THE EFFECT OF CREDIT RISK ON OUTPUT: EVIDENCE FROM FRANCE, GERMANY, ITALY AND SPAIN DATA

KREDİ RİSKİNİN ÜRETİME ETKİSİ: FRANSA, ALMANYA, İTALYA VE İSPANYA VERİLERİNDEN KANIT

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ABSTRACT

This paper analyzes the effect of credit risk on output for four significant countries within the Euro area; namely France, Germany, Italy and Spain. For this aim, bivariate VAR model is applied for a closer look at the effect of the credit risk on output and the classical VAR model is applied to put the credit risk in a country specific structure for the 1999:01-2015:08. The main conclusion is that the credit risk has immediate, strong and long-lasting negative impact on output for the aforementioned countries. Furthermore, the effect of the credit risk on output has the strongest for Italy, longest for Spain and smallest for France. Germany has relatively short but strong credit risk effect on its own output.

Keywords: Credit risk, Output, Monetary transmission mechanism, Euro area

JEL Classification: B53 · E32 · E50

ÖZ

Bu çalışma, kredi riskinin üretim üzerindeki etkisini Euro bölgesinin başta gelen dört ülkesi olan Fransa, Almanya, İtalya ve İspanya için analiz etmektedir. Bu amaçla, kredi riskinin üretim üzerindeki etkisine daha yakından bakmak için iki değişkenli VAR modeli ve kredi riskini ülkeye özgü bir yapıda değerlendirmek için klasik VAR modeli 1999:01-2015:08 dönemi için uygulanmıştır. Temel sonuç, dört Euro bölgesi ülkesi için de, kredi riskinin üretim üzerinde ani, güçlü ve uzun süre kalıcı bir negatif etkiye sahip olduğudur. Ayrıca, kredi riskinin üretim üzerindeki etkisi İtalya için en güçlü, İspanya için en uzun ve Fransa için en küçük etkiye sahiptir. Almanya, nispeten kısa fakat güçlü bir kredi riski etkisine sahiptir.

Anahtar Sözcükler: *Kredi riski, Üretim, Parasal aktarım mekanizması, Euro bölgesi,*

JEL Sınıflandırması: *B53 · E32 · E50*

1. Introduction

Most of the countries in euro area are still struggle with lower growth, high unemployment, weak loan growth, higher financial vulnerabilities and public debt despite of the European Central Bank's (ECB) very low political rates, even negative, and large scale unconventional monetary expansion[1] since the 2008 global financial crisis. In other words, monetary transmission mechanism has not worked well for the most of the countries in euro area. Thus, studies on transmission mechanism have focused on non-neoclassical channels, especially bank-based channels since banking sector provides strong link between savers and corporations.

The monetary transmission mechanism describes how changes in short-run political interest rates affect the real macro aggregates, such as output and employment. Jorgenson (1963) and Tobin (1969) explain the relationship between political interest rates and output with investment model, Modigliani and Brumberg (1954) and Friedman (1957) and Ando and Modigliani (1963) with life-cycle and permanent-income models of consumption, and Mundell (1963) and Fleming (1962) with international IS/LM-type models. Besides the neoclassical channels, three non-neoclassical channels suggest different explanations on how the monetary policy affects the economy without giving much emphasis on interest rates but market imperfections: effects on credit supply from government interventions in credit markets, bank lending and bank capital channels, and the balance-sheet channel (for more information, see Boivin et al., 2010).
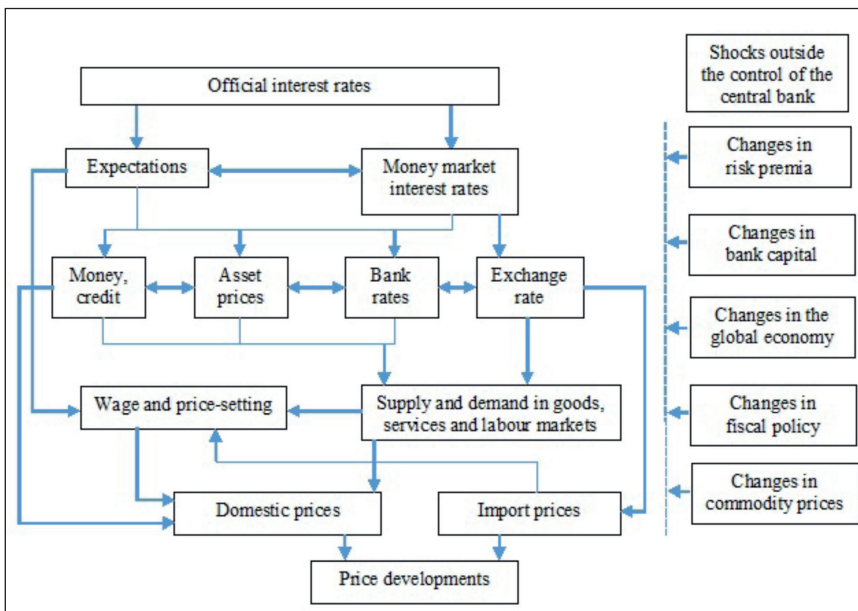
Graph 1. Monetary Transmission Mechanism

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1   The ECB deposit facility rate was 3.25 percent on October 15, 2008, and –0.20 percent as of September 10, 2014, in line with the traditional Keynesian recommendation of decreasing interest rates to support investment. Furthermore, the ECB's balance sheet was €1.5 trillion just before the 2008 global crisis and increased to around €3 trillion in 2012 through long-term refinancing and other monetary operations. Rodríguez and Carrasco (2014) present a chronological analysis of the ECB's monetary actions between 2007 and 2014.

The ECB illustrates the monetary transmission mechanism as in graph 1. Changes in key policy rates affect the money market interest rates and expectations. Bank lending and deposit rates follow the money market rates and, at the end, consumption, saving, and investment decisions changes. Here, the money market plays a vital role in the operation of the interest rate channel. Other important channels are the exchange rate and the asset price channels (see ECB 2010). The role of credit risk is mainly described as outside shocks from the central bank's control in terms of "changes in risk premia". However, it is hard to say that the role of credit risk is limited and exogenous when considering the literature on the effects of credit risk on output.

Credit risk is the possibility that a bank's borrower will fail to meet their obligations as outlined in an agreement. A successful credit risk management means the greatest return on investment at the lowest credit risk. Therefore each loan without repayment increases the non-performing loans, decreases bank's equity, and in the end, may result in a bank failure if the bank cannot pay off its liabilities. There is a growing literature on the effects of the credit risk on output, especially after the 2008 global financial crisis. Hoggarth et al. (2005) use the stress testing as credit risk indicator and find that both UK banks' total and corporate write-offs are significantly related to deviations of output from potential. Ciccarelli et al. (2010) study on the detailed answers from the US and Euro area bank lending surveys within a standard VAR model and find that the credit channel amplifies the impact of a monetary policy shock on GDP and credit supply restrictions to firms in the Euro area and tighter standards for mortgage loans in the US contributed significantly to the reduction in GDP during the crisis. Glen and Mondragón-Vélez (2011) find that loan loss provisions are determined mainly by real GDP growth, private sector leverage, and a lack of capitalization within the banking system for twenty-two advanced economies for the period 1996–2008. Gilchrist and Egon (2012) construct a credit spread index by using micro-level data, and find credit spread has considerable predictive power for future economic activity.

Gilchrist and Mojon (2014) construct new credit risk indicators for the euro area, Germany, France, Italy and Spain using average spreads on the yield of private-sector bonds relative to the yield on German federal-government securities of matched maturities. They find that credit spreads have strong predictive power for a variety of real activity and lending measures for the euro area as a whole and for individual countries. The results of the VAR analysis indicate that disruptions in corporate credit markets lead to sizable contractions in output across the euro area.

In this paper, I reinvestigate the effect of credit risk on output using the credit risk indicator build by Gilchrist and Mojon (2014) for France, Germany, Italy and Spain for the 1999:01-2015:08 period by employing bivariate and classical VAR models. The remainder of the paper is organized as follows. Section 2 presents the model and data; section 3 discusses the empirical results. The paper ends with some brief concluding remarks.

2. Model and Data

Vector autoregressive models (VARs) is used to understand the effect of credit risk on output. Firstly, *a bivariate VAR model* is conducted, where there are only two variables, y_{1t} and y_{2t} as industrial production and credit risk, respectively, each of whose current values depend on different combinations of the previous values of both variables, and error terms:

$$Y_t = A(L) Y_{t-1} + \varepsilon_t \qquad (1)$$

where Y_t is the vector of endogenous variables and ε_t is the residuals vector. It is assumed that residuals to be independent and identically normally distributed with mean equal to zero and covariance matrix $\sum$. The vector of endogenous variables contains only two variables; industrial production (y_t) and the credit risk cr_t:

$$Y_t' = \begin{bmatrix} y_t & cr_t \end{bmatrix} \qquad (2)$$

As a second step, Peersman and Smets (2001), Majon and Peersman (2001) and Cecioni and Neri (2011) models are followed with some modifications for specification a common VAR model for Germany, France, Spain and Italy. *The classical VAR model* has the following representation:

$$Y_t = A(L)Y_{t-1} + B(L)X_t + \varepsilon_t \qquad (3)$$

where Y_t is the vector of endogenous variables, X_t is the vector of exogenous foreign variables and ε_t is the residuals vector. It is assumed that residuals to be independent and identically normally distributed with mean equal to zero and covariance matrix $\sum$. The vector of endogenous variables contains industrial production y_t, the harmonized index of consumer prices p_t, the commodity price index cp_t, the credit risk cr_t and U.S./Euro foreign exchange rate x_t:

$$Y_t' = \begin{bmatrix} y_t & p_t & cp_t & cr_t & x_t \end{bmatrix} \qquad (4)$$

The US industrial production y_t^{US} is added to VAR model as exogenous variable to control for changes in world demand:

$$X_t' = \begin{bmatrix} y_t^{US} \end{bmatrix} \qquad (5)$$

The US industrial production influences the other variables of the model but there is no feedback from the endogenous variables to the exogenous variable, i.e. to the United States (US) industrial production. The using of the exogenous variable(s) also helps to solve the so-called price puzzle[2] in the model.

It is decomposed the variance-covariance matrix of the reduced form residuals $\sum$ using a standard Cholesky factorization in VAR models and the variables are ordered as in (4). It is assumed that the credit risk has no contemporaneous impact on output, prices, but may affect the exchange rate immediately. The Schwarz tests are determined the lag order as one for all the VAR models, except France for bivariate model, which is determined the lag order as two. The Portmanteau tests show that there is no significant serial correlation in the residuals. I allow for an implicit cointegrating relationship in the data since I do not provide an explicit long-run analysis in the paper, following the methodology used by Christiano, Eichenbaum and Evans (1999).

All the VARs are estimated with data in log levels, except for credit risk which is just in level and not seasonally adjusted. The monthly data refer to the period 1999:01-2015:08 with 200 observations[3]. Credit risk is taken from Gilchrist and Mojon (2014), who developed new credit risk indicators for France, Germany, Italy and Spain. The credit risk indicator is a spread and reflects

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2   See for more information, Sims (1992).
3   For a detailed definition and descriptive statistics of the data set, see Appendix A1.

that the difference between the yield of each country's nonfinancial corporations (NFC) bonds and the yield on German federal-government securities of matched maturities. Thus, the credit risk indicator -hereafter credit risk- signifies the difference between the borrowing rates of NFCs and the risk-free rate[4].

3. Results

Impulse response functions trace the effects of a shock of endogenous variable on to the other variables in the VAR. Figure 1 provides the impulse responses to a credit risk shock for France, Germany, Italy and Spain for the bivariate VAR model. *The bivariate VAR* evidence suggests that a positive credit risk shock has significant and persistent decreasing effect on output for all countries. The negative effect on output reaches its peak in 16 months for France, 19 months for Germany, 24 months for Italy and 30 months for Spain. The negative effect of one standard deviation shock of credit risk on industrial production[5] at the peak level is strongest in Italy (-1,49%) and Germany (-1,30%) and then Spain (-1,12%) and France (-1,08%).
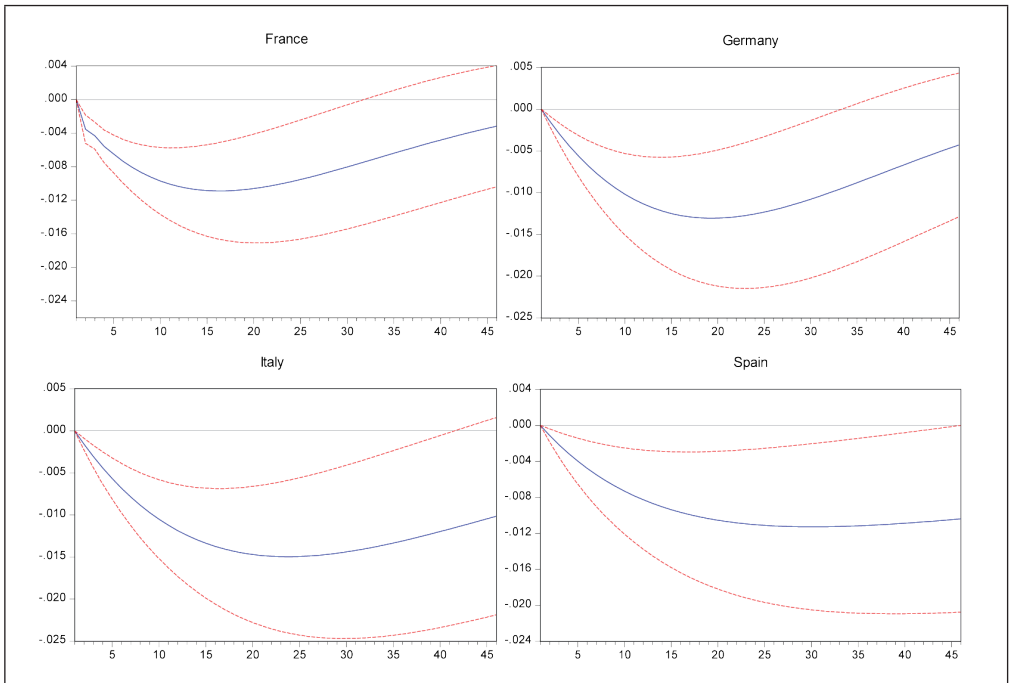

Figure 1. Responses of Output to One-Standard-Deviation Shock to the Credit Risk (Bivariate VAR)[6]

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4   For further information on measuring credit risk, see Gilchrist and Mojon (2014).
5   The size of one standard deviation shock of credit risk is different across countries, which creates difficulties to comparison of the countries; but this also implies that each individual country has its own credit risk shock.
6   Response to Cholesky one standart deviation innovations +/- 2 standart error.

The impulse response results of *the classical VAR* are presented in Figure 2[7]. In the classical VAR model, a positive credit risk shock is still significant and has large decreasing effect on output for four countries. The negative effect on output reaches its peak in 8 months for Germany, 10 months for France, 13 months for Italy and 14 months for Spain. The negative effect of one standard deviation shock of credit risk on industrial production at the peak level is strongest in Italy (-0,68%) and Spain (-0,65%) and then Germany (-0,56%) and France (-0,40%). In classical VAR model, reaching the peak level in terms of months is shorter and the effect of credit risk on industrial production is smaller in comparison with bivariate model as expected due to inclusion of other variables.

When considering the results of the impulse responses of bivariate and classical VAR models, it may conclude that the Italy and Spain are two most effected countries from the negative effect of credit risk on output. For classical VAR model, one standard deviation increase in credit risk has strong and immediate effect on German industrial production; it reaches peak level in 8 months and decreases industrial production by -0,56%. France is the least effected country from the negative effect of credit risk on output with reaching the peak level in 10 months by decreasing -0,40% in industrial production.
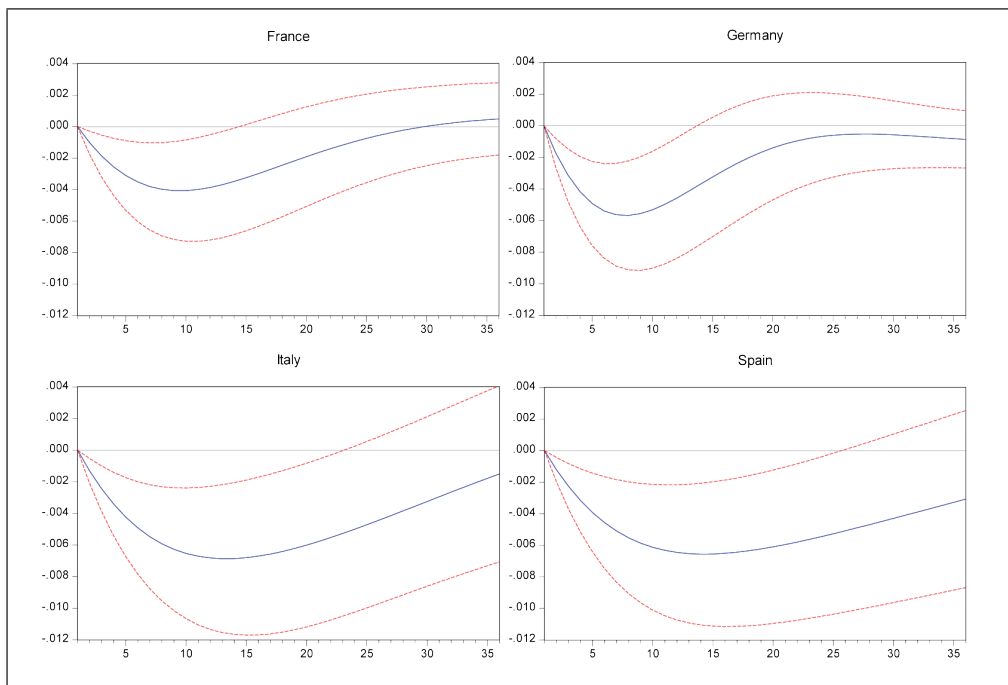

Figure 2. Responses of Output to a One-Standard-Deviation Shock to the Credit Risk (VAR)[8]

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7   For all impulse response graphs, see Appendix A2.
8   Response to Cholesky one standart deviation innovations +/- 2 standart error.

4. Conclusion

In this study, the effect of credit risk on output is analyzed for four Euro area countries, namely France, Germany, Italy and Spain. For this aim, a bivariate VAR model and a classical VAR model are constructed for four countries for the 1999:01-2015:08 period. I use the each country's NFC' average spreads on the yield of NFC bonds relative to the yield on German federal-government securities as credit risk indicator. The classical VAR model consists of five endogenous variable (industrial production, the harmonized index of consumer prices, the commodity price index, the credit risk and U.S./Euro foreign exchange rate) and an exogenous variable, US industrial production.

The main conclusion is that the credit risk has immediate, strong and long-lasting negative impact on output for four Euro area countries. The results of the impulse responses from bivariate and classical VAR models show us the credit risk has the strongest effect on output in Italy and longest effect in Spain. On the other hand, Germany has relatively short but strong credit risk effect on its own output. According to classical VAR model, while Italy and Spain are two most effected countries from the negative effect of credit risk on output, France is the least effected country.

The Euro area countries have the same monetary policy designing by ECB but different growth rates after the 2008 global financial crisis. The better understanding of the effect of credit risk on output may contribute to conduct more comprehensive and constructive monetary policy.

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Appendix A1: Data

Definitions of the Data Set

Industrial production: Production in industry - monthly data (2010 = 100), NACE_R2: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply, Seasonally adjusted and adjusted data by working days. Eurostat.

Harmonized index of consumer prices: HICP (2005 = 100) - monthly data (index), All-items HICP. Eurostat.

Commodity price index: Crude Oil Prices: Brent – Europe, Dollars per Barrel, Not Seasonally Adjusted, FRED Data.

U.S./Euro foreign exchange rate: U.S. Dollars to One Euro, Not Seasonally Adjusted, FRED Data.

US industrial production: Industrial Production Index, Seasonally Adjusted, Index 2012=100, FRED Data.

Credit risk: The average spreads on the yield of NFC bonds relative to the yield on German federal-government securities of matched maturities for each country's nonfinancial corporations (NFC).

Data Descriptions

	BRENT	IP_FR	IP_GR	IP_IT	IP_SP	IP_US	PRC_FR	PRC_GR	PRC_IT	PRC_SP
Mean	3,982	4,666	4,583	4,666	4,686	4,582	4,632	4,638	4,639	4,640
Median	4,108	4,695	4,581	4,720	4,744	4,570	4,637	4,641	4,644	4,665
Maximum	4,888	4,765	4,707	4,803	4,865	4,681	4,756	4,759	4,793	4,803
Minimum	2,329	4,533	4,420	4,502	4,485	4,468	4,477	4,503	4,448	4,401
Std. Dev.	0,619	0,062	0,086	0,100	0,118	0,051	0,086	0,080	0,105	0,125
Skewness	-0,405	-0,374	-0,086	-0,453	-0,336	0,074	-0,175	-0,016	-0,158	-0,346
Kurtosis	2,069	1,601	1,470	1,554	1,598	2,071	1,734	1,677	1,788	1,794
Jarque-Bera	12,68	20,97	19,74	24,27	20,14	7,37	14,37	14,58	13,07	16,11
Probability	0,001	0,000	0,000	0,000	0,000	0,025	0,000	0,000	0,001	0,000

Data Descriptions

	SPR_NFC_BUND_DE	SPR_NFC_BUND_FR	SPR_NFC_BUND_IT	SPR_NFC_BUND_SP	US_EU
Mean	1,137	1,259	1,729	1,776	1,220
Median	1,090	1,140	1,545	1,520	1,268
Maximum	3,510	4,090	5,520	6,040	1,575
Minimum	0,390	0,440	0,560	0,520	0,852
Std. Dev.	0,536	0,693	0,970	1,015	0,179
Skewness	1,621	1,557	1,364	1,218	-0,477
Kurtosis	6,972	6,293	4,828	4,499	2,351
Jarque-Bera	219,18	171,29	89,93	68,24	11,10
Probability	0,000	0,000	0,000	0,000	0,003

Notes: *BRENT: Oil Price, IP: Industrial Production, FR: France, GR: Germany, IT: Italy, SP: Spain, US: United States, PRC: Price, SPR_NFC_BUND: Credit risk indicator US_EU: U.S./Euro foreign exchange rate.*
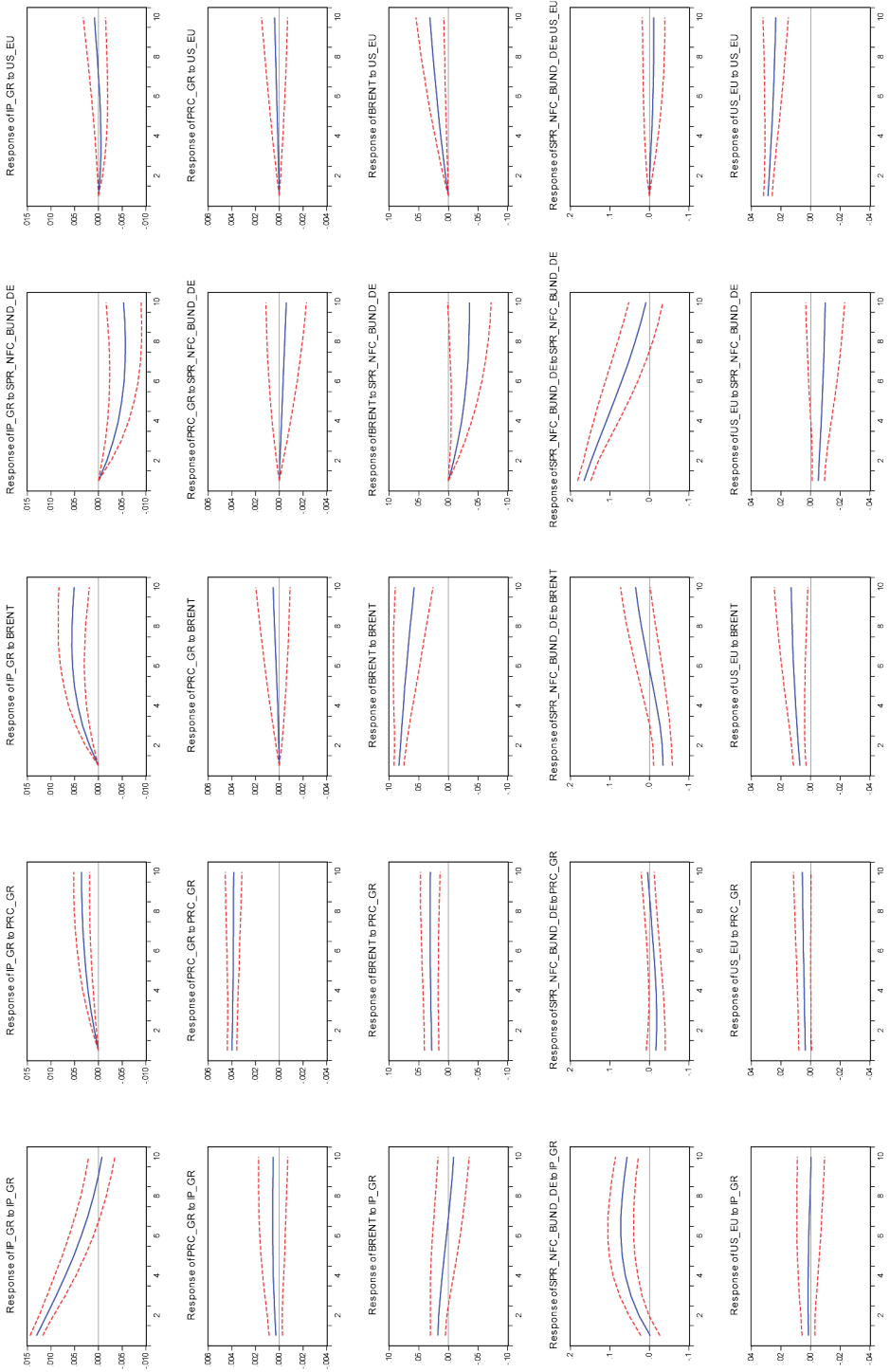
Appendix A2: Impulse Responses for the classical VAR models, France

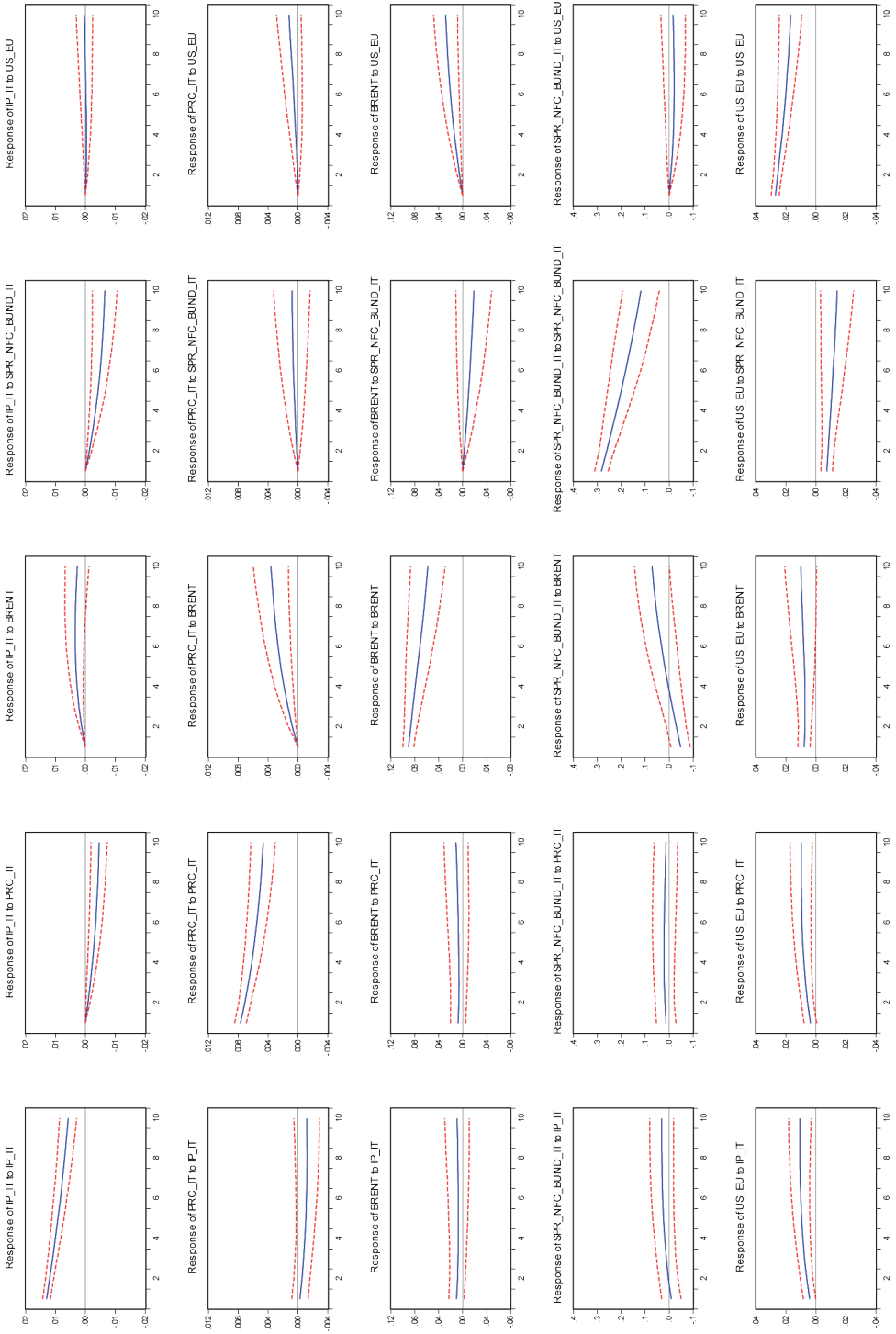Response to Cholesky One S.D. Innovations ± 2 S.E.
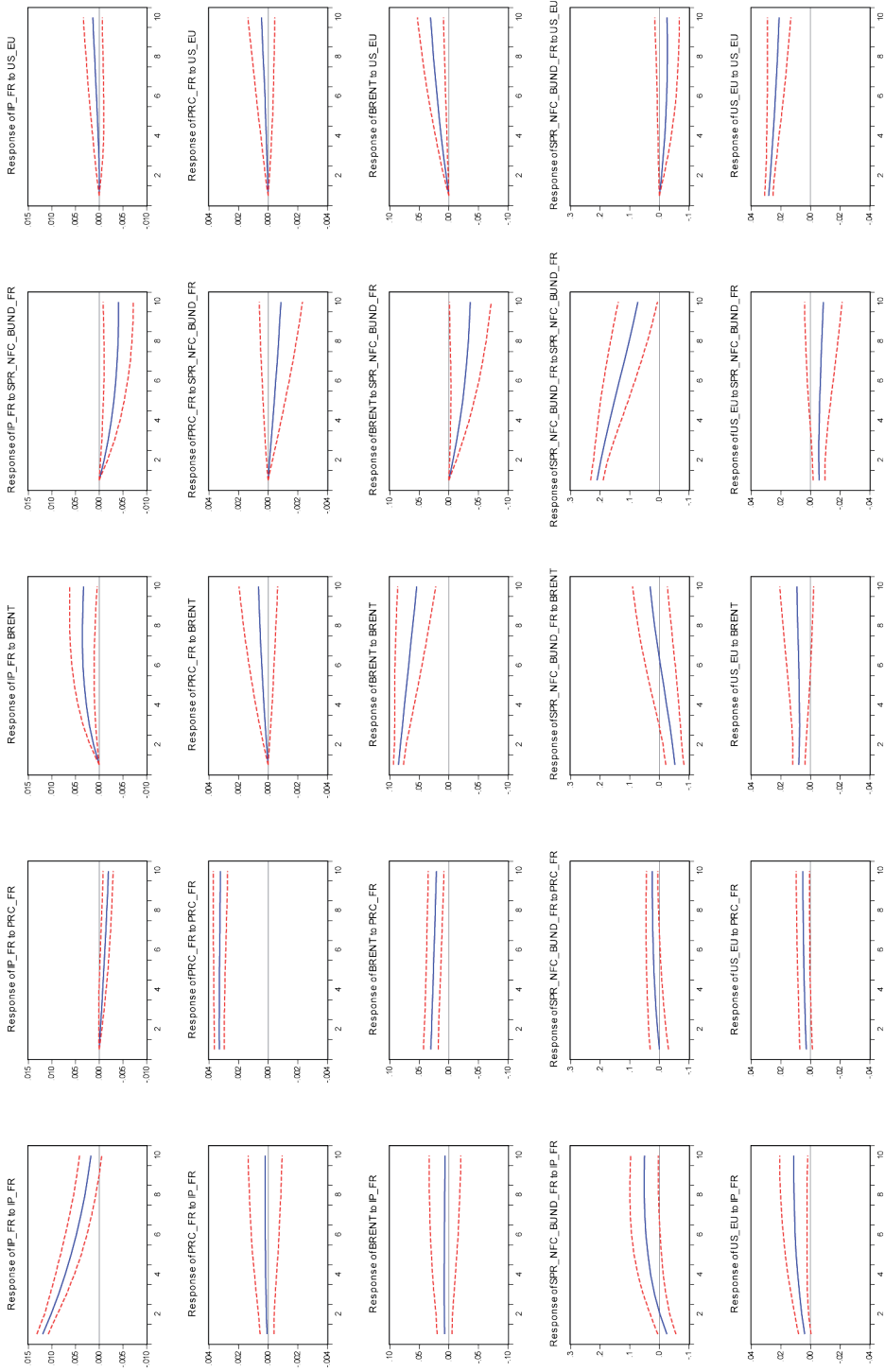
Appendix A2: Impulse Responses for the classical VAR models, Germany

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

Appendix A2: Impulse Responses for the classical VAR models, Italy

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

Appendix A2: Impulse Responses for the classical VAR models, Spain