Housing Finance, Housing Shocks and the Business Cycle: Evidence from OECD Countries[1]

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Preliminary. Comments Welcome.

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Abstract

This paper quantifies the role of the housing sector in the business cycle of advanced economies. We identify housing demand and supply shocks in a standard monetary VAR model augmented with a housing sector, by combining sign restrictions with conventional exclusion restrictions. We estimate the relative importance of housing shocks for consumption, house prices and residential investment, and relate them to an index of housing finance development, as well as a few other variables possibly explaining their cross country variation. The main findings of the paper are as follows: (i) Housing shocks (demand and supply combined) explain about 20 percent of consumption variance in the typical OECD economy over a three-year forecast horizon, and their importance seems to have increased over time. There is however a strong heterogeneity across countries; (ii) housing demand shocks are much more important than housing supply shocks for consumption volatility and are also transmitted in a qualitatively different manner; (iii) the distribution of housing shocks in the cross section of countries we consider is associated with the degree of mortgage market development; and (iv) contrary to conventional wisdom, the global imbalances do not seem to have had a large role on the boom-bust cycle of the typical OECD economy. We interpret this evidence as consistent with housing finance innovation having amplified the spillovers from the housing sector to the rest of the economy over the last two decades in these economies by strengthening the role of housing as collateral for non-housing consumption, via house prices.

I. Introduction

The recent boom and bust in house prices and residential investments in many advanced countries has ignited a debate on the link between housing and the business cycle---e.g., Leamer (2007) for instance. At the same time, over the last two decades, the national systems of housing finance of the most advanced economies have undergone dramatic changes, adding to the uncertainty on the link between housing and economic activity. By increasing the availability and lowering the cost of housing finance, these changes have contributed to the spectacular growth of mortgage debt in a number of countries that reformed their housing finance systems more aggressively.

This paper quantifies the role of the housing sector in the business cycle of advanced economies and investigates the extent to which the varying importance of housing shocks across countries can be traced to differences in the national systems of housing finance.

The level of development of the system of housing finance is summarized via a summary index that captures the depth and flexibility of mortgage markets, and in particular the extent to which fluctuations in the value of housing as a collateral can be translated into households' borrowing. Components of such index are the loan to value ratios, the possibility (or lack thereof) of mortgage equity withdrawal, the ability to refinance the mortgage at no penalty for prepayment, and the average mortgage maturity.

To quantify the importance of the housing sector for the business cycle, we identify housing demand and housing supply shocks in a standard monetary VAR model by combining sign restrictions with conventional exclusion restrictions. To control for the possibility that housing shocks pick up business cycle variability ultimately caused by the global imbalances rather than a home grown housing sector dynamics, we identify also a global liquidity shocks by adding a measure of global liquidity to these VAR. The estimated relative importance of housing shocks for consumption variability are then related to the index housing finance development constructed and a few other variables possibly explaining the cross country variation in the incidence of the housing sector on the business cycle of these economies.

Relative to the booming literature on housing and the business cycle, the main contribution of this paper is twofold. First, it focuses on the housing sector as a source of volatility in the broader economy, as opposed to housing as a channel of transmission of

other shocks, such as monetary policy shocks or productivity shocks, thereby providing clear causal statements about the role of housing in the business cycle as opposed to documenting only statistical associations. Second, it addresses the issue above from a broad cross-country perspective, rather than focusing on a single or just a few countries. The paper provides evidence for the typical OECD economy, based on panel estimates that may be useful in developing new models of the housing sector and the business cycle, as well as an investigation of the large differences across individual countries that are encountered.

Our main empirical findings are as follows. First, we find that more developed housing finance systems are associated with a larger share of housing shocks in consumption variability. Second, we find clear evidence of an increased importance of housing shocks in consumption volatility over time, which is consistent with the generalized transition toward more liberalized and innovative mortgage markets across all the countries considered. Interestingly, the time changes in the incidence of housing demand shocks on consumption variability are more pronounced in those countries that score highest in our index.

Third, we find that housing supply shocks have a distinct transmission mechanism from housing demand shocks: while the former have small permanent effects on GDP and consumption, the latter have temporary, but much stronger effects. While both types of shocks affect residential investments significantly, only housing demand shocks have significant impact on house prices as well as a spillover to the broader economy at business cycle forecast horizons. In addition, while housing demand shocks have a hump-shaped impact on residential investment and house prices, housing supply shocks decay monotonically. Furthermore, the distribution of housing supply shocks in the cross section of countries we consider is also different from the distribution of housing demand shocks.

Fourth, we find that monetary policy reacts positively and significantly to housing demand shocks, whereas it barely responds to shocks that originate from the supply side of the market. Finally, we find that the global liquidity shock that we identify has had a negligible importance for output and consumption volatility in the typical OECD economy over the past two decades or so, even though we find that an increase in global liquidity can lower short-term interest rates significantly. Thus, contrary to much common wisdom, we find that although the global imbalances may have contributed to generate a low-interest rate environment in the typical OECD economy, this has had a very limited role in explaining the

recent boom-bust cycle in the housing sector and the associated spillover to the broader economy.

We interpret our empirical findings as consistent with a view that assigns to housing as a collateral a key role in affecting households' ability to borrow, and to extract equity from the changing value of the collateral (see for instance Mullbauer and Murphy, 2008). Three results clearly point in that direction: first, the observed evidence that housing *demand* shocks, rather than *supply* shocks, are particularly important for consumption. In other words, it is those shocks that drive house prices up during an upturn that induce an expansion in housing collateral values, and therefore boost households' ability to borrow, extract equity, and in turn expand non-housing consumption. Second, our evidence that the role of housing demand shocks in explaining the variability of consumption is stronger in those countries where the degree of mortgage market development/flexibility is higher. Third, the fact that such role has increased over time, paralleling the process of mortgage market liberalization in several countries.

This interpretation can be cast within a relatively simple dynamic stochastic general equilibrium model of the business cycle with a stylized representation of the housing sector in which the expected value of the housing stock serves as collateral against current borrowing for non-housing consumption.[2] In such models, the increased use of housing as collateral for non-housing borrowing strengthens the feedback effect from house prices to non-housing consumption via increased higher collateral for borrowing, thereby amplifying the spillovers effects from the housing sector to the rest of the economy. We see the quantitative analysis of a similar DSGE model reproduce the evidence documented in this paper, as well as the analysis of optimal monetary policy in such an environment, as a fruitful area for future research.

Two strictly related papers to ours are the one of Smets and Jarocinski (2007), who analyze the role of housing demand shocks identified in a way similar to ours, and Calza, Stracca, and Monacelli (2008), who focus on monetary policy shocks. There are four main differences with respect to the paper of Smets and Jarocinski (2007). First, we look at both housing demand and supply shocks; second, we look at a broad set of countries rather than

[2] See for instance Calza et al. (2008) and Iacoviello and Neri (2008).

the US only; third, we analyze the effects of housing shocks not only on output, house prices and residential investment, but also on consumption; fourth, we relate the relative incidence of housing shocks across countries to the structure of housing finance. Compared to Calza, Stracca, and Monacelli (2008), this paper focuses on housing as a source of shocks, as opposed to housing as part of the transmission mechanism of monetary policy.

The rest of the paper is structured as follows. Section II provides a brief review of changes in housing finance in advanced economies over the last two decades, together with a description of an index that aims at describing the cross-country differences in the present level of mortgage market development. Section III describes the econometric model we use in the analysis and reports the empirical results on the typical OECD economy. Section IV documents and discusses the strong heterogeneity we find this cross section of OECD economies and also attempts at explaining it with the proposed index of mortgage market development. Section V concludes.

II. Developments in Housing Finance

Over the past 30 years, housing finance systems in many advanced countries have undergone profound changes. Until the 1980s, mortgage markets were generally highly regulated. Mortgage lending was dominated by specialized lenders, facing limited competition in segmented markets—typically depository institutions such as savings and loan associations in the United States and building societies in the United Kingdom. Regulations included interest rates ceilings and quantitative limits on mortgage credit and repayment periods. These regulations resulted in chronic or temporary credit rationing in the mortgage market, and made it difficult for households to access mortgage credit (Girouard and Blöndal, 2004).

Deregulation of mortgage markets beginning in the early 1980s unleashed competitive pressures from non-traditional lenders, forcing all players to provide better pricing and to extend the range of services offered to households, thus facilitating their access to mortgage credit. The process of deregulation, however, took various forms in different countries (Lea and Diamond, 1992).

In the United States, the deregulation of housing finance markets coincided with the phasing out of interest rate controls under regulation Q in the early 1980s (Wachter and Green, 2007). Together with the development of a secondary mortgage market—which greatly facilitated the funding of mortgage lending via capital markets—this prompted banks and other financial institutions to enter the mortgage market. In the United Kingdom, deregulation occurred mainly via the abolition of credit controls ("the corset") in the mid 1980s, which heightened competitive pressures in the mortgage market. In Canada, Australia and the Nordic countries, deregulation of housing financial markets was also relatively rapid, and almost completed by the mid-1980s.

In all these countries, the process of deregulation opened the way to more competition into credit market and hence easier access to mortgage credit. As an example, in the United States, Canada and Australia, and the Netherlands, the share of the total household sector's outstanding loans issued by non-banking financial institutions was twice as large in 2005 compared to the average over the period 1980-1990, while mortgage credit grew very rapidly over the same period in the countries at the forefront of the liberalization process (Figure 2).

By contrast, in some continental European countries and Japan, the reform process was slower and/or less comprehensive. To be sure, restrictions on interest rates were gradually removed and barriers to entry into mortgage markets eased also in Germany, France and Italy. However, the continued dominance of public-sector financial institutions in the residential mortgage market in these countries hampered the liberalization process: on average in these countries, non-banking financial institutions accounted for about 1 percent of total outstanding loans to the household sector in 2005 (only slightly up from the mid 1990s), compared to about 30 percent in the United States (Figure 1), and mortgage credit in these countries did not rise as fast as in the previous set of countries (Figure 2). In Japan, the removal of interest rate and credit controls began in the early 1980s, but was not completed until the mid-1990s. Perhaps as a result, non-banking financial institutions accounted for a significant share of the total loan outstanding, but mortgage debt grew much slower than in faster liberalizing countries.

Following the process of deregulation outlined above, mortgage markets in advanced countries have all moved towards a more competitive housing finance model—where households have easier access to housing credit (Jappelli, 1992). Despite this common trend, significant cross-country differences in mortgage contracts remain—reflecting the uneven progress in liberalizing mortgage markets discussed above as well as more deep-seated differences in the legal systems of these countries as well as regulatory structures.[3]

In order to summarize cross-country differences in institutional features of the mortgage markets and thus in households' ability to access housing-related financing, we constructed a synthetic index of mortgage market development as a simple average of five indicators: the typical loan to value ratios, the standard length of mortgage loans, the availability of mortgage equity withdrawal, the existence of refinancing options, and the development of secondary markets for mortgage loans. In particular, high LTV ratios and longer repayment terms allow borrowers to take out more debt while keeping debt service-to-income ratios affordable. The ability to borrow against accumulated home equity allow households to tap their housing wealth directly and borrow more when house prices increases, while early repayment fees influence households' scope for refinancing their mortgage debt in the event interest rates decline. Finally, the more developed is the secondary markets for mortgage loans, the easier it should be for lenders to tap funding via capital markets and thus, all else being equal, provide credit to households.[4]

In constructing the index, we assign values of 0, 0.5 and 1 to each country depending on whether mortgage equity withdrawal and free prepayment are not existent, limited, or

[3]A crucial element in this regard is the legal protection of collateral. In countries where high administrative costs and a long period of time are required to realize the collateral's value in the event of default, banks are likely to be discouraged from making larger loans relative to the value of the property, and from lending to higher-risk borrowers (OECD, 2004). A variable capturing some of these features is used as possible determinant of the share of housing shocks in output variability in section IV of the paper.

[4] While there is clear evidence that a high share of floating housing-finance stock with variable interest rate strengthen the monetary policy transmission mechanism, it is unclear, from and ex ante perspective, whether a higher share of floating rate mortgage should be seen as an indication of innovative or deregulated housing finance system or not. In addition, in the data, a high share of floating mortgage debt is very closely associated with the limited or inexistent ability to pre pay mortgages. For this reason, we do not include this variable in our index, we shall consider it as an additional explanatory variable in the cross section analysis of the importance of the housing sector in Section IV of the paper.

widespread, respectively. For all other variables, we assign each county a value between 0 and 1, equal to the ratio to the maximum value across all countries. The index is therefore between 0 and 1, with values closer to 1 indicating easier household access to mortgage credit.

The results, shown in Table 1, indicate that significant differences remain in the institutional features of mortgage markets across the advanced countries considered—differences that are very closely associated with the stock of household mortgage debt as a share of GDP (Figure 3). Among these countries, the United States, Denmark, the Netherlands, Australia, and Sweden appear to have the most "flexible" mortgage markets—markets where it is easier for households to access housing-related credit. In these countries, typical LTV ratios hover around 90 percent, the standard length of mortgage is 30 years, mortgage products specifically designed for equity withdrawal are widely marketed, and standard loans include an option to prepay without compensating the lender for capital or market value losses. Moreover, in these countries, financial markets are relatively more important as a source of funding of mortgage lending: for instance, about 60 percent of mortgages were being securitized in the United States at end-2004, compared with about 15 percent for the EU 15 area (see BIS, 2006). By contrast, continental Europe countries tend to rank at the bottom of this index, suggesting that mortgage markets in these countries provide more limited access to financing.

III. Housing Shocks and the Business Cycle

This section quantifies role of the housing sector in the business cycle of the typical OECD economy.[5] In the first subsection, we briefly discuss the model we specify and estimate. In the second subsection, we report and discuss impulse responses to the shocks we consider. In the third subsection, we report and discuss variance decompositions.

A. The Econometric model

To establish a causal link from the housing sector to the broader economy and quantify the role that housing plays in accounting for output and consumption fluctuations we use a standard, monetary Vector Autoregression (VAR) model, for output (real GDP), inflation (GDP deflator), and the policy interest rate (in percent, annual terms), augmented with a stylized representation housing sector. The housing sector is included in this VAR model in the simplest possible way: by including one price and one quantity variable---real house prices and real residential investment, respectively. As theory suggests that an important channel of transmission of housing shocks is through the impact of house price change on consumption, an alternative specification of the VAR model that we consider includes real consumption rather than real GDP.[6]

This VAR system also includes a measure of global monetary liquidity to control for the fact that housing shocks could be picking up some of the same factors driving the "global trade imbalances," such as for instance the high and growing saving rates of emerging Asian economies and oil exporters. The measure we use is the sum of world international reserve measured in US dollar plus US M0.[7]

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[5] While the relative importance of the housing sector was estimated also for newly industrialized OECD economies such as South Korea and the Czech Republic, the lack of comparable information on their system of housing finance prevent their inclusion in the cross section analysis in section IV below.

[6] We do not include both real GDP and consumption to keep the size of the VAR model as small as possible.

[7] See Matsumoto (2008) for a detailed discussion of this measure and a comparison with alternative measures of global liquidity. As Matsumoto (2008) notes, this measure is also used among practitioners---See for example The Economist (2005) and Deutsche Bank (2007).

All the variables considered enter the VAR in (log) levels.[8] Although we cannot reject the presence of a unit root in some of the variables in our cross section of time series based on standard unit root tests, consistent with Christiano et al. (1999), we estimate the systems in levels, without explicitly modeling cointegration relationships.[9] The specification is balanced, in the sense that all real and nominal series have the same expected order of integration. In addition, a time trend is also included to capture the gradual decline of inflation rates and nominal policy interest rates over time, although the estimation results with and without a time trend are very similar. This VAR specification is the same for all countries to avoid introducing differences in country responses due to different model specifications, and because it would be practically difficult to search for a data-congruent specification for each considered country. In particular, somewhat arbitrarily, we include two lags of each variable in every system (determined by using standard specification tests on the VAR for the United States).

This VAR system is estimated separately for 18 OECD countries, using quarterly data for the period 1983:Q1 to 2007:Q4 (Results with a 1985:q4 starting date are very similar and available on request). To asses whether there has been a change in the housing sector's contribution to the business cycle over time, we estimate the same VARs over the period from 1970:Q1 (or the first year for which the data are available) to 2007:Q4 and compare results. In principle, one would like to compare two separate samples, before and after the liberalization of mortgage market finance in the early-mid 1980s, as we discussed section II. Unfortunately, however, only for a subset of the countries in our sample we have long enough data series to split the sample in two and examine changes over time.[10] Note, however, that proceeding in this manner we implicitly stacks the ex ante odds against the

[8] Al variables are defined in the Data Appendix. The model is similar to that recently estimated for the United States by Jarociński and Smets (2007).

[9] Sims, Stock and Watson (1990) show that if cointegration among the variables exists, the system's dynamics can be consistently estimated in a VAR in levels.

[10] Countries with data from 1970:Q1 are: Australia, Canada, Finland, France, Germany, Italy, Japan, Netherlands, Sweden, United Kingdom, and United States. Countries with different starting dates are Austria (1986:Q3), Belgium (1988:Q1), Denmark (1990:Q1), Greece (1994:Q1), Ireland (1997:Q1), Norway (1978:Q1) and Spain (1995:Q1).

possibility to find evidence of a structural change in the role of housing in the business cycle in the second sub-period. We thus see any evidence we may find of structural change in the second part of the sample period as a conservative assessment of such a possibility.

Housing demand and supply shocks are identified with sign restrictions within an otherwise block recursive structure: that is, both housing demand and housing supply shocks are assumed to have no contemporaneous effect on aggregate output and prices within a quarter. Following Jarociński and Smets (2007), housing demand shocks are then identified as those that move residential investment and real house prices in the same direction for the first 4 quarters of transmission of the shock. Housing supply shocks are those that move residential investment and house prices in opposite direction over the same four-quarter horizon. As there are several rotations consistent with these criteria, the median across them is reported in the paper.

A global liquidity shock is identified by assuming that the global liquidity measure that we use, which is common across all countries, responds to all other variables in the case of the United States, and does not respond to any other variable, in the case of all other countries. Thus, global liquidity shocks are then identified by ordering this variable last in the VAR for the US and first for all other countries.

An aggregate demand shock, an aggregate supply shock, and a monetary policy shock are also in the VAR, but they are not identified separately, as the block recursive structure of the system permits to asses the relative importance of the housing shocks and the global liquidity shock without identifying these other shocks separately.

B. Impulse responses

Figure 4A, 4B, and 4C report the impulse response functions (together with a two-standard deviation error band) to a housing supply shock, a housing demand shock, and a global liquidity shock in the typical OECD economy, estimated from the VAR system with real GDP. Figure 5A, 5B, and 5C report the same impulse responses estimated from a VAR system with real consumption rather than real GDP. The typical OECD economy is defined as the average economy in the cross section, i.e., as represented by the average of the impulse responses across section.

This is a pooled estimate of the impulse response for a panel-VAR model with heterogenous slope coefficients (i.e., slope coefficients that vary across countries). This estimator was proposed and studied by Pesaran and Smith (1995) and Pesaran, Smith, and Im (1996) for dynamic panel data models, and is obtained by estimating the individual unit (the VAR model above in our case) country-by-country, with ordinary least squares, and then taking averages of the estimates (e.g., impulse responses or variance decompositions in our case) across countries. We use arithmetic averages, but one could also compute weighted averages, weighting by the inverse of the standard error of the individual estimate or the size of the unit in the cross section, usually yielding similar results. The variance of the mean group estimator can be calculated by taking the variance across individual units (i.e., across countries for each time horizon in the case of the impulse responses and the variance decompositions) and dividing it by (1-N). As Pesaran, Smith, and Im (1996) prove, this adjustment yields a consistent estimate of the true cross-section variance of the mean group response.

Turning to the estimation results, housing supply shocks have a qualitatively and quantitatively different transmission mechanism than housing demand shocks. First, while both supply and demand shocks have similar impact on residential investments, the impact on house prices is quantitatively much larger in the case of housing demand shocks. Second, the transmission of supply shocks to the housing sector is hump-shaped in the case of demand shocks, while decays monotonically in the case of supply shocks. Third, and most important, while housing supply shocks have little or no impact on the aggregate economy in the short-to medium term (i.e., within the first three years), housing demand shocks do have economically small but statistically significant effects on both real GDP and inflation that peak within two years. Hosing supply shocks have only a small, permanent long run effect on real GDP, with no significant effects on aggregate inflation. Both housing demand and supply shocks have statistically weak effects on our measure of global liquidity. Interestingly, housing demand shocks are associated with a strong and persistent tightening of the monetary policy stance, associated in turn with the inflation response to the shock, consistent with a stabilizing role of monetary policy in response to these shocks. The policy interest rate and aggregate inflation instead hardly reacts in the case of housing supply shocks.

Global liquidity shocks themselves affect policy interest rates markedly in the typical OECD economy, as often argued in both the international policy debate and the academic literature, but there is no evidence of meaningful spillover effects to the housing sector, or

the broader economy. This is prima facie evidence against the notion that the ongoing housing boom and bust cycle has originated outside the advanced economies at the center of these developments, such as the United States, the United Kingdom, Australia which are among the few advanced economies with persistent current account deficits.[11]

As we can see, when we estimate the model with real consumption rather than real GDP, all impulse responses are very similar. This suggests that the GDP-based estimates are driven by consumption dynamics, which is the largest expenditure component in these economies.

C. Variance decompositions

Table 2, 3, and 4 report the share of residential investment, house price, and GDP or consumption forecast variance explained by each of the three shocks considered, on average across the countries considered, together with their estimated standard error (in brackets).

As we can see from Table 2, housing demand and housing supply shocks have large and comparable importance on short-term residential investment variability, which is also roughly constant over time. This suggests that housing shocks are very important for the housing sector of the typical OECD economy, and this importance is constant over time. Interestingly, however, the importance of housing supply shocks for residential investment variability declines significantly over the forecast horizons, from about 40 percent on impact to about 20 percent over a five year horizon, while the importance of housing demand shocks persists much longer at about 40 percent over the same forecast horizon. The results in Table 2 also speak to the very limited importance of global liquidity shocks for residential investment dynamics once we control for housing shocks. The assessed relative importance of different shocks is the same whether measured based on the VAR model including real GDP or real consumption.

Housing demand shocks and housing supply shocks explain a different share of house price variability, as we can see from Table 3 that reports the variance decompositions of real house prices. Housing demand shocks explains between 40 and 60 percent of the variance of real house prices depending on the forecast horizons---with higher shares explained at shorter

[11] This evidence, therefore, raises the interesting possibility that country specific housing demand and supply shocks may be an important contributor to the global external imbalances rather than the other way around.

forecast horizons, consistent with the presence of a relatively inelastic supply of housing in the short term. In contrast, housing supply shocks explain a roughly constant share of house price variance across forecast horizons of 20-25 percent. Interestingly, the evidence in Table 3 also shows that the share of variance of real house prices explained by housing demand shocks has increased slightly over time, but only at short forecast-horizons, to close to 70 percent of house price variance on impact.[12] The increased importance of housing demand shocks over time, however, is not strongly significant statistically based on the standard errors of the estimates reported in Table 3. Note finally that the results in Table 3 continue to suggest that global liquidity shocks do not have a strong role in house price dynamics and that the results do not change if we look at the system estimated with real GDP and real consumption.

Housing demand and supply shocks have different spillover effects to the broader economy, as Table 4 clearly shows. Table 4 reports the variance decompositions for real GDP and consumption due to the three shocks we consider. As we can see, hosing demand shocks explain a larger share of GDP variance, and an even larger share of consumption variance, than housing supply shocks (10-15 percent and 5-7 percent of total variability, respectively, at a five-year forecast horizon). The shares of variance explained by both shocks increase with the forecast horizon, consistent with the fact that it takes time for hosing sector shocks to spill over to the rest of the economy. Finally, and importantly, we note that the share of consumption variance explained by hosing demand shocks has increased significantly in the second sub-period, in a strongly significant manner statistically. This suggests that the housing sector might have become a more important source of aggregate volatility over the past two decades in the typical OECD economy at the same time in which these economies all underwent a more or less deep process of housing finance liberalization and development; thus, providing prima facie evidence that these two phenomena may be related. Not surprisingly, global liquidity shocks continue to have negligible effects on real GDP and real consumption variability.

[12] Note that these results cannot speak to the level of the aggregate volatility in the typical OCED economy. So they are consistent with aggregate volatility either increasing or decreasing over time, as for instance suggested by the so called the so-called great moderation debate.

IV. Housing Finance and the Importance of Housing for Aggregate Volatility

The impulse responses and the variance decompositions for the typical OECD-economy discussed in the previous section mask large differences across countries in the incidence of housing demand and supply shocks. In this section, we document this heterogeneity and attempt to explain it with the characteristics of the mortgage market discussed in section I, as well as with a few other possible explanatory variables.

The shares of GDP and consumption variance explained by housing demand and supply shocks (at a three-year forecast horizon) differ widely across countries, as Figure 6 and 7 highlight. Consistent with the evidence reported earlier on the different transmission of hosing demand and supply shocks in the typical OECD economy, Figure 6 and 7 also show that the countries for which housing demand shocks are important are not the same for which housing supply shocks are most important: the simple correlation between the share of GDP or consumption forecast variance explained by housing demand and supply shocks is below 0.2 in both sample periods. Similarly, the countries for which the share of GDP or consumption variance explained by housing demand shocks has increased over time are not the same for which the share of variance explained by housing supply shocks has increased over time.

Very strong heterogeneity can also be found by looking at the incidence of housing demand and housing supply shocks on residential investment and house price volatility, as Figure 8 and 9 show. In the previous section, we saw that housing demand shocks are more important than housing supply shocks for aggregate volatility. In addition, from a theoretical perspective, the right measure of aggregate volatility to focus on is consumption. Furthermore, the distribution of the incidence of housing demand shocks on consumption variability is very closely correlated to the incidence on residential investment and house prices, with simple correlations around .8 (not reported). Therefore, in the rest of the analysis in this section, we focus on the incidence of housing demand shocks on consumption.

In order to attempt at explaining the strong heterogeneity we documented, we consider the index of mortgage market development and all its individual components in Table 1, as well as a few other variables potentially associated with in the incidence of the housing sector on aggregate volatility. These include the share of variable-rate mortgages, the home-ownership ratio, a measure of housing supply price elasticity, a measure of regulatory

restrictions on housing transactions, and a measure of possible tax distortions, and finally a demographic factor variable.[13]

A few variables, in addition to the mortgage market index, are individually associated with the share of consumption variance explained by housing demand, but these associations are not strong statistically, as Table 5 shows. Table 5 reports a battery of univariate OLS regressions of the incidence of housing demand shocks in consumption variance on each of possible determinants considered. Among these, the only measure that has a strongly statistically significant association is the share of mortgage backed securities in new residential loans. Several other variables, however, have a coefficient with the expected sign and t-statistics above 1. In addition, if we regress the shares of consumption variance due to housing demand shocks in both the first and the second sample period on the mortgage-to-GDP ration, we find a close association: with a coefficient of 0.2 and t-stat of about 2.[14]

The reason why the association between the mortgage market index and the consumption variance share is not very strong can be seen from Figure 10, which reports a scatter plot these two variables, and Table 1. As we can see, there are a few countries, with a relatively high value of the index and low share of consumption variance, including Canada, the Netherlands, the UK, Sweden, Norway, and Finland, which either have a very high share of floating-rate mortgages or a relatively low share of home-ownership, or both. A high share of variable-rate mortgages, all else equal, makes monetary policy more effective in stabilizing consumption and hence helps containing the impact of housing shocks on consumption, while a lower share of home-owners, all else equal, should reduce the importance of the hosing sector for aggregate volatility. For instance, when we regress the share of consumption variance explained by housing demand shocks on our mortgage market index and the latter two variables, we find a very good fit of the cross section distribution, loosing only marginally on the strength of the association with the mortgage index and its statistical significance.

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[13] The mortgage market development index and its components are reported in Table 1 and discussed in section II. The additional variable considered are defined in the data appendix.

[14] Recall that the share of mortgage debt in GDP, in the second sample, correlates very closely with our mortgage market development index, as Figure 3 illustrates.

From a theoretical perspective, the results found are plausible. In principle the effect of more developed mortgage markets on consumption and output volatility is ambiguous, as two countervailing effects may be at work. On the one hand, households' ability to smooth consumption in the face of adverse shocks affecting their income may be enhanced through more ready access to financing collateralized by home equity (Dynan, Elmendorf, and Sichel, 2006, and Campbell and Hercowitz, 2005). On the other hand, macroeconomic fluctuations may be amplified by endogenous variations in collateral constraints tied to housing stock values—the "financial accelerator" analyzed by Kiyotaki and Moore (1997), Bernanke and Gertler (1995), and Bernanke, Gertler, and Gilchrist (1999), and Iacoviello (2005).

However, while the role of housing finance in consumption smoothing is potentially relevant, its full impact may not apply to all households (Dynan and Kohn, 2007). First, many households that experience income shortfalls are unlikely to be able to borrow to smooth consumption, even in economies with more flexible mortgage markets. So if income falls short of expectations at the same time as house prices weaken, some households may need to revise down their spending plans sharply. Second, as illustrated by recent developments among sub-prime mortgage borrowers in the United States, easier access to housing-related credit may weaken the budget constraint of some households and induce excessive borrowing. The excessive accumulation of debt may imply that an adverse shock to income can more easily lead to financial distress, thus amplifying rather than smoothing the response of consumption to income (Debelle, 2004). Finally, for consumers whose spending is credit-constrained even when home equity finance is available, innovation that facilitates borrowing against rising home values is likely to increase the response of consumption to various economic shocks—consistent with a "financial accelerator" mechanism as opposed to inducing smoother consumption profiles.

For instance, increased share of aggregate volatility explained by hosing demand shocks can be generated by general equilibrium models with housing as collateral such as Iacoviello (2005) and Monacelli (2008). As house prices increase, in these models, impatient consumers raise the amount of their mortgage loans against the greater value of their collateral or to re-finance their mortgages, and use the additional funds for non-housing consumption.

V. Conclusions

The recent boom and bust in the housing market of several advanced economies, after a long period of financial innovation and liberalization, triggered a debate on the role of the housing sector for the business cycle. In this paper we quantifies the role of the housing sector in the business cycle of advanced economies and investigate the extent to which the varying importance of housing shocks across different countries can be traced to differences in the national systems of housing finance.

The main result of the paper is that more developed hosing finance systems seem to be associated with a larger share of housing shocks in aggregate consumption volatility. We also find evidence of an increased importance of housing shocks in consumption volatility over time, which is consistent with the generalized move toward more liberalized and innovative mortgage markets across all the countries considered.

Second, we find that housing supply shocks have a distinct transmission mechanism from housing demand shocks: while both types of shocks affect residential investments significantly, only housing demand shocks have significant impact on house price as well as spillover to the broader economy at business cycle forecast horizons, consistent with a housing collateral view of the role of housing in the business cycle. Finally, we find that the global liquidity shock that we identify has had a negligible importance for output and consumption volatility in the typical OECD economy over the past two decades or so, even though we find that an increase in global liquidity can lower short-term interest rates significantly. Thus, contrary to much common wisdom, we find that although the global imbalances may have contributed to generate a low-interest rate environment in the typical OECD economy, this has had a very limited role in explaining the recent boom-bust cycle in the housing sector and the associated spillover to the broader economy.

We interpret the findings reported in the paper as evidence that the greater availability of collateral for borrowing in economies with more developed mortgage markets has amplified the financial accelerator effect from endogenous variations in the collateral constraint tied to the value of homes. Exploring the extent to which SDGE models with a housing sector can reproduce the empirical facts documented in this paper, indeed, is an interesting area for future research.

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Data Appendix

Variable	Source	Note
Real house prices	OECD and BIS	Nominal house prices are deflated using Consumer Price Index (Bank for International Settlements data only)
Real residential investment	OECD Analytical Database	
Real private consumption	OECD Analytical Database	
Real disposable income	OECD Analytical Database	
Consumer price index	OECD Analytical Database	
Short-term interest rates	OECD Analytical Database, International Financial Statistics database, OECD *Economic Outlook*, Haver Analytics	

House Prices

Country	Source	Start Date
Australia	OECD	1970:Q1
Austria	BIS	1986:Q3
Belgium	BIS	1988:Q1
Canada	OECD	1970:Q1
Denmark	OECD	1970:Q1
Finland	OECD	1970:Q1
France	OECD	1970:Q1
Germany	OECD	1970:Q1
Greece	BIS	1993:Q1
Ireland	OECD	1970:Q1
Italy	OECD	1970:Q1
Japan	OECD	1970:Q1
Netherlands	OECD	1970:Q1
Norway	OECD	1970:Q1
Spain	OECD	1971:Q1
Sweden	OECD	1970:Q1
United Kingdom	OECD	1970:Q1
United States	OECD	1970:Q1

Other indexes

Demographic index: population growth, average 1995-2005.

Regulation: average of (a) total transaction costs of purchasing a house (as percent of property value-- Global Property Guide (http://www.globalpropertyguide.com/articleread.php?article_id=95&cid=); (b) number, time (in days) and cost (in percent of value) of procedures to register property--Doing Business database, World Bank; and (c) number, time (in days) and cost (in percent of debt) of enforcing contracts (Doing Business database, World Bank). For each of these variable we assign to every country in our sample a value between 0 and 1, equal to the ratio to the maximum value across all countries; the index is then obtained as simple averages of these values.

Tax: average of (a) tax on imputed rent (binary variable=yes/no); (b) mortgage-related interest relief (binary variable=yes/no); (c) capital gains on housing assets; (d) inheritance tax (binary variable=yes/no' and (e) taxes on property (percent of GDP)--Housing Statistics in the European Union 2005/2006, Housing Markets and adjustment in Monetary Union, OECD, Working Paper No. 550, and OECD, Taxing Wages, 2005). For each of these variable we assign every country in our sample a value between 0 and 1, equal to the ratio to the maximum value across all countries; the index is then obtained as simple averages of these values.

Price Elasticity of Housing Supply: obtained as in J. Swank, J. Kakes, A.F. Tieman, 2002, "The Housing Ladder, Taxation, and Borrowing constraints". Netherlands Central Bank, WO Research Memoranda, N. 688; it is the coefficient on house prices from a regression of housing permits on the following variables: house prices, real wages, cost of capital (weighted average of short-term and long-term interest rates) and producer confidence index.

Mortgage Equity Withdrawal: difference between residential loans and residential investments, divided by personal disposable income (source: OECD and national statistical offices).

Table 1. Mortgage market characteristics and index

Country	Average term (years)	Average LTV (percent)	Equity release products	Free Prepay	Mortgage Market Index
Netherlands	30	87	1	1	1.0
Denmark	30	80	1	1	1.0
United States	30	76	1	1	1.0
Sweden	25	88	1	1	1.0
New Zealand	28	83	1	0.5	0.8
United Kingdom	25	69	1	0.5	0.8
Australia	25	65	1	0.5	0.8
Canada	25	60	1	0	0.6
Finland	17	78	1	0	0.6
Norway	17	70	1	0	0.6
Ireland	20	80	0.5	0	0.5
Spain	20	70	0.5	0	0.5
Japan	25	75	0	0	0.4
Belgium	20	83	0	0	0.4
Germany	25	67	0	0	0.4
Austria	25	60	0	0	0.4
France	15	78	0	0	0.3
Switzerland	18	66	0	0	0.3
Greece	18	55	0	0	0.3
Italy	15	55	0	0	0.3
Average	**22.6**	**72.2**	**0.6**	**0.3**	**0.6**

Table 1 MMI and other financial characteristics (cont.)

Country	Mortgage Market Index	Mortgage Market Depth (Share of GDP, 2005)	Home Ownership (share)	Variable rate mortgages (share)	Average size of government securities markets (share of GDP, 1996-2001)	Relative importance of market financing (index)	Legal rights (index)	Inflation volatility (1995-2004)
Australia	0.8	0.77	0.70	0.84	0.25	0.36	9	1.69
Canada	0.6	0.44	0.66	0.29	0.68	0.27	7	0.85
Denmark	1.0	1.01	0.52	0.30	0.59	0.36	7	0.51
Finland	0.6	0.44	0.65	0.93	0.38	0.04	6	0.99
France	0.3	0.29	0.55	0.32	0.43	0.04	3	0.67
Germany	0.4	0.52	0.44	0.16	0.29	0.03	8	0.51
Ireland	0.5	0.61	0.77	0.85	0.31	0.20	8	1.54
Italy	0.3	0.17	0.74	0.78	0.98	0.14	3	1.09
Japan	0.4	0.36	0.60	0.22	0.64	0.28	6	0.87
Netherlands	1.0	0.96	0.52	0.36	0.49	0.13	7	0.92
Norway	0.6	0.52	0.78	0.90	0.20	0.23	5.5	1.04
Spain	0.5	0.52	0.82	0.93	0.51	0.16	5	0.91
Sweden	1.0	0.54	0.46	0.50	0.51	0.08	6	1.06
United Kingdom	0.8	0.78	0.68	0.72	0.34	0.13	10	0.79
United States	1.0	0.73	0.67	0.35	0.51	1.00	7	0.67
Austria	0.4	0.24	0.56	0.25	0.34	0.03	5	0.73
Belgium	0.4	0.36	0.65	0.25	1.04	0.07	5	0.62
Greece	0.3	0.18	0.80	0.85	0.78	0.21	3	2.22
New Zealand	0.8	0.78	0.65	0.84	0.30	0.21	9	5.34
Switzerland	0.3	0.86	0.35	0.80	0.22	0.21	6	0.56
Corr. with MMI	**1.0**	**0.7**	**-0.1**	**-0.1**	**-0.2**	**0.4**	**0.6**	**0.2 (-0.11)**

Table 2. Forecast Variance Decomposition of Residential Investment: Average Across Countries

Panel A. Housing Demand Shock

Time horizon (quarters)	2	5	13	19
First period	45%	50%	41%	39%
	(0.034)	(0.033)	(0.037)	(0.037)
Second period	42%	47%	41%	38%
	(0.047)	(0.041)	(0.043)	(0.045)

Panel B. Housing Demand Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	47%	52%	44%	41%
	(0.032)	(0.032)	(0.035)	(0.032)
Second period	47%	51%	43%	40%
	(0.040)	(0.033)	(0.037)	(0.040)

Panel C. Housing Supply Shock

Time horizon (quarters)	2	5	13	19
First period	41%	26%	18%	17%
	(0.026)	(0.020)	(0.019)	(0.022)
Second period	42%	25%	16%	16%
	(0.038)	(0.026)	(0.023)	(0.023)

Panel D. Housing Supply Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	43%	27%	19%	18%
	(0.029)	(0.027)	(0.025)	(0.027)
Second period	42%	24%	18%	18%
	(0.037)	(0.028)	(0.024)	(0.025)

Panel E. Global Liquidity Shock

Time horizon (quarters)	2	5	13	19
First period	1%	2%	3%	3%
	(0.002)	(0.004)	(0.007)	(0.007)
Second period	1%	2%	3%	3%
	(0.002)	(0.005)	(0.005)	(0.005)

Panel F. Global Liquidity Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	1%	2%	2%	3%
	(0.002)	(0.004)	(0.006)	(0.006)
Second period	1%	2%	2%	2%
	(0.003)	(0.006)	(0.004)	(0.004)

Table 3. Forecast Variance Decomposition of House Prices: Average Across Countries

Panel A. Housing Demand Shock

Time horizon (quarters)	2	5	13	19
First period	64%	58%	40%	33%
	(0.028)	(0.033)	(0.042)	(0.041)
Second period	69%	62%	47%	41%
	(0.041)	(0.041)	(0.057)	(0.057)

Panel B. Housing Demand Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	63%	58%	43%	37%
	(0.026)	(0.031)	(0.038)	(0.039)
Second period	65%	58%	45%	40%
	(0.034)	(0.038)	(0.057)	(0.057)

Panel C. Housing Supply Shock

Time horizon (quarters)	2	5	13	19
First period	27%	23%	18%	18%
	(0.026)	(0.024)	(0.025)	(0.024)
Second period	22%	16%	12%	12%
	(0.037)	(0.026)	(0.021)	(0.020)

Panel D. Housing Supply Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	26%	21%	16%	15%
	(0.026)	(0.024)	(0.021)	(0.023)
Second period	23%	15%	10%	11%
	(0.032)	(0.023)	(0.017)	(0.017)

Panel E. Global Liquidity Shock

Time horizon (quarters)	2	5	13	19
First period	0%	1%	3%	3%
	(0.002)	(0.003)	(0.006)	(0.008)
Second period	1%	1%	2%	3%
	(0.002)	(0.003)	(0.005)	(0.005)

Panel F. Global Liquidity Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	0%	1%	3%	3%
	(0.001)	(0.003)	(0.006)	(0.007)
Second period	0%	1%	2%	2%
	(0.001)	(0.003)	(0.005)	(0.005)

Table 4. Forecast Variance Decomposition of Output and Consumption: Average Across Countries

Panel A. Housing Demand Shock

Time horizon (quarters)	2	5	13	19
First period	2%	7%	10%	12%
	(0.004)	(0.015)	(0.023)	(0.026)
Second period	2%	8%	13%	14%
	(0.005)	(0.018)	(0.030)	(0.030)

Panel B. Housing Demand Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	2%	8%	13%	14%
	(004)	(0.014)	(0.024)	(0.027)
Second period	3%	11%	20%	22%
	(0.009)	(0.024)	(0.041)	(0.045)

Panel C. Housing Supply Shock

Time horizon (quarters)	2	5	13	19
First period	1%	2%	4%	6%
	(0.003)	(0.005)	(0.011)	(0.013)
Second period	1%	2%	6%	7%
	(0.002)	(0.006)	(0.014)	(0.016)

Panel D. Housing Supply Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	1%	2%	4%	5%
	(0.001)	(0.004)	(0.012)	(0.013)
Second period	1%	2%	5%	6%
	(0.004)	(0.005)	(0.010)	(0.013)

Panel E. Global Liquidity Shock

Time horizon (quarters)	2	5	13	19
First period	1%	3%	3%	4%
	(0.003)	(0.008)	(0.008)	(0.008)
Second period	1%	3%	3%	3%
	(0.004)	(0.009)	(0.007)	(0.007)

Panel F. Global Liquidity Shock (Consumption)

Time horizon (quarters)	2	5	13	19
First period	0%	2%	2%	3%
	(0.002)	(0.004)	(0.005)	(0.005)
Second period	0%	2%	2%	3%
	(0.001)	(0.004)	(0.005)	(0.005)

Table 5. Consumption variance share and possible determinants

	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat	Coeff t-stat
Mortgage market development index	0.3 **1.3**												
Population growth		0.19 **1.6**											
Regulatory restrictions on housing transactions			0.06 0.1										
Tax factors				-0.35 -0.7									
Price elasticity of housing supply					-0.04 **-0.9**								
Ability to prepay mortgage						0.09 **0.9**							
Loan-to-value ratio							-0.002 **-1.3**						
Mortgage maturity								0.01 **1.0**					
Mortgage equity withdrawal									0.01 0.6				
Mortgage backed market										0.02 **2.0**			
Share of variable rate mortgages											-0.03 -0.15		
Home ownership ratio												0.55 **1.3**	

Table 6. Close correlates of the consumption variance share

	Coefficients	*t Stat*
Index	0.20	0.93
Variable rate	-0.47	-1.92
Home Ownership	1.46	2.44

Regression Statistics	
Multiple R	0.62
R Square	0.38
Adjusted R Square	0.21

Figure 1. Share of Total Outstanding Loans Issued by Nonbank Financial Institutions to the Household Sector (percent)

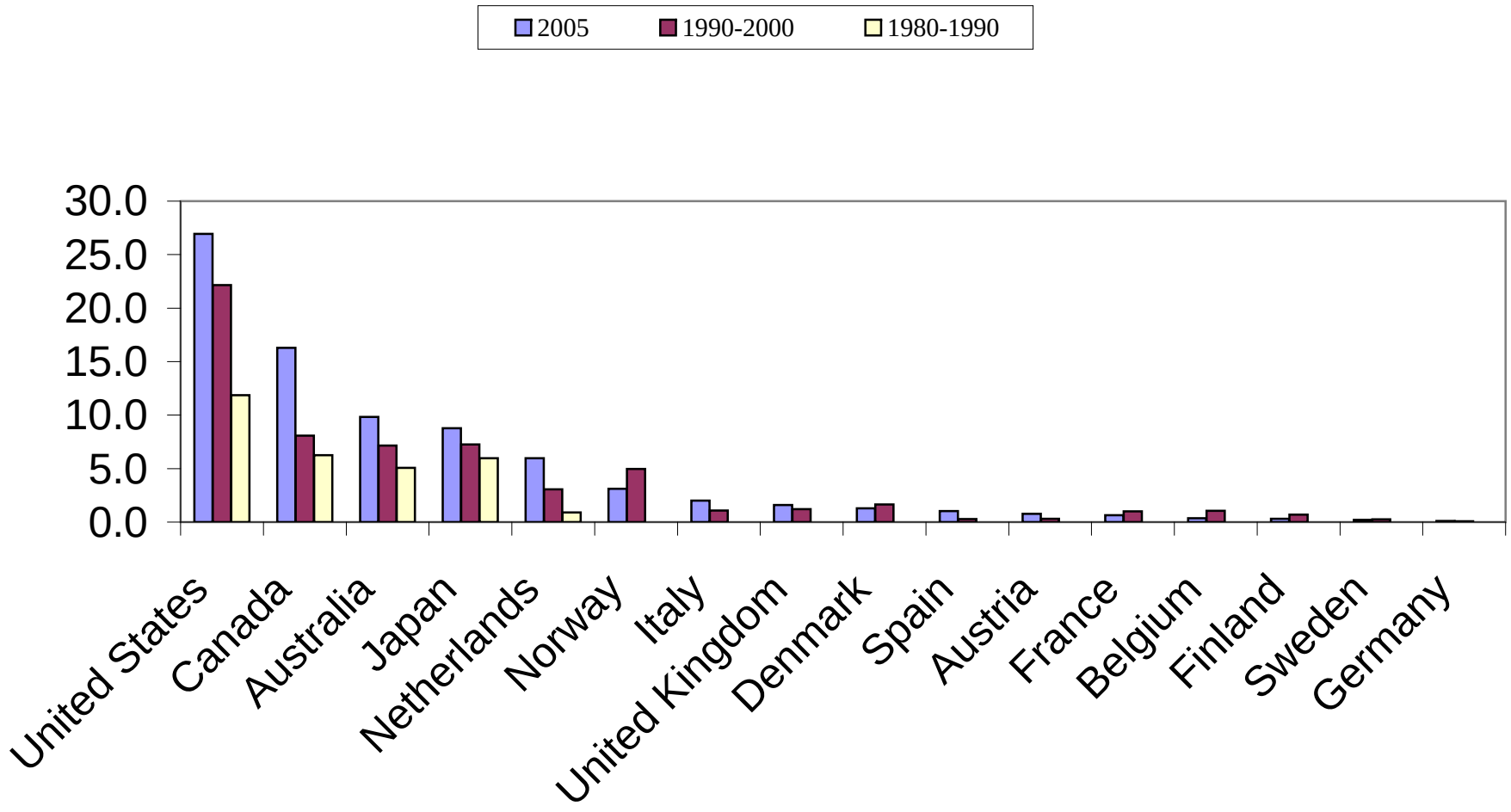


Figure 2. Mortgage Debt Outstanding (percent of GDP)

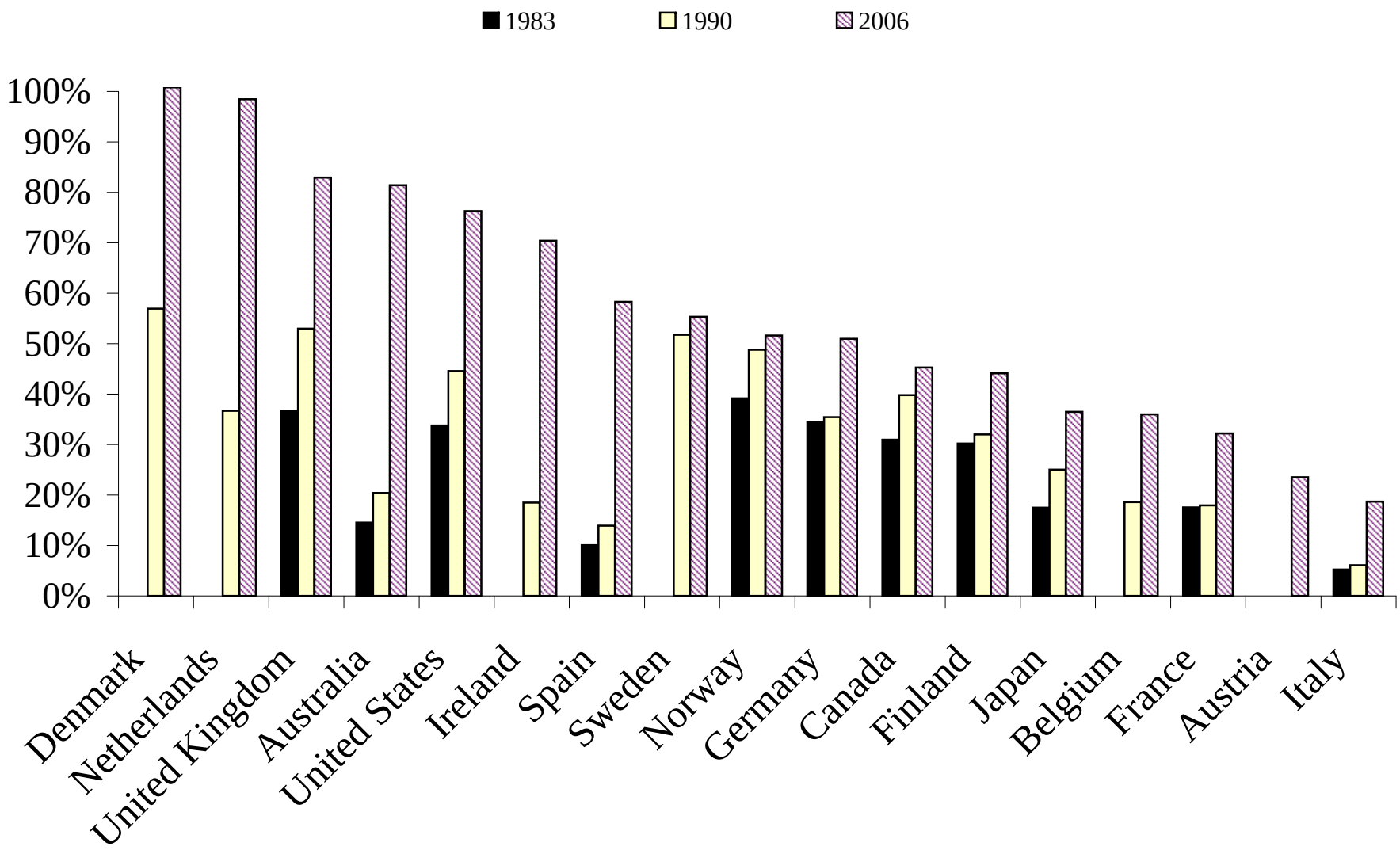


Figure 3. Mortgage Market Index and Residential Mortgage-Debt-to-GDP Ratio
(Correlation: 0.8; t-statistic: 5.2)

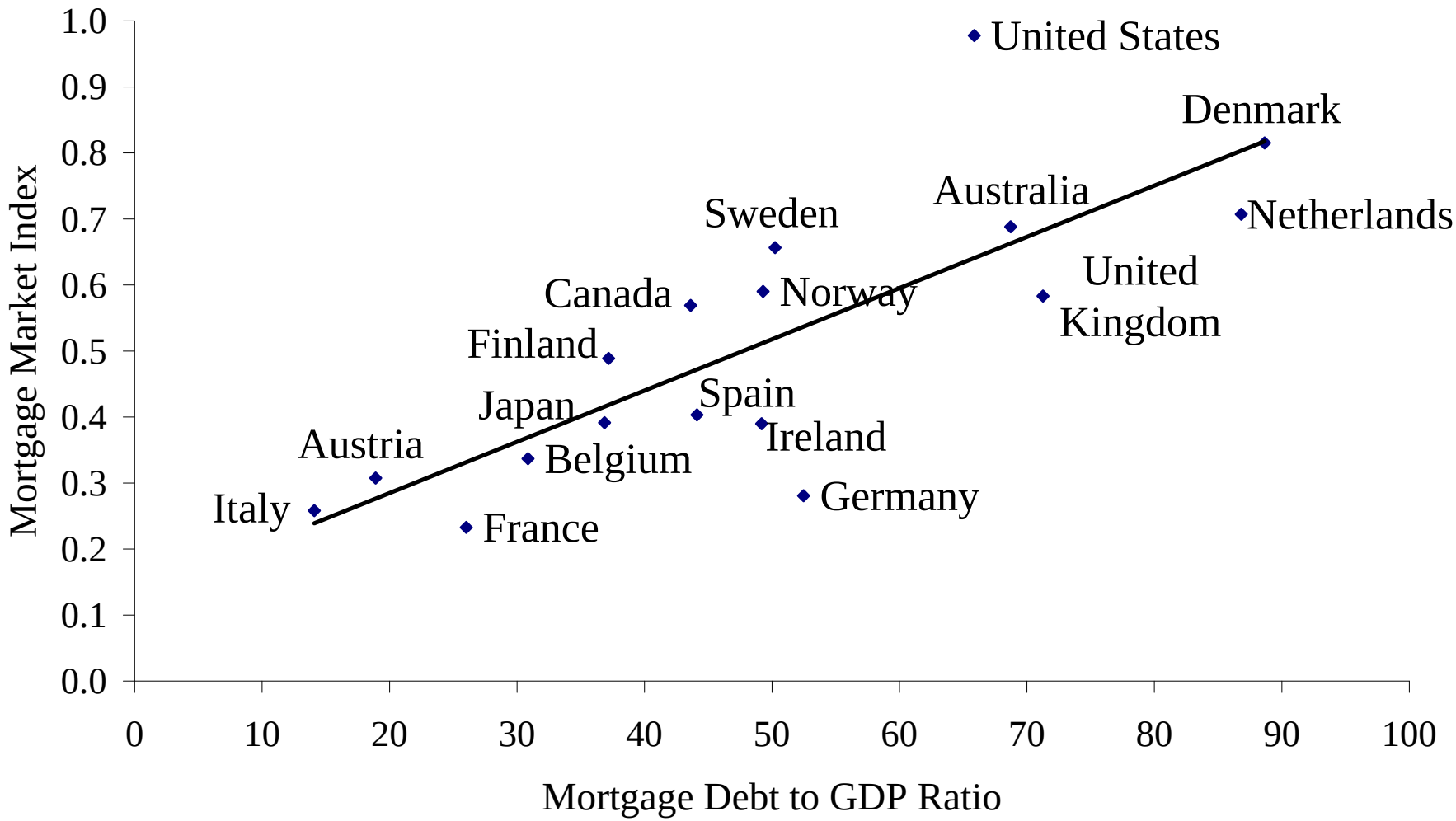


Figure 4.A. Impulse Response to Housing Supply Shock

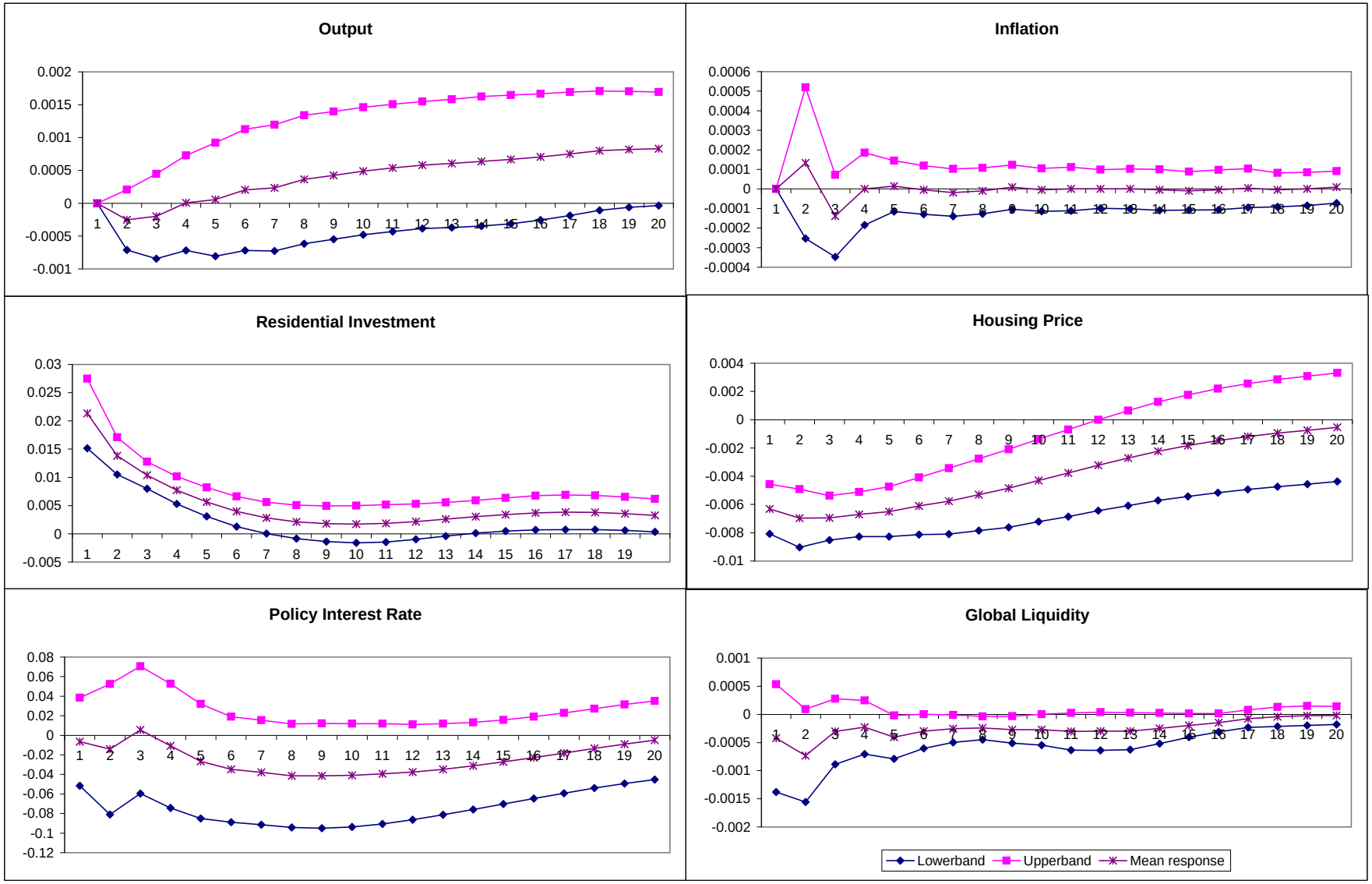


Figure 4.B. Impulse Response to Housing Demand Shock

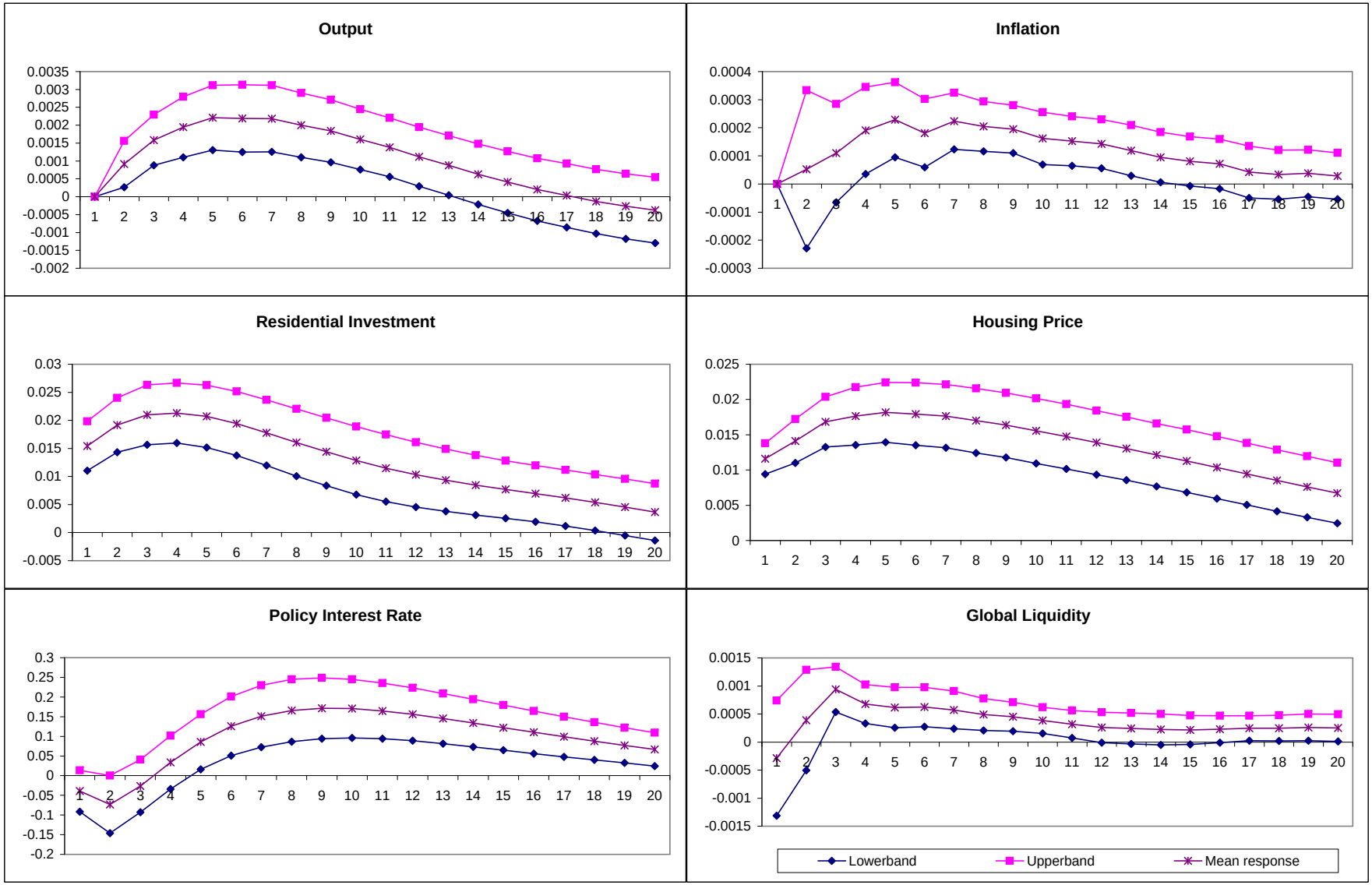


Figure 4.C. Impulse Response to Liquidity Shock

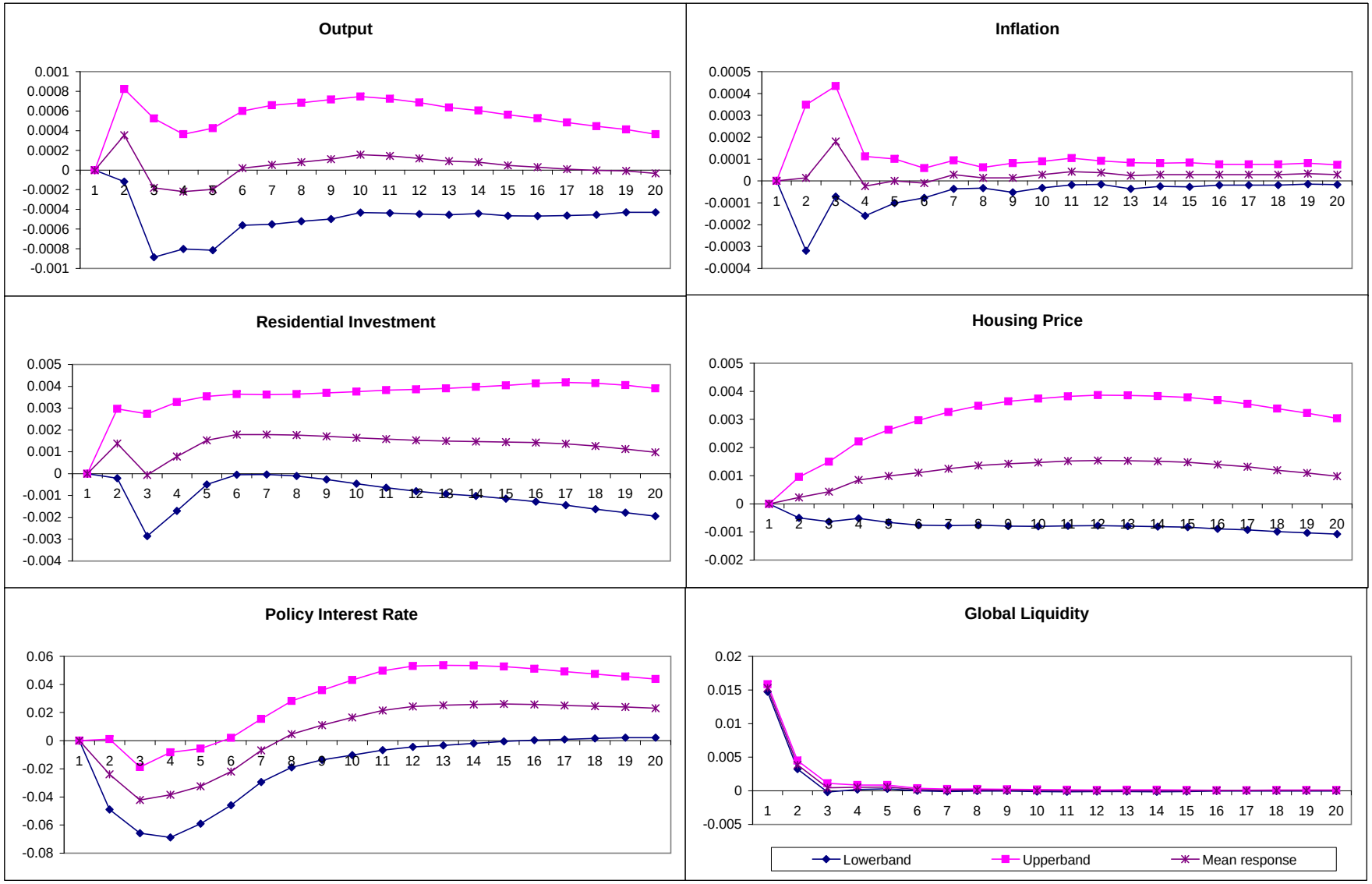


Figure 5.A Impulse Response to Housing Supply Shock (Consumption)

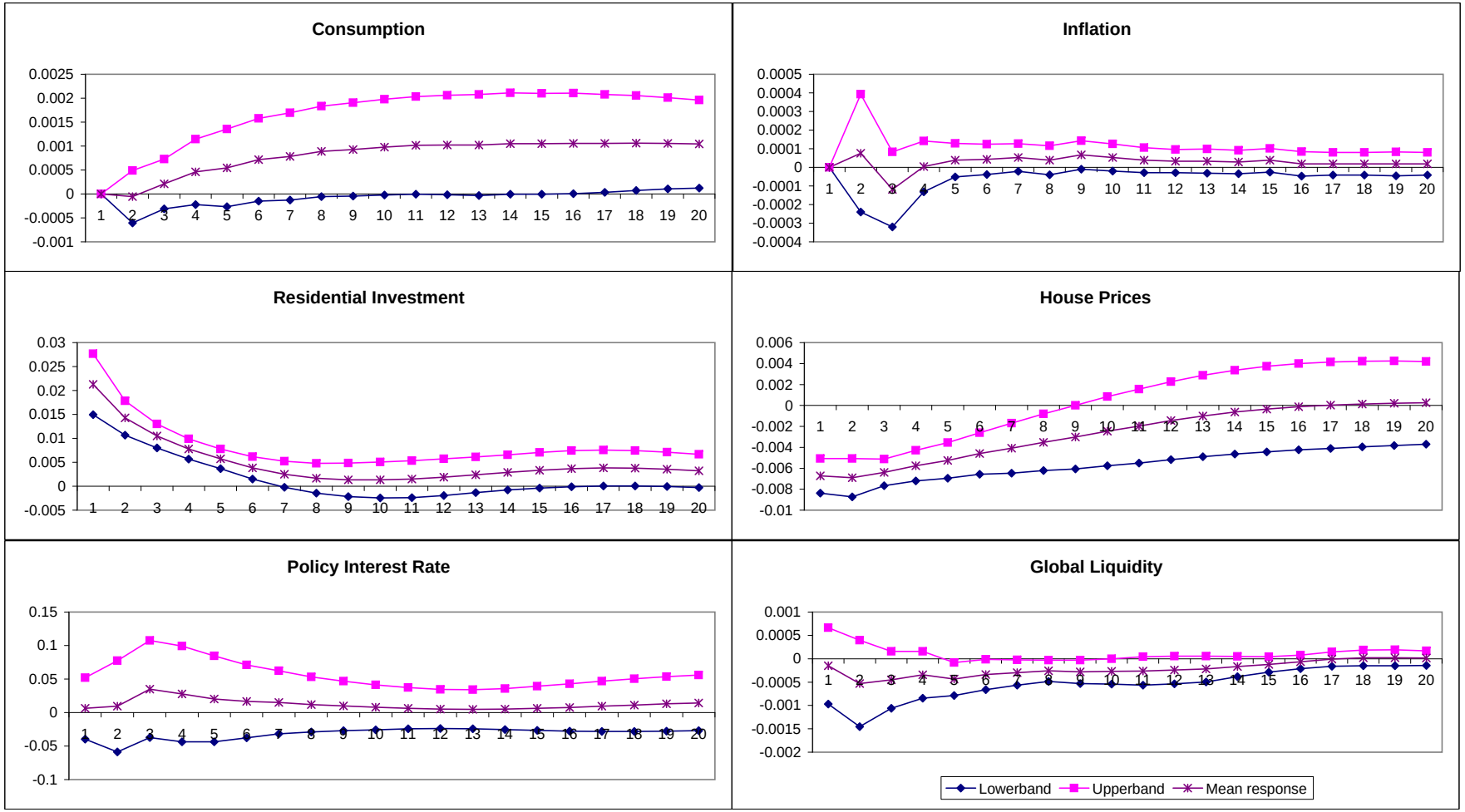


Figure 5.B Impulse Response to Housing Demand Shock (Consumption)

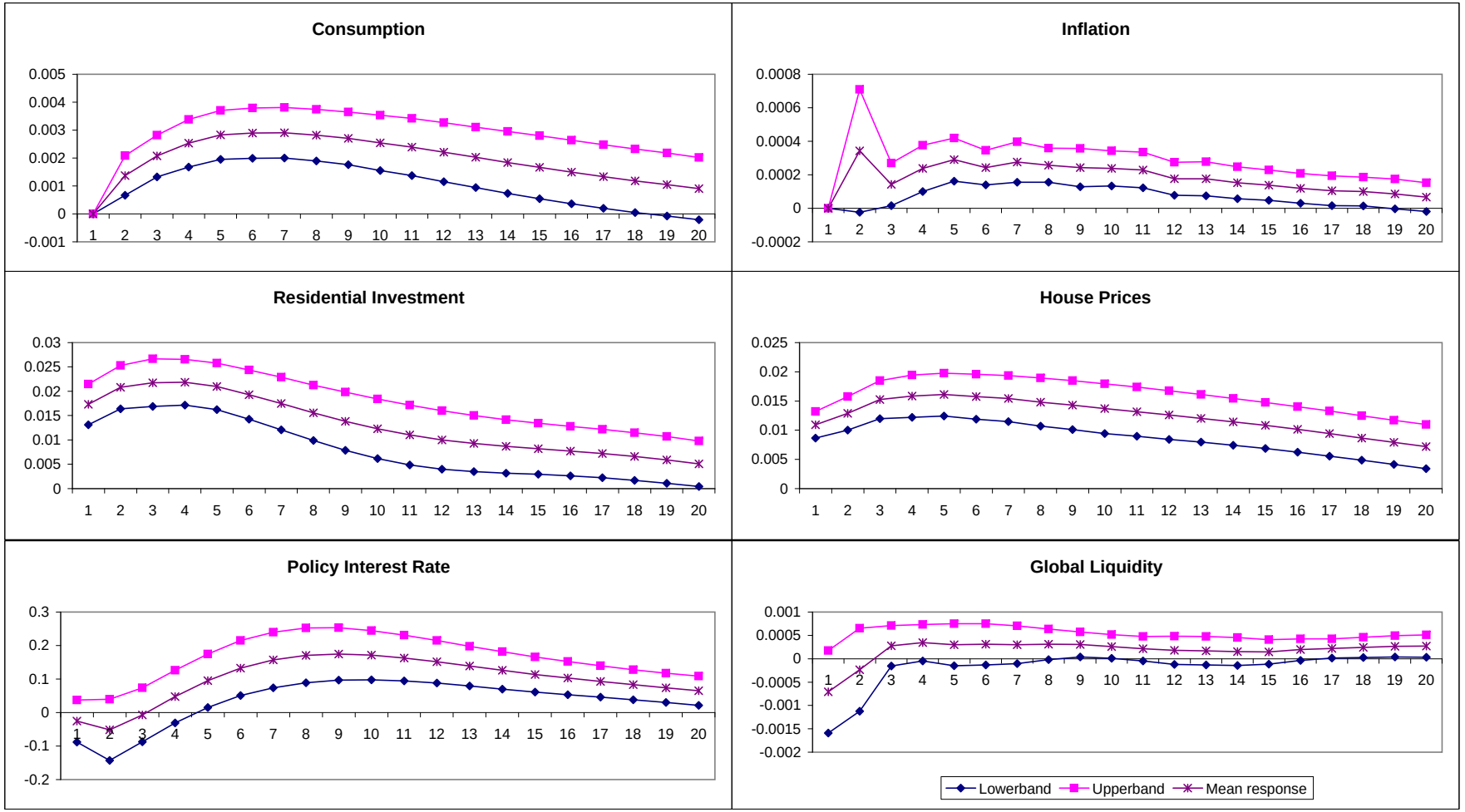


Figure 5.C Impulse Response to Liquidity Shock (Consumption)

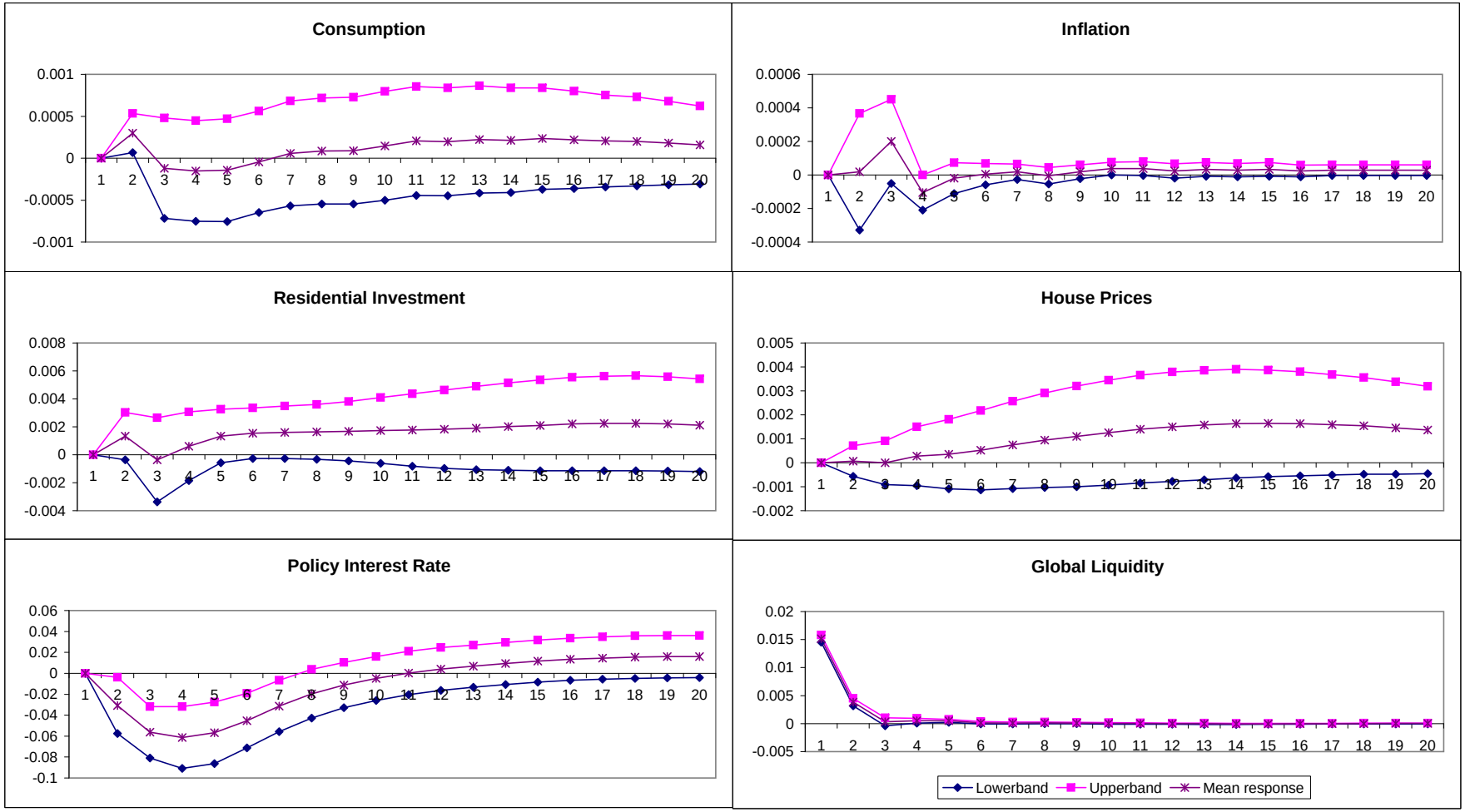


Figure 6. Output Variance Shares

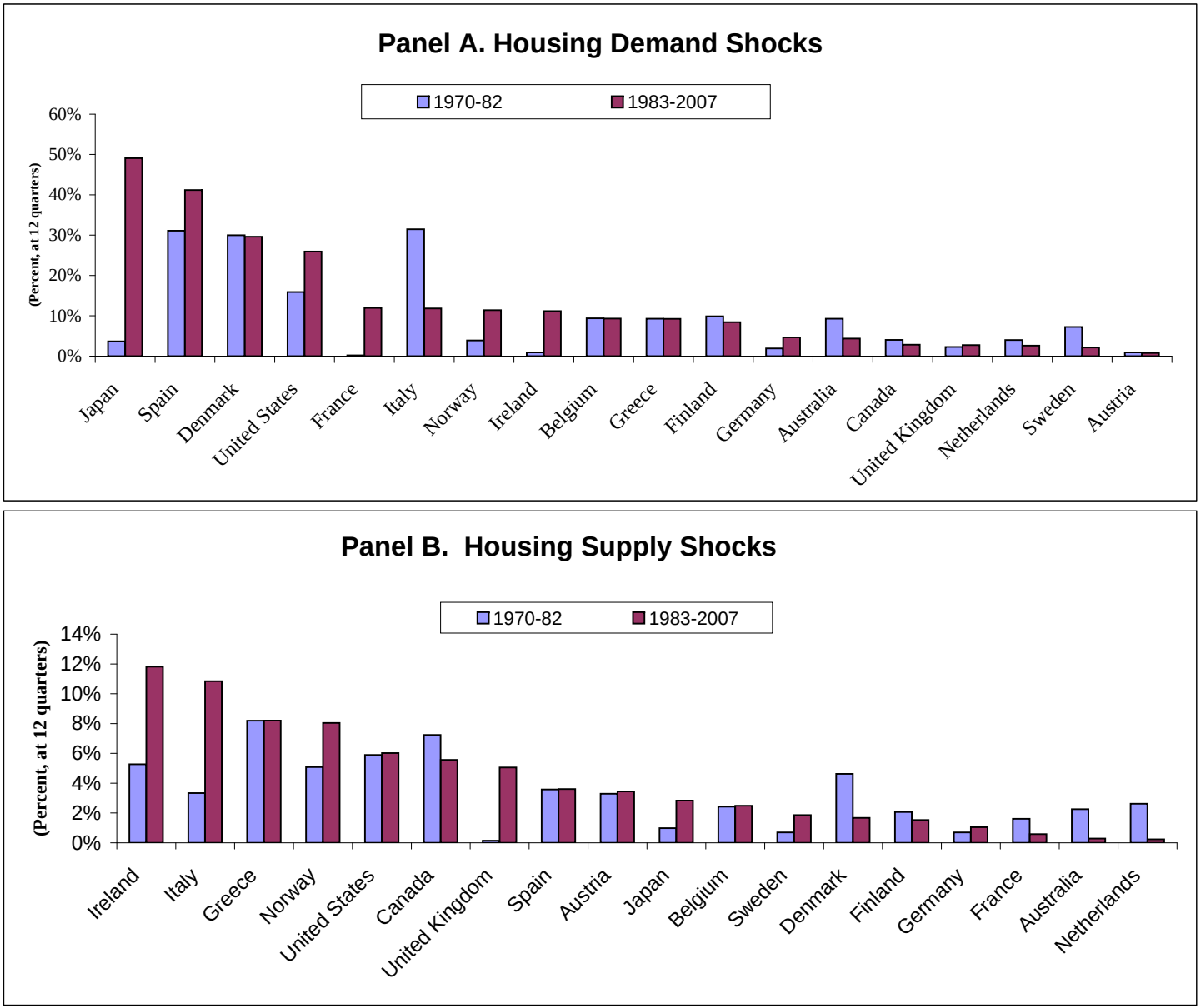


Figure 7. Consumption Variance Shares

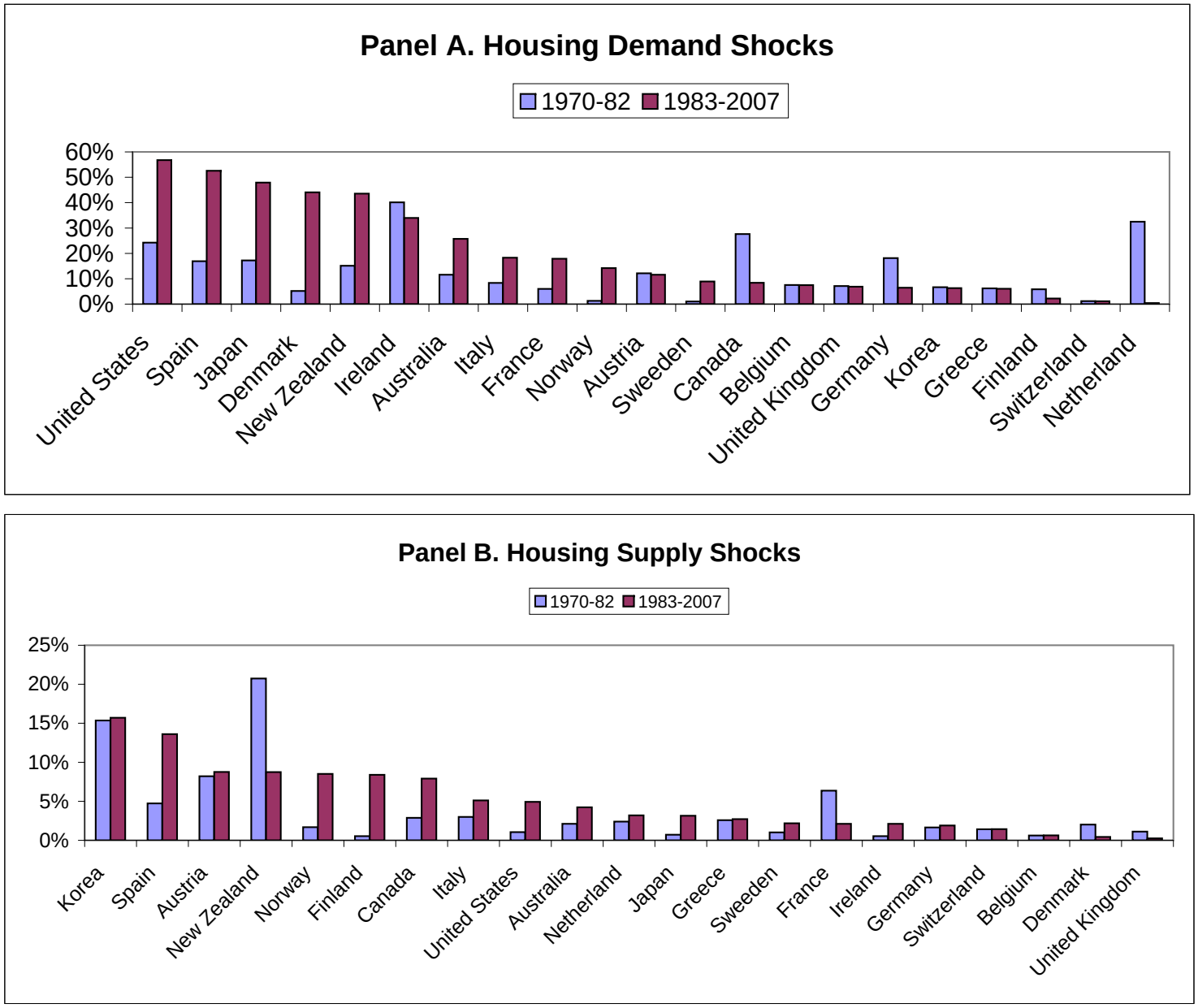
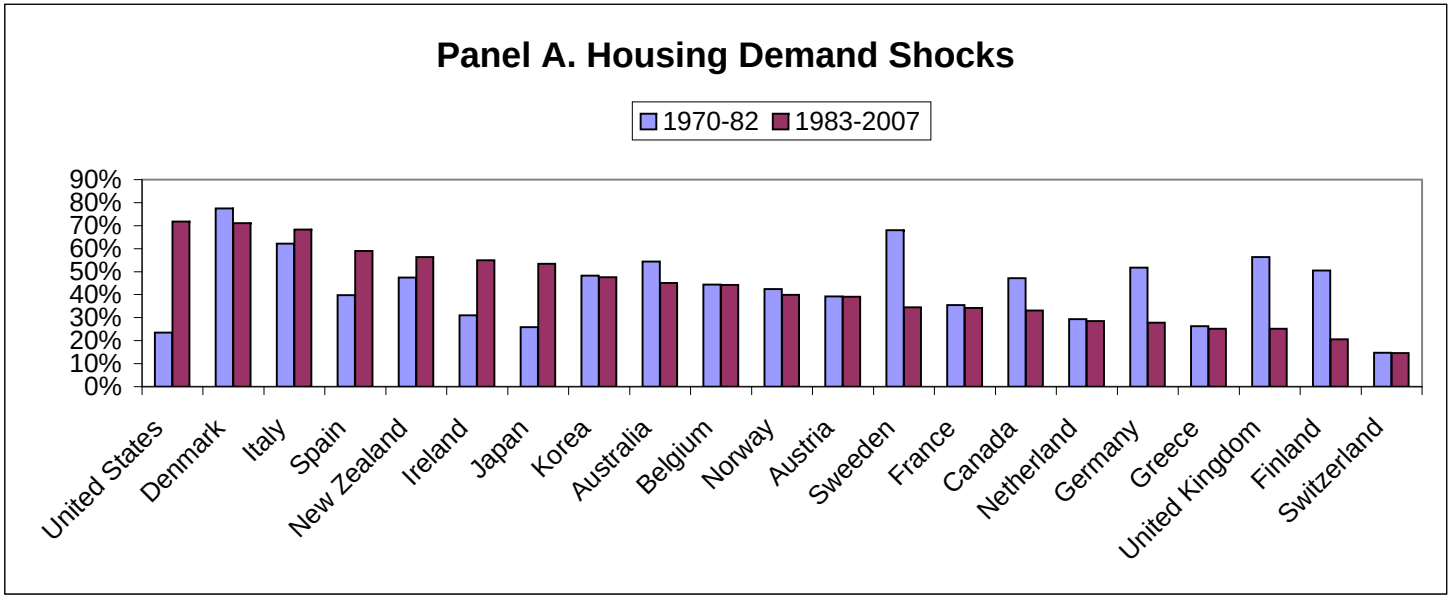


Figure 8. Residential Investment Variance Shares - C



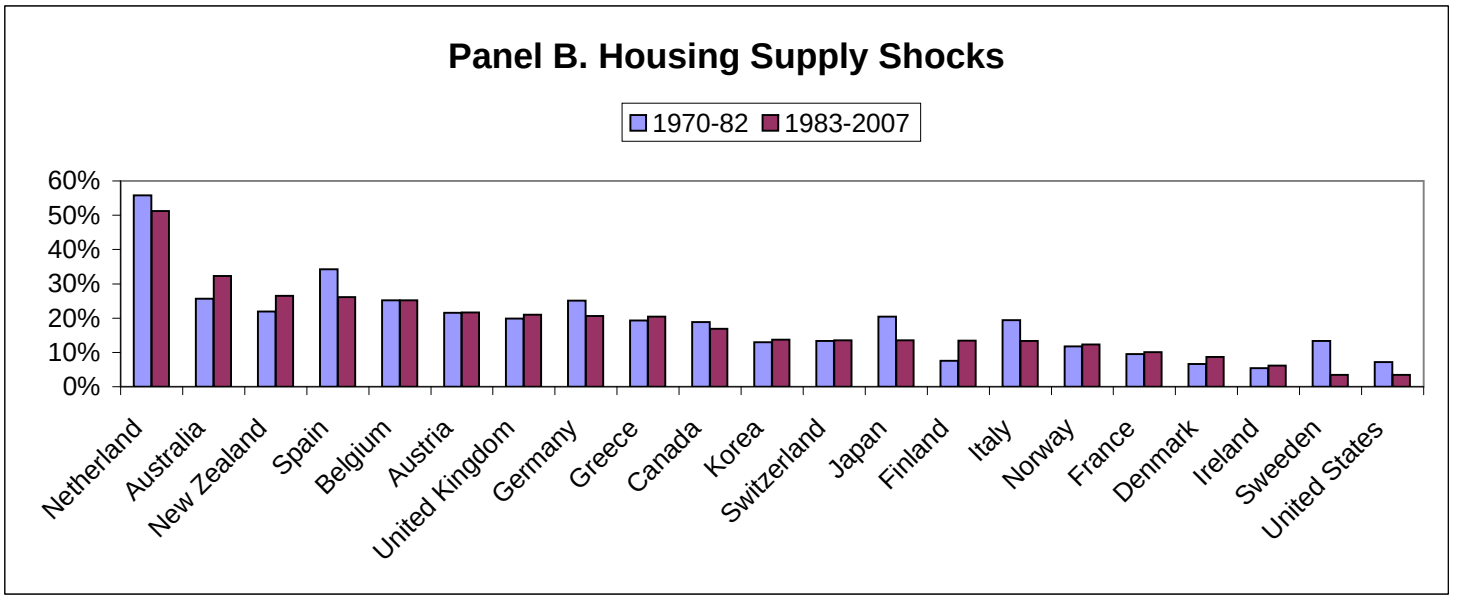
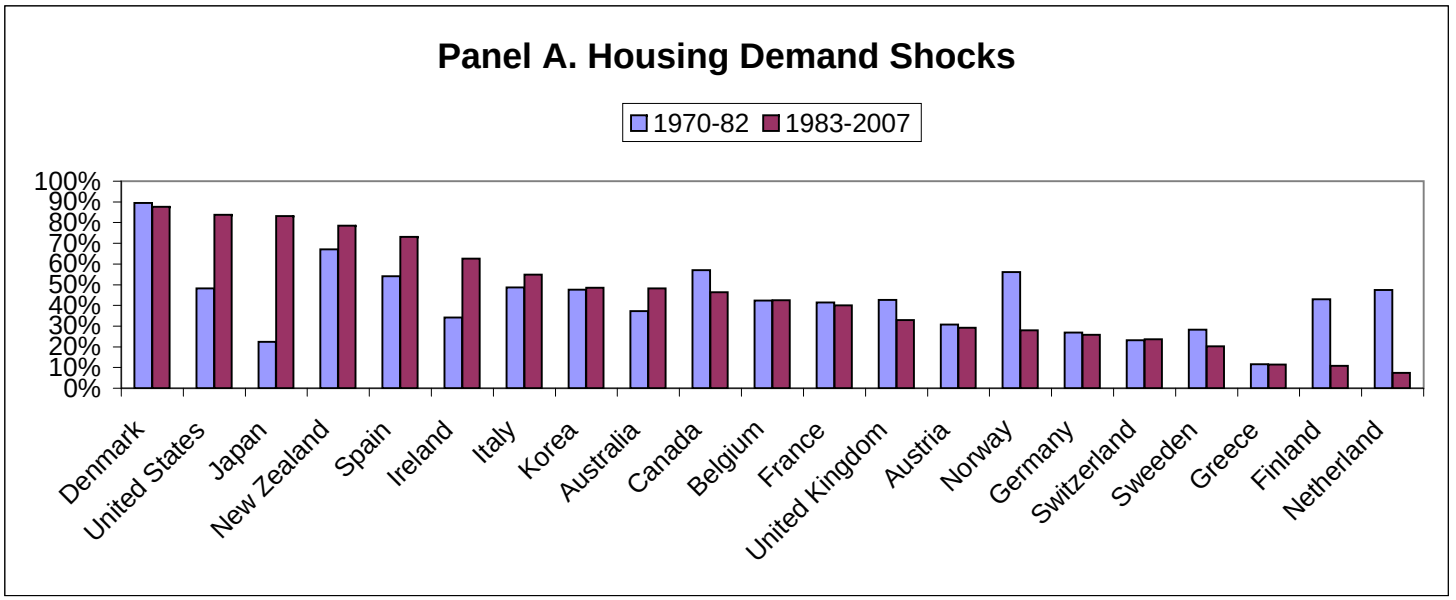


Figure 9. House Price Variance Shares - C



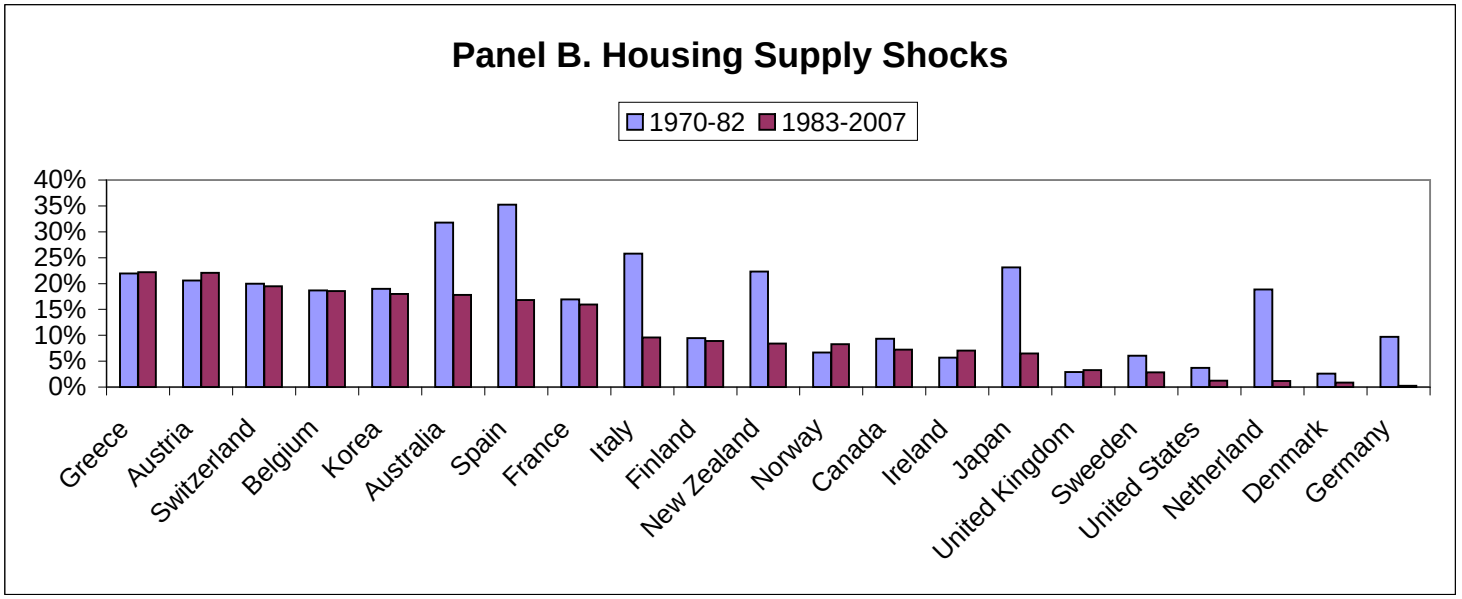


Figure 10. Consumption Variance Share and Mortgage Market Index

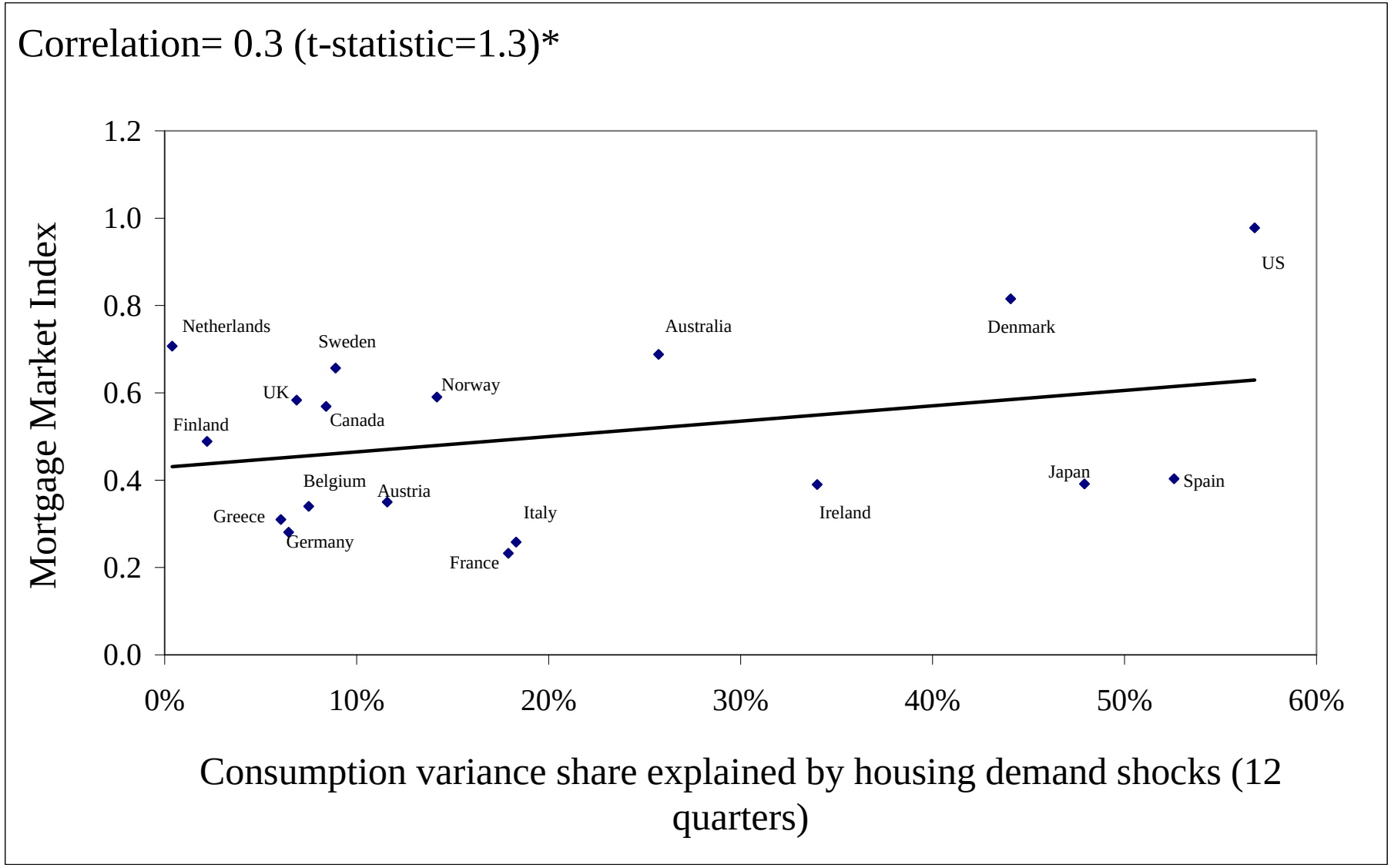


Figure 11. Consumption Variance Share and Mortgage/GDP