

Jannsen, Nils; Potjagailo, Galina; Wolters, Maik

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Monetary Policy during Financial Crises: Is the Transmission Mechanism Impaired?

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Monetary Policy during Financial Crises: Is the Transmission Mechanism Impaired?

Preliminary, work in progress.

Abstract

We study the effects of monetary policy on output during financial crises. We use a large panel of advanced and emerging economies to guarantee a sufficiently high number of financial crises episodes. A financial crises dummy, which is constructed based on the narrative approach, is interacted with other key macroeconomic variables in a panel VAR. Theory suggests that monetary policy might be more effective in financial crises if it can ease malfunctioning of financial markets for example by loosening credit constraints or restoring confidence. Alternatively, deleveraging and uncertainty might predominate and make the economy less interest rate responsive and monetary policy less effective in financial crises. Taking a sample from the mid 1980s to today we find that an expansionary monetary policy shock is very effective in raising GDP during the recessionary period of a financial crisis. The effect is stronger than in non-crises times. In contrast, during the recovery period of a financial crisis, monetary policy has a very small effect on GDP. These differences can be explained by a confidence channel. During the joint occurrence of a recession and a financial crisis an expansionary monetary policy shock increases consumer confidence and GDP. During the following recovery monetary policy has no effects on confidence or GDP. Other variables like credit, housing prices and exchange rates can at most partially explain differences in transmission between the different regimes.

Keywords: monetary policy transmission, financial crisis, financial stability,
state-dependence, panel VAR

JEL-Codes: C33, E52, E58, G01

1 Introduction

The recent financial crisis and Great Recession led many central banks to conduct massive monetary expansions with the aim of tranquilizing financial markets, boosting economic growth and stabilizing prices. Despite very low policy rates and a variety of expansionary unconventional policy actions, GDP growth remained unexpectedly low in many countries during the years following the crisis. For example, forecasts by the OECD overpredicted growth rates during the Great Recession and the following recovery (Pain et al., 2014). One possible explanation is that the persistently adverse impact of the crisis was underestimated so that despite effective and highly expansionary monetary policy GDP growth remained lower than expected (see e.g. Mishkin, 2009). A second possibility is that monetary policy transmission was less effective in spurring GDP growth compared to non-crisis times (see e.g. Krugman, 2008).

We study whether monetary policy transmission differs around financial crises and non-crises times. This question is of high relevance for monetary policy makers: if effective, monetary expansions can be used as an important tool to shield the economy from large recessions that often come along with severe financial crises. If, however, monetary policy transmission is impaired during and after financial crises, monetary expansions that are needed to bring GDP growth rates back to normal levels are very large. This could either exclude monetary policy completely from the set of stabilizing policy tools or lead to a new trade-off for central banks between stabilizing output in the short-run and the risk of causing financial instability that leads to more volatile output in the medium-run.

Financial crises most often occur together with recessions and economic theory suggests several reasons for possible asymmetries in monetary policy transmission during expansions and recessions. A prominent explanation for policy transmission asymmetries over the business cycles are credit constraints. Bernanke and Gertler (1995) show that in presence of financial market frictions there is an external finance premium which monetary policy is able to affect, thus amplifying the traditional interest rate channel of monetary transmission. Via this financial accelerator expansionary monetary policy can lower the external finance premium by increasing the net worth and collateral of creditors through higher asset prices and by stimulating credit supply. Bernanke and Gertler (1995) argue that this credit channel should be particularly strong when the economy is in a recession, when credit constraints are more likely to bind and a decrease of the external finance premium through monetary stimulus is particularly effective.¹

Other channels suggest the opposite: monetary policy would be less effective in recessions than in expansions. First, if firms and consumers lose confidence in their business and employment prospects, lower interest rates may not stimulate borrowing, investment and spending on durables (Morgan, 1993).² Second, prices might be more flexible upwards than downwards: loose policy might cause large price increases with just small effects on output. Such a scenario

¹There is, however, also the possibility that credit demand is weaker in recessions so that credit constraints might not bind anymore once the economy goes into recession making expansionary policy not more effective than during expansions (Morgan, 1993).

²Similarly, optimism would weaken the effectiveness of tight monetary policy in booms. To explain asymmetries in policy transmission the outlook would need to change asymmetrically over the business cycle or the outlook would need to matter more in recessions than in booms (Morgan, 1993).

can be generated in menu cost models with trend inflation (see e.g. Ball and Mankiw, 1994).

Reasons for changes in monetary policy transmission in recessions and financial crises are difficult to clearly separate because of the linkages between recessions and crises. Some of the above aspects on recessions might be amplified in financial crises, but there might also be some additional aspects leading to different transmission in recessions and financial crises.

Christiano et al. (2004) find that in closed economies monetary policy becomes more effective in financial crisis because it can ease collateral constraints. Hence, the effect of the financial accelerator increases. In this context also the cost channel of monetary policy transmission (see e.g. Barth III and Ramey, 2002) plays a crucial role as firms are likely to be liquidity constraints and in need of external financing. If monetary policy is effective in decreasing the cost of external funding by loosening credit constraints, output might increase not only via the demand side, but also via the supply side. While the cost channel would amplify the positive output effects of a cut in interest rates, it dampens inflationary pressure as it decreases marginal cost of production for firms. In open economies, however, an interest rate cut could also lead to a tightening of collateral constraints via a depreciation and a currency mismatch between assets and liabilities (Christiano et al., 2004).

But even in relatively closed economies it is not clear a priori whether the financial accelerator remains active (and is amplified). Financial crises often mark the end of periods of low risk perceptions, asset price bubbles, credit and consumption booms. In turn, the period after a financial crisis is typically characterized by strong balance-sheet adjustments and deleveraging (Reinhart and Rogoff, 2009; Bech et al., 2014). In such periods low credit demand and supply and can lower the effects of monetary policy on output.

Another characteristic of financial crises is a large increase in uncertainty (Bloom, 2009). Increased uncertainty can lead via real-option effects - if investment is partially irreversible - to lower investment: investors wait and postpone investment decisions until more information arrives and uncertainty is at least partially resolved (see e.g. Bernanke, 1983; Dixit and Pindyck, 1994; Bloom, 2009). In this case expansionary monetary policy might have weaker effects as investment is less responsive to interest rate changes. Hence, the monetary transmission mechanism can be impaired after a financial crisis and monetary policy can become less effective than in 'normal' recessions. On the other hand, those monetary policy measures that aim at stabilizing financial markets might be effective after financial crises if they are able to restore the credit channel of monetary policy.

Finally, Vavra (2014) argues that in times of high volatility—which is usually the case in financial crises—monetary policy faces a worse inflation-output tradeoff. He shows using micro data that firms adjust prices more often so that the real effects of monetary policy are smaller compared to normal times.

Similar to the theoretical explanations described above, results from empirical papers are divided regarding the asymmetry of monetary policy effectiveness during recessions and expansions. Weise (1999), Garcia and Schaller (2002), Peersman and Smets (2002) and Lo and Piger (2005) find that monetary policy is more effective during recessions than expansions, while more

recent papers by Tenreyro and Thwaites (2013) and Caggiano et al. (2014) find the opposite.^{3,4}

The empirical literature on differences in monetary policy transmission during expansions, recessions and financial crises is still small and inconclusive. Kannan et al. (2009) and Bech et al. (2014) use panels of advanced economies to analyze the effects of monetary policy during financial crisis episodes, which are defined using the narrative analysis of Borio and Drehmann (2009), Laeven and Valencia (2008, 2010) and Reinhart and Rogoff (2008a, 2008b, 2009). Kannan et al. (2009) study how the stance of monetary policy affects the duration of recessions, while Bech et al. (2014) analyze the dependence of recovery growth rates on the stance of monetary policy during the preceding recession. Both find that monetary policy is less effective in recessions associated with financial crises than in other recessions. Note, however, that the two studies use very simple identification schemes and might therefore be subject to causality issues. Kannan et al. (2009) identify monetary policy shocks as residuals of simple estimated Taylor rules without an interest rate smoothing term.⁵ Bech et al. (2014) compute deviations of interest rates from a natural rate measure and control in addition for the intensity of the downturn.

While these papers use a comprehensive definition of financial crises, other papers focus on specific aspects like increases in financial stress or uncertainty. While these are certainly important characteristics of financial crises, they can also increase in periods not associated with a financial crisis as for example following the terrorist attacks of 9/11 or the Iraqi invasion on Kuwait in August 1990. Hubrich and Tetlow (2012) use a Markov Switching VAR together with a financial stress index from the Fed to study inter alia monetary policy transmission in the US. They find that in times of high financial stress expansionary monetary policy even further increases the level of financial stress. Agents regard conventional policy actions that would normally be beneficial as confirmation of incipient financial difficulties. The resulting higher levels of financial stress almost completely balance the expansionary effects of monetary policy on output so that monetary policy is not effective when financial stress is high. Aastveit et al. (2013) also focus on the US and use an identified SVAR to estimate the effects of monetary policy. Rather than considering differences between financial crises and normal times they focus particularly on differences in monetary policy transmission under high and low levels of economic uncertainty. As measures of economic uncertainty they use stock market volatility, but also non-financial measures such as an economic policy uncertainty index. They find that the effects of monetary shocks on output and investment are weaker at high levels of uncertainty.

While these papers find that monetary policy is not very effective in financial crises, there also exists a number of papers which find the opposite. Ciccarelli et al. (2013) focus on the 2009 financial crisis only and recursively estimate a panel VAR over the period 2002

³There is also a literature analysing asymmetries of expansionary and contractionary policy shocks, which could be linked to asymmetries in recessions and expansions if expansionary shocks occur more often in recessions. See, e.g., Weise (1999) for an overview regarding this strand of the literature.

⁴Tenreyro and Thwaites (2013) compare their methodology (smooth transition local projection method with monetary policy shocks of the narrative approach by Romer and Romer (2004)) with the approaches of previous work by Weise (1999), Garcia and Schaller (2002), Peersman and Smets (2002) and Lo and Piger (2005) who find opposite results and explain why the specific assumptions made by these studies may be too restrictive. Caggiano et al. (2014) use a smooth transition VAR, but their paper focusses on the effects of uncertainty shocks and documents differences of monetary policy in recessions and expansions only as a byproduct.

⁵Whether endogeneity issues are taken into account by using IV regression remains unclear from the paper and the appendix

to 2011 for 12 euro area economies. They find that monetary policy had stronger effects on aggregate output during the financial crisis and that this amplification operated through the credit channel. Similar results are obtained by Dahlhaus (2014) and Zheng (2013) who focus on the US and differentiates between normal times and financial crises using a financial stress indicator. However, empirical investigations that focus on single economies might suffer from the problem that they tend to identify too many periods as financial crises, because they need a sufficient number of observations for estimation.

We contribute to this literature by combining a large panel dataset, a comprehensive definition and measurement of financial crises and an established structural identification of monetary policy shocks. We estimate an interacted panel VAR (IPVAR) for 21 advanced economies and, in an alternative specification, with 21 OECD and 24 emerging market economies over the period 1984 to 2013. Our dataset covers 46 financial crisis episodes, among which 20 occurred in advanced economies and 26 in emerging economies. Potential asymmetries in monetary transmission are captured by augmenting the VAR with an exogenous dummy variable for financial crises and alternatively, with exogenous dummy variables that distinguish between recession and expansion periods in and outside of financial crises. Financial crises episodes are taken from Laeven and Valencia (2013), who use the narrative approach for identification. Recession episodes were identified by the Bry-Boschan algorithm for quarterly data (see e.g. Harding and Pagan, 2002). By using the panel VAR methodology, we are able to include a large number of financial crisis episodes in the data set, which increases the estimation precision relative to single-country VARs. At the same time, the inclusion of interaction terms allows us to detect systematic asymmetries in monetary transmission between financial crisis episodes and normal times, over many economies and different historical financial crises. The IPVARs is estimated with OLS and fixed effects. Monetary policy shocks are identified using the Cholesky identification scheme.

We find that output reacts stronger during the recessionary period of a financial crisis, but weaker during the following recovery than during non-crises times. The results are dominated by the recent global financial crisis. Leaving out this episode, we find that output reacts weaker during financial crises—including recessionary and expansionary parts—than during non-crises times. Having established these stylized facts, we analyse the transmission channels that lead to these differences in the effectiveness of monetary policy between financial crises and non-crises times.

First, we disentangle changes in policy transmission, i.e. the effects of the interest rate on inflation and output, and changes in systematic policy reactions, i.e. reactions of the interest rate to lags of the interest rate and output and inflation. The latter could be interpreted as changes in monetary policy rule parameters. To disentangle the two effects, we construct counterfactual scenarios, in which we use monetary policy parameters estimated during normal times and use them together with the transmission parameters during financial crises. We find that larger effects of monetary policy on output during the recessionary part of financial crises are not driven by changes of systematic monetary policy, but by changes of monetary policy transmission.

Second, we add measures of credit, share prices, house prices, exchange rates, and a consumer

confidence indicator to our VAR model. Our results indicate that monetary policy has a much stronger effect on confidence during the recessionary period of a financial crisis than during the following expansionary period of a financial crisis and during normal expansions. We find that the impulse responses of the confidence indicator closely comove with the ones of GDP. Also the response of share prices shows similar dynamics as the GDP response. During the joint occurrence of a recession and a financial crisis an expansionary monetary policy shock increases confidence and GDP. During the following recovery a policy shock has no significant effect on these two variables. Thus, during the most volatile period of a financial crisis monetary expansionary policy actions might restore confidence of market participants and prevent an even worse crisis. During the following recovery when the economy is less volatile other things like deleveraging dominate so that monetary policy has neither an effect on confidence nor on GDP.

While expansionary monetary policy increases confidence in the most imminent phase of a crisis, this does not lead to an increase in credit. Credit reacts very weakly during the recessionary part of a crisis, but strongly during the following recovery. So, the reaction is exactly the opposite to the one of GDP. A possible explanation is that it is more difficult for firms to raise money from capital markets or to retain profits during the recovery from a recession in a financial crisis. Hence, expansionary monetary policy can increase the volume of credit because firms use this as a substitute for other forms of financing. They do, however, not use this for additional investment. Thus, expansionary monetary policy leads to an increase in credit, but not in output.

An expansionary monetary policy shock also leads to a currency depreciation. The depreciation is much more persistent in non-crises times than during a financial crisis. Within a crisis the depreciation is similar during the recession and expansion period, so that exchange rate movements cannot explain the differences in the effects of a monetary policy shock on GDP. The reaction of house prices also differs between regimes, but again in a way that is not systematically related to the differences of the response of GDP between the different regimes.

For future work, we plan to include additional aspects to control for state dependence of some effects. Examples include the reaction of fiscal policy, the exchange rate regime and a measure of openness of economies. Finally, we plan to include monetary aggregates possibly combined with a sign restriction identification to include expansionary monetary policy measures at the zero lower bound on nominal interest rates.

The remainder of the paper is structured as follows. In section 2 we describe the dataset. Section 3 explains the econometric methodology, section 4 presents and discusses the estimation results including various robustness checks. In section 5 we add additional variables to analyse changes in transmission channels of monetary policy during crises and non-crises times. Finally, section 6 concludes.

2 Data

Analyses of financial crisis episodes typically encounter the problem of very few historical financial crises episodes in most advanced economies leading to weak inference. For this reason,

we estimate our VAR based on a large cross-country panel data set and we construct various dummy measures to capture the financial crises effects. In this section, we first describe the endogenous variables included in our sample, as well as the sources of these variables and the data transformations we applied. Then, we present the indicators of financial crises used in our analysis.

2.1 Data on endogenous variables

Our panel data set is based on quarterly data for the period 1984Q1 to 2013Q4 covering 21 advanced economies and 24 emerging economies. Data sources for real GDP, CPI and money-market short-term interest rates are the OECD Economic Outlook, OECD Main Economic Indicators and the IMF Financial Database.⁶ Data for bank credit to private sector are taken from a dataset of the Bank for International Settlements.⁷ Data for effective exchange rates are taken from the OECD Economic Outlook and data for house prices are taken from the International House Price Database from the Dallas Fed. Data for consumer confidence, which are based on survey data, are taken from national sources. For example for economies of the European Union data are taken from the Business and Consumer Surveys of the European Commission⁸. We have standardized the consumer confidence indicator by using their mean and their standard deviation to guarantee that these indicators have the same scale across countries. Finally, share prices are taken from the Main Economic Indicators of the OECD and are based on the most prominent share price index of each country.

Table 1 in the appendix presents the data sources for the variables and countries in detail. The table also shows a list of the 45 countries included in the sample and the time periods covered for each country. While data for advanced economies are usually available for the entire time period of 1984 to 2013, this is not true for many emerging economies. As a consequence our panel is unbalanced.⁹ In a few cases, data for emerging economies are available for early years, but show extreme values such as very high interest rates or high inflation rates. For this reason we only include emerging economies in our data set from the year on when their interest rates had come down to levels below 100 percent and when the inflation rate had reached reasonably low levels.¹⁰ Data for the additional variables such as house prices and consumer confidence are hardly available for emerging economies, such that we will only include these variables in the specifications with advanced economies. Data from the IMF and from national sources are

⁶The GDP series for China is based on data from the National Bureau of Statistics China and Abeysinghe and Rajaguru (2004).

⁷This variable measures the total amount of credit (i.e. loans and debt securities) provided by domestic banks to non-financial corporations, households and non-profit institutions serving households. The data are provided in nominal terms and in domestic currency (see <http://www.bis.org/statistics/credtopriv.htm>). Data series are not available for New Zealand.

⁸Data on consumer confidence are not available for the complete estimation period for many countries, but only from 1985 onwards. In case of Norway it is only available from mid-1992 onwards such that we cannot include roughly half of the period of the financial crisis that started in 1991 when we include consumer confidence in our model.

⁹In some of our robustness checks, we use estimation periods beginning in 1970. In these cases, for even more countries data are not available for the complete estimation period.

¹⁰This strategy shortens the available time series for Russia, Turkey, Mexico, Argentina, Bulgaria and Romania. Table 1 shows the covered time periods for emerging economies after these transformations.

not available in seasonally adjusted form and are, therefore, seasonally adjusted using a stable seasonal filter.¹¹

2.2 Financial crisis indicators

As our main indicator for financial crisis episodes we use a dummy variable from the systematic banking crises data set of Laeven and Valencia (2013). This data set is available in annual frequency for the period 1970 to 2011 for all of the 45 economies in our data set. A systemic banking crisis is defined as a time period in which defaults of corporations and financial institutions increase and non companies face in general great difficulties paying back outstanding debt in time. Such a situation may be accompanied by declining asset prices and increasing risk-premia.

In particular, Laeven and Valencia (2013) define a banking crisis as an event that meets two conditions:

1. Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations).
2. Significant banking policy intervention measures in response to significant losses in the banking system.

Laeven and Valencia (2013) consider the first year that both criteria are met to be the year when the crisis became systemic. The authors argue that these two criteria indicate when a crisis becomes systemic. The first criterion shows the degree of financial distress, but it not always easy to quantify. Therefore, the second criterion is added as an indirect measure of financial distress. Regarding the end of a financial crisis Laeven and Valencia (2013) define two conditions that need to hold: real GDP growth and real credit growth are positive for at least two consecutive years. As this leads to some very long crises periods, they truncate in addition the maximal duration at 5 years.

We transform the data to quarterly frequency by assuming that each quarter of financial crisis year is a financial crisis quarter as well.¹² The database of Laeven and Valencia only covers the period until 2011 so that they could not identify the end of the financial crises that started in the years 2007/2008. We extend their database until the year 2013. We follow their methodology and use bank credit to the private sector (in national currency) taken from the International Financial Statistics from the IMF deflated using the CPI data described above and our GDP series described above. When credit data are not available, we rely only on GDP growth for determining the end point of a financial crisis. We also truncate the duration of a

¹¹In order to deseasonalize the series, we first detrend the data using a 5-term moving average filter. Then we calculate a centered estimate of the seasonal component by using seasonal dummies and averaging the detrended data over each quarter. Finally, we subtract the estimated seasonal component from the original data.

¹²As an alternative, we also pursued a more "conservative" strategy by assuming that the financial crisis begins in the last quarter of the first year and ends in the first quarter of the last year of a financial crisis indicated in the original data set. Results for advanced economies are very robust to this change, while results for emerging markets become unstable. This might be due to the fact that financial crisis episodes in emerging markets are often quite short and span one to three years only. Cutting of the first and the last three quarters then implies excluding too many crisis observations and makes inferences for financial crises episodes difficult.

financial crisis at five years so that the end point of the financial crises that started in the years 2007 or 2008 is not later than 2011 or 2012, respectively.

In addition to the baseline financial crisis dummy, we also construct additional indicators to further disentangle recession phases from recovery phases in and outside of financial crisis periods. In particular, we construct a dummy for recession episodes within our sample period 1984-2013 using the version of Harding and Pagan (2002) of the Bry-Boschan algorithm.¹³ Then, we compare our recession dummy with the banking crisis dummy of Laeven and Valencia for each country and we create three new dummies that take the value 1 respectively for the quarters during which a country experienced both a recession and a financial crisis ($FC + Rec$ dummy), a financial crisis but no recession (i.e. recovery phase, $FC + Exp$ dummy) and, alternatively, a recession but no financial crisis ($NoFc + Rec$ dummy). In doing so we are able to compare the effects of monetary policy shocks during recession and recovery periods of a financial crisis and during recessions and expansions outside of financial crisis times.

Figure 1 shows GDP, GDP growth, the financial crisis episodes and recessions for the 21 OECD countries. Figure 2 shows the same information for the 24 emerging economies. In each plot, the upper part shows real GDP as a black line and the lower part shows non-annualized quarterly GDP growth as black bars. The shaded areas in the upper plot indicate the financial crisis episodes, while the shaded areas in the lower parts indicate recessions. Similar graphs for CPI, and short-term interest rates are in the appendix. It is apparent that financial crises are very rare events and that they are very different from recessions. In the 21 OECD countries only 20 financial crises occurred in our sample. In the US and in Sweden two crises occurred, in Canada, Australia and New Zealand no crisis occurred and in the majority of countries one crisis occurred. Of the 20 financial crises episodes 15 belong to the recent global financial crisis. Four financial crisis events have taken place in the early 1990s in the US, Sweden, Finland and Norway. Another crisis occurred in Japan around the year 2000. Recessions occur much more frequently. There are 86 recessions in the 21 OECD countries ranging from two recessions per country (Canada, Australia, Netherlands, Ireland) to seven recessions (Greece). Most of the recessions are shorter than the average financial crisis. During a financial crisis usually one recession occurs close to the beginning of the crisis followed by a recovery period. In some countries of the euro area a second recession followed during the recent global financial crisis. However, most recessions occurred outside of financial crises.

In the 24 emerging economies financial crises occurred somewhat more frequently. The sample includes 26 crisis episodes - despite a shorter sample for many countries - including for example the Asian crisis and the Latin American debt crises. The emerging economies were much less affected by the recent global financial crisis. The Laeven and Valencia dataset includes the Great Recession as a financial crisis only in 4 (Russia, Ukraine, Hungary, Latvia) out of the 24 countries.

¹³This method identifies local peaks and troughs in the level of GDP. Hence, turning points depend on the movements around the local minima and maxima. Once the turning points or peaks and troughs have been identified a recession can be computed as the period from the peak to the trough and an expansion from trough to peak.

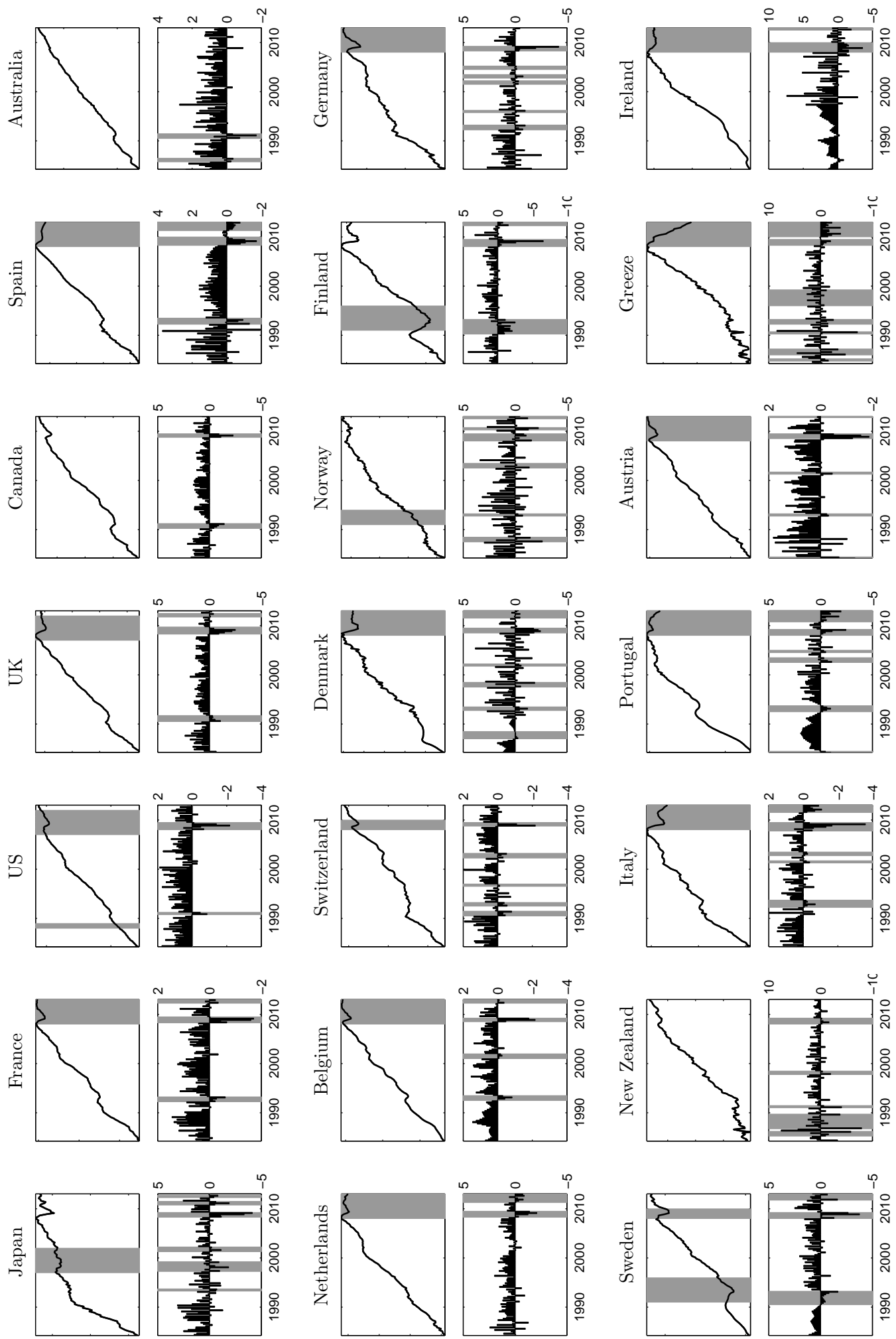


Figure 1: Financial crises and recession data advanced economies. Notes: the figures show in the upper part log real GDP and in the lower part quarterly (non-annualized) real GDP growth. In the upper part the shaded area show financial crises and in the lower part the shaded area show recessions.

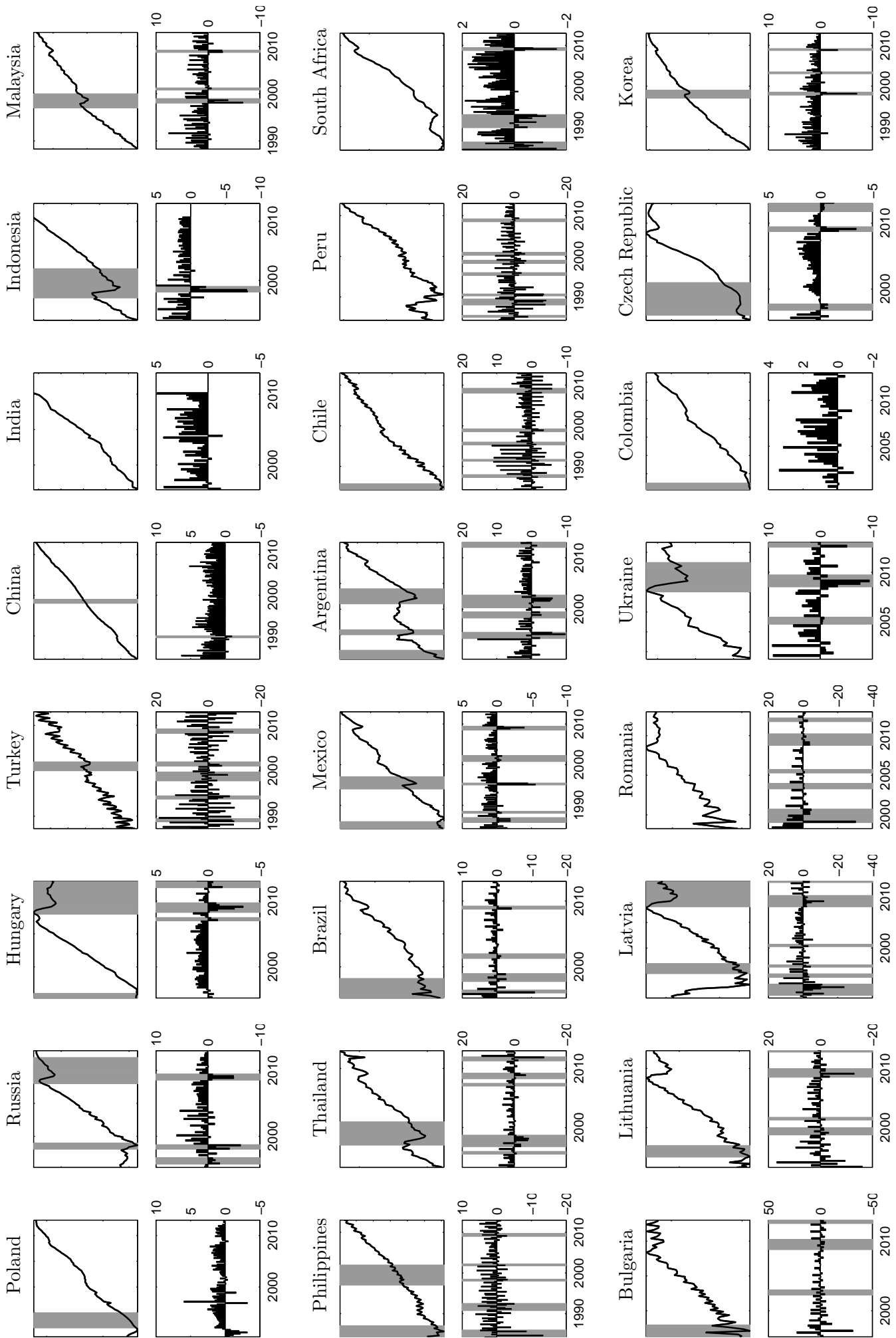


Figure 2: Financial crises and recession data emerging economies. Notes: the figures show in the upper part log real GDP and in the lower part quarterly (non-annualized) real GDP growth. In the upper part the shaded area show financial crises and in the lower part the shaded area show recessions.

3 Methodology

We use an interacted panel VAR model, which exploits the cross-country dimension, accounts for the dynamics between the main macroeconomic variables in the spirit of VAR analysis and allows an interaction of macroeconomic variables with different financial crises and recession indicators.¹⁴ In our model, we account for potential asymmetric effects of monetary policy shocks during financial crises and recessions, relative to times with no financial crises and expansions.

The baseline reduced-form PVAR without interaction terms is given by:

$$y_{it} = A_{0i} + A(L)y_{it-1} + \epsilon_{it}, \quad (1)$$

where $y_{i,t}$ is a vector of endogenous variables, A_{0i} is a vector of country-specific fixed effects, $A(L)$ is a lag polynomial with VAR coefficients and $\epsilon_{i,t}$ are error terms with zero mean and country-specific variances, which can be correlated with each other.¹⁵

The linear panel VAR will then be augmented with an exogenous financial crisis dummy and an interaction term between the endogenous variables and the dummy. The baseline interacted PVAR (IPVAR) is then given by

$$y_{it} = A_{0i} + A_{0i}^{FC} D_{it}^{FC} + A(L)y_{it-1} + A(L)^{FC} y_{it-1} D_{it}^{FC} + \epsilon_{it}, \quad (2)$$

where $D_{i,t}^{FC}$ is a dummy, which takes the value 1 if there was a systematic financial crisis in country i and period t and the value 0 otherwise, A_{0i}^{FC} is a coefficient vector for the financial crisis dummy and $A(L)^{FC}$ is a lag polynomial with VAR coefficients for the interaction terms between the endogenous variables and the dummy.

We extend the baseline IPVAR model subsequently by interacting the endogenous variables with with three exogenous dummy variables that allow us to distinguish between periods of recessions and recoveries both in and outside of financial crises episodes: the $FC + Rec$ dummy takes the value 1 if there was a systematic financial crisis accompanied by a recession in country i and period t and the value 0 otherwise, the $FC + Exp$ dummy that takes the value 1 if there was a systematic financial crisis accompanied by an expansion (i.e. recovery phase) in country i and period t and the $NoFC + Rec$ dummy that takes the value 1 if there was *no* systematic financial crisis but a recession in country i and period t .

When using interaction terms in our IPVAR model the impulse responses of each endogenous variable to a monetary policy shock will depend on the value of the dummy variable or the state of the economy that the dummy variable represents. Therefore, the impulse response functions need to be evaluated at both possible values of each dummy variable in order to receive the

¹⁴Panel VARs have been used in other empirical applications with the aim to increase estimation precision and to detect common country dynamics. See Goodhart and Hofmann (2008), Assenmacher-Wesche and Gerlach (2008), Gambacorta et al. (2012), Tobin and Weber (2012) and Sá et al. (2011). The latter two studies also include interaction terms into the panel VAR.

¹⁵We implicitly assume dynamic homogeneity, i.e. the same VAR coefficients $A(L)$ hold for all countries. We also assume that there are no dynamic interdependencies across countries, i.e. the endogenous variables of country i are not affected by other countries' variables. These are strong assumption in a cross-country framework, but they drastically reduce the number of parameters to be estimated and is therefore frequently used in panel VAR applications.

effect in a particular regime. We extend one IPVAR model either by one interaction term (to differentiate between financial crisis episodes and non-crisis episodes) or by three interaction terms (to additionally differentiate between recessions and expansions).

One interaction term with the financial crisis dummy implies two different regimes:

1. Financial crisis regime ($D_{it}^{FC} = 1$)
2. Normal times ($D_{it}^{FC} = 0$).

Three interaction terms imply four possible regimes:

1. Financial crisis and recession regime¹⁶ ($D_{it}^{FC+Rec} = 1$, $D_{it}^{FC+Exp} = 0$, $D_{it}^{NoFC+Rec} = 0$)
2. Financial crisis recovery phase regime¹⁷ ($D_{it}^{FC+Rec} = 0$, $D_{it}^{FC+Exp} = 1$, $D_{it}^{NoFC+Rec} = 0$)
3. Recession regime outside of financial crises ($D_{it}^{FC+Rec} = 0$, $D_{it}^{FC+Exp} = 0$, $D_{it}^{NoFC+Rec} = 1$)
4. Expansion regime outside of financial crises (all dummies are put to zero).

Impulse responses to the monetary shock will be calculated conditional on the regime, assuming that the economy stays in the regime that prevailed when the shock hit, e.g., does not move from the normal times regime to the financial crisis regime during the horizon of the impulse responses.

In the benchmark specification, the vector of endogenous variables is $[gdp_t, p_t, i_t]$ where gdp_t is the log of real GDP, p_t is the log CPI and i_t is the short-term interest rate. In additional specifications, we will extend our IPVAR model consecutively by adding house prices, bank credit to private sector, effective exchange rates, consumer confidence and share prices.

We estimate the IPVARs will be estimated with OLS and fixed effects. Monetary policy shocks are identified recursively, assuming that output and prices do not react on impact to interest rate movements, while credit variables and exchange rates can react to interest rate shocks instantaneously. This corresponds to ordering the interest rates after output and prices and before credit, exchange rates, consumer confidence and share prices in $y_{i,t}$ for each country.¹⁸

4 Results

We will first present some stylized facts about the effects of monetary policy in financial crises and normal times and afterwards analyse the transmission in more detail to explain the differences.

¹⁶We attribute recessions that start during a financial crisis completely to this regime and not to the recession regime outside of financial crises.

¹⁷While this regime mainly consists of the recovery periods after a recession it also includes in some cases the beginning of a financial crisis until the recession starts.

¹⁸While the recursive identification method is widely used in structural VAR analysis of monetary policy transmission, it has produced strong price puzzles when applied to PVARs (see for instance Goodhart and Hofmann (2008) and Assenmacher-Wesche and Gerlach (2008)). Therefore, we plan to identify the monetary policy shock via sign restrictions as a robustness check for our baseline IPVAR with one interaction term in future work. Here, we plan to follow the methodology of (Uhlig, 2005) and to restrict GDP to increase, CPI to increase and the short-term interest rate to decrease during the first four quarters after the monetary expansion.

4.1 Effectiveness of monetary policy in financial crises and non-crises times

Figure 3 shows impulse responses to a monetary policy shock identified with the Cholesky identification in a three variable PVAR for the 21 OECD countries in our sample with two lags. We start with the OECD countries as we regard the data as more reliable than the full sample of countries. We order GDP and CPI before the interest rate. According to this identification, the interest rate reacts on impact to changes in GDP and CPI. GDP and CPI react instead with a lag of one quarter to a change in the interest rate. The left column shows the effects of a monetary policy shock during financial crises, while the right column shows the effects during non-crises times.

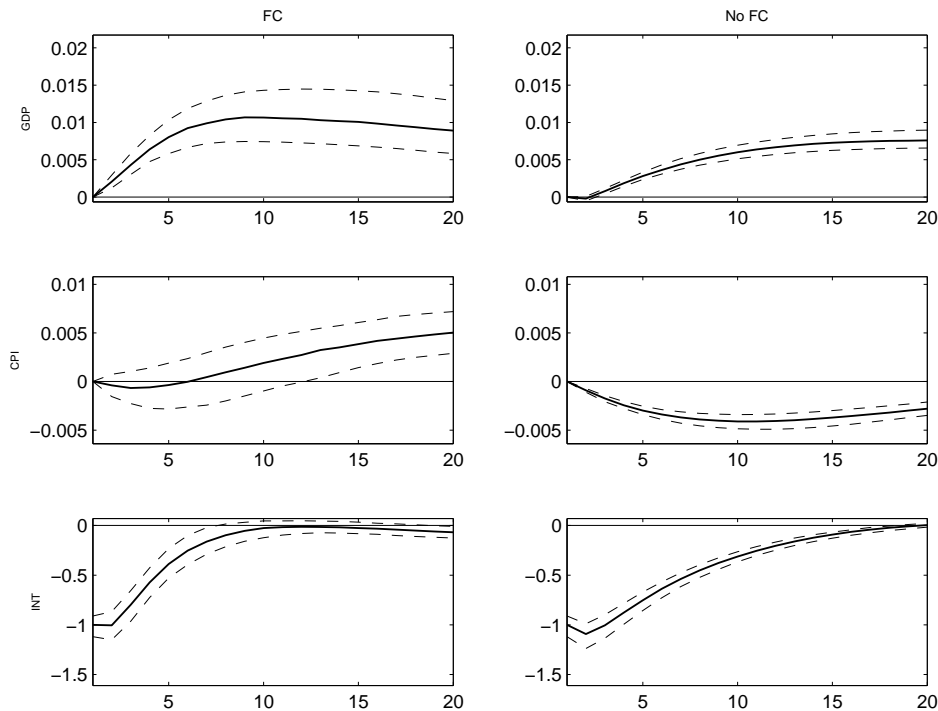


Figure 3: Effects of a monetary policy shock in financial crises and normal times.

Notes: 21 OECD economies, 1984-2013, Cholesky identification.

An expansionary monetary policy shock leads to an increase in GDP of about 1% during financial crises, while the effect on GDP in normal times is somewhat weaker. During financial crises GDP, reacts much quicker than during non-crises times. The effect on prices is also higher during financial crises. The inflation response in normal times is even negative. We attribute this to the panel VAR methodology because other authors find similar counterintuitive responses of inflation to a monetary policy shock in panel VARs. For instance, Goodhart and Hofmann (2008) find a completely positive inflation response after a contractionary monetary policy shock for a sample from 1985-2006 for a panel VAR of 17 advanced economies.¹⁹ Regarding the response of the interest rate we also detect important differences between the two regimes. The decline in interest rates is much more persistent in normal times compared to financial crises. We will

¹⁹We plan to check robustness of our results using the sign restriction identification. In this way one can enforce a positive inflation response and check whether the other responses change. We also plan to include additional variables that capture inflation expectations to resolve these large prize puzzle issues. Adding commodity prices as others have done, did not resolve the problems with the inflation response.

check below how the difference in systematic monetary policy in the different regimes affects the results. The quicker return of the interest rate to steady state shows that the strong response of GDP during financial crises cannot be explained by the interest rate being lower for a longer period.

As discussed in the introduction many papers find differences in monetary policy transmission during recessions and expansions. The definition of financial crises used for the results in figure 3 does not distinguish between recessions and recoveries within the financial crises periods. To better understand the different dynamics in financial crises and in normal times we now distinguish in both regimes between recessions and recoveries by adding our three additional dummies that identify episodes of recessions during financial crises, expansions during financial crises, recessions in non-crises times, expansions in non-crises times. Figure 4 shows impulse responses to an expansionary monetary policy shock in all four regimes.

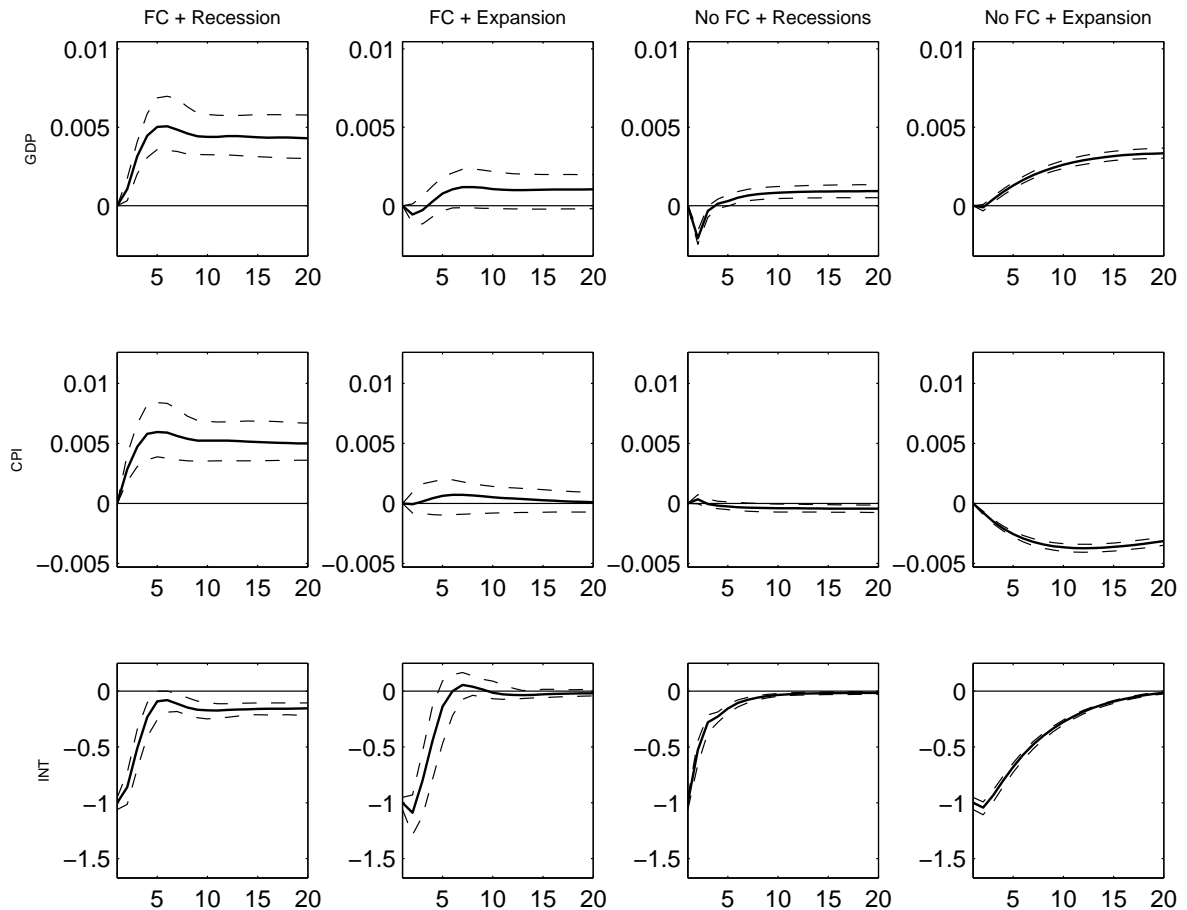


Figure 4: The role of recessions and expansions in financial crises.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

The effects of GDP reveal a much clearer picture than in the previous figure. During financial crises a decrease in the interest rate leads to a quick and large increase in GDP when the economy is in addition in a recession. Monetary policy is highly effective and increases GDP more than in all other regimes. In contrast, the following recovery during which the economy is still in a financial crisis shows very different effects of monetary policy. Monetary policy is ineffective and barely increases real GDP at all. The slight increase that the impulse response shows is

not significant. The effects on inflation are also much higher during the recessionary period of a financial crises compared to the following recovery. The impulse responses show that the decrease in the interest rate is slightly more persistent during a recession than during the recovery in a financial crises, but the differences are too small to explain the differences in the reaction of GDP and inflation.

Figure 4 also distinguishes between recessions and expansions in non-crises times. We find that monetary policy has weaker effects on GDP during recessions than during expansions. We will examine below whether this is caused by the more persistent decrease in the interest rate in expansions as shown in the graph in the lower right. The effect on inflation is again negative in expansions and close to zero in recessions. Hence, we plan to check robustness of the effects on GDP using sign restrictions that force that inflation response to being negative below in future work.

The differences of monetary policy transmission during the recessionary and the expansionary part of a financial crisis shed light on the contradictory results of the literature on the effects of monetary policy shocks during financial crises. Some authors find that monetary policy is more effective (see e.g. Ciccarelli et al., 2013; Dahlhaus, 2014; Zheng, 2013), while others find that monetary policy is less effective (see e.g. Hubrich and Tetlow, 2012; Aastveit et al., 2013; Kannan et al., 2009; Bech et al., 2014). We find that overall GDP reacts slightly more as shown in figure 3. Once we differentiate between the recessionary and expansionary part of the crises, we can see that only during the former monetary policy is more effective, while it is less effective during the recovery.

Regarding the effectiveness of monetary policy during recessions, our results show that monetary policy is only more effective during recessions, if these occur together with a financial crises. During normal recessions, monetary policy has smaller effects than during expansions.²⁰ The existing literature on differences in monetary policy effects on GDP does not distinguish between recessions related to a financial crisis and other recessions. So, the results in this literature very much depend on whether the specific sample includes financial crises or not. This can possibly explain why some papers find that monetary policy is more effective during recessions, while others find that it is less effective.

What are possible reasons for these differences in monetary policy transmission? We will analyse this further below by adding additional variables to our model. At this point, one can conjecture that during the joint occurrence of a recession and a financial crisis monetary policy can have quick positive effects on GDP. Potential transmission channels, in which monetary policy might be more effective could be loosening credit constraints, lowering uncertainty and financial stress and in this way increasing confidence of market participants. By contrast, recoveries during financial crises are often characterized by a period of deleveraging and sectoral reallocation. During these periods agents might regard expansionary monetary policy that would normally be beneficial as confirmation of incipient financial difficulties (Hubrich and Tetlow, 2012).

²⁰We also ran a regression without a financial crises dummy, but only a dummy for recessions. In this case we find that monetary policy is slightly less effective in recessions than in expansions. The differences are, however, very small.

4.2 Validity check

We run a robustness check to ensure the validity of our baseline findings. It is well known that OLS fixed effects panel estimates with lagged endogenous variables are biased (see e.g. Holtz-Eakin et al. 1988). Usually, the bias goes to zero as the number of observations approaches infinity. The number of observations in our application is sufficiently large to avoid a sizable bias. Unfortunately, the fixed effects estimates are still inconsistent in a dynamic panel if the coefficients on the lagged endogenous variables are heterogeneous across countries. To solve this problem one can use the mean group estimator of Pesaran and Smith (1995). In this case individual VARs are estimated for the different countries and the final estimate is an average of the coefficients of the individual country estimates. Unfortunately, this approach is not feasible in our application. We capture financial crises with dummy variables, but in some countries only one crisis or even no crisis occurs in the sample. So, the effect of a financial crisis cannot be estimated in single country VAR.

To check whether the resulting bias is sufficiently small to generate reliable results we compare fixed effects OLS estimates with the pooled mean group estimator for a specification without financial crises and recession dummies. Figure 5 compares fixed effects OLS panel VAR estimates which are potentially biased with the mean group estimates for the same specification. The main difference is that the confidence bands are wider for the mean group estimates. This is not surprising given the larger number of observation in the direct panel estimation compared to taking an average of individual country VARs with much less observations. The point estimates of the impulse responses are very similar for both estimators, so that we conclude that the bias in the fixed effects OLS estimates is sufficiently small to achieve reliable results.

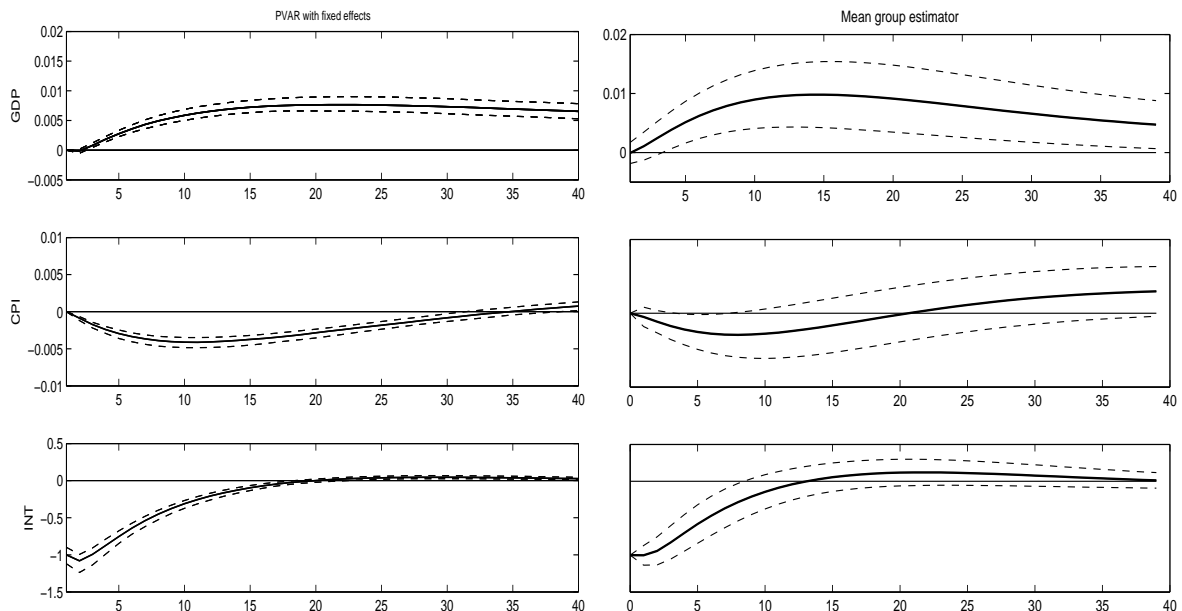


Figure 5: PVAR estimated with fixed effects and with the mean group estimator.

Notes: 21 OECD economies, 1984-2013, Cholesky identification.

4.3 Emerging Economies

Having analysed results for the 21 OECD economies, we now include the additional 24 emerging economies. Figure 6 shows impulse responses for the financial crisis and the non-crisis regimes. An expansionary monetary policy shock leads to a quicker increase in GDP during financial crises compared to normal times. The increase in GDP is, however, less persistent than in the baseline case. After a while the GDP response in non-crisis times even becomes stronger than the one during financial crises.

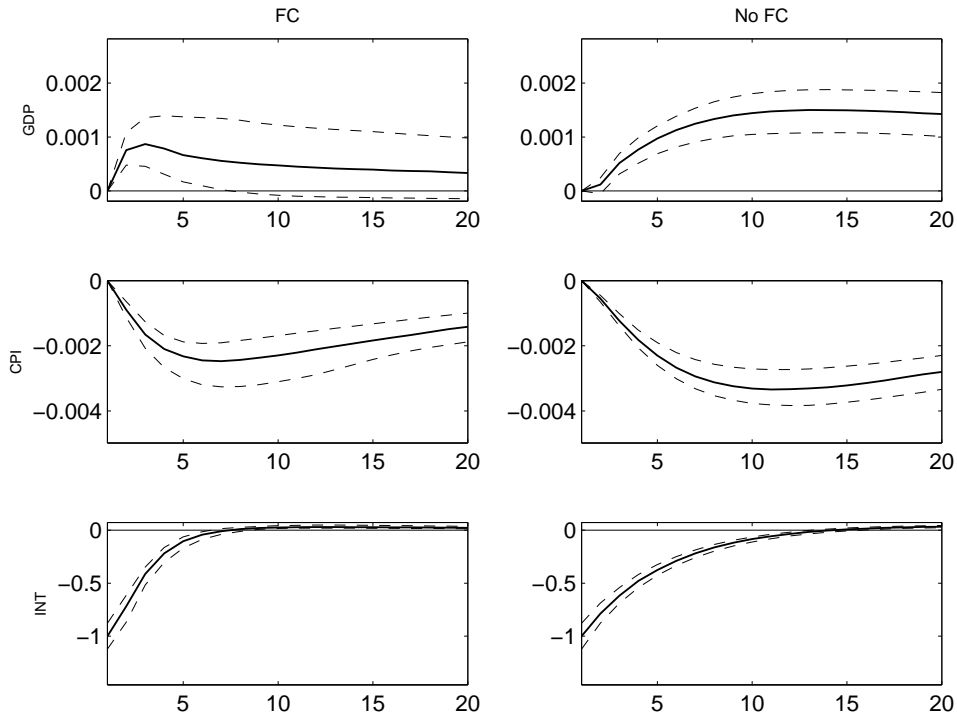


Figure 6: Effects of a monetary policy shock in financial crises and normal times.
Notes: 21 OECD and 24 emerging countries, 1984-2013, Cholesky identification.

Figure 7 show the results with for four regimes. The effects on GDP during the recessionary episode of a financial crisis is positive on impact and larger than during non-crisis times. During the following recovery the effect on GDP is even negative. This is in line with the results and explanations in Hubrich and Tetlow (2012) who argue that during these periods agents might regard expansionary monetary policy that would normally be beneficial as confirmation of incipient financial difficulties. While the results for recessions and expansion during financial crises are roughly similar to the sample with OECD countries only, the results for recessions during non-crisis times are very different. Here, an expansionary monetary policy shock has the largest effects on GDP compared to the other three regimes. For the OECD economies the effects on GDP during normal recessions were lower compared to expansions. Hence, a possible explanation for the conflicting results from the literature on the effectiveness of monetary policy during recessions and expansions is the composition of the sample. In emerging economies, an expansionary monetary policy shock has larger effects during recessions than during expansions, while it is the other way around in advanced economies.

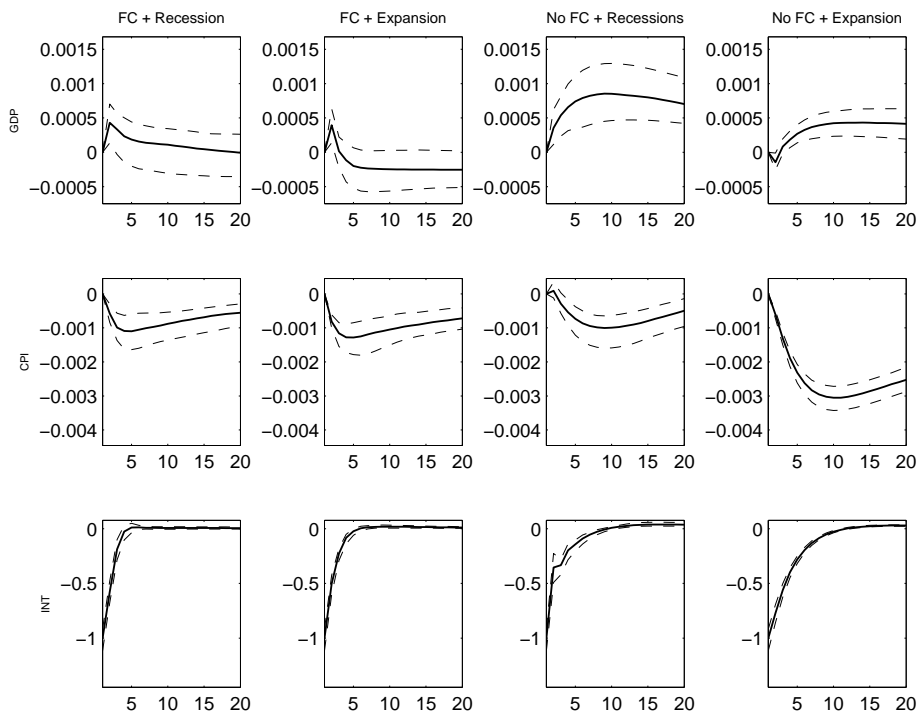


Figure 7: The role of recessions and expansions in financial crises.
Notes: 21 OECD and 24 emerging countries, 1984-2013, Cholesky identification.

4.4 Is the Great Recession special?

The financial crisis of 2007/2008 might possibly be different from other earlier crises like the one in Scandinavia in the early 1990s because it was not regionally bounded. Therefore, we check in the following to which extent our results are dominated by the most recent crisis and whether this episode has been different from previous crises. In our sample of OECD countries only 5 financial crises occurred before the most recent crisis. We can only show results for estimates with two regimes, but not for four regimes, because with these few observations we were not able to compute stable PVAR estimates for the latter. Figure 8 shows results for the OECD countries for a sample from 1984 to 2007. GDP reacts as in the full sample quicker during financial crises compared to non-crises times. The reaction is, however, only for the first five or six quarters larger than in non-crises times, which is different from the results that include the recent global financial crisis.

To increase the number of financial crisis observations figures 9 and 10 show results for OECD and emerging economies for the case of two and four regimes. During the recessionary part of financial crises, GDP reacts again quicker to an expansionary monetary policy shock than in non-crisis times. Afterwards, however, there is no significant effect on GDP at all during financial crises. Hence, the large effects on GDP during the recessionary part of financial crises that we found before, might be restricted to the recent financial crisis.

To examine this issue further, figures 11 and 12 show results for the sample 2008 to 2013 for OECD economies and for all economies in our sample, respectively. In both cases, we have very few observations so that we can show results only for the two regime case. It is apparent that the recent crisis was indeed special in the sense that monetary policy was more effective

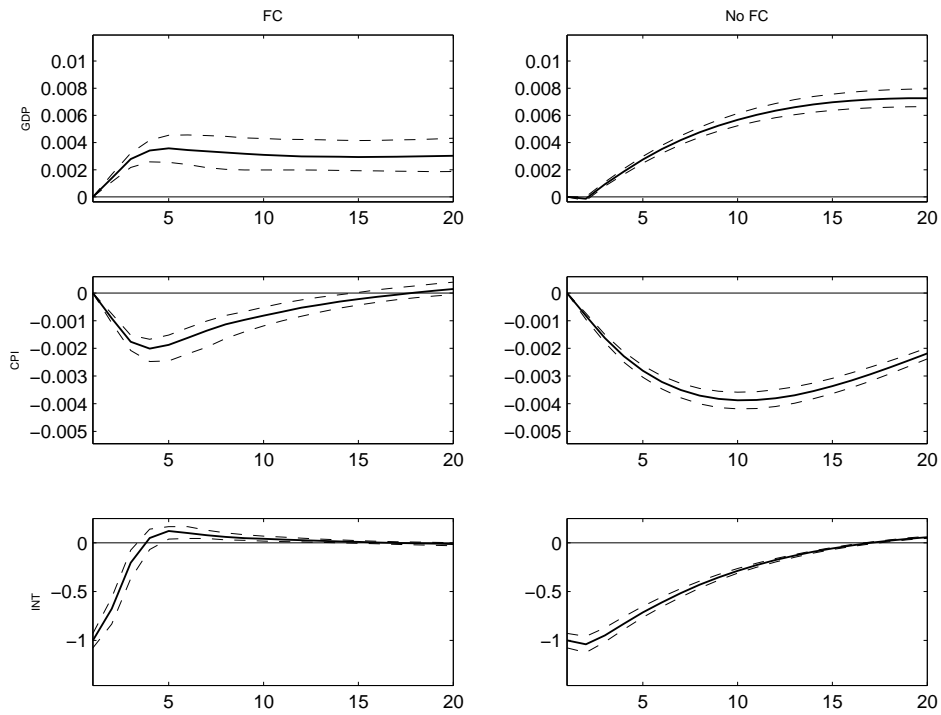


Figure 8: Effects of a monetary policy shock in financial crises and normal times.
 Notes: 21 OECD countries, 1984-2007, Cholesky identification.

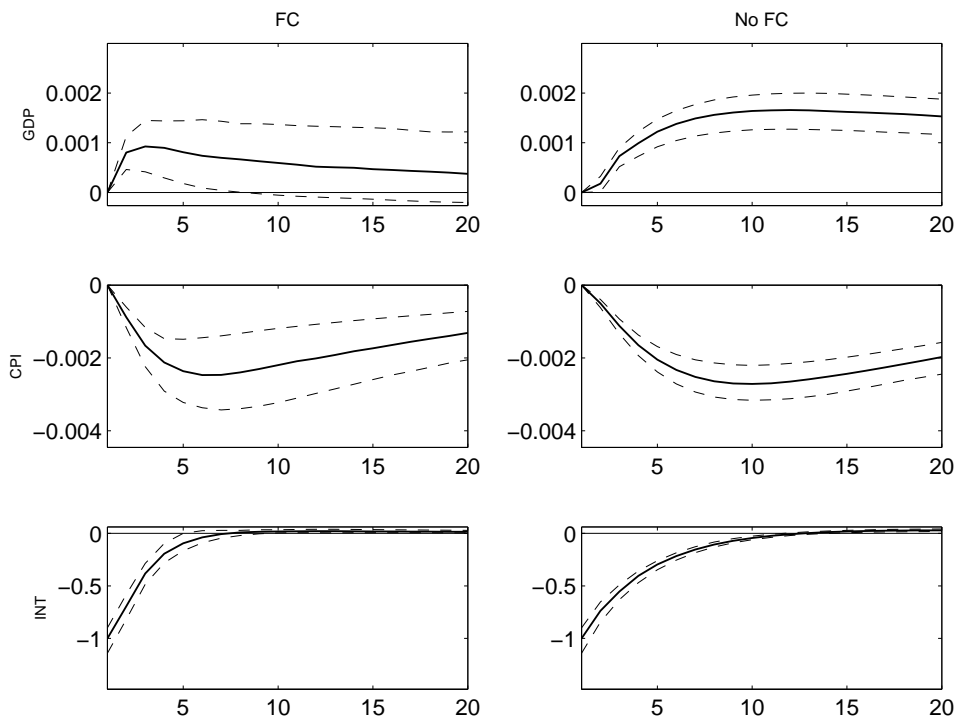


Figure 9: Effects of a monetary policy shock in financial crises and normal times.
 Notes: 21 OECD and 24 emerging countries, 1984-2007, Cholesky identification.

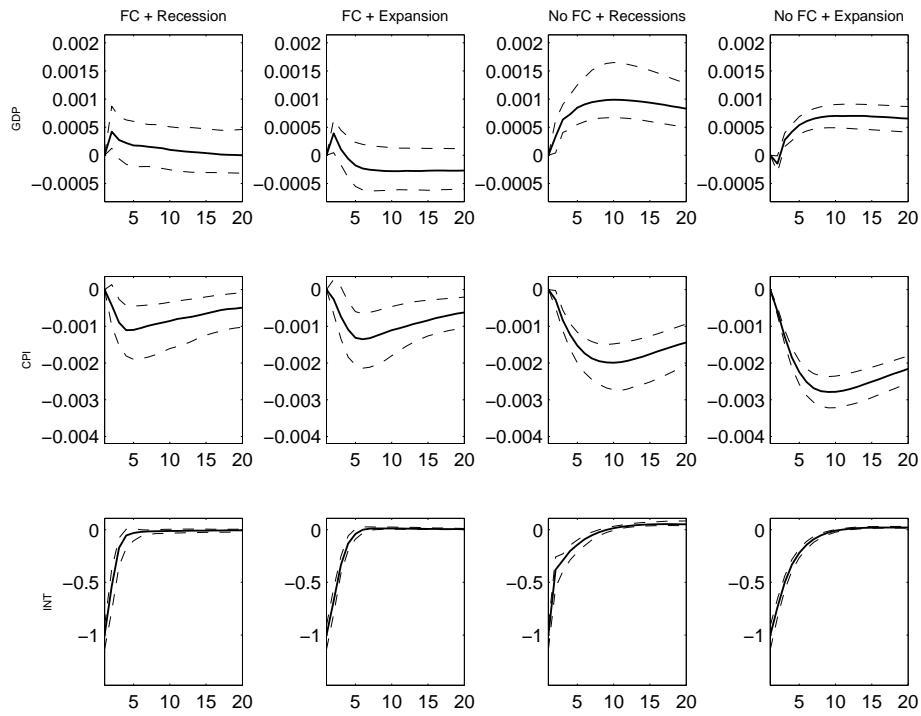


Figure 10: The role of recessions and expansions in financial crises.
 Notes: 21 OECD and 24 emerging countries, 1984-2007, Cholesky identification.

in increasing GDP than in previous crises. One explanation might be the global dimension and the severity of this crisis. Expansionary monetary policy might have been perceived by market participants as a commitment signal that a worse outcome of the crisis as in the Great Depression will be prevented leading to a strong increase in GDP. Note also, that for this short sample the responses of CPI inflation show the expected sign.

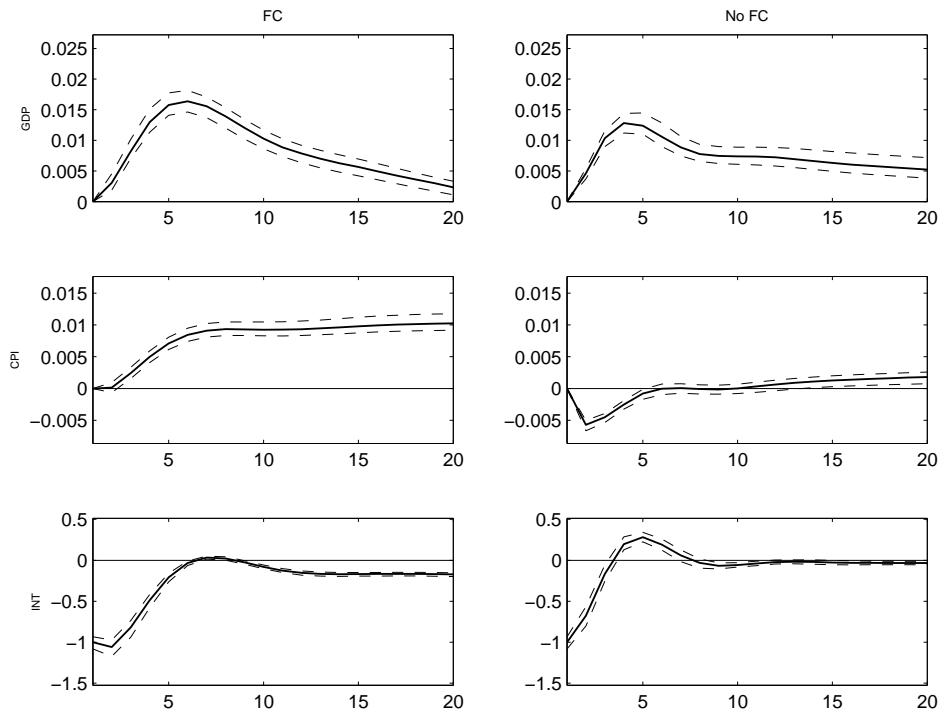


Figure 11: Effects of a monetary policy shock in financial crises and normal times.
Notes: 21 OECD countries, 2008-2013, Cholesky identification.

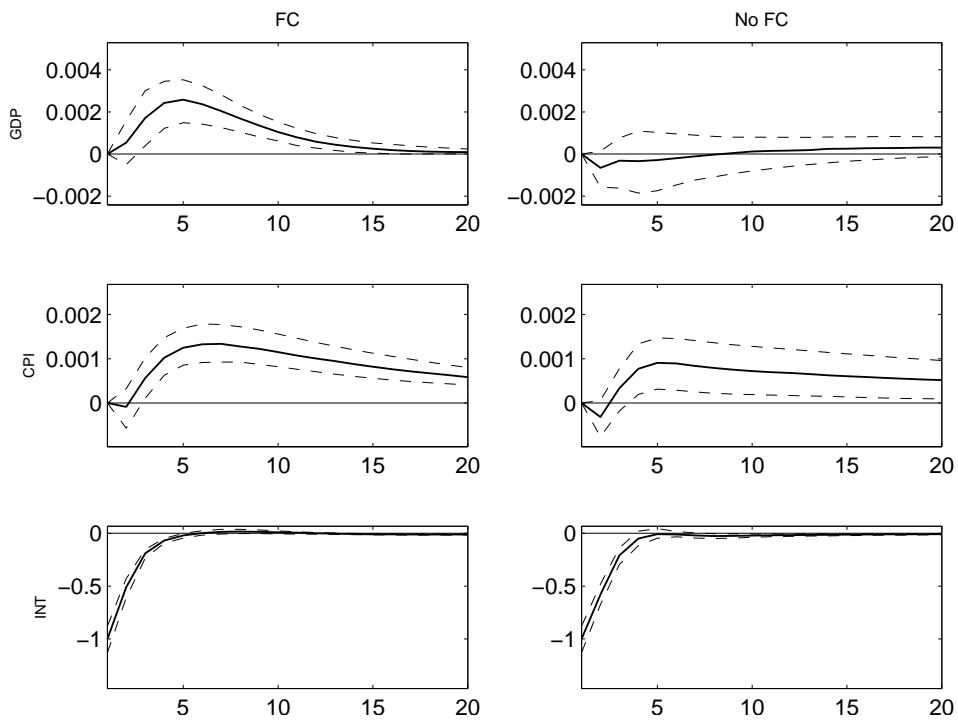


Figure 12: Effects of a monetary policy shock in financial crises and normal times.
Notes: 21 OECD and 24 emerging countries, 2008-2013, Cholesky identification.

5 Transmission channels of monetary policy in crises and non-crises times

So far we have identified some stylized facts regarding the effects of a monetary policy shock during financial crises, recessions and normal times. We have, however, not yet analysed which transmission channels are at work.

5.1 Change in transmission or change in monetary policy?

Differences in the effects of a monetary policy shock between crises and non-crises times and recessions and expansions can have two causes. First, the monetary transmission mechanism might be different. Reasons for this include credit constraints, additional effects of increases in uncertainty and others. Second, the effects might be different because systematic monetary policy has changed. In the above analysis we ensure that the size of the monetary policy shock is the same in all regimes. Thus, the discretionary part of monetary policy is the same in all regimes. The systematic part of monetary policy, i.e. monetary policy rule parameters, are not hold constant across regimes. If a financial crisis occurs, the central bank might adjust the monetary policy rule to the special conditions of a financial crisis. Therefore, a larger effect of a monetary policy shock on GDP during the joint occurrence of a financial crisis and a recession could in principle be caused by more expansionary monetary policy. An example would be a larger response of the interest rate to its own lags, i.e. the interest rate smoothing part of a monetary policy rule, to hold the interest rate lower for longer.

To systematically disentangle changes in the transmission mechanism and systematic monetary policy we construct a counterfactual. We compute impulse responses when the monetary policy parameters estimated during normal times are also used in the other regimes. Technically, we set the financial crisis and recession dummies in the interest rate equation in all periods to zero, while they take their baseline values in the GDP and CPI equations. The transmission of changes in the interest on GDP and CPI is thus allowed to be different across regimes, but the reaction of the interest rate to lags of itself and of GDP and CPI is the same in all regimes.

Figure 13 shows the results for the case of a dummy for financial crises, but no dummy for recessions. Comparing it to figure 3 shows that when we control for changes in monetary policy, the effects on GDP are still larger during financial crises compared to normal times.

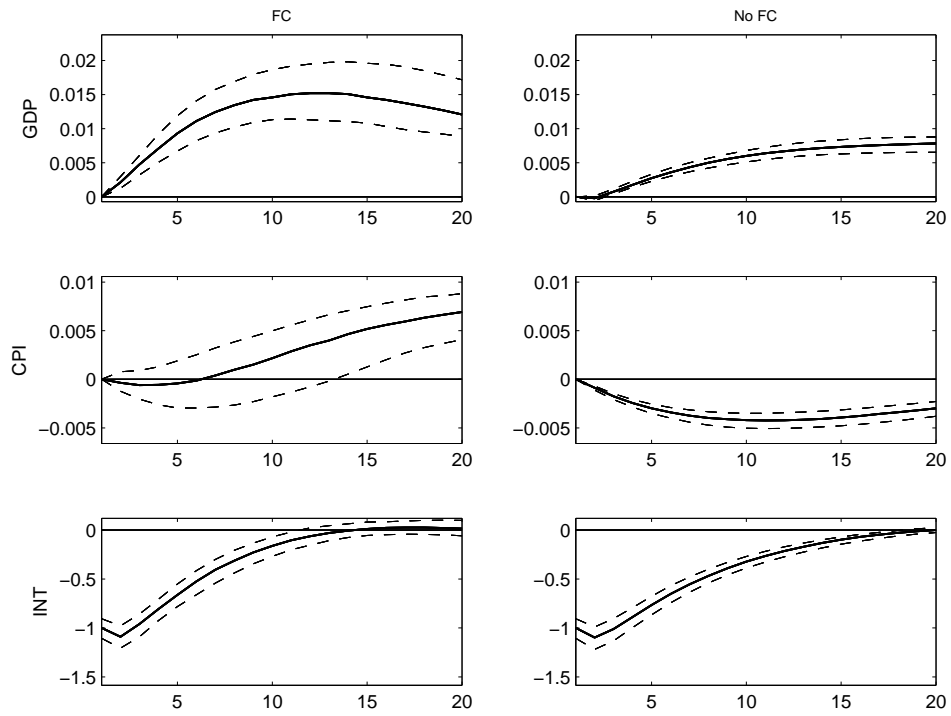


Figure 13: The role of changes in systematic monetary policy in financial crises and normal times.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

Figure 14 shows the same exercise in the case where we have additional dummies for recessions. Comparing it to figure 4 shows that there is almost no difference between the baseline and the counterfactual simulations. Hence, the largest part of the differences of monetary policy shocks between the four regimes are indeed caused by changes in policy transmission rather than changes in monetary policy itself.

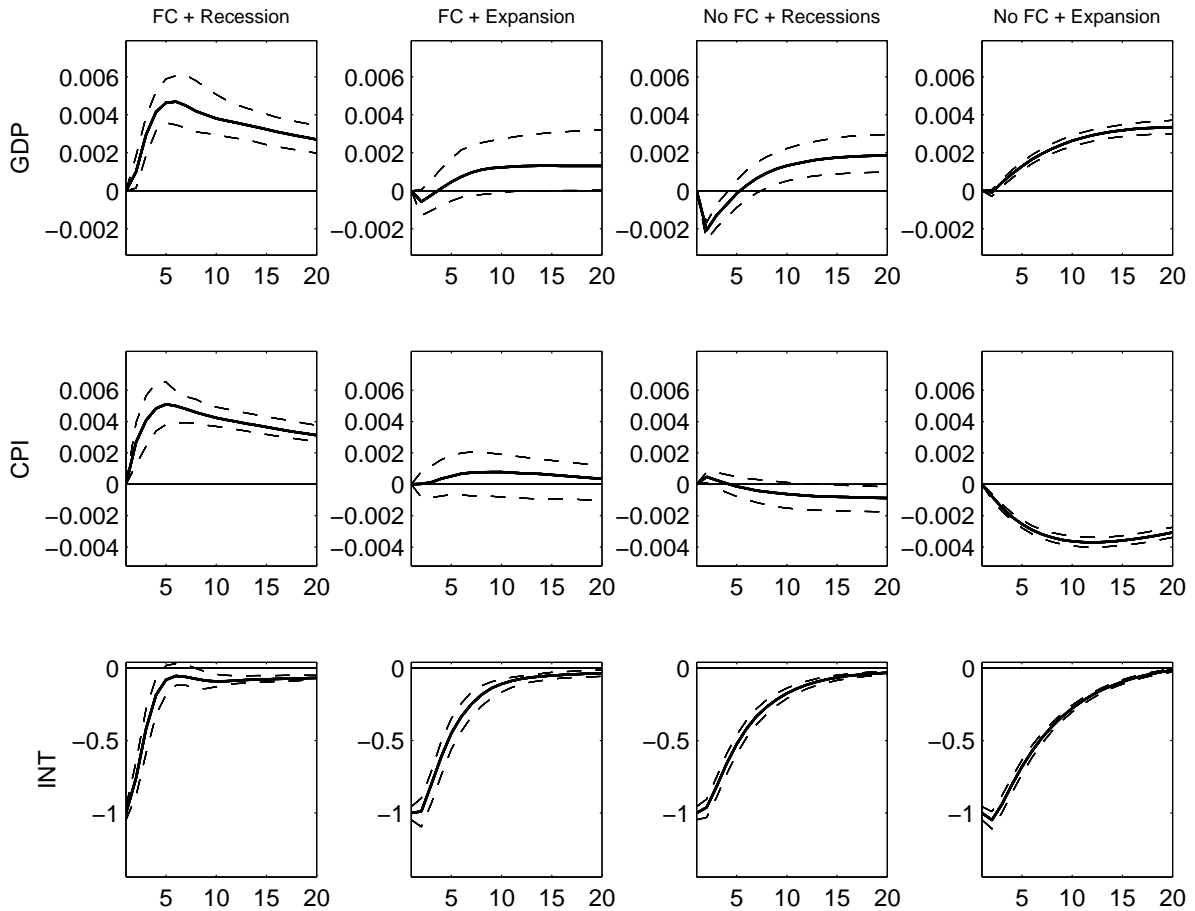


Figure 14: The role of changes in systematic monetary policy during recessions and expansions in financial crises.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

5.2 The role of credit, confidence, house prices exchange rates

In this subsection we add additional variables that are potentially important for the monetary policy transmission mechanism to the PVAR. We study transmission via credit, house prices, exchange rates, consumer confidence and share prices. Already in the baseline specification without additional variables the PVAR contains many parameters, but only few financial crisis episodes. Therefore, we add only one variable at a time to the PVAR rather than adding all at once. We do not (yet) have data for all countries, so that we only show results for the OECD countries. In each of these PVARs the responses of GDP, CPI and the interest rate are very similar. Therefore, in figure 15 (two regimes) and 16 (four regimes) we only show the impulse responses for the additional variables. Figures showing impulse responses of all variables in each PVAR are contained in the appendix (figures 17 to 26).

The impulse responses show that there are no strong differences in the response of credit between financial crises and normal times. Distinguishing in addition between recessionary and expansionary periods shows some differences. The results are somewhat surprising and show that the financial accelerator cannot explain the differences of the effects of a monetary policy shock that we found in section 4. The effects of a monetary policy shock on credit are weakest

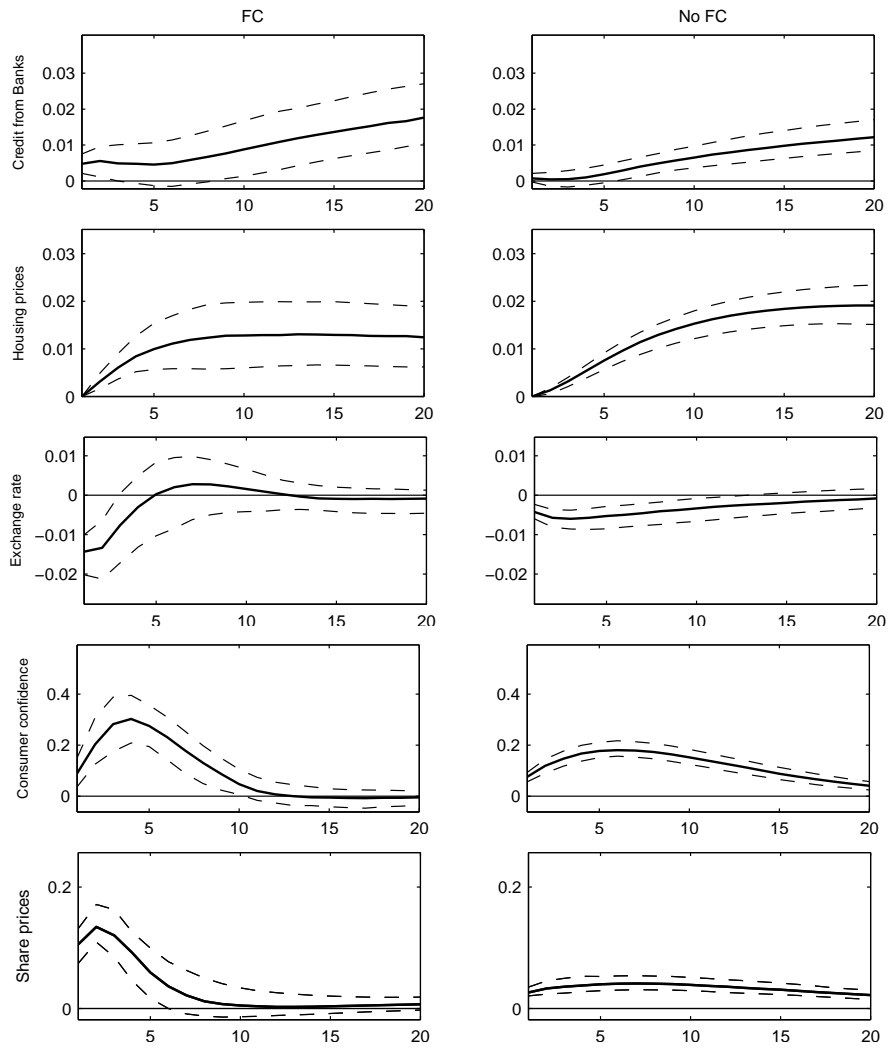


Figure 15: Effects of a monetary policy shock on additional variables in financial crises and normal times.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

during the joint occurrence of a financial crisis and a recession. Credit does not move at all. Hence, the expansion in monetary policy does not lead to an increase in credit. In contrast, during the recovery episode of a financial crisis where the monetary policy effects on GDP are weakest, the effects on credit are the largest. After an expansionary monetary policy shock the volume of credit increases, but this does not yet lead to an increase in output. So, the reaction is exactly the opposite of the one of GDP. A possible explanation is that it is more difficult for firms to raise money from capital markets or to retain profits during the recovery from a recession in a financial crisis. Hence, expansionary monetary policy can increase the volume of credit because firms use this as a substitute for other forms of financing. They do, however, not use this for additional investment. Thus, expansionary monetary policy leads to an increase in credit, but not in output.

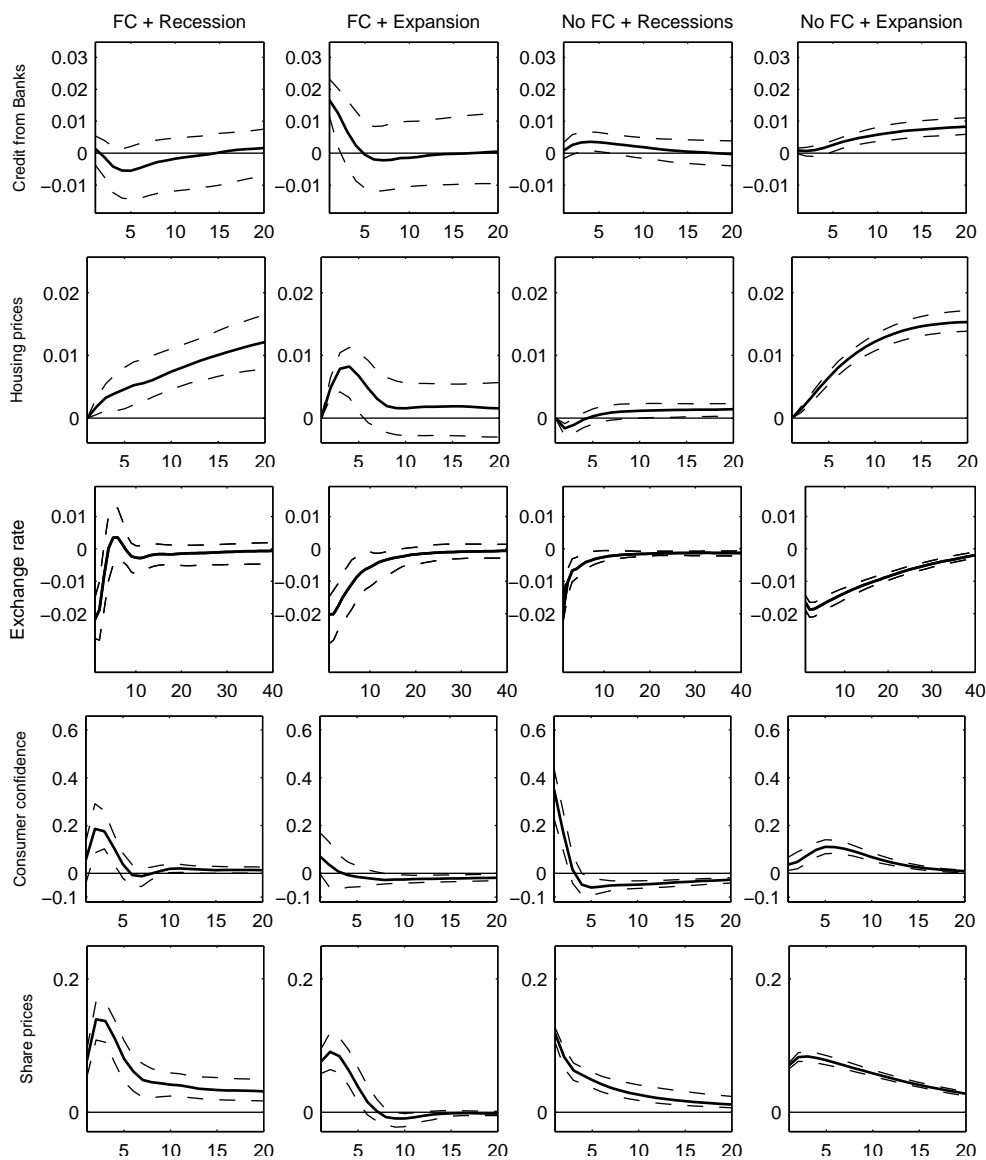


Figure 16: The role of recessions and expansions in financial crises for additional variables. Notes: 21 OECD and 24 emerging countries, 1984-2013, Cholesky identification.

Similarly, the response of house prices cannot explain the strong initial increase in GDP to

a monetary policy shock during the most imminent period of a financial crises nor the absence of an increase in GDP during the following recovery. House prices react with a delay during the recessionary period of a crisis, but immediately - before going back to zero - in the recovery phase. Hence, monetary policy transmission might work through the housing market on output for the period two to five years after the monetary policy shock, but not in the short-run. During non-crisis times the impulse response for housing prices is very similar to the one GDP so that during normal times the housing market might be very important for the transmission of a monetary policy shock on output.

The exchange rate depreciates following an expansionary monetary policy during all regimes. The depreciation is, however, somewhat stronger during financial crises. During recessions (in and outside of financial crises) the exchange rate response is back at zero after one year only, while the response is much more persistent during expansions. Exchange rates probably play some role for monetary policy transmission during all regimes, but the dynamics do not indicate that exchange rates are one of the main drivers that could explain the different dynamics of GDP in the different regimes.

The response of consumer confidence is quicker and initially stronger during financial crises than during normal times. This is driven by the recessionary part of financial crises, while during the recovery consumer confidence does not react significantly to a monetary policy shock. Hence, the dynamics of the consumer confidence response during financial crises are at least for the first one to two years very similar to the one the GDP response. So, an expansionary monetary policy shock might be viewed by market participants as a signal that policy makers are committed to prevent a worsening of the situation and might increase confidence, decrease uncertainty and in this way increase GDP. This explanation seems in particular plausible if one recalls that the strong increase in GDP in response to an expansionary monetary policy shock during the recessionary part of financial crises is mainly driven by dynamics during the most recent global financial crisis. In this crisis a loss in confidence and increases in uncertainty have played a large role (see e.g. Bloom, 2009). There were frequent discussions of whether the situation could become as bad as during the Great Depression. Once central banks started large expansionary policy programs this might have led to an increase in confidence and GDP.

The responses of share prices look roughly similar to the responses of consumer confidence except that in the recovery period of a financial crises share prices react positively. On the one hand, the response of share price might reflect increases in confidence. On the other hand the positive effects might make it easier for companies to get financing from capital markets and from retaining profits, which might lead to an increase in GDP.

6 Conclusion and Outlook

In this study, we analyze the effectiveness of monetary policy during financial crisis episodes compared to non-crises episodes. We find that monetary policy has a somewhat larger effect on GDP during financial crises; in particular GDP reacts faster to changes in monetary policy as compared non-crises episodes. When we differentiate between recessionary and expansionary periods within financial crises, it becomes obvious that the effectiveness of monetary policy differs

sharply in these two periods. While monetary policy has large effects on GDP in recessionary periods, which usually take place at the beginning of a financial crisis, monetary policy has hardly any significant effect on GDP in expansionary periods of financial crises, which usually take place at later stages of financial crises. Moreover, the effects in recessionary periods of financial crises are considerably larger than in non-crises episodes. Within non-crises episodes the effects of monetary policy are larger in expansions than in recessions.

Our results are largely robust when we change our estimation periods or change our country sample by including emerging economies in our estimation sample. We show that the differences in the effectiveness of monetary policy during financial crises are mainly due to changes in the transmission of monetary policy shocks but not due to systematic changes in how monetary policy reacts to the economic environment during financial crises. When we study the transmission channels of monetary policy in more detail, we find evidence in favor of an important role of the confidence channel. Consumer confidence and share prices - two measures that proxy market confidence - react more strongly to monetary policy shocks during recession phases of financial crises as compared to both expansionary periods of financial crises and expansionary periods in non-crises times. By contrast, we do not find a particular role for the credit channel of monetary policy.

This paper presents preliminary results and is work in progress. We plan to extend our analysis by conducting further robustness checks and by extending the analysis of differences in the transmission channels of monetary policy during financial crises and non-crises periods.

As a first robustness check, we plan to control for unconventional monetary policy measures such as quantitative easing, as many central banks have used such measures during the most recent financial crises. For various reasons, we do not expect that our results will change dramatically when controlling for unconventional measures. First, the literature on the effects of unconventional monetary policy measures indicates that while these measures might have had some stimulating effects on the economy, these effects have not been overwhelmingly large. Second, in case these measures were indeed effective, then monetary policy has actually been more expansionary during the recent financial crisis than what is incorporated in our estimates. As a consequence, we might rather have a tendency to overestimate the effects of monetary policy during financial crises, what would even strengthen our results. Note that we already control to some extent for unconventional monetary policy measures in the euro area by using the EO-NIA interest rate as the policy instrument of the ECB, in which the effects of unconventional measures should show up (Ciccarelli et al., 2013). As an extension, we plan to use shadow rates of US monetary policy, as described, for example in Lombardi and Zhu (2014). Moreover, we plan to identify monetary policy shocks by using monetary aggregates, which partially mirror unconventional monetary policy measures. First preliminary results indicate that our results do not change dramatically when using monetary aggregates for the identification of monetary policy shocks.

As a second robustness check, we plan to control for the exchange rate regime of a country. In a fixed exchange rate regime - and when capital mobility is reasonably high - monetary policy should have less room to react to the domestic environment. Currently, we plan to follow the strategy used in Corsetti et al. (2012), who investigate the size of government spending

multipliers.

As a third robustness check, we plan to control for the stance of fiscal policy. However, there might be some problems with data availability, since, to best of our knowledge, a comprehensive data set for fiscal variables based on quarterly data is not available. To the extent that fiscal policy was very expansionary during financial crises, as it was the case in many countries at the beginning of the most recent financial crises, we might overestimate the effects of monetary policy when we do not control for fiscal policy. However, in cases when fiscal policy was very restrictive, as it was the case in some euro area countries that experienced a debt crisis in the later stage of the recent financial crises, we might also underestimate the effects of monetary policy.

To further investigate potential differences in the transmission channel of monetary policy during financial crises compared to non-crises times, we plan to extend the set of variables used in our empirical investigation. In particular, we will try to include a measure of risk premia into our model. We will also use different expenditure variables such as consumption, housing and non-housing investment and net trade instead of aggregate GDP.

Finally, we want to address the so-called price puzzle that shows up frequently in our results and that is to some extent inherent to panel models when investigating the effects of monetary policy. To address the price puzzle, we plan to use sign restrictions to identify monetary policy shocks with the aim to check whether our results remain stable when monetary policy shocks have the effects on prices that are expected by theory. In some of our robustness checks, we use alternative estimation periods. In some of these robustness checks, in particular when we use shorter estimation periods, the price puzzle disappears, but our results regarding the effects of a monetary policy shock on GDP remain largely stable.

References

- Aastveit, K. A., G. J. Natvik, and S. Sola (2013). Economic uncertainty and the effectiveness of monetary policy. *Norges Bank*.
- Abeyasinghe, T. and G. Rajaguru (2004). Interpolated quarterly gdp data for malaysia, indonesia, thailand, philippines and china. *Journal of Forecasting* 23, 431–447.
- Assenmacher-Wesche, K. and S. Gerlach (2008). Monetary policy, asset prices and macroeconomic conditions: a panel-VAR study. *National Bank of Belgium*.
- Ball, L. and G. N. Mankiw (1994). Asymmetric price adjustment and economic fluctuations. *The Economic Journal* 104(423), 247–261.
- Barth III, M. J. and V. A. Ramey (2002). The cost channel of monetary transmission. In B. S. Bernanke and K. Rogoff (Eds.), *NBER Macroeconomics Annual 2001*, Volume 16.
- Bech, M., L. Gambacorta, and E. Kharroubi (2014). Monetary policy in a downturn: are financial crises special? *International Finance* 17(1), 99–119.
- Bernanke, B. S. (1983). Irreversibility, uncertainty, and cyclical adjustment. *The Quarterly Journal of Economics* 98(1), 85–106.
- Bernanke, B. S. and M. Gertler (1995). Inside the black box: the credit channel of monetary policy transmission. *National Bureau of Economic Research*.
- Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica* 77(3), 623–685.
- Caggiano, G., E. Castelnuovo, and N. Groshenny (2014). Uncertainty shocks and unemployment dynamics in u.s. recessions. *Journal of Monetary Economics* forthcoming.
- Christiano, L. J., C. Gust, and J. Roldos (2004). Monetary policy in a financial crisis. *Journal of Economic Theory* 119, 64–103.
- Ciccarelli, M., A. Maddaloni, and J.-L. Peydró (2013). Heterogeneous transmission mechanism: monetary policy and financial fragility in the eurozone. *Economic Policy* 28(75), 459–512.
- Corsetti, G., G. Müller, and A. Meier (2012). What determines government spending multipliers? *Economic Policy* 72, 523–564.
- Dahlhaus, T. (2014). Monetary policy transmission during financial crises: An empirical analysis. Bank of Canada Working Paper 2014-21.
- Dixit, A. and R. Pindyck (1994). *Investment under Uncertainty*. Princeton University Press.
- Gambacorta, L., B. Hofmann, G. Peersman, et al. (2012). The effectiveness of unconventional monetary policy at the zero lower bound: A cross-country analysis. *CEPR Working Paper No 8348*.

- Garcia, R. and H. Schaller (2002). Are the effects of monetary policy asymmetric? *Economic In* 40(1), 102–119.
- Goodhart, C. and B. Hofmann (2008). House prices, money, credit, and the macroeconomy. *Oxford Review of Economic Policy* 24(1), 180–205.
- Harding, D. and A. Pagan (2002). Dissecting the cycle: a methodological investigation. *Journal of Monetary Economics* 49(2), 365–381.
- Hubrich, K. and R. J. Tetlow (2012). Financial stress and economic dynamics: the transmission of crises. Finance and Economics Discussion Series Federal Reserve Board 2012-82.
- Kannan, P., A. Scott, and M. E. Terrones (2009). *From recession to recovery: how soon and how strong?*, Chapter 3, pp. 103–138. International Monetary Fund.
- Krugman, P. (2008). Depression economics returns. The New York Times.
- Laeven, L. and F. Valencia (2013). Systemic banking crises database. *IMF Economic Review* 61(2), 225–270.
- Lo, M. C. and J. Piger (2005). Is the response of output to monetary policy asymmetric? Evidence from a regime-switching coefficients model. *Journal of Money, Credit and Banking*, 865–886.
- Lombardi, M. J. and F. Zhu (2014). A shadow policy rate to calibrate US monetary policy at the zero lower bound. BIS Working Papers 452, Bank for International Settlements.
- Mishkin, F. S. (2009). Is monetary policy effective during financial crises? *American Economic Review* 99(2), 573–577.
- Morgan, D. P. (1993). Asymmetric effects of monetary policy. *Federal Reserve Bank of Kansas City Economic Review* 78(21-33).
- Pain, N., C. Lewis, T.-T. Dang, Y. Jin, and P. Richardson (2014). Oecd forecasts during and after the financial crisis: A post mortem. OECD Economics Department Working Papers, No. 1107.
- Peersman, G. and F. Smets (2002). *Monetary Transmission in Diverse Economies*, Chapter Are the effects of monetary policy in the euro area greater in recessions than in booms?, pp. 28–48. Cambridge University Press Cambridge, UK.
- Reinhart, C. M. and K. S. Rogoff (2009). Is the 2007 us sub-prime financial crisis so different?: An international historical comparison. *Panoeconomicus* 56(3), 291–299.
- Romer, C. D. and D. H. Romer (2004). A new measure of monetary shocks: Derivation and implications. *The American Economic Review* 94(4), 1055–1084.
- Sá, F., P. Towbin, and T. Wieladek (2011). Low interest rates and housing booms: the role of capital inflows, monetary policy and financial innovation. *Bank of England Working Paper*.

- Tenreyro, S. and G. Thwaites (2013). Pushing on a string: US monetary policy is less powerful in recessions. *Centre for Economic Performance, LSE*.
- Towbin, P. and S. Weber (2012). Limits of floating exchange rates: The role of foreign currency debt and import structure. *Journal of Development Economics*.
- Uhlig, H. (2005). What are the effects of monetary policy on output? Results from an agnostic identification procedure. *Journal of Monetary Economics* 52(2), 381–419.
- Vavra, J. (2014). Inflation dynamics and time-varying volatility: New evidence and an Ss interpretation. *Quarterly Journal of Economics* 129(1), 215–258.
- Weise, C. L. (1999). The asymmetric effects of monetary policy: A nonlinear vector autoregression approach. *Journal of Money, Credit and Banking*, 85–108.
- Zheng, J. (2013). Effects of us monetary policy shocks during financial crises-a threshold vector autoregression approach. *Crawford School Research Paper* (64).

A Data sources

Table 1: Data sources and description

Variable	Country or country group	Source	Seasonal adjustment
Gross domestic product (2005 market prices)	Advanced economies ²¹ , Poland, Czech Republic, Turkey, Mexico, Korea	OECD Economic Outlook	SA
	India, Indonesia	OECD Main Economic Indicators	SA
	China	National Bureau of Statistics China and Abeyasinghe and Rajaguru (2004)	SA (stable seasonal filter)
	Remaining emerging economies	IMF Financial Statistics	SA (stable seasonal filter)
CPI All items (Index, 2010=100)	Advanced economies	OECD Main Economic Indicators	SA (stable seasonal filter)
	China, Chile	National Sources	SA (stable seasonal filter)
	Remaining emerging economies	IMF Financial Statistics	SA (stable seasonal filter)
Short-term interest rate (money-market rate)	Advanced economies	OECD Economic Outlook	SA
	Emerging economies	IMF Financial Statistics	SA (stable seasonal filter)
Credit from banks to private sector	Advanced economies except New Zealand	Bank for International Settlements	SA (stable seasonal filter)
Effective exchange rate	Advanced economies	OECD Economic Outlook	SA (stable seasonal filter)
House prices	Advanced economies	Federal Reserve Bank of Dallas	SA (stable seasonal filter)
Consumer confidence	Advanced economies	National sources	SA (stable seasonal filter)
Share prices	Advanced economies	OECD Main Economic Indicators	SA (stable seasonal filter)
Countries and time periods included			
Advanced economies (1984-2013)	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, US		
Emerging economies	Argentina (1992-2013), Brazil (1995-2013), Bulgaria (1998-2013), Chile (1984-2013), China (1987-2013), Colombia (2000-2013), Czech Republic (1995-2013), Hungary (1995-2013), India (1996-2009), Indonesia (1993-2009), Korea (1984-2013), Latvia (1994-2013), Lithuania (1994-2013), Malaysia (1988-2013), Mexico (1989-2013), Peru (1996-2013), Philippines (1984-2013), Poland (1991-2013), Romania (2000-2013), Russia (1996-2013), South Africa (1984-2013), Thailand (1993-2013), Turkey (1996-2013), Ukraine (2001-2013)		

²¹Until the year 1990 data for GDP and interest rate were only available for Western Germany. These data were multiplied by the share of the time series for the Federal Republic of Germany and the Western German series in 1991Q1 and used for the period 1984-1990.

B Impulse responses of PVARs with additional variables

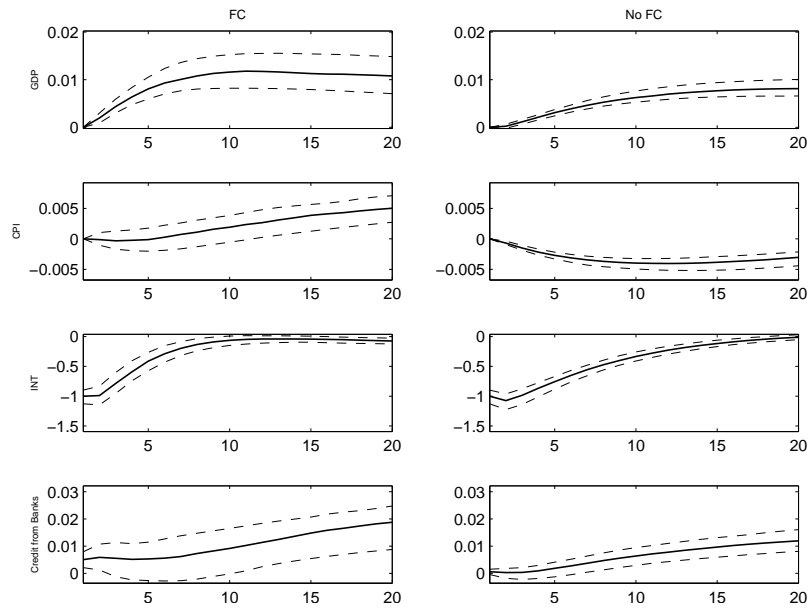


Figure 17: Effects of a monetary policy shock on banks' credit to private sector in financial crises and normal times.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

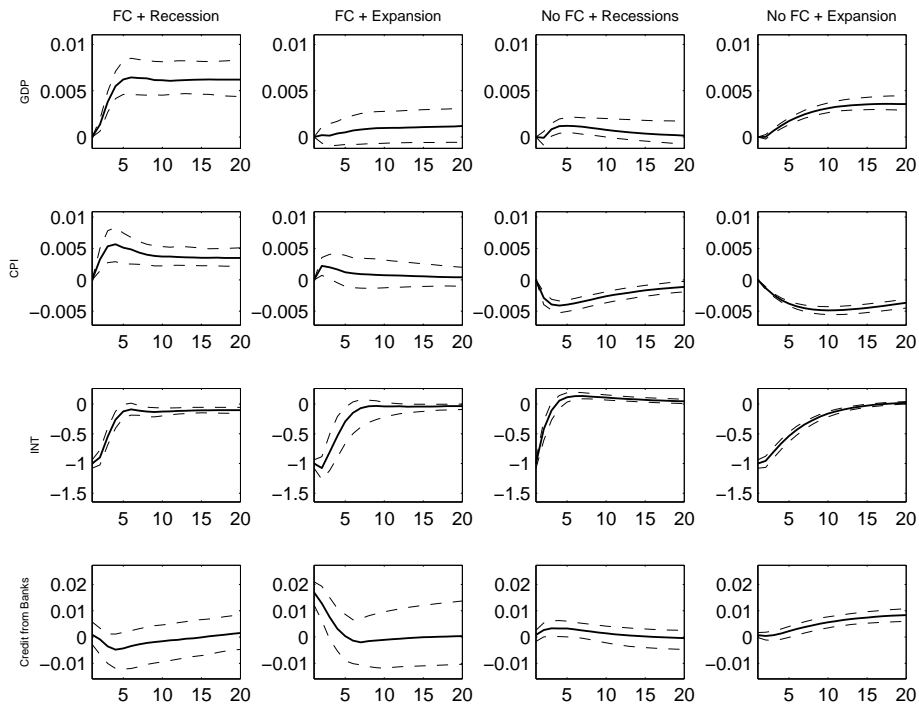


Figure 18: Effects of a monetary policy shock on banks' credit to private sector in recessions and expansions.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

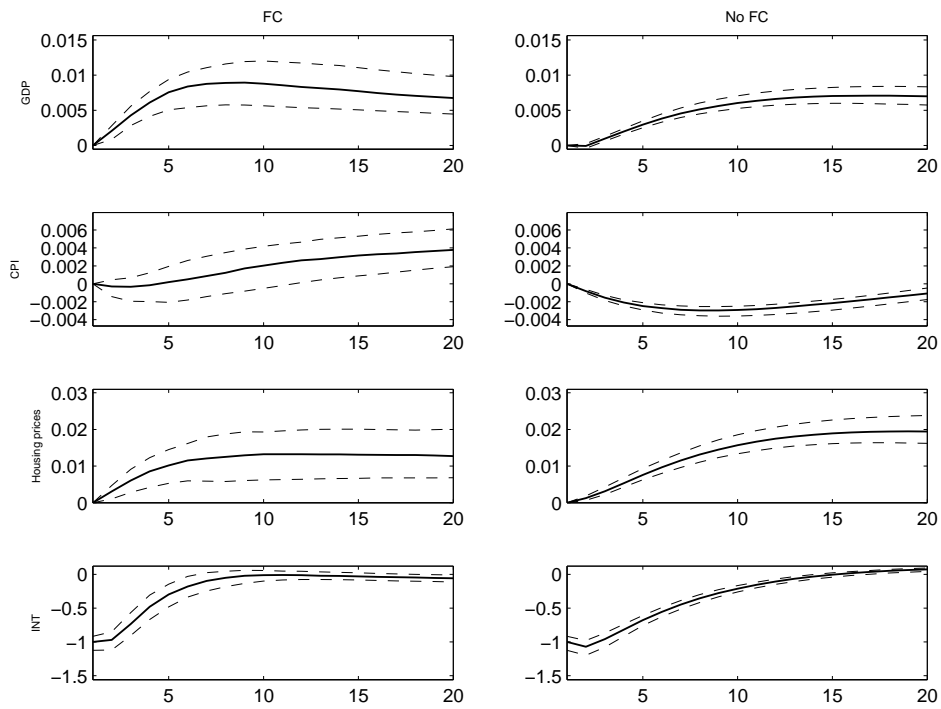


Figure 19: Effects of a monetary policy shock on housing prices in financial crises and normal times.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

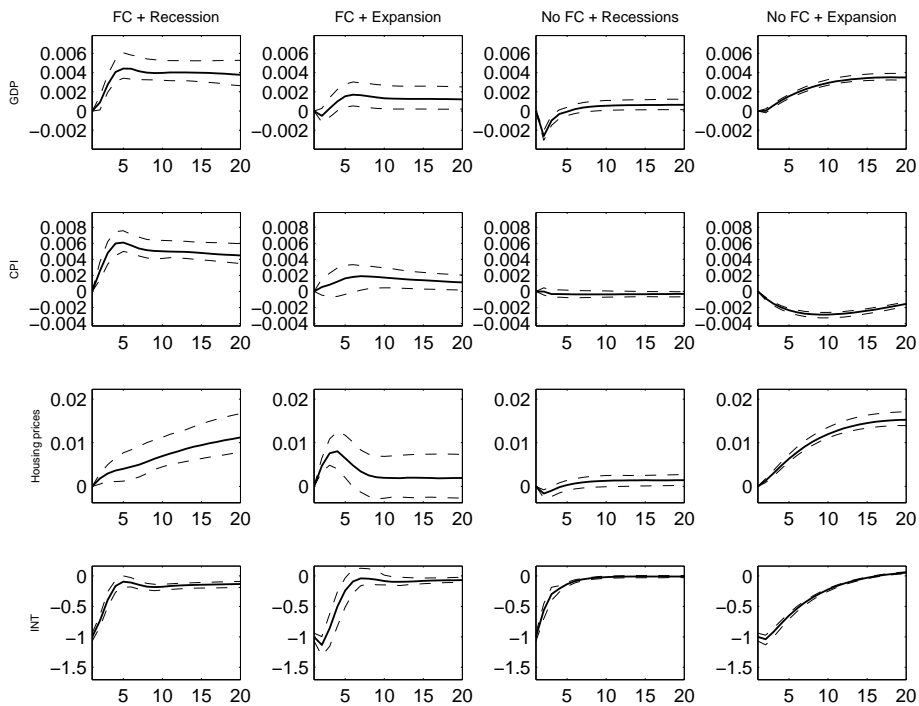


Figure 20: Effects of a monetary policy shock on housing prices in recessions and expansions.

Notes: 21 OECD countries, 1984-2013, Cholesky identification

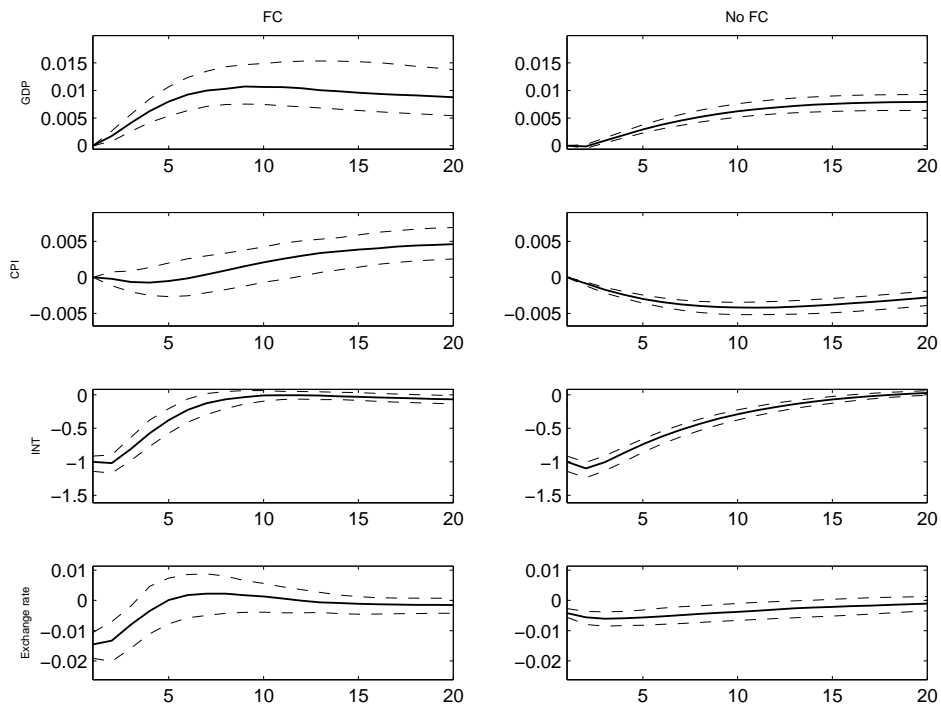


Figure 21: Effects of a monetary policy shock on effective exchange rates in financial crises and normal times.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

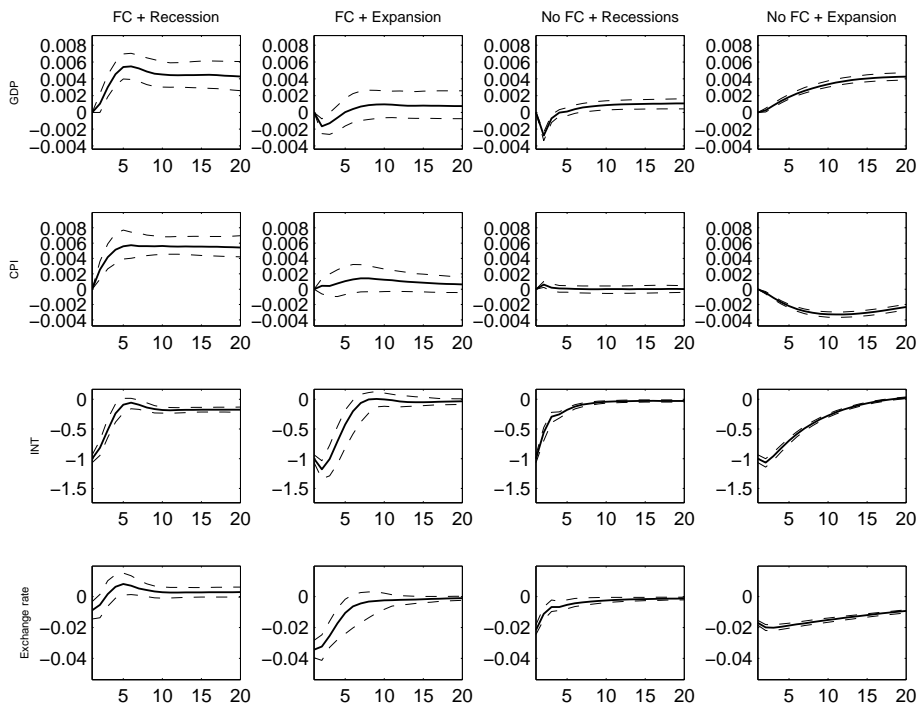


Figure 22: Effects of a monetary policy shock on effective exchange rates in recessions and expansions.

Notes: 21 OECD countries, 1984-2013, Cholesky identification

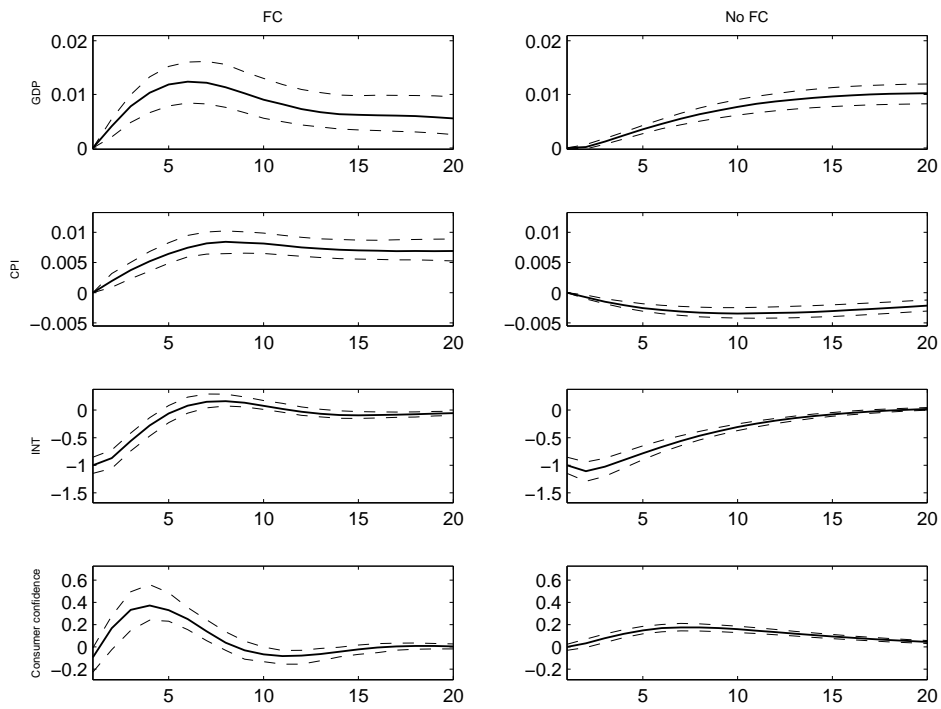


Figure 23: Effects of a monetary policy shock on consumer confidence in financial crises and normal times.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

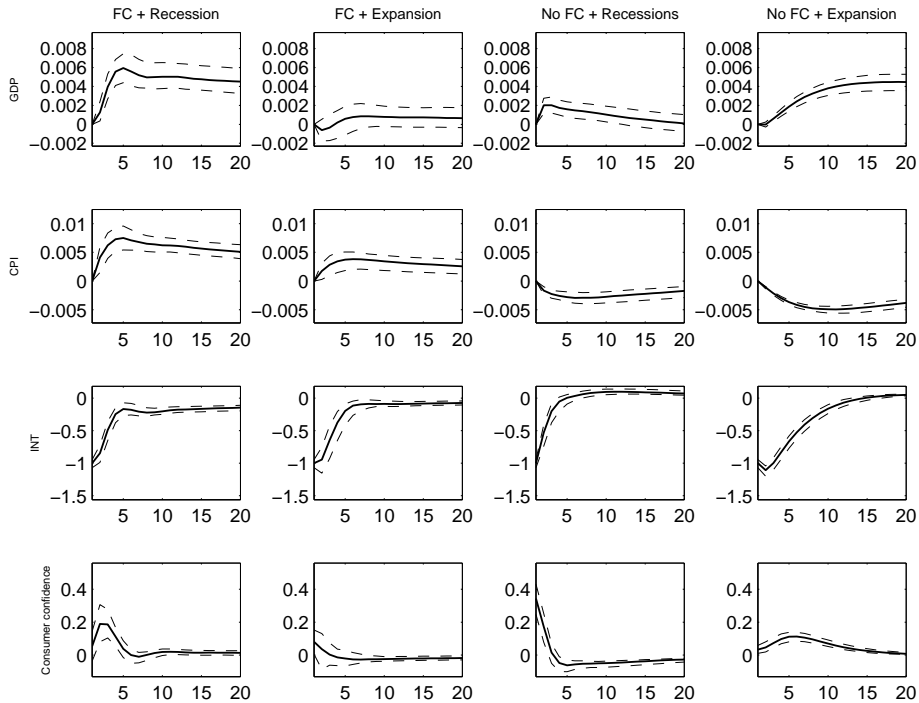


Figure 24: Effects of a monetary policy shock on consumer confidence in recessions and expansions.

Notes: 21 OECD countries, 1984-2013, Cholesky identification

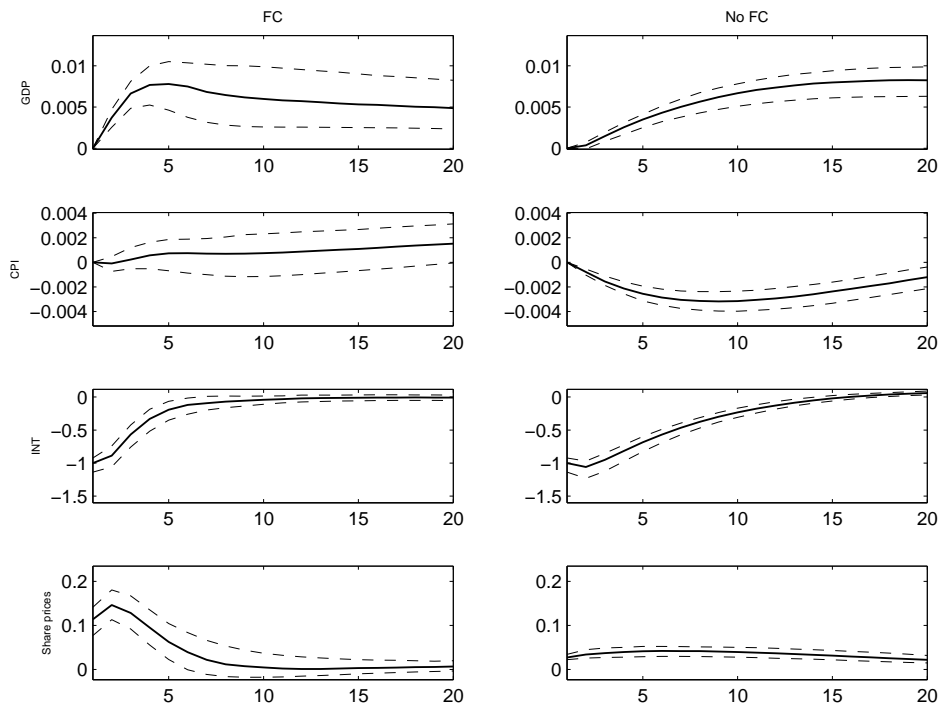


Figure 25: Effects of a monetary policy shock on share prices in financial crises and normal times.

Notes: 21 OECD countries, 1984-2013, Cholesky identification.

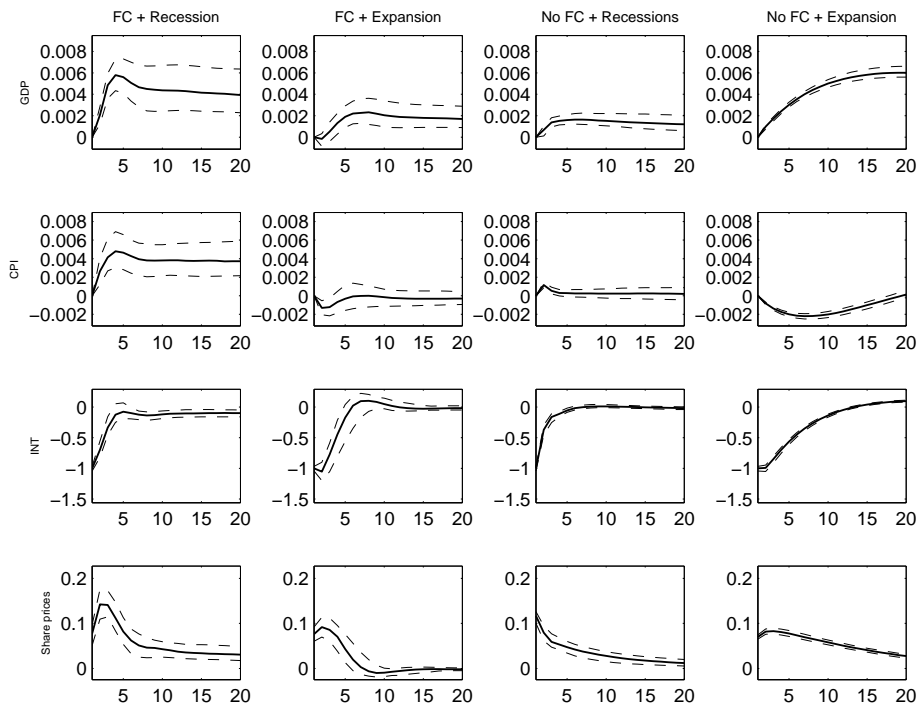


Figure 26: Effects of a monetary policy shock on share prices in recessions and expansions.

Notes: 21 OECD countries, 1984-2013, Cholesky identification

C Graphs showing the data

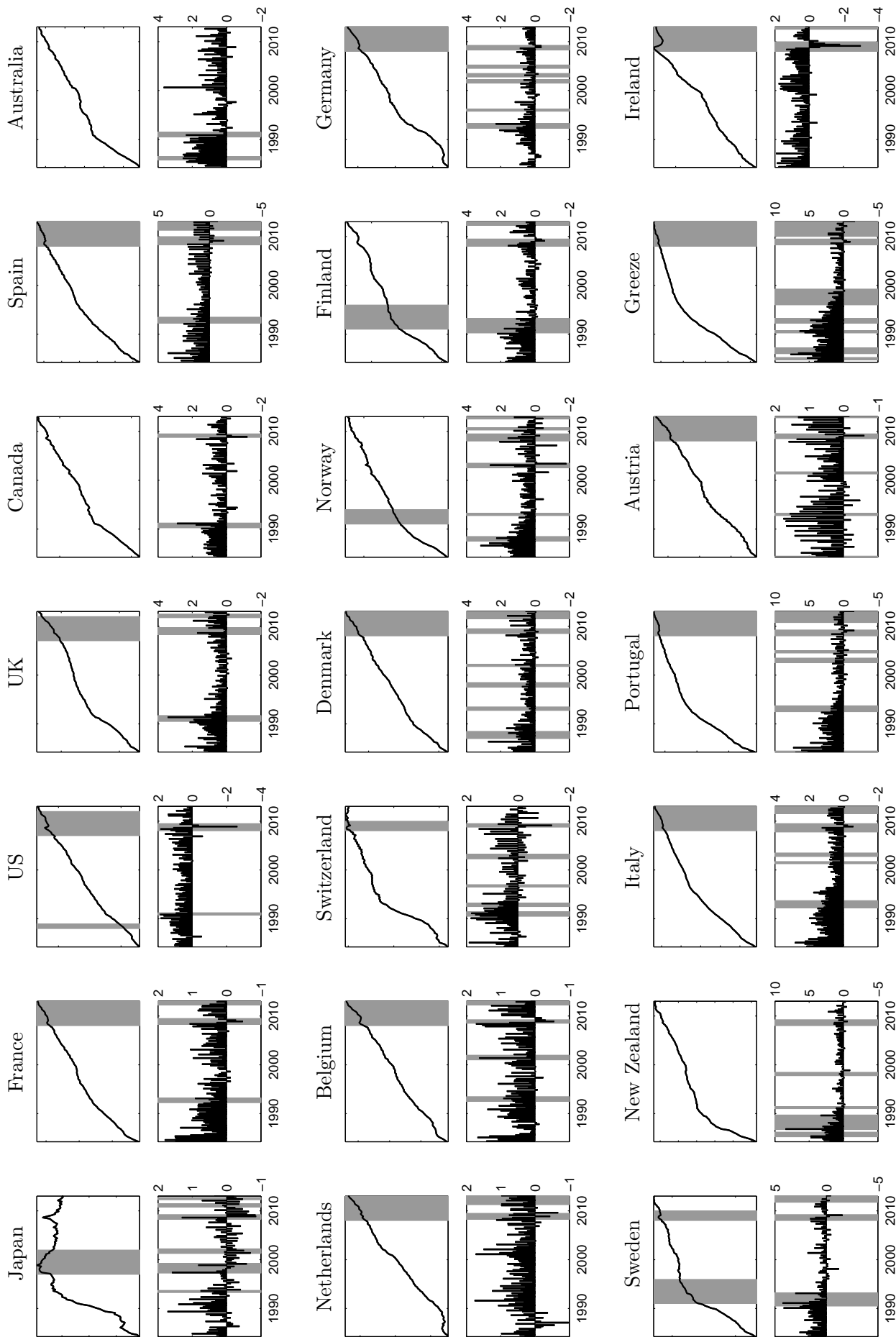


Figure 27: CPI Data, Advanced Economies. Notes: the figures show in the upper part log CPI and in the lower part quarterly (non-annualized) CPI inflation. In the upper part the shaded area show financial crises and in the lower part the shaded area show recessions.

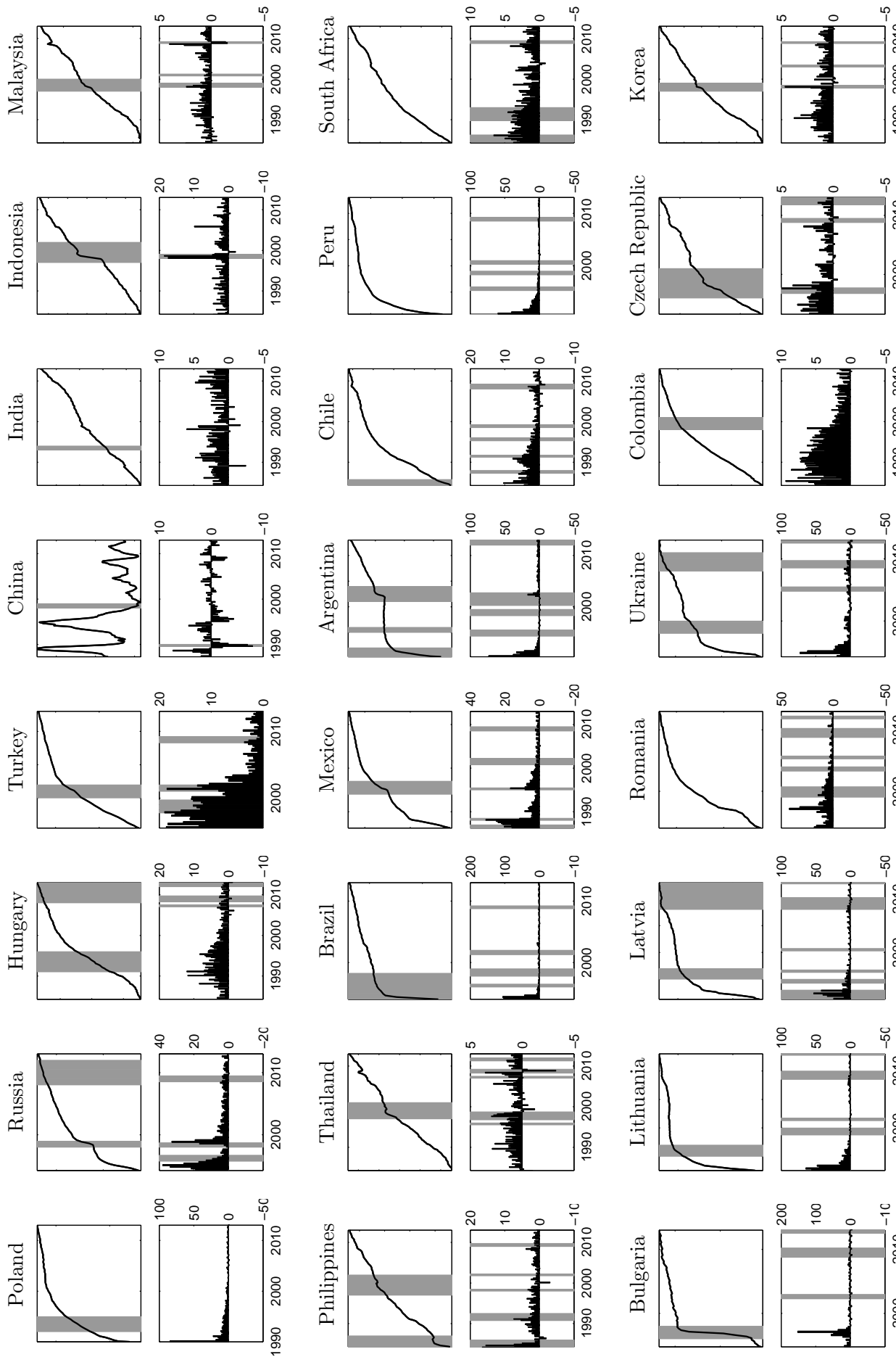


Figure 28: CPI Data, Emerging Economies. Notes: the figures show in the upper part log CPI and in the lower part quarterly (non-annualized) CPI inflation. In the upper part the shaded area show financial crises and in the lower part the shaded area show recessions.

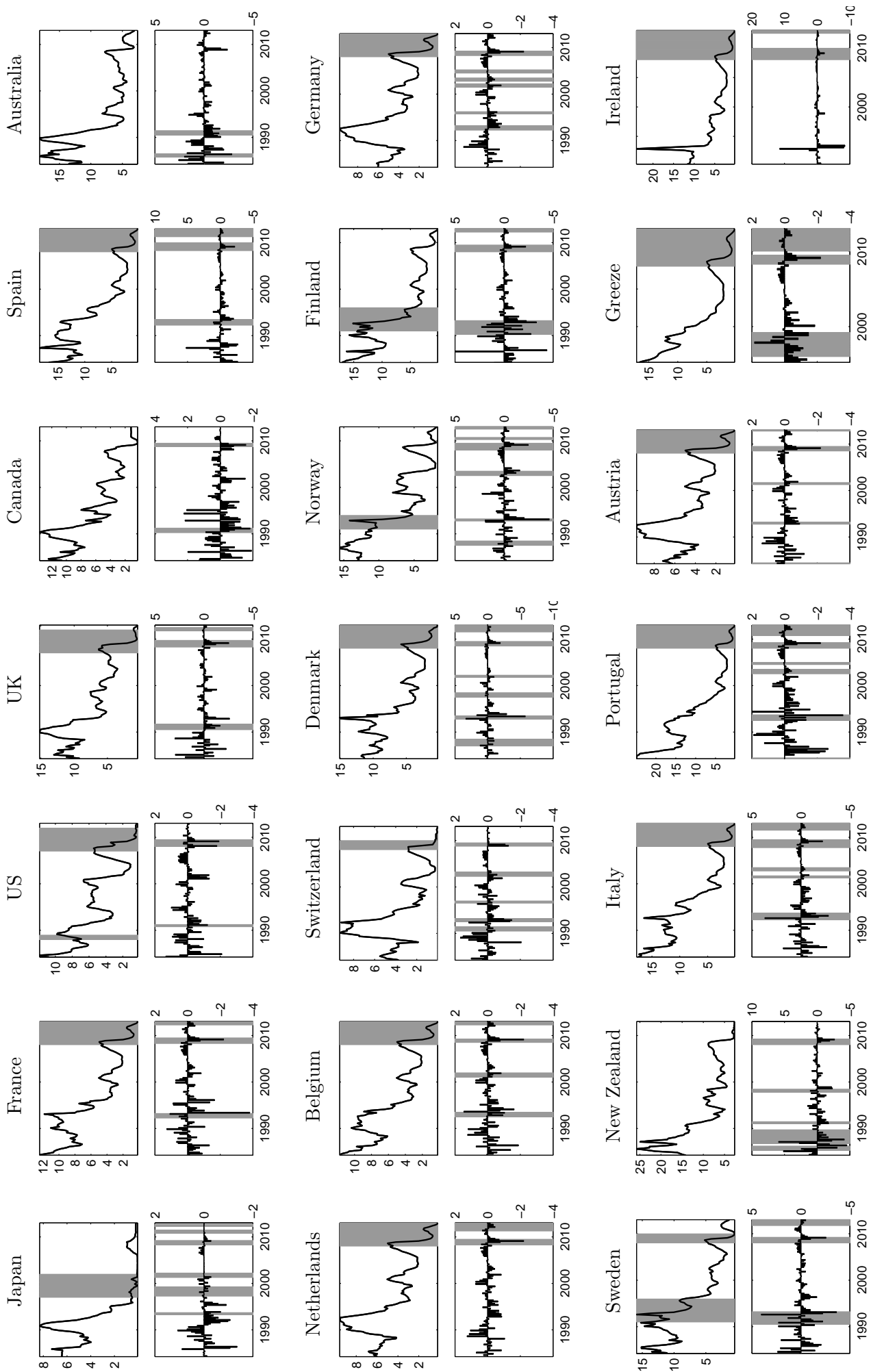


Figure 29: Interest Rate Data, Advanced Economies. Notes: the figures show in the upper part interest rates in levels and in the lower part percentage point changes in interest rates. In the upper part the shaded area show financial crises and in the lower part the shaded area show recessions.

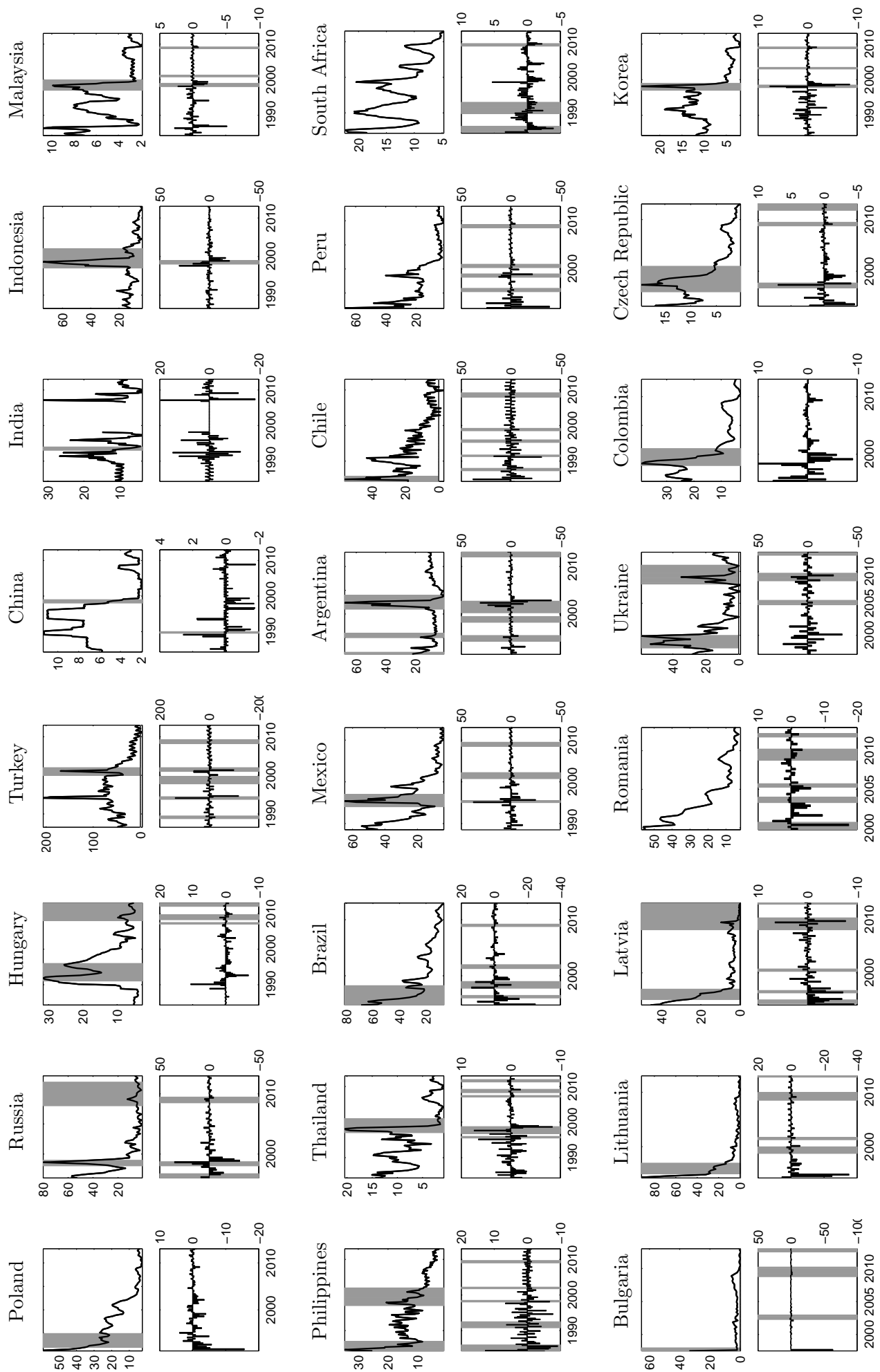


Figure 30: Interest Rate Data, Emerging Economies. Notes: the figures show in the upper part interest rates in levels and in the lower part percentage point changes in interest rates. In the upper part the shaded area show financial crises and in the lower part the shaded area show recessions.

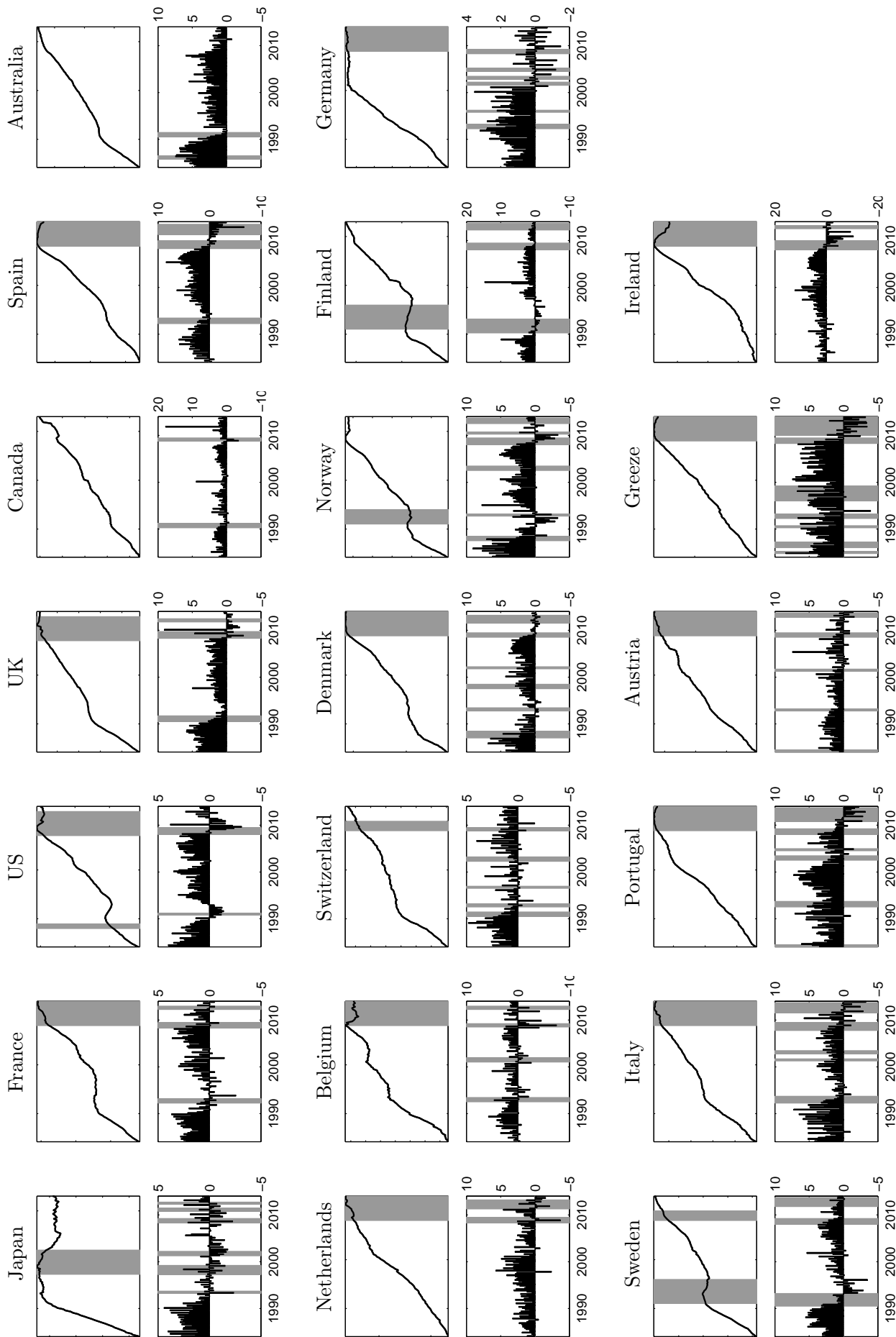


Figure 31: Credit Data, Advanced Economies. Notes: the figures show in the upper part credit in log-levels and in the lower part percentage changes in credit. In the upper part the shaded area show financial crises and in the lower part the shaded area show recessions.