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Gas price shocks, the current account, and the real exchange rate: An empirical analysis for the EU

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A B S T R A C T

The aim of this paper is to analyse how gas price shocks affect the real exchange rate (RER) and the current account (CA) for a panel of countries from the EU28. We estimate VAR models and account for the possibility of asymmetric effects in gas price shocks. Our results show that the effects on the RER and CA are short-lived and that there are asymmetries in some cases.

1. Introduction

1.1. Motivation

The relationships between oil prices and macroeconomic fundamentals have been thoroughly studied in the literature on economics since the pioneering work of Hamilton (1983). The effect of the prices of other energy sources has in contrast been largely neglected by researchers despite the importance of that effect for the global economy.

Energy prices can cause the real exchange rate (RER) to fluctuate through the trade channel (Amano and van Norden, 1998) or through the wealth channel (Golub, 1983; Krugman, 1983). The first of these two channels assumes that energy prices capture exogenous terms-of-trade shocks, and that those prices determine the RER in the long run. The wealth channel operates through the current account balance (CA) meanwhile. A rise in energy prices causes the CA in energy-importing countries to deteriorate, and the RER then depreciates if the country is either relatively highly dependent on energy imports or has relatively inelastic demand for energy.

The CA is related to the external position of the country as a whole. Most economies around the world saw large amounts of capital flow in and out of the country over the past century, and in many cases this came hand-in-hand with large CA imbalances. External imbalances within the euro area grew substantially between the introduction of the euro in 1999 and the global financial crisis of 2008–09, and several explanations have been suggested for this. Blanchard and Giavazzi (2002) and Lane and Pels (2012) conclude that the external imbalances were the consequence of a demand shock, as the high degree of mobility of capital and the low interest rates that financial integration allowed caused a credit boom. In contrast, Trichet (2011) and Draghi (2012) suggest that wage growth that was inconsistent with the underlying productivity trends caused a loss of competitiveness in the periphery. Ordóñez et al. (2015)

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analyse the evolution of the real unit labour costs in the euro area countries and conclude that external imbalances and the loss of competitiveness in the periphery were caused not by the misalignment of wages and productivity, but by differences between the drivers of growth in the core and periphery countries.

1.2. Brief literature review

Recent contributions have comprehensively analysed how both the CAs and RERs of European economies have evolved (Bajo-Rubio et al., 2014; Coleman and Cuestas, 2021; Cuestas et al., 2022; Cunado et al., 2010; Gil-Alana, 2000; Gil-Alana et al., 2008; Christidou and Panagiotidis, 2010). This recent wave of papers has however neglected the effect that supply shocks coming from commodity prices have. There is a new challenge in the current climate of economic turmoil that has followed the Covid-19 pandemic and the Russian invasion of Ukraine and subsequent war on European soil, and that is the surge in energy bills for both gas and electricity that resulted from the exponential rise in prices for natural gas in Europe. The energy mix and the degree of dependency on energy imports vary greatly across EU countries, and so the consequences of a rise in energy prices can be asymmetric across EU member countries, with each experiencing a different degree of deterioration in the CA, which may lead to CA imbalances.

Papers on commodity shocks include Ordóñez et al. (2019), Cuestas and Gil-Alana (2018) and Cuestas and Ordóñez (2018), who analyse the impact of an oil price shock on unemployment. Jiménez-Rodríguez and Sánchez (2005) and Jimenez-Rodriguez (2009) analyse how oil shocks impact real economic growth, and show that oil shocks have a detrimental effect on the macroeconomy and that there are clear asymmetric effects. Among papers focusing on how commodity shocks affect the real exchange rate are Amano and van Norden (1995, 1998), who find that real exchange rates are clearly dependent on oil price shocks. In the most recent literature, Caballero and Simsek (2023) highlight that it is important to account for short-lived temporary supply shocks when deciding on the optimal monetary policy.[1]

1.3. The current situation and this paper's contribution

The countries of the European Union (EU) imported 55.6 % of the energy they consumed in 2021, though the degree of import dependency varied widely between countries. Dependency on energy imports was relatively high in Germany at 63.8 %, Italy at 73.5 %, and Spain at 69.1 % among the four biggest economies, whereas in France it was 44.1 %. The dependency ratio of the EU15 was 63.8 %, which was significantly higher than the import dependency ratio of 42.8 % in the CEE countries. These figures however change dramatically when dependency on imports of gas is considered, as the EU has a dependency ratio for imported gas of 83.6 %. It should also be noted with this reliance on gas imports that there is particular reliance on a single supplier, Russia. This is particularly so in the CEE countries, as imports of Russian gas were 100 % of total imports of gas in 2021 in Czechia and Latvia, 95 % in Hungary, 80 % in Bulgaria, and 67 % in Estonia, for example. Finland had the highest dependency ratio among Western countries at 97 %, followed by Germany at 66 %. Greece, Italy, and the Netherlands were all dependent on Russia for 35–40 % of their gas, while some other countries, such as Portugal or Spain, are not really dependent on Russia at all for their gas supply. The different patterns of dependence on gas from Russia in western and eastern EU countries need to be accounted for when the effect of gas prices on the RER and the CA is analysed.

This paper consequently aims to answer the following questions: (1) Have gas price shocks affected the real economy as a standard supply shock? (2) Do movements in gas prices affect the RER and the CA? (3) Is the effect on the RER and the CA of positive or negative gas price shocks asymmetric? (4) Could shocks to the gas price be a source of CA imbalances? We conduct the analysis using a panel of EU28 countries. We estimate VAR models and produce generalised impulse response functions (Pesaran and Shin, 1998) to assess how gas price shocks affect investment and GDP, and, most importantly, the RER and the CA. We also separate the Central and Eastern European Countries (CEECs) from the other 17 EU countries, which are the EU15 plus Cyprus and Malta. We include a number of control variables in the model, which are described in Section 2.

The remainder of the paper is organised as follows. Section 2 describes the empirical set up and presents the results of our analysis. The last section concludes.

2. Empirical analysis

We use quarterly data for the EU28 nations running from 2010Q1 to 2019Q2 to calculate the log of the real effective exchange rate (LRER) deflated by the consumer price index for the main industrial trading partners, with an increase in the LRER indicating an increase in real terms; the current account as a percentage of GDP (CA); the log of real government consumption (LGC); the log of real gross fixed capital formation (LGFCF); the log of trade openness (LO), calculated as the sum of exports and imports as a proportion of GDP; the log of the terms of trade (LTOT), calculated as the ratio between export prices and import prices; and log of real GDP (LY). All of our information comes from Eurostat and is in line with the literature. Most of our variables are expressed in log form since we are mainly interested in relative changes in the variables. As a proxy of natural gas prices, we use the Dutch TTF in logs LN from https://tradingeconomics.com/commodity/eu-natural-gas.

We use traditional VAR models (Sims, 1980) to estimate the impact of gas price shocks on the real exchange rate, the current

[1] See also Fornaro and Wolf (2023).

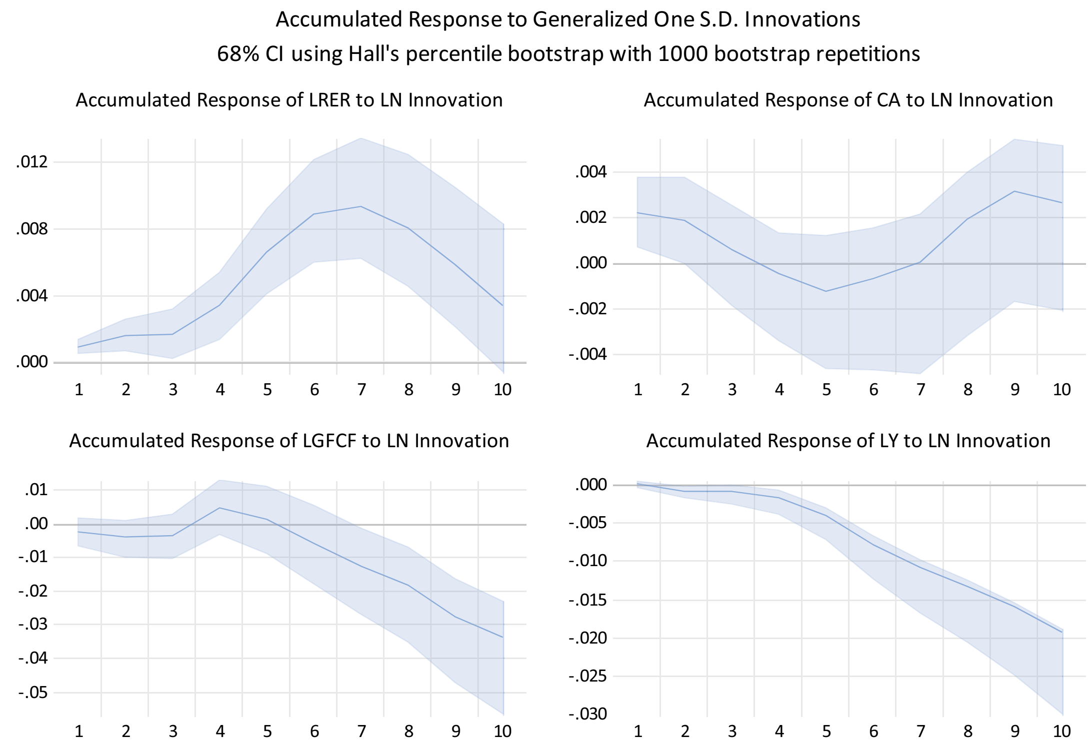

Fig. 1. Reaction of key variables to a gas price shock, EU28 VAR(5).
Note: Shadowed areas represent confidence intervals of one standard deviation.

account, investment and output. We use a panel set up with country fixed effects. The VAR model estimates the following vector of equations:

$$\pi Y_{it} = \delta(L)Y_{it} + \theta D_i + \varepsilon_{it} \tag{1}$$

where π is a matrix of restrictions on the contemporaneous parameters, L is the lag operator, Yi_t is a vector of endogenous variables, and D_i collects the country fixed effects. As π cannot be fully identified, we use the generalised impulse response functions proposed by Pesaran and Shin (1998).

Our analysis looks at models with the lag length selected using Schwarz's Bayesian information criterion, with a maximum of eight. The models fulfil the conditions of invertibility and stability.[2] Fixed effects dummies are included in all the models estimated along with three centred seasonal dummies. All the confidence intervals of the impulse response functions are bootstrapped, which takes care of any biases in the estimated standard errors.

In addition, we disentangle the effects of positive and negative gas price shocks by splitting the gas price variable in two as *GUP* and *GDOWN*, which are defined as:

$$GUP_t = LN_t \;\; if \;\; \Delta LN_t > 0 \;\; and \;\; 0 \;\; otherwise \tag{2}$$

and

$$GDOWN_t = LN_t \;\; if \;\; \Delta LN_t < 0 \;\; and \;\; 0 \;\; otherwise \tag{3}$$

Fig. 1 displays the impulse response functions to a gas price shock for the LRER and the CA for the panel of EU28 countries. The response of LGFC and LY shows we are dealing with a clear supply shock with permanent effects. The shock has a positive effect on the LRER, indicating an appreciation in the exchange rate, but this effect does not seem to last very long. The response of the CA indicates an improvement on impact, but this then disappears immediately. This initial positive effect may be related to more expensive products being exported.

Fig. 2 shows the responses to a gas price shock for the CEECs. It appears for them that the LGFCF falls on impact but reacts positively in the following quarters. This may be because rising prices give a positive signal for investment since the rise in prices may be mistaken for a demand shock. However, the reaction of LY again depicts a clear supply shock. We also observe that the reaction of the

[2] The roots of the characteristic polynomial all lie within the unit circle. Results available on request.

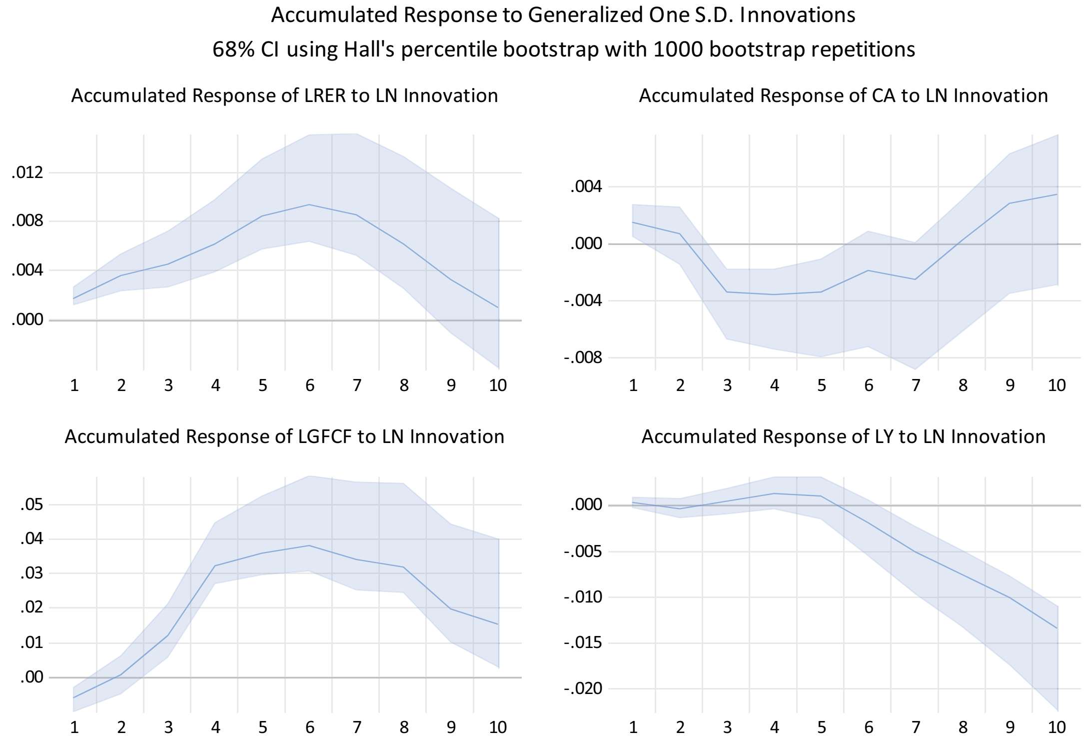

Fig. 2. Reaction of key variables to a gas price shock, CEECs VAR(5).
Note: Shadowed areas represent confidence intervals of one standard deviation.

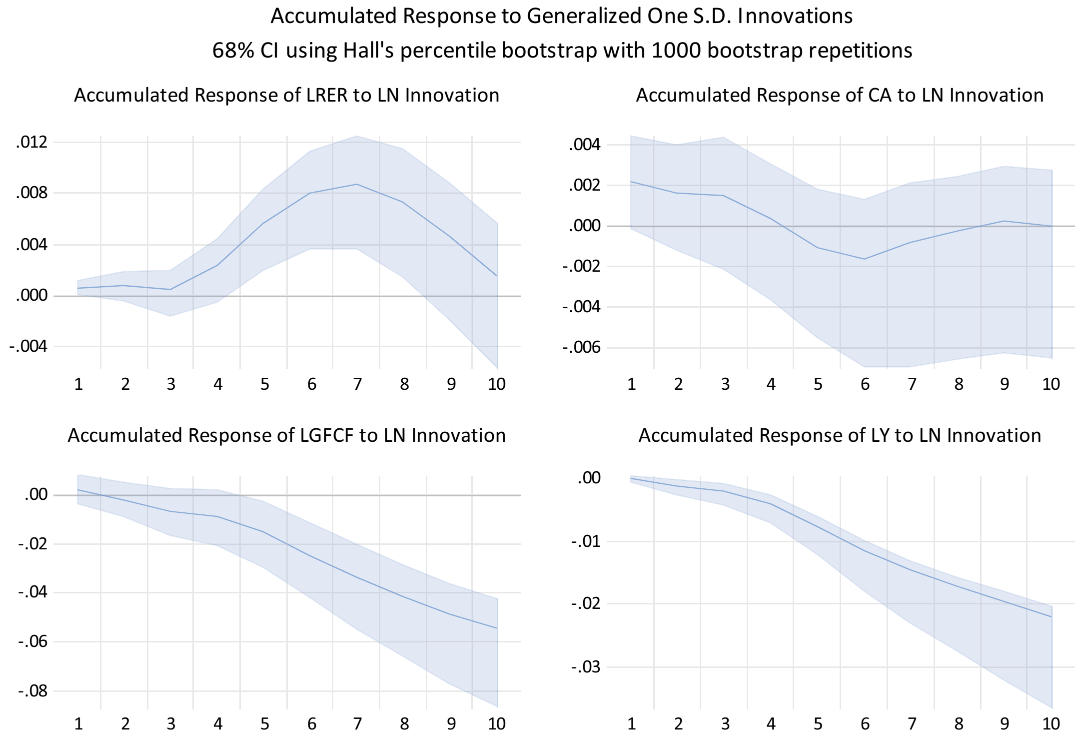

Fig. 3. Reaction of key variables to a gas price shock, EU15+2 VAR(5).
Note: Shadowed areas represent confidence intervals of one standard deviation.

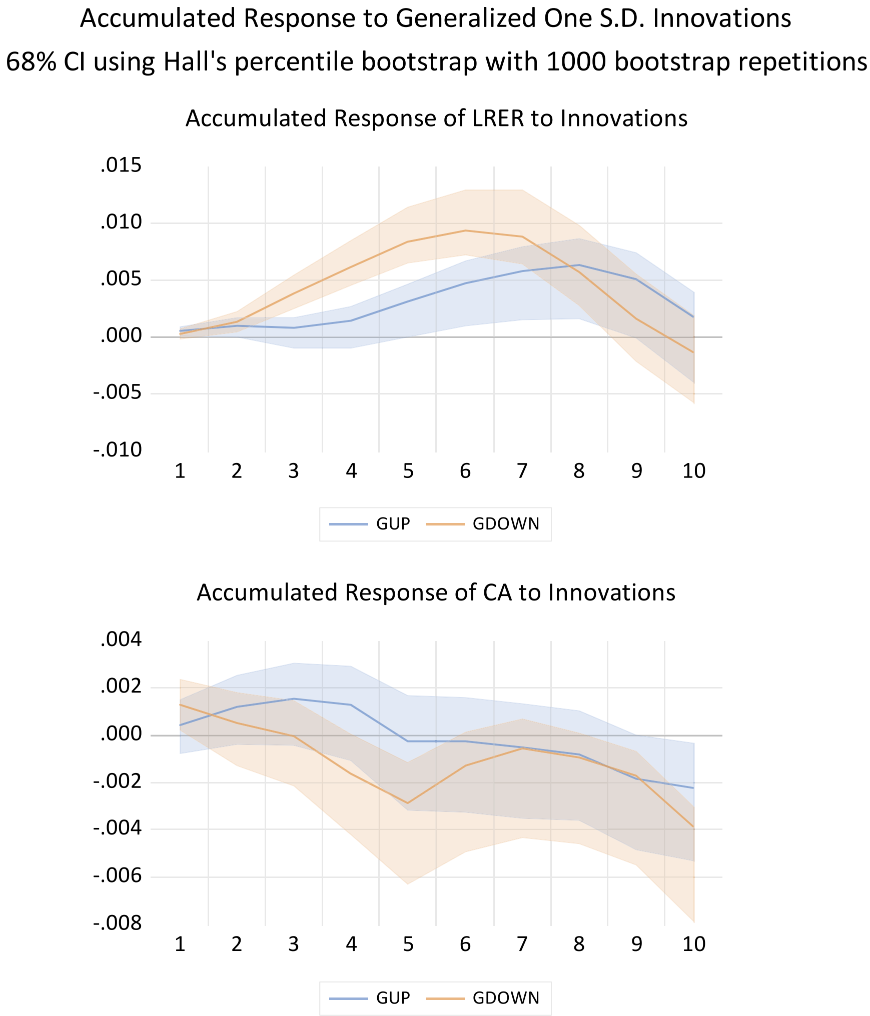

Fig. 4. Reaction of key variables to an asymmetric gas price shock, EU28 VAR(8).
Note: Shadowed areas represent confidence intervals of one standard deviation.

RER is stronger than that in the EU28, meaning that the increase in prices has a much more strongly negative impact on competitiveness in these countries. This gas price shock also creates a minor deterioration in the CA, which only lasts three quarters. Comparing this result to the equivalent response in Fig. 1 indicates that the CAs of the CEECs are more sensitive to supply shocks of this kind.

Fig. 3 depicts the responses for the same variables for the remainder of the EU countries. The results are very similar to those shown in Fig. 1 for the full EU28.[3]

Figs. 4–6 plot the asymmetric effect on the LRER and the CA of positive and negative gas price shocks. A positive response means that the variable moves in the same direction as the sign of the shock, and this indicates whether the effects are significantly different.

Fig. 4 illustrates that the effect of a negative gas price shock is significantly different to that of a positive shock. This means that the effect when the price of gas goes down is stronger, and is a depreciation, than that from a positive gas price shock, which is seen as an appreciation. This may be because the industries in the exporting sectors in the EU28 have high levels of energy intensity.

Fig. 5 analyses the responses in the CEECs to a negative shock and to a positive one. These graphs indicate that there is no apparent difference in absolute terms in the effects of negative and positive gas price shocks on the RER. However, the CA response to a positive gas price shock is positive but barely significant, whereas the effect from a negative gas price shock is significant. This finding may be somewhat puzzling, but the movement of the lines shows that both negative and positive shocks make the CA worse, and this effect is clearer in the long run.

[3] We have included the non-accumulated versions of Figs. 1-3, i.e. Figs. A1, A2 and A3, the Granger causality tests and the variance decomposition for the model in Fig. 1 in the Appendix.

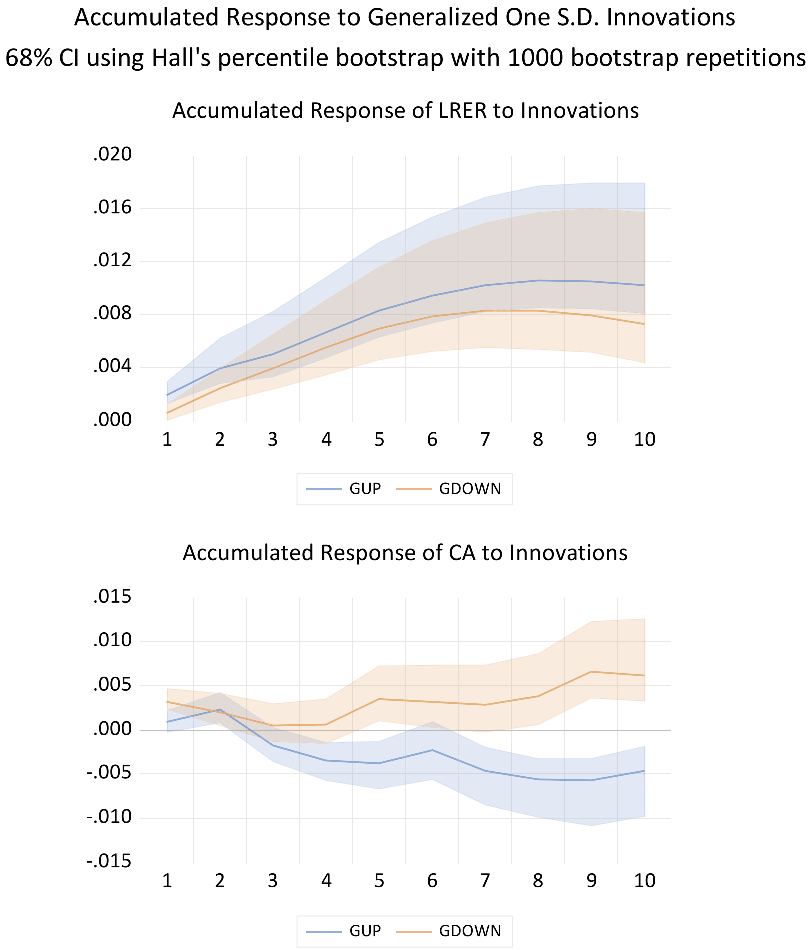

Fig. 5. Reaction of key variables to an asymmetric gas price shock, CEECs VAR(4).
Note: Shadowed areas represent confidence intervals of one standard deviation.

Similar results are depicted in the second graph in Fig. 6 for the case of the CA, but the result for the LRER is interesting. A positive gas price shock has hardly any effect on the LRER, but the depreciation of the RER caused by a negative shock is stronger in absolute terms than the response to the positive gas price shock. This provides an explanation for the results from Fig. 3, as the seemingly positive relationship between gas price shocks and the RER comes from drops in gas prices, not from rises in them.

The apparently puzzling result can be explained by considering how rises in gas prices affect the volume and value of imports and the variation in exports, or the price effect and the volume effect. The rise in gas prices causes volumes of imports to decrease, reducing the value of imports, while at the same time it causes the value of imports to increase because of the quantity imported. Given that these countries are highly dependent on gas and have great difficulty in diversifying their energy mix, the price effect tends to dominate over the volume effect, driving up the value of imports. A rise in gas prices consequently makes exports less competitive and leads to a decline in them. The combined effect of an increase in the value of imports and a decrease in exports is that the current account deteriorates. However, when gas prices fall, the volume effect dominates over the price effect. The reason is simple; gas becomes a relatively cheaper source of energy and so it is consumed more than before, and the volume of imports increases as a consequence. A drop in gas prices makes exports more competitive meanwhile and so they increase, but the effect on imports dominates, leading to a deterioration in the current account. In the case of the RER in Fig. 6, a positive shock to gas prices causes a depreciation of the currency in real terms for the Western EU countries, which can be related to the rise in the price of imported gas. However, a negative shock to the price of gas has a stronger effect on national prices, as the world becomes more competitive, and so EU countries have to drop their prices further to compete internationally.

Our results are in line with those cited in the introduction section, as we find there are asymmetries in how commodity prices affect the macro-variables analysed. However, we find here that these shocks are mostly short lived, which stands in contrast to the results of Amano and van Norden (1995, 1998).

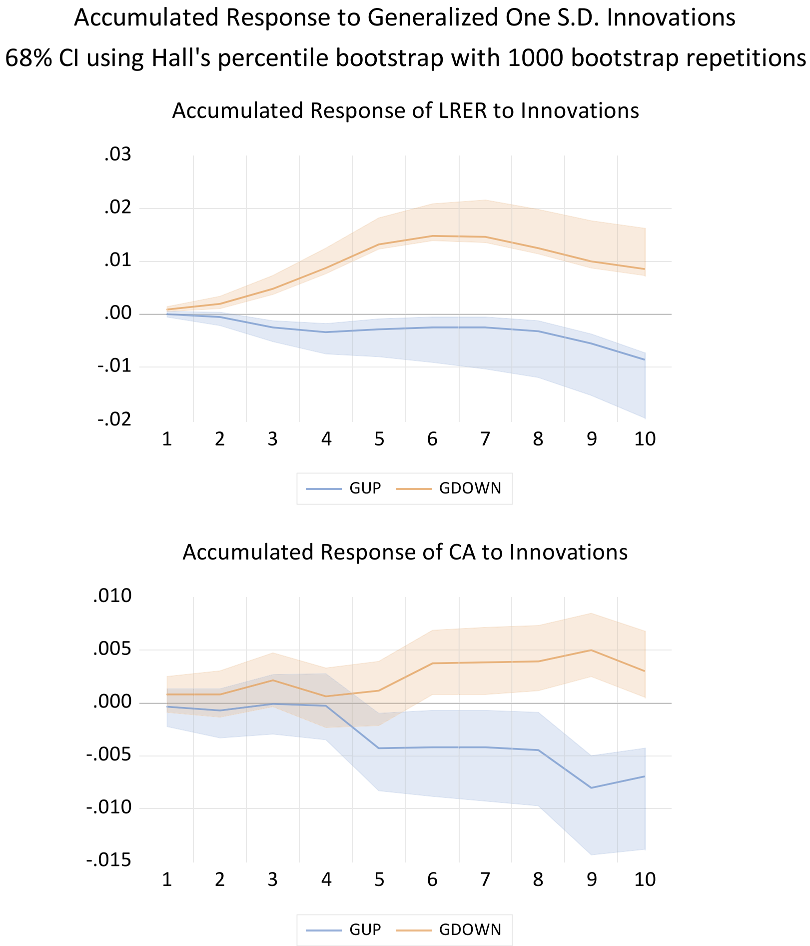

Fig. 6. Reaction of key variables to an asymmetric gas price shock, EU15+2 VAR(6).
Note: Shadowed areas represent confidence intervals of one standard deviation.

3. Conclusion

We have built on recent contributions examining the determinants of RER and CA for the EU28 and extended the previous RER and CA models by analysing how they are affected by gas price shocks.

We estimate VAR models and label gas price shocks as supply shocks, and we find that these shocks have only temporary effects on the two variables. We also observe that negative shocks may have a stronger effect in absolute terms than positive shocks.

Policy responses could emanate from this analysis. The relative dependence of these countries on commodities makes them exposed to external supply shocks, and if a country needs to keep its real exchange rate and current account steady in order to maintain its competitiveness and its external position, it will have to design policies that can make sure that shocks to gas prices do not affect the prices of the products that it exports.

CRediT authorship contribution statement

Juan Carlos Cuestas: Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Mercedes Monfort:** Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Javier Ordóñez:** Conceptualization, Formal analysis, Investigation, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare no conflicts of interest.

Data availability

Data will be made available on request.

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Appendix A

Sources of data

Variable	Source	Transformation	Acronym
Real Exchange Rate	Eurostat	logs	LRER
Current account / GDP	Eurostat	None	CA
Real government consumption	Eurostat	logs	LGC
Real gross capital formation	Eurostat	logs	LGFCF
Openness = (exports + imports) / GDP	Eurostat	logs	LO
Terms of trade = Export price / Import price	Eurostat	logs	LTOT
Dutch TTF natural gas	https://tradingeconomics.com/commodity/eu-natural-gas	logs	LN

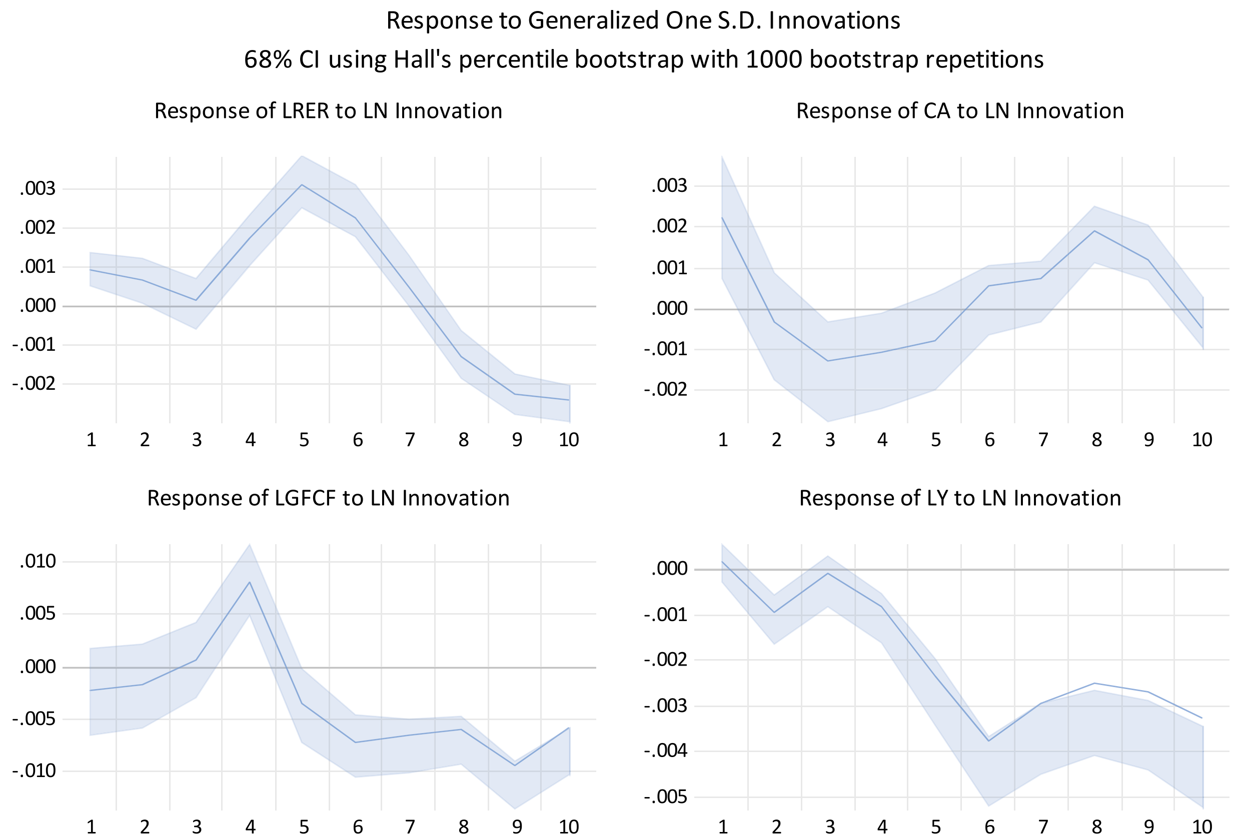


Fig. A1. Reaction of key variables to a gas price shock, EU28 VAR(5). Non-accumulated.
Note: Shadowed areas represent confidence intervals of one standard deviation.

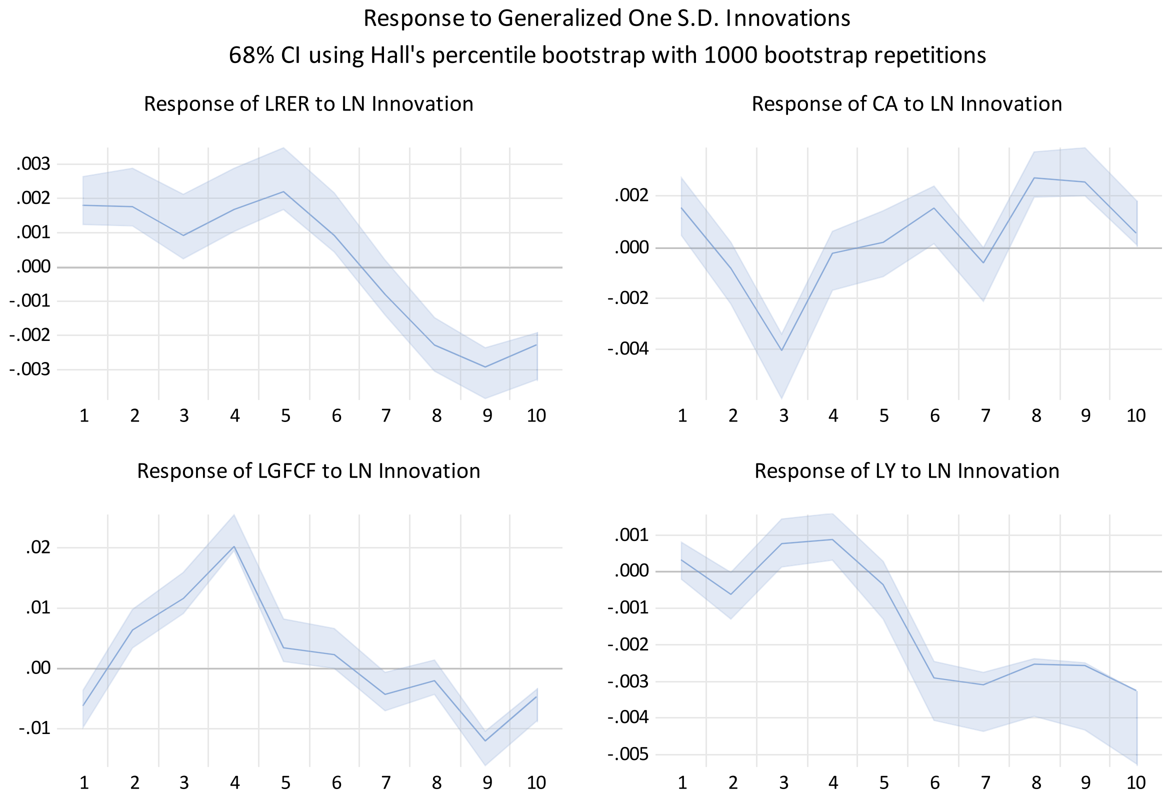


Fig. A2. Reaction of key variables to a gas price shock, CEECs VAR(5). Non-accumulated.
Note: Shadowed areas represent confidence intervals of one standard deviation.

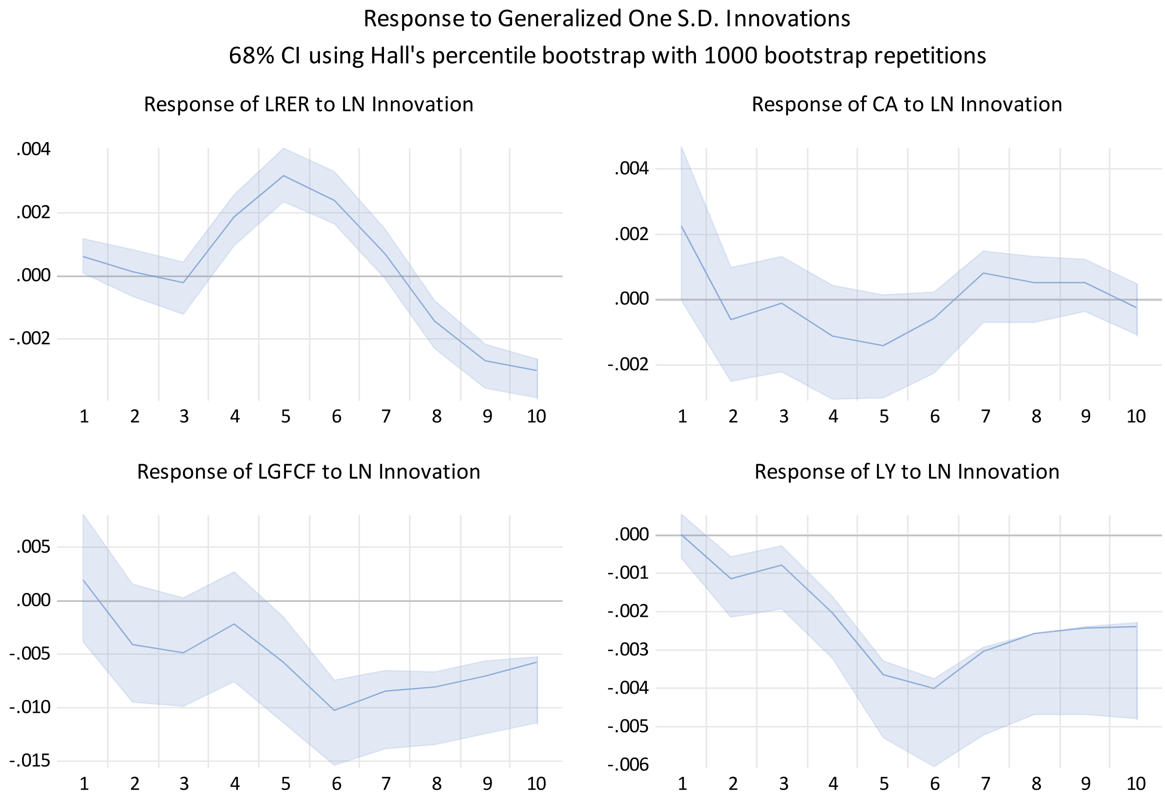


Fig. A3. Reaction of key variables to a gas price shock, EU15+2 VAR(5). Non-accumulated.
Note: Shadowed areas represent confidence intervals of one standard deviation.

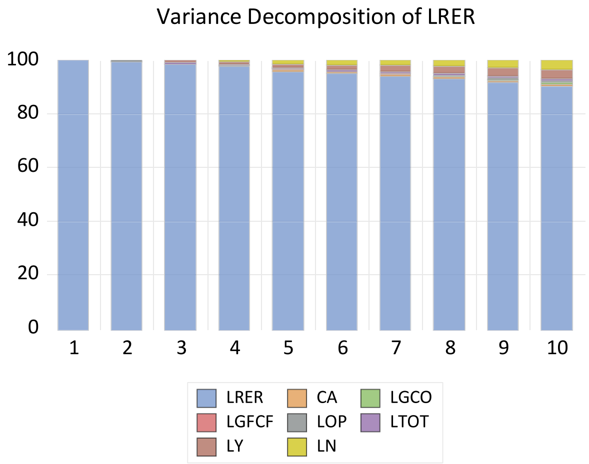
Granger causality test on VAR model Fig. 1

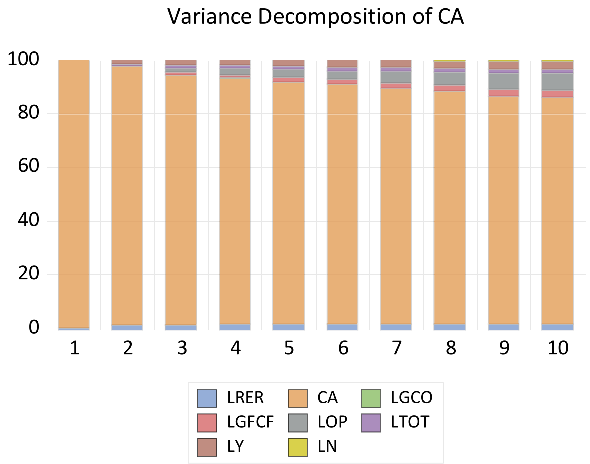
LRER	
Excluded	Prob.
CA	0.105325
LGCO	0.339678
LGFCF	0.673441
LOP	0.063745
LTOT	0.007050
LY	0.043721
LN	0.000000
All	0.000000

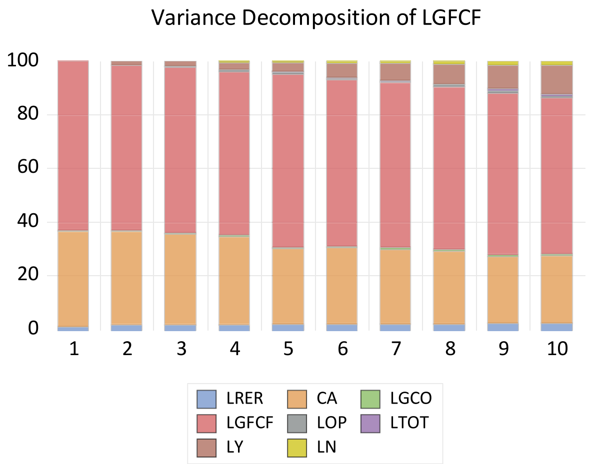
CA	
Excluded	Prob.
LRER	0.005399
LGCO	0.607607
LGFCF	0.030182
LOP	0.000000
LTOT	0.020824
LY	0.000000
LN	0.050150
All	0.000000

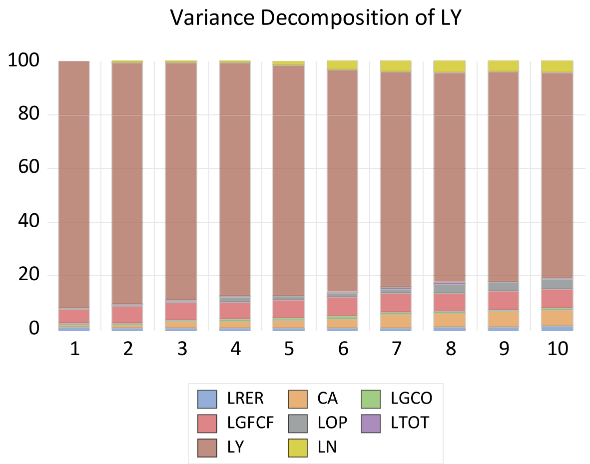
LY	
Excluded	Prob.
LRER	0.241671
CA	0.001486
LGCO	0.090788
LGFCF	0.041981
LOP	0.000000
LTOT	0.129071
LN	0.000000
All	0.000000

LGFCF	
Excluded	Prob.
LRER	0.158703
CA	0.000188
LGCO	0.088608
LOP	0.048797
LTOT	0.322959
LY	0.000000
LN	0.444854
All	0.000000









References

Amano, Robert A., van Norden, Simon, 1995a. Terms of trade and real exchange rates: the Canadian evidence. J. Int. Money Finance 14 (1), 83–104.

Amano, Robert A., van Norden, Simon, 1998. Exchange rates and oil prices. Rev. Int. Econ. 6 (4), 683–694.

Bajo-Rubio, Oscar, Díaz-Roldán, Carmen, Esteve, Vicente, 2014. Sustainability of external imbalances in the OECD countries. Appl. Econ. 46 (4), 441–449.

Blanchard, Olivier, Giavazzi, Francesco, 2002. Current account deficits in the euro area: the end of the Feldstein-Horioka puzzle? Brookings Pap. Econ. Act. 2002 (2), 147–186.

Caballero, Ricardo J., Simsek, Alp, 2023. A note on temporary supply shocks with aggregate demand inertia. Am. Econ. Rev.: Insights 5 (2), 241–258.

Christidou, Maria, Panagiotidis, Theodore, 2010. Purchasing power parity and the European single currency: some new evidence. Econ. Model. 27 (5), 1116–1123.

Coleman, Simeon, Cuestas, Juan Carlos, 2021. Panel cointegration, quantile regressions, asymmetric adjustments and crises: the case of EU current accounts. Econ. Syst. 45 (4), 100870.

Cuestas, Juan Carlos, Gil-Alana, Luis A., 2018. Oil price shocks and unemployment in Central and Eastern Europe. Econ. Syst. 42 (1), 164–173.

Cuestas, Juan Carlos, Monfort, Mercedes, Shimbov, Bojan, 2022. Has the relationship between the real exchange rate and its fundamentals changed over time? Baltic J. Econ. 22 (2), 68–89.

Cuestas, Juan Carlos, Ordóñez, Javier, 2018. Oil prices and unemployment in the UK before and after the crisis: a Bayesian VAR approach. A note. Phys. A: Stat. Mech. Appl. 510, 200–207.

Cunado, Juncal, Gil-Alana, Luis A., Gracia, Fernando Pérez de, 2010. European current account sustainability: new evidence based on unit roots and fractional integration. East Econ. J. 36 (2), 177–187.

Draghi, Mario., 2012. Competitiveness of the Eurozone and Within the Eurozone', Speech at the Colloquium. Les défis de la compétitivité, Paris, 13 March. https://www.ecb.europa.eu/press/key/date/2012/html/sp120313.en.html.

Fornaro, Luca, Wolf, Martin, 2023. The scars of supply shocks: implications for monetary policy. J. Monet. Econ. https://www.sciencedirect.com/science/article/pii/S0304393223000417 November 9, 2023.

Gil-Alana, Luis A., 2000. 'Mean reversion in the real exchange rates. Econ. Lett. 69 (3), 285–288.

Gil-Alana, Luis A., Luqui, Natalia, Cunado, Juncal, 2008. Trade balance and exchange rate: unit roots, co-integration and long memory in the US and the UK'. Econ. Notes 37 (1), 59–74.

Golub, S., 1983. Oil prices and exchange rates. Econ. J. 93, 576–593.

Hamilton, J.D., 1983. Oil and the macroeconomy since world war II'. J. Polit. Econ. 99, 228–248.

Jimenez-Rodriguez, Rebeca, 2009. Oil price shocks and real GDP growth: testing for non-linearity. Energy J. 30 (1). http://www.iaee.org/en/publications/ejarticle.aspx?id=2295. October 31, 2022.
Jiménez-Rodríguez, Rebeca, Sánchez, Marcelo, 2005. Oil price shocks and real GDP growth: empirical evidence for some OECD countries. Appl. Econ. 37 (2), 201–228.
Krugman, P., 1983. Oil shocks and exchange rate dynamics. In: Frenkel, J.A. (Ed.), Exchange Rates and International Macroeconomics. University of Chicago Press.
Lane, P.R., Pels, B., 2012. Current Account Imbalances in Europe. IIIS Discussion Paper 397, Trinity College, Dublin. https://www.tcd.ie/triss/assets/PDFs/iiis/iiisdp397.pdf.
Ordóñez, Javier, Monfort, Mercedes, Cuestas, Juan Carlos, 2019. Oil prices, unemployment and the financial crisis in oil-importing countries: the case of Spain. Energy 181, 625–634.
Ordóñez, Javier, Sala, Hector, Silva, José I., 2015. Real unit labour costs in Eurozone countries: drivers and clusters. IZA J. Eur. Labor Stud. 4 (1), 15.
Pesaran, H.Hashem, Shin, Yongcheol, 1998. Generalized impulse response analysis in linear multivariate models. Econ. Lett. 58 (1), 17–29.
Sims, Christopher A., 1980. Macroeconomics and reality. Econometrica 48 (1), 1–48.
Trichet, J.-C. 2011. 'Competitiveness and the smooth functioning of EMU'. Lecture at the University of Liège, 23 February. https://www.ecb.europa.eu/press/key/date/2011/html/sp110223.en.html.