

## ANALYSIS OF THE EFFECT OF THE EUROPEAN DEBT CRISIS ON THE SAUDI ARABIAN ECONOMY

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### ABSTRACT

This paper investigates the economic impact of the 2009 European debt crisis on Saudi Arabia's real economy from 2004 Q2 to 2014 Q2 using a structural vector autoregressive model (SVAR). The results of the impulse response functions obtained from the aggregated data show that the shock to European imports from Saudi Arabia had a significant impact on the real effective exchange rate, inflation rate, and economic growth that lasted for three periods. Moreover, the variance decomposition analysis shows that Europe's imports from Saudi Arabia explain approximately 20% of the variance of the Saudi real effective exchange rate and real economic growth, 10% of the interest rate variability, and only 5% of the inflation rate variance. The results of the individual country analysis show that the impact of shocks to imports from all European countries had an instantaneous impact, except for France and Spain, where the impact on the economic growth was significant in the second and sixth periods respectively. The results suggest that Saudi Arabian policymakers should continue the process of export diversification in order to reduce its dependence on this region.

**Keywords:** European Debt Crisis; Real Economy; Structural VAR; Saudi Arabia.  
**JEL Classification:** B17; C58; G01; G17.

## 1. Introduction

The European sovereign debt crisis of 2009 renewed the debate regarding the spillover effects and transmission of a financial crisis occurring in a single region on the economies of other regions (Gabor, 2014; Blecker, 2016; Bello and Rodgers, 2016). However, this debate appeared before the European financial crisis with the eruption of the Asian crisis in 1997 (Frankel and Schmukler, 1997; Baig and Goldfajn, 1999; Park and Song, 2001) and more recently with the subprime crisis that affected the American economy and subsequently extended to the global financial market (Longstaff, 2010; Celik, 2012; Kim *et al.*, 2015). Empirically, most previous studies related to this matter have relied on using financial data to explore whether the possible existence of contagion effects from the market caused crises in other markets. The econometric tools commonly used to investigate this issue analyse the dependence structure and spill-over effects among different stock markets.

In addition, financial crises over the last two decades have led experts to stress the importance of exploring the level of vulnerability countries have to exogenous shocks (Dooley and Hutchison, 2009). From existing empirical studies, it is clear that the degree of vulnerability caused by the eurozone crisis differed significantly both from country to country and from region to region (Mollah *et al.*, 2016; Dua, 2017; Ayton and Rao-Nicholson, 2018; Benlagha, 2020). In addition, countries were exposed in various ways. Some were very open to trade, others were not; some had large short-term

external debts or current account deficits, or both, others did not; some had large foreign currency debts, others did not (Blanchard *et al.*, 2010).

Most studies investigating the impact of the European crisis on real economies have focused on the traditional partnerships of Europe, including Africa (Bello and Rodgers, 2016), the US (Blecker, 2016), and Japan (Gabor, 2014). However, despite the growing economic relations between eurozone and Gulf Cooperation Council (GCC), no empirical studies assess the effects of the debt crisis on the latter. In particular, over the last two decades Saudi Arabia—as the strongest economy in the GCC area—has established strong trade partnerships with European countries. In 2017, six European countries (France, Italy, Belgium, the Netherlands, and Germany) made up 10% of the total exports of Saudi Arabia, and about 30% of their total imports were from six European countries (France, the UK, Germany, Italy, Spain, and the Netherlands).

In this paper, we contend that we should also consider further country-level study to extend our understanding of the effects of the sovereign debt crisis across the continent. To do so, we rely on European aggregated data as well as that from individual countries over the period from 2004 Q2 to 2014 Q2 to assess and analyse the economic impact of the European debt crisis on Saudi Arabia's real economy. This paper contributes to the current literature in two ways. The first contribution to the literature is that we analyse the impact of the Euro crisis not only by considering Europe one block but also by

examining country-level effects. The second contribution is that it explores new illustrations of the country-level effects of the European debt crisis. To the best of our knowledge, no empirical study has been conducted on the effects of the Eurozone debt crisis on the Saudi Arabian economy.

Empirically, we investigate our research question by using the AB-SVAR framework. The methodology is comprised of two stages. Both stages involve the use of response impulse functions and variance decomposition analysis to assess the impact of the structural one standard deviation shock on Saudi Arabian exports on the main macroeconomic indicators of the country. However, while the analysis is conducted in the first step using aggregated data for all European countries, the analysis in the second step uses Saudi Arabia's four biggest European trade partners. The impulse response functions (IRFs) analysis in the first part is completed by an analysis of the accumulated IRFs.

The following results are found. First, the impulse response functions for the Europe aggregated data show that a shock to Europe's imports from Saudi Arabia has a significant impact on its real effective exchange rate, inflation rate, and economic growth that lasts for three periods. Second, the results of the variance decomposition analysis show that Europe's imports from Saudi Arabia significantly contribute to explaining the variance decomposition of the real effective exchange rate and the real economic growth of Saudi Arabia. However, the contribution of the European imports is

moderate for the interest rate variance and very low for the inflation rate variance.

The rest of the paper is organised as follows. Section 2 reviews the existing literature. Section 3 introduces the data and the empirical methodology. Section 4 presents and discusses the results. Finally, the empirical results are brought to a conclusion in section five.

## 2. Literature review

### 2.1. Transmission channels

A large base of theoretical literature on financial crises places cross-country channels at the centre stage of explaining spill-over and contagion effects (Forbes and Chinn, 2004; Brutti and Sauré, 2016; Efthymios *et al.*, 2016; Ghulam and Doering, 2018; Kim and Lee, 2019). In the empirical literature investigating the transmission mechanisms of economic crises, two important propagation channels have been identified. First, countries that are highly integrated with global markets tend to register larger losses to their outputs during periods of crisis (see Fratzscher, 2002 and Cetorelli and Goldberg, 2011). Second, trade relationships including both bilateral and third party market competition are considered the basic channel of crisis transmission due to the probability of the loss of international competitiveness and income effects (see, for instance, Glick *et al.*, 1999; Forbes and Chinn, 2004).

Macroeconomic data is most commonly used to empirically assess these transmission channels (Goldstein and Xie, 2009; Berkmen *et al.*, 2012; Dungey *et al.*, 2018). For

instance, Goldstein and Xie (2009) analyse how the global financial crisis affected emerging Asian countries. In particular, they explore and debate the reaction patterns of the propagation of the crisis in the emerging Asian economy. They identified foreign trade and currency as the main channels of transmission. Berkmen and colleagues (2012) explore the determinants of growth performance by estimating cross-country regressions pre- and post-2009 financial crisis. Their results indicate that most variation in economic growth is due to a very limited number of factors. They suggest that countries suffering more than others from a financial crisis are those with higher credit development and leveraged domestic financial systems.

Dungey and colleagues (2018) use an extension of the SVAR model to investigate the impact of direct and indirect shocks on the variation in trade behaviour of a set of ASEAN-4 and NIE-4 countries. The identification mechanism shows the international transmission channel of a particular crisis changes considerably from period to period.

Other studies use microeconomic data to mutually assess both the financial and trade transmission channels (Chava and Purnanandam, 2011; Shikimi and Yamada, 2019). Chava and Purnanandam (2011) use the assets of accounting and return data from 304 firms and assess the impact of the 1998 Russian crisis on the US banking system. Their findings suggest that the transmission of financial shock is mostly due to the high integration of the financial sector and that the banking system is the main channel of this

propagation of the considered exogenous shock.

In addition, recent stylised facts show that the transmission mechanism differs considerably across country groups (Chava and Purnanandam, 2011; Sbracia and Zaghini, 2013; Caporin *et al.*, 2013; Neaime *et al.*, 2018; Anastasopoulos, 2018). For instance, for emerging markets, the financial channel surpasses the trade channel (see Verick, 2011). However, for most developing economies, the trade channel appears to be the main transmission channel of crisis.

## 2.2. European debt crisis

The European debt crisis that began in September 2009 and continued until July 2012 has been characterised by the banking system of Iceland; it extended after that to other European countries, namely Italy, Spain, Portugal, Greece, and Ireland. This European crisis led to growing uncertainty in European economies (Claeys and Vasicek, 2012; Bekaert *et al.*, 2014). Consequently, its transmission effects on other developed countries and emerging markets became a motivating subject for scholars and researchers. (Constancio, 2012; Stracca, 2015; Aizenman *et al.*, 2016).

Aizenman and colleagues (2016) used event study methodology to investigate the financial contagion of the European debt crisis to a set of developing economies, assessing the effects of stock and bond markets on the eurozone crisis. They find that the effect of the crisis on returns in the investigated asset markets was mixed and limited. Stracca (2015) evaluates the effect of the European crisis globally. The main

finding of that study is the absence of significant global repercussions of the European debt crisis on the global financial market.

Recently, Kollmann and colleagues (2016) applied the New Keynesian DSGE model to three regions (European area, the US, and the rest of world) to assess the factors contributing to the divergent European area and US adjustment paths. Their findings show that the 2008–2009 recession was mostly associated with financial stocks for the European area and the US.

In summary, although many efforts have been devoted to examining the impact of the European crisis on financial markets, little attention has been paid to the impacts and transmission effects of the crisis on the real economy of emerging or developed countries. To fill this gap in the empirical literature, we use the SVAR framework, applying it to a set of macroeconomic variables to analyse the transmission of the European sovereign debt crisis to the Saudi economy. Moreover, despite the growing economic and financial integration between European and GCC countries—and Saudi

Arabia in particular—none of the aforementioned studies focuses on the propagation of the Eurozone crisis to Saudi Arabia's financial and economic markets.

### 3. Empirical methodology

#### 3.1. Data description

The data set employed in this study to investigate the economic impact of the European debt crisis on the Saudi Arabian real economy includes five macroeconomic variables. The list of variables includes the real effective exchange rate, the inflation rate, the interest rate, the economic growth of Saudi Arabia, and Saudi Arabian export data, comprised of exports to each European country and the aggregated exports to all European countries. The data for the macroeconomic variables covers the period from the second quarter of 2004 to the beginning of the third quarter of 2014 ( $T = 42$  observations).

The list of variables and their sources are reported in Table 1 below.

Table 1: Variables descriptions

Variable	Definition	Symbol	Source
Real GDP growth	It is the first difference of the logarithm of the gross domestic product measured in constant U.S dollar 2010.	DLRGDP	IMF and SAMA <sup>1</sup>
Inflation rate	Is the first difference of the logarithm of consumer price index?	INF	IMF and SAMA
Interest rate	Real interest rate	INT	IMF and SAMA

<sup>1</sup> Saudi Arabian monetary authority.

Real effective exchange rate	The real effective exchange rate	DLREER	IMF and SAMA
Imports	It represent the imports of the European countries from the Saudi Arabia (constant US dollar 2010)	DLIMP	IMF and SAMA

In Table 2, exports and imports into Saudi Arabia to/from its main European partners are reported. The table shows that the primary partner of Saudi Arabia among the considered European countries, in terms of exports is Italy followed by Spain and France. In contrast, the main partner of Saudi Arabia in terms of import operations is Germany followed by Italy and France. However, the least partner in terms of imports is Spain. By focusing on the crisis period, Panel 1 of the table shows that the export shares of Saudi Arabia declined in 2009 only for Spain. While in 2010 the

exports shares declined for France and Germany. In terms of exports volumes, there is a significant decline for the exports of Saudi Arabia to Spain and Italy in 2009 and a decline of exports for Germany and France in 2010.

Regarding the imports reported in Panel 2 of the Table 2, the shares of imports of Saudi Arabia have significantly decreased in 2010 for all the countries under study. This preliminary analysis motivates the empirical investigation of the impact of the European crisis on the Saudi Arabia imports exports along with other economic variables.

Table 2: Saudi Arabia Export and Imports share

Period	France		Germany		Italy		Spain		World
<b>Panel 1. Exports</b>									
	Amount	%	Amount	%	Amount	%	Amount	%	Total
2006	256,151.96	0.12	104,766.47	0.05	400,961.47	0.19	365,680.79	0.17	210,823,971.73
2007	269,730.93	0.12	141,375.15	0.06	468,838.06	0.20	269,730.93	0.12	232,855,982.64
2008	267,643.80	0.09	209,260.53	0.07	466,762.98	0.15	331,095.61	0.11	312,999,364.05
<b>2009</b>	<b>282,628.49</b>	<b>0.15</b>	<b>219,692.37</b>	<b>0.11</b>	<b>365,012.86</b>	<b>0.19</b>	<b>181,158.84</b>	<b>0.09</b>	<b>107,360,155.95</b>
<b>2010</b>	<b>210,960.80</b>	<b>0.08</b>	<b>200,906.38</b>	<b>0.08</b>	<b>628,256.79</b>	<b>0.25</b>	<b>356,167.65</b>	<b>0.14</b>	<b>250,577,015.62</b>
2011	190,612.77	0.05	323,583.87	0.09	971,514.01	0.27	410,903.71	0.11	364,139,418.64
2012	283,119.29	0.07	235,478.49	0.06	932,768.90	0.24	439,069.62	0.11	387,373,982.62
2013	228,441.35	0.06	288,992.36	0.08	790,735.39	0.21	554,409.75	0.15	375,360,918.00
2014	244,005.37	0.07	225,278.05	0.07	890,703.96	0.26	1,003,958.51	0.29	341,947,182.54
<b>Panel 2. Imports</b>									
2006	2,553,424.53	3.77	5,559,007.91	8.21	2,729,997.49	4.03	722,461.17	1.07	67,681,047.98
2007	2,937,017.05	3.34	7,898,529.96	8.99	4,017,564.85	4.57	1,136,209.26	1.29	87,816,600.60
2008	3,800,389.02	3.38	8,432,226.81	7.51	4,527,440.86	4.03	1,300,739.23	1.16	112,273,148.08
<b>2009</b>	<b>3,379,186.86</b>	<b>3.65</b>	<b>7,527,493.65</b>	<b>8.14</b>	<b>3,450,124.37</b>	<b>3.73</b>	<b>1,175,566.03</b>	<b>1.27</b>	<b>92,457,155.43</b>
<b>2010</b>	<b>3,590,823.15</b>	<b>3.47</b>	<b>8,169,999.81</b>	<b>7.88</b>	<b>3,294,012.92</b>	<b>3.18</b>	<b>1,206,097.77</b>	<b>1.16</b>	<b>103,621,530.06</b>
2011	3,888,022.46	3.04	8,948,546.92	6.99	4,525,365.66	3.54	1,423,747.65	1.11	127,962,726.62
2012	4,448,059.96	3.61	10,914,030.44	7.22	4,520,349.12	2.99	1,805,800.12	1.19	151,260,012.54
2013	4,629,511.65	2.84	11,801,955.29	7.24	5,288,103.41	3.24	2,024,651.33	1.24	163,013,498.70
2014	4,496,243.60	2.67	12,416,571.62	7.38	5,728,654.71	3.58	2,185,420.57	1.30	168,239,638.20

**Notes:** US \$ Thousands. Data are collected from the World Integrated Trade Solution database.

### 3.2.AB- SVAR model

The econometric approach proposed in this study to examine the impact of the European debt crisis on the Saudi Arabian economy is the impulse response functions (IRFs) and the forecast error variance decomposition (FEVD) techniques obtained from the estimation of a structural vector autoregressive (SVAR) model. An important issue that arise when using the SVAR model is related to the identification of the orthogonal innovations (see Amisano and Giannini, 1997; Breitung *et al.*, 2004; and Kilian, 2009). In other words, what are the economic restrictions that should be imposed on the error terms to identify the orthogonal innovations?

In this analysis, we use the  $A - B - SVAR$  model which consists of estimating the SVAR model in two steps. First, a reduced form of the VAR model will be estimated, then in a second step the structural  $A - B - SVAR$  model will be estimated after imposing the short-run economic restrictions.

#### 3.2.1 The $A - B - SVAR$ model

The reduced form of the  $AB - SVAR$  model of Amisano and Giannini (1997) is given by,

$$A Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + B u_t \quad (1)$$

Where,  $Y_t$  is an  $(n \times 1)$  vector which includes all the variables of the model,  $Y_t = [DLIMPE_t, DLREER_t, INF_t, INT_t, DLRGDP_t]$  The optimal lag  $p$  is of the estimated VAR

model, which is determined based on the information criteria.  $A_i$  for  $i = 1, \dots, p$  is a  $(5 \times 5)$  matrix. The two matrices  $A$  and  $B$  are of particular interest in our context since all the economic restrictions will be imposed in these two matrices.  $u_t$  is the vector of the structural shocks, denoted by,  $u_t = [u_t^{RIMP}, u_t^{REER}, u_t^{INF}, u_t^{INT}, u_t^{RGDP}]$  which is assumed to be uncorrelated with mean zero,  $E(u_t) = 0$  and  $E(u_t u_t') = I_n$ .

The reduced form of model (1) is obtained by multiplying both sides of Eq. 1 by the inverse of the matrix,  $A^{-1}$ ,

$$Y_t = A_1^* Y_{t-1} + A_2^* Y_{t-2} + \dots + A_p^* Y_{t-p} + \varepsilon_t \quad (2)$$

Where,  $A_i^* = A^{-1} A_i$  for  $i = 1, \dots, p$ , and  $\varepsilon_t = A^{-1} B u_t$ . The innovations of the reduced form representation,  $(\varepsilon_t)$ , assumed to be a white noise but can be possibly correlated with each other due to contemporaneous effect are related to the structural shocks  $(u_t)$  by,

$$A \varepsilon_t = B u_t \quad (3)$$

#### 3.2.2 Identification and short-run restrictions

Imposing the short-run economic restrictions on the contemporaneous' relationship between variables is the most important feature behind the development of the SVAR model. In contrast to the recursive Cholesky orthogonalization approach where the variables are ordered based on their degree of

exogeneity, the identification of the SVAR model is made based on restrictions that are derived from the economic theory (Charfeddine and Barkat, 2020).

In equation (4) below, the coefficients to be estimated are denoted by ‘NA’.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ NA & 1 & 0 & 0 & 0 \\ NA & NA & 1 & 0 & 0 \\ NA & NA & NA & 1 & 0 \\ NA & NA & NA & NA & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{RIMP} \\ \varepsilon_t^{REER} \\ \varepsilon_t^{INF} \\ \varepsilon_t^{INT} \\ \varepsilon_t^{RGDP} \end{bmatrix} = \begin{bmatrix} NA & 0 & 0 & 0 & 0 \\ 0 & NA & 0 & 0 & 0 \\ 0 & 0 & NA & 0 & 0 \\ 0 & 0 & 0 & NA & 0 \\ 0 & 0 & 0 & 0 & NA \end{bmatrix} \begin{bmatrix} u_t^{RIMP} \\ u_t^{REER} \\ u_t^{INF} \\ u_t^{INT} \\ u_t^{RGDP} \end{bmatrix} \quad (4)$$

The economic restrictions imposed on the first contemporary relationship, given by the first row of Eq. 4, suggest that the imports of the European countries (as group or individually) instantaneously affect the real exchange rate, inflation rate, interest rate, and economic growth of the Saudi Arabian macroeconomic variables, but the same is not true of the inverse. These assumptions are based on the fact that the European economy is very large compared to the Saudi economy. For instance, an increase in European imports from Saudi Arabia will positively affect global demand, which in turns will affect all the considered variables—real exchange rate, inflation rate, interest rate and economic growth. The second contemporary relationship, illustrated by the second row of Eq. 4, assumes that the real effective exchange rate is affected only by the variable level of import, not vice versa. The

restrictions in row two assume that exchange rate has a contemporary influence on the other three macroeconomic variables (inflation rate, interest rate, and economic growth). This later restriction is intuitive, given that the real exchange rate is a key element in almost all economic theoretical models, such as the Balassa–Samuelson effect, the Mundell–Fleming model, and so on. Row three of Eq. 4 indicates that inflation is assumed to be contemporaneously affected by both the European imports and the real effective exchange rate, but not vice versa. It also demonstrates that the inflation rate has a contemporary impact on the interest rate and economic growth. Economically, these assumptions can be explained by the Fisher effect theory and empirical evidence supporting the negative relationship between inflation rate and economic growth (Fischer, 1981; Fischer, 1982). Row four of Eq. 4 reports the interest rate equation, which assumes that this variable is affected contemporaneously by European imports growth, the real effective exchange rate, and the inflation rate, but not vice versa. This fourth equation assumes that the interest rate temporarily affects economic growth, which can be explained by several economic theories, including investment theory, where interest rate is the main determinant. The last row of Eq. 4 corresponds to the economic growth equation, which assumes that Saudi Arabian economic growth is mostly endogenous—it is affected by all the variables, and it does not immediately affect all the others.

Finally, as a final refinement to our model estimation, in the estimated AB-SVAR

model all the non-significant coefficients will be restricted to zero. The validity of the constraints of the over-identification situation will be examined via a likelihood ratio test.

It is commonly known that matrix  $B$  is not necessarily the identity matrix (see Amisano and Giannini, 1997; Kilian, 2009). By not assuming that  $B = I$ , we allow for more flexibility in the SVAR model.

#### 4. Results analysis and discussion

##### 4.1. Preliminary analysis

Table 3 provides summary statistics for the main macroeconomic variables used in assessing the effect of the European sovereign debt crisis on Saudi Arabia's economy. In addition to the five summary statistics, the table includes the Jarque–Bera test statistic for the inflation and the interest rate of Saudi Arabia in levels and for the first difference of the logarithm (growth rate) of its imports and real GDP. The average inflation rate in Saudi Arabia is about 0.967 points, reaching a maximum of 3.21 in the first quarter of 2008. The real GDP reached a

peak in the second quarter of 2015 and a minimum in the first quarter of 2009. The summary statistics show that Spain had the highest import growth rate, whereas Italy had the lowest. The imports of the European countries reached a peak in the first quarter 2011, and the lowest import operations were observed in the first quarter of 2009. In terms of the variability of imports, Saudi import operations to France were the highest among the studied countries. The most stable import volume is for Germany. Regarding the skewness, the results reported in Table 1 fail to identify specific patterns for the different series. Some series are negatively skewed (real GDP, imports to Europe, imports to France, and imports to Germany). The remaining series are positively skewed. In addition, the results show that all the country-level import series have kurtosis close to three, indicating the absence of fat-tailed distribution. All the variability measures, in addition to the Jarque–Bera test statistic, indicate that the null hypothesis of normality is rejected for all the Saudi macroeconomic series. However, we fail to reject the normality assumption for all the import series.

Table 3. Descriptive statistics of the macroeconomic variables

	RGDP	REER	IMPE	IMPFRA	IMPGER	IMPITA	IMPSPAIN	INF	INT
Mean	0.335	-0.078	2.378	1.412	1.747	1.277	2.919	0.965	3.080
Median	2.065	-0.555	3.321	3.595	1.442	-1.978	2.798	0.748	2.000
Maximum	5.668	8.940	22.583	52.417	22.109	43.935	33.747	3.210	5.500
Minimum	-9.334	-3.684	-28.291	-53.850	-29.013	-29.136	-29.950	-0.606	1.500
Std. Dev.	4.328	2.230	10.221	25.853	11.517	19.405	13.916	0.809	1.512
Skewness	-1.026	1.479	-0.845	-0.462	-0.154	0.530	0.005	0.738	0.763
Kurtosis	2.612	7.653	4.421	2.830	2.961	2.284	2.844	3.336	1.738
J-B	7.445 (0.024)	51.932 (0.000)	8.335 (0.015)	1.506 (0.471)	0.165 (0.921)	2.793 (0.247)	0.041 (0.979)	4.012 (0.135)	6.859 (0.032)

**Notes:** All variables are in log differences except for the inflation and the interest rate. J-B refers to the Jarque-Bera test of normality.

Table 4 reports the results of the unit root tests (ADF, PP, and KPSS). These tests fail to reject the hypothesis of stationarity for all

the Saudi and European macroeconomic series. This result means that the log first differencing is sufficient to determine all the series' stationarity, except for the inflation and interest rates series, which are stationary in level.

Table 4. ADF, PP, and KPSS unit root tests

	LEVELS			FIRST DIFFERENCES		
	ADF	PP	KPSS	ADF	PP	KPSS
RGDP	-1.548	-1.827	0.583**	-7.563***	-7.892***	0.082
REER	-2.474	-2.555	0.554**	-5.421***	-3.768***	0.392
IMPE	-1.273	-1.243	0.689**	-6.152***	-6.141***	0.070
IMPFRA	-2.559	-2.583	0.476**	-6.802***	-9.136***	0.289
IMPGER	-1.881	-1.697	0.699**	-6.376***	-12.046***	0.125
IMPITA	-2.297	-2.171	0.533**	-9.388***	-9.410***	0.293
IMPSPAIN	-1.275	-1.079	0.743***	-8.141***	-8.606***	0.085
INF	-3.358**	-3.368**	0.189	-	-	-
INT	-1.250	-1.537	0.400	-	-	-

Notes: \*, \*\* and \*\*\* indicate the rejection of the null hypothesis at the 10%, 5% and 1% respectively.

The null hypothesis is non-stationarity for the ADF and PP tests and stationarity for the KPSS test.

Table 5 shows the pairwise correlation coefficients between the Saudi macroeconomic variables and the European aggregated import volumes, as well as those of individual countries. The table shows that only the correlation between Italy's imports from Saudi Arabia and the real GDP of the UK are significant, at 10% significance levels. The correlation between imports and all the rest of the Saudi macroeconomic variables is very weak, except for the real effective exchange rate. The real effective exchange rate seems to be negatively related

to the import volumes of all the studied countries and the aggregated level.

Table 5. Pairwise correlations

	IMPEU	IMPFRA	IMPGER	IMPITA	IMPSPAIN
RGDP	0.366*	0.105	0.013	0.478**	0.153
INF	0.050	0.102	0.181	0.037	-0.003
INT	0.015	-0.112	0.089	0.159	0.121
REER	-0.389*	-0.263*	-0.102	-0.323*	-0.260

Notes: \*, \*\* and \*\*\* indicate the rejection of the null hypothesis at the 10%, 5% and 1% respectively.

#### 4.2. SVAR results analysis

##### 4.2.1. Results for the aggregated European countries

The IRFs are important and extremely helpful tools to use when assessing the

impact of a one-time shock (to the innovations) on the endogenous variables of the model (real effective exchange rate, inflation rate, interest rate, real economic growth). The results of the impulse responses of the four main macroeconomic variables of the Saudi Arabian economy are reported in Figure 1, along with confidence bands (red dotted lines) at 95% confidence levels. These impulse responses are represented by the

middle lines in the figures (a, b, c, and d). It is important to remember that when the horizontal line falls into the confidence interval, then the null hypothesis—that shocks to the imports of the European countries from Saudi Arabia have no significant impact on the Saudi macroeconomic variable—cannot be rejected.

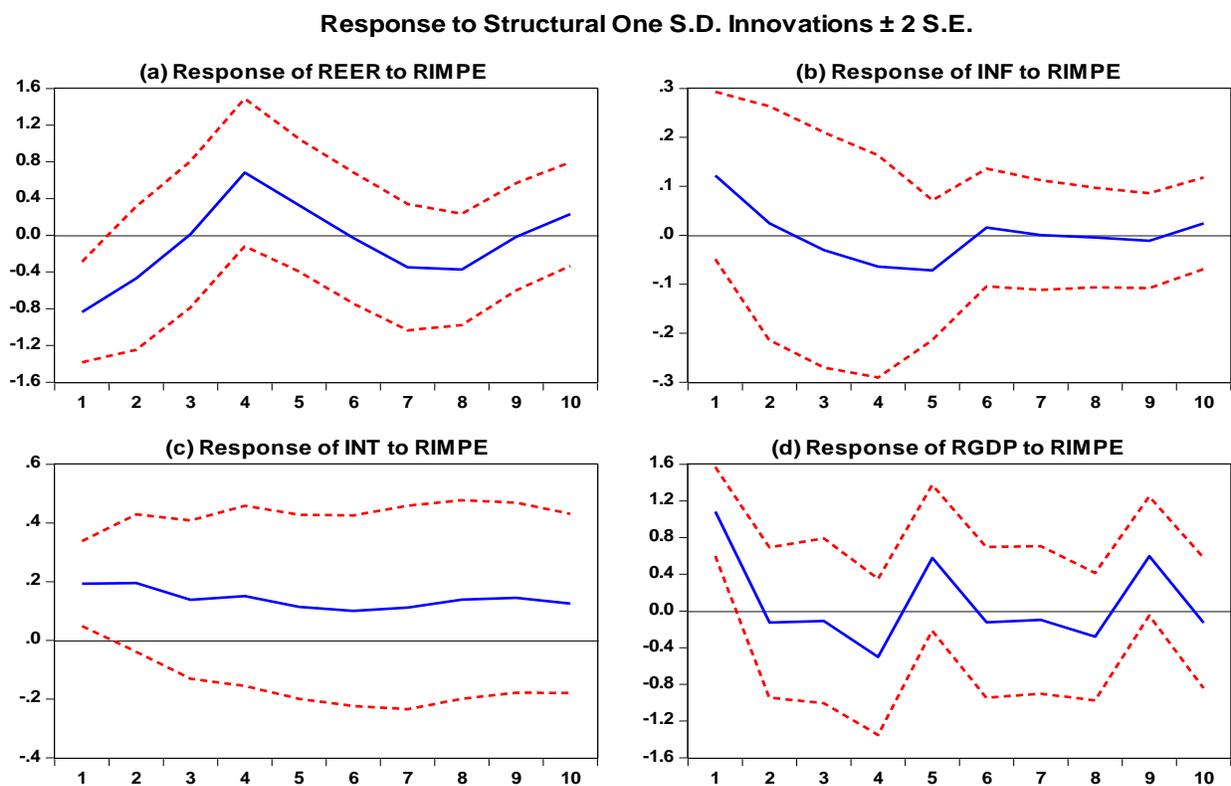


Figure 1: IRF of the Saudi Arabian real effective exchange rate, inflation rate, interest rate, and real GDP growth to structural one standard deviation shock on the European real imports growth.

Figures 1a through 1d report the IRFs for structural one standard deviation innovations to the European countries' real imports for the real effective exchange rate, inflation rate, interest rate, and real economic growth of Saudi Arabia respectively. The results of the IRFs show that the responses of the real

effective exchange rate, interest rate, and real economic growth are significant and instantaneous. These results are expected, given that from an economic point of view the imports of a country stimulate its global demand and its economic activity, resulting in a positive impact on the real GDP. The

results show also that the duration of the impact is not very long since the impact of the shock dies after approximately one period to one period and half (one semester to one semester and half). This positive impact on economic growth can create new opportunities for investments, which in turn increase the interest rate in the country. The results show the absence of any significant impact on the inflation rate during the twelve periods under analysis.

For a better understanding of the impact of a structural one standard deviation shock on the real imports of these European countries, we report the results of the accumulated impact in Table 6. The results shows that, for the three significant variables in the case of IRFs, the impact of one-time shocks on the real imports of the European countries lasts for three quarters (from Q1 to Q3) and die completely after that for the interest rate variable. The response becomes significant again for the real effective exchange rate in periods 6 and 8, as well as at period 10 for the real economic growth. This result is particularly interesting for Saudi Arabian policymakers tasked with designing strategies to fully benefit from the increase in exports to European countries.

Table 6: Accumulated Response to Structural One Standard Innovation on the real imports growth

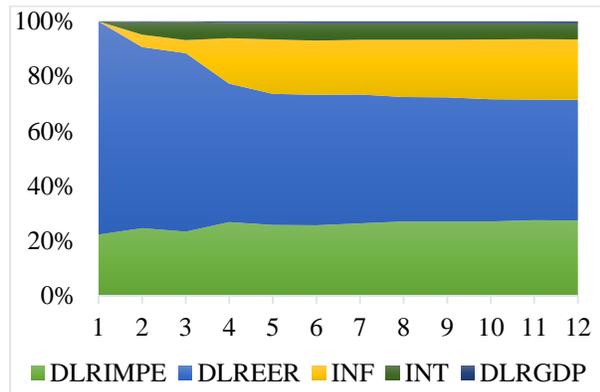
	REER	INF	INT	RGDP
1	-0.837***	0.122	0.193***	1.084**
2	-1.304***	0.147	0.388**	0.958**
3	-1.293**	0.116	0.526*	0.849*
4	-0.610	0.053	0.677	0.346

6	-0.314*	-0.003	0.891	0.801
8	-1.034*	-0.008	1.142	0.422
10	-0.820	0.006	1.412	0.892**
12	-0.587	-0.033	1.583	0.354

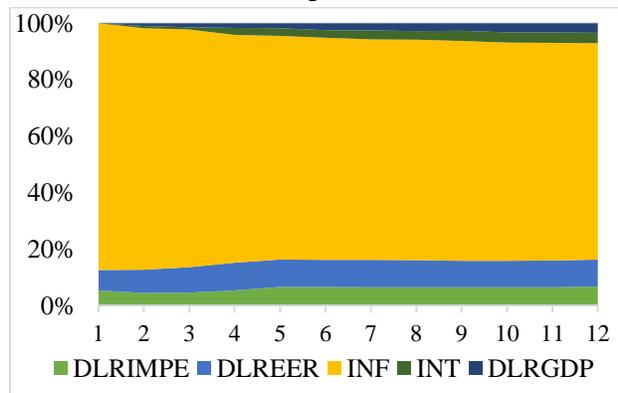
Finally, we complete our examination with an analysis of the variance decomposition of the real effective exchange rate, the inflation rate, the interest rate, and the real economic growth. The results are reported in Figure 2. The results show that four variables—all except interest rate—are the main contributors to their variance decomposition. In particular, we find that European imports explain approximately 28%, 7%, 10%, and 23% of the variance decomposition of the real effective exchange rate, the inflation rate, interest rate, and the real economic growth of Saudi Arabia respectively.

The analysis by variable shows that the real effective exchange rate's power of explanation for the variance decomposition is weak for the inflation rate and interest rate, but it is approximately 30% in the first quarter and increases to approximately 38% after 12 quarters. For the inflation rate, the results show that the variable has significant power in explaining the variance decomposition of all the variables. For instance, from the first quarter to 12<sup>th</sup> quarter, the power of explanation for the variance decomposition of the real effective exchange rate of inflation rate has increased from 0% in the first year to 22% in the 12<sup>th</sup> quarter. Figure 2c shows that inflation explains approximately 8.25% of the variance decomposition of the interest rate in the first year and increases to approximately 57.5% after 12 quarters (3 years). The results show

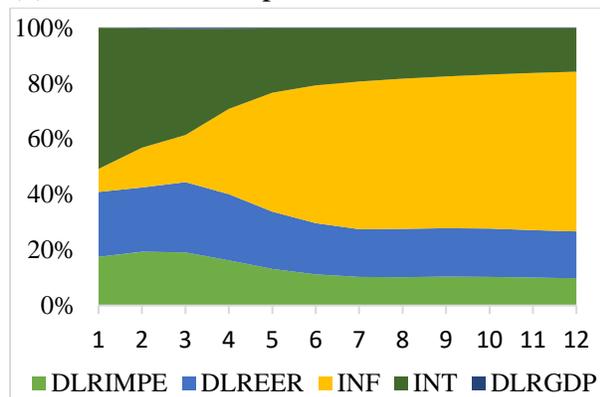
that the contribution of the real economic growth to the variance decomposition of the real effective exchange rate is close to zero for almost all the variables.



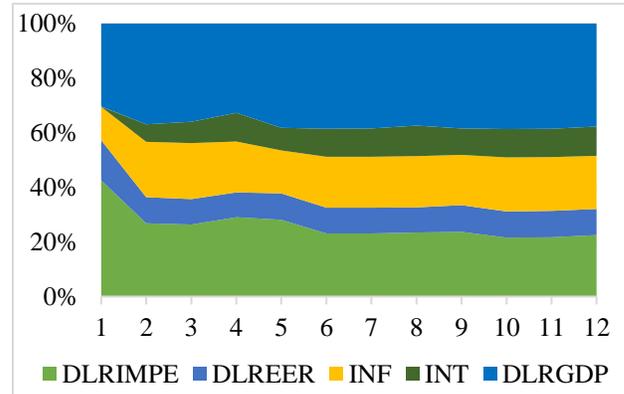
(a) Variance decomposition of REER



(b) Variance decomposition of INF



(c) Variance decomposition of INT



(d) Variance decomposition of RGDP

Figure 2: Variance decomposition analysis of the real effective exchange rate, inflation rate, interest rate, and real economic growth.

4.2.2. Results for individual European countries

In the second step, we continue our analysis of the economic impact of the European debt crisis by focusing on the top four European countries (France, Germany, Italy, and Spain). For each of the four countries, we estimate an SVAR model wherein the European imports variable used in the previous analysis is replaced by the imports of the four countries separately. The results of the IRFs for France, Germany, Italy, and Spain are reported in Figures 3, 4, 5 and 6 respectively.

*i. IRFs results for France*

The results of the IRFs for France are reported in Figure 3. The impact of a structural one standard deviation shock on imports to France from Saudi Arabia fluctuates between negative and positive. The same pattern of fluctuation has been observed for the two variables inflation rate and real

economic growth, while the impact is positive during the first four quarters for inflation. The results show that the impact for interest rate is positive and remains positive until quarter 12. The impact for all four series is not significant except for GDP in period 2, where the impact is significant, given that the interval confidence bands are above the horizontal line. These results indicate that any negative shock to the imports to France

from Saudi Arabia will have a negative impact on Saudi Arabian real economic growth in the second quarter. The results indicate that the Saudi Arabia economy is not sensitive to shocks affecting the France economy. This result is in line with the share of Saudi Arabia export to France reported in Table 2, which indicates that the share which is smaller than the other European countries such as Italy and Spain.

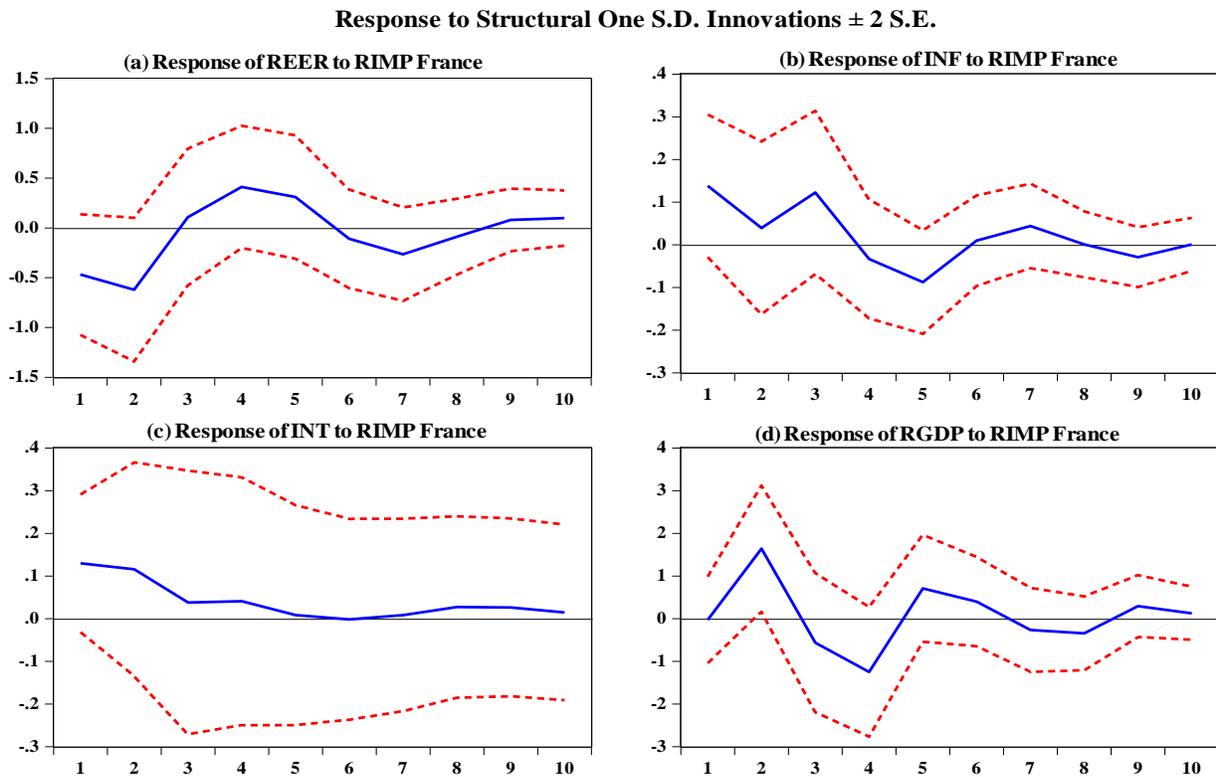


Figure 3: IRFs of the Saudi Arabian real effective exchange rate, inflation rate, interest rate, and real GDP growth to structural one standard deviation shock on the France real imports growth

We complete the analysis for France by examining the accumulated IRFs for the impact of a shock on the real imports to France from Saudi Arabia with respect to the four macroeconomic indicators considered in this study. To save space, we report in appendix A the results for only those

variables which had a significant impact. We find that only two variables—interest rate and real economic growth—show a significant positive response, meaning the impact lasts for two periods (two quarters).

ii. IRFs results for Germany

The results of the IRFs for Germany are reported in Figure 4. We find that for all four variables, the impact of a structural one standard deviation shock on Germany's real imports from Saudi Arabia fluctuates from positive to negative. However, the impact is significant in only the first year for two variables—inflation rate and real economic growth—at 5% and 10% respectively. We complete the analysis as before by reporting

**Response to Cholesky One S.D. Innovations  $\pm$  2 S.E.**

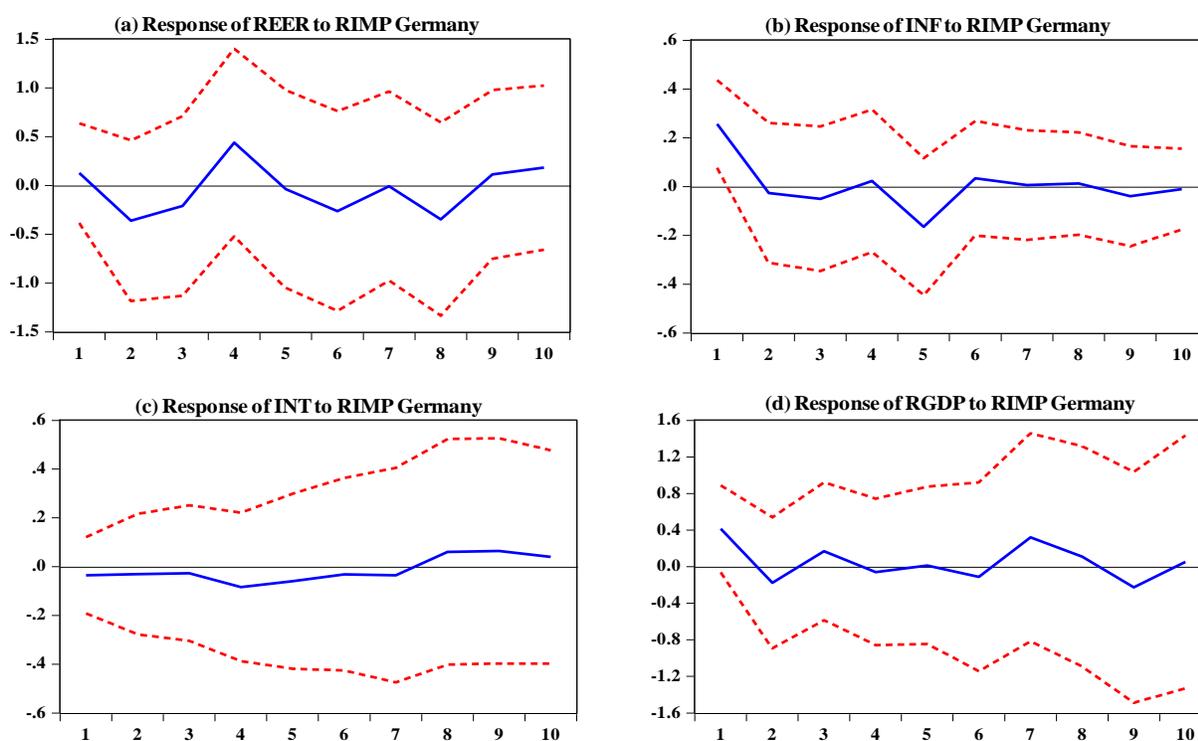


Figure 4: IRFs of the Saudi Arabian real effective exchange rate, inflation rate, interest rate, and real GDP growth to structural one standard deviation shock on the Germany real imports growth.

The results show also that Saudi Arabia's real economic growth and inflation rate respond positively to a one standard deviation structural shock to the real imports of Germany, indicating that any positive (negative) shock to the German economy will have a positive (negative) impact on the

in the appendix the accumulated IRFs for the impact of a shock on the real imports of Germany from Saudi Arabia. The results reported in Figure A2 show that, similar to the case of France, only for two variables—inflation rate (at 10% level of significance) and real economic growth (5% level of significance)—are the impacts significant.

Saudi Arabian inflation rate and real economic growth. Consequently, applied to our context, these results show the Saudi Arabian economy (or, specifically, its inflation rate and economic growth) responded negatively to the impact of the European debt crisis of 2009–2012.

iii. IRFs results for Italy

The case of Italy is particularly interesting, as we find that all four Saudi macroeconomic variables employed in our study (real effective exchange rate, inflation rate, interest rate, and economic growth) respond significantly to a structural one standard deviation shock to Italy’s real imports from Saudi Arabia (see Figure 5). We find that two variables—real effective exchange rate and real economic growth—respond positively to a positive shock on the real imports of Italy, but the impact dies after the first year. From quarter 2 to 12, the impact fluctuates between

positive and negative but remains insignificant during the whole period for the case of real effective exchange rate. However, for the case of real economic growth, a significant response is found in quarters 2 and 6. The results show that the inflation rate responds positively and significantly to a structural shock to the real imports of Italy from Saudi Arabia. This impact is significant for two quarters and becomes insignificant after that. Finally, the interest rate responds negatively and significantly to a positive shock to the real imports to Italy from Saudi Arabia. This impact also lasts for two periods (two quarters) and then becomes insignificant.

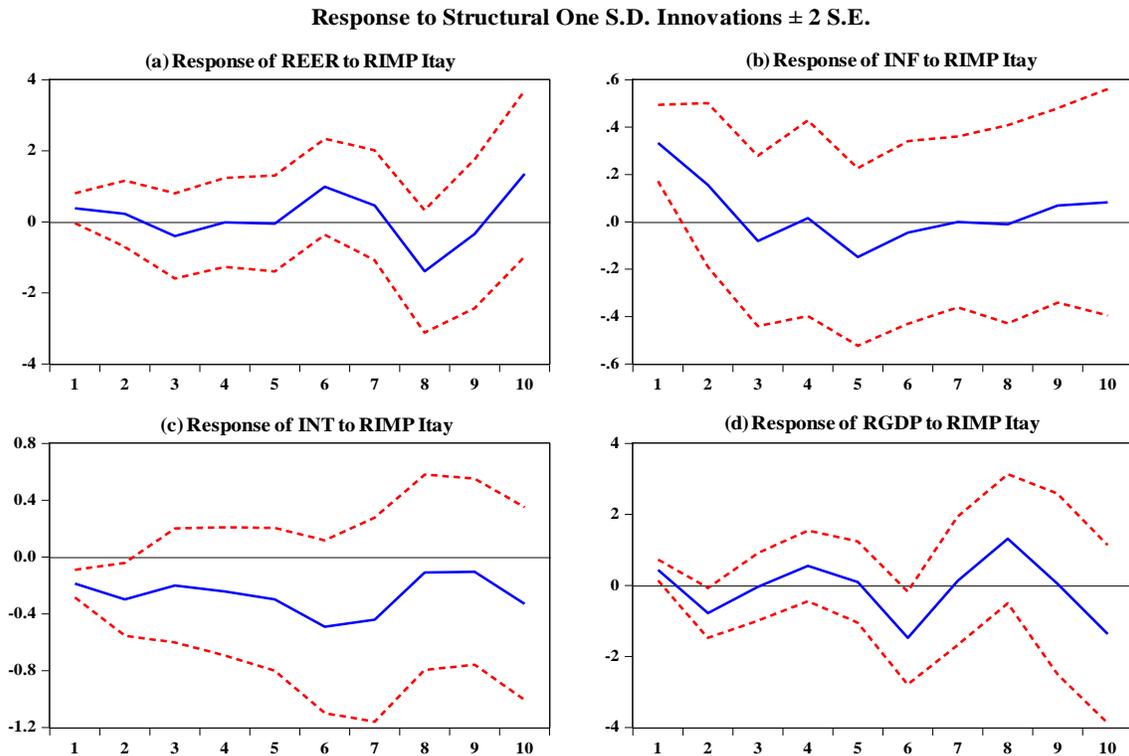


Figure 5: IRFs of the Saudi Arabian real effective exchange rate, inflation rate, interest rate, and real GDP growth to structural one standard deviation shock on the Italy real imports growth.

Regarding the accumulated responses, see Figure A3 in the appendix. We find that they are significant for the real effective exchange rate and real economic growth despite becoming insignificant after the first year. The accumulated response of the inflation rate stays significant for three quarters, compared to five quarters for the interest rate. The positive responses of the real economic growth indicate that a positive (negative) shock to real imports to Italy from Saudi Arabia will have a positive (negative) impact on real economic growth. This result means that the European debt crisis had a negative impact on the real economic growth of Saudi Arabia.

#### iv. IRFs results for Spain

Finally, the results of the IRFs for the case of Spain are reported in Figure 6. The results show that, following a structural one standard deviation shock to Spain's real imports from Saudi Arabia, the response of the real effective exchange rate is negative and significant for the first quarter, then becoming insignificant until quarter 12. The response of inflation is insignificant for twelve quarters. The responses of the interest rate and real economic growth are positive and significant. They become insignificant after the first quarter for the real economic growth and significant at quarter 4 for the interest rate.

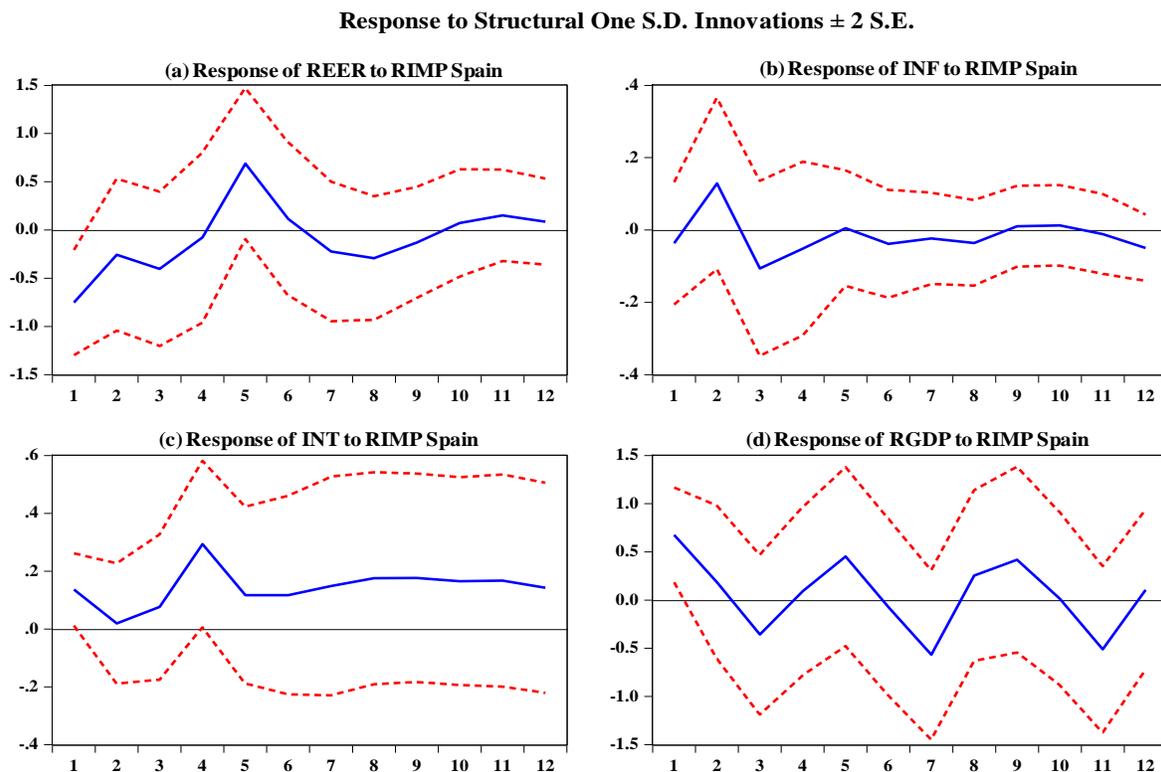


Figure 6: IRFs of the Saudi Arabian real effective exchange rate, inflation rate, interest rate, and real GDP growth to structural one standard deviation shock on the Spain real imports growth.

The results of the IRFs accumulated responses are reported in Figure A4 for the real effective exchange rate and real economic growth, as they are the only two variables where the accumulated responses are significant following a structural one standard deviation shock to the real imports to Spain from Saudi Arabia. For the real effective exchange rate, the accumulated responses are negative and significant, lasting for the first four quarters and then becoming significant again in quarter 9. For the real economic growth, the accumulated response of the variable is positive and significant until quarter two, appearing again for quarters 5 and 6 and then once more in quarters 9 and 10.

## 5. Conclusion

In this paper, we apply the impulse response functions obtained from the estimation of an SVAR model to study the impacts of the European debt crisis on the Saudi Arabian real economy. The analysis is conducted in two steps. First, we use aggregated data for all European countries; second, we assess the impact of the European debt crisis by analysing the bilateral relationship between Saudi Arabia and four European countries—namely France, Germany, Italy, and Spain. Our findings can be summarised with two statements. First, the IRFs for the European aggregated data reveal that a shock to Saudi Arabian exports to Europe has a significant impact on the real effective exchange rate,

inflation rate, and economic growth that last for three periods after the shock.

Second, the results of the variance decomposition analysis show that Europe's imports from Saudi Arabia significantly contribute to explaining the variance of the real effective exchange rate and the real economic growth of Saudi Arabia. However, the contribution of the European imports is moderate for the interest rate variance and very low for the inflation rate variance.

Overall, this empirical study shows that the European crisis has affected Saudi Arabia's key macroeconomic variables. This finding supports the hypothesis that the European crisis affected countries both within and outside the Eurozone (European Union, 2013; Acharia *et al.*, 2017). The significant impact of the European crisis on the Saudi economy can be explained by the strong integration between the Saudi economy and various European countries. In fact, countries with higher levels of global integration are more exposed to external shocks than countries that are less integrated (Collins and Biekpe, 2003).

Taken together, our findings suggest the need for further investigation into the different mechanisms behind the contagion effects of the crisis in Saudi Arabia. A deeper look into the transmission channels of the European crisis to the Saudi economy would be of significant interest.

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## Appendix A

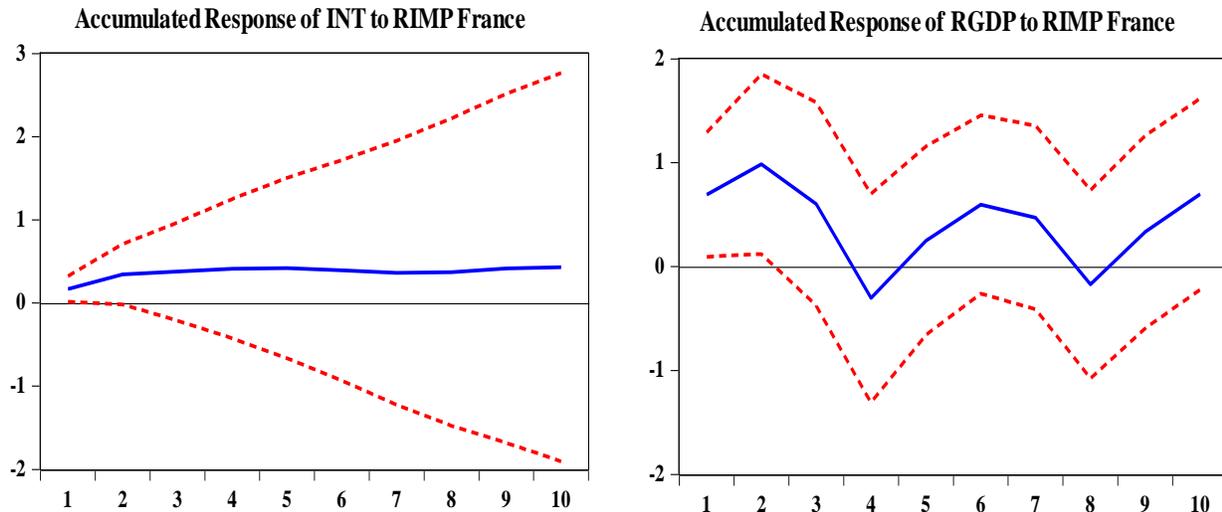
Accumulated Response to Structural One S.D. Innovations  $\pm 2$  S.E.

Figure A1: Accumulated response to structural one standard deviation shock on the interest rate and the real economic growth of France.

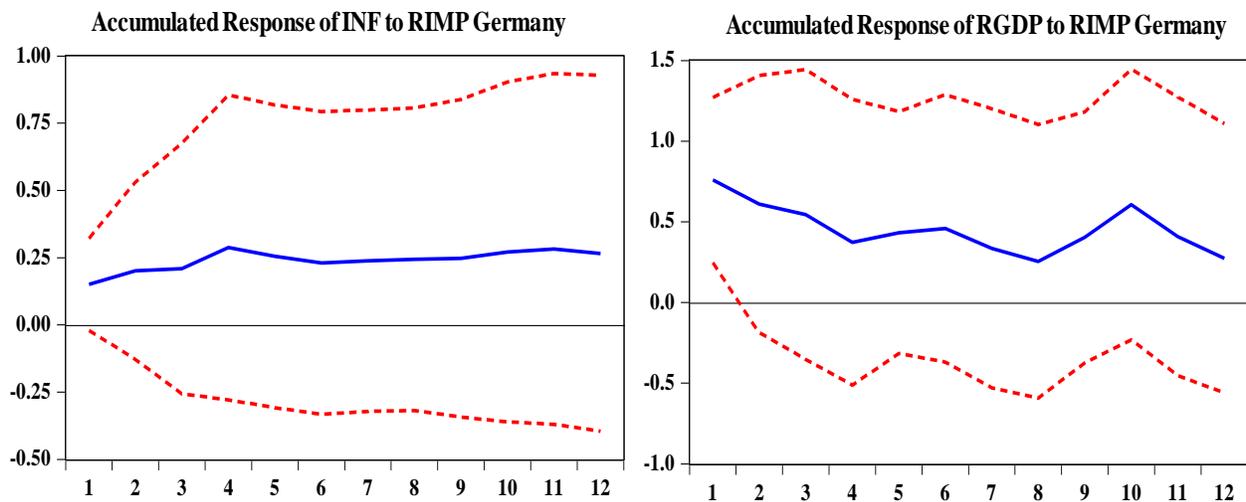
Accumulated Response to Structural One S.D. Innovations  $\pm 2$  S.E.

Figure A2: Accumulated response to structural one standard deviation shock on the interest rate and the real economic growth of Germany.

Accumulated Response to Structural One S.D. Innovations  $\pm 2$  S.E.

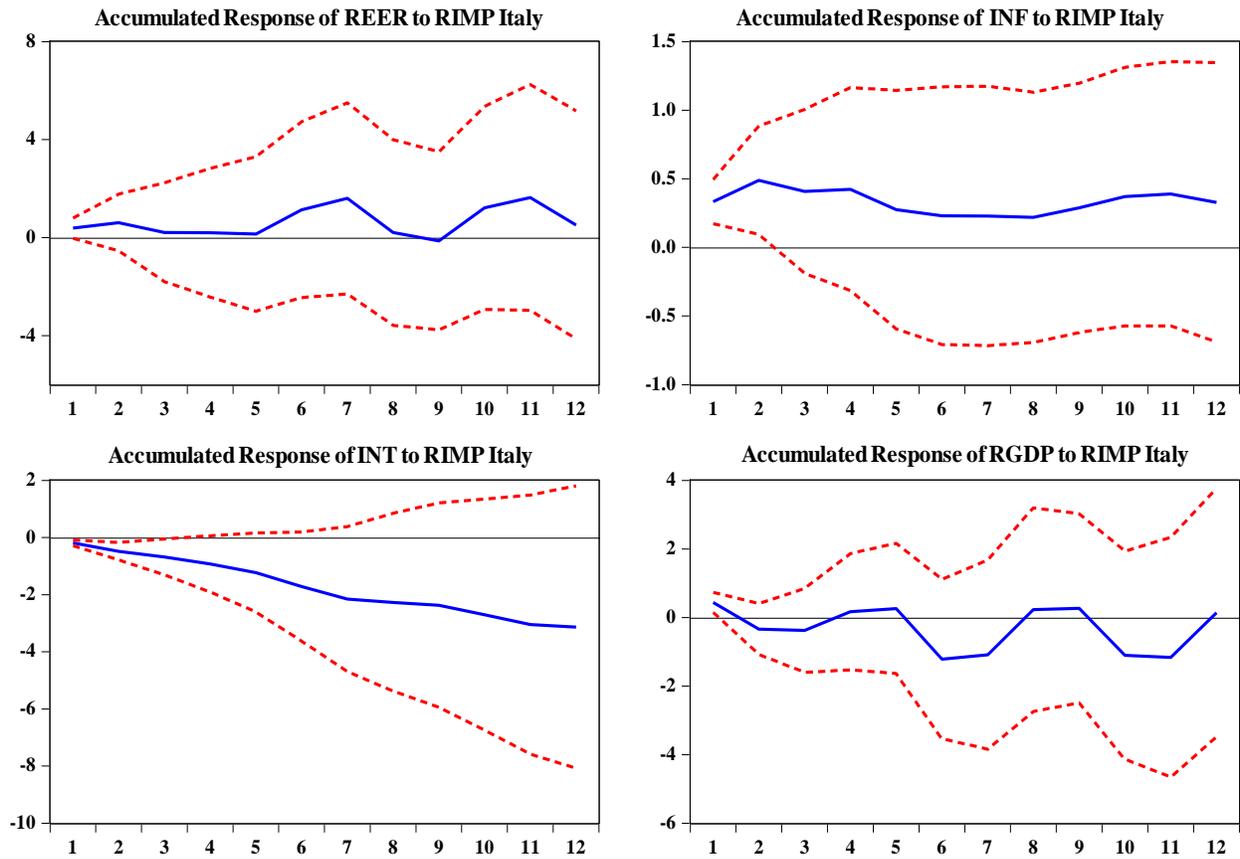


Figure A3: Accumulated response to structural one standard deviation shock on the interest rate and the real economic growth of Italy.

Accumulated Response to Structural One S.D. Innovations  $\pm 2$  S.E.

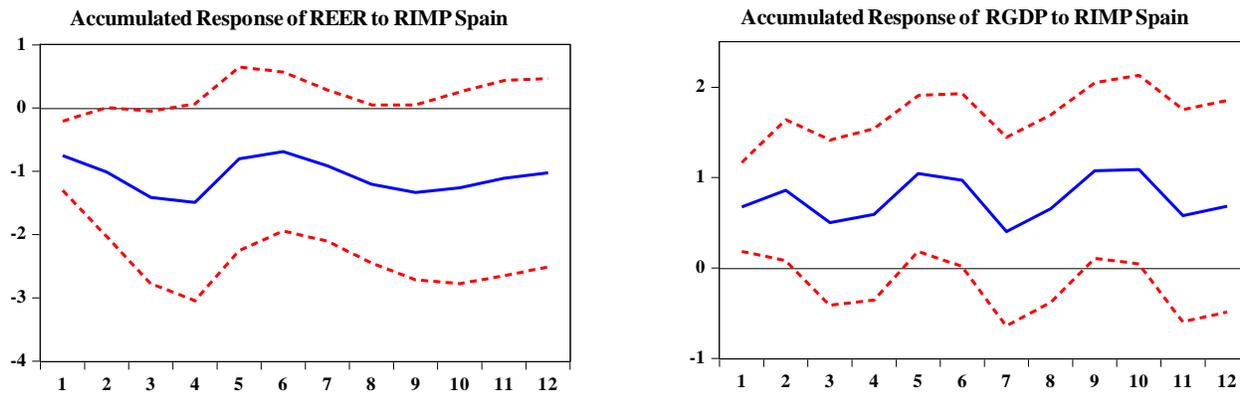


Figure A4: Accumulated response to structural one standard deviation shock on the interest rate and the real economic growth of Spain.

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