countries. Bank credit (CREDIT) is included to capture possible credit channel effects, perhaps amplified by asset price movements.

The role of asset prices is represented by two endogenous variables. The nominal values of privately owned houses (HOUSE) and equity (EQUITY) are computed as the product of a price index and a stock variable. Stock variables are included to capture the trend behavior (though they have little effect in our differenced specification). Since the vast majority of the movements in the house and equity value series are determined by the price components, we refer to these asset value variables as asset prices.

Four exogenous variables enter the VAR. A real world trade index (WT), a nominal commodity price index (PCOM), and the interest rate for the US (RS^{US}) capture global influences on economic activity in the individual countries. The interest rate for Germany (RS^{GE}) has a prominent effect on several countries in our sample. Owing to their substantial trade with Germany, Austria, Belgium, Denmark, and the Netherlands pegged their exchange rates to that of Germany, and hence the German interest rate loomed large. For this group of four countries, we include both RS^{GE} and RS^{US} as exogenous variables.[7]

2.2. Pre-testing

We begin by examining the order of integration and cointegration in our seven endogenous variables. All variables are in logs except for RS. As shown in the ADF tests presented in Appendix B, most of these level series are I(1), although the first difference of the log of the price level is sometimes a borderline case. Based on these results, we then test for the number of cointegrating vectors. If we find that the rank is close to full rank, we could follow Sims, Stock, and Watson (1990) and estimate the model in log levels. However, both the trace and maximum eigenvalue tests indicate that the null hypothesis of a full rank is rejected at the 1% level.[8] These results, coupled with a concern about seasonality, leads us to enter the variables in the VAR as annualized differences, $\Delta_4(x) = x(t) - x(t-4)$. As indicated in the tables in Appendix B, the vast majority of the annualized difference series are I(0).

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[7] Kakes (2000) and Smets and Wouters (1999) adopt a similar approach to modeling the effect of German interest rates.

[8] The results of Cheung and Lai (1993) indicate that, given our short sample, co-integration tests should be evaluated at the 1% level. The results of the cointegrating tests are available upon request from the corresponding author.

3. Model Specification

The primary goal of our study is to quantify the impacts of asset price shocks on real variables at horizons of one, two, and three years. We are interested in characterizing the response of real variables to asset price shocks rather than estimating structural parameters of taste and technology, and thus a VAR modeling approach is appealing. Moreover, since we wish to allow asset prices to affect and be affected by monetary policy contemporaneously, the structural shocks can not be identified by a Choleski decomposition. These considerations lead us to adopt a structural VAR (SVAR) modeling strategy.

The SVAR is estimated in an efficient maximum likelihood procedure that effectively depends on two steps. First, we estimate the following reduced form,

$$y_t = C(L)\, y_{t-1} + D(L)\, x_t + \varepsilon_t, \qquad (1)$$

where y_t is a k-vector of endogenous variables (k=7 in our model), x_t is a vector of exogenous variables, and C(L) and D(L) are polynomials in the lag operator, L. (Regarding the lag length, the likelihood function is very flat over different lag lengths, and hence selection statistics are not very useful. We choose a lag length of two as a compromise between the need to conserve degrees of freedom and the need to allow for rich dynamics.) The vector ε_t contains the reduced-form residuals or innovations, and has a variance-covariance matrix $\Sigma = E[\varepsilon_t\, \varepsilon_t']$. To identify asset price shocks, we begin by assuming that the economy can be described by the following general structural model,

$$G(L)\, y_t = D(L)\, x_t + u_t, \qquad (2)$$

where u_t are the structural disturbances that are serially uncorrelated and have an orthonormal variance-covariance matrix. These unobservable structural disturbances are related to the observable reduced-form residuals by the following relation,

$$G_0\, \varepsilon_t = u_t, \qquad (3)$$

where G_0 is the k x k matrix of coefficients multiplying y_t in (2) and this matrix is related to Σ as follows,

$$\Sigma = G_0^{-1} (G_0^{-1})'. \tag{4}$$

Estimation of G_0 with equation (4) and the coefficients in C(L) and D(L) in (1) allows us to relate structural shocks in asset prices (u_{HOUSE} and u_{EQUITY}) to real GDP and other endogenous variables.

In order to identify the shocks, we need to impose (k(k-1)/2) restrictions on the G_0 matrix of coefficients. These restrictions can be based on long-run considerations or contemporaneous effects. Since our primary interest is in short-run and medium-run impacts of asset price variables, we do not impose long-run restrictions in order to avoid potentially serious misspecification problems (Faust and Leeper, 1997). Instead, we specify the G_0 matrix based on the contemporaneous restrictions following from theoretical priors. We assume that output is largely predetermined, and is affected contemporaneously only by technology shocks and, in light of the substantial evidence concerning finance constraints (Hubbard, 1998), by credit innovations,

$$\varepsilon_{GDP} = -\alpha_{13}\varepsilon_{CREDIT} + u_{GDP} . \tag{5a}$$

Prices are assumed to respond sluggishly to all model variables, and hence are only affected by the price shock,

$$\varepsilon_{PC} = u_{PC}. \tag{5b}$$

Regarding credit and asset prices, we allow for a full set of interactions. Housing and equity assets serve as collateral that may allow households and firms to overcome asymmetric information problems and obtain credit. Moreover, the availability of credit may serve to stimulate asset prices. We also assume that asset prices and credit are affected by monetary policy. These consideration lead to the following specification of the credit innovation,

$$\varepsilon_{CREDIT} = -\alpha_{34}\varepsilon_{HOUSE} - \alpha_{35}\varepsilon_{EQUITY} - \alpha_{37}\varepsilon_{RS} + u_{CREDIT}. \qquad (5c)$$

We further assume that the housing and equity innovations are each affected by output and that exchange rates affect equity by via short-term capital flows but not housing assets,

$$\varepsilon_{HOUSE} = -\alpha_{41}\varepsilon_{GDP} - \alpha_{43}\varepsilon_{CREDIT} - \alpha_{45}\varepsilon_{EQUITY} - \alpha_{47}\varepsilon_{RS} + u_{HOUSE}. \qquad (5d)$$

$$\varepsilon_{EQUITY} = -\alpha_{51}\varepsilon_{GDP} - \alpha_{53}\varepsilon_{CREDIT} - \alpha_{54}\varepsilon_{HOUSE} - \alpha_{56}\varepsilon_{EX} - \alpha_{57}\varepsilon_{R} + u_{EQUITY} \qquad (5e)$$

The exchange rate is determined by contemporaneous output and interest rate shocks, as well as exchange rate shocks. We assume that the effect of price shocks is transmitted to exchange rates through the interest rate, and hence there is no independent effect of price innovations,

$$\varepsilon_{EX} = -\alpha_{65}\varepsilon_{EQUITY} - \alpha_{67}\varepsilon_{RS} + u_{EX}. \qquad (5f)$$

The monetary authorities are in a position to respond quickly to all current information, and the interest rate innovation responds to innovations in all model variables, as well as its own shock,

$$\varepsilon_{RS} = -\alpha_{71}\varepsilon_{GDP} - \alpha_{72}\varepsilon_{PC} - \alpha_{73}\varepsilon_{CREDIT} - \alpha_{74}\varepsilon_{HOUSE} - \alpha_{75}\varepsilon_{EQUITY} - \alpha_{76}\varepsilon_{EX} + u_{RS}. \qquad (5g)$$

We summarize the restrictions represented in equations (5) in the following matrices,

$$\begin{bmatrix} 1 & 0 & a_{13} & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & a_{34} & a_{35} & 0 & a_{37} \\ a_{41} & 0 & a_{43} & 1 & a_{45} & 0 & a_{47} \\ a_{51} & 0 & a_{53} & a_{54} & 1 & a_{56} & a_{57} \\ 0 & 0 & 0 & 0 & a_{65} & 1 & a_{67} \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} e_{GDP} \\ e_{PC} \\ e_{CREDIT} \\ e_{HOUSE} \\ e_{EQUITY} \\ e_{EX} \\ e_{RS} \end{bmatrix} = \begin{bmatrix} u_{GDP} \\ u_{PC} \\ u_{CREDIT} \\ u_{HOUSE} \\ u_{EQUITY} \\ u_{EX} \\ u_{RS} \end{bmatrix} \qquad (6)$$

For each country we tried above model with some adaptations to increase the quality of the model. The adaptations implied slight differences from the G_0-matrix as presented in model (6): imposing more zero-restrictions on especially the parameters α_{13}, α_{41}, α_{37} and α_{47}. For evaluating the overall quality of the model we used the following criteria:

- convergence of the shocks in the Impulse-Response analysis to 0;
- arithmetic convergence of the G_0-estimation routines;
- well-behaved confidence bands: no increasing forecasting variance, ‘fractals’ or bubbles;
- plausibility of the signs of the Impulse-Response Functions ;
- insignificance of the overidentification test (in case the model uses more restrictions than the just-identified model above).

If these criteria could not be met easily we re-estimated the model using another sample period. For instance for the Netherlands we only use the post-1982 data representing a consistent exchange rate and wage moderation policy, for Sweden and Finland we omit the breaks due to the banking crises of 1991-1994 and 1990-1992, respectively, and for Germany we leave out the 1991-1993 break due to the German unification.

4. Asset Price Shocks and Cumulative Responses

The standard approach to computing impulse responses (IRs) is to shock the SVAR with a one standard deviation shock computed from the VAR innovations. However, this procedure precludes meaningful comparisons because the size of the shocks will differ across countries. For example, a country whose asset markets have been relatively turbulent will have larger one standard deviation shocks and, ceteris paribus, larger impulse responses. To avoid this historical happenstance, we replace the one standard deviation shocks with unit shocks that are equal across countries.

Figures 1a and 1b present the cumulative impulse responses (CIRs) of GDP to unit shocks in housing and equity prices, respectively. The results reveal a great deal of heterogeneity. After 12 quarters, a housing price shock leads to a decline in growth rates of GDP in five of the twelve countries. The largest declines are in France and Germany, and the largest increases are in Japan and the United Kingdom. For an equity price shock, five countries have declines in GDP, though only two of the countries (Belgium and Spain) show declines for both shocks. An important difference is that the response of GDP growth (as indicated by the scale of the vertical axes in Figures 1a and 1b) is much greater for housing shocks. The two largest positive responses to a HOUSE shock slightly exceed a one percentage point change in the growth rate of GDP over five years. The comparable largest changes to an EQUITY shock are about one-tenth as large. There is clearly substantial heterogeneity of responses across countries and across shocks.

The above analysis of aggregate effects is informative, but may be affected by further heterogeneity among the components of final demand. For example, households may be finance constrained due to asymmetric information problems, and the extent of these constraints may vary across countries because of differences in of allocating financial resources. In this case, examining the responsiveness of GDP will not uncover this financing channel. Moreover, a housing price shock that results in greater investment in residential capital may divert resources from business capital. In the aggregate, these two responses may cancel each other, thus providing a misleading impression of the effect of asset prices.

In light of these aggregation issues, Figures 2, 3, and 4 examine the effect of asset price shocks on consumption (CONS), residential investment (INVT-R), and business investment (INVT-B). The SVAR model is the same as before with GDP replaced by one of these components. For housing shocks, the response of consumption spending continues to be heterogeneous (Figure 2a). However, as shown in Figure 3a, a positive shock to housing stimulates residential investment for 11 of the 12 countries. Germany presents an interesting case where a large negative response of CONS is balanced by a large positive response to INVT-R. Figure 5 plots the responses of CONS and INVT-R to a housing shock across the 12 countries at 4, 8, and 12 quarters. In the latter case, there is evidence of a broad negative relation across countries.

Figures 2b, 3b, and 4b plot the IRs for the three components of GDP to an equity price shock. The patterns seen with GDP remain: there is substantial heterogeneity across countries and the effects per component are much smaller than for housing shocks.

5. Cross-Country Patterns in Cumulative Responses

The above heterogeneity of the CIRs may reflect underlying variation in important institutional characteristics. In this section, we examine the relation between the CIRs and institutional characteristics that measure either the exposure to asset price movements or the "noise" in the environment. Standard correlation and Spearman rank correlation are computed between the CIRs in Figures 1 to 4 and various institutional characteristics

Table 1 shows that, at horizons of 8 or 12 quarters, the responses of consumption spending to house price shocks are positively related to the percentage of homes that are owner occupied (OWNOCC). At a 12 quarter horizon, the relation is statistically significant at conventional levels. This is an important result because OWNOCC varies widely among the 12 countries, from a minimum of 40% in Germany and Japan to 78% in Spain. This spread in homeownership implies substantially different responses to housing price shocks, and suggests that finance constraints are eased by homeownership. It is also interesting to note that the correlation between OWNOCC and GDP is close to zero, and thus the strength of this asset price channel would have been hidden in an analysis of the aggregate.

By contrast, there is no noticeable cross-country relation between the response of real variables and the exposure to the equity market as measured by the equity ownership by households (EQUITYOWN). This absence of an effect may reflect the modest impact of equity shocks on real activity or that equity tends to be held by wealthier individuals for whom finance constraints tend to be unimportant.

By contrast, we find a positive relation between the response of residential investment to equity price shocks and the exposure of the total economy to equity price fluctuations as measured by equity market capitalization to GDP (EQUITYCAP).

A second set of tests (not reported) focuses on the extent to which the "noise" in the economy mutes asset price channels. In a seminal article, Lucas (1973) shows that the cross-country effect of monetary policy on real activity depends on the amount of variation in the policy variable. The more variation in the environment, the more difficult it is for agents to discern temporary from permanent movements. We apply this logic to the role of asset prices. In economies where the variation of asset prices is low, we would expect shocks to have a stronger impact than in economies where the variation is high and agents have a difficult time extracting signal from noise. We measure "noise" by the coefficient of variation of housing or equity prices to their sample means. We also include a third measure for price inflation. In none of these three cases is there a systematic relationship between the CIRs for housing and equity prices and the coefficients of variation.

6. Are Policymakers Concerned about Asset Prices?

Further information about the role of asset prices can be obtained by examining the percentage of the forecast error in a given variable at a given horizon that is attributable to specific shocks. These variance decompositions allocate the forecast error to all shocks, and the contributions of all shocks sum to 100%. Here we are interested in the question whether policymakers are concerned about asset price movements, which can be evaluated in terms of the variance decomposition for our monetary policy indicator, RS.[9]

The variance decompositions for RS are presented in Table 2, and we are particularly interested in columns 5 and 6 for housing and equity price shocks, respectively. In most cases, the percentage of the variation in forecast error after 12 quarters is very close to the longer-run values at 20 or 30 quarters (the exceptions are Japan and Sweden). A benchmark value can be obtained if we assume that each of the seven shocks contribute equally to the variation in housing prices. In this case, we would expect the reported percentages to be approximately 15%. By this benchmark, housing prices do not have much influence on monetary policy. Only in Italy with a statistic of 18% and Sweden at horizons of 20 or 30 quarters with a statistic of 30% has monetary policy responded to the housing market. Monetary authorities seem to resist responding to movements in housing prices, perhaps concerned that financially fragile households are unable to withstand economically adverse interest rate movements.

However, monetary policy has clearly been responsive to equity shocks. The percentage of the forecast error in RS explained by equity shocks exceeds the benchmark in half of the 12 countries. These results are consistent with equity's role as a predictor of future economic activity (as witnessed by its role in several indices of leading economic indicators), and monetary authorities incorporating this information into a forward-looking Taylor rule. The results in Table 2 strongly suggest that the monetary authorities pay particularly close attention to developments in equity markets.

[9] Clarida and Gertler (1997, Section 10.4.4) undertake a similar analysis of the Bundesbank monetary policy.

7. Summary and Conclusions

This paper examines the response of 12 highly industrialized economies to shocks to housing and equity prices. Our interest in computing short-run and medium-run responses and in allowing asset prices and monetary policy to interact leads us to use a structural VAR. We obtain four key results. First, housing price shocks have a much larger effect on the real side of the economy than equity prices. Second, our disaggregate analysis reveals that housing shocks have the most impact through consumption. Third, this transmission channel is sensitive to variation in home ownership. Fourth, monetary policy has responded to equity price shocks but not housing shocks, thus neutralizing the impact of the equity market on the aggregate economy. These results suggest that the task of choosing an appropriate monetary policy for several countries with differing institutional characteristics is complicated by asset shocks and their impact on the real sectors of the aggregate economy.

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Appendix A: Data Definitions And Sources

CONS: Consumption Spending.
Constant prices 1990. All countries - OECD National Accounts.

CREDIT: Bank credit to the private sector,.
Constant prices 1990. All countries - IMF, International Financial Statistics. Nominal figures have been deflated by the private consumption deflator.

EQUITY: Market value of equity of the business sector.
All countries - EQUITY = EQUITYR * PEQ/100.
EQUITYR - Real value of equity of the business sector.
EQUITYR = EQUITYR(-1) + INVT-B - D * EQUITYR(-1), where annualized depreciation rate D = 0.06. Starting value derived from OECD, Flows and stocks of fixed capital. INVT-B and PEQ defined elsewhere in this appendix.

EQUITYCAP: Stock market capitalization relative to nominal GDP.
All countries - IFS.

EQUITYOWN: Shares owned by households, relative to their total financial assets.
All EMU countries - ECB.

EX: Nominal effective exchange rate.
Index 1990=100. All countries - Exchange rates from Datastream. Own reweighting using calculated trade weights of 1990.

GDP: Gross domestic product.
Constant prices 1990. All countries - OECD National Accounts

HOUSE: Market value of stock of private owner occupied houses.
All countries - HOUSE = HOUSER * PH/100.
HOUSER - Rebuilding value of stock of private owner occupied houses.
HOUSER = HOUSER(-1) + INVT-R - D * HOUSER(-1), where annualized depreciation rate D = 0.02. Starting value derived from OECD, Flows and stocks of fixed capital. INVT-R and PH defined elsewhere in this appendix.

INVT-B: Investment in fixed assets of the business sector.

Constant prices 1990. Calculated as total investment in fixed assets minus residential investment and government investment. Source: OECD National Accounts and Quarterly National Accounts. For Austria, Belgium, Germany, Spain, Sweden interpolation of annual data for government investment and residential investment.

INVT-R: Residential investment
Constant prices 1990, OECD Quarterly National Accounts. For Austria, Belgium, Germany, Spain, Sweden, interpolation of annual data.

OWNOCC-H: Percentage of homes owner-occupied. All countries - BIS.

PC: Price deflator for private consumption.
(1990=100). All countries - OECD National Accounts

PCOM: Price of commodities.
(in own currency), index 1990=100. All countries - HWWA. Price denominated in dollars converted into national currencies using dollar exchange rates.

PEQ: Share price index.
(1990=100) All countries - IMF, International Financial Statistics.

PH: Residential property prices.
Index 1990=100. Sources:
Austria - Wiener Immobilienbörse, Technische Universität. Price per m^2 new and existing dwellings in Vienna. Series starts in 1986. Semiannual data have been linearly interpolated. Before 1986 linked to interpolated annual data from former housing studies.
Belgium - Antwerpse Hypotheekbank, Valeurs Mobiliers. Quarterly index of prices of small and medium dwellings as from 1981:I. Before 1981 linked to interpolated annual series from former housing studies. Price index is expressed in percent of 'officially appraised value' in 1992.
Denmark - Danmarks Statistik, Monthly Review. Quarterly index of single family dwellings as from 1971:I.
Germany - Bundesbank. Interpolation of annual prices in DEM 1000 of new or existing good quality 'Reihenhaus' in West Germany.
Spain - Banco de España and Ministerio de Obras Publicas, Transportes y Medio Ambiente. Quarterly prices per m^2 in pesetas. Before 1987 linked to interpolated annual data from former housing studies.
Finland - Statistics Finland. Quarterly price index per m^2 of existing flats in housing corporate bodies that have been on sale through real estate agents. Series start in 1978:I.

France - Federation Nationale des Agents Immobiliers, Observatoire National des Marches de l'Ancien. Data compiled from 12,000 transactions by FNAIM members. Annual data as from 1995 of existing dwellings in FFR per m^2. Linked before 1995 to data from former housing studies. Annual data have been interpolated by Ginsburgh method using housing prices in Paris from the French notaryship.

Italy - Banca d'Italia. Semiannual prices of new estate in the capitals of the 96 Italian provinces. Series start in 1970. Semiannual data have been linearly interpolated.

Japan - Bank of Japan, Financial and Economic Statistics Monthly. Data represent changes in residential land prices.

Netherlands - Kadaster as from 1992:I. Before 1992:I Nederlandse Vereniging van Makelaars. Selling price of existing dwellings in thousands of NLG. Monthly data have been converted into quartely averages.

Sweden - Statistics Sweden, Statistika Meddelanden. Price index of owner occupied dwellings based on notary transactions. Quarterly series start in 1986:I. Before 1986 linked to interpolated data from former housing studies.

United Kingdom - Bank of England. Data as from 1993 represent prices of all dwellings from a 5% survey of mortgagers conducted by the Department of the Environment. Before 1993 based on mortgage lending by Building Societies.

RS: Three-month money market interest rate (%).
All countries - De Nederlandsche Bank, Quarterly Bulletin.

WT: Relevant world trade.
Volume index 1990=100. All countries - Reweighted import volumes of the other 11 countries plus the United States, using calculated trade weights of 1990.

Appendix B: Unit Root Tests on Levels and Differences

This appendix contains the p-values from the ADF test for all 12 countries plus the United States. The series are in log levels (LN) and the first and seasonal differences of logs (Δ(LN) and Δ^4(LN), respectively). For example, the first line in the entry for Austria shows that, for GDP,

a) log levels ~ I(1): LN(GDP) does not reject the null hypothesis of a unit root (p-value$_{ADF}$ = 0.1994 > 0.05);

b) Seasonal differences of logs ~ I(0): Δ^4(LN(GDP)) rejects the null hypothesis of a unit root (p-value$_{ADF}$ = 0.0013 < 0.05).

AUSTRIA

Variable	LN	Δ(LN)	$\Delta(\Delta$(LN))	Δ_4(LN)	$\Delta(\Delta_4$(LN))	$\Delta(\Delta(\Delta_4$(LN)))
GDP	0.1994	0.0019		0.0013		
CONS	0.0177			0.0000		
INVT-B	0.6130	0.0002		0.0000		
INVT-R	0.6481	0.0480		0.1335	0.0001	
PC	0.0106			0.0296		
CREDIT	0.2889	0.0536	0.0000	0.0927	0.0000	
PCOM	0.0051	0.0000		0.0000		
WT	1.0000	0.0942	0.0000	0.0463		
EX	0.9974	0.0000		0.0264		
EQUITY	0.3461	0.0000		0.0045		
HOUSE	0.1253	0.1708	0.0000	0.0145		
RS	0.4161	0.0000				

BELGIUM

Variable	LN	Δ(LN)	$\Delta(\Delta$(LN))	Δ_4(LN)	$\Delta(\Delta_4$(LN))	$\Delta(\Delta(\Delta_4$(LN)))
GDP	0.0346			0.0784	0.0000	
CONS	0.0189			0.0862	0.0000	
INVT-B	0.3885	0.0331		0.0302		
INVT-R	0.1906	0.0194		0.0684	0.0000	
PC	0.0365			0.1726	0.0000	
CREDIT	0.1304	0.0169		0.0507	0.0000	
PCOM	0.0995	0.0000		0.0001		
WT	1.0000	0.0033		0.0990	0.0000	
EX	0.2620	0.0000		0.0126		
EQUITY	0.5234	0.0000		0.0011		
HOUSE	0.0017			0.3749	0.0000	
RS	0.1589	0.0000				

DENMARK:

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0.4884	0.0011		0.0062		
CONS	0.1110	0.0001		0.0125		
INVT-B	0.3256	0.0002		0.0002		
INVT-R	0.2676	0.0000		0.0007		
PC	0.0174			0.1411	0.0000	
CREDIT	0.8171	0.0004		0.0014		
PCOM	0.1382	0.0000		0.0006		
WT	1.0000	0.0028		0.1820	0.0000	
EX	0.6643	0.0000		0.0019		
EQUITY	0.1716	0.0000		0.0026		
HOUSE	0.1799	0.0000		0.0034		
RS	0.2780	0.0000				

FINLAND

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0.4952	0.0030		0.0425		
CONS	0.1028	0.0458		0.0827	0.0000	
INVT-B	0.7700	0.0000		0.0022		
INVT-R	0.5333	0.0000		0.0003		
PC	0.2672	0.0084		0.1601	0.0000	
CREDIT	0.1604	0.1396	0.0000	0.2316	0.0000	
PCOM	0.1550	0.0000		0.0012		
WT	0.9999	0.0455		0.1104	0.0000	
EX	0.1984	0.0000		0.0017		
EQUITY	0.0394			0.0489		
HOUSE	0.9795	0.0121		0.0246		
RS	0.3993	0.0000				

FRANCE

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0,0461	0,0000		0,0255		
CONS	0,0323			0,0151		
INVT-B	0,3081	0,0000		0,0147		
INVT-R	0,2019	0,0000		0,0006		
PC	0,8818	0,2407	0,0000	0,0193		
CREDIT	0,9995	0,0000		0,0213		
PCOM	0,1510	0,0000		0,0027		
WT	1,000	0,0040		0,1458	0,0000	
EX	0,2269	0,0000		0,0293		
EQUITY	0,3368	0,0000		0,0102		
HOUSE	0,4551	0,0376		0,0357		
RS	0,2335	0,0000				

GERMANY

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0.1687	0.0007		0.0008		
CONS	0.1264	0.0011		0.0314		
INVT-B	0.1180	0.0000		0.0000		
INVT-R	0.2909	0.0007		0.0402		
PC	0.2358	0.1868	0.0000	0.1883	0.0000	
CREDIT	0.5630	0.0000		0.0001		
PCOM	0.0053			0.0000		
WT	0.6869	0.0009		0.3015	0.0000	
EX	0.9931	0.0000		0.0001		
EQUITY	0.2173	0.0000		0.0069		
HOUSE	0.1343	0.0765	0.0000	0.0537	0.0035	
RS	0.0407					

ITALY

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0,4330	0,0000		0,0000		
CONS	0,3862	0,0000		0,0000		
INVT-B	0,5362	0,0000		0,0036		
INVT-R	0,0284			0,0021		
PC	0,0629	0,2949	0,0000	0,0849	0,0011	
CREDIT	0,4113	0,0000		0,0212		
PCOM	0,2283	0,0000		0,0103		
WT	1,0000	0,0001		0,1234	0,0000	
EX	0,2035	0,0000		0,0914	0,0000	
EQUITY	0,1393	0,0001		0,0361		
HOUSE	0,0253			0,0150		
RS	0,2094	0,0000				

JAPAN

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0,0140			0,0050		
CONS	0,0018			0,0189		
INVT-B	0,3355	0,0070		0,0071		
INVT-R	0,1753	0,0000		0,0007		
PC	0,5603	0,0319		0,0920	0,0000	
CREDIT	0,9760	0,0084		0,0188		
PCOM	0,0415			0,0110		
WT	1,0000	0,0000		0,0084		
EX	0,0995	0,0000		0,0147		
EQUITY	0,2780	0,0000		0,0134		
HOUSE	0,2106	0,0525		0,0206		
RS	0,0064					

NETHERLANDS

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	1,0000	0,0001		0,0140		
CONS	0,2596	0,0149		0,1327	0,0000	
INVT-B	0,0545	0,0109		0,0000		
INVT-R	0,9094	0,0000		0,0000		
PC	0,0465			0,1073	0,0000	
CREDIT	1,0000	0,0356		0,0765	0,0000	
PCOM	0,0044			0,0000		
WT	1,0000	0,0024		0,0600	0,0000	
EX	0,9615	0,0000		0,0347		
EQUITY	0,8554	0,0000		0,0013		
HOUSE	0,5559	0,0059		0,0349		
RS	0,0491					

SPAIN

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0.0922	0.0721	0.0000	0.0733	0.0000	
CONS	0.1509	0.0004		0.1025	0.0000	
INVT-B	0.1525	0.0035		0.0136		
INVT-R	0.9474	0.0297		0.2402	0.0053	
PC	0.0032			0.0758	0.0000	
CREDIT	0.1776	0.0435		0.0334		
PCOM	0.3341	0.0000		0.0064		
WT	1.0000	0.0073		0.2264	0.0000	
EX	0.0036			0.0812	0.0000	
EQUITY	0.9997	0.0000		0.0329		
HOUSE	0.3432	0.0343		0.0410		
RS	0.3107	0.0000				

SWEDEN

Variable	LN	Δ(LN)	Δ(Δ(LN))	Δ_4(LN)	Δ(Δ_4(LN))	Δ(Δ(Δ_4(LN)))
GDP	0,1273	0,0007		0,0001		
CONS	0,2151	0,0054		0,0007		
INVT-B	0,0224	0,0014		0,0001		
INVT-R	0,2882	0,0040		0,0332		
PC	0,8810	0,0539		0,0619	0,0000	
CREDIT	0,0907	0,0156		0,0231		
PCOM	0,0390			0,0016		
WT	1,0000	0,0034		0,2196	0,0000	
EX	0,1026	0,0000		0,0038		
EQUITY	0,3036	0,0000		0,0227		
HOUSE	0,0771	0,0914	0,0000	0,0905	0,0000	
RS	0,2646	0,0000				

UNITED KINGDOM

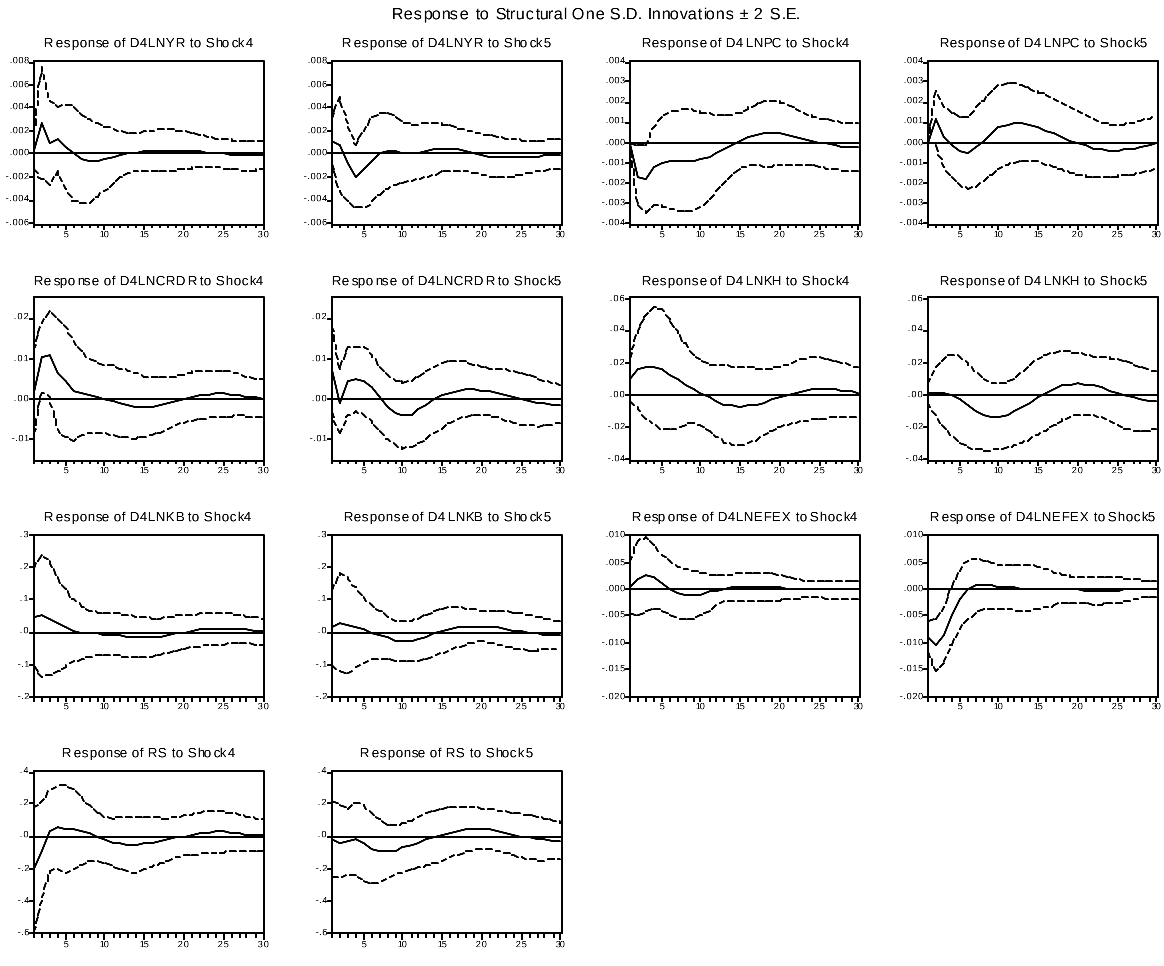
Variable	LN	Δ(LN)	$\Delta(\Delta$(LN))	Δ_4(LN)	$\Delta(\Delta_4$(LN))	$\Delta(\Delta(\Delta_4$(LN)))
GDP	0.7062	0.0000		0.0070		
CONS	1.0000	0.0257		0.0184		
INVT-B	0.7087	0.0000		0.0146		
INVT-R	0.0938	0.0000		0.0000		
PC	0.0049			0.2464	0.0000	
CREDIT	0.5728	0.0071		0.0190		
PCOM	0.0757	0.0000		0.0081		
WT	0.9999	0.0164		0.1425	0.0000	
EX	0.2468	0.0000		0.0294		
EQUITY	0.0938	0.0000		0.0448		
HOUSE	0.3381	0.0073		0.0213		
RS	0.1022	0.0000				

Appendix C: Impulse Responses of all Seven Endogenous Model Variables to Standardized Shocks in HOUSE and EQUITY

<u>Legend:</u>

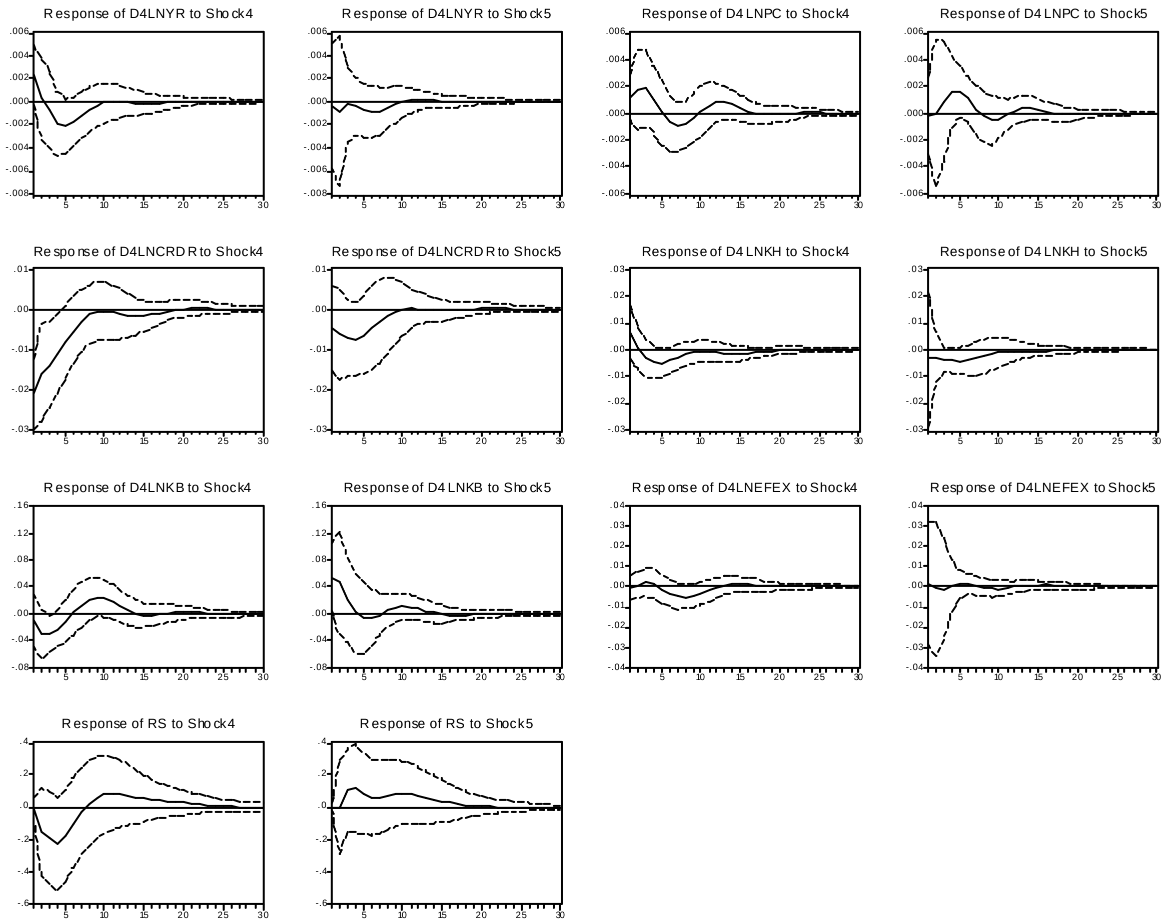
Shock 4:	Housing Price Shock
Shock 5:	Equity Price Shock
D4LNYR:	GDP
D4LNPC:	PC
D4LNCRDR:	CREDIT
D4LNKH:	HOUSE
D4LNKB:	EQUITY
D4LNEFEX:	EX
RS:	RS

AUSTRIA

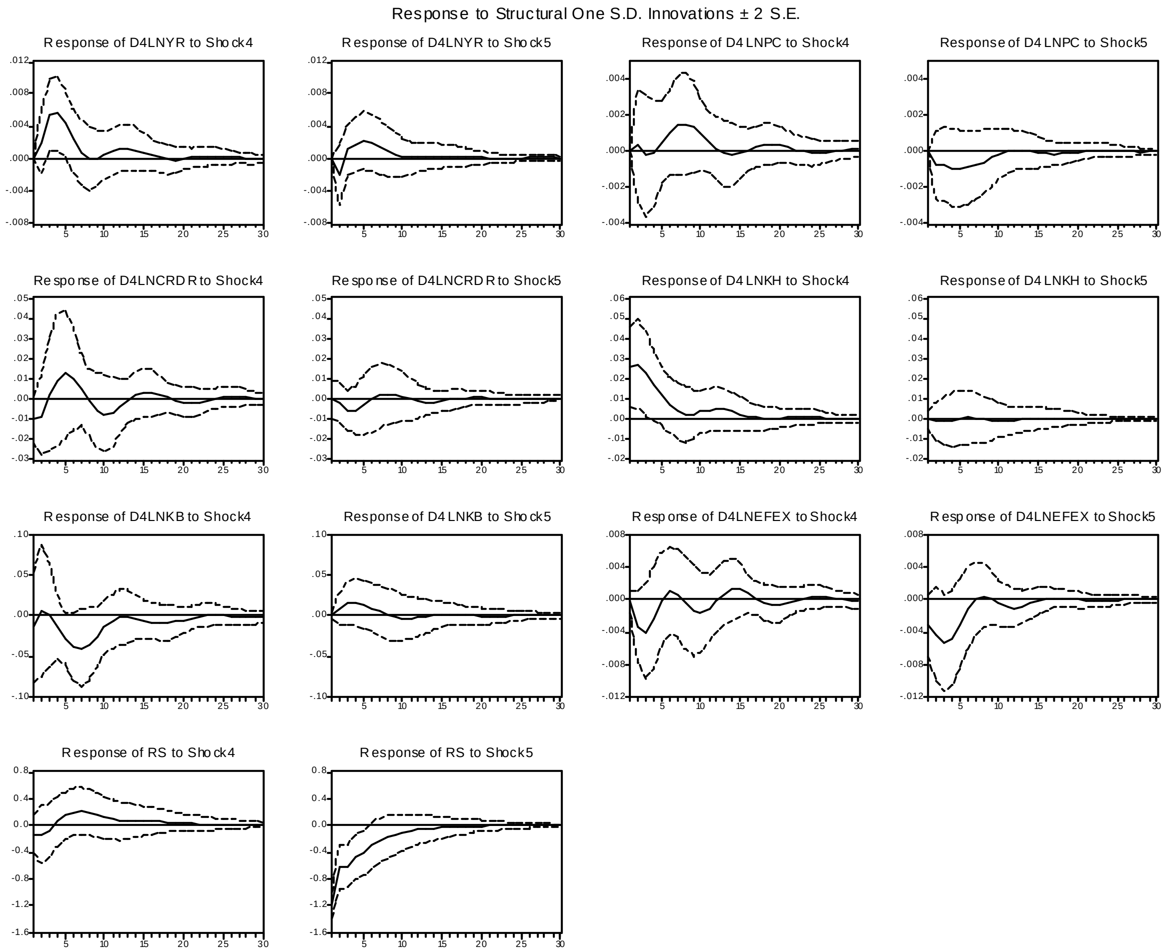


BELGIUM

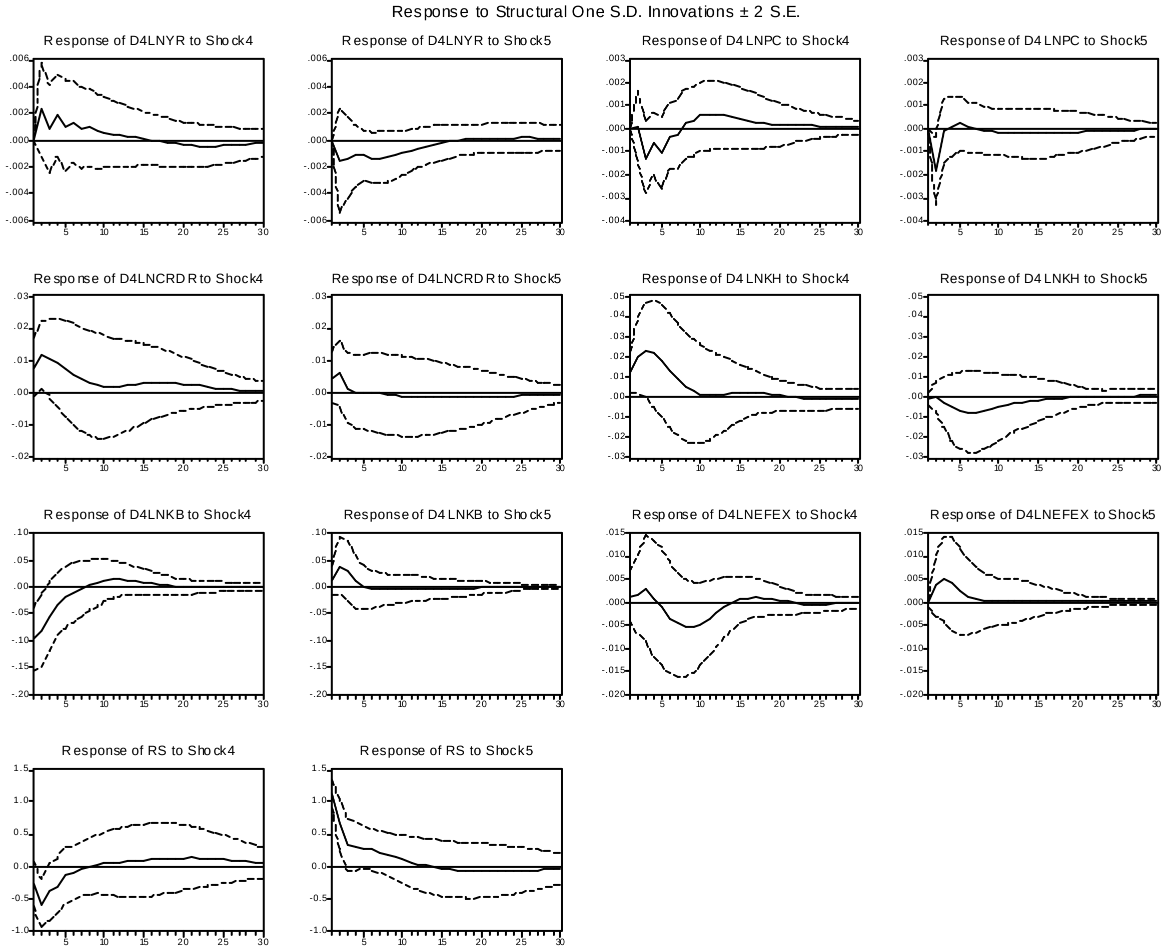
Response to Structural One S.D. Innovations ± 2 S.E.



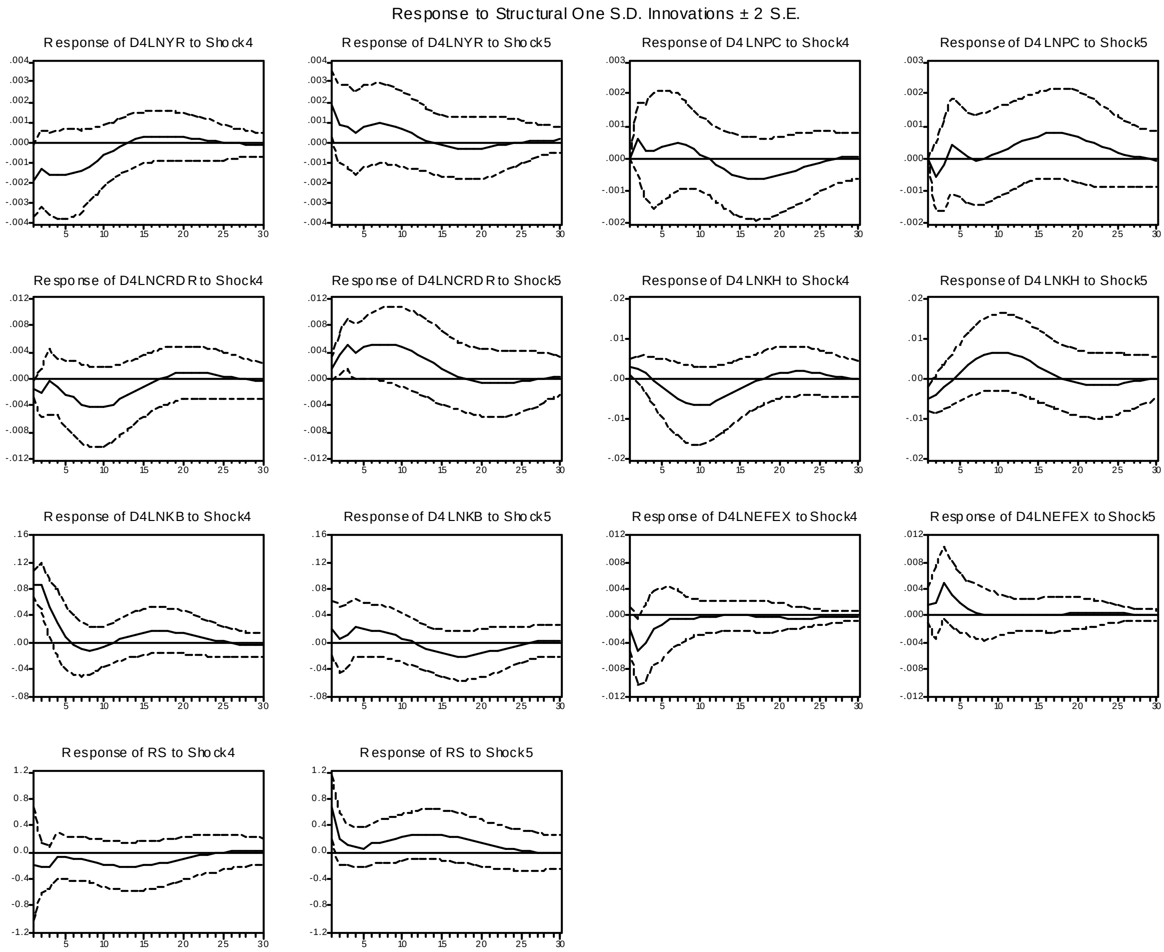
DENMARK


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

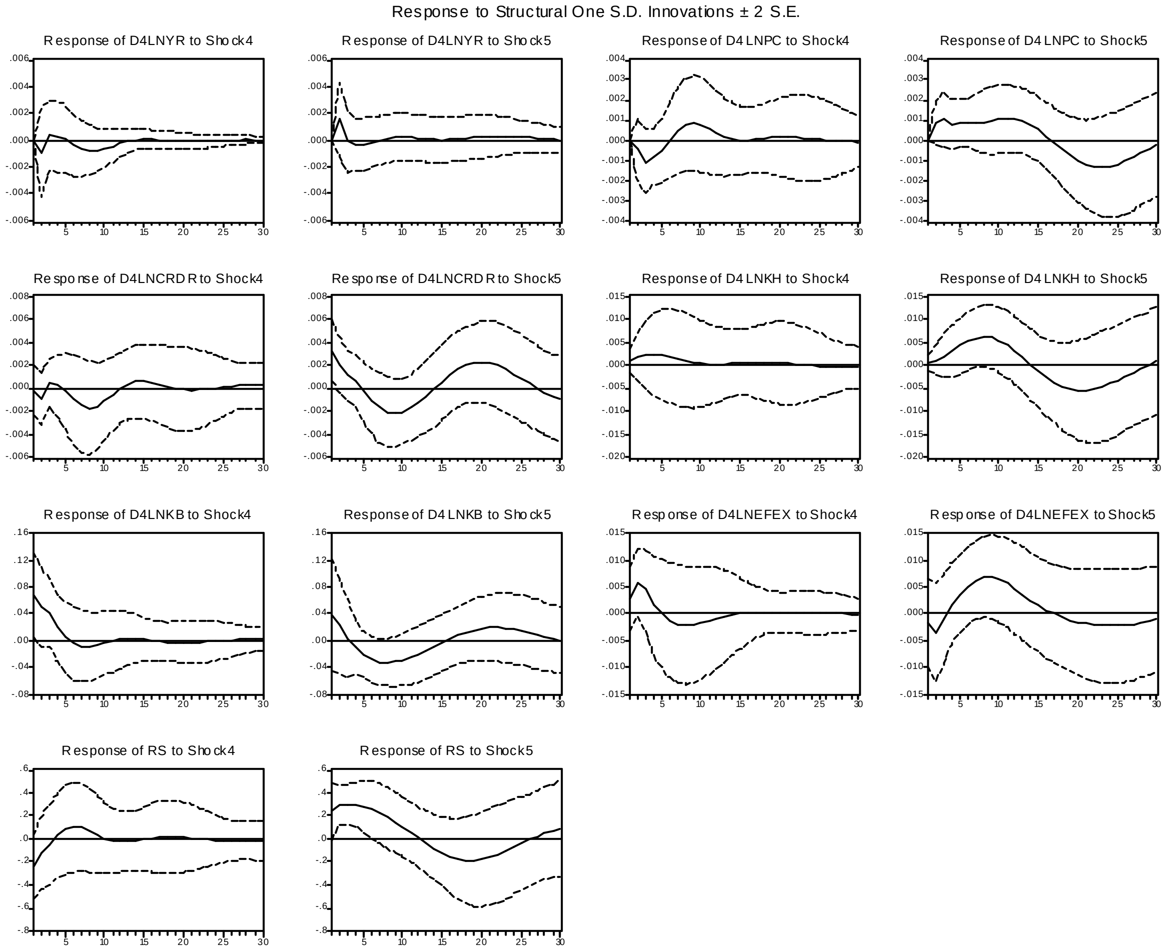
FINLAND


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

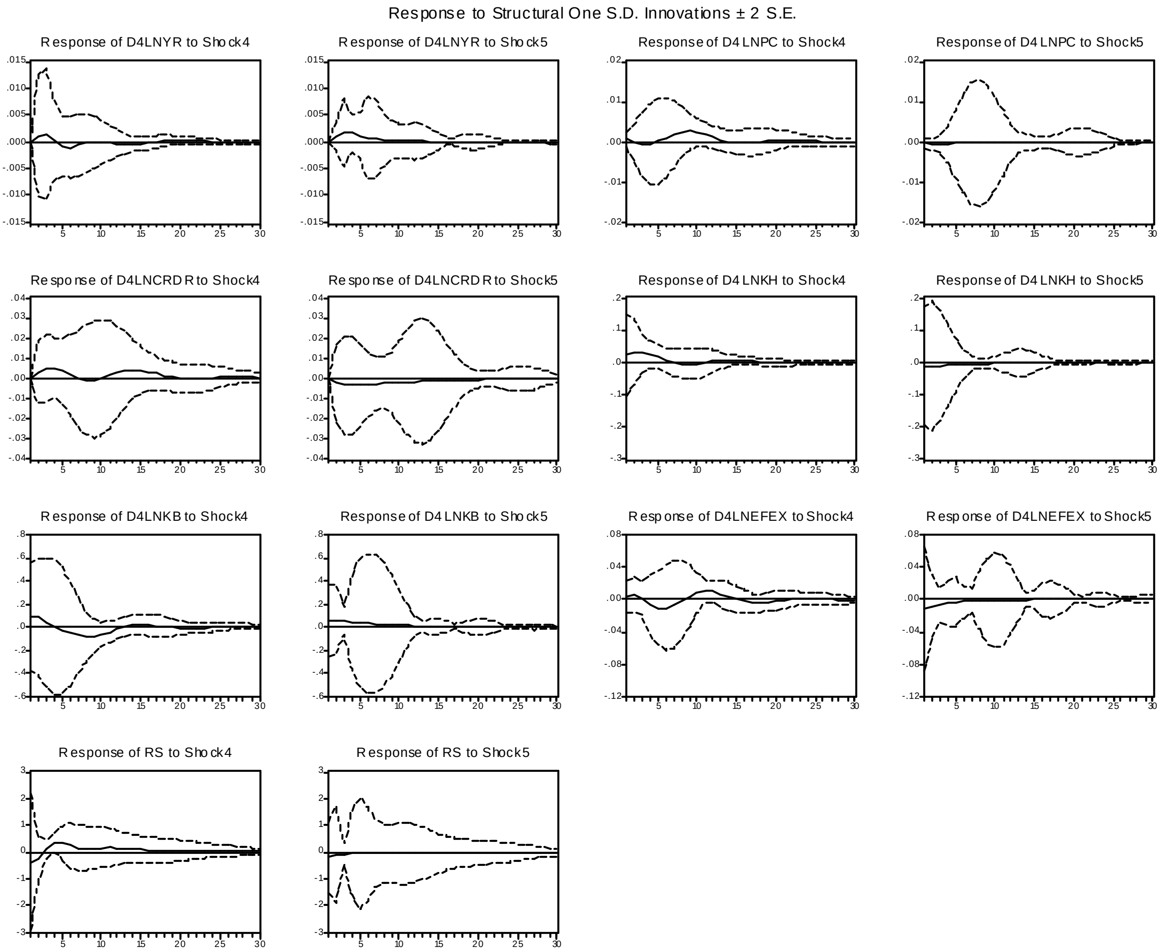
FRANCE


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

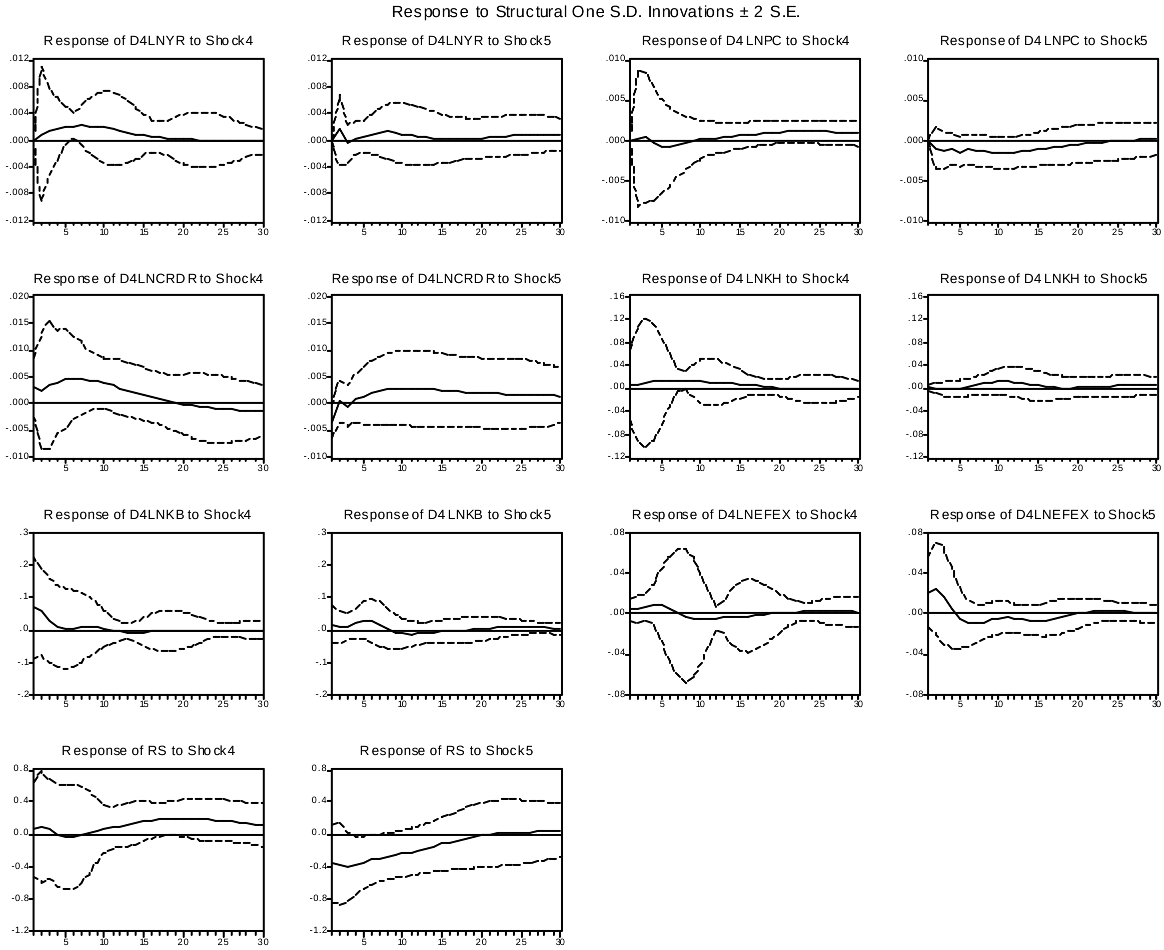
GERMANY


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

ITALY

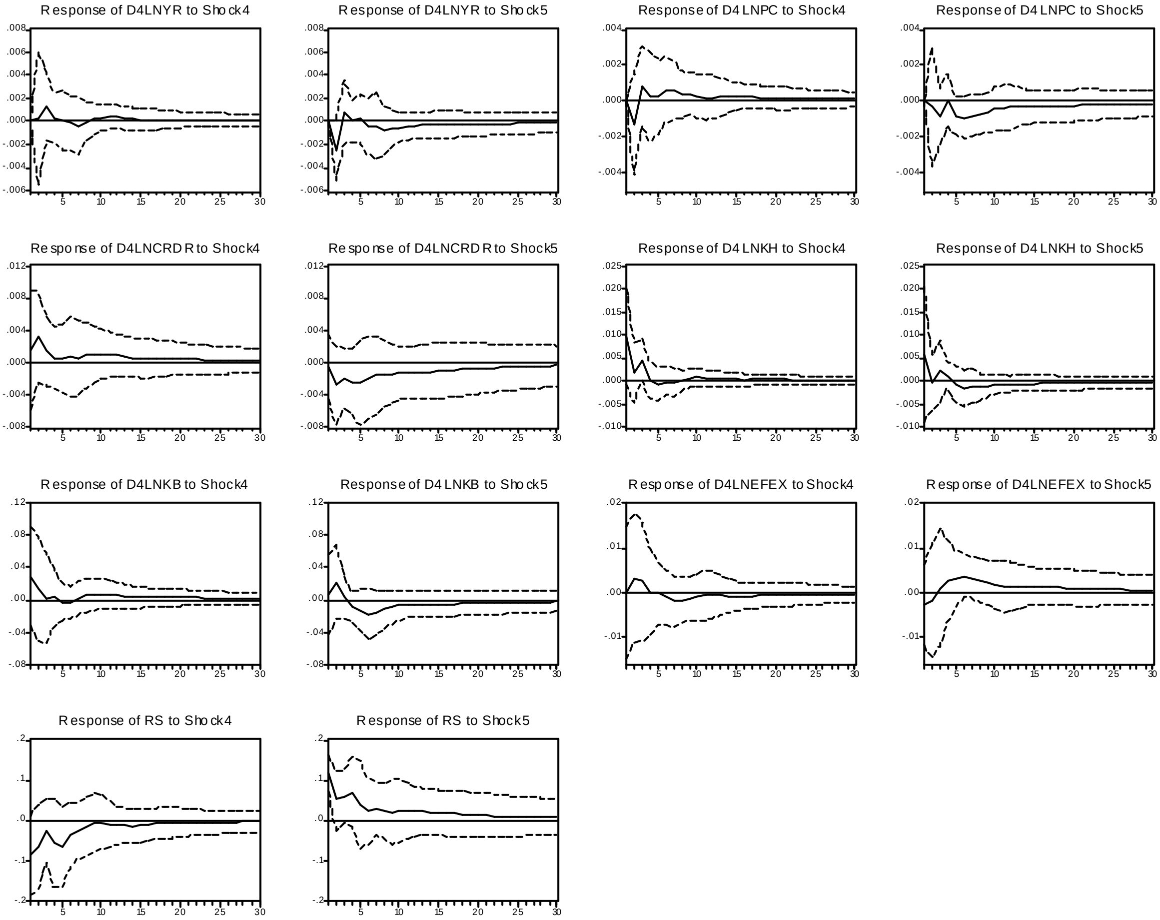

Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

JAPAN

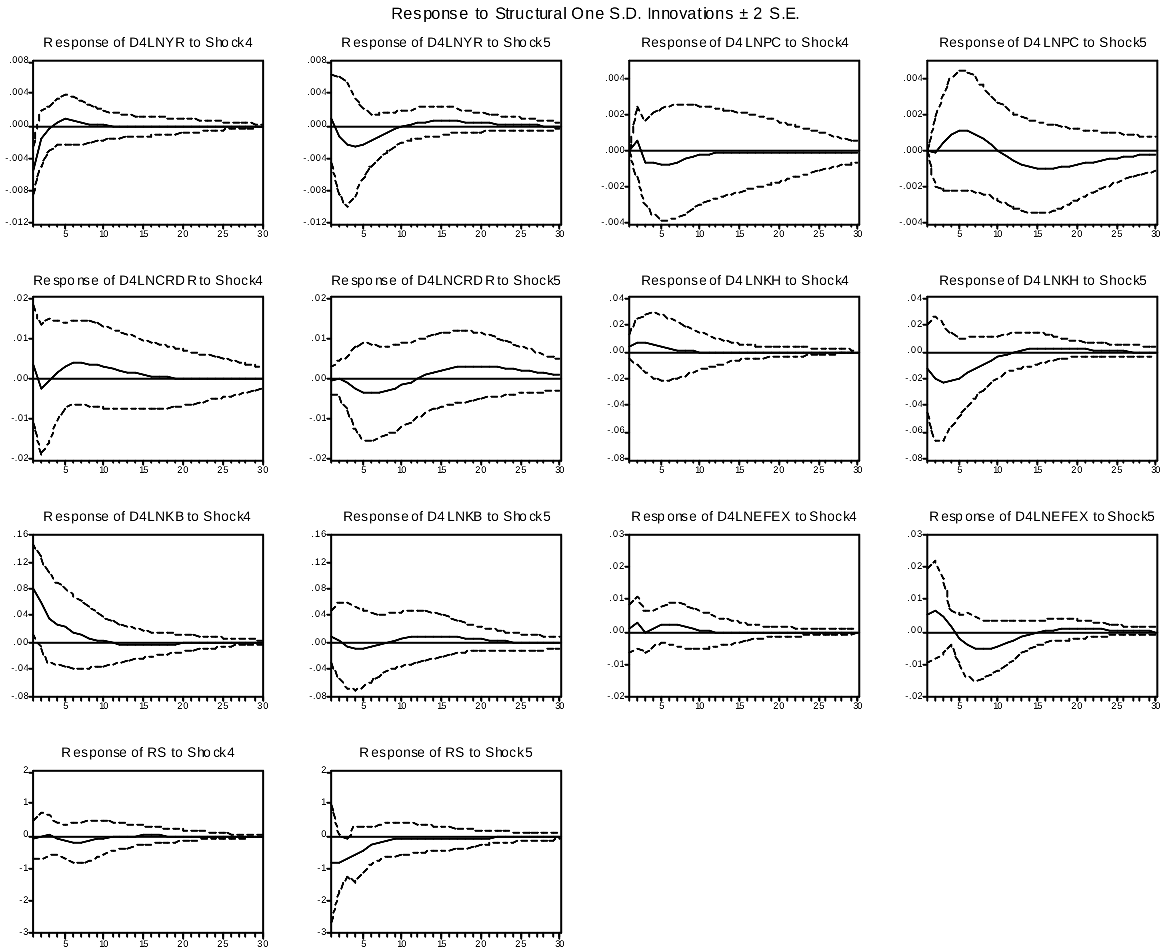

Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

NETHERLANDS

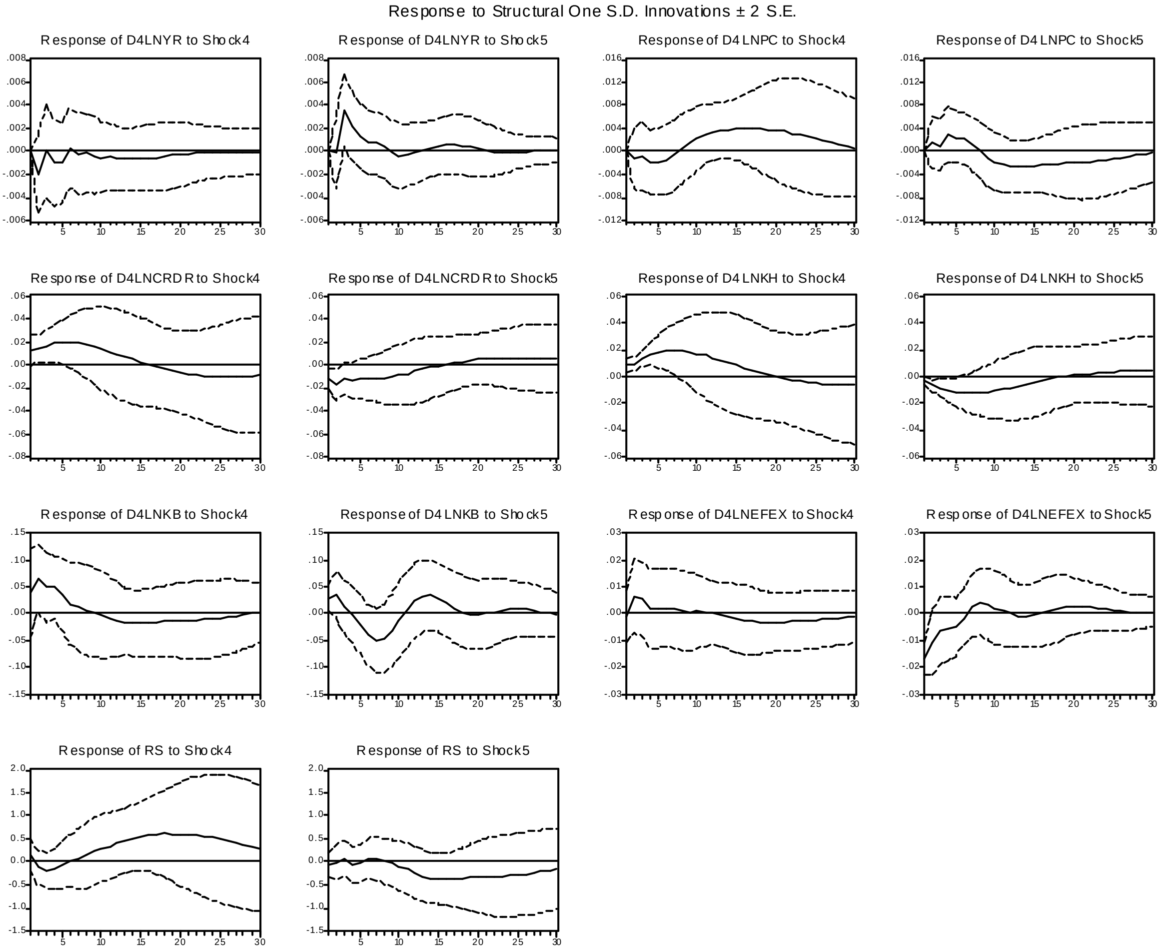
Response to Structural One S.D. Innovations ± 2 S.E.



SPAIN


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

SWEDEN


Response to Structural One S.D. Innovations ± 2 S.E.
Response of D4LNYR to Shock4
Response of D4LNYR to Shock5
Response of D4LNPC to Shock4
Response of D4LNPC to Shock5
Response of D4LNCRDR to Shock4
Response of D4LNCRDR to Shock5
Response of D4LNKH to Shock4
Response of D4LNKH to Shock5
Response of D4LNKB to Shock4
Response of D4LNKB to Shock5
Response of D4LNEFEX to Shock4
Response of D4LNEFEX to Shock5
Response of RS to Shock4
Response of RS to Shock5

UNITED KINGDOM

Response to Structural One S.D. Innovations ± 2 S.E.

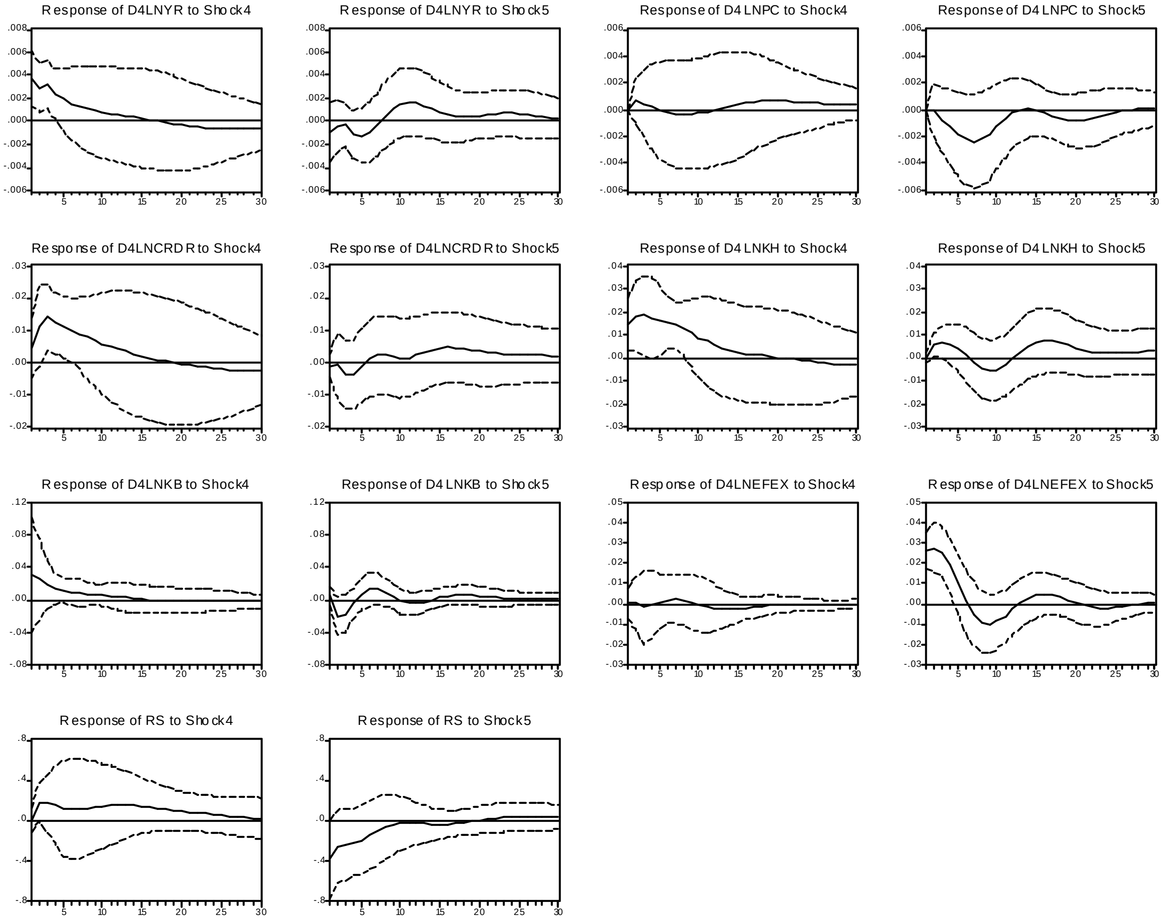


TABLE 1a
Responsiveness of real GDP (and components) to house price shocks, and country characteristics

	Home ownership		Mortgage debt over GDP		Mortgage debt over total liabilities households	
Real GDP						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	-0.049	-0.154	0.422	0.518*	0.228	0.178
8	0.024	-0.028	0.426	0.497*	0.259	0.250
12	0.073	-0.028	0.359	0.497*	0.263	0.250
Real Consumption						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	-0.255	-0.235	0.428	0.370	-0.080	-0.321
8	0.400	0.421	0.191	0.211	0.146	0.143
12	0.586**	0.540*	-0.016	0.116	0.039	0.142
Real nonresidential business investment						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	-0.037	0.045	0.215	0.165	-0.431	-0.428
8	0.277	0.182	0.066	0.218	-0.158	0.000
12	0.333	0.284	0.038	0.112	0.114	0.143
Real residential investment						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	-0.115	0.000	0.247	0.278	0.249	0.535
8	-0.116	0.080	0.153	0.173	0.101	0.357
12	-0.219	0.119	0.144	0.088	0.117	0.357

TABLE 1b
Responsiveness of real GDP (and components) to share price shocks, and country characteristics

	Share ownership households		Equity dependence firms		Stock market capitalization	
Real GDP						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	-0.202	-0.095	-0.229	-0.143	-0.227	-0.244
8	-0.194	-0.180	-0.259	-0.333	-0.119	-0.097
12	-0.253	-0.261	-0.287	-0.166	0.129	0.014
Real Consumption						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	0.160	0.500	0.348	0.452	0.150	0.007
8	-0.023	0.142	0.010	0.047	0.238	-0.021
12	0.116	0.404	0.200	0.261	0.396	0.125
Real nonresidential business investment						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	0.305	0.238	0.160	0.285	-0.158	-0.083
8	0.210	0.095	-0.018	0.238	-0.063	-0.147
12	0.225	0.119	-0.001	0.214	0.272	0.251
Real residential investment						
	Correlation	Spearman	Correlation	Spearman	Correlation	Spearman
4	-0.178	-0.500	-0.378	-0.404	0.432	-0.126
8	-0.409	-0.452	-0.598	-0.309	0.529*	0.104
12	-0.345	-0.524	-0.469	-0.476	0.517*	0.174

Table 2: Variance Decompositions of Monetary Policy (RS)
for each of the 12 Countries at Horizons of 4, 8, 12, 20, and 30 Quarters

Austria

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.260612	4.172639	7.272319	18.46475	**20.31636**	**1.176491**	44.87394	3.723503
8	0.285054	5.096122	5.366743	12.9127	**14.24817**	**6.907663**	44.80479	10.66382
12	0.295614	5.005214	5.258591	12.33219	**13.95229**	**9.984699**	42.19258	11.27444
20	0.310725	5.090769	4.76234	13.26639	**14.24093**	**10.34892**	41.02928	11.26137
30	0.316474	5.05152	4.647944	13.47534	**14.20227**	**10.84727**	40.52288	11.25277

Belgium

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.114967	82.53011	5.29002	2.316047	**6.501385**	**1.398924**	0.920618	1.042892
8	0.13913	72.69753	10.78551	3.535885	**7.739768**	**2.169137**	0.796744	2.27542
12	0.15097	69.73559	10.41516	4.735754	**8.441299**	**3.281077**	1.068424	2.322695
20	0.152054	68.48461	10.16834	4.947382	**9.033852**	**3.556686**	1.522337	2.286794
30	0.152139	68.44572	10.16291	4.949149	**9.073258**	**3.553789**	1.53001	2.285159

Denmark

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.143769	1.514839	8.492925	4.022569	**1.385665**	**82.29176**	1.020912	1.271335
8	0.190686	1.84387	8.53776	3.868607	**5.178064**	**77.49422**	1.967987	1.109494
12	0.197426	1.830947	9.806121	3.852837	**6.170494**	**75.31404**	1.948407	1.077156
20	0.20169	2.026409	9.849694	3.914085	**6.758265**	**74.31907**	2.066587	1.065894
30	0.20223	2.043586	9.864059	3.921942	**6.814493**	**74.216**	2.07461	1.065312

Finland

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.228866	3.424134	0.732807	5.179498	**21.26288**	**63.34141**	1.447606	4.611668
8	0.245115	11.49228	0.628427	5.395119	**16.45369**	**52.06733**	2.321628	11.64152
12	0.24963	10.24002	1.51492	8.807154	**12.05639**	**38.31546**	6.984217	22.08183
20	0.253834	6.667277	3.880781	10.48689	**8.601347**	**24.26466**	19.03083	27.06822
30	0.253962	6.352756	4.429958	10.88351	**8.623995**	**21.8213**	21.02426	26.86422

France

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.18886	3.030831	15.77886	40.71122	**5.968221**	**21.01219**	6.133739	7.364945
8	0.203658	2.395052	13.22344	37.18693	**5.772916**	**17.63577**	13.50034	10.28554
12	0.215935	1.922407	10.51215	31.66478	**7.794768**	**19.09415**	15.26614	13.7456
20	0.236792	2.053444	8.900269	26.58944	**11.30313**	**23.59605**	13.71937	13.8383
30	0.240174	2.265497	9.218731	26.21993	**11.30617**	**23.66194**	13.66458	13.66315

Germany

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.155661	6.488601	3.610827	4.035196	**12.5804**	**50.22786**	1.56894	21.48818
8	0.181029	10.18301	11.20897	8.405406	**8.414557**	**41.5335**	2.998827	17.25573
12	0.201752	9.423543	11.77477	8.924921	**7.641554**	**39.14979**	5.363389	17.72203
20	0.215217	7.456805	19.93674	13.87253	**5.258582**	**34.87786**	5.199661	13.39782
30	0.227298	7.055928	20.21663	13.48507	**4.689617**	**33.87464**	7.340842	13.33728

Italy

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.259861	11.90182	27.47683	9.191046	**18.14351**	**2.67763**	27.65954	2.949629
8	0.346923	10.06227	38.32229	8.890621	**17.23533**	**1.846983**	17.70088	5.941629
12	0.367845	9.360577	40.29441	8.394112	**17.57505**	**1.967124**	15.93881	6.469912
20	0.372195	9.151451	40.94563	8.152308	**18.01497**	**2.157103**	14.84351	6.735023
30	0.373023	9.099422	41.00198	8.077396	**18.13384**	**2.203474**	14.66537	6.818527

Japan

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.142134	0.402136	14.29148	1.621167	**1.231311**	**50.54323**	27.42621	4.484464
8	0.198508	1.030121	12.24563	2.914983	**1.009079**	**55.72885**	22.09516	4.97618
12	0.213373	0.943467	11.14183	2.696017	**1.866399**	**57.23192**	19.68325	6.437109
20	0.222691	4.102029	8.954475	2.428024	**9.375705**	**44.68188**	16.47557	13.98232
30	0.226918	12.66061	12.03234	1.695926	**12.11319**	**30.03641**	13.59356	17.86796

Netherlands

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.093169	19.08197	1.375861	2.665128	**12.00385**	**18.26322**	21.42743	25.18254
8	0.126983	17.38157	1.429614	1.893992	**11.66374**	**14.04705**	16.36423	37.21981
12	0.138805	16.64482	1.314706	1.741363	**10.4177**	**13.22681**	20.10746	36.54713
20	0.148983	17.33761	1.291532	1.637027	**9.649488**	**12.66525**	19.94468	37.47442
30	0.153028	17.48608	1.290196	1.585095	**9.360323**	**12.45949**	20.1225	37.69632

Spain

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.235535	10.71933	6.55111	17.82286	**0.485747**	**52.68627**	10.24891	1.485772
8	0.260305	10.71679	21.20794	14.32399	**2.116707**	**33.43423**	16.32087	1.879476
12	0.266521	11.2624	22.68496	13.87634	**2.01789**	**29.70026**	18.0987	2.359457
20	0.271091	11.0055	23.72204	13.8434	**1.921001**	**28.7712**	18.25564	2.481223
30	0.271387	10.94125	23.85828	13.82741	**1.909834**	**28.70397**	18.22387	2.53539

Sweden

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.216288	1.039502	9.911777	6.53831	**4.750424**	**0.703448**	65.85831	11.19822
8	0.261322	1.336651	21.88355	8.064182	**3.483086**	**0.662762**	50.45297	14.1168
12	0.278853	3.072587	18.33877	8.405711	**11.39481**	**2.740457**	43.88985	12.1578
20	0.30123	15.57536	11.87153	5.381242	**29.85616**	**11.16794**	20.3881	5.759666
30	0.308239	22.38828	13.84844	3.513174	**30.9775**	**10.85613**	13.70414	4.712345

United Kingdom

Horizon	Total Var.	GDP	PC	CREDIT	**HOUSE**	**EQUITY**	EX	RS
4	0.100651	2.578189	11.61172	3.820261	**4.277318**	**16.37516**	59.30746	2.029883
8	0.112728	2.421289	8.677664	16.15453	**4.614136**	**13.7965**	48.7228	5.613092
12	0.11856	2.570842	7.735574	20.47476	**6.476601**	**12.36583**	44.758	5.618398
20	0.128571	2.680905	11.22454	19.72518	**9.301392**	**11.42092**	40.52304	5.124028
30	0.131185	2.683911	17.10875	19.07997	**8.966585**	**10.5063**	36.65848	4.995999

FIGURE 1a
Cumulative Impulse-Response of real GDP to standardized shock to house prices

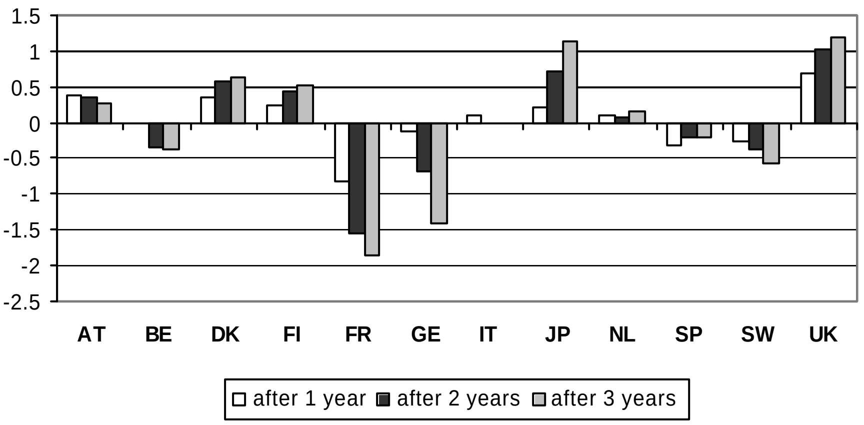


FIGURE 1b
Cumulative Impulse-Response of real GDP to standardized shock in share prices

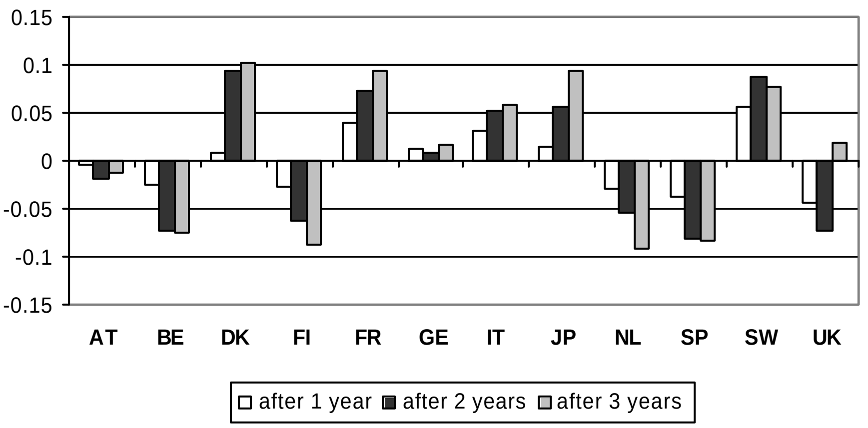


FIGURE 2a
Cumulative Impulse-Response of real consumption expenditure to standardized shock in house prices

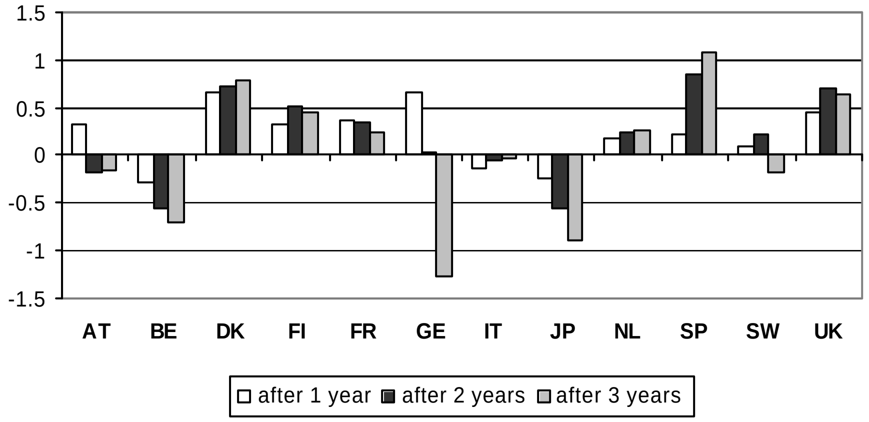


FIGURE 2b
Cumulative Impulse-response of real consumption expenditure to standardized shock in share prices

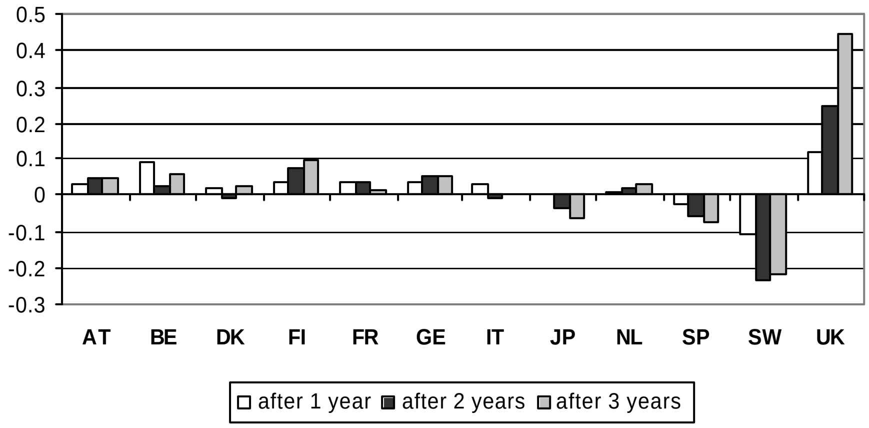


FIGURE 3a
Cumulative Impulse-Response of real residential investment to standardized shock in house prices

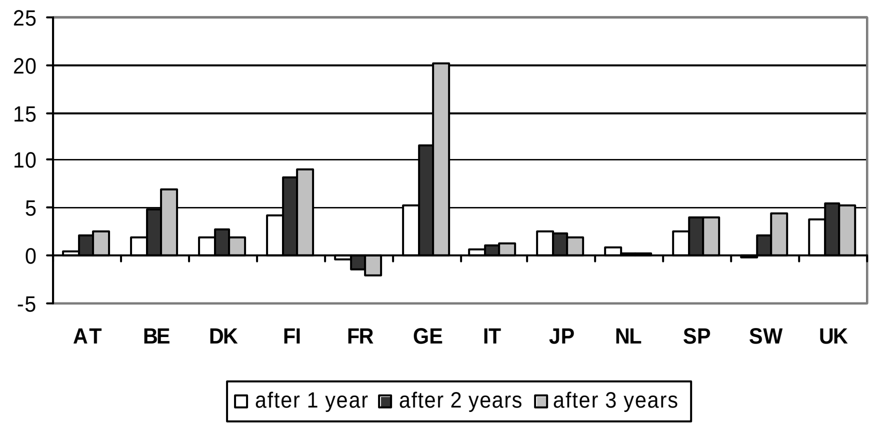


FIGURE 3b
Cumulative Impulse-Response of real residential investment to standardized shock in share prices

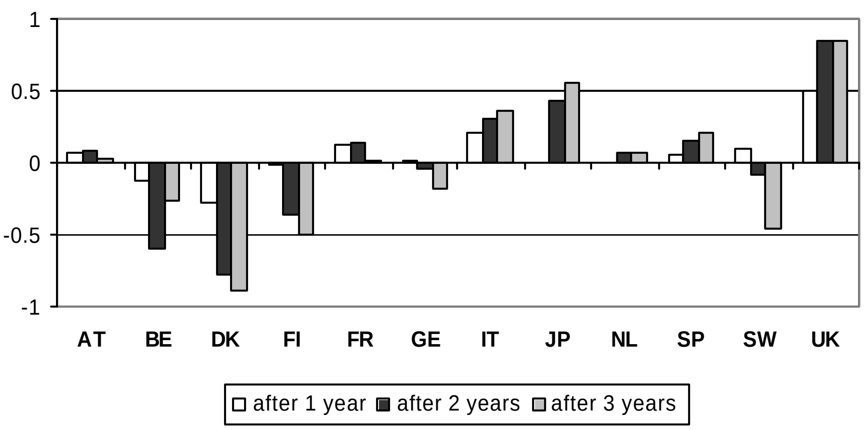


FIGURE 4a
Cumulative Impulse-Response of real business investment to standardized shock in house prices

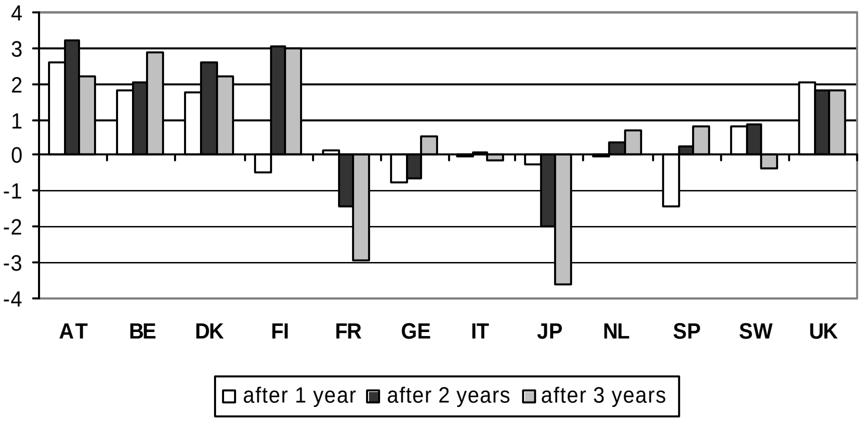


FIGURE 4b
Cumulative Impulse-response of real business investment to standardized shock in share prices

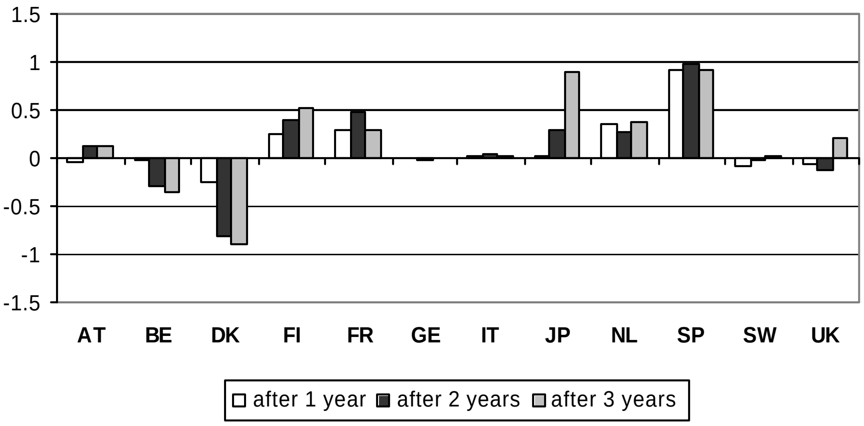


FIGURE 5
Cumulative impulse-responses of consumption
and residential investment to house price shocks