The effect of Housing in the Monetary Transmission Mechanism of Consumption in Euro Countries

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Abstract

This paper examines the indirect effect housing plays in the monetary transmission mechanism (MTM) of consumption. This is done by following the method of Giuliodori (2005) and estimating structural vector autoregressive models (SVAR) for 16 developed countries, from the first quarter of 1970 to the last quarter of 2018. For each country, two Impulse response functions of two different SVARs are compared. The first one in which house prices are treated endogenously and the second one in which house prices are treated exogenously. This second model is created to remove the indirect effect housing has on consumption, while keeping the direct effect. The paper finds that in countries with relatively larger mortgage markets the indirect effect of housing in the MTM of consumption is larger. The results are consistent over time, including the financial crisis of 2008 and in the euro regime.

Table of Contests

Introduction

The effectiveness of any monetary policy depends crucially on the monetary transmission mechanism (MTM). In other words, in what way a monetary contraction or expansion affects economic conditions of the country in question. For example, how a rise in the policy interest rate affects aggregate demand, inflation, house prices, or consumption, both contemporaneously and over a few quarters. How an interest rate shock affects consumption is an interesting topic by itself, and is in large what this paper is about, the focus will, however, be more specific. The hypothesis is that while an interest rate shock should have a direct effect on consumption, it should also influence house prices, which in turn influences consumption. It is this indirect effect that a shock to the interest rate has on consumption through house prices that is the topic of this paper. The second hypothesis is that the size of the mortgage market affects the importance of this indirect effect. Research has been done on this topic, but often only comparing a few heterogeneous or sometimes only one country during a relatively short period.

This paper will fill the gap of results concerning the euro-area, comparing these results with previous periods as well as with other regions. The reason is that the effect of two-way causality may be reduced since the European central bank when setting its policy interest rate, must take in to account the economy of all euro countries, compared to a national central bank, that only needs to take in to account the economy of a single country. A comparison of the results may, therefore, be more robust. If the results seem robust to this change of institution, the paper will also make use of the now much longer time series available to find if the results are persistent over time and different financial regimes. The paper will also use a larger sample of countries than previous studies and data post the financial crisis of 2008 to see if the effects are a general phenomenon.

Previous research

Iacoviello (2002) examines the main explainers of variation in house prices. He estimates VAR models on six European countries spanning from around 1970 to around 1998 (differing between the countries because of data availability) using an error-correction specification. He includes quarterly data on output, real money, real house prices, consumer price index, and short-term interest rates. He finds that this model can explain the effect on house prices following a monetary shock and that this effect is significant. He also concludes that the effect depends on the countries individual financial market institutions. While he does not estimate the indirect effect explicitly he still estimates that the monetary transmission mechanism affects both housing and output, depending on market characteristics.

Giuliodori (2005) estimates individual structural vector autoregressive models for nine countries using quarterly data on consumption, output, real house prices, money market interest rates, and consumer price index in levels. The data set is from the third quarter of 1979 to the fourth quarter of 1998. The purpose is to examine the effect of interest rate on consumption working through the housing sector. He finds that interest rates influence house prices and that house prices effects consumption. He also uses a counterfactual scenario where they shut off the effect of housing prices working through the transmission mechanism, to estimate the effect housing has in the MTM. They conclude that housing has a propagating effect on the MTM in countries with a more developed and efficient mortgage market.

Elbourne (2008) conducts the same analysis on the UK only, using a dataset spanning from January 1987 to May 2003. He however also includes exchange rate and money supply. He uses monthly data instead of quarterly, some of which they have estimated from quarterly data using an AR process. He arrives at similar results, but he estimates that the effect of house prices in the MTM is smaller than Guiliodori's estimate.

Data

The countries in the sample are Australia, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, South Africa, Spain, Sweden, United Kingdom, and the United States. The periods span from 1976Q2 for Australia, 1975Q1 for Canada, 1972Q1 for Denmark, 1977Q4 for Finland, 1976Q1 for Ireland, 1971Q1 for Italy, 1985 Q2 for Japan, 1984Q4 for New Zealand, 1976Q2 for South Africa, 1974Q1 for Spain 1972Q1 for UK and from 1970Q1 for the rest of the countries, until last quarter 2018. The variables included are nominal house price index, converted to real house prices by the consumer price index, the consumer price index itself, money market interest rate, real GDP, and real consumption. The nominal house prices are gathered from the Bank of international settlements long series on house prices (BIS, 2019). The money market interest rate and the consumer price index are gathered from the IMF's International Financial Statistics (IMF, 2019a) (IMF, 2019b), and the real GDP and real consumption are gathered from OECD statistics using 2010 US dollars (OECD, 2019a) (OECD, 2019b).

Method

The method will closely resemble that of Giuliodori (2005) estimating structural vector autoregressive (SVAR) models to estimate the effect interest rate shocks has on the other variables and the effect of house prices in the MTM. The structural form of the SVAR will be derived using Cholesky-decomposition. By doing this, one assumes that every endogenous variable can only be contemporaneously affected by the variables specified in order after that variable. One can also assume the opposite order of specification, it makes no difference, as long as one is consistent. The order of the variables, therefore, must be decided by economic arguments before the model can be estimated. This forces the modeler to assume that no two variables can be contemporaneously affected by each other. If the modeler believes this to be the reality a different method of restrictions must be used than the Cholesky-decomposition.

The following set of equations (Figure 1) can characterize the structural form of the vector autoregressive model used, in the real model there can be more lags than one however, and the number is decided using the Schwarz Bayesian information criterion (SBIC).

Figure 1 Structural form of original equation system

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MMR = RHP   + CON   + CPI    + GDP   + L.MMR + L.RHP + L.CON + L.CPI   + L.GDP + MMR-Shock
RHP  = CON   + CPI    + GDP   + L.MMR + L.RHP + L.CON + L.CPI   + L.GDP + RHP-Shock
CON  = CPI   + GDP    + L.MMR + L.RHP + L.CON + L.CPI   + L.GDP + CON-Shock
CPI  = GDP   + L.MMR + L.RHP + L.CON + L.CPI   + L.GDP + CPI-Shock
GDP  = L.MMR + L.RHP + L.CON + L.CPI   + L.GDP + GDP-Shock
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MMR = Money Market Rate, CON = Consumption, CPI = Consumer Price Index, GDP = Gross Domestic Product, RHP = Real House Prices, L. = Lag of.

The order of the variables in the model resembles that of Giuliodori (2005) as following: Money Market rate, Real House Prices, Consumption, CPI, GDP. This means that the interest rate is assumed to depend contemporaneously on all the other variables, Real house prices on GDP, CPI and consumption, consumption on GDP and CPI, and CPI only on GDP. By allowing the interest rate to depend contemporaneously on all the other variables, any difference between the euro regime and otherwise may be found in different estimation of these parameters.

Each of these equations can be estimated efficiently using OLS. By using this Cholesky decomposition, the error of each equation can be interpreted as structural shocks, and impulse responses can be calculated from each of these shocks. This works because of the recursive

structure of the system. The way it works is that an unexpected increase in GDP must depend on the GDP-shock, since it is assumed that GDP is unaffected contemporaneously be the other variables by assumption. In turn this means that an unexpected increase in CPI must depend on a CPI-shock, when taking contemporaneous GDP (the GDP-shock) and the other variables into account. This logic can continue up until the least exogenous variable, in this case the interest rate.

In practice what the software does however is estimating the below reduced form of the equation system (Figure 2) instead and transforming the resulting matrix of estimated coefficients (including errors).

Figure 2 Reduced form of original equation system

```
MMR  = L.MMR + L.RHP + L.CON + L.CPI  + L.GDP + Error
RHP  = L.MMR + L.RHP + L.CON + L.CPI  + L.GDP + Error
CON  = L.MMR + L.RHP + L.CON + L.CPI  + L.GDP + Error
CPI  = L.MMR + L.RHP + L.CON + L.CPI  + L.GDP + Error
GDP  = L.MMR + L.RHP + L.CON + L.CPI  + L.GDP + Error
```

The estimated coefficients are however fewer in this model than in the structural one, and the error cannot be interpreted as structural shocks. Using Cholesky-decomposition this is solved by assuming that B_0 in the below matrix equation (1) is upper triangular and that the error matrix ε_t is zero on the off-diagonal. This is the same as putting the previously explained restrictions on the contemporaneous effects of the variables, and assuming that the structural shocks are uncorrelated. This makes it possible to convert equation (2), the reduced form equation system to equation (1), the structural form, since they now have the same number of unknown coefficients.

$$(1)\ B_0 Y_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \cdots + B_k Y_{t-k} + \varepsilon_t$$

$$(2)\ Y_t = D_1 Y_{t-1} + D_2 Y_{t-2} + \cdots + D_3 Y_{t-k} + u_t$$

$D_1 = B_0^{-1} B_1$ etc. and $u_t = B_0^{-1} \varepsilon_t$

All variables excluding the interest rate were found to be integrated of order one. Growth rates will, therefore, be used in these variables. An alternative would be to use an error correction model. The variables would, in that case, have to be checked for cointegration, and the model would be more complicated. In this case, a simple structural VAR was enough to find

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interesting results and was therefore used. Giuliodori (2005) used the variables in levels without using an error correction model.

After estimating each model, still following the method of Giuliodori (2005), impulse response functions (IRFs) will be calculated using a shock to the interest rate (MMR-Shock in the model) as the impulse variable. This will show the effects of a monetary shock to the endogenous variables of each country model. To find the effect of housing in the monetary transmission mechanism, each model will be estimated once again, now however treating the lags of the real house prices as exogenous variables. This means that the endogenous variables are as following: Money Market Rate, Consumption, CPI, GDP, but also including Real house prices (and the appropriate number of lags) as an exogenous variable. This will cut off the indirect effect interest rates have on consumption working through the housing market, while maintaining the direct effect that both the interest rate and house prices have on consumption. Impulse response functions will once again be calculated based on these alternative models. A comparison of the impulse response functions of the interest rate on consumption in the two models will be made. The structural form of this counterfactual model can be represented by the following system of equations (Figure 3),

Figure 3 Structural form of counterfactual equation system

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MMR = CON    + CPI      + GDP   + L.MMR + L.CON + L.CPI  + L.GDP + RHP   + L.RHP + MMR-Shock
CON  = CPI    + GDP      + L.MMR + L.CON + L.CPI  + L.GDP + RHP   + L.RHP + CON-Shock
CPI  = GDP    + L.MMR   + L.CON + L.CPI  + L.GDP + RHP   + L.RHP + CPI-Shock
GDP  = L.MMR + L.CON   + L.CPI  + L.GDP + RHP   + L.RHP + GDP-Shock
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The analysis will be conducted in three steps. First the individual country models will be estimated using data before 1999 in other words before the introduction of the euro. Secondly models will be estimated using the remaining data. Thirdly a comparison will be made of the effects in the two different periods, if a change is found it will be compared to the non-euro countries in the sample to make sure the change is not due to a general change in all countries during 1999. If no significant change can be found between the two periods, a third group of models will be estimated using the entire sample, to maximize the power of the test.

Results

Before the European monetary union

In this section, the results of the impulse response functions using the data from before 1999 will be presented. In the next section, the impulse response functions using the data from after 1999 will be presented. The IRFs can be found in Figure 5-8 in the appendix.

A shock to the interest rate in the pre-EMU period results in a significant temporary increase in the interest that decays, lasting around ten quarters in all the countries in the sample. This is what one might expect, and it shows how a monetary shock can have effects lasting longer than the shock itself.

When it comes to the consumption, the primary variable of interest of this paper, a shock to the interest rate, results in a significant decrease in the growth rate in Canada, Denmark, Finland, France, Germany, Ireland, Netherlands, and New Zealand. In Australia, Italy, Japan, South Africa, Spain, Sweden, and the United Kingdom, no significant effect is found. Only in the United States does a shock to the interest rate result in a significantly positive effect on the growth rate of consumption. This seems to indicate that the monetary transmission mechanism affects consumption negatively in general. While the US may be affected differently than the rest of the sample, it is also possible that the positive effect is a random phenomenon.

Regarding inflation, a monetary shock has a significant positive effect in Canada, Denmark, Finland, France, Germany, Ireland, Italy, New Zealand, and the United States. In all other countries, the effect is insignificant. This may seem counterintuitive, and it is. Following a monetary contraction, inflation should decrease, not increase. This is a common phenomenon called the price puzzle, which can appear when estimating similar VAR models like this one. One solution to the price puzzle is to put additional restrictions in the structure of the model, for example by restricting the lag of the interest rates effect on inflation to zero. Further explanation and proof can be found in Estrella (2015). Given the purpose of this paper, there will be no attempt to solve it in this model.

Concerning the growth of aggregate GDP, a monetary shock results in a significant decrease in Australia, Canada, Denmark, Finland, France, Germany, Ireland, Italy, and the Netherlands, only in the United States is the effect slightly positive, while it is insignificant in the remaining

countries. Turning to the effect on the real house prices, the effect is significantly negative in Denmark, Finland, France, Ireland, Italy, New Zealand, South Africa, Sweden, and the United States. These results are summarized in Table 1.

After the European monetary union

This section presents the results of the impulse response functions using the data after 1999. The IRFs can be found in Figure 9-12 in the appendix. A shock to the interest rate decays over a period of around 10 quarters. In Denmark, Spain, Sweden, and the United Kingdom, the growth of consumption is significantly negatively affected. In Ireland and the Netherlands, the effect is significantly positive. In all other countries, it is insignificant. Also in this period does the monetary transmission mechanism tend to affect consumption negatively, the evidence is not as clear however. Inflation is significantly positively affected by the shock in all countries except Canada, France, Japan, and South Africa, where the effect is insignificant. GDP is negatively affected in all countries except Australia, Canada, Italy, South Africa, and the United States. The real house prices are negatively affected in all countries, excluding Canada, Germany, and Japan, where the effect is insignificant and Italy where the effect is positive.

Comparing the two periods

This section will, as described in the method, compare the monetary transmission mechanisms of the two periods, to evaluate if the introduction of the euro, has changed the workings of them. Table 1 and Table 2 summarizes the results from the IRFs over the two periods. Looking at the two tables, they seem to describe two relatively similar scenarios, where interest rates and inflation are affected positively by the monetary shock, and GDP and house prices negatively. Regarding consumption, the similarities are not as clear. Before 1999 all countries except the United States experienced a negative or insignificant effect on its consumption growth following a shock to its interest rate. After 1999 the results among the euro countries differ. While the Netherlands and Ireland experience a positive shock to its consumption growth, Spain experience a negative shock. In Finland, France, Germany, and Italy, the effect is no longer significant at all. This may be the result of a slightly smaller data set in the period after 1999 but could also mean that monetary policy has become less effective after the implementation of the euro. Looking at Spain, Sweden, and the United Kingdom; some of their

results are now significant, unlike before 1999. While the two periods are not identical, there seems to be no clear evidence that the IRFs differ in a significant systematic way.

Table 1 the effects of the IRFs pre-EMU   *Table 2 the effects of the IRFs post-EMU*

Country	MMR	CON	CPI	GDP	RHP
Australia	+	Ins.	Ins.	-	Ins.
Canada	+	-	+	-	Ins.
Denmark	+	-	+	-	-
Finland	+	-	+	-	-
France	+	-	+	-	-
Germany	+	-	+	-	Ins.
Ireland	+	-	+	-	-
Italy	+	Ins.	+	-	-
Japan	+	Ins.	Ins.	Ins.	Ins.
Netherlands	+	-	Ins.	-	Ins.
New Zealand	+	-	+	Ins.	-
South Africa	+	Ins.	Ins.	Ins.	-
Spain	+	Ins.	Ins.	Ins.	Ins.
Sweden	+	Ins.	Ins.	Ins.	-
United Kingdom	+	Ins.	Ins.	Ins.	Ins.
United States	+	+	+	+	-

Country	MMR	CON	CPI	GDP	RHP
Australia	+	Ins.	+	Ins.	-
Canada	+	Ins.	Ins.	Ins.	Ins.
Denmark	+	-	+	-	-
Finland	+	Ins.	+	-	-
France	+	Ins.	Ins.	-	-
Germany	+	Ins.	+	-	Ins.
Ireland	+	+	+	-	-
Italy	+	Ins.	+	Ins.	+
Japan	+	Ins.	Ins.	-	Ins.
Netherlands	+	+	+	-	-
New Zealand	+	Ins.	+	-	-
South Africa	+	Ins.	Ins.	Ins.	-
Spain	+	-	+	-	-
Sweden	+	-	+	-	-
United Kingdom	+	-	+	-	-
United States	+	Ins.	+	Ins.	-

Ins. = Insignificant

Table 3 summarizes the results of Figure 13-16, IRFs based on the entire sample period. As can be seen the effects on the interest rates are as expected positive, and the CPI mostly, Sweden is the exception. Italy is the only euro country with an insignificant effect on consumption, however not in the entire sample. Regarding GDP, both Spain and Italy experience an insignificant effect, accompanied by South Africa, Sweden, and the UK. Still, only the United States experience a positive effect. Looking at the real house prices, in neither Italy, Spain nor the Netherlands can a significant effect be found. This is, however, also the case of Japan, New Zealand, and the United Kingdom. Without forehand knowledge of which

countries are euro-members, any similarities in contrast to non-euro countries would be difficult to find.

Table 3 the effects of the IRFs total Sample

Country	MMR	CON	CPI	GDP	RHP
Australia	+	Ins.	+	-	-
Canada	+	-	+	-	-
Denmark	+	-	+	-	-
Finland	+	-	+	-	-
France	+	-	+	-	-
Germany	+	-	+	-	-
Ireland	+	-	+	-	-
Italy	+	Ins.	+	Ins.	Ins.
Japan	+	Ins.	+	-	Ins.
Netherlands	+	-	Ins.	-	Ins.
New Zealand	+	-	+	-	Ins.
South Africa	+	Ins.	Ins.	Ins.	-
Spain	+	-	Ins.	Ins.	Ins.
Sweden	+	Ins.	-	Ins.	-
United Kingdom	+	Ins.	Ins.	Ins.	Ins.
United States	+	+	+	+	-

The counterfactual scenario

In this section the results of the counterfactual scenario will be analyzed.

Figures 17-32 describe two IRFs for each country. The blue one is the original impulse response function of the interest rate, for consumption. The red one is the same but calculated from the VAR model treating the real house prices as exogenous variables, to remove the indirect effect of house prices in the monetary transmission mechanism. The left part of each figure is created from the data before 1999, and the right part from data after 1999.

In no country are the IRFs significantly different, in neither of the two periods. In some countries, the difference is, however, larger than in others, and the blue IRFs are always either indistinguishable from the red or below it, giving some support that the effect of housing in the MTM is not purely random. In other words, house prices are either insignificant in the MTM or propagating in a negative manner. Figure 4 shows the graphs for Italy and the Netherland pre-EMU. One can see that in Italy the two graphs are indistinguishable while in the Netherlands the blue IRF is clearly below the red, implying a negative propagating effect of house prices in the MTM of consumption.

Figure 4 Comparison of IRFs, Italy and Netherlands, Pre-EMU
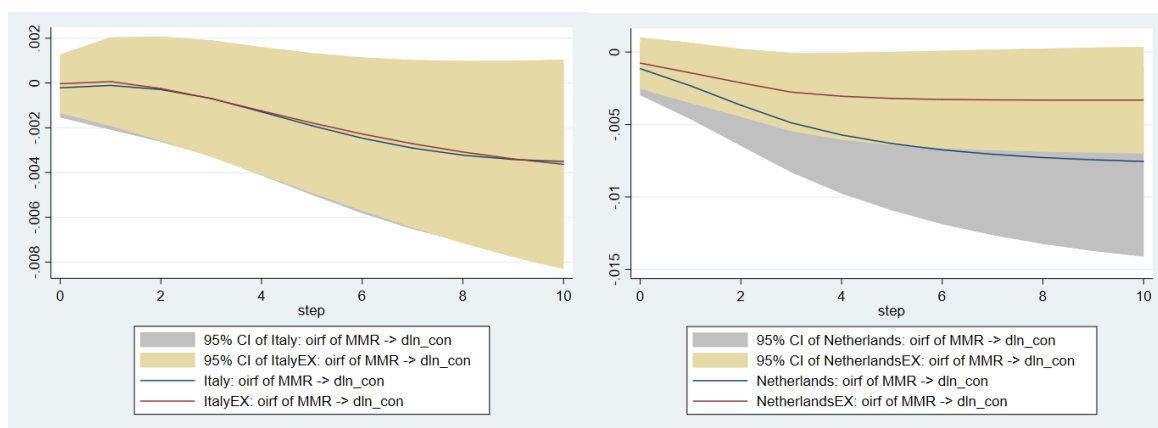
Another interesting point is that while the results differ some between the two periods, more in some than others, the pattern is generally the same. Countries with large differences between the two IRFs in one period tend to have large differences in the other period as well. One might conclude that the difference is slightly bigger post euro in some countries. In no country is the effect noticeably smaller. One potential problem is that in several countries post-euro the two IRFs are entangled, while it may be random, it is also possible that the sample period is too small to estimate the IRFs efficiently. The second reason is supported by the fact that this is not as apparent in the slightly longer period pre-EMU, or not at all when doing the test for the total sample period. While there is still good reason to focus the analysis on euro countries post euro, this may be pointless if the IRFs are not properly estimated.

Given the similarities between the two periods, both in the difference of the two IRFs and the behavior of the different IRFs as previously analyzed, the benefits of analyzing the total period outweighs the costs. The focus will instead be on the EU-member countries, to increase the number of countries for comparison. One might include all the countries, but it is assumed that the EU countries markets may be better compared thanks to their integrated inner market.

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Figures 33-48 describes the previous scenario but using the total sample period. These results are more apparent than the results from the separate periods. The blue IRFs are always below the red, still not statistically significant, however. In some countries, the difference is still clearly larger than in others. Table 4 describes in what countries the difference is bigger and in what it is smaller, as well as characteristics of the countries different mortgage markets. The countries with a bigger effect are sorted alphabetically at the top and the one with a smaller effect alphabetically at the bottom. Green color means that the number is one of the five biggest in its column and red, one of the five smallest. All characteristics are gathered from the European Mortgage Federation (2017), except for the Loan to value ratio for Finland, which is extracted from the Finnish Financial Supervisory Authority and Bank of Finland (2018). Except for the Loan to value ratio, the characteristics are averages of the data available in the report, to minimize potential shocks.

Regarding the Loan to value ratio, there seems to be some correlation with the housing effect in the MTM; large numbers seem to correlate with large effects. The numbers are however relatively similar in size, most between 65 and 80 percent. The owner occupation rate is the characteristic with the least correlation if any at all with the effect. These numbers are, however, even closer to each other in size. The two last characteristics, Outstanding residential loans to disposable income ratio and to the GDP ratio shows the clearest correlation. Finland and the United Kingdom being the exceptions. The numbers of the United Kingdom are however smaller than the other big effect countries, and Finland larger than some of the small effect countries. While the results are not absolute, there seems to be a tendency for countries with large mortgage markets, measured by the different characteristics to have a larger difference between the IRFs, and vice versa. This supports the hypothesis that the difference is not purely random, and that the size of the mortgage market has some effect regarding the size of the indirect effect of housing in the MTM.

Table 4 The effect of housing in the MTM and mortgage market characteristics

Country	Effect	Loan to Value Ratio	Owner Occupation Rate	Outstanding Residential Loans to Disposable Income Ratio	Outstanding Residential Loans to GDP Ratio
Denmark	Bigger	80%	66%	183%	87%
Finland	Bigger	81%	73%	68%	39%
Ireland	Bigger	72%	73%	123%	59%
Netherlands	Bigger	100%	67%	203%	99%
Sweden	Bigger	64%	69%	146%	73%
France	Smaller	79%	63%	59%	38%
Germany	Smaller	76%	53%	69%	45%
Italy	Smaller	69%	73%	29%	20%
Spain	Smaller	64%	79%	91%	58%
United Kingdom	Smaller	77%	69%	108%	71%

Conclusion

This paper estimated structural vector autoregressive models for 16 countries, examining the monetary transmission mechanism and the effect housing has in it. The focus was on the euro countries. It first compared the period before the introduction of the euro, with the period after. Minor differences were found, but none that clearly separated the euro countries from the non-euro countries, and none that implied a systematic change in the MTM between the two periods. Running the test on the entire sample period also produced reasonable results. An analysis was made to extract the role housing played in the monetary transmission mechanism. While there were no statistically significant proofs that housing do play a role, there were quite large differences between the countries, but not between the two periods. It was quite clear that housing, in general, does play a negative propagating role in MTM when examining all the countries together. There were signs however that the second period may have been too short, to estimate the IRFs properly. Comparing the effect of housing in the MTM over the entire sample period for the EU countries, showed that the size of the mortgage market might influence the role housing has in the MTM. While these results are not new, they may be assumed to be more robust, compared to earlier studies, partly because of a larger sample of countries, a more extended period, and inclusion of countries in a monetary union.

References

BIS (2019), "Residential property prices: long series (nominal)", Bank of international settlements. Available at: https://www.bis.org/statistics/pp_long.htm?m=6%7C288%7C595

Elbourne, Adam, (2008), "The UK housing market and the monetary policy transmission mechanism: An SVAR approach", *Journal of Housing Economics*, 17, issue 1, p. 65-87, https://EconPapers.repec.org/RePEc:eee:jhouse:v:17:y:2008:i:1:p:65-87.

Estrella, Arturo (2015), "The price Puzzle and Var", *Macroeconomic Dynamics* 19, 1880–1887.

European Mortgage Federation (2017), "Hypostat 2017", European Mortgage Federation.

Finnish Financial Supervisory Authority and Bank of Finland (2018), "Makrovakausraportti TALVI 2:2018", Finnish Financial Supervisory Authority and Bank of Finland.

Giuliodori, Massimo, (2005), "The Role of House Prices in the Monetary Transmission Mechanism across European Countries", *Scottish Journal of Political Economy*, 52, issue 4, p. 519-543, https://EconPapers.repec.org/RePEc:bla:scotjp:v:52:y:2005:i:4:p:519-543.

IMF (2019a), "International financial statistics, Interest Rates, Money Market, Percent per annum", International Monetary Fund. Available at: http://data.imf.org/?sk=daa407c5-03ee-4a6a-b55b-5782c2966def&dsId=DS_1465410744907

IMF (2019b), "International financial statistics, Consumer Price Index, All items, Index", International Monetary Fund. Available at: http://data.imf.org/?sk=daa407c5-03ee-4a6a-b55b-5782c2966def&dsId=DS_1465410744907

Matteo Iacoviello, Matteo (2002), "House Prices and Business Cycles in Europe: a VAR Analysis". *American Economic Review*, Vol. 95, No. 3 (June), pp. 739–764.

OECD (2019a), "OECD statistics, Subject: B1_GE: Gross domestic product – expenditure approach, Measure: CQRSA: National currency, current prices, quarterly levels, seasonally adjusted", Organisation for Economic Co-operation and Development. Available at: https://stats.oecd.org/#

OECD (2019b), "OECD statistics, Subject: P31S14_S15: Private final consumption expenditure, Measure: CQRSA: National currency, current prices, quarterly levels, seasonally adjusted", Organisation for Economic Co-operation and Development. Available at: https://stats.oecd.org/#

Appendix

Pre EMU

Figure 5 Impulse response functions, Australia, Canada, Denmark, Finland, Pre-EMU
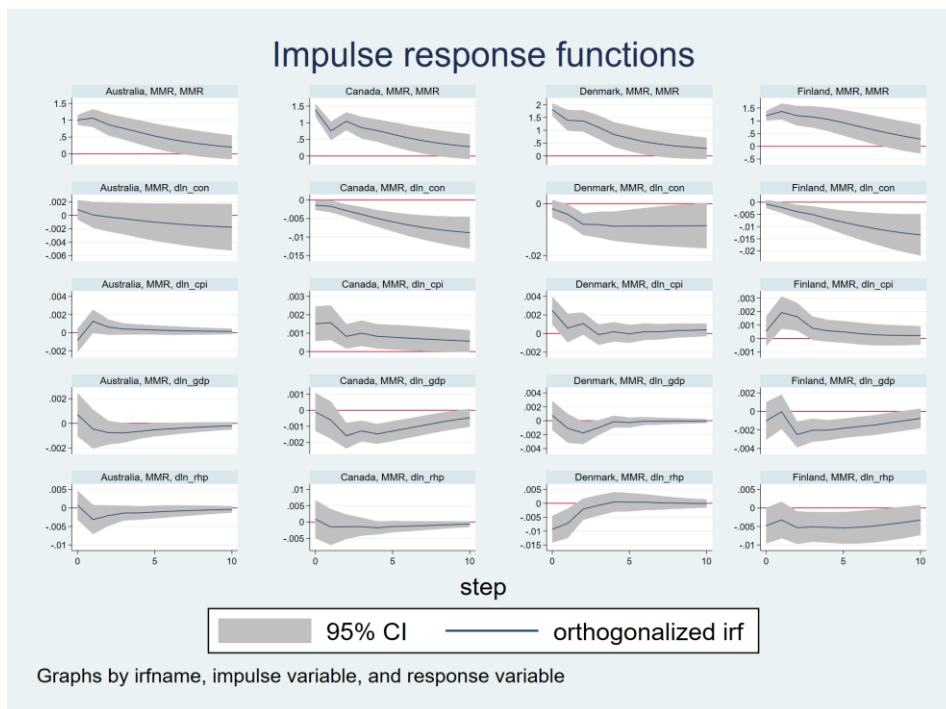
Figure 6 Impulse response functions, France, Germany, Ireland, Italy, Pre-EMU
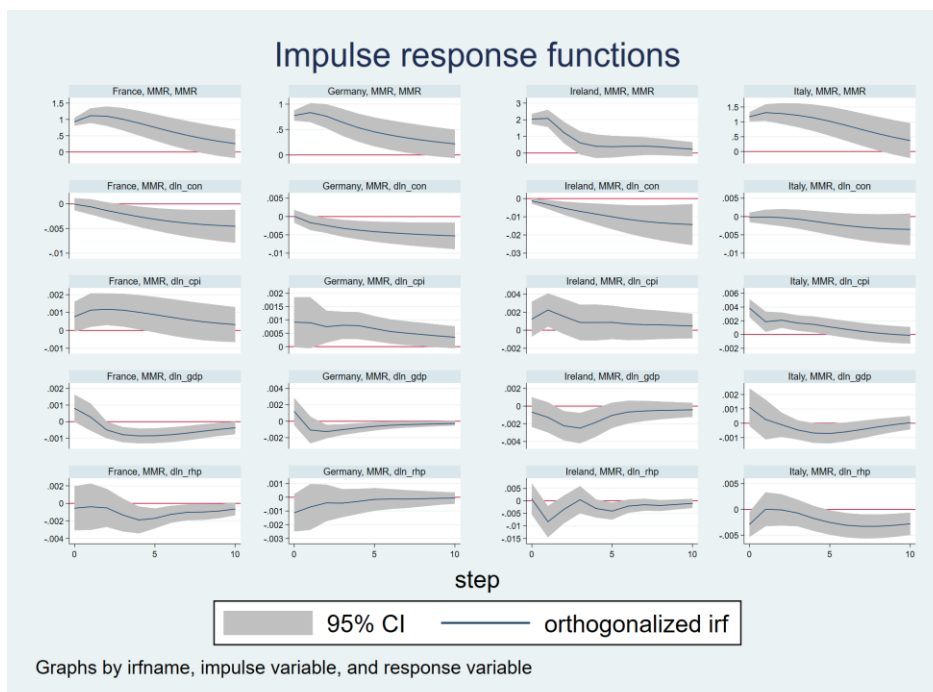
Figure 7 Impulse response functions, Japan, Netherlands, New Zealand, South Africa, Pre-EMU
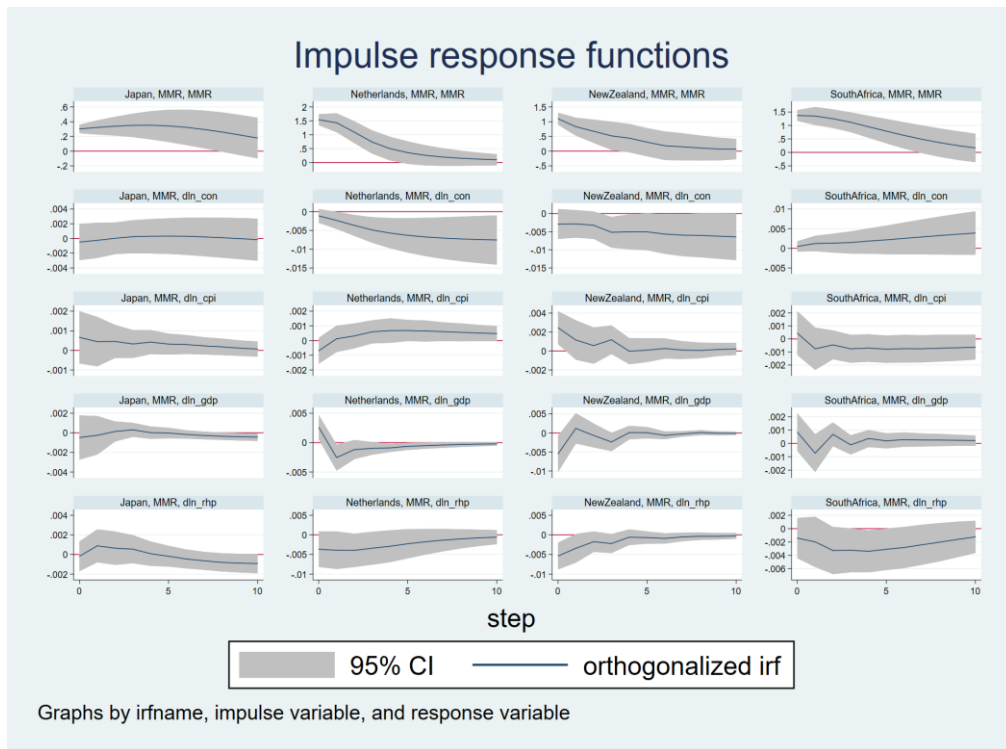
Figure 8 Impulse response functions, Spain, Sweden, United Kingdom, United States, Pre-EMU
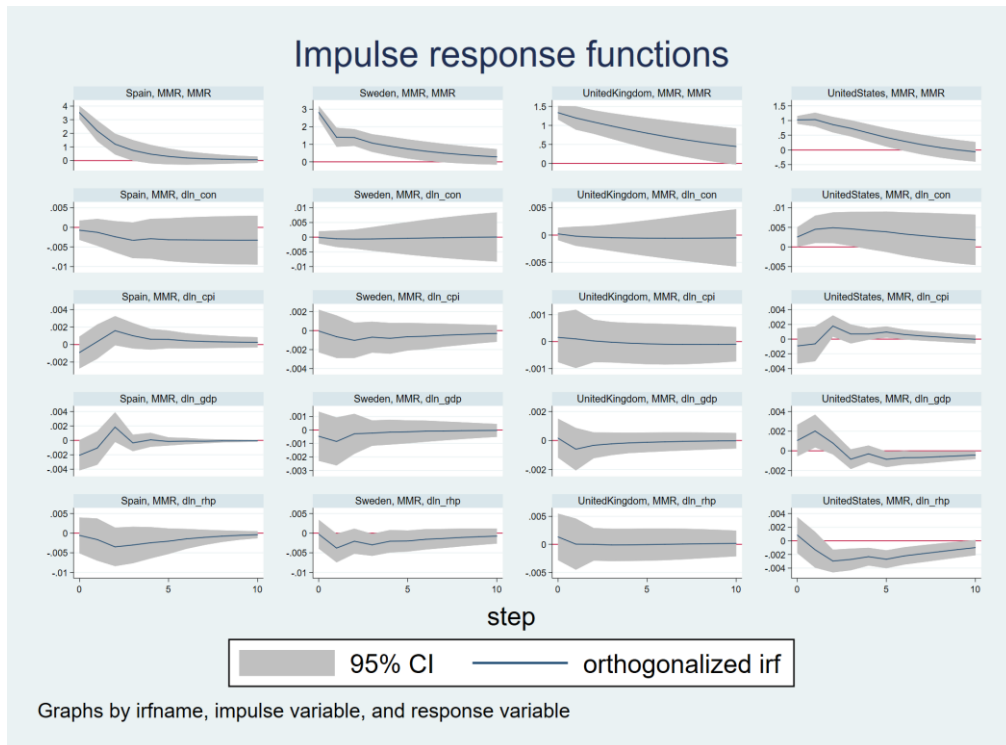
Post EMU

Figure 9 Impulse response functions, Australia, Canada, Denmark, Finland, Post-EMU
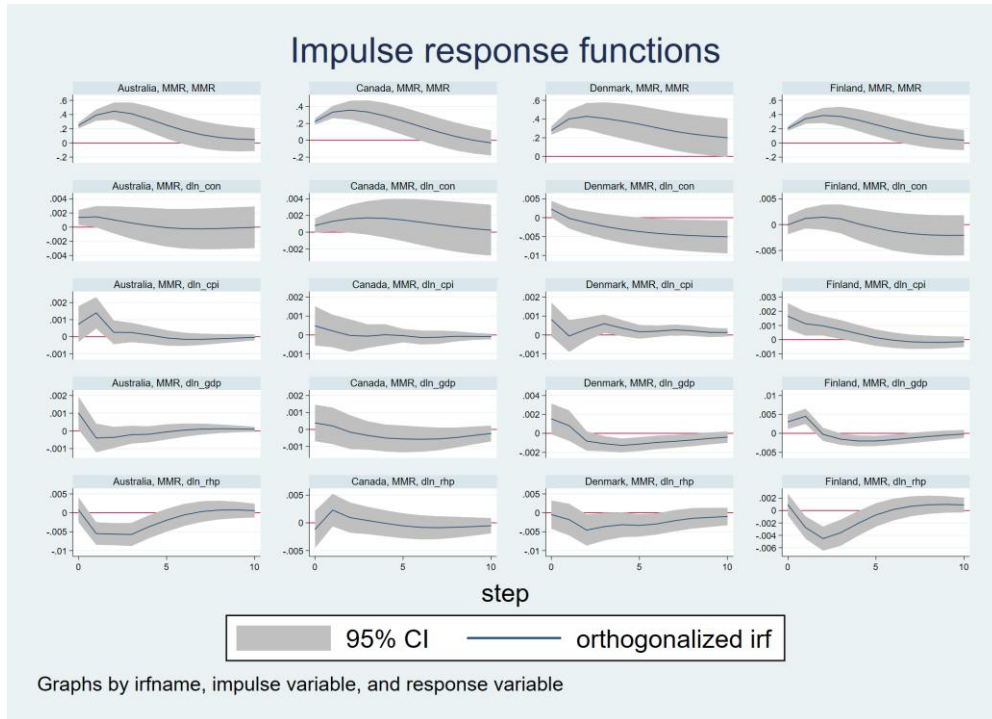
Figure 10 Impulse response functions, France, Germany, Ireland, Italy, Post-EMU
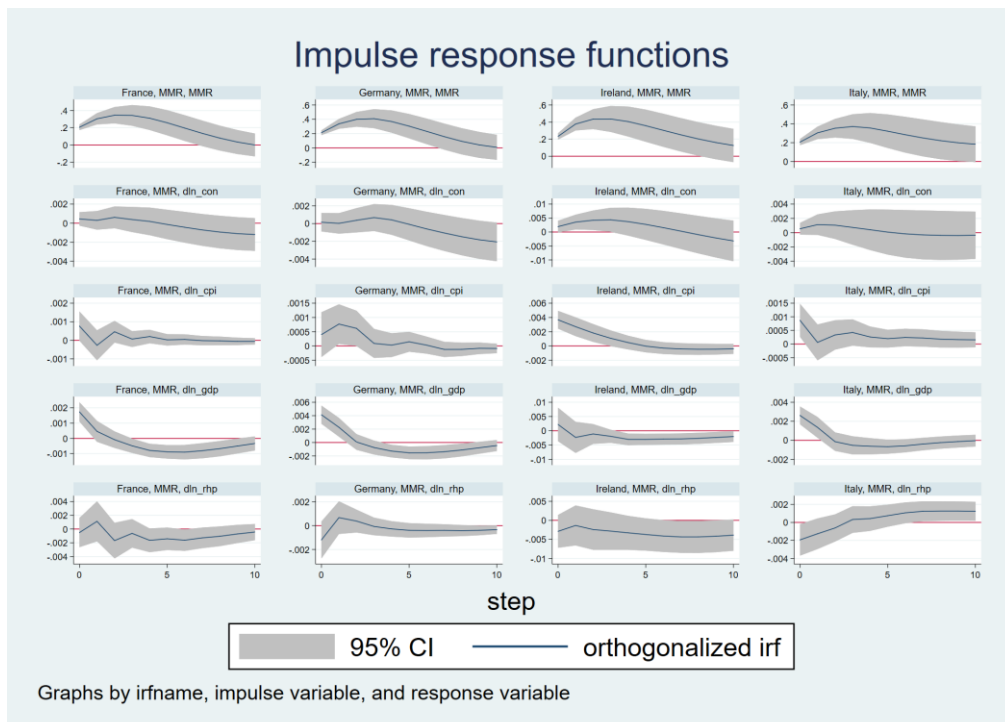
Figure 11 Impulse response functions, Japan, Netherlands, New Zealand, South Africa, Post-EMU
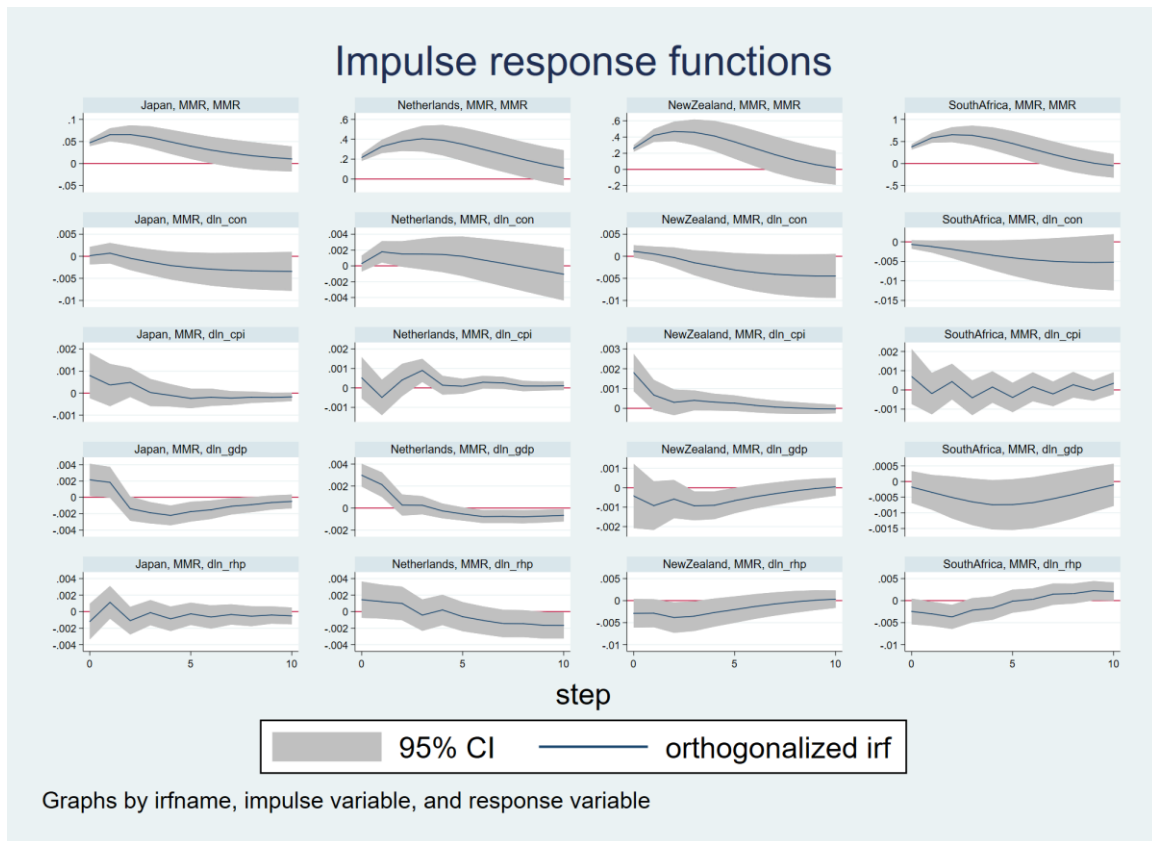
Figure 12 Impulse response functions, Spain, Sweden, United Kingdom, United States, Post-EMU
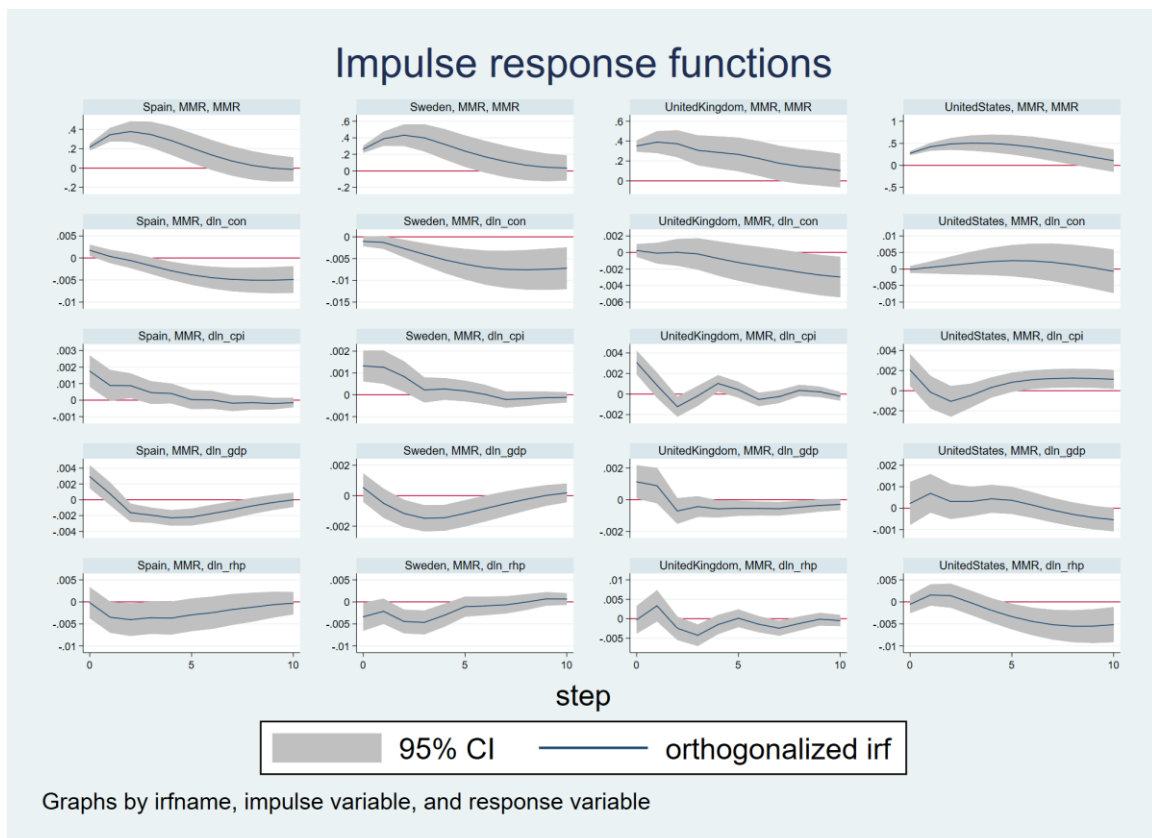
Total

Figure 13 Impulse response functions, Australia, Canada, Denmark, Finland, Total sample period
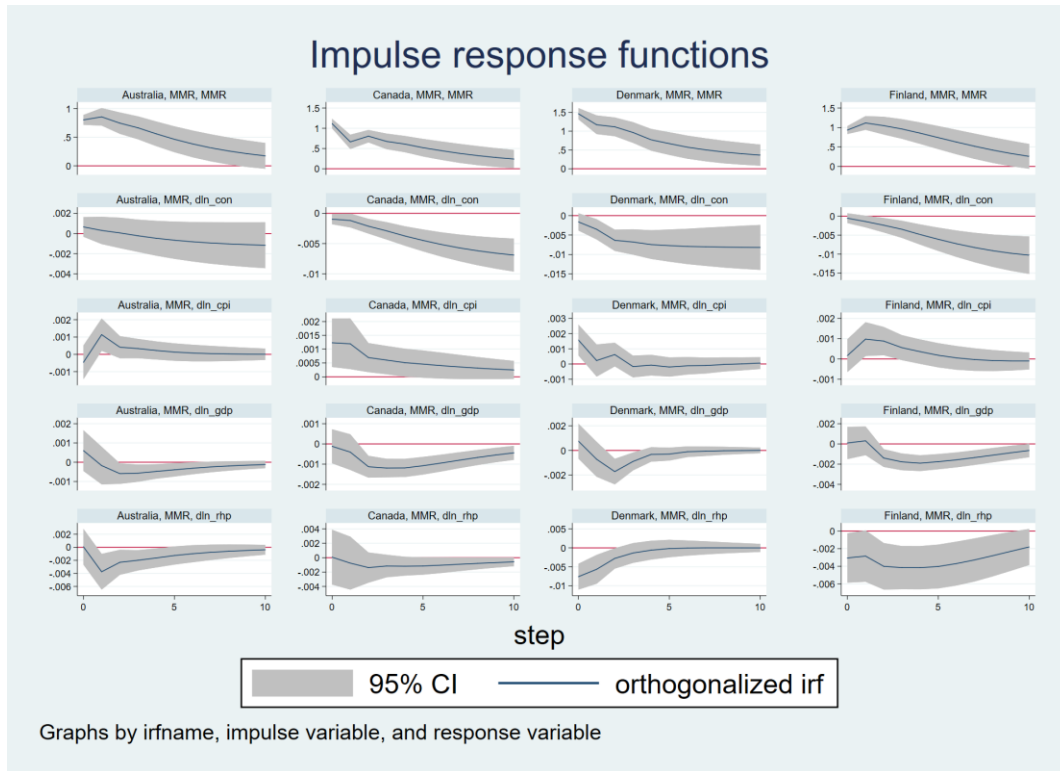
Figure 14 Impulse response functions, France, Germany, Ireland, Italy, Total sample period
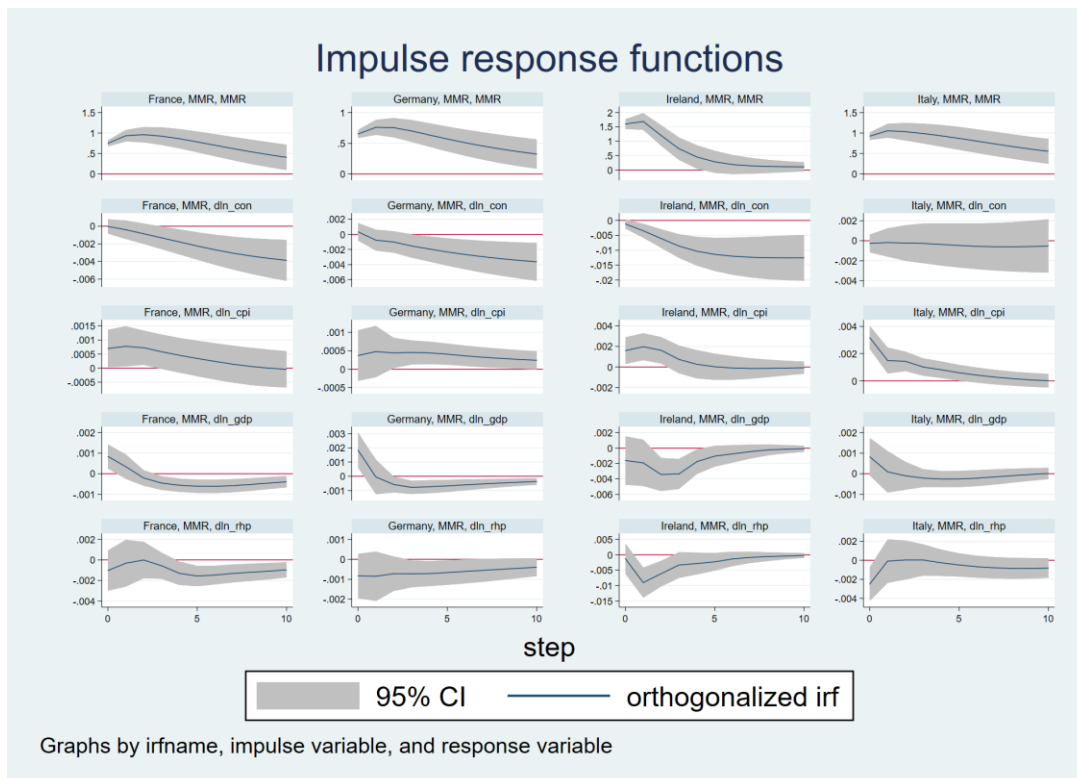
Figure 15 Impulse response functions, Japan, Netherlands, New Zealand, South Africa, Total sample period
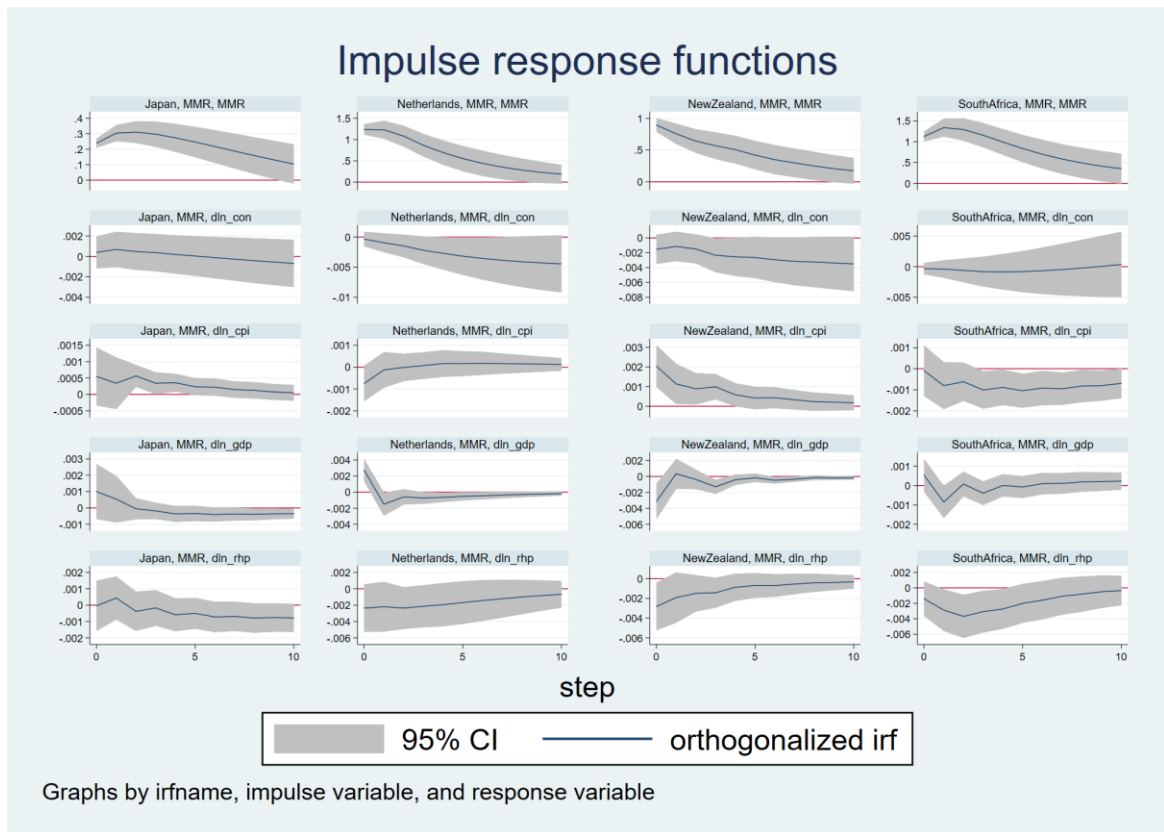
Figure 16 Impulse response functions, Spain, Sweden, United Kingdom, United States, Total sample period
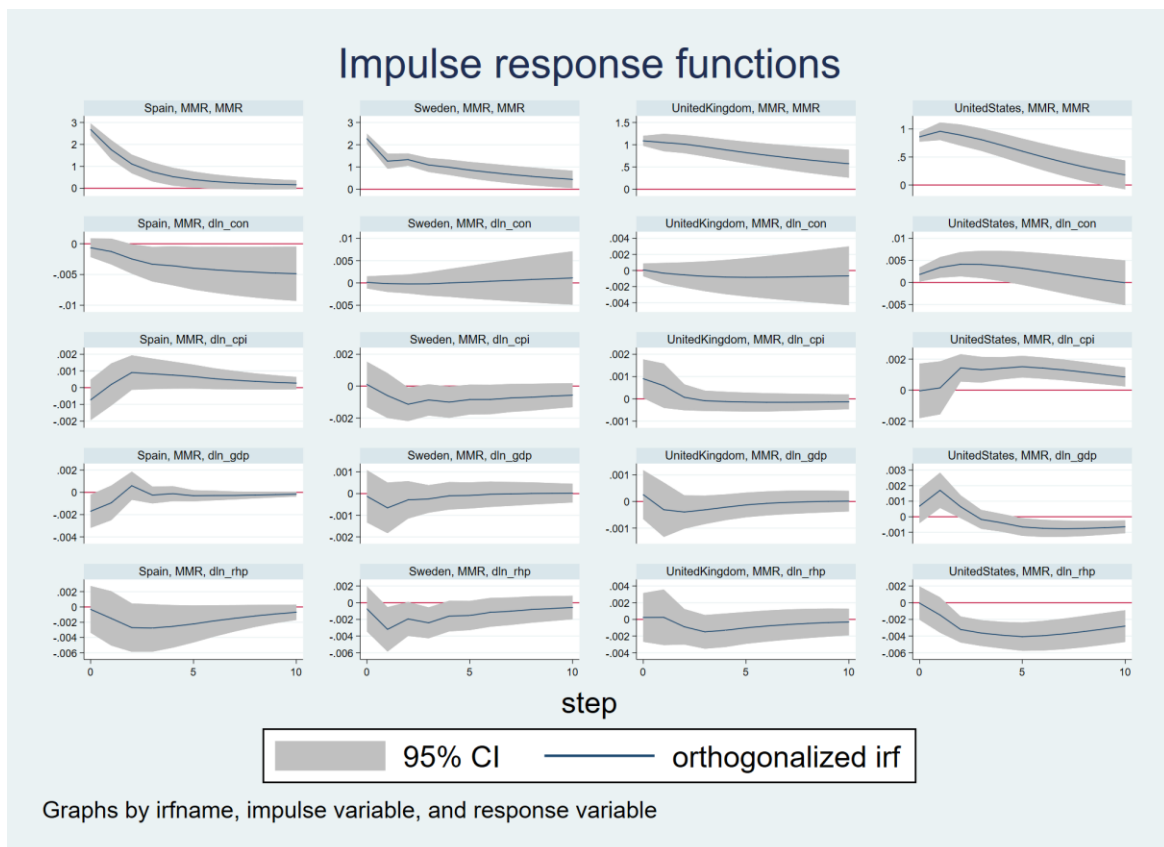
Comparison

Figure 17 Comparison of IRFs, Australia, split sample
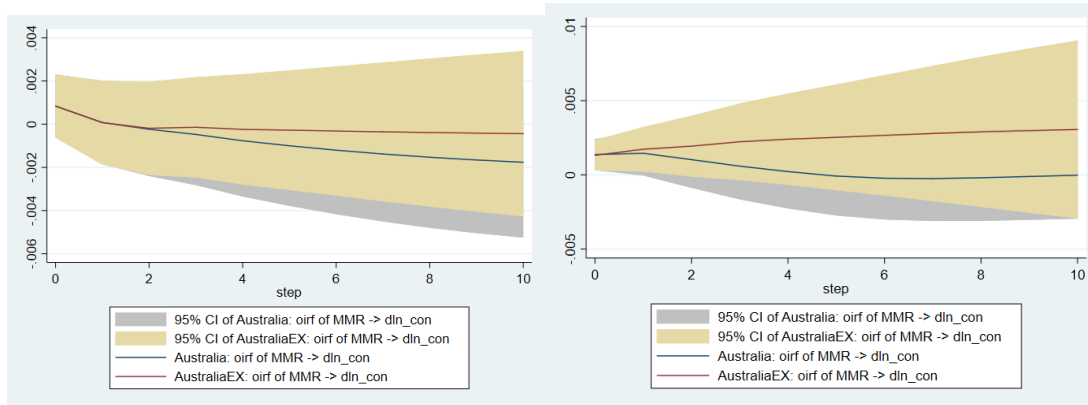
Figure 18 Comparison of IRFs, Canada, split sample
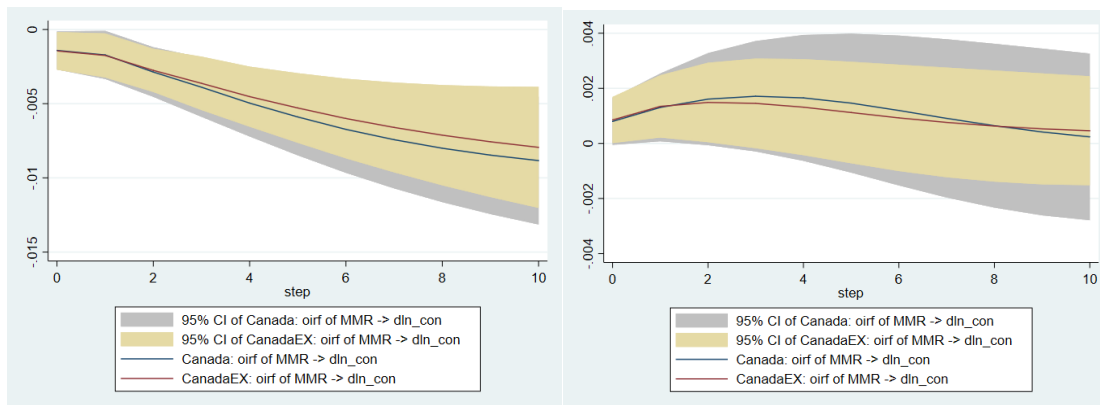
Figure 19 Comparison of IRFs, Denmark, split sample
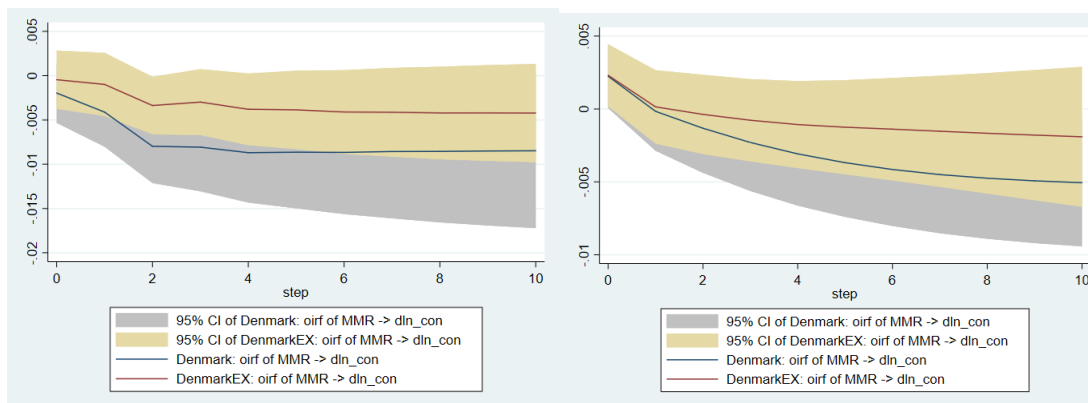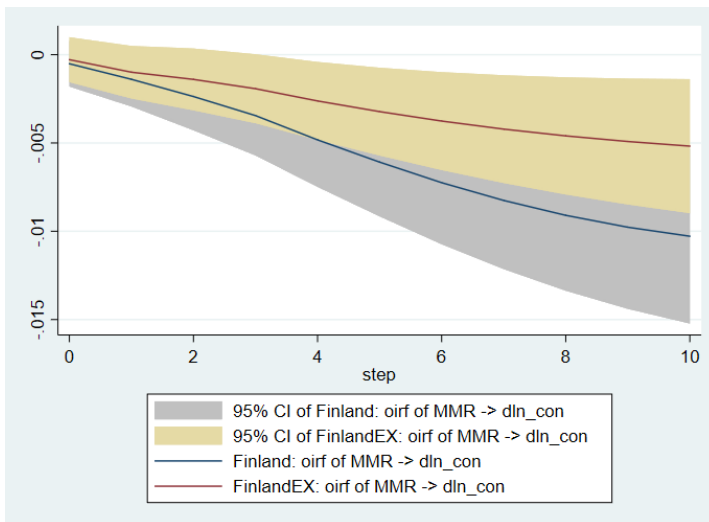
Figure 20 Comparison of IRFs, Finland, split sample
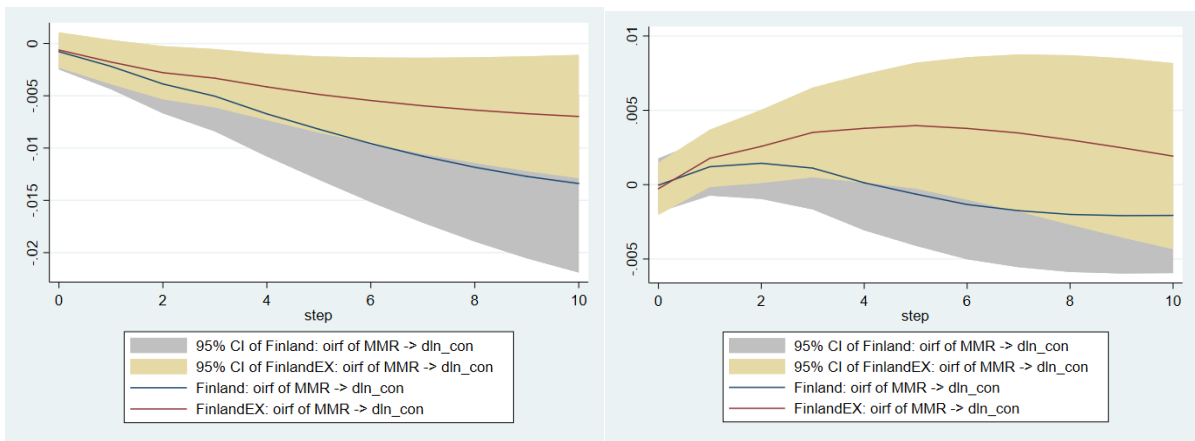
Figure 21 Comparison of IRFs, France, split sample
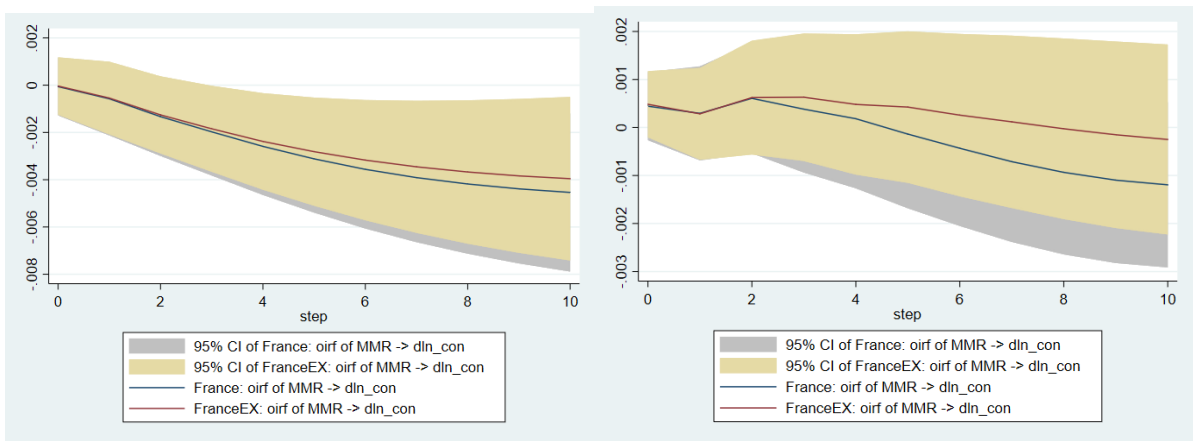

Figure 22 Comparison of IRFs, Germany, split sample
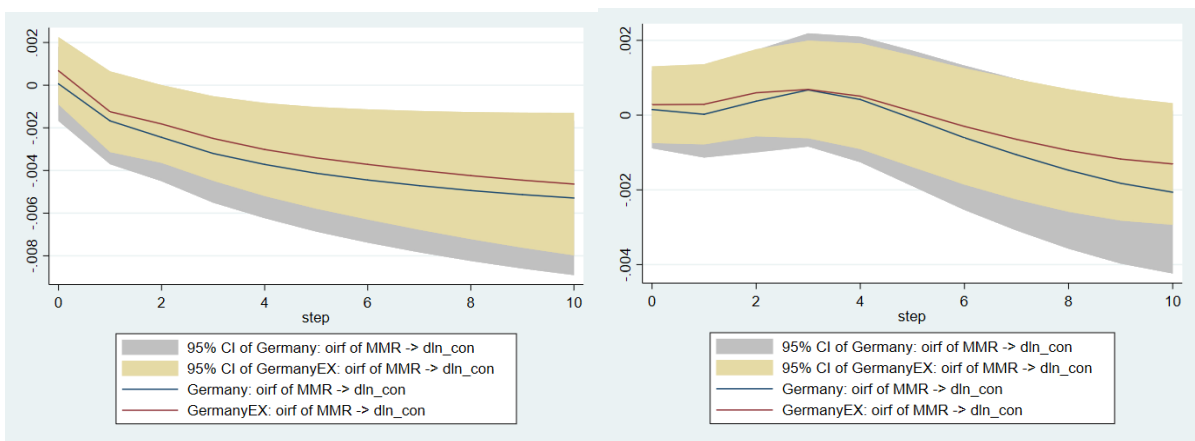
Figure 23 Comparison of IRFs, Ireland, split sample
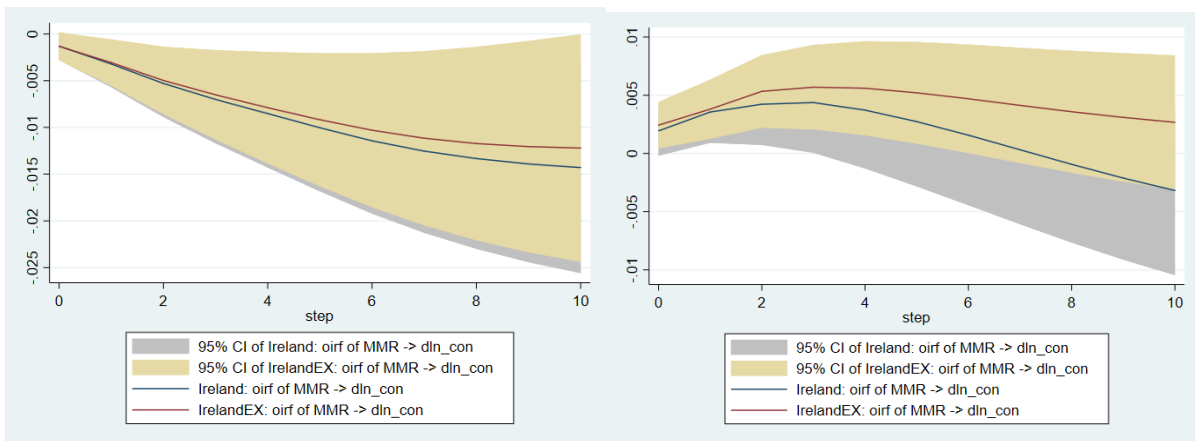
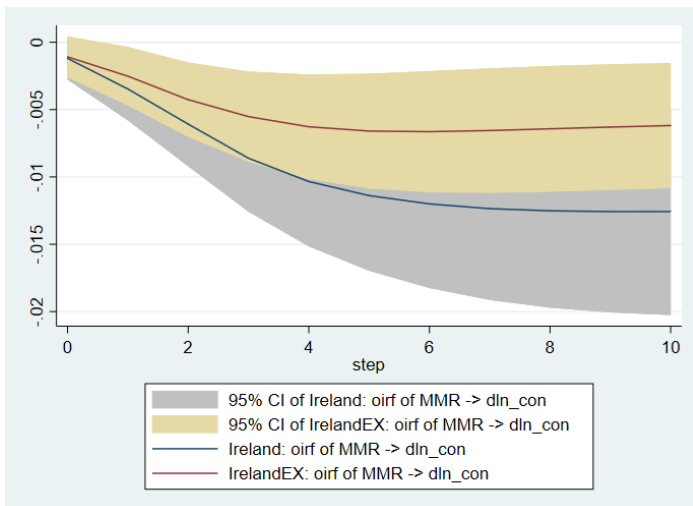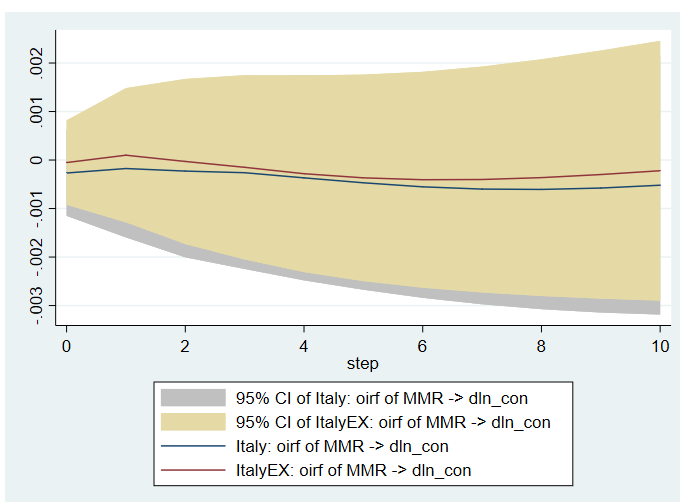*Figure 24 Comparison of IRFs, Italy, split sample*
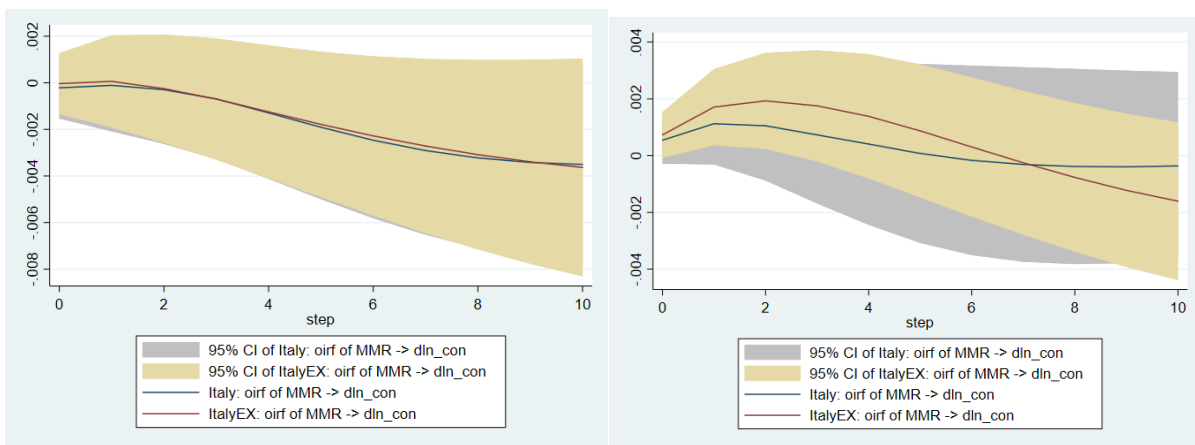
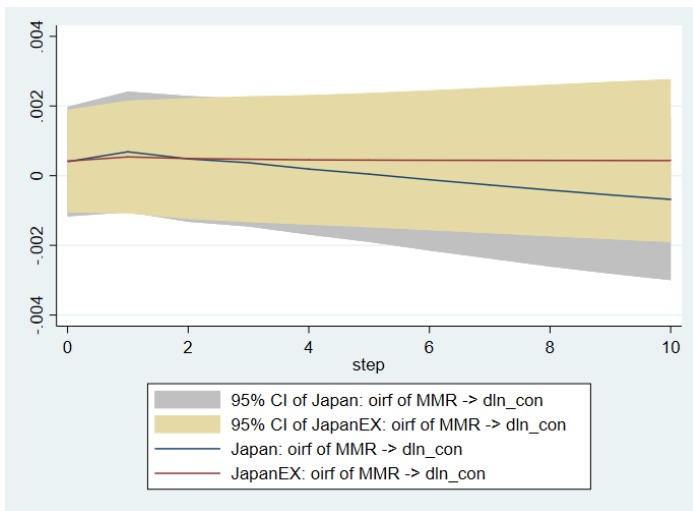*Figure 25 Comparison of IRFs, Japan, split sample*
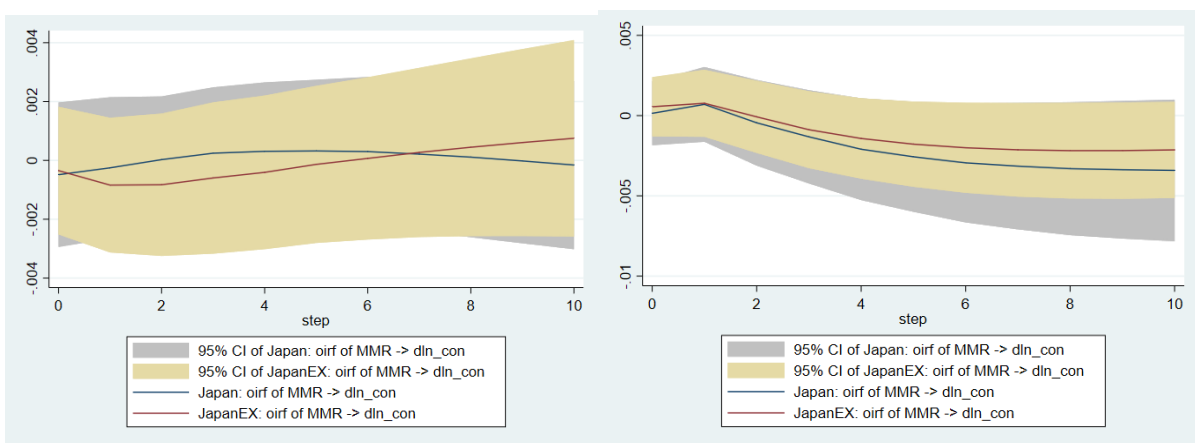
*Figure 26 Comparison of IRFs, Netherlands, split sample*
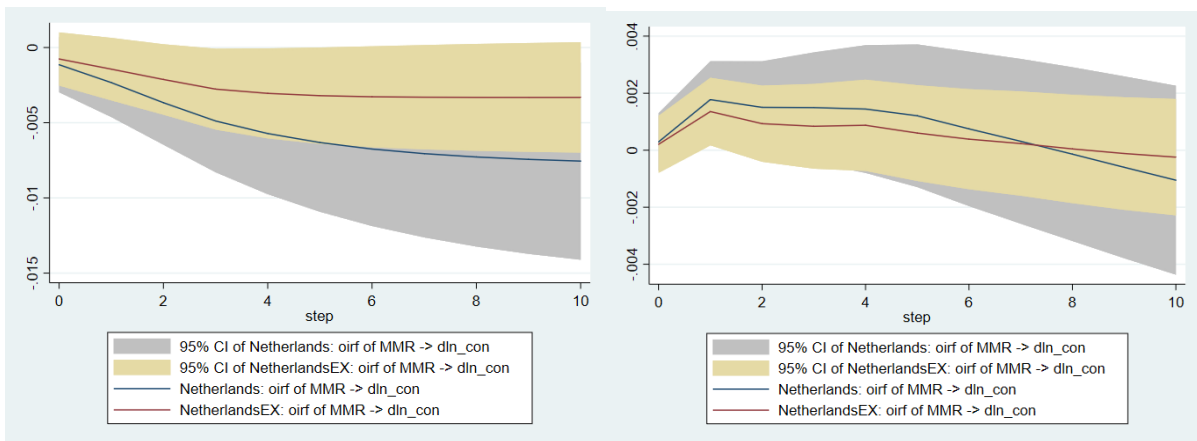
Figure 27 Comparison of IRFs, New Zealand, split sample
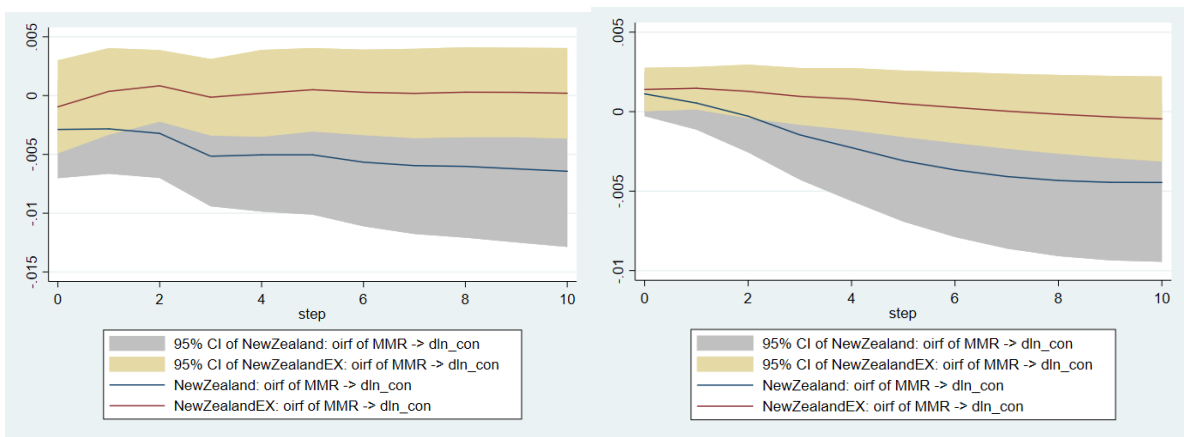
Figure 28 Comparison of IRFs, South Africa, split sample
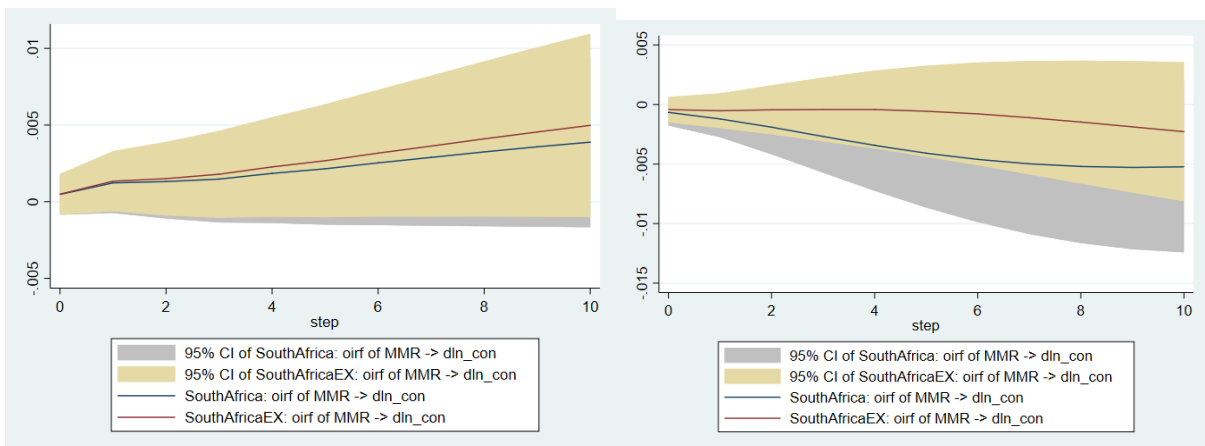
Figure 29 Comparison of IRFs, Spain, split sample
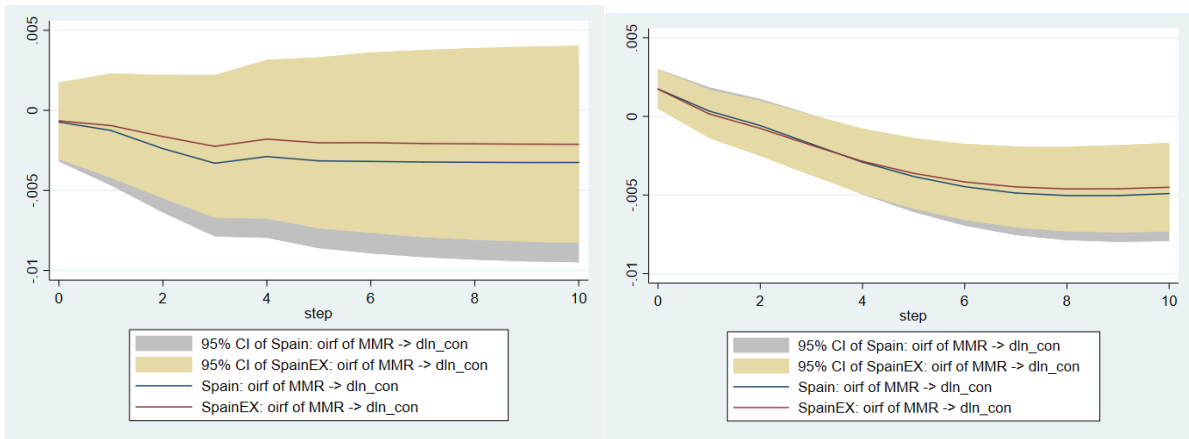
Figure 30 Comparison of IRFs, Sweden, split sample
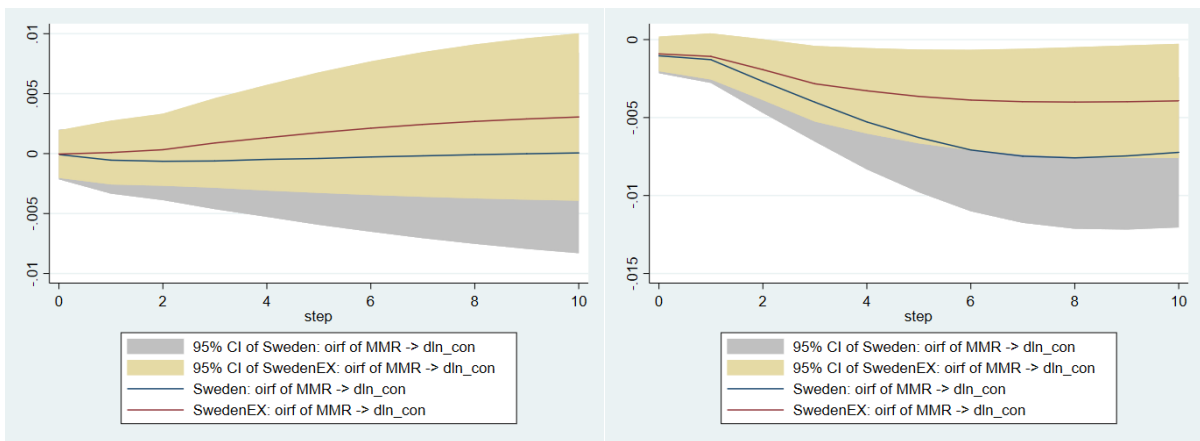
Figure 31 Comparison of IRFs, United Kingdom, split sample
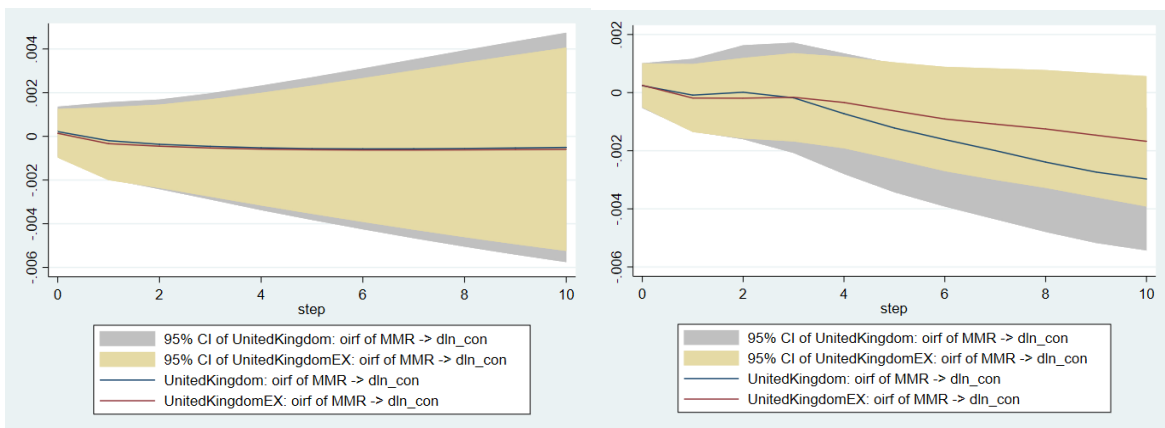
Figure 32 Comparison of IRFs, United States, split sample
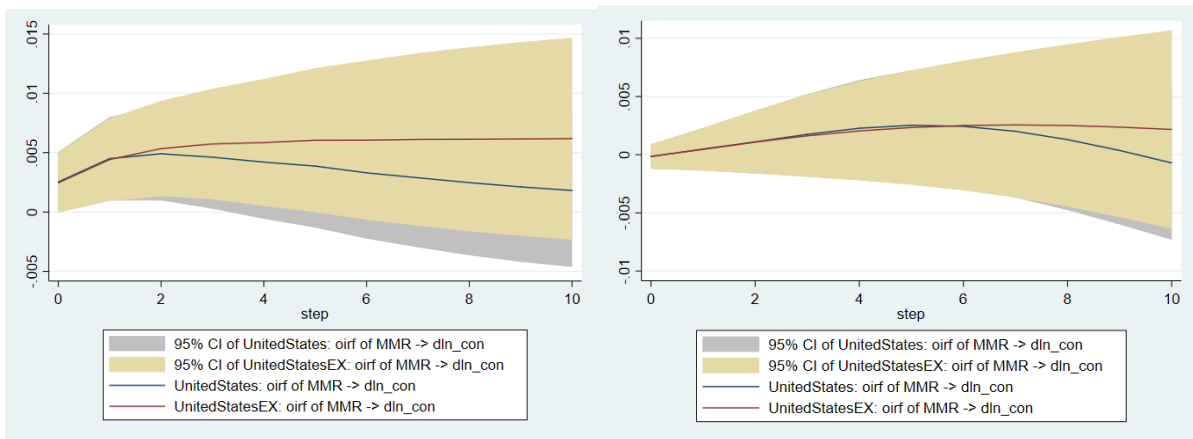
Figure 33 Comparison of IRFs, Australia, total sample
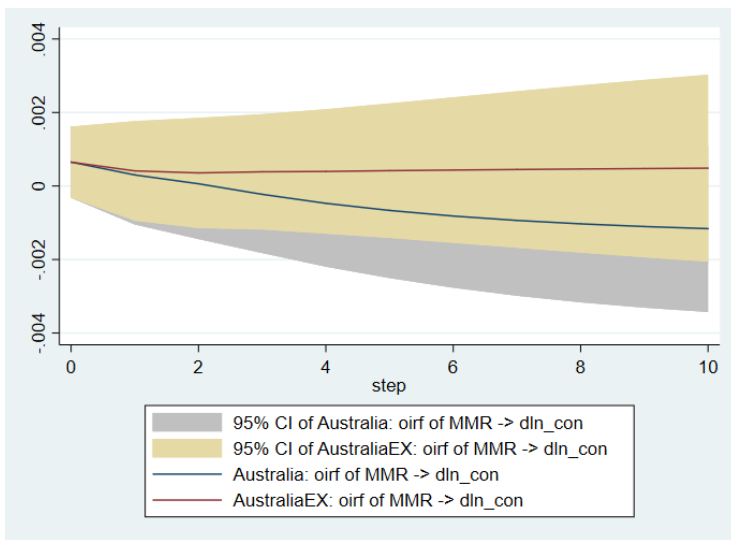
Figure 34 Comparison of IRFs, Canada, total sample
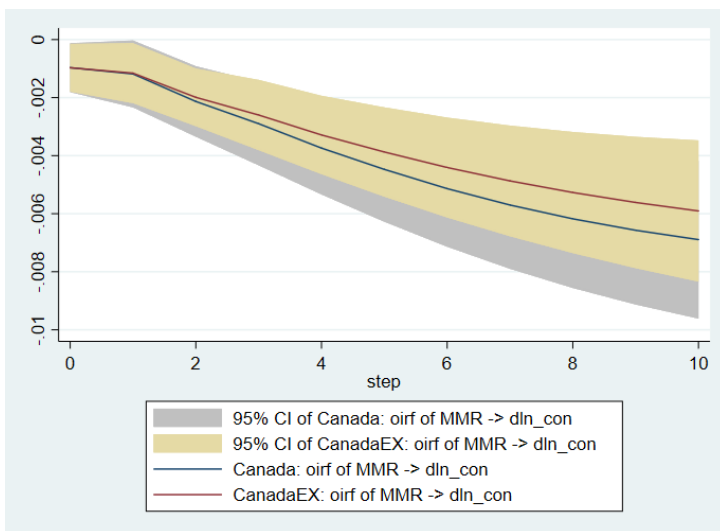
Figure 35 Comparison of IRFs, Denmark, total sample
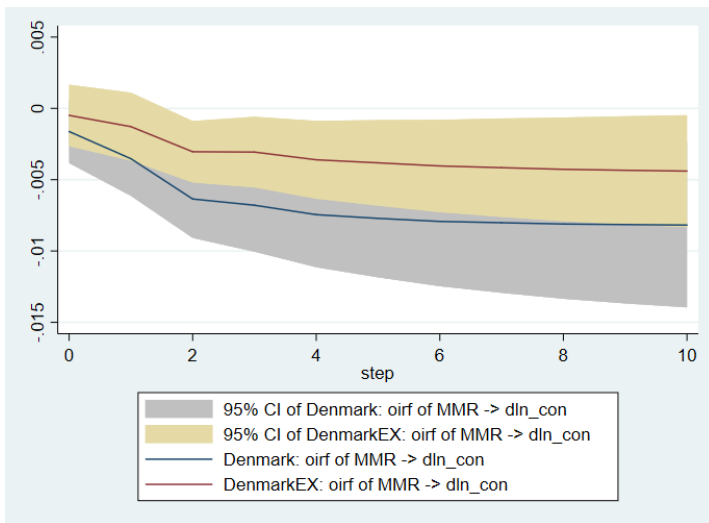
Figure 36 Comparison of IRFs, Finland, total sample

Figure 37 Comparison of IRFs, France, total sample
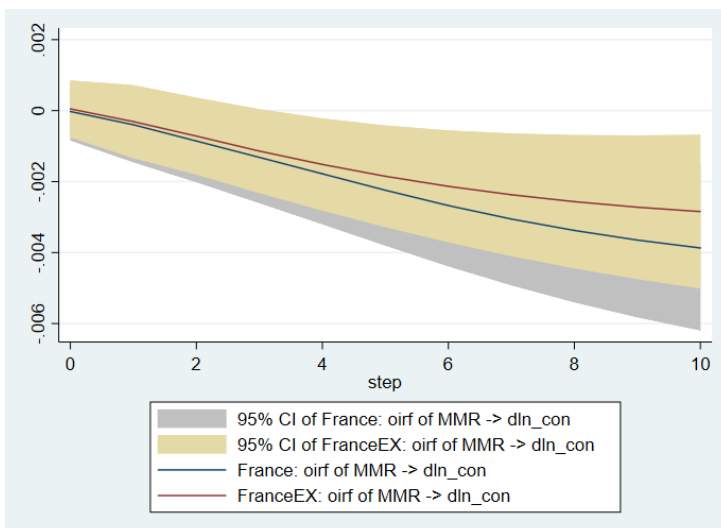
Figure 38 Comparison of IRFs, Germany, total sample
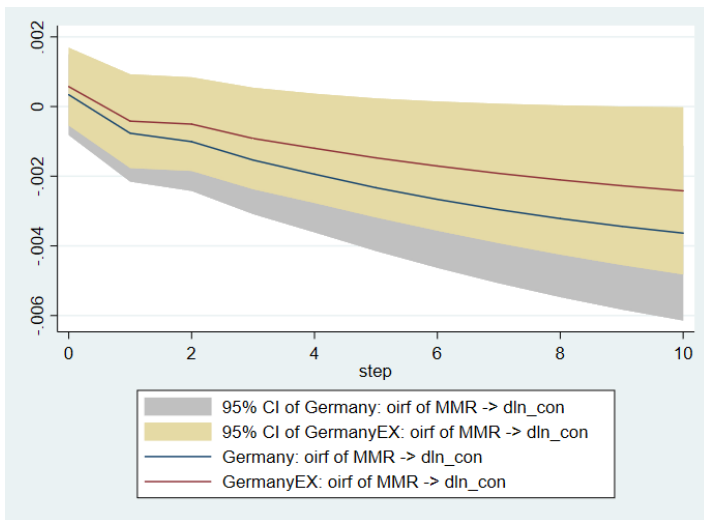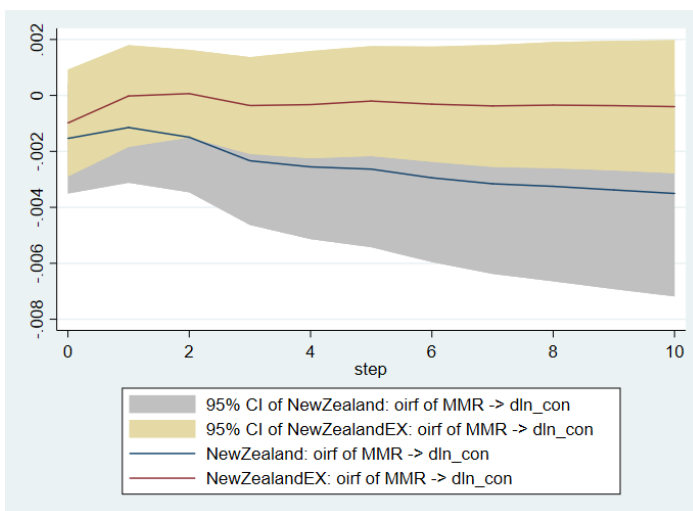

Figure 39 Comparison of IRFs, Ireland, total sample

Figure 40 Comparison of IRFs, Italy, total sample

Figure 41 Comparison of IRFs, Japan, total sample

Figure 42 Comparison of IRFs, Netherlands, total sample
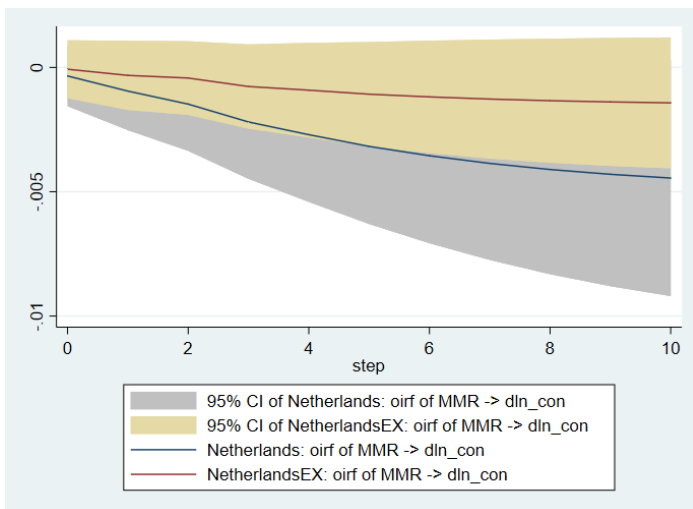
Figure 43 Comparison of IRFs, New Zealand, total sample

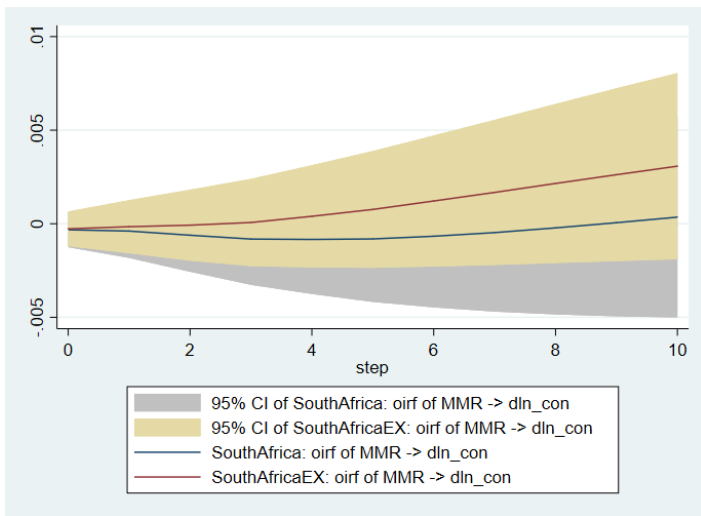*Figure 44 Comparison of IRFs, South Africa, total sample*

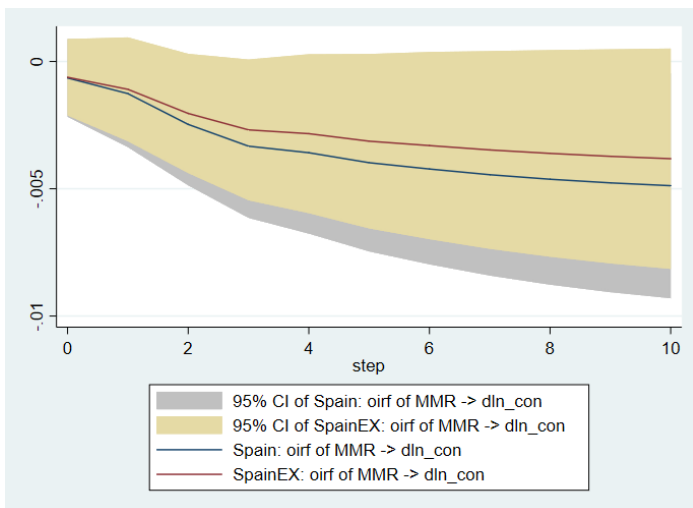*Figure 45 Comparison of IRFs, Spain, total sample*

Figure 46 Comparison of IRFs, Sweden, total sample

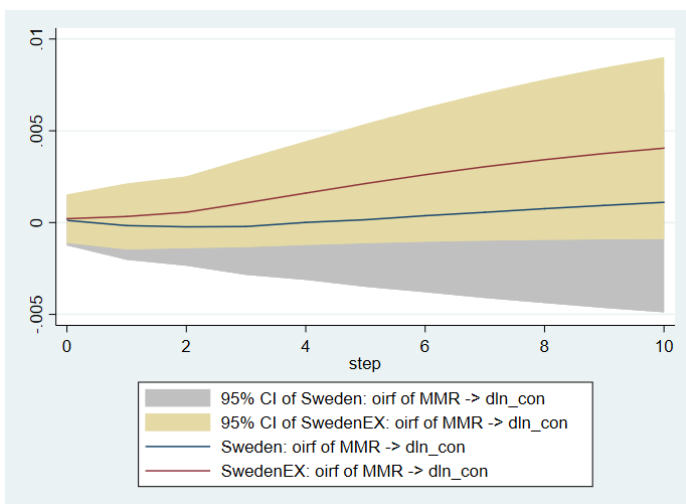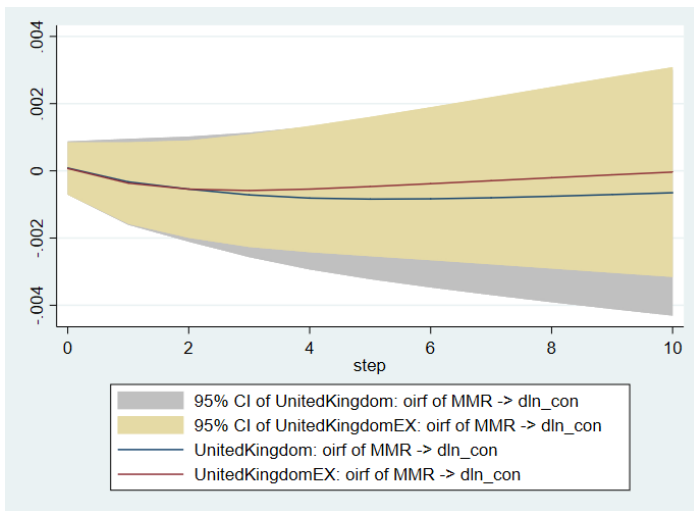*Figure 47 Comparison of IRFs, United Kingdom, total sample*

Figure 48 Comparison of IRFs, United States, total sample