Housing Channels of Monetary Policy Transmission in European Industrial and Transition Countries

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Abstract

We estimate an identical vector autoregressive (VAR) model with house prices and residential investment for 14 European industrial countries, 7 Central and Eastern European (CEE) countries and the US. Using counterfactual simulations of consumption and investment responses to policy rate induced housing demand shocks, we study the role of the housing market in the monetary policy transmission. Consistent with the literature, we find evidence of more pronounced wealth and collateral channels in countries with flexible mortgage markets. Institutional factors such as loan-to-value ratios, availability of mortgage equity withdrawal, fee-free prepayment and securitization of mortgage loans strengthen the role of the housing market in the monetary policy transmission. The type of mortgage contract (variable or fixed) is not crucial. Countries exhibiting housing effects have high ratios of mortgage debt to GDP. Housing effects are also observed in the Baltic countries Estonia and Lithuania exhibiting strong growth of mortgage debt during the last decade.

JEL Classification Codes: C32, E52, F41

Key Words: House prices, monetary transmission, housing channels, impulse responses, counterfactual simulation, VAR, CEE, industrial and transition countries

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1 Introduction

In the last years, the role of housing for the macroeconomy has often become a matter of discussion due to strong house price increases in many countries and the following financial crisis. The important role that housing plays in the transmission of unexpected policy rate shocks to the business cycle has aroused a growing interest among central bankers and researchers in recent years. One reason of the importance of housing for the real economy is the large fraction of more than one half out of total households' net worth (about 60 percent in the euro area in 2007 and about 50 percent in the US in 2008) that it represents. Furthermore, housing assets are spread more evenly over the population as for example stocks. More than a half of the households in the majority of euro area countries, the UK, and the US own a property, which makes consumption decisions vulnerable to changes in house prices. A real estate can also be used as a collateral in the lending sector amplifying the impact of housing in the monetary transmission mechanism by changing the value of the balance-sheet position of households. The latter has gained in importance in the recent financial crisis due to a worsening in the credit-risk position of mortgage indebted households following a fall in their collateral values. Real estate investment becomes more attractive with increasing house prices and, as a consequence, can also increase. These are only some of the channels[1] through which housing intermediates in the monetary policy transmission and whose strength depends on different institutional features of the mortgage markets. In which European industrial and transition countries housing channels are pronounced and which institutional factors are crucial for the monetary policy transmission through housing are some of the questions we will try to answer in this paper.

We, first, estimate an identical VAR model for 7 Central and Eastern European (CEE) countries, 14 Western-European countries and the US and then conduct counterfactual simulations for each of the countries in the sample. In spite of the most existing studies concentrating only on a small sample of industrial countries (mainly the US or the UK), we extend the analysis by also including European transition countries, for which little house price data is available. We account for structural breaks in each industrial country. The VAR models include the same variables and the same ordering for each country, which makes the results well comparable across countries. We use a counterfactual simulation to disentangle the housing channels of monetary policy transmission. Although some studies already use this technique, a deeper examination of the different housing channels across a broad sample of countries is needed, as mortgage markets differ considerably across countries within the European Monetary Union (EMU). Furthermore, we will address the question whether the new EU member states that have not adapted the Euro

[1] We will refer to them further as housing effects

yet, show differences in the transmission of policy rate shocks through house prices. We will also show whether the transmission through the housing channels has changed within a country in which a structural break has been observed.

The results of this paper shed light on the role of heterogeneity in the housing markets in the transmission of monetary policy shocks. We find evidence for existing housing channels in countries with well developed housing markets. In countries with less developed housing markets, on the other side, weak or no housing channels have been observed. Institutional factors such as high loan-to-value ratios, long loan maturity, availability of mortgage equity withdrawal, fee-free prepayment, and a large stock of secured products are observed in the industrial countries in which strong housing channels have been observed. We find evidence that housing effects are more pronounced in both industrial and transition countries with high shares of mortgage debt of GDP. However, our results show that housing channels are not necessarily stronger in countries with variable rate mortgage contracts. Housing effects can still play an important role in the monetary policy transmission in countries with fix rate mortgage contracts if the mortgage market is well developed and complete. We observe wealth and collateral effects in Denmark, Ireland, the Netherlands, Spain, Sweden, and the US. The Tobin's q channel is pronounced in the Netherlands, Norway and Sweden. In Denmark, Sweden, Spain and the US the role of the housing market in the monetary transmission has amplified since the mid 1990s, especially the wealth and collateral channels have gained in importance. Although the CEE countries have still incomplete mortgage markets, housing effects are observed for some of them. Wealth effects are observed in Estonia and Lithuania – the countries with the highest ratio of mortgage indebtedness to GDP across the CEE economies. Tobin's q effects are shown only in Estonia.

The paper is structured as follows. Section 2 discusses the monetary policy channels of transmission through housing and examines institutional differences in the housing markets across the countries in the sample. In Section 3, the estimation methodology will be explained and the results of the estimation presented. Section 4 explains the results from the counterfactual simulations and discusses the existence of indirect housing channels. Section 5 concludes.

2 Housing channels in the monetary transmission mechanism

The housing market can influence consumption and residential investment directly through the cost-of-capital effect and the interest-rate-income effect or indirectly through the wealth effect, the rents and savings effect, the collateral effect or the Tobin's q effect (see Fig. 1). The strength of these effects depends on institutional factors as well as on the pass-trough from monetary policy rates to mortgage rates. The higher the fraction of the policy rate change transmitted

to a mortgage rate, the stronger will be the role of the housing sector for consumption and investment.

2.1 Direct housing effects

The user-cost of capital effect arises from the direct impact of the interest-rate channel and presents the expected cost of holding housing capital for a given period (ECB (2006)). It takes account of several factors, of which the mortgage rate is most important. Other factors are related to the depreciation of the house, expected appreciation of house prices and taxes payed on housing capital gains or tax deductability of mortgage. Changes in the user-cost of capital can affect household spending as well as residential investment. When policy rates decrease, long-term interest rates also tend to decline according to the expectation hypothesis of the term structure. Thus, the user cost of capital decreases and the demand for housing increases. A rise in housing demand leads to an increase in housing construction and hence to higher aggregate demand in the economy (Mishkin (2007)). However, even an equal change in retail rates can have different after-tax effects on borrowers across countries if mortgage interest tax relief is available (MacLennan et al. (1998)). In most euro area countries except Germany, France and the UK mortgage interest tax relief is available (see Tab. 4).

Another direct housing effect stemms from the interest rate income of existing borrowers with variable mortgage loan rates. With falling interest rates, borrowers have to repay less and, as a result, can spend more on consumption (see MacLennan (1994)). The net effect on consumption will depend on the relative propensity to spend, i.e. on the redistribution effect. It is assumed that net borrowers have higher propensity to consume than net lenders. Countries in which the prevailing type of mortgage contracts have variable rates[2] are Finland, Greece, Ireland, Italy, Norway, Portugal, Spain and the UK (see Tab. 2). These countries will be more sensitive to interest rate shocks, as interest rate changes feed through quickly into monthly mortgage payments. Variable mortgage rate contracts in the CEE countries are available to a large extent in Bulgaria, Lithuania, Poland and Slovenia (see Tab. 3). In Hungary such contracts have been introduced in 2005 but most of the outstanding mortgage debt is in form of fixed rate contracts. The remaining countries have outstanding mortgage contracts with initially fixed interest rates[3]. However, the period of fixation differs across countries. In Sweden most of the fixed rate contracts are made for more than 1 but less than 5 years. In Germany and

[2]Variable interest rates contracts are tied to a reference rate for (less than) one year, following an external index (e.g. Euribor, central bank base rate).

[3]Initially fixed interest rate contracts have an initial period with fixed rates varying from 1 to 20 years and then can be fixed for another period or reverted to a variable rate. In most cases interest rates have also been fixed for the next period. Most common, however, are periods of 5 or 10 years.

the Netherlands for more than 5 years, in Belgium and France the mortgage rate is fixed for more than 10 years. The differences of the type of mortgage rate are due to different factors such as legislation incentives for banks (e.g. Spain), unfamiliarity with long term fixed rate products (e.g. UK), unattractive fixed rate mortgage loans at falling interest rates (e.g. Italy). In the US, where mortgage securitization is available, there are more loans with fixed rates although penalty-free prepayment for variable rate contracts is common. As mortgage lenders can fund the loans through fixed-coupon callable mortgage-backed securities, they do not bear any borrower's default risk as in other countries (e.g. Spain and the UK) (Green and Wachter (2005)). Though mortgage contracts of fix rate type are more common in the US, the high level of securitization enables faster pass-through from mortgage rates to the broader capital markets and augments the role of monetary policy in the transmission mechanism (Mishkin (2007)).

There is also evidence that highly indebted households have higher long-run marginal propensity to consume (MPC) than other homeowners (see Tobin (1980)) and, therefore, a more pronounced wealth effect can be observed for those households[4] (Hoeller and Rae (2007)). A reasonable explanation of this correlation is that in countries with high mortgage indebtedness credit conditions have been weaker and loans have been awarded also to homeowners with less collateral. The highest mortgage-debt values are observed in Denmark, Ireland, the Netherlands, and the UK ranging between 80 and 100 percent of GDP (see Tab. 2). The lowest indebtedness is shown in Italy (20 percent) followed by Belgium, France and Greece. CEE countries have comparatively much lower indebtedness ranging between 9 and 17 percent of GDP (see Tab. 3). Only in Estonia this share represents 39 percent of GDP in 2008, increasing significantly from only 4.7 percent in 2000. This enormous growth of the mortgage market was pushed by the financial market liberalization and the buoyant economic growth of the country. Furthermore, as a consequence of the currency board, inflation decreased significantly and Estonian interest rates tightly followed the low ECB rates in the first half of the decade. Although mortgage debt represents only a small share of the GDP, the outstanding mortgage stock in the CEE countries has nearly doubled from 2004 to 2007 (ECB (2009a)). In the euro area, the ratio of mortgage debt to GDP increased from 37.5 percent in 2000 to 49.8 percent in 2008. This can be attributed to low interest rates, to liberalized and more efficient mortgage markets or to higher competition of banks for market shares (ECB (2006) and ECB (2009a)). Furthermore, improving expectations of future income, income growth and a more favorable tax treatment of housing loans in the CEE countries (e.g. Czech Republic, Estonia, Lithuania, Hungary) could have lead to the robust increase of the mortgage debt[5]. The strongest growth is declared in countries with

[4] See Section 2.2.

[5] However, the stock of mortgage debt in the CEE countries is still at a low level. Clear property rights and

initially lower mortgage debt-to-GDP ratios as Ireland, Italy and Spain, Bulgaria, Lithuania and Poland, which indicate a process of catch-up towards more flexible mortgage markets. High increases have also been observed in the UK and Estonia. Only in Germany the growth was negative.

The role of the effects stemming from the interest rate channel also depends on the extent to which bank rates respond to changes in policy rates. A look at Figures 2 and 3 can raise some questions concerning the pass-through from policy rates to bank lending rates. In most industrial countries, the spread between both interest rates remains relatively constant over the entire sample and does not vary much across countries. The biggest spread has been observed in Belgium. Variations in the spread have been observed mainly in the US, Norway and France, where the lending rate has not responded fully to a decline in the money market rate in the first half of the 1990s and the 2000s. The spreads across the CEE countries differ considerably. The value of the lending rate in Bulgaria, Lithuania and Slovenia is more than twice of that of the money market rate. However, in most of them a slight trend of convergence of lending rates towards money market rates has been observed. In Poland and Hungary spreads are small, similar to these in industrial countries.

2.2 Indirect housing effects

The wealth effect, the collateral effect, the rents and savings effect and the Tobin's q effect count to the indirect housing effects because they appear following a policy rate induced change in house prices (see Fig. 1). The strength of these effects is deeply determined by institutional factors that differ considerably across countries. The housing channels of monetary policy transmission can be more pronounced in countries with more developed mortgage markets, such as Ireland, the Netherlands, the UK, the US and Nordic countries. In continental European countries, where mortgage markets are characterized by less flexibility, consumption and investment should react less to policy rate induced house price changes (see MacLennan et al. (1998) and Catte et al. (2004)). In CEE countries, in which the flexibilization of the mortgage markets has recently been observed, only small housing effects should be observed.

2.2.1 The housing wealth effect

The wealth effect results from the transmission of monetary policy to consumption through the indirect interest rate channel. It is based on the life cycle theory (or permanent-income theory) of consumption developed by Ando and Modigliani (1963). It operates at an individual level

systems of title deeds can, therefore, still increase this share (ECB (2009a))

and considers that the income expected over the entire lifetime determines current consumption spending. This effect is often believed to be the strongest indirect housing effect partially because more than a half of the households in the considered countries own a real estate and this affects consumption, which share in GDP is 57 percent in the euro area in 2007 (see ECB (2009b)). When house prices increase, the value of the real estate of home-owners increases too. Therefore, an additional incentive exists for them to consume more out of the increased value of the housing wealth. Besides being an investment asset, a mortgage can also provide housing services (Iacoviello (2000)). The price of consuming these services is either the rent for tenants or the *imputed* rent for homeowners that they would have spent if renting a house. Therefore, a house price increase has two effects on homeowners that run in opposite directions (ECB (2009b)). In terms of an asset, an increase in housing wealth makes homeowners wealthier. In terms of a service good, living in the house becomes more expensive due to higher opportunity costs. So, even though mortgage payments do not change, homeowners implicitly have to pay more for living in the own house. The net wealth effect is, therefore, unclear and can depend on the time period that the homeowner plans to live in the same house. For homeowners that intend to spend the entire lifetime in the same house and to pass it through to their children, a rise in house prices will be associated with an increase in the implicit cost of their house (Mishkin (2007)). Hence, consumption spending will probably not increase for such homeowners. For those homeowners that will move to another house, the net effect will depend on the reason of the movement (Zhu (2005) and Mishkin (2007)). If the person moves to a cheaper house, funds can be raised and used for consumption purposes. The contrary is true if the mover replaces the old house by a more expensive one.

The strength of the housing wealth effect also depends on whether the house price changes (gains or losses) are perceived to be permanent or temporary (Zhu (2005)). Households often treat changes in housing wealth as more permanent than financial wealth, suggesting that housing wealth may have a larger impact on consumption than changes in other asset prices. Furthermore, Lettau and Ludvigson (2003) find that changes in house prices are less volatile than those in other equities as for example in stocks. Therefore, households change their expenditure faster following a change in house prices. Catte et al. (2004) argue, however, that a change in housing wealth has less impact on consumption than other assets because most variations in housing wealth reflect changes in valuation rather than changes in the stock of housing[6].

The strength of the wealth effect on consumption will depend also on the financial position of the household. Wealthier homeowners, for example, do not react to house price changes as

[6]See also the next subsubsection.

strong as young (and less wealthy) first time home-buyers or tenants[7]. The housing wealth effect is also likely to be stronger for younger households because the time span that remains for them to work is longer (Attanasio et al. (2005)). So, if there is a change in their future earnings expectations (e.g. belief of higher productivity, expectation of lower taxes) or a reduction in uncertainty, the value of total earnings over the entire lifetime increases or the discount rate of future incomes decreases and households will have higher disposable income to spend on consumption.

2.2.2 The collateral effect

The collateral effect, also called the balance-sheet effect, results from the transmission of monetary policy to consumption through the credit channel. The collateral effect, in contrast to the wealth effect, does not imply a change in lifetime consumption, but a change in the timing of consumption, as an increase in the amount of collateral does not increase household wealth (Benito et al. (2006)). In frictionless credit markets, a change in the collateral value will not affect bank and investment decisions. However, due to information asymmetries in credit markets, households can borrow more against the collateral value of their homes when house prices increase. For existing mortgage borrowers, the terms of the loan can be alleviated and they have to spend less on mortgage payments, and hence, substitute against other consumption goods (Mishkin (2007)). Furthermore, through the financial accelerator framework, higher collateral values reduce the gap between the risk-free rate and the effective interest rate (see Bernanke and Gertler (1989)). The lower the risk premium is, the cheaper it is for households to borrow leading to an increase in consumption and investment (see Kuttner and Mosser (2002) and Mishkin (2007)). When house prices increase, homeowners have additional collateral that they can use to withdraw equity from by increasing the borrowing secured by housing assets. The importance of the mortgage equity withdrawal (MEW) for stimulating consumer expenditure depends on the extent to which housing wealth can be accessed, and in particular, on the cost to extract equity and thus, on the flexibility and efficiency of mortgage markets. Countries in which MEW is available are the UK, US, the Netherlands and the Nordic countries Denmark, Finland, Norway, and Sweden (see Tab. 1). In the majority of continental European countries, such as France, Belgium, Germany and Italy, MEW is, however, not available due to legal protections of collateral and long legal procedures for repossessions (Hoeller and Rae (2007)). In Spain and Ireland the use of MEW is limited. A majority of studies[8] emphasizes the role of the MEW for

[7] There exists evidence for a negative correlation between the wealth of the household and the MPC. The MPC is lower for households with higher incomes (Souleles (1999)).

[8] See e.g. Greenspan and Kennedy (2005) and Hatzius (2005).

consumption because MEW allows households to "tap their housing wealth and extract housing equity when house prices rise" (Cardarelli et al. (2008)). Hoeller and Rae (2007) show that the size of the MEW is strongly correlated with the MPC. The low incentive to consume out of the increased housing value can be attributed to more severe liquidity constrains in credit markets in these countries. In spite of the considerations above, some authors (see Benito et al. (2006) and Mishkin (2007)) have doubts on the direct effect of MEW in determining consumer expenditure. One of their arguments is that households that withdraw equity are more likely to use the funds to pay off debt or save them, rather than immediately spend them. Furthermore, homeowners who undergo substantial appreciation of their housing are most probably less or even not credit-constrained. According to the permanent-income hypothesis, wealthier households should spend more, so MEW should be "the last step on the way to higher consumer spending" (Mishkin (2007)). Another critical aspect is that MEW can be reinvested in the housing sector instead to feed back to consumption. The net effect of MEW per se is, therefore, unknown and requires an in-depth empirical analysis.

2.2.3 The rents and savings effect

The rents and savings effect[9] can offset the wealth and collateral effects. It can also be referred to as a negative wealth effect implying that an increase in house results in a decrease of consumption expenditure. This effect is relevant for those households that do not have housing wealth. Increasing house prices affect tenants negatively in two ways. First, if they have planned to buy a house in the near future and have saved, their savings are worth less. So, they have to substitute current consumption against higher savings and therefore a savings effect will be observed[10]. Second, their available income reduces due to an increase in rents – a rents effect. Both effects can reduce consumption expenditure of these households. The extent to which tenants react to house price changes depends on the housing tenant structure[11] and on the elasticity of rents to house price changes (ECB (2009b)). If the rental market is subject to high rent controls the house price increase will be passed through to the rent with a lag and only to some extent, therefore, implying a less pronounced rents and savings effect. Considering the ratio of homeowners, it can be suggested that the higher it is, the less households could potentially be affected by the rents and savings effect.

[9] It is also called the income effect or the negative wealth effect.

[10] This effect can also be regarded as a part of the wealth effect and then the net wealth effect will be negative. However, we decide to separate the positive and negative part of the wealth effect in two effects – a wealth effect and a rents and savings effect. This will allow us to determine which of both effects prevail in Section 4.

[11] The degree of owner occupation will be discussed in Section 2.3

2.2.4 The Tobin's q effect

Interest rates affect residential construction not only directly by the user-cost of capital but also indirectly through changes in house prices. The profitability of housing investment according to the Tobin's q approach in the special case of housing depends on the market price of the real estate relative to the housing replacement costs (Tobin (1969)). A Tobin's q value higher than 1 suggests that house prices rise faster than the construction costs, and therefore, investing in housing is profitable. Construction costs arise from the acquisition of land and the construction of the housing property – purchase of materials and employment.

Real estate investment represents on average about 6.5 percent of GDP in advanced countries (Cardarelli et al. (2008)). It is notably higher in Ireland (12 percent) and in Spain (9 percent), where an increased construction activity has been observed. However, since 1996 residential investment as a share of GDP has been following a downward trend in the euro area (ECB (2006)). To a large extent, it reflects Germany's slow-down in residential investment after the unification's construction boom. The residential-investment-to-GDP ratio exhibits a slight increase in the euro area when Germany is excluded from the calculations.

The strength of the Tobin's q effect depends mainly on the price elasticity of housing supply. Catte et al. (2004) find a significant negative correlation between the volatility in house prices and the supply of housing for the period from 1970 to 2002. Countries with less flexible housing supply according to this study are the UK, the Netherlands and Denmark. In the short run, however, the supply of housing is inelastic due to institutional factors such as constraints in the land availability, the local planning system, the ease in accessing credit, supply of social housing, construction costs and competitive conditions in the construction sector (Zhu (2005)). The long-run elasticity of housing supply is mainly determined by the scarcity of urban land (Catte et al. (2004)). In the UK restrictive zoning regulation and slow authorization process cause a rigidity in housing supply and make house prices more volatile (see Bramley (1993), Swank et al. (2002), Barker (2003), OECD (2004)). Zoning regulations and slow administrative procedures also explain the supply rigidity in the Netherlands and Denmark (Hoeller and Rae (2007)). In Finland, although it is sparsely populated, house prices have risen much faster than construction costs because of slow planning processes and because of a "low municipality incentive to provide costly infrastructure outside the metropolitan areas" (Hoeller and Rae (2007)). The rise in house prices in Spain is due, on the one side, to the incentive of municipalities, which hold one tenth of the rezoned land to keep land prices high. As they benefit from rezoning, they have an interest to approve more developments. On the other side, the length and the complexity of local planning procedures make the housing supply strengthen and accelerate the house price

increases (OECD (2006)).

2.3 Institutional differences across countries

Despite the liberalization and the deregulation of mortgage markets, significant differences remain in the extent of mortgage market flexibility across European countries. Thus, the strength of the monetary policy transmission through housing will depend above all on some institutional factors such as the degree of owner occupation, transaction costs, prepayment fees, loan-to-value (LTV) ratios, loan maturity, equity release products that enable mortgage borrowers to overcome credit constraints, and mortgage securitization that enables lenders to diversify default risk and to offer more attractive credit conditions and increase loan supply. Recent studies (see e.g. Calza et al. (2007)) have shown that the more developed the mortgage market is, the stronger the correlation between consumption and house prices is.

Home ownership According to the considerations in Section 2.2.1, the net effect of a house price increase on consumption is not clear. A look at the home-ownership ratio can give an insight of what the net effect of house prices on consumption could be, depending on whether tenants or homeowners prevail. The results in Table 2 show that owner-occupation structures differ considerably across countries. The share of owner-occupied housing is very high in Greece, Italy and Spain ranging between 80 and 85 percent in 2008, followed by Belgium (78 percent), Ireland (75 percent), Norway (77 percent) and Portugal (76 percent). In Denmark, Finland, France, the Netherlands and Sweden the rates are lower than the euro area average (around 52 to 59 percent), which may be explained by the fact that households are highly active in renting out housing (ECB (2009a)). Germany is an outlier with an owner-occupier rate of only 43 percent in 2008. According to a survey (see ECB (2009a)), households in Germany own 75 percent of all residential property, 30 percent of which is rented by the private sector to other households. The high share of private renting is due to low regulations on rent increases. On the other end are CEE countries with shares of owner occupation ranging between 75 and 97 percent (see Tab. 3). In Bulgaria, Estonia, Hungary and Lithuania the rates are even higher than 92 percent mainly due to wide privatization processes in the 1990s in these ex-communist countries. An outlier is the Czech Republic where only 59 percent of the residential property was owner occupied in 2008. This may be due to the restitution of many dwellings to former owners and the slow privatization procedures of state housing. Furthermore, about 90 percent of the rental stock is subject to high rental controls and the rents have remained low[12]. This may cause households to prefer to rent instead of buying a house at a price that is comparatively high to the

[12]For more details see www.globalpropertyguide.com

average income and also to house prices in the rest of Europe. Furthermore, in more favorable mortgage markets, where households can access a mortgage loan easier, home-ownership rates may tend to be higher. However, high home-ownership rates are not necessarily related to more flexible mortgage markets. In developed countries such as Spain and Italy, and in CEE countries, the high share of owner-occupation could find its explanation in cultural differences or political regimes (former communist republics). The preference of these households to transfer housing property to their children (Catte et al. (2004)) rather than using it for self-financing, for example in the retirement period (e.g. reverse mortgages, moving to a smaller house, etc.) could also explain the high share of owner-occupation.

Transaction costs Housing transaction costs and taxation can influence the house purchase decision and hence, the housing tenure structure. Higher transaction costs make housing assets less liquid and impede the transmission mechanism from the housing sector to consumption. Transaction costs include among others stamp duties, inheritance taxes, taxes on imputed rents and capital gains on housing assets. Table 4 shows the taxation of residential property for the industrial countries. The highest transaction costs in 2004 have been observed in Belgium, Greece, Italy, Spain, the Netherlands, and also in France, ranging from 8 to 17 percent of the house purchase price. These costs can lower the level of housing transactions in these countries. In Portugal, the UK and Sweden transaction costs present the lowest share of between 1 and 2 percent. The favorable tax regime in these countries may enhance the role of the housing in the monetary transmission mechanism as housing assets are more liquid and flexible. However, a direct comparison of transaction costs should be made with caution, as these costs are estimated differently in each country and the available data does not always refer to the same year or time period. An inheritance tax is common for almost all industrial countries except Greece and Portugal. A tax on capital gains when selling the real estate after 10 or more years has been raised in Greece, Portugal, Spain, Sweden and the UK. In the remaining countries principal owner-occupied dwellings are exempted from the tax. Imputed rents are taxed mainly in Nordic countries – Denmark Norway, and Sweden, in the Netherlands, and in Belgium. Stamp duty is charged in most countries. The highest stamp duty is payed in Greece and Belgium (between 10 and 13 percent in 2001), the lowest in Portugal, the UK, Sweden and Denmark (between 0.8 and 3 percent). In countries where mortgage interest tax relief is available, households will have a higher incentive to buy a house and free funds that they can spend on consumption. Catte et al. (2004) found that a more favorable tax treatment of mortgage interest by lower after tax mortgage rates leads to higher variability in house prices. Higher house price variability strengthens the role of housing in the monetary transmission mechanism. Negative tax wedges

and high house price variation have been observed in the Netherlands, Spain and Finland. The opposite is true for Germany and the UK, where mortgage tax deductability is not allowed.

Furthermore, in countries in which fee-free prepayment of the mortgage loan is available, changes in policy rates will have larger impact on consumption as households prefer to repay earlier when interest rates fall. Countries in which this option exists are the US, Denmark, Finland, Ireland and Sweden (see Tab. 1).

Loan-to-value ratio High loan-to-value (LTV) ratios and long loan maturities can indirectly contribute to changes in consumption spending by making households more vulnerable to house price changes. The higher the LTV ratios are, the easier it is for liquidity-constrained households to get a higher loan against a given collateral. In countries such as the Netherlands, France, Ireland, Belgium, Denmark, and Sweden LTV ratios are very high starting from 80 percent up to 100 percent in the Netherlands. The lowest LTV ratios are observed in the Mediterranean countries Portugal, Greece, Spain, and Italy ranging between 56 and 65 percent in 2008 (see Tab. 1). One reason could be the existence of asymmetric information between borrowers and lenders, against which lenders protect themselves by lowering LTV ratios (or increasing down-payments) (Chiuri and Japelli (2001)). As argued by Casolaro et al. (2005), it can be also caused by low social capital, weak legal enforcement and considerable variation across regions. LTV ratios differ considerably not only across industrial countries but also across CEE countries. Very high LTV ratios ranging from 90 to 100 percent in 2008 have been observed in Estonia, Poland and Bulgaria as a result of the deregulation of the housing and financial markets (see Tab. 3). In Slovenia, the Czech Republic, and Hungary the values are among the lowest in the European Union, between 56 and 61 percent. That LTV rates in these countries did not increase to the same extent as in other developing countries can be explained by a slow deregulation of the housing markets or by problems in the legal environment such as underdevelopment of the land registration system or the foreclosure procedure[13]. Lithuania is somewhere in the middle with a share of 75 percent and therefore similar to the US, the UK, and Germany.

Securitization The development of secondary mortgage markets and securitization lowers the risk in bank balance sheets as it allows them to transfer it through asset-backed securities to institutional investors. The funding via capital markets enables banks to provide more credit to households, thereby increasing the stock of household mortgage debt (see Hirtle (2007) and Cardarelli et al. (2008)). Countries in which securitization is available show a high degree of mortgage market flexibility and development. Mortgage loans can be repackaged in form of

[13]See http://www.globalpropertyguide.com/Europe/Slovenia/Price-History

residential mortgage backed securities (RMBS) or covered bonds. RMBS are common in the US and account for about 70 percent of total residential lending in 2006 (see Tab. 2). Covered bonds are mainly used in Europe and present a high share of total residential lending in Denmark, Sweden, Spain, Germany and Ireland. The difference to RMBS is that in case of a default "the investors' claim is not limited only to the mortgage pool of the special purpose vehicle (SPV), but to the issuer as well" (Ahearne et al. (2005)). In Europe, RMBS have been used mainly in Portugal, the UK and the Netherlands with a share between 18 and 25 percent in 2006. The UK's RMBS accounted for more than half of the European issuance in 2004 (see Ahearne et al. (2005)) reaching almost 80 percent of the European RBMS in 2008 (see ESF (2008)). RMBS are also available in Italy, Spain and Ireland. A secondary market for RMBS does not exist in the CEE countries (see Tab. 3) with deposits being the main funding source in these countries. However, mortgage securitization in form of covered bonds presents half of the residential lending in the Czech Republic and Hungary.

Index of Mortgage Market Flexibility In order to measure the flexibility of the mortgage market, the IMF constructs an index that summarizes the discussed institutional factors above and enables the direct comparison of the mortgage market completeness across developed countries (see Cardarelli et al. (2008)). The heterogeneity of the institutional features explains why the IMF-index varies strong across economies. The highest index values ranging between 66 and 98 percent are assigned to the US, Denmark, the Netherlands and Sweden (see Tab. 1). Mortgage markets in these countries are characterized by LTV ratios of about 80 percent, mortgage maturity of about 30 years and availability of MEW and fee-free prepayment. Continental European countries such as Belgium, France, Germany and Italy are at the lower end mainly due to the low securitization and the rather limited access to financing as shown by the low shares of mortgage debt.

3 Estimation

3.1 Existing evidence

The role of house prices in the monetary transmission will be assessed by estimating an identical vector autoregressive (VAR) model for each country in the sample. The indirect housing effects for consumption and investment are disentangled by conducting counterfactual simulations following Bernanke et al. (1997). Existing studies on the role of wealth in the transmission mechanism mainly estimate VAR models and analyze impulse responses. Only a few authors quantify the housing effects for industrial countries. Ludvigson et al. (2002) estimate a SVAR for

the US in the period from 1966:1 to 2000:3, including a variable of total wealth. They find that the wealth channel is of a minor importance for the transmission of monetary policy to consumption in the US. Elbourne (2008) estimates an eight-variable SVAR for the UK from 1987:M1 to 2003:M5 and comes to similar results for the housing effects in UK. Giuliodori (2005) conducts counterfactual simulations for 9 European countries using a VAR for the pre-EMU period from 1979:3 to 1998:4. He finds out that house prices play an important role in the monetary transmission mechanism in countries with flexible and developed mortgage markets such as Sweden, the UK, Spain and the Netherlands.

The role of the housing markets in the transmission of policy shocks for the new euro area members is also important concerning the future adaption of the Euro, however, it has not been studied yet. Only a few studies estimate the effect of interest rate shocks on output using a VAR framework. Existing literature for CEE countries is summarized in Table 8. Most studies use monthly data and, therefore, include the construction output index and not GDP or consumption, for which only quarterly data is available. Most of the estimations start in the mid 1990s and range until 2007. The countries included are mainly Poland, Hungary, the Czech Republic and Slovenia. The VAR models do not include a house price variable. Only Posedel and Vizek (2009) include housing variables in order to study the house price determinants in 3 CEE countries. Studies by Jarocinski (2008), Anzuini and Levy (2007), as well as Elbourne and de Haan (2009) compare the role of the monetary policy among the old and the new euro area members. The results of the first two authors show similarities of impulse responses across both groups. Elbourne and de Haan (2009), however, find substantial differences in the monetary transmission across the CEE countries in the sample.

3.2 Data

The empirical analysis is conducted for 22 countries including 7 CEE countries (Bulgaria, the Czech Republic, Estonia, Hungary, Lithuania, Poland and Slovenia), 14 Western-European countries (Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden and the UK) and the US. The reason for choosing this broad sample of industrial countries lies in the heterogeneity of their housing markets, in differences in the available financial housing instruments and in the flexibility of their mortgage markets. Furthermore, we extend the sample by also including CEE countries in order to compare the differences in the monetary policy transmission through housing across euro area and non euro area countries.

The data are quarterly and estimation samples range up to the second quarter of 2008. The

sample period for the CEE countries begins in late 1990s, depending on the house price data availability. For industrial countries estimations begin in the 1980s, however, the samples differ across countries as we account for structural breaks. Chow tests indicate that for most of the industrial countries the sample periods should be splitted around the mid-1990s, with splitting points ranging between 1992 and 1999. For France and Ireland the entire sample period has been estimated as no significant structural break points have been observed. A VAR for Germany has been estimated starting in 1992 in order to account for possible structural breaks during the unification and also due to a lack of data for whole Germany prior to 1990[14].

Our VAR model consists of 5 variables. Bearing the risk of omitting important information by using a small model, we try to find a trade-off of constructing a good economic model and saving degrees of freedom. The variables included are the consumer price index (CPI), private consumption expenditures (CONS), gross fixed capital formation (in housing) (GFCF)[15], house prices (HP) and a money market rate (IR). The majority of the time series come from the International Financial Statistics (IFS) of the IMF (see Tab. 7). Where data from the IFS was not available, other sources such as the OECD and DataStream have been used. All the variables except interest rates are in real terms (deflated using the CPI and index values), seasonally adjusted and in logarithms. The house prices for the most industrial countries come from the OECD[16]. Data for Belgium, Greece and Portugal have been provided by the Bank for International Settlements (BIS). The data for the CEE countries comes from national sources and the BIS (see Tabs. 5 and 6). House price data for the industrial countries has been indexed to 100 in 2000 and to 100 in 1998 for the CEE countries. Figure 4 shows the evolution of real house prices across the countries in the sample. In the majority of the industrial countries, house prices increase in the second half of the 1980s due to a deregulation and liberalization of the mortgage markets. We observe that in the first half of the 1990s, house prices fall slightly and then increase in the second half of the 1990s for nearly a decade. Only in Germany house prices are decreasing since the the mid 1990s after a slight increase in the early 1990s due to the unification of East and West Germany. On the upper end are Spain and Greece, where house prices reach an index value of almost 200. In Finland a strong house price increase is observed in late 1980s, followed by a strong decrease until the mid 1990s. The level of the house prices in the US until 2000 is beyond the rest of the countries. Exception make France, Italy and Spain. However, in the majority of these countries (e.g. UK, Denmark, Ireland, Greece, etc.) house prices increase rapidly in the mid 2000s. The CEE countries follow the trend and increase

[14]Only estimated data for West Germany is available.

[15]For most industrial countries GFCF for housing was available. For the CEE countries only total GFCF was available.

[16]For details on house price description and sources see Tabs. 5 and 6.

steadily in the first years of the 2000s. Due to strong economic growth, low interest rates and a rapid expansion of mortgage markets, property prices in most of them (e.g. Bulgaria, Estonia, Lithuania and Slovenia) rise rapidly from 2004 to 2007. In the Czech Republic house prices increased slowly until 2003 and stay unchanged until 2006 where a faster increase is observed probably due to a deregulation of controlled rents[17]. House prices in Hungary rise fast until 2004 when interest rate subsidies for mortgages were cut and the house price growth decelerated.

3.3 Methodology

Following the vast majority of VAR literature based on the monetary policy transmission, we estimate a VAR in levels, as the monetary policy transmission mechanism is a short-run phenomenon although unit root tests indicate that most of the variables are integrated (see Tab. 14). This estimation is not efficient, as it does not account for the existing stochastic trends and hence for the long-run dynamics, but it produces consistent estimates (see Sims et al. (1990))[18]. Furthermore, long run restrictions are made based on economic theory and are often controversial and not reliable, and can lead to potential inconsistency, when the incorrect identifying restrictions are imposed (Favero (2001)).

The reduced-form VAR model is given as follows:

$$Y_t = C_1 Y_{t-1} + ... + C_p Y_{t-p} + u_t \tag{1}$$

where Y_t represents a $(5x1)$ vector of endogenous variables in time t depending on p $(5x1)$-lagged vectors of dependent variables. C_1 to C_p are $(5x5)$ coefficient matrices of the lagged variables. As the vector of the forecast errors u_t does not correspond to a particular fundamental economic shock, the structural VAR model has been estimated in the form:

$$AY_t = AC_1 Y_{t-1} + ... + AC_p Y_{t-p} + B\varepsilon_t \tag{2}$$

with

$$Au_t = B\varepsilon_t \Leftrightarrow u_t = A^{-1} B\varepsilon_t \tag{3}$$

The ε_t is a $(5x1)$ vector of structural economic shocks. Impulse responses (IRs) of the endogenous variables have been computed multiplying the variables in Equation 2 by a lag-operator L from

[17] For more information see www.globalpropertyguide.com.

[18] Sims et al. (1990) show that when the variables are cointegrated, a VAR in levels can be estimated consistently. We conduct Trace and Maximum Eigenvalue cointegration tests and the results indicate that in all estimations the variables are cointegrated (see Tab. (9)). An alternative would be to estimate the VAR in first differences. We loose, thereby, however, important information contained in the levels. Hence, the model could be misspecified and over-differentiated (see Giuliodori (2005))

order p equal to the number of lags:

$$AY_t = C_1 LY_t + ... + C_p L^p Y_t + B\varepsilon_t \tag{4}$$

with $L^p Y_t = Y_{t-p}$. Equation 4 allows us to express the depended variables Y_t only in terms of the structural shocks ε_t. Therefore we rewrite it as:

$$Y_t = (I + C_1 L + C_2^2 L^2 + ... + C_p L^p)^{-1} A^{-1} B\varepsilon_t \tag{5}$$

and eliminate the lag-polynomial L:

$$Y_t = \Psi_0 \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \Psi_2 \varepsilon_{t-2} + ... \tag{6}$$

where the matrices Ψ include the response coefficients to one standard deviation (S.D.) shocks in ε_t over 20 quarters. The impulse response functions in Equation 6 are computed from the matrices A, B, and C_1, C_2,...,C_p. The C matrices are estimated in the reduced-form VAR via ordinary least squares (OLS). A and B are estimated from the SVAR via maximum likelihood.[19] After estimation the impulse responses, counterfactual simulations have been conducted setting the effect of the house price shock on consumption or investment to zero. That is, the coefficient c_{24} (c_{34}) in the C matrices is set to zero in order to account for housing effects on consumption (investment). Then both coefficients c_{24} and c_{34} in each C matrix are simultaneously set to zero in order to disregard also external housing effects on investment that can influence consumption and vice versa. However, shutting off the lagged effects of house prices on consumption (investment) will have little impact, if consumption (investment) is predictable strongly by lagged consumption (investment) and not much by other variables (see Ludvigson et al. (2002)).

The number of lags included in each model is specified, in order to account for remaining residual autocorrelation and ranges between 1 and 3 (see Tab. 9). We identify the economic shocks using a Choleski decomposition of the estimated covariance matrix of the reduced-form residuals from Equation 1. Here we presume that the true economic model is recursive with the vector of endogenous variables given as $Y_t = (CPI_t, CONS_t, GFCF_t, HP_t, IR_t)$. Following Bernanke and Blinder (1992), we assume that monetary authorities are concerned about the dynamics in macroeconomic variables such as inflation, consumption and investment (see also Ludvigson et al. (2002) and Giuliodori (2005)). Furthermore, central banks react to current and past information about house prices. Consumption and investment move slowly to innovations

[19] For detailed calculation of impulse response functions an additional appendix can be provided. Please contact the authors for more information.

in policy variables. We assume that investment reacts to new information about consumption and consumer prices. Consumption responds only to price shocks. The house price equation represents a housing demand function that depends on current consumption, investment and prices but does not react to shocks in policy rates within the same quarter.Although house price changes affect consumption and investment, this does not happen within the same quarter as actual house price data is often not available[20].

3.4 Results

Tables 10 and 11 summarize the results for the peak values of the impulse responses of consumption, investment and house prices to positive one S.D. interest rate and house price shocks. Consumption falls temporary in all countries after the shock (see Figs. 5 and 6). Only in Greece and Slovenia a very slight insignificant increase of consumption spending has been observed. Impulse responses are significant in Denmark, Spain, France, Ireland, Sweden and the UK. In Belgium, Germany, Spain, Greece, Italy and the US consumption reacts in the first 1 to 2 quarters after the shock with an increase. The strongest reaction after a one S.D. interest rate shock has been observed in the transition countries Lithuania and Estonia followed by Ireland – consumption decreases by respectively 4.8, 2.0 and 1.6 percent. Interest rate shocks have small impact on consumption in Belgium, Greece and Portugal. In the majority of countries the peak response is reached after 4 years. In the Czech Republic, Hungary and Lithuania consumption recovers more slowly.

A one S.D. interest rate shock decreases investment in all countries except in Sweden[21] (see Figs. 7 and 8). A slight initial increase in investment has been observed in Belgium, Greece and Italy. Similar to the above results, investment responds stronger in CEE countries than in industrial countries. The highest peak response values are assigned to Estonia, Lithuania, Poland and Ireland followed by the US and the Nordic countries. Consistent with the existing literature, we find that the effect of an interest rate shock on investment is much larger at the peak and quicker than the effect on consumption. Investment in industrial countries recovers faster that in CEE countries. It reaches its peak response after 11 quarters at the latest, whereas most CEE countries need at least 12 quarters for investment to begin to recover.

Interest rate shocks decrease house prices in all countries (see Figs. 9 and 10). Significant responses are observed in economies with well developed mortgage markets such as Denmark, Ireland, the Netherlands, Norway, Spain, the UK and the US, as well as in Estonia. Here, we

[20] In some countries house price data were gathered on annual or half-annual basis.

[21] Results for Sweden are not robust. The positive investment response turns negative if we start the estimation earlier or later than 1994.

also observe that house prices respond stronger to the shocks in CEE countries.

In most countries investment reacts positively to house price increases explained by Tobin's q effects. Peak response values do not differ considerably across industrial and CEE countries. In Ireland, Portugal and Sweden[22], however, investment in housing decreases immediately after the shock. Positive but short-lasting effects of only 1-2 years are observed in Greece, the Netherlands and the US. Reasonable explanations can be the existence of a common cause to both house prices and investment or reverse causation, meaning that house prices increase after a decline in housing investment. The last assumption is supported by the low share of house prices of less than 6 percent in explaining variations of investment in these countries (see Tab. 13) and the high share of residential investment in explaining house price variations of between 20 and 45 percent. These results suggest that the housing demand shocks in these countries are not stemming from the house prices but rather from changes in residential investment. The response of house prices to GFCF is positive and significant in almost all of above countries (in Portugal the shock is insignificant, in Greece it is negative). Therefore, we can assume that although consumption decreases following a rise in house prices (see Figs. 11 and 12), a housing demand shock is represented by a shock in residential investment and it increases consumption in all these countries except in Greece.[23] Housing demand shocks stemming from changes in house prices have positive effects for consumption in the majority of the remaining countries. Only in Italy consumption decreases suggesting that rents and savings effects could exist. Consumption in CEE countries reacts positive to an unexpected rise in house prices.

Table 13 shows results for variance decompositions and we can see that they differ considerably across countries. Interest rate shocks explain a maximum of about 20 and 40 percent of the variation in consumption in Ireland, France, Lithuania, Italy, Sweden, Spain, the US and Denmark. The highest shares of 58 and 48 percent have been observed, however, in the UK and in Estonia. Thereby, the role of policy rate shocks has increased considerably in the UK, Denmark, Italy and Sweden, and decreased in Belgium. Interest rate shocks explain a large share in the variation of housing investment in Ireland, Estonia, the US (although their role has decreased) and France, followed by Finland, Lithuania, the Netherlands, Italy and Denmark.[24] The role of the housing markets for explaining variations in consumption has increased significantly in Belgium and Italy, and decreased in Finland, Spain, the UK and the US. Nonetheless, house prices explain a maximum of about one half of the variation in consumption in Spain. House

[22]The investment response for Sweden is, however, not robust. If we estimate the sample starting before 1993, residential investment reacts positively to a house price shock.

[23]These results are consistent to the findings of Musso et al. (2010). They find that a shock in residential investment has the characteristics of a housing demand shock in the US, whereas in the euro area it is the house price shock.

[24]The role of the shocks has increased considerably in Denmark, Finland and Italy.

prices have become less important in explaining variations in investment in Belgium, Denmark, Finland, Sweden and the UK. Interest rates have become more important for house price variations in Denmark, Finland, Italy, Spain, the UK and the US. House price variations in Estonia, Ireland and the UK are explained to between 42 and 48 percent by variations in interest rates. One third of the variations in house prices in Bulgaria, Lithuania, France, the Netherlands and the US is explained by changes in interest rates. The role of residential investment for variations in house prices has increased in all countries in which structural breaks have been observed, except in Italy. Furthermore, we observe that in countries in which inflation explained a high share of the variation in house prices, the role of inflation has decreased since the mid 1990s. However, inflation still explains about 40 percent of house prices in Sweden.

Overall, the responses accord with the economic theory behind a model of monetary policy transmission. Our results show that no qualitative differences in impulse responses across new and old euro area members exist, consistent with the results from Jarocinski (2008). The interest rate and the house price shocks explain a higher share of the variations in consumption, investment and house prices in the US, in Nordic and in Baltic countries than in continental European and CEE countries. For a majority of countries our results remain robust against inclusion or exclusion of different variables (mortgage rate, GFCF, GDP), varying the estimation period and the number of lags.

4 Evidence for housing effects

In this section we turn to the key objective of this paper, namely to assess the role of the housing market for the monetary policy transmission across European industrial and transition countries and to study whether it depends on the degree of development in their mortgage markets. In order to shed light on this question, we conduct counterfactual simulations of the impulse responses of consumption and investment to interest rate shocks. Table 15 and Figures 15 to 20 report the results. In each figure, the dark blue line is the impulse response from the VAR estimation, the red dashed line is the simulated impulse response when the effect of house prices on consumption (investment) has been shut off and the green dotted line is the simulated impulse response when the house price effect is set to zero in both the consumption and the investment equation. In most of the countries consumption and investment are less responsive to monetary shocks under the counterfactual scenario than under the baseline model when lagged values of house prices influence consumption and investment. In this case, housing wealth and collateral effects and Tobin'q effects will be pronounced. If, however, simulated impulse responses lie below the estimated ones, house prices alleviate the negative interest rate

effect on consumption and lead to rents and savings (or negative wealth) effects on consumption. The housing effects are significant when the simulated responses lie outside the confidence bands of the estimated responses. We account for housing effects also when they are not significant but close to the confidence bands of the estimated responses. Figures 15, 16 and 17 show that wealth and collateral effects are observed in Sweden, Spain and Denmark. The CEE countries do not show big differences in simulated and estimated impulse responses. However, wealth effects exist for the Baltic countries Estonia and Lithuania that can be explained by the higher share of mortgage debt to GDP compared to that in the remaining CEE countries. The stronger reaction of simulated impulse responses in Ireland, the Netherlands and the US could be interpreted as a prevailing existence of rents and savings over wealth and collateral effects. However, as we have already shown in Section 3.4, housing demand shocks in these countries are represented by the residential investment equation and lead to increases in consumption. In order to estimate correctly the housing effects on consumption, we simulate new impulse responses to an interest rate shock by setting the investment variable in the consumption equation to zero and leaving all other variables as in the baseline model.[25] By this, we assume that it is rather residential investment that transmits a policy rate shock to the real economy and house prices adjust as a consequence. This assumption is fostered by the results from the variance decompositions which show a Granger causality from residential investment to house prices. The results in Figures 16 and 17 show that the *new* response of consumption under the counterfactual scenario (blue dash-dotted line) is significantly smaller than under the baseline model (dark-blue line). These results show that wealth and collateral effects also exist in Ireland, the Netherlands, and the US. Simulated impulse responses in Germany and the UK lie slightly above estimated[26]. In the remaining countries both impulse responses run close to each other. Insignificant and small rents and savings effects are observed in Finland and Italy. Tobin's q effects on (residential) investment are pronounced in Sweden, the Netherlands, Norway, and in Estonia. The role of the monetary transmission through the wealth and collateral channels has amplified since the mid 1990s in half of the countries in which a structural break has been observed (Denmark, Sweden, Spain and the US)(see Tab. 16).

Overall, the results above show that housing markets are important for the transmission of monetary policy decisions to consumption and investment in countries where the underlying mortgage market is more developed, consistent with the existing evidence on housing channels. Most of the industrial countries in which housing effects have been observed have high ratios of

[25]Small rents and savings effects are also observed in Portugal and in the UK before 1998. We simulate, therefore, new impulse responses according to above considerations.

[26]The results for the UK are consistent with existing studies from Ludvigson et al. (2002) and Elbourne (2008).

outstanding mortgage debt to GDP of over 60 percent and a high index of mortgage market completeness. In the majority of these countries institutional factors such as long loans maturities of more than 30 years, LTV ratios of between 70 and 80 percent, mortgage equity withdrawal, fee free prepayment and mortgage securitization distinguish the mortgage markets. Furthermore, in countries in which housing effects have been observed, interest rate and house price shocks explain a high share of the variations in consumption (investment) and house prices. Mortgage markets in CEE countries play a small role in monetary transmission mechanism as they are still not complete, mortgage equity withdrawal is not available and mortgage securitization is limited. However, housing effects are observed in the Baltic countries, which may be due to the higher share of mortgage debt to GDP. We find that significant housing effects exist also for countries with fixed mortgage rate contracts suggesting a stronger role of the credit channel over the interest rate channel and hence, collateral effects. The findings above do not imply that housing effects do not exist in the remaining countries. Exogenous house price shocks can still influence consumption and investment as shown in Section 3.4. However, endogenous house price changes driven by innovations in policy rates have small impact on consumption and investment.

5 Conclusion

In this paper we study the role of the housing markets for the monetary policy transmission. We assume that housing channels to consumption and investment are more pronounced in countries with more flexible and developed mortgage markets. To research this issue we, first, compare institutional features of the mortgage markets across 21 European industrial and transition countries and the US. We find that Nordic countries, the UK and the US have more flexible and developed mortgage markets. Housing markets across CEE countries show similarities concerning the type of mortgage rate, the low stock of secured mortgages and the high share of owner occupation. However, mortgage markets in CEE countries are still not complete and mortgage debt represents a much smaller share of the total GDP compared to industrial countries. Second, we estimate a five-variable VAR model with house prices and (residential) investment for each country and conduct counterfactual simulations of the impulse responses of consumption and investment to interest rate shocks. The bigger the difference of both responses, the more important the indirect housing channels for the monetary policy transmission will be. Our results show that European industrial and transition countries do not differ considerably in the transmission of monetary and house price shocks to consumption, investment and house prices. Furthermore, we find that institutional features of mortgage markets can explain to a large extent the existence of housing channels and are consistent with existing studies about the role

of the housing markets for the monetary policy transmission. Wealth, collateral and Tobin's q effects are observed mainly in Nordic countries, the US and in Baltic countries. We find that in industrial countries with well pronounced housing effects, mortgage equity withdrawal, high mortgage securitization and fee-free prepayment are available. The existence of housing effects in Estonia and Lithuania can be explained by the strong expansion of mortgage loans in the last decade and the high share of owner occupied housing. The role of the housing markets for the monetary policy transmission has increased in half of the countries in which a structural break has been observed. Wealth and collateral effects have gained in importance in Denmark, Sweden, Spain and the US.

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Appendix

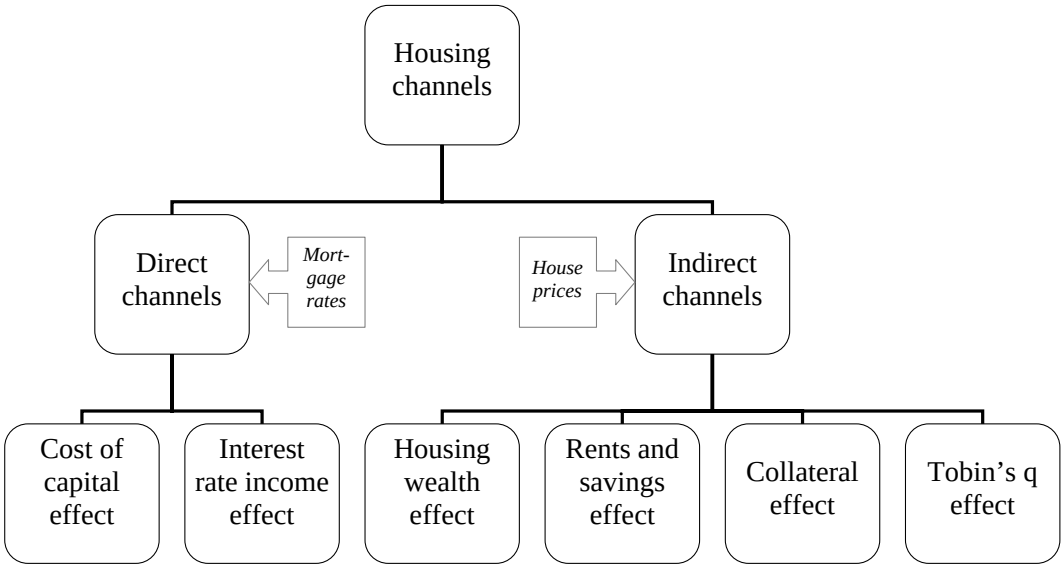

Figure 1: Direct and indirect housing channels (own illustration)

Country	Mortgage market index of completeness	Typical mortgage maturity (years)	Average typical LTV ratio	Mortgage equity withdraw (MEW)	Refinancing (fee-free prepayment)
Year	**2008**	**2007**	**2008**	**2003-2007**	
Belgium	34%	20	80%	no	no
Denmark	82%	30	80%	yes	yes
Finland	49%	20-25	70%	yes	yes
France	23%	19	91%	no	no
Germany	28%	25-30	72%	no	no
Greece	35%	15-20	58%	no	no
Ireland	39%	31-35	83%	limited	yes
Italy	26%	22	65%	no	no
Netherlands	71%	30	100%	yes	no
Norway	59%	17	70%	yes	no
Portugal	-	30-40	56%	-	no
Spain	40%	30	61%	limited	no
Sweden	66%	40	80%	yes	yes
UK	58%	25	77%	yes	limited
US	98%	30	75%	yes	yes

Table 1: Institutional factors across industrial countries

Sources: EMF (2006a), EMF (2008), Cardarelli et al. (2008), ECB (2008), ECB (2009a), Calza et al. (2009)

Country	Outst. RMBS from resid. lending	Outst. covered bonds from resid. lending	Total outst. securitization from resid. lending	Mortgage debt outst. (from MFIs) to GDP	Prevailing type of mortgage rate (a)	Share of variable interest rates	Share of owner occupier
	2006	**2008**		**2008**	**2007**	**2007**	**(b)**
Belgium	2.0%	no	2.0%	39.8%	fixed (>10y)	10%	78.0%
Denmark	no	100.0%	100.0%	95.3%	fixed	30%	54.0%
Finland	no	4.0%	4.0%	47.5%	variable	96%	59.0%
France	3.0%	7.0%	10.0%	35.9%	fixed (>10y)	15%	57.4%
Germany	no	18.9%	18.9%	46.1%	fixed (>5y)	15%	43.2%
Greece	8.0%	6.4%	14.4%	32.0%	variable	90%	80.6%
Ireland	12.0%	15.5%	27.5%	80.0%	variable	67%	74.5%
Italy	15.0%	2.0%	17.0%	19.8%	variable	47%	80.0%
Netherlands	18.0%	3.6%	21.6%	99.1%	fixed (>5y)	18%	57.0%
Norway	no	13.4%	13.4%	53.3%	variable	-	77.0%
Portugal	25.0%	11.5%	36.5%	63.3%	variable	99%	76.0%
Spain	13.0%	46.7%	59.7%	62.0%	variable	91%	84.5%
Sweden	0.9%	63.5%	64.4%	60.6%	fixed (>1y)	50%	52.0%
UK	18.0%	12.9%	30.9%	80.5%	variable	72%	59.0%
US	69.0%	0.2%	69.2%	77.0%	initial fixed	35%	67.8%

Table 2: Institutional factors across industrial countries (continued)

Sources: EMF (2006a), EMF (2008), Cardarelli et al. (2008), ECB (2008), ECB (2009a), Calza et al. (2009); *Notes:* (a) Fixed (>5y) means fixed mortgage rate initially for more than 5 years; (b) Last estimation available: for NO in 2001, for DE, IT in 2002, for BE, FI, FR, PT, SE in 2007, for the remaining countries in 2008.

Country	Typical mortgage maturity (years)	Average typical LTV ratio	RMBS from residential lending	Outst. covered bonds from resid. lending	Mortgage debt outst. (from MFIs) to GDP	Prevailing type of mortgage rate	Share of variable interest rates	Share of owner occupier
Year	**2007**	**2008**	**2006**	**2008**	**2008**	**2007**	**2007**	**(a)**
Bulgaria	-	80%-90%	no	no	11.6%	variable	-	96.5%
Czech Republic	-	56%	no	56.0%	10.8%	-	-	58.7%
Estonia	30	100%	no	no	39.2%	initial fixed	-	96.0%
Hungary	13	61%	no	48.4%	14.0%	fixed until 2005	74%	92.0%
Lithuania	-	75%	no	no	17.3%	variable	-	97.0%
Poland	20-30	90%	no	1.0%	15.6%	variable	99%	75.0%
Slovenia	above 20	61%	no	no	9.1%	variable	80%	82.0%

Table 3: Institutional factors across CEE countries

Sources: EMF (2006a), EMF (2008), Cardarelli et al. (2008), ECB (2008), ECB (2009a), Calza et al. (2009); *Notes:* (a) Last estimation available: for BG in 2002, for HU in 2003, for PL in 2004, for CZ, SI in 2007, for the remaining countries in 2008.

Country	Total transaction costs (a)	Inheritance tax (b)	Tax on housing capital gains (c)	Tax on imputed rents	Stamp duty	Mortgage interest tax relief
	2004	**2002**	**2008**	**2008**	**2001**	**2008**
Belgium	17.1%	yes	no	yes	10%-12.5%	yes
Denmark	3.3%	yes	no	yes	1.5%	yes
Germany	4.5%	yes	no	no	3.5%	no
Greece	11%-13%	no	yes	no	11%-13%	yes
Finland	-	yes	no	no	4%	yes
France	7.8%	yes	no	no	2%-3%	yes
Ireland	5.1%	yes	no	no	0%-9%	yes
Italy	11.8%	yes	no	no	3%,10%	yes
Netherlands	8.6%	yes	no	yes	6%	yes
Norway	-	yes	no	yes	-	-
Portugal	0.8%	no	yes	no	0.8%	yes
Spain	9.7%	yes	yes	no	-	yes
Sweden	2.4%	yes	yes	yes	1.5%-3%	yes
UK	1.9%	yes	yes	no	1%,2%,4%	no
US	-	yes	no	no	-	-

Table 4: Mortgage costs across industrial countries

Sources: ECB (2003), EMF (2006b), ECB (2009a); *Notes:* (a) Total transaction costs include notary's fee, property and mortgage registration, property tax, property valuation costs, loan tax; (b) On own (principal) house; (c) Only on selling own home after 10 years; In DK and US principal owner-occupied dwellings are exempt.

Countries:	**Definition:**	**Source:**
Bulgaria	Residential property prices per m2 national currency of existing flats in big cities	BIS database
Czech Republic	Residential property price per m2 of all dwellings in whole country, quarterly average	BIS database, Financial Stability Report of the Czech National Bank
Estonia	Residential property prices per m2 national currency of existing flats in Tallinn, Q-all	BIS database
Hungary	FHB Index is based on actual buying and selling transaction data of residential real estate from more than 800000 residential properties located in over 3000 municipalities.	*www.fhbindex.hu*
Lithuania	Registered sales private homes m2 housing price changes in the country (compared with 1998, IV quarter in percentage)	Lithuanian State Register of Real Estate
Poland	House price per m2 national currency of usable floor space of a residential building. Relation of outlays incurred in construction of new residential buildings (other than one-dwelling) by investors other than individual to the usable floor of these buildings	REAS and Polish Central Statistical Office
Slovenia	Average advertised prices of houses for Ljubljana per m2 in Euro	Slovenian Statistical Office and SLONEP, www.slonep.net

Table 5: House price data for CEE countries

Notes: The house price data of BG, EE, HU, PL and SI are indexed to 100 in 1998. The index of CZ and PL takes 100 in 1999.

Countries:	**Definition:**	**OECD Source*:**
Belgium	Existing dwellings, whole country (1988=100)	BIS, Stadim, Nationale Bank van Belgie
Denmark	Index of one-family house sold	Statistics Denmark
Finland	Housing prices in metropolitan area, debt free, price per m2	Bank of Finalnd
France	Indice de prix des logements anciens, France	INSEE
Germany	Index for total Germany, total resales	Bundesbank
Greece	Residential property prices per dwelling of all dwellings in urban Greece excluding Athens	BIS database
Ireland	Second hand houses	Irish Department of Environment
Italy	Media 13 area urbane numeri indice dei prezzi medi di abitazioni, usate	Nomisma
Netherlands	Existing dwellings	Nederlandsche Bank
Norway	Nationwide index for dwellings	Statistics Norway
Portugal	Residential property prices per m2 of all dwellings in the whole country	BIS database
Spain	Precio medio del m2 de la vivienda, mas de un año de antiguedad	Banco de Espana
Sweden	One and two dwelling buildings	Statistics Sweden
UK	Mix-adjusted house price index	ODPM
US	Nationwide single family house price index	OFHEO

Table 6: House price data for industrial countries

Notes: *Data for the developed countries is available from OECD. Data for BE comes from BIS. The house price indices take 100 in 2000. For BE in 1988.

	Countries:	**Euro**	**CPI**	**Consumption**	**GFCF**	**Interest Rate**	**Lending Rate**
			IFS of IMF	*IFS of IMF & OECD*	*IFS of IMF & DataStream*	*IFS of IMF*	*IFS of IMF*
BG	Bulgaria	no	91864...ZF...	91896F..ZF..	91893E..ZF...	91860B..ZF...	91860P..ZF...
CZ	Czech Republic	no	93564...ZF...	93596F..ZF...	93593E..ZF...	93560B..ZF...	93560P..ZF...
EE	Estonia	no	93964...ZF...	93996F..ZF...	93993E..ZF...	93960B..ZF...	93960P..ZF...
HU	Hungary	no	94464...ZF...	94496F..ZF...	94493E..ZF...	94460C..ZF...	94460P..ZF...
LT	Lithuania	no	94664...ZF...	94696F..ZF...	94693E..ZF...	94660B..ZF...	94660P..ZF...
PL	Poland	no	96464...ZF...	96496F..ZF...	96493E..ZF...	96460B..ZF...	96460P..ZF...
SI	Slovenia	yes	96164...ZF...	96196F..ZF...	96193E..ZF...	96160B..ZF...	96160P..ZF...
BE	Belgium	yes	12464...ZF...	central bank	BGOCFIHSD	12460B..ZF...	12460P..ZF...
DK	Denmark	no	12864...ZF...	12896F..ZF...	DKOCFIHSD	12860B..ZF...	12860P..ZF...
FI	Finland	yes	17264...ZF...	OECD: P31S14/CARSA	FNOCFIHSD	17260B..ZF...	17260P..ZF...
FR	France	yes	13264...ZF...	OECD: P31S14/CQRSA	FROCFIHSD	13260B..ZF...	13260P..ZF...
DE	Germany	yes	13499BIRZF...	OECD: P31S14/CQRSA	BDOCFIHSD	13460B..ZF...	13460P..ZF...
IE	Ireland	yes	17864...ZF...	OECD: P31S14_S15	IROCFIHSD	17860B..ZF...	17860P..ZF...
IT	Italy	yes	13664...ZF...	OECD: P31S14/CQRSA	ITOCFIHSD	13660B..ZF...	13660P..ZF...
NL	Netherlands	no	13864...ZF...	OECD: P31S14/CQRSA	NLOCFIHSD	13860B..ZF...	13860P..ZF...
NO	Norway	yes	14264...ZF...	14296F..ZF...	NWOCFIHSD	14260B..ZF...	14260P..ZF...
ES	Spain	yes	18464...ZF...	OECD: P31S14/CQRSA	ESGFCCNHB	18460B..ZF...	18460P..ZF...
SE	Sweden	no	14464...ZF...	14496F..ZF...	SDOCFIHSD	14460B..ZF...	14460P..ZF...
UK	United Kingdom	no	11264...ZF...	UKCNHLD.D	UKOCFIHSD	11260B..ZF...	UKINTER3
US	United States	no	11164...ZF...	11196F.CZF...	USOCFIHSD	11160B..ZF...	11160PA.ZF...

Table 7: Data sources

Authors	**Year**	**Countries**	**Period**	**Frequency**	**Variables (Ordering)**	**Method (Identification)**
Posedel & Vizek	2009	HR, EE, PL	1998-2007	quarterly	gdp, mr, hloan, COI, hp	Choleski
Elbourne & de Haan	2006/2009	CZ, HU, PL, SK, SI	mid 90s-2004	monthly	oil, ffr, ip, cpi, m, i, ex	SVAR & Choleski
Jarocinski	2008	panel: CZ, HU, PL, SI	mid 90s-2007	monthly	gdp, cpi, i, ex	Bayesian est. with exchangable prior
Anzuni & Levy	2007	CZ, HU, PL	1993-2002	monthly	cpi, ip, m, i, oil	SVAR & Choleski
Gavin & Kemme	2004/2007	CZ, HU, PL (panel)	1995-2006	quarterly	gdp, cpi, i, ex	Panel SVAR, mixed estimation

Table 8: Review of of studies on VAR estimations of monetary policy transmission for CEE countries

Notes: mr: mortgage rate, hloan: housing loan, COI: Construction Output Index, hp: house price, i: money market rate, ex: exchange rate, oil: oil price, ffr: federal funds rate, ip: industrial production, m: money stock;

	Country	Estim. Period	Lag length	Cointegration tests: Trace	Max-Eigen
BG	Bulgaria	1997:3-2008:4	2	2	1
CZ	Czech Republic	1999:1-2008:4	1	3	1
EE	Estonia	1999:2-2008:3	2	1	1
HU	Hungary	1998:1-2008:4	1	0	0
LT	Lithuania	1998:4-2009:2	1	2	0
PL	Poland	1998:4-2008:2	1	4	4
SI	Slovenia	1995:1-2008:2	1	2	1
BE	Belgium	1988:1-1998:4	2	2	1
		1999:1-2007:4	2	3	3
DK	Denmark	1980:1-1999:4	2	2	2
		2000:1-2008:1	1	2	1
FI	Finland	1979:1-1992:1	2	2	2
		1996:1-2008:2	2	2	1
FR	France	1986:1-2008:2	3	2	0
DE	Germany	1992:1-2007:4	2	1	1
GR	Greece	2000:1-2008:2	1	1	1
IE	Ireland	1978:2-2008:1	1	3	3
IT	Italy	1980:1-1995:3	3	5	3
		1996:2-2008:2	3	4	3
NL	Netherlands	1987:1-2003:3	3	3	3
NO	Norway	1993:1-2008:2	1	1	2
PT	Portugal	1995:1-2008:2	1	2	2
ES	Spain	1977:1-1995:1	2	4	2
		1998:1-2008:2	2	1	1
SE	Sweden	1975:1-1993:3	2	2	2
		1994:1-2008:1	2	3	1
UK	UK	1986:1-1997:3	1	3	0
		1998:2-2008:2	1	1	0
US	US	1975:1-1994:4	2	5	2
		1996:2-2008:1	3	3	2

Table 9: Lag length and cointegration tests

Notes: AIC: Akaike information criterion; FPE: Final Prediction Error; HQ: Hannen-Quinn information criterion; SC: Schwarz information criterion; Max-Eigen: Maximum Eigenvalue

	Country	Estim. Period	IR -> CONS		IR -> GFCF		IR -> HP		HP -> CONS		HP->GFCF	
			Peak	Quarter	Peak	Quarter	Peak	Quarter	Peak	Quarter	Peak	Quarter
BG	Bulgaria	1997:3-2008:4	-0.00724	3	-0.01085	18	-0.05142	11	0.00539	7	0.01502	15
CZ	Czech Republic	1999:1-2008:4	-0.00118	20	**-0.00483**	7	-0.00999	15	0.00177	12	0.00408	15
EE	Estonia	1999:2-2008:3	**-0.02124**	11	**-0.04513**	10	**-0.05352**	9	**0.01343**	3	0.02510	3
HU	Hungary	1998:1-2008:4	-0.00621	20	-0.00602	20	-0.00998	10	**0.00862**	20	**0.00825**	20
LT	Lithuania	1998:4-2009:2	**-0.04782**	20	**-0.07735**	20	**-0.11319**	20	0.01186	10	**0.03354**	3
PL	Poland	1998:4-2008:2	**-0.00565**	15	**-0.02015**	16	-0.00871	19	0.00379	12	0.01269	14
SI	Slovenia	1995:1-2008:2	0.00559	6	0.00508	12	-0.00663	6	0.01014	20	0.01375	20

Table 10: VAR estimation results for CEE countries

Notes: "IR->CONS" effect of one S.D. interest rate shock on consumption; "Peak" is the peak value of an impulse response over 20 quarters, "Quarter" is the quarter in which the peak value is observed. Bold values are significant at 95% analytical standard error confidence interval.

	Country	Estim. Period	IR -> CONS		IR -> GFCF		IR -> HP		HP -> CONS		HP->GFCF	
			Peak	Quarter	Peak	Quarter	Peak	Quarter	Peak	Quarter	Peak	Quarter
BE	Belgium	1999:1-2007:4	-0.00078	5	0.00214	4	-0.00176	20	**0.00253**	2	0.00699	6
DK	Denmark	2000:1-2008:1	**-0.00409**	7	**-0.01737**	5	**-0.01539**	7	**0.00394**	6	0.01385	5
FI	Finland	1996:1-2008:2	-0.00117	10	**-0.01500**	7	-0.00579	6	-0.00104	9	-0.01405	10
FR	France	1986:1-2008:2	**-0.00657**	16	**-0.01652**	11	**-0.03025**	20	0.00390	15	**0.01140**	12
DE	Germany	1992:1-2007:4	-0.00542	8	-0.00542	8	-0.00301	13	0.00258	14	**0.01145**	3
GR	Greece	2000:1-2008:2	0.00018	2	-0.00194	9	-0.00119	6	-0.00068	9	**0.01202**	4
IE	Ireland	1978:2-2008:1	**-0.01635**	17	**-0.04534**	9	**-0.03423**	18	-0.00770	20	-0.00921	18
IT	Italy	1996:2-2008:2	**0.00160**	2	-0.00571	8	-0.00323	6	**-0.00200**	6	0.00414	13
NL	Netherlands	1987:1-2003:3	-0.00573	14	**-0.01522**	6	**-0.01423**	10	**-0.00301**	11	**0.01504**	3
NO	Norway	1993:1-2008:2	-0.00194	4	**-0.01062**	3	**-0.00471**	5	0.00219	20	0.00544	2
PT	Portugal	1995:1-2008:2	-0.00073	7	-0.00299	8	-0.00153	12	-0.00144	9	-0.00546	8
ES	Spain	1998:1-2008:2	**-0.00357**	10	-	-	**-0.01314**	6	**0.00442**	11	-	-
SE	Sweden	1994:1-2008:1	**-0.00361**	7	**0.01178**	4	**-0.00544**	9	-0.00183	10	-0.00812	4
UK	UK	1998:2-2008:2	**-0.00251**	8	-0.01018	5	**-0.01325**	8	0.00024	12	0.00154	5
US	US	1996:2-2008:1	-0.00358	17	**-0.02122**	10	**-0.00669**	13	-0.00213	20	0.00656	3

Table 11: VAR estimation results for industrial countries*Notes:* GFCF is not included in the model for Spain; see also *Notes* from Tab. 10.

Country	**Estim. Period**	**IR->CONS**		**IR->GFCF**		**IR->HP**		**HP->CONS**		**HP->GFCF**	
		Max	Quarter	Max	Quarter	Max	Quarter	Max	Quarter	Max	Quarter
Bulgaria	1997-2008	10.79%	5	4.55%	20	30.81%	17	10.15%	20	12.87%	20
Czech Republic	1999-2008	1.60%	20	11.79%	11	5.49%	20	3.14%	17	10.72%	19
Estonia	1999-2008	47.80%	15	44.23%	14	41.08%	14	19.22%	4	16.28%	5
Hungary	1998-2008	11.16%	20	7.21%	20	15.53%	20	21.41%	20	16.21%	20
Lithuania	1998-2009	32.05%	20	32.19%	20	30.28%	20	8.49%	8	30.85%	4
Poland	1998-2008	13.70%	20	11.30%	20	7.61%	20	7.50%	7	5.18%	15
Slovenia	1995-2008	1.81%	11	0.74%	16	4.45%	10	4.05%	20	3.71%	20

Table 12: Variance decomposition for CEE countries

Notes: "IR->CONS" means how much a one S.D. interest rate shock contributes to the variance in consumption; "Max" is the maximal value over 20 quarters and "Quarter" the quarter in which the maximal value is observed.

Country	**Estim. Period**	**IR->CONS**		**IR->GFCF**		**IR->HP**		**HP->CONS**		**HP->GFCF**	
		Max	Quarter	Max	Quarter	Max	Quarter	Max	Quarter	Max	Quarter
Belgium	1999-2007	2.09%	7	1.87%	5	1.45%	20	20.16%	20	18.16%	7
Denmark	2000-2008	21.70%	10	19.75%	9	23.09%	10	20.81%	8	13.48%	18
Finland	1996-2008	5.45%	15	32.07%	12	15.29%	15	4.06%	20	21.39%	20
France	1986-2008	38.41%	20	45.06%	17	35.31%	20	14.19%	19	20.06%	16
Germany	1992-2007	5.03%	17	8.64%	12	11.84%	20	19.47%	20	36.41%	10
Greece	2000-2008	0.13%	18	0.52%	14	0.71%	10	2.95%	13	14.08%	6
Ireland	1978-2008	38.80%	20	53.56%	20	45.34%	20	7.34%	20	2.00%	20
Italy	1996-2008	30.44%	20	24.47%	20	14.91%	19	29.47%	8	11.81%	16
Netherlands	1987-2003	22.36%	20	26.83%	11	36.40%	14	7.58%	3	17.91%	4
Norway	1993-2008	3.13%	20	14.48%	7	8.80%	11	2.79%	20	3.22%	20
Portugal	1995-2008	0.88%	12	1.55%	16	3.13%	18	4.37%	20	5.52%	19
Spain	1998-2008	22.64%	14	-	-	21.94%	9	49.89%	20	-	-
Sweden	1994-2008	29.49%	16	9.72%	20	17.81%	20	5.70%	20	3.71%	11
UK	1998-2008	58.12%	20	14.48%	17	47.35%	13	0.56%	20	0.34%	14
US	1996-2008	22.51%	20	41.42%	13	33.64%	16	8.26%	5	15.06%	19

Table 13: Variance decomposition for industrial countries*Notes:* GFCF is not included in the model for Spain; see also *Notes* from Tab. 12

Augmented Ducky Fuller Unit Root Tests					
Country	**CPI**	**CONS**	**GFCF**	**HP**	**IR**
Bulgaria	I(1)***	I(1)***	I(1)***	I(2)**	I(0)***
Czech Republic	I(1)**	I(1)***	I(1)**	I(1)***	I(1)**
Estonia	I(0)**	I(2)***	I(0)**	I(1)***	I(1)***
Hungary	I(1)**	I(2)***	I(1)***	I(0)***	I(1)***
Lithuania	I(2)***	I(1)***	I(1)***	I(1)***	I(2)**
Poland	I(1)**	I(0)***	I(2)***	I(1)***	I(2)***
Slovenia	I(0)**	I(2)***	I(2)***	I(1)***	I(0)*
Belgium	I(1)**	I(1)***	I(1)**	I(1)**	I(1)***
Denmark	I(1)***	I(1)***	I(1)***	I(1)***	I(1)***
Finland	I(2)***	I(1)***	I(1)**	I(1)***	I(1)***
France	I(2)***	I(1)***	I(1)***	I(2)***	I(1)***
Germany	I(1)**	I(1)***	I(1)***	I(1)**	I(0)***
Greece	I(1)***	I(2)***	I(0)*	I(1)**	I(0)*
Ireland	I(1)***	I(2)***	I(1)***	I(1)**	I(1)***
Italy	I(2)***	I(2)***	I(1)***	I(1)***	I(1)***
Netherlands	I(1)**	I(2)***	I(1)***	I(2)***	I(1)***
Norway	I(1)***	I(1)***	I(1)***	I(1)***	I(0)***
Portugal	I(1)***	I(0)*	I(0)*	I(2)***	I(1)***
Spain	I(1)***	I(1)*	*not incl.*	I(0)***	I(1)**
Sweden	I(2)***	I(1)***	I(1)**	I(2)***	I(1)***
UK	I(1)*	I(0)***	I(1)***	I(2)***	I(1)***
US	I(1)**	I(1)***	I(2)***	I(2)***	I(2)***

Table 14: Augmented Ducky Fuller unit root tests

Notes: Based on Akaike information criterion; *, **, ***: sign. at respectively 10%, 5% and 1%; I(...) indicates the order of integration, I(0) means the variable is stationary.

	Country	Estim. Period	Housing Effects		
			Wealth/Collateral	**Rents&Savings**	**Tobin's Q**
BG	Bulgaria	1997:3-2008:4	small	no	small
CZ	Czech Republic	1999:1-2008:4	no	no	no
EE	Estonia	1999:2-2008:3	yes	no	yes
HU	Hungary	1998:1-2008:4	no	no	no
LT	Lithuania	1998:4-2009:2	yes	no	small
PL	Poland	1998:4-2008:2	no	no	small
SI	Slovenia	1995:1-2008:2	no	no	no
BE	Belgium	1999:1-2007:7	no	no	no
DE	Germany	1992:1-2007:4	small	no	small
DK	Denmark	2000:1-2008:1	yes	no	no
ES	Spain	1998:1-2008:2	**yes**	no	-
FI	Finland	1996:1-2008:2	no	small	no
FR	France	1986:1-2008:2	no	no	small
GR	Greece	2000:1-2008:2	no	no	small
IE	Ireland	1978:2-2008:1	**yes**	no	no
IT	Italy	1996:2-2008:2	no	small	small
NL	Netherlands	1987:1-2003:3	**yes**	no	yes
NO	Norway	1993:1-2008:2	no	no	yes
PT	Portugal	1995:1-2008:2	no	no	reverse
SE	Sweden	1994:1-2008:1	**yes**	no	**yes**
UK	UK	1998:2-2008:2	small	no	no
US	US	1996:2-2008:1	yes	no	small

Table 15: Simulation results for the existence of indirect housing channels

Notes: Significant channels are bold.

Country	**Belgium**		**Denmark**		**Spain**		**Finland**		**Italy**		**Sweden**		**UK**		**US**	
Estim. Period	1988:1-1998:4	1999:1-2007:4	1980:1-1998:4	2000:1-2008:1	1977:1-1995:1	1998:1-2008:2	1979:1-1992:1	1996:1-2008:2	1980:1-1995:3	1996:2-2008:2	1975:1-1993:3	1994:1-2008:1	1975:1-1988:4	1990:1-2008:2	1975:1-1994:4	1996:2-2008:1
Wealth/Collateral	no	no	no	yes	small	**yes**	no	no	no	small	no	**yes**	small	small	no	yes
Rents&Savings	no	no	no	no	no	no	no	small	no	small	no	no	no	no	no	no
Tobin's Q	small	no	no	no	**-**	-	no	no	no	small	**yes**	**yes**	no	no	small	small

Table 16: Simulation results for the existence of indirect housing channels before and after a structural break*Notes:* Significant channels are bold.

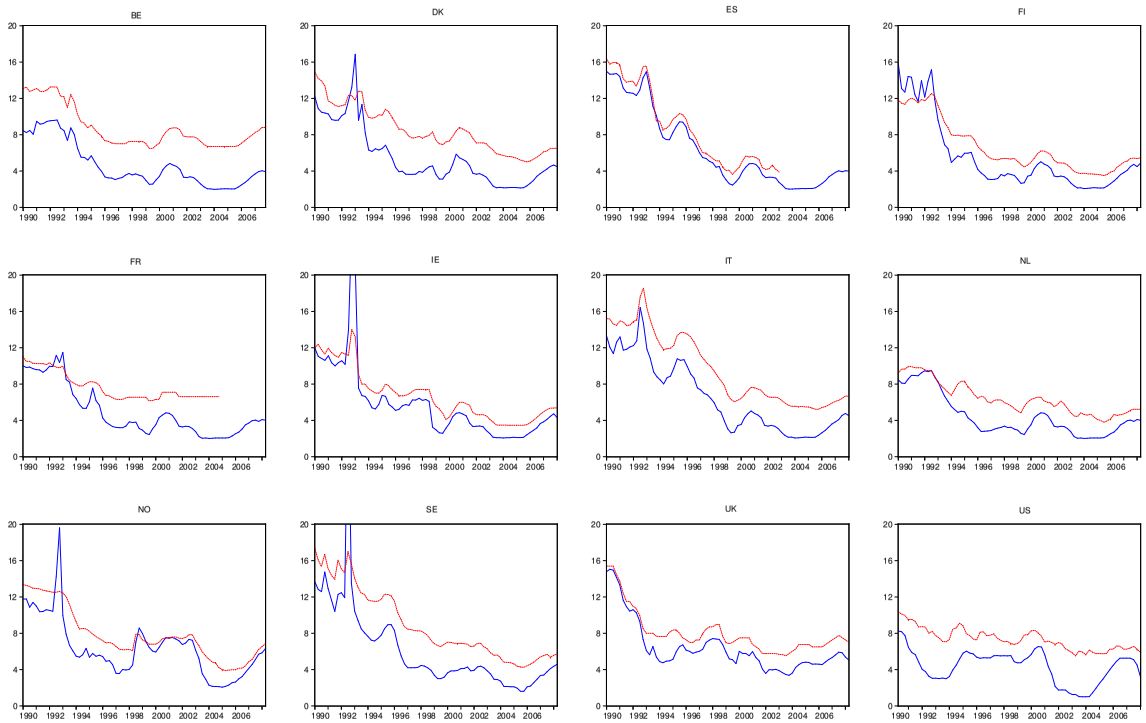

Figure 2: Money market rates and lending rates in industrial countries

Notes: Red dashed line: a lending rate; blue continuous line: a money market rate; a mortgage rate has been used for IE, NO, UK and US; for definitions and sources see Table 7.

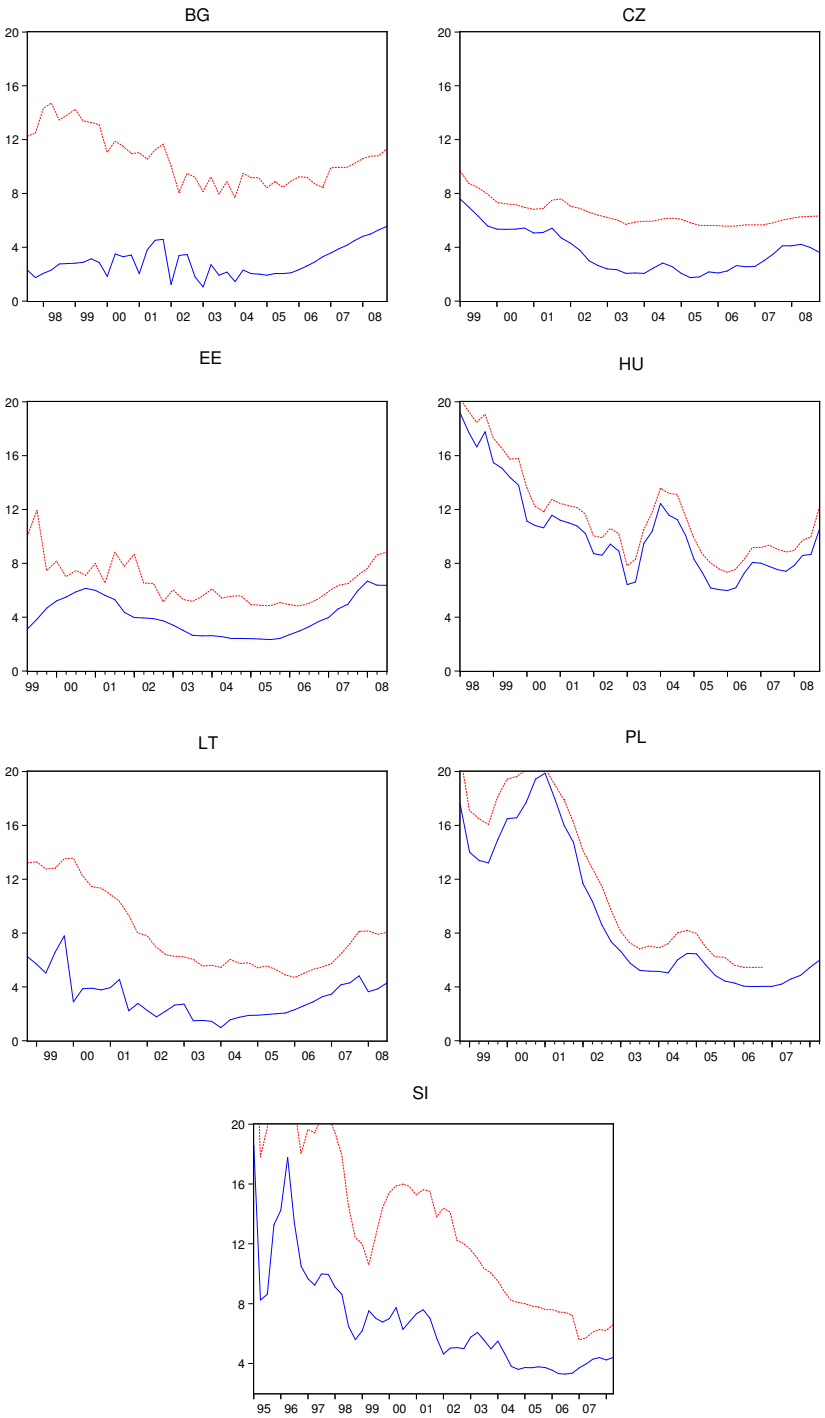

Figure 3: Money market rates and lending rates in CEE countries

Notes: Red dashed line: a lending rate; blue continuous line: a money market rate; a mortgage rate has been used for IE, NO, UK and US; for definitions and sources see Table 7.

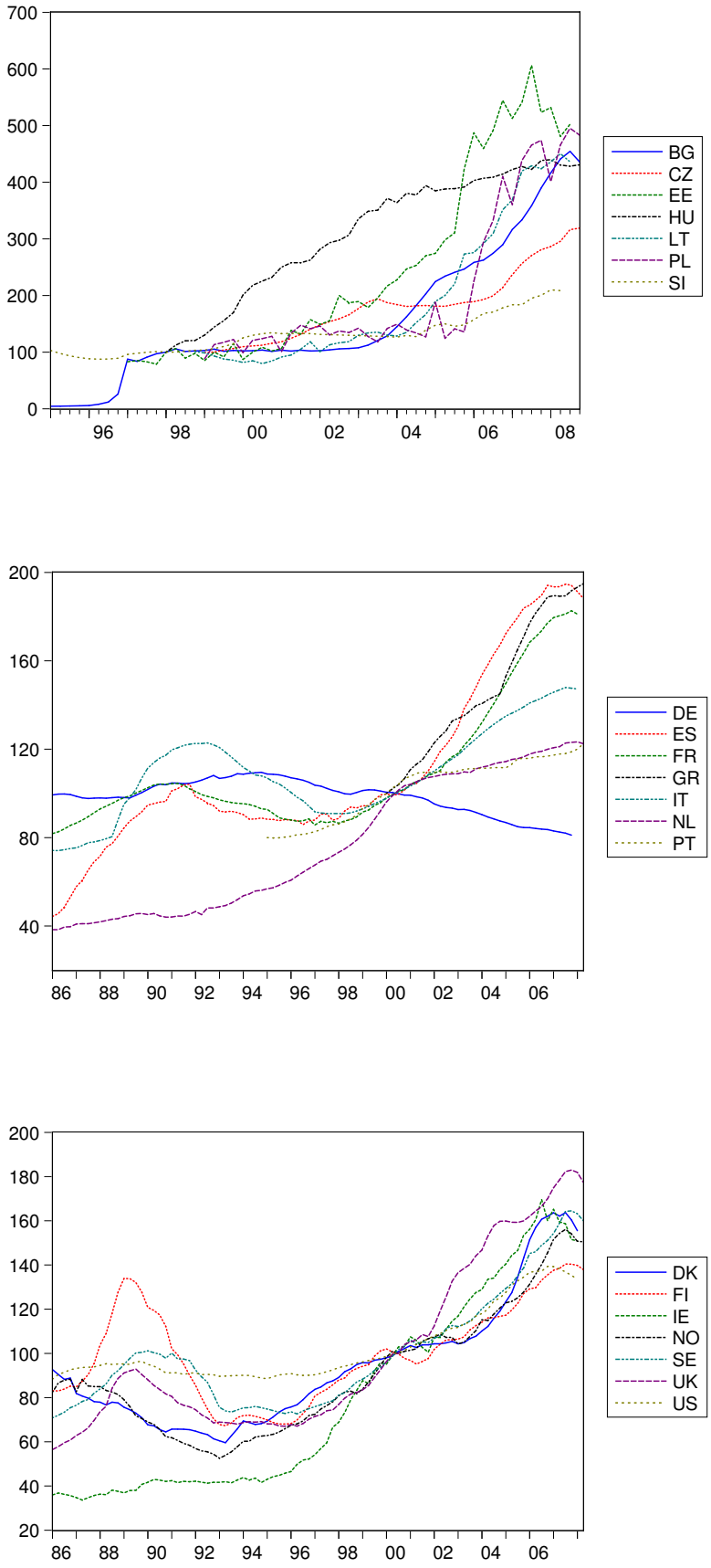

Figure 4: House price indices in CEE and industrial countries*Sources:* See Tables 5 and 6

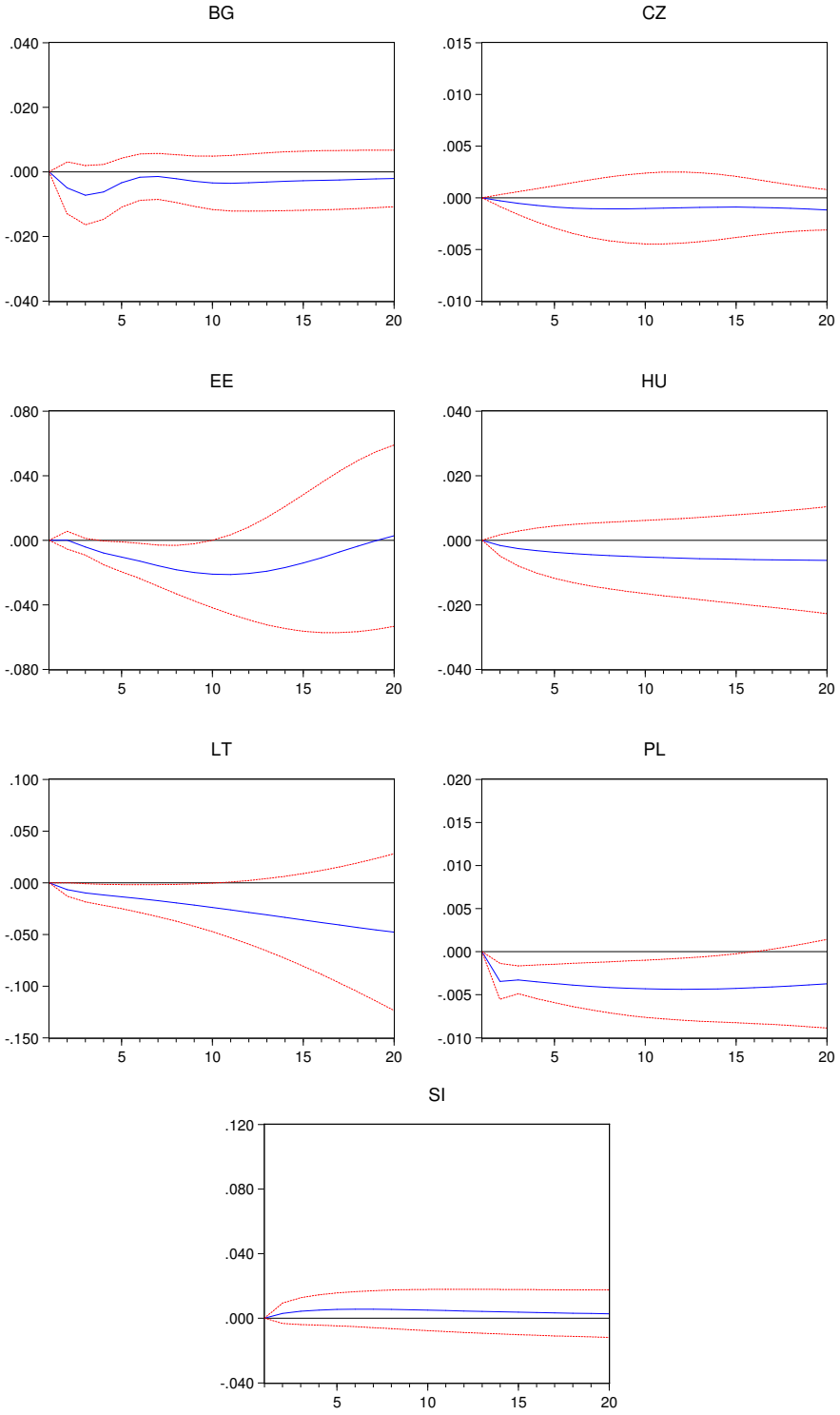

Figure 5: A one S.D. interest rate shock to consumption in CEE countries

Notes: Analytical (asymptotic) 2 standard deviations error bands.

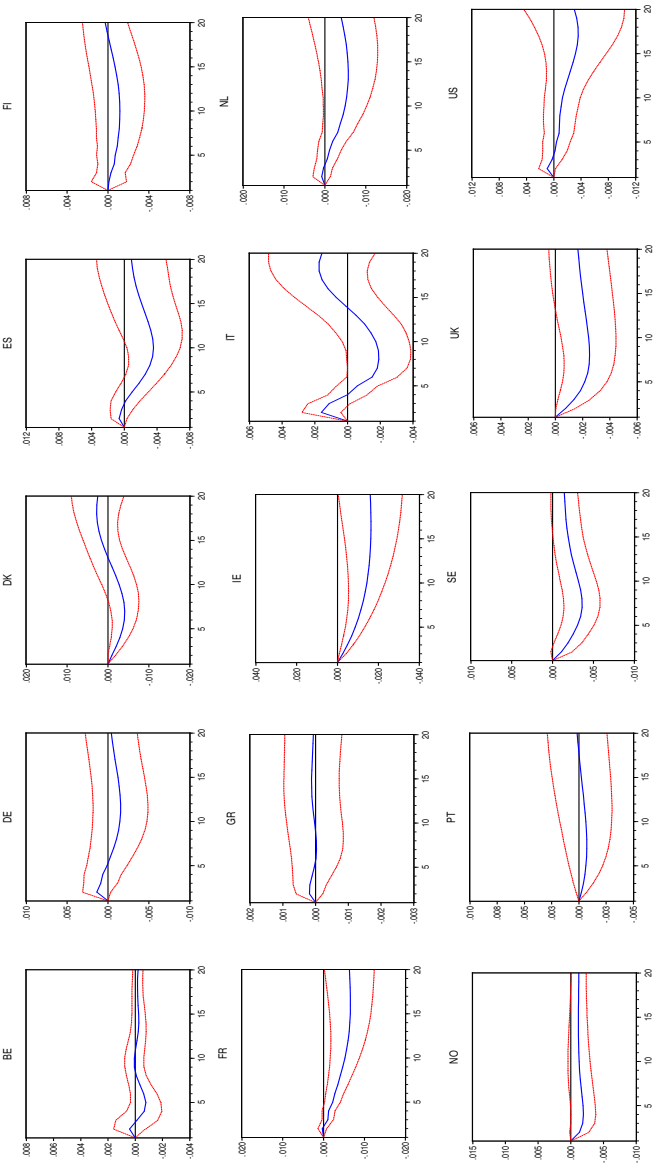

Figure 6: A one S.D. interest rate shock to consumption in industrial countries

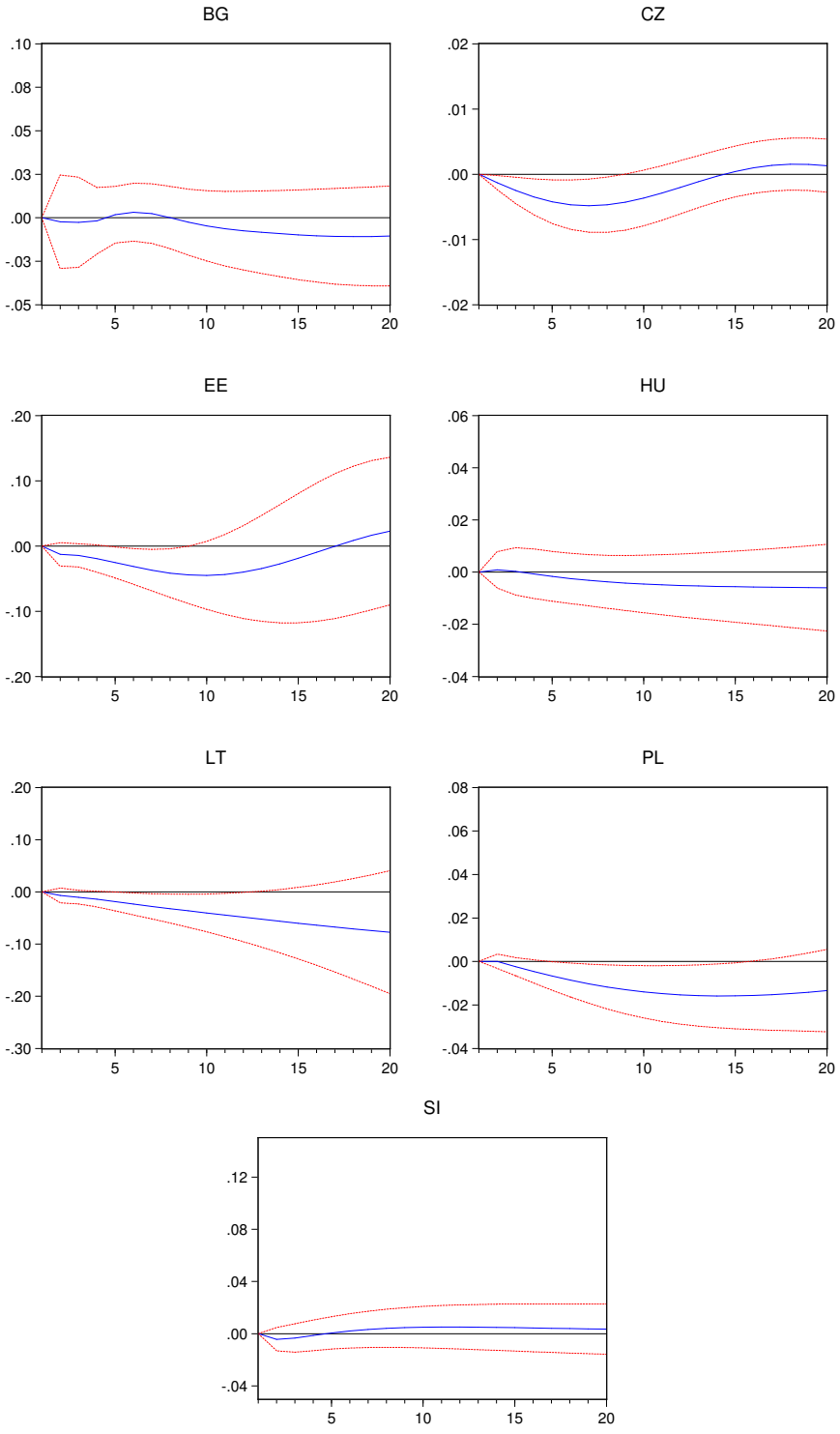

Figure 7: A one S.D. interest rate shock to investment in CEE countries

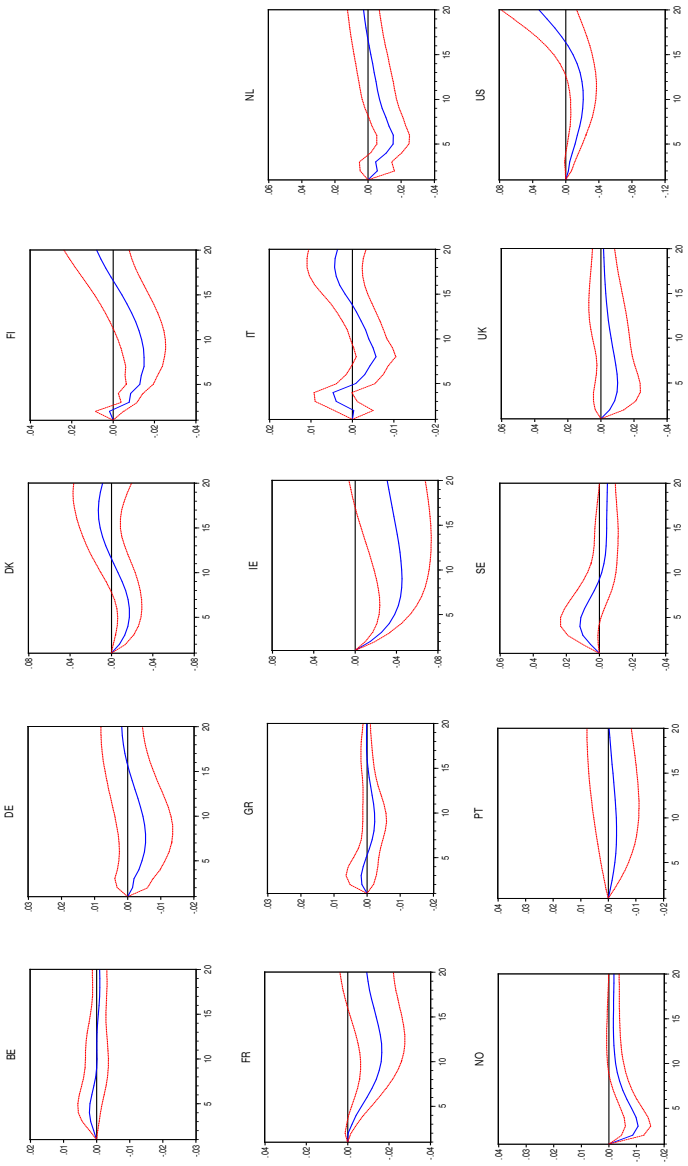

Figure 8: A one S.D. interest rate shock to investment in industrial countries

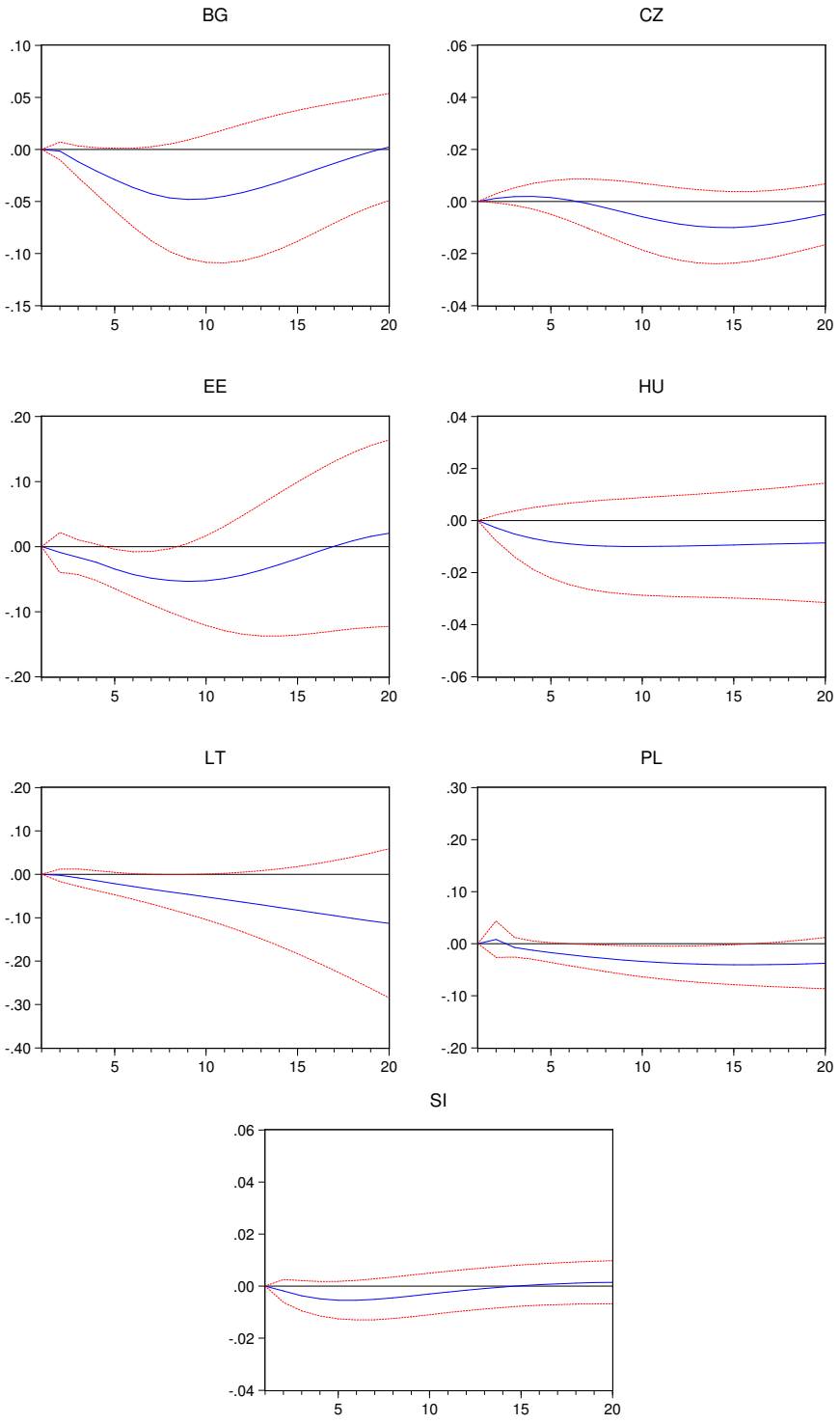

Figure 9: A one S.D. interest rate shock to house prices in CEE countries

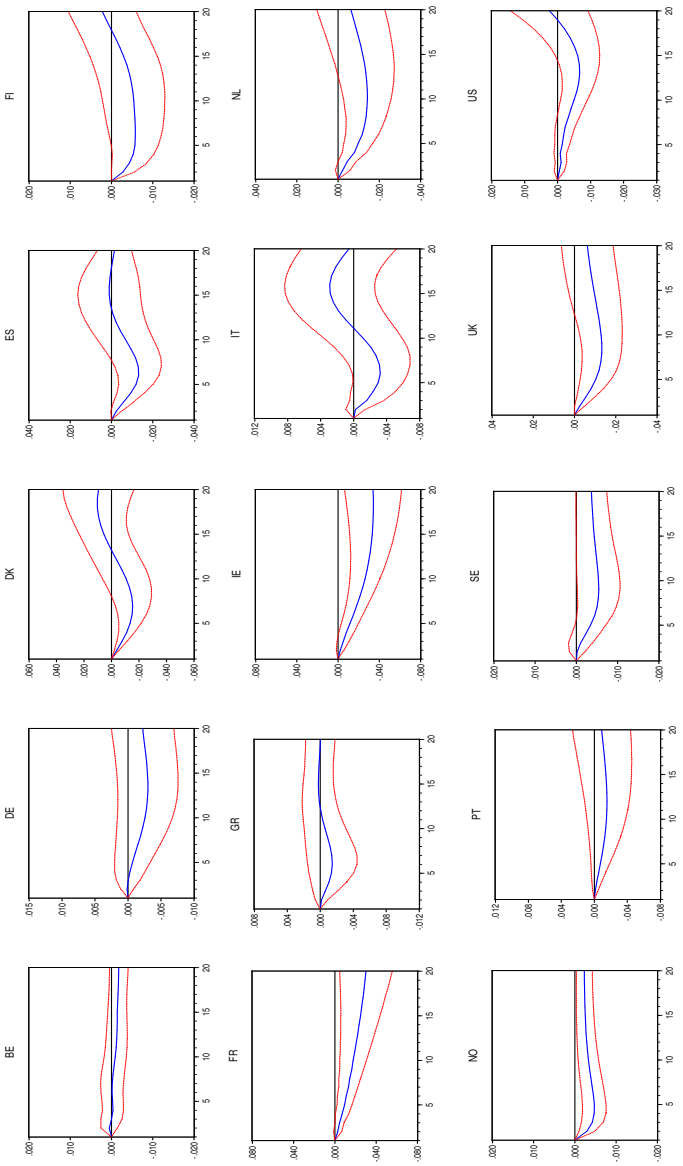

Figure 10: A one S.D. interest rate shock to house prices in industrial countries

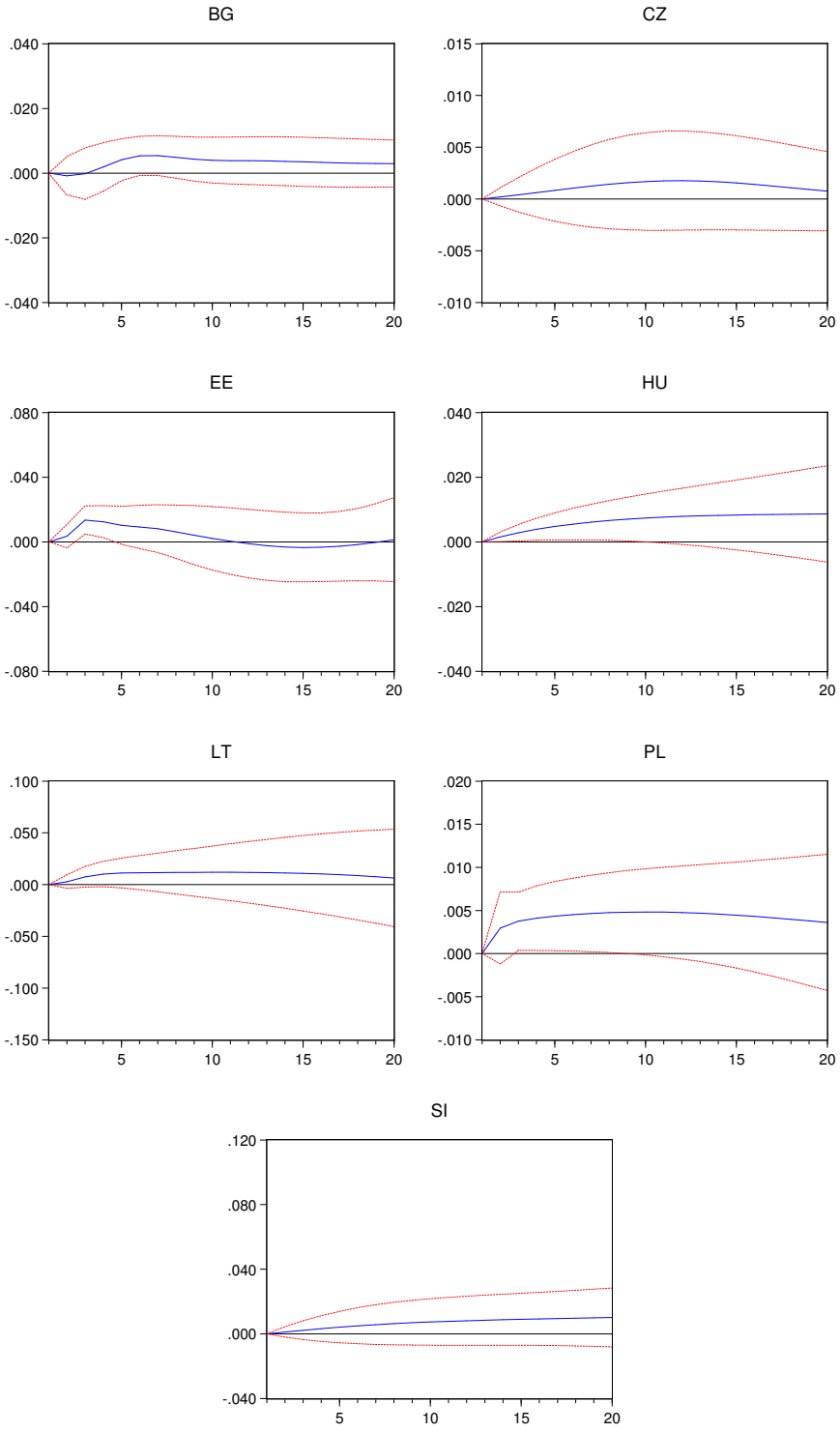

Figure 11: A one S.D. house price shock to consumption in CEE countries

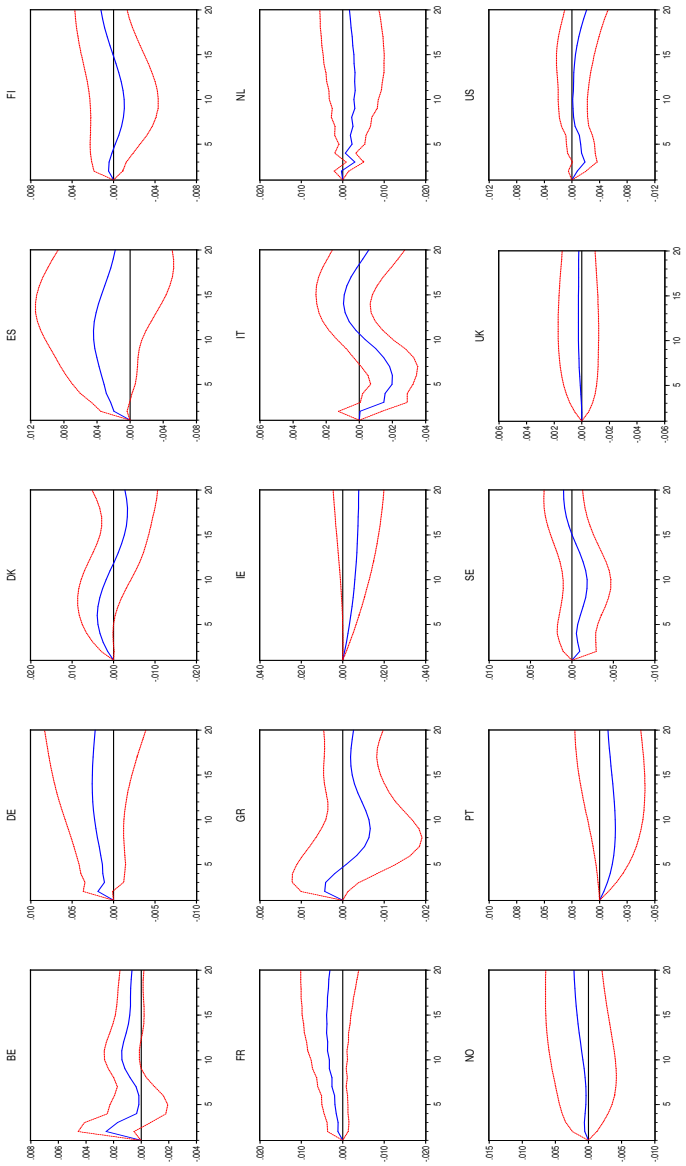

Figure 12: A one S.D. house price shock to consumption in industrial countries

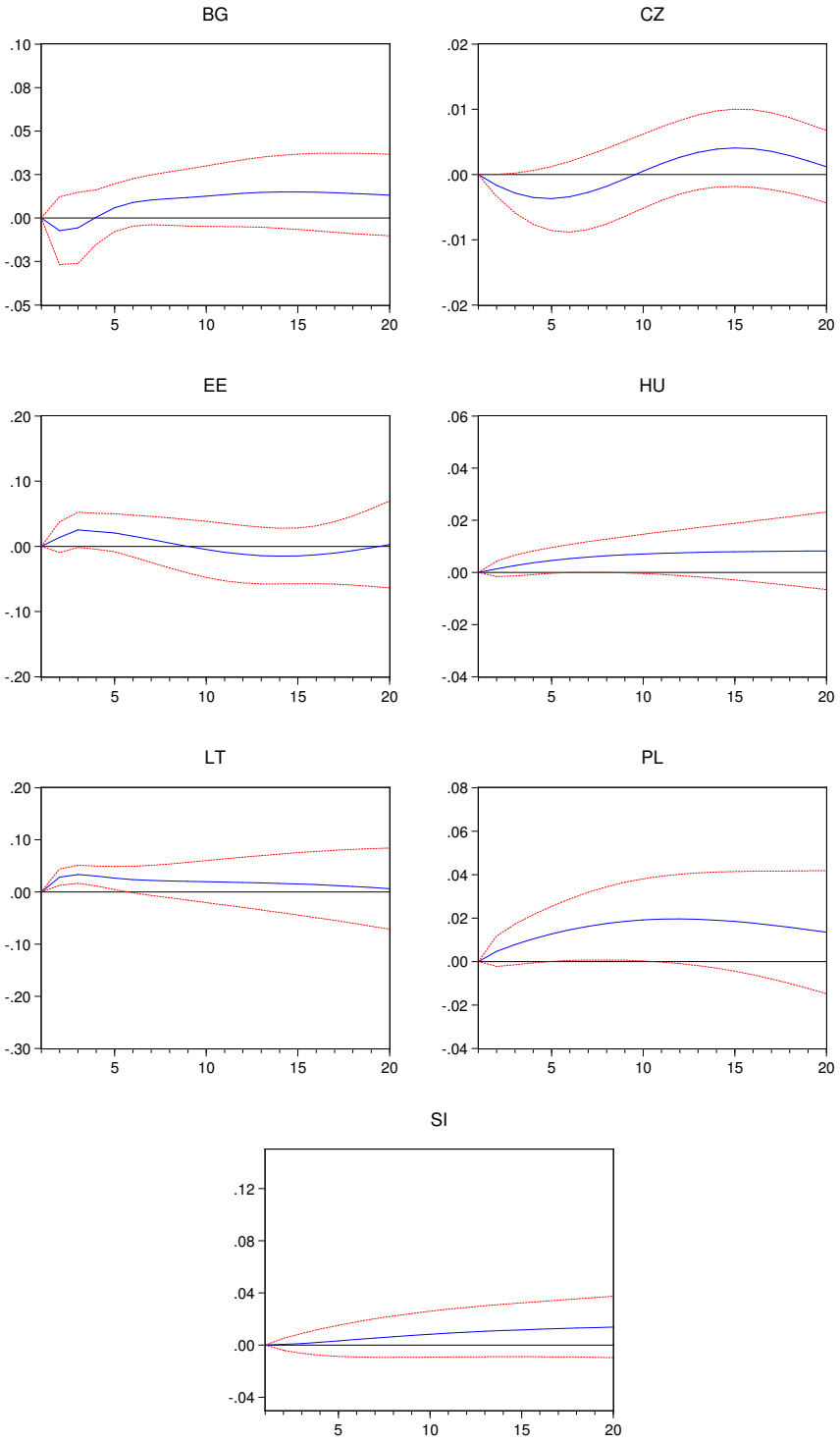

Figure 13: A one S.D. house price shock to investment in CEE countries

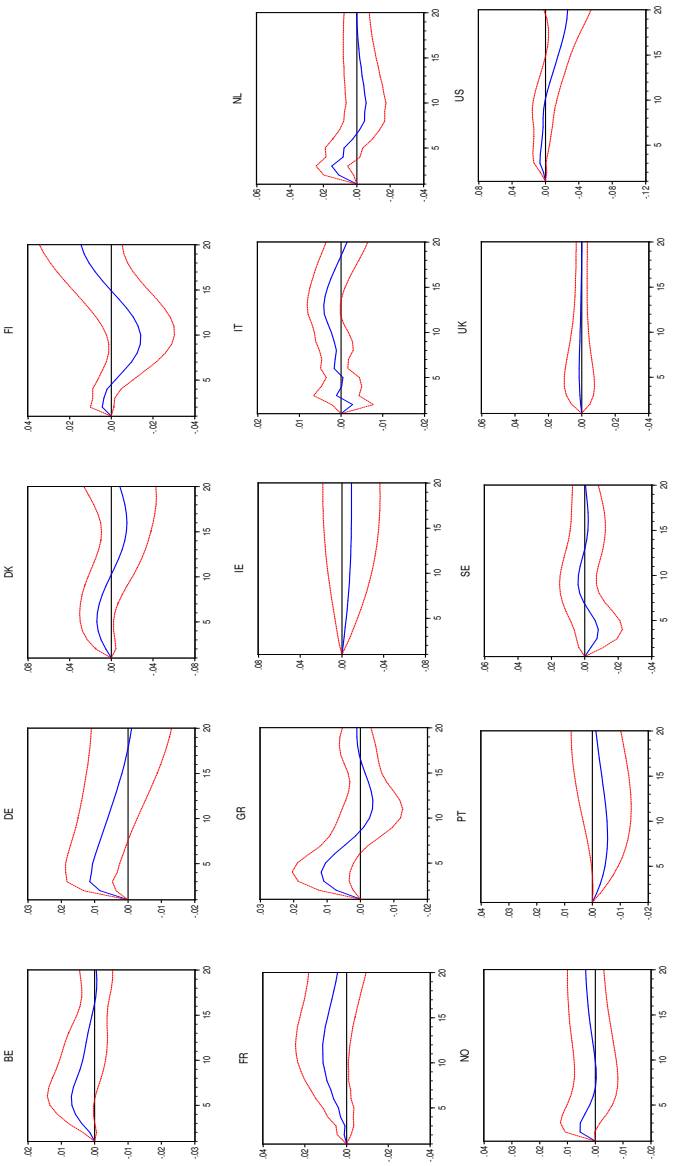

Figure 14: A one S.D. house price shock to investment in industrial countries

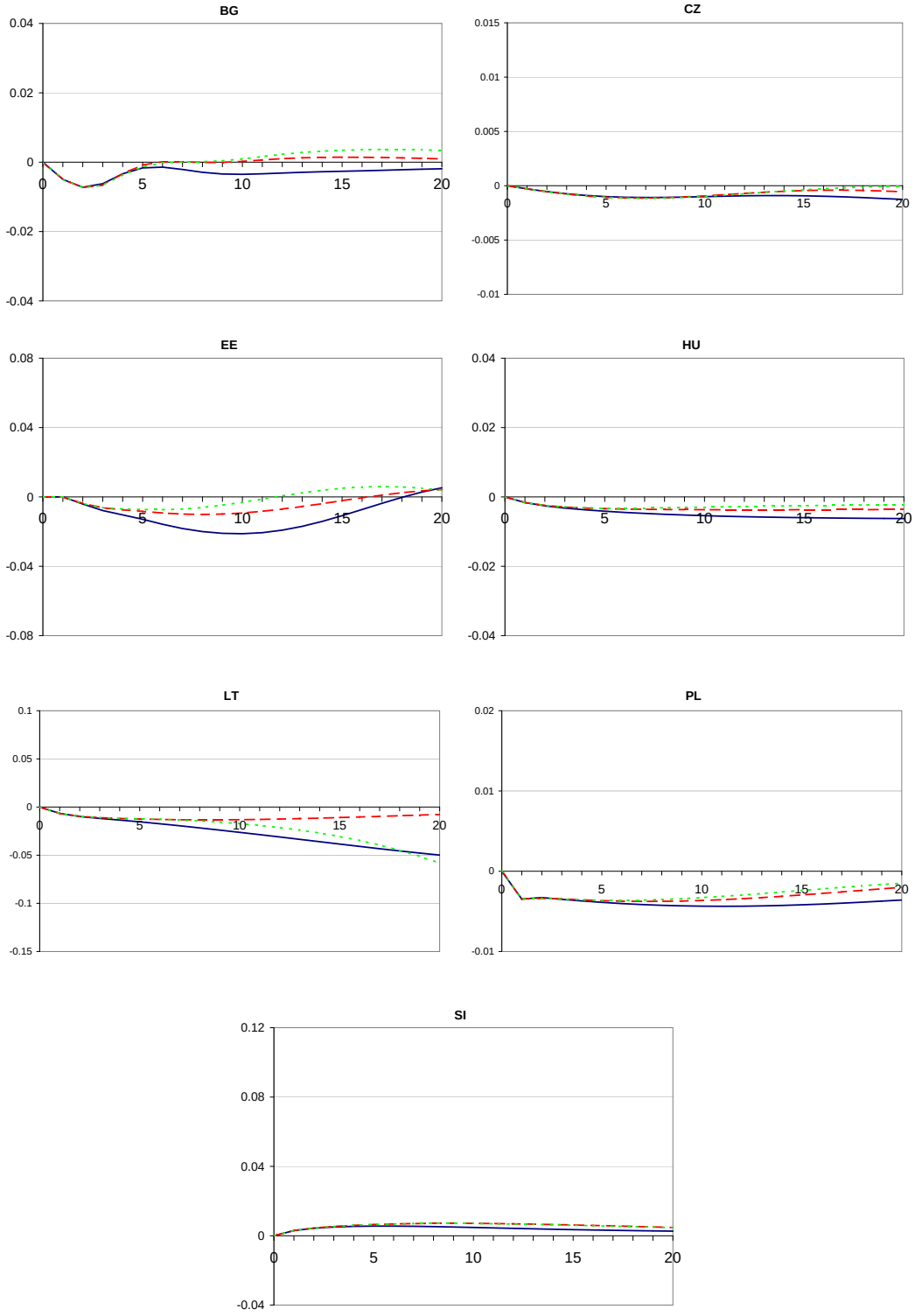

Figure 15: Simulation results for consumption in CEE countries

Notes: Dark-blue solid line is the baseline model; red dashed line is the counterfactual simulation when the house price effect in the consumption equation is set to zero; green dotted line is the counterfactual simulation when the house price effect in both the consumption and the investment equation is set to zero.

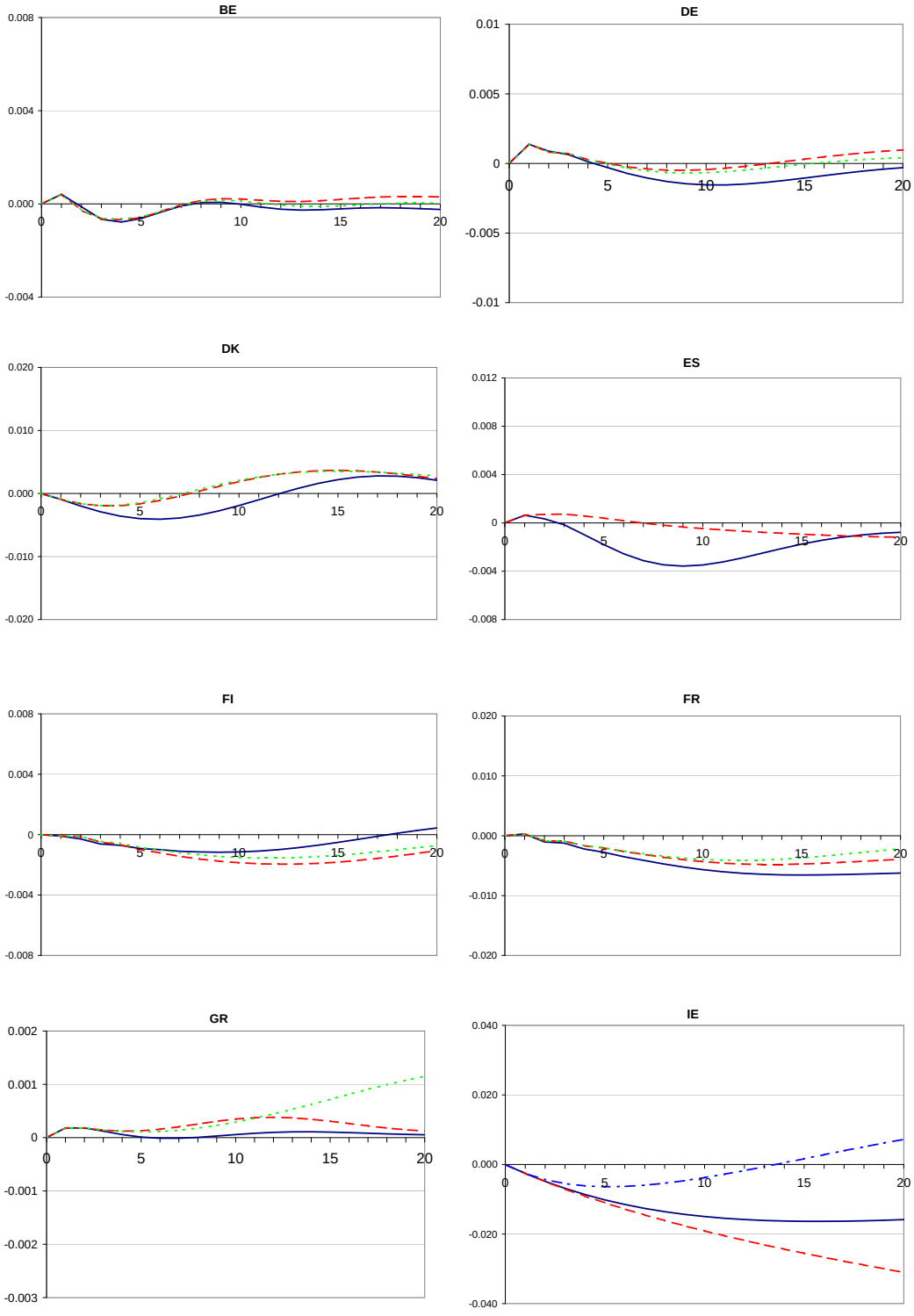

Figure 16: Simulation results for consumption in industrial countries
Notes: See *Notes* from Figure 15.

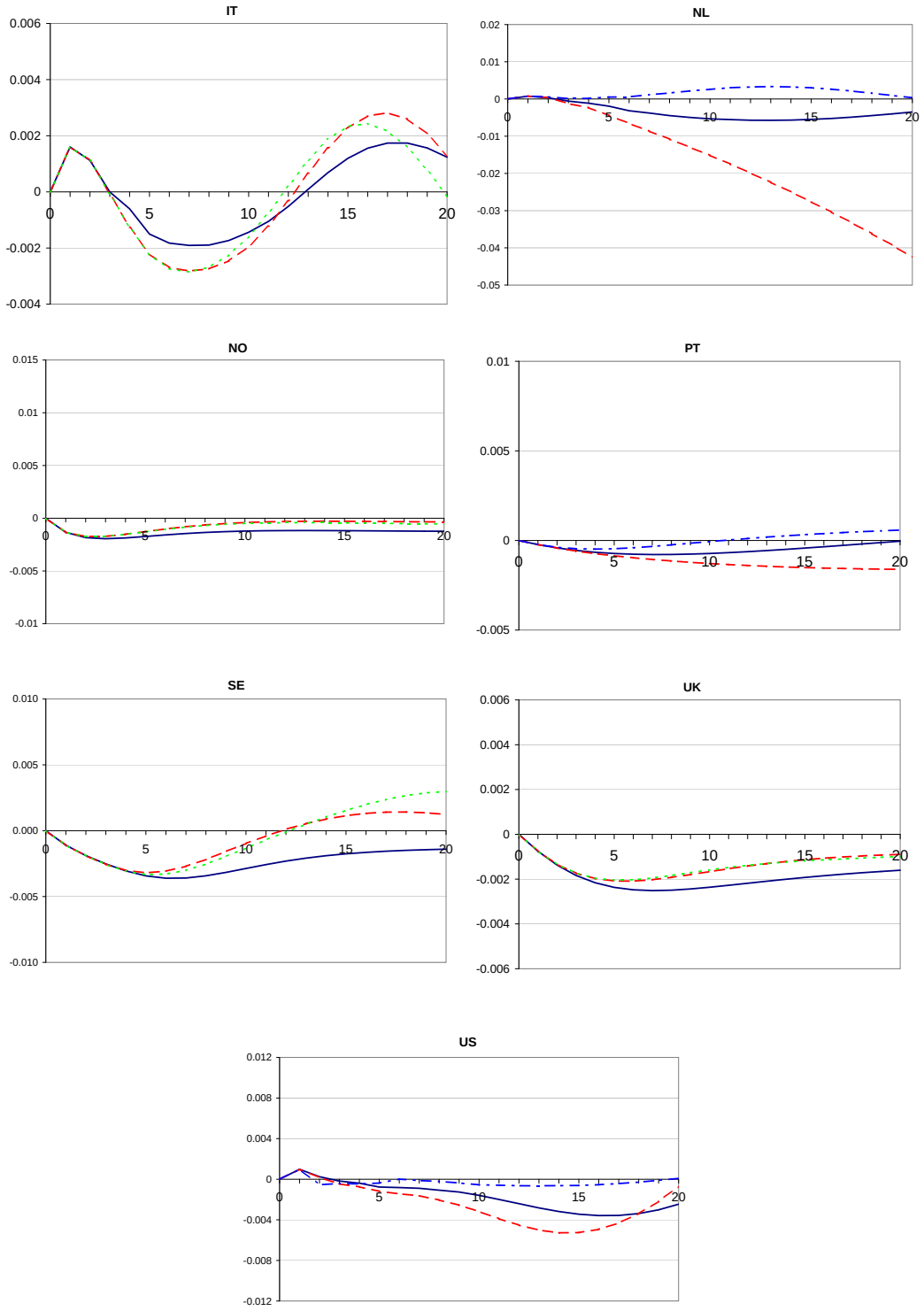

Figure 17: Simulation results for consumption in industrial countries (continued)

Notes: Blue dash-dotted line: counterfactual simulation when the investment effect in the consumption equation is set to zero; see also *Notes* from Figure 15.

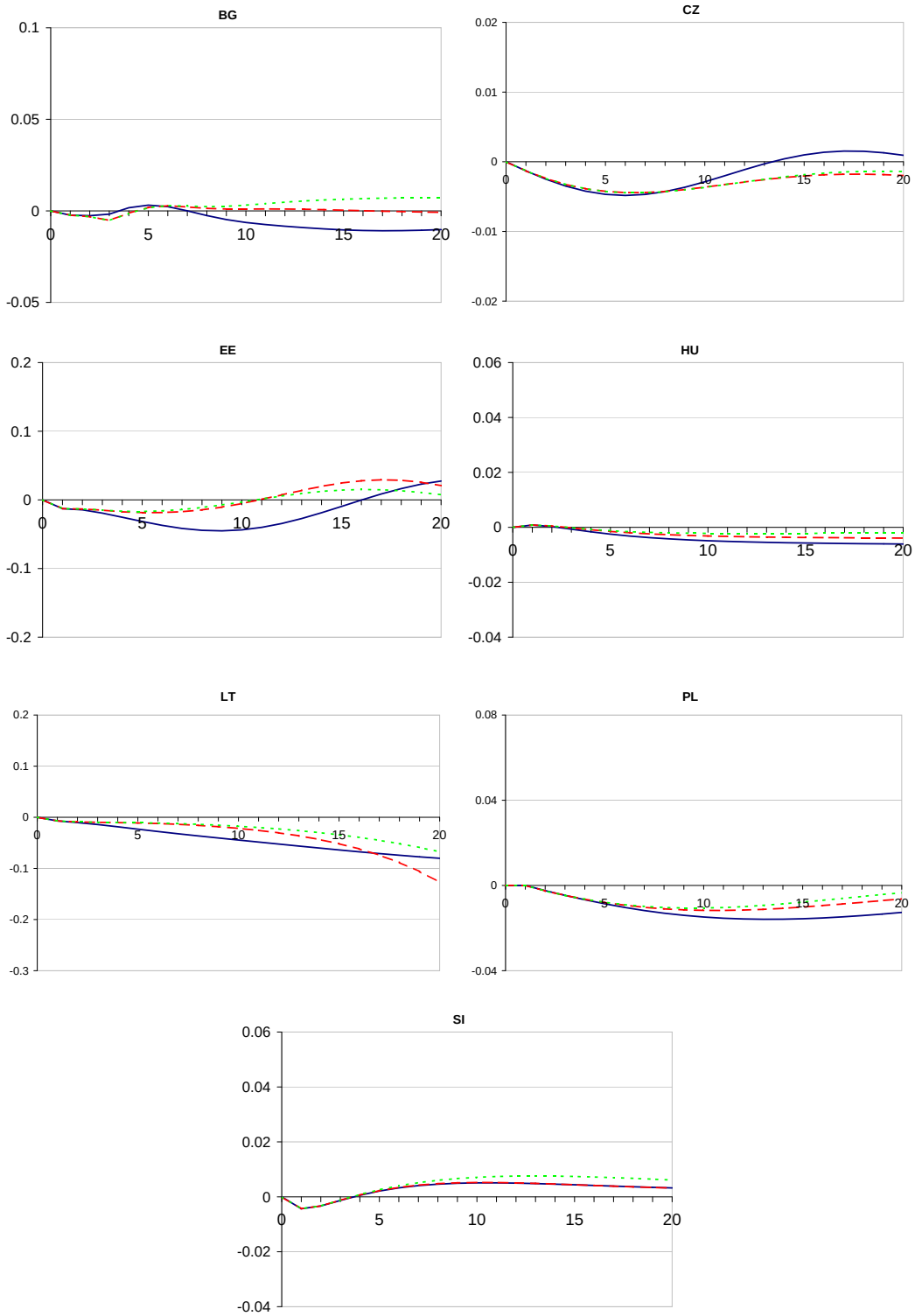

Figure 18: Simulation results for investment in CEE countries*Notes:* See *Notes* from Figure 15.

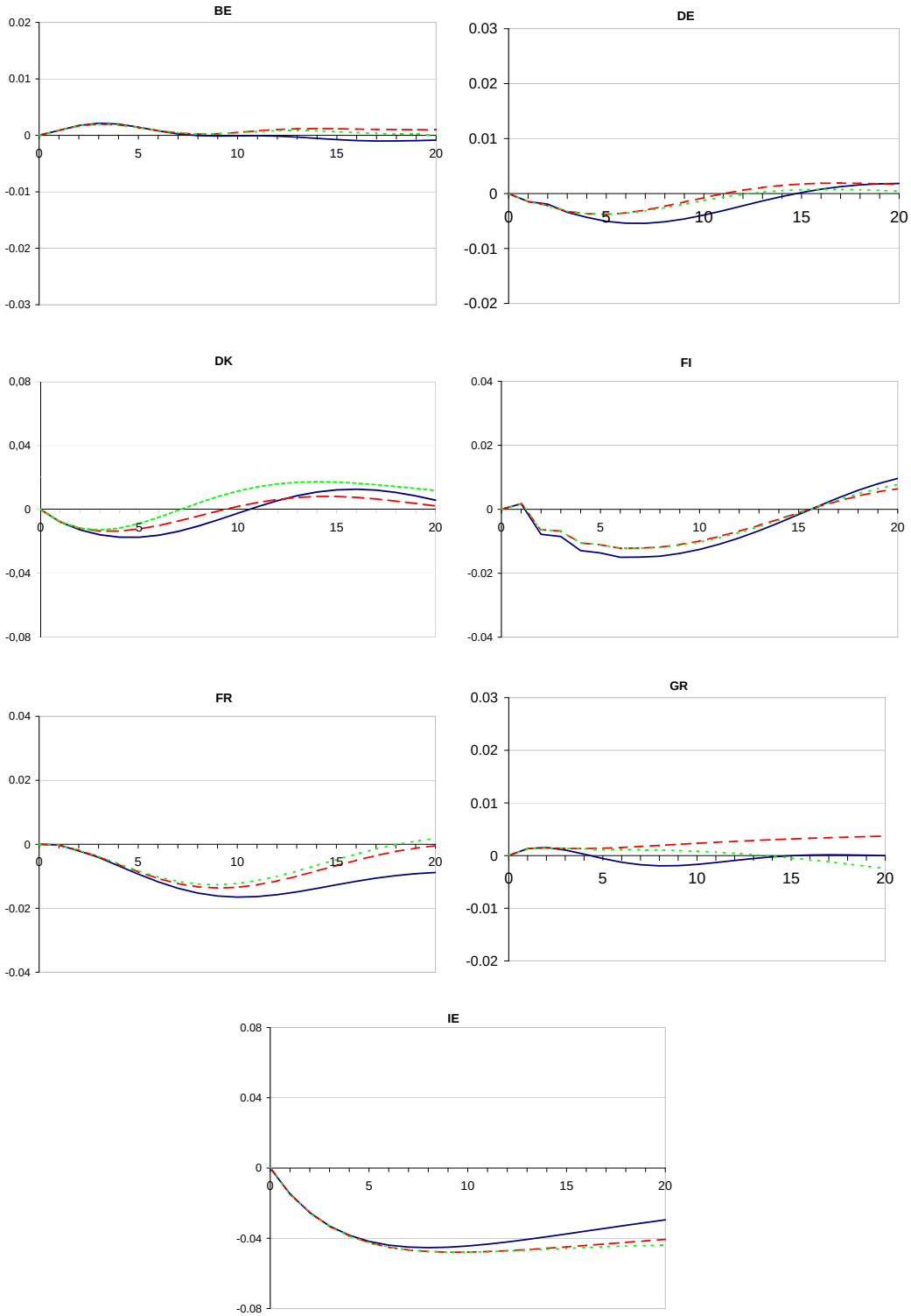

Figure 19: Simulation results for investment in industrial countries
Notes: See *Notes* from Figure 15.

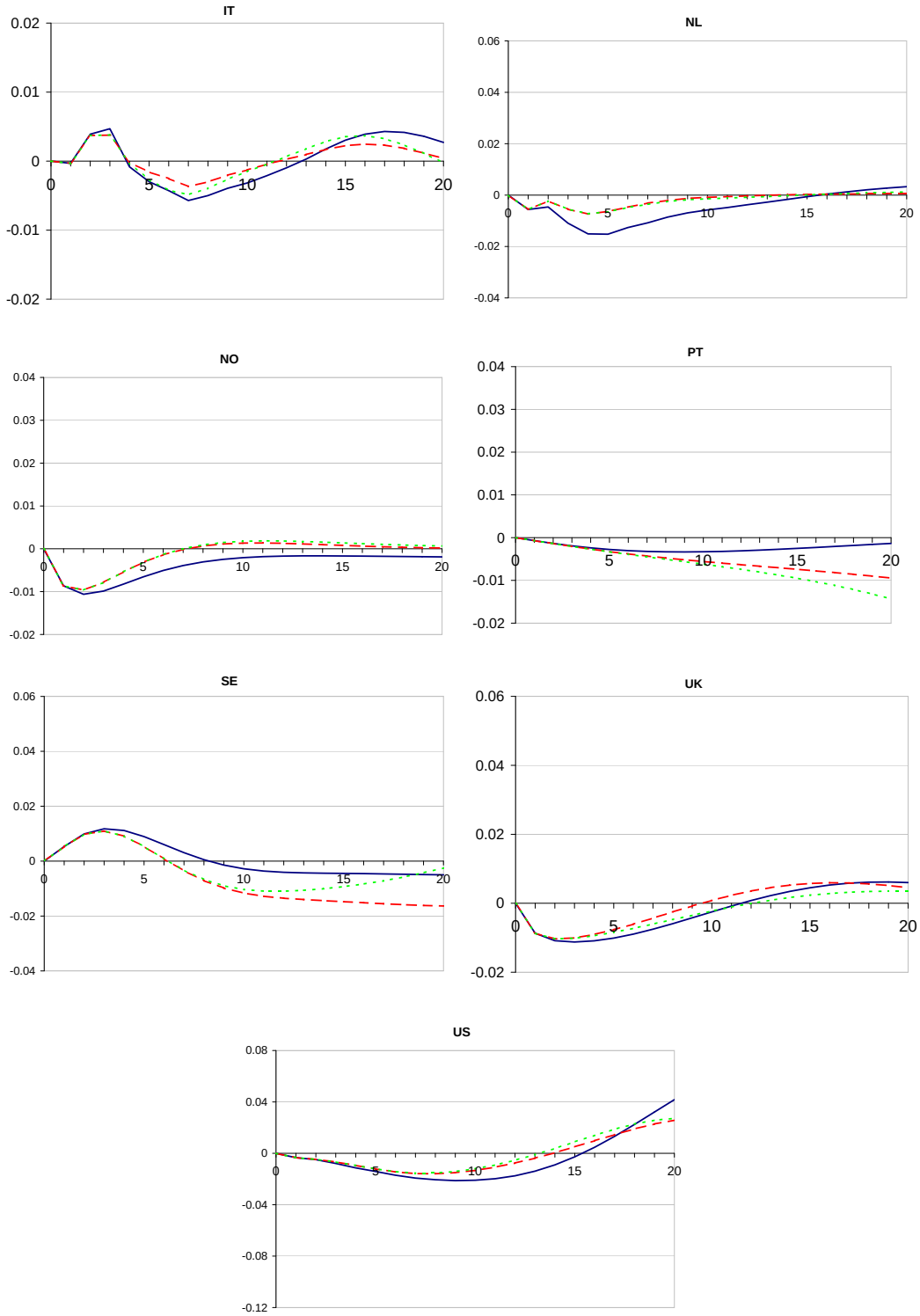

Figure 20: Simulation results for investment in industrial countries (continued)

Notes: See *Notes* from Figure 15.

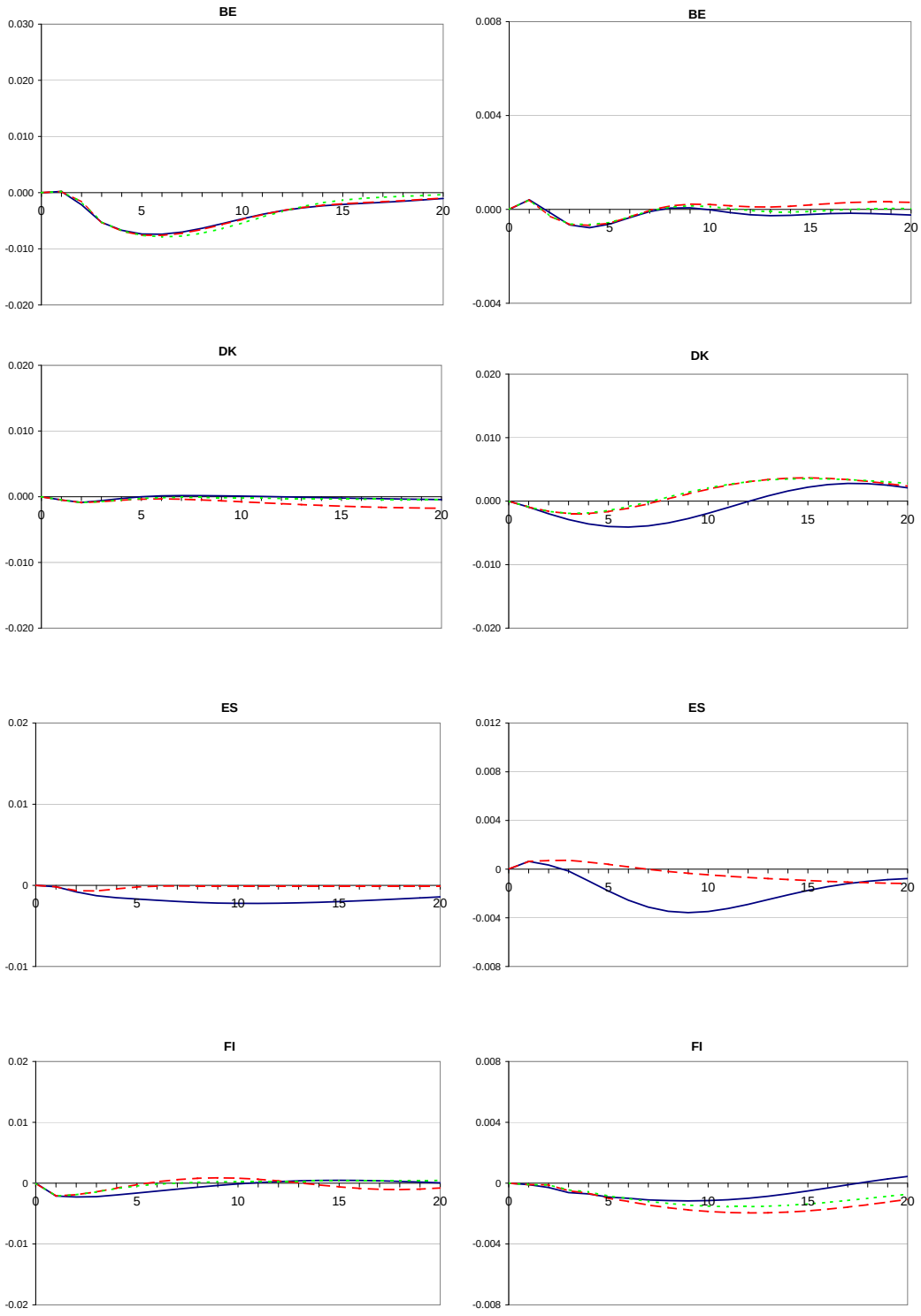

Figure 21: Comparison of simulation results for consumption before and after a structural break

Notes: Left side - before the structural break, right side - after it; Dark-blue solid line is the baseline model; red dashed line is the counterfactual simulation when the house price effect in the consumption equation is set to zero; green dotted line is the counterfactual simulation when the house price effect in both the consumption and the investment equation is set to zero.

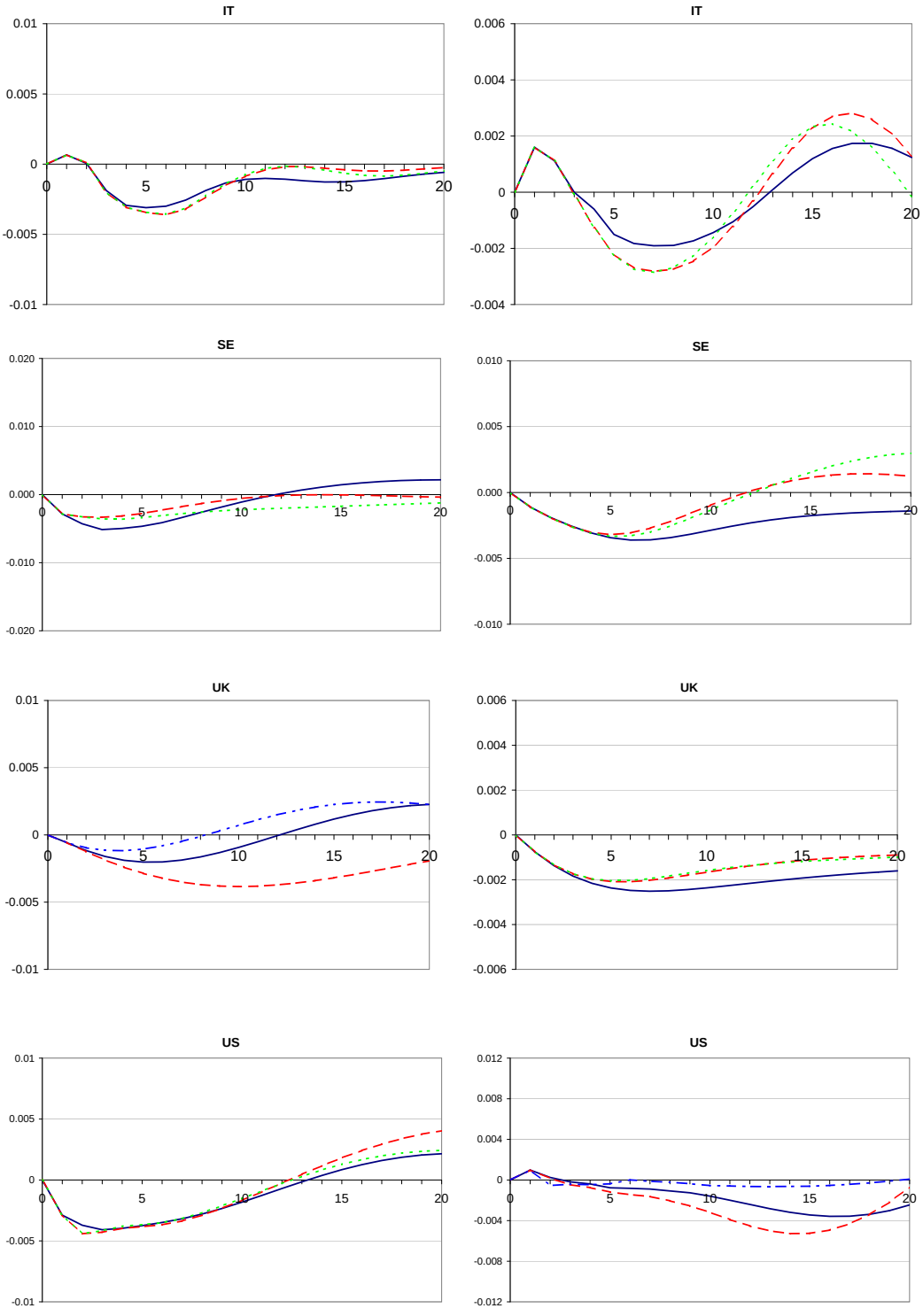

Figure 22: Comparison of simulation results for consumption before and after a structural break (continued)

Notes: Blue dash-dotted line: counterfactual simulation when the investment effect in the consumption equation is set to zero; See also *Notes* from Figure 21

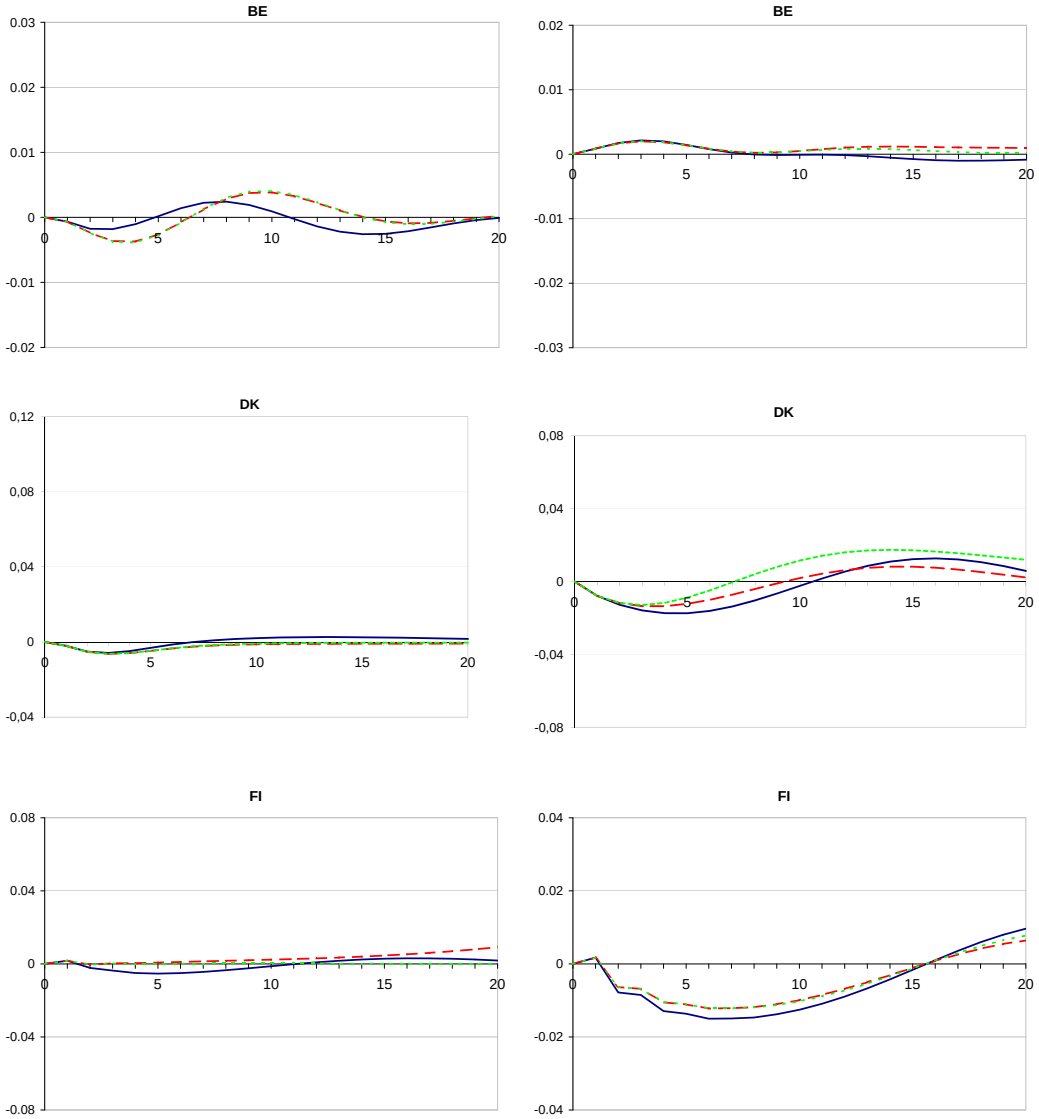

Figure 23: Comparison of simulation results for investment before and after a structural break

Notes: See *Notes* from Figure 21

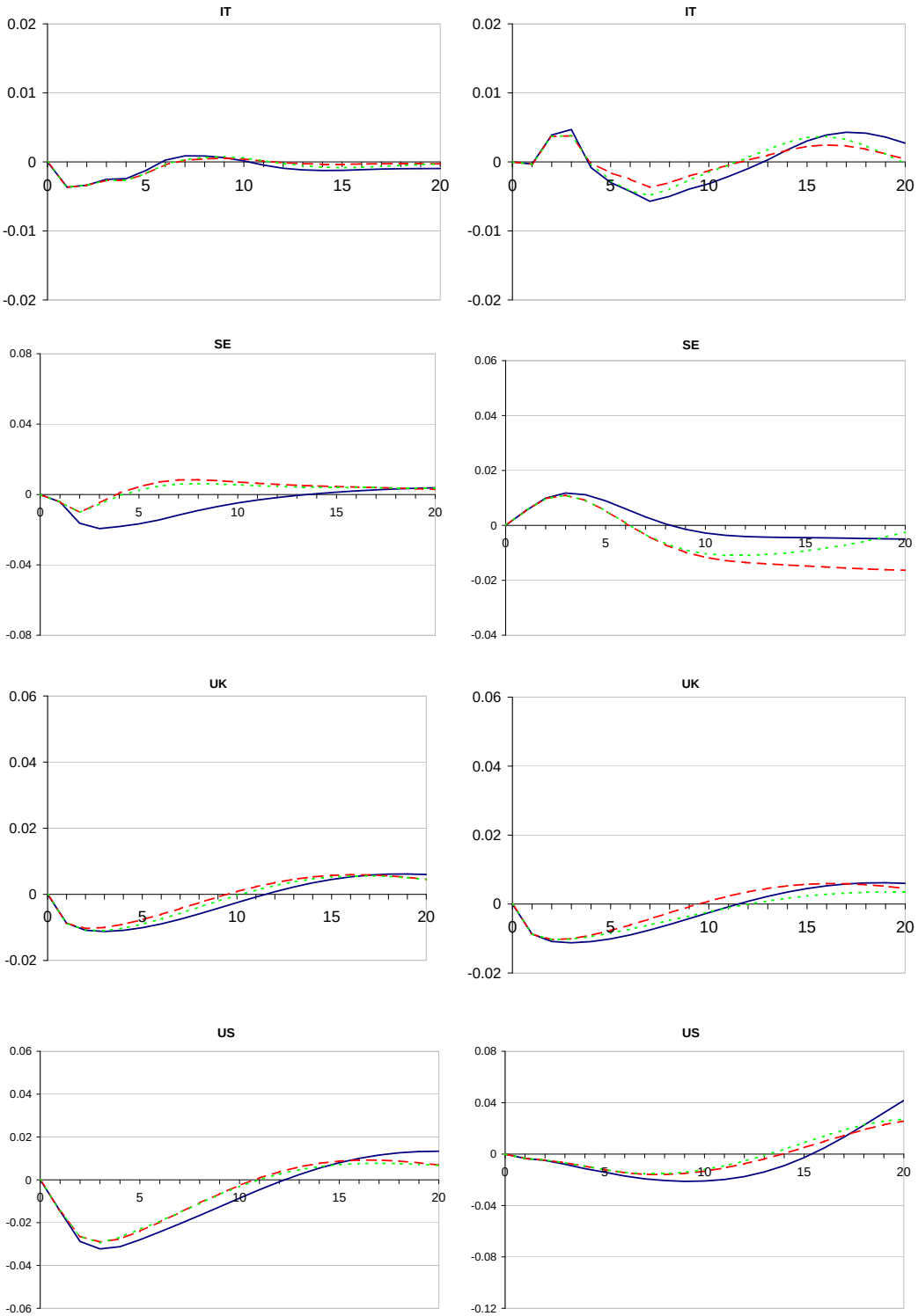

Figure 24: Comparison of simulation results for investment before and after a structural break

Notes: See *Notes* from Figure 21