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Panel cointegration, quantile regressions, asymmetric adjustments and crises: The case of EU current accounts

Simeon Coleman [a], Juan Carlos Cuestas [b,c,*]

[a] Loughborough University, Loughborough, LE11 3TU, UK
[b] Department of Economics and IEI, Jaume I University, Spain
[c] Department of Economics and Finance, Tallinn University of Technology, Estonia

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ABSTRACT

This paper investigates the relationships between the current account and several fundamentals, including the real exchange rate, government consumption, investment, openness, terms of trade and real income in the EU28 group of countries. A main feature of the study is that we also assess the relationships for two subgroups, the EU15 + Cyprus and Malta, and the CEECs. Using data spanning the period between 1995*q*1 and 2019*q*2, we identify similarities and differences between the responses in these two subgroups, which are obscured when an aggregate study of the EU28 is conducted, rather than sub-groups. Our results suggest that, in assessing the current account for economic blocs, an *a priori* assumption of similar relationships for member countries may be misplaced.

1. Introduction

Over the past half century, both advanced and emerging economies have experienced significant capital flows, often accompanied by large current account imbalances. These then raise some concerns regarding the potential adverse consequences of abrupt interruptions of these capital flows and their determinants (see, for example, Edwards, 2004). More recently, the significant capital flights that have been associated with the Great Recession of 2008 and the European Sovereign Debt crisis of 2010 have provided additional impetus for better understanding the determinants of countries' current accounts. Although such crises and phenomena have renewed both academic and policy interest in current account theory, much of the empirical focus has been on the country level, with a limited assessment of economic blocs. The relevance for economic blocs, such as the European Union (EU), should not be underestimated, since there are potential knock-on effects that capital flights will have on member states due to their high levels of economic integration.

Several theories including the intertemporal approach to the current account, initially proposed by Sachs (1981) and extended by Obstfeld and Rogoff (1995, 1996), and the Feldstein and Horioka model from the 1980s, have been utilized extensively in the extant literature, albeit typically for country-level analyses. The real economy implications of current account levels and imbalances have been highlighted in both OECD and developing country studies (see, for example, Arestis and Gonzalez-Martinez, 2016; Isgut, 2001). Although huge current account deficits are not necessarily detrimental if the capital is used for productive investments, there is wide

* Corresponding author at: Department of Economics and IEI, Jaume I University, Spain.
E-mail address: cuestas@uji.es (J.C. Cuestas).

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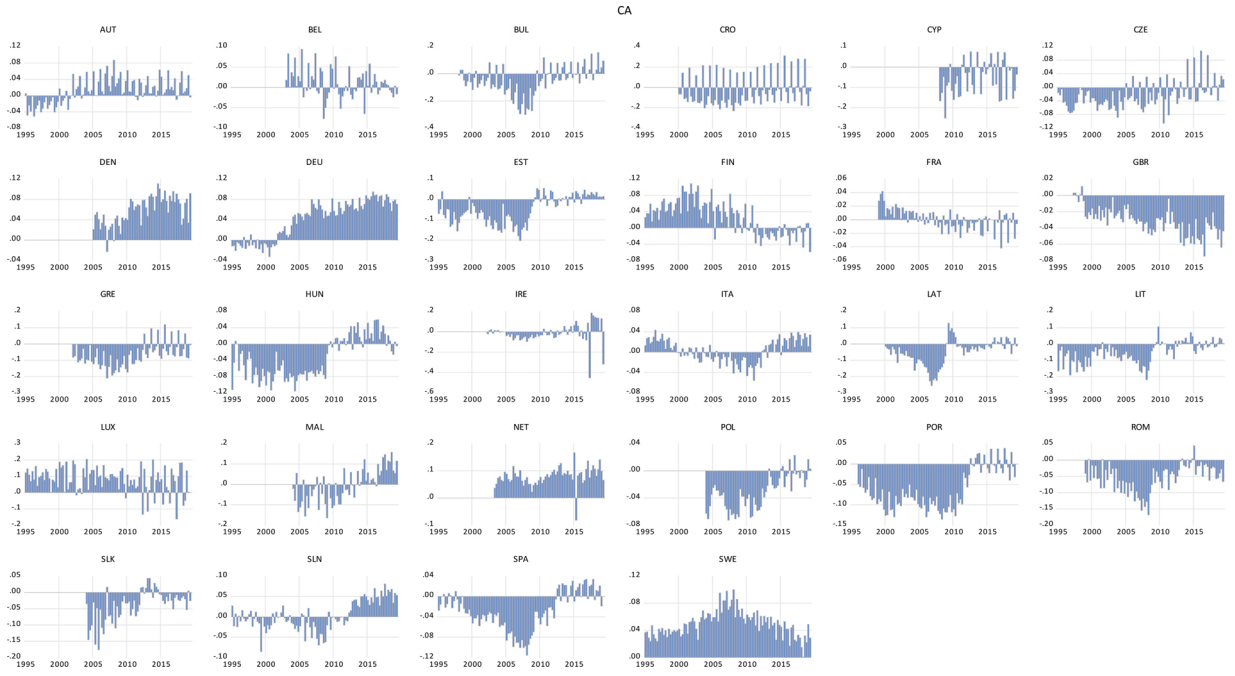

Fig. 1. Current account/GDP (for EU28 countries).
Source: Eurostat, seasonally unadjusted data.

agreement that the longer such deficits remain, the worse off future generations are likely to be as they are likely to be burdened with excessive debts and interest payments, particularly when unproductive investments have been made. On the other hand, countries with consistent current account surpluses may face upward pressure on their currencies and may need to take some bold steps to control such demand-driven currency appreciations and maintain their export competitiveness, e.g. Japan. Against this background, a critical assessment of current account evolution, determinants and drivers is crucial for policy for both macro- and microeconomic stability. While the current account, similar to the tip of an iceberg, is observable, credible policy formulation hinges on a better understanding of its relationship with the underlying determinants. It is this area to which this study aims to contribute.

The EU, being an economic and political union of countries and operating an internal (or single) market that allows free movement of goods, capital, services and people between member states, lends itself well to analysing an economic bloc. The integration features enshrined within the EU, particularly the common currency for the nineteen euro members, and the trade and political ties among the countries present an appropriate case to analyse the determinants of the current account within such an economic bloc. This study focuses on the EU28 group of countries on the premise that the current account helps to accommodate adjustments to various shocks and provides a crucial link between the EU countries and other economies. Further, the mechanics of TARGET2, a real-time gross settlement system operated by the Eurosystem, implies that central and commercial banks can submit payment orders to TARGET2 for processing and settlement in central bank money. The system aims to prevent a sudden stop for euro area countries as foreign private debt is substituted by foreign public debt in the event of a crisis. In addition, analyses of the evolution and determinants of the current account are a key issue in the EU political economy agenda, due to the potentially negative effect of uncontrolled current accounts on future generations, and on the credibility of member states risking failure to repay accumulated external debt.[1] Of the aforementioned features, the relevant one our study focuses on is the free flow of capital, which in turn affects each country's current account. In this investigation, we employ several empirical methodologies, namely the dynamic OLS (DOLS) approach, the Bayesian vector autoregressive (BVAR) model and quantile regressions, to estimate a panel data model for the current account. More specifically, we estimate long-run equations by means of DOLS in a panel framework, where the current account (hereafter *CA*) is determined by the real exchange rate (*RER*), *government consumption*, *investment*, *openness* as the sum of exports and imports over GDP, *terms of trade* and *real income*. Further, in order to investigate possible nonlinearities, we also account for structural breaks and investigate asymmetric effects for periods following currency appreciations and depreciations. Furthermore, as a robustness check, we also estimate Bayesian panel vector autoregressive models (BVARs). These are complemented by generalised impulse response functions (IRFs) (Pesaran and Shin, 1998). For completeness and to determine whether differences exist between groupings within the EU28 group, we also consider the EU15 + 2 group and the CEEC groups. The joint evidence from these estimators supports the view that considering structural breaks and possible nonlinear behaviours is important in empirical analyses. A main finding of the study, however, is that while an assessment

[1] The Macroeconomic Imbalance Procedure, the legal arm under the EU economic governance reforms of 2011 monitoring the current accounts of the EU countries, underscores the importance.

Table 1
DOLS long-run estimates (full sample period).

Variable	All	CEECs Pooled	EU15 + 2	All	CEECs Pooled (weighted)	EU15 + 2	All	CEECs Group Mean	EU15 + 2
q	0.04* (0.02)	0.11*** (0.03)	−0.04 (0.03)	0.01 (0.02)	0.10*** (0.03)	−0.03 (0.02)	−0.02 (0.03)	0.05 (0.04)	0.06 (0.11)
gco	−0.09*** (0.02)	0.08*** (0.03)	−0.24*** (0.03)	−0.14*** (0.02)	0.10*** (0.03)	−0.25*** (0.02)	−0.13*** (0.03)	0.03 (0.04)	0.19*** (0.07)
gfcf	−0.22*** (0.01)	−0.26*** (0.02)	−0.19*** (0.01)	−0.21*** (0.01)	−0.25*** (0.02)	−0.20*** (0.01)	−0.19*** (0.01)	−0.22*** (0.02)	0.07 (0.05)
op	0.02 (0.01)	0.03* (0.01)	0.01 (0.02)	0.01 (0.01)	0.02 (0.02)	0.00 (0.01)	0.01 (0.02)	0.06*** (0.02)	−0.11*** (0.04)
tot	0.13*** (0.03)	0.23*** (0.04)	0.29*** (0.04)	0.13*** (0.02)	0.23*** (0.04)	0.24*** (0.03)	0.32*** (0.07)	0.28*** (0.07)	0.27** (0.12)
y	0.33*** (0.03)	0.24*** (0.04)	0.43*** (0.03)	0.35*** (0.03)	0.23*** (0.04)	0.43*** (0.03)	0.27*** (0.04)	0.09*** (0.05)	−0.12 (0.14)
Adj-R^2	0.76	0.78	0.75	0.75	0.78	0.75	–	–	–
No. obs.	2295	925	1370	2295	925	1370	2295	925	1361
No. countries	28	11	17	28	11	17	28	11	17

Notes: ***, **, * indicate significance at the 1%, 5% and 10 % levels, respectively.

Table 2
DOLS long-run estimates (with break in 2008*q*1).

Variable	All	CEECs	EU15 + 2	All	CEECs	EU15 + 2	All	CEECs	EU15 + 2
pre- 2008q1		Pooled			Pooled (weighted)			Group Mean	
q	0.01 (0.03)	0.10** (0.04)	−0.01 (0.03)	−0.02 (0.02)	0.05 (0.04)	0.00 (0.03)	−0.05 (0.13)	0.10 (0.13)	−0.17 (0.20)
gco	−0.11*** (0.02)	0.04 (0.04)	−0.40*** (0.05)	−0.15*** (0.02)	0.05 (0.04)	−0.37*** (0.04)	−0.10 (0.09)	−0.11 (0.10)	−0.09 (0.14)
gfcf	−0.21*** (0.02)	−0.24*** (0.03)	−0.19*** (0.02)	−0.21*** (0.02)	−0.21*** (0.03)	−0.21*** (0.00)	−0.16*** (0.03)	−0.14*** (0.04)	−0.17*** (0.05)
op	0.02 (0.02)	−0.02 0.02	0.06** (0.03)	0.03** (0.01)	−0.00 (0.02)	0.05** (0.02)	0.06 (0.05)	−0.08 (0.05)	0.15* (0.08)
tot	0.03 (0.04)	0.20** (0.08)	0.27*** (0.06)	0.07** (0.03)	0.19*** (0.07)	0.23*** (0.05)	0.41*** (0.15)	0.35* (0.19)	0.44** (0.20)
y	0.26*** (0.04)	0.20*** (0.05)	0.48*** (0.06)	0.30*** (0.04)	0.17*** (0.05)	0.49*** (0.05)	0.07 (0.13)	0.04 (0.14)	0.10 (0.19)
post- 2008q1									
q	−0.03 (0.04)	0.14* (0.08)	−0.04 (0.04)	−0.02 (0.03)	0.05 (0.07)	−0.02 (0.03)	0.19*** (0.06)	0.41*** (0.09)	0.04 (0.09)
gco	−0.16*** (0.04)	0.09 (0.06)	−0.32*** (0.04)	−0.15*** (0.03)	0.14** (0.06)	−0.26*** (0.03)	−0.14*** (0.04)	0.00 (0.06)	−0.24*** (0.06)
gfcf	−0.23*** (0.01)	−0.20*** (0.02)	−0.25*** (0.04)	−0.22*** (0.01)	−0.17*** (0.02)	−0.25*** (0.01)	−0.18*** (0.02)	−0.19*** (0.02)	−0.17*** (0.02)
op	0.01 (0.07)	0.08** (0.03)	−0.02 (0.02)	0.04** (0.02)	0.11*** (0.03)	0.01 (0.02)	0.05* (0.03)	0.09*** (0.03)	0.01 (0.04)
tot	0.10 (0.07)	0.21 (0.14)	0.14** (0.06)	0.09** (0.04)	0.25* (0.13)	0.11*** (0.04)	0.25** (0.10)	0.02 (0.15)	0.40 (0.12)
y	0.43*** (0.04)	0.15** (0.07)	0.57*** (0.04)	0.38*** (0.04)	0.07 (0.07)	0.51*** (0.05)	0.23*** (0.05)	0.08 (0.06)	0.33 (0.07)
Adj-R^2	0.84	0.86	0.83	0.84	0.86	0.83	–	–	–
No. obs.	1877	803	1074	1877	803	1074	2252	927	1325
No. of countries	21	9	12	21	9	12	27	11	16

Notes: ***, **, * indicate significance at the 1%, 5% and 10 % levels, respectively.

Table 3
DOLS equality of long-run estimates restrictions model (with break in 2008*q*1).

	All	CEECs Pooled	EU15 + 2	All	CEECs Pooled (weighted)	EU15 + 2	All	CEECs Group mean	EU+2
Test Statistic *F-statistic Chi-square*	P-value 0.00 0.00	P-value 0.00 0.00	P-value 0.06 0.06	P-value 0.00 0.00	P-value 0.00 0.00	P-value 0.12 0.12	P-value 0.03 0.02	P-value 0.00 0.00	P-value 0.38 0.38
Normalized Restriction (= 0)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)
q(t<2008Q1)- q (t>2007Q4)	0.03 (0.05)	−0.04 (0.08)	0.03 (0.06)	0.00 (0.03)	0.00 (0.07)	0.02 (0.04)	−0.25 (0.15)	−0.30 (0.16)	−0.20 (0.22)
gco(t<2008Q1)- gco (t>2007Q4)	0.05 (0.05)	−0.06 (0.07)	−0.07 (0.06)	−0.00 (0.04)	−0.09 (0.07)	−0.11 (0.05)	0.04 (0.10)	−0.11 (0.12)	0.14 (0.15)
gfcf(t<2008Q1)- gfcf (t>2007Q4)	0.03 (0.02)	−0.04 (0.03)	0.06 (0.03)	0.02 (0.02)	−0.03 (0.03)	0.04 (0.03)	0.02 (0.04)	0.04 (0.04)	−0.00 (0.05)
op(t<2008Q1)- op (t>2007Q4)	0.00 (0.03)	−0.09 (0.04)	0.08 (0.03)	−0.01 (0.02)	−0.11 (0.04)	0.04 (0.03)	0.01 (0.05)	−0.17 (0.06)	0.13 (0.08)
tot(t<2008Q1)- tot (t>2007Q4)	−0.07 (0.08)	−0.02 (0.16)	0.13 (0.09)	−0.02 (0.05)	−0.06 (0.15)	0.12 (0.06)	0.16 (0.17)	0.32 (0.24)	0.04 (0.23)
y(t<2008Q1)- y (t>2007Q4)	−0.16 (0.06)	0.05 (0.08)	−0.10 (0.07)	−0.09 (0.05)	0.10 (0.09)	−0.02 (0.07)	−0.15 (0.13)	−0.04 (0.15)	−0.23 (0.20)

Table 4
DOLS long-run asymmetric model estimates (Appreciation vs Depreciation).

Variable *Appreciation t-1*	All	CEECs Pooled	EU15 + 2	All	CEECs Pooled (weighted)	EU15 + 2	All	CEECs Group Mean	EU15 + 2
q	0.11*** (0.03)	0.18*** (0.04)	0.02 (0.05)	0.07*** (0.02)	0.17*** (0.04)	−0.01 (0.04)	−0.00 (0.07)	0.08 (0.05)	−0.06 (0.11)
gco	−0.08*** (0.03)	0.08** (0.04)	−0.28*** (0.04)	−0.12*** (0.02)	0.08** (0.04)	−0.25*** (0.04)	−0.16*** (0.04)	0.00 (0.05)	−0.27*** (0.06)
gfcf	−0.24*** (0.02)	−0.28*** (0.02)	−0.21*** (0.02)	−0.23*** (0.01)	−0.27*** (0.02)	−0.21*** (0.02)	−0.20*** (0.02)	−0.23*** (0.02)	−0.18*** (0.03)
op	0.01 (0.02)	0.02 (0.02)	0.00 (0.03)	0.01 (0.02)	0.02 (0.02)	0.01 (0.02)	0.00 (0.03)	0.05* (0.03)	−0.03 (0.04)
tot	0.17*** (0.04)	0.32*** (0.06)	0.24*** (0.07)	0.17*** (0.04)	0.33*** (0.06)	0.22*** (0.05)	0.47*** (0.13)	0.30*** (0.09)	0.58*** (0.20)
y	0.32*** (0.04)	0.22*** (0.05)	0.47*** (0.06)	0.35*** (0.04)	0.21*** (0.05)	0.43*** (0.05)	0.28*** (0.07)	0.11* (0.06)	0.39*** (0.11)
Depreciation t-1									
q	−0.08*** (0.03)	0.09 (0.06)	−0.19*** (0.03)	−0.08*** (0.02)	0.09* (0.05)	−0.15*** (0.03)	−0.00 (0.07)	0.12 (0.07)	−0.09 (0.11)
gco	−0.10*** (0.03)	0.02 (0.04)	−0.15*** (0.04)	−0.14*** (0.02)	0.02 (0.04)	−0.19*** (0.03)	−0.14** (0.06)	0.02 (0.06)	−0.25*** (0.09)
gfcf	−0.16*** (0.02)	−0.18*** (0.03)	−0.19*** (0.02)	−0.16*** (0.02)	−0.16*** (0.02)	−0.18*** (0.02)	−0.19*** (0.02)	−0.18*** (0.02)	−0.19*** (0.03)
op	0.05*** (0.01)	0.08*** (0.02)	−0.00 (0.02)	−0.16*** (0.02)	0.07*** (0.02)	0.00 (0.01)	0.00 (0.03)	0.03 (0.03)	−0.00 (0.05)
tot	0.17*** (0.05)	0.16** (0.07)	0.35*** (0.08)	0.20*** (0.05)	0.17*** (0.07)	0.31*** (0.06)	0.13 (0.13)	−0.10 (0.15)	0.27 (0.19)
y	0.26*** (0.04)	0.11** (0.05)	0.38*** (0.05)	0.30*** (0.03)	0.10** (0.05)	0.38*** (0.04)	0.32*** (0.07)	0.10 (0.07)	0.46 (0.10)
Adj-R^2	0.74	0.76	0.73	0.75	0.76	0.73	–	–	–
No. obs.	2233	920	1313	2233	920	131	2279	920	1359
No. countries	27	11	16	27	11	16	28	11	17

Notes: ***, **, * indicate significance at the 1%, 5% and 10 % levels, respectively.

of the current account for the entire economic bloc is important, the relationships for subgroups within the bloc may differ.

2. Brief literature review and background: Potential determinants of current account balances

Despite the relatively extensive body of theoretical literature on the subject, there are comparatively few comprehensive studies empirically analysing the current account fundamentals for economic blocs within a panel framework. Related and relevant work in this area includes studies on the OECD (see, among others, Trehan and Walsh, 1991; Wu, 2000; Wu et al., 2001; and Harkmann and

Table 5
DOLS long-run equality restrictions, asymmetric model.

	All	CEECs Pooled	EU15 + 2	All	CEECs Pooled (weighted)	EU15 + 2	All	CEECs Group mean	EU15 + 2
Test Statistic	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value	P-value
F-statistic	0.00	0.00	0.01	0.00	0.00	0.14	0.55	0.08	0.91
Chi-square	0.00	0.00	0.01	0.00	0.00	0.14	0.55	0.08	0.91
Normalized Restriction (= 0)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)	Value (std. Error)
q(apre)- q(depre)	0.19 (0.05)	0.09 (0.08)	0.21 (0.06)	0.15 (0.03)	0.08 (0.07)	0.13 (0.06)	0.00 (0.10)	−0.04 (0.09)	0.03 (0.15)
gco(apre)- gco (depre)	0.02 (0.04)	0.06 (0.05)	−0.12 (0.07)	0.02 (0.04)	0.07 (0.05)	−0.07 (0.05)	−0.02 (0.07)	−0.02 (0.06)	−0.02 (0.11)
gfcf(apre)- gfcf (depre)	−0.08 (0.03)	−0.10 (0.03)	−0.02 (0.04)	−0.07 (0.02)	−0.11 (0.03)	−0.02 (0.03)	−0.01 (0.03)	−0.05 (0.03)	0.01 (0.05)
op(apre)- op(depre)	−0.04 (0.02)	−0.06 (0.03)	0.01 (0.03)	−0.03 (0.02)	−0.05 (0.03)	0.01 (0.03)	−0.00 (0.04)	0.02 (0.04)	−0.02 (0.06)
tot(apre)- tot(depre)	0.00 (0.07)	0.16 (0.10)	−0.10 (0.12)	−0.03 (0.07)	0.15 (0.10)	−0.08 (0.10)	0.34 (0.18)	0.41 (0.18)	0.30 (0.28)
y(apre)-y(depre)	0.06 (0.06)	0.11 (0.07)	0.09 (0.08)	0.05 (0.05)	0.11 (0.07)	0.05 (0.07)	−0.04 (0.09)	0.01 (0.08)	−0.07 (0.15)

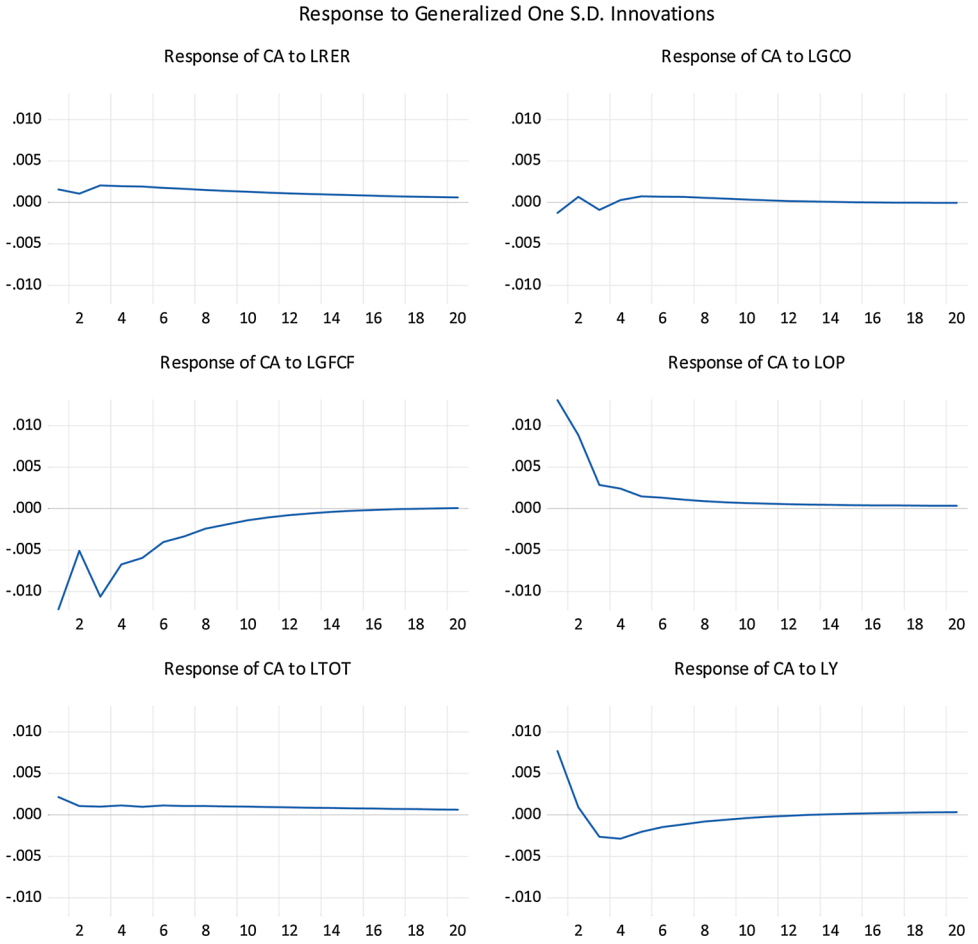

Fig. 2. BVAR Impulse Response Functions (full sample period).

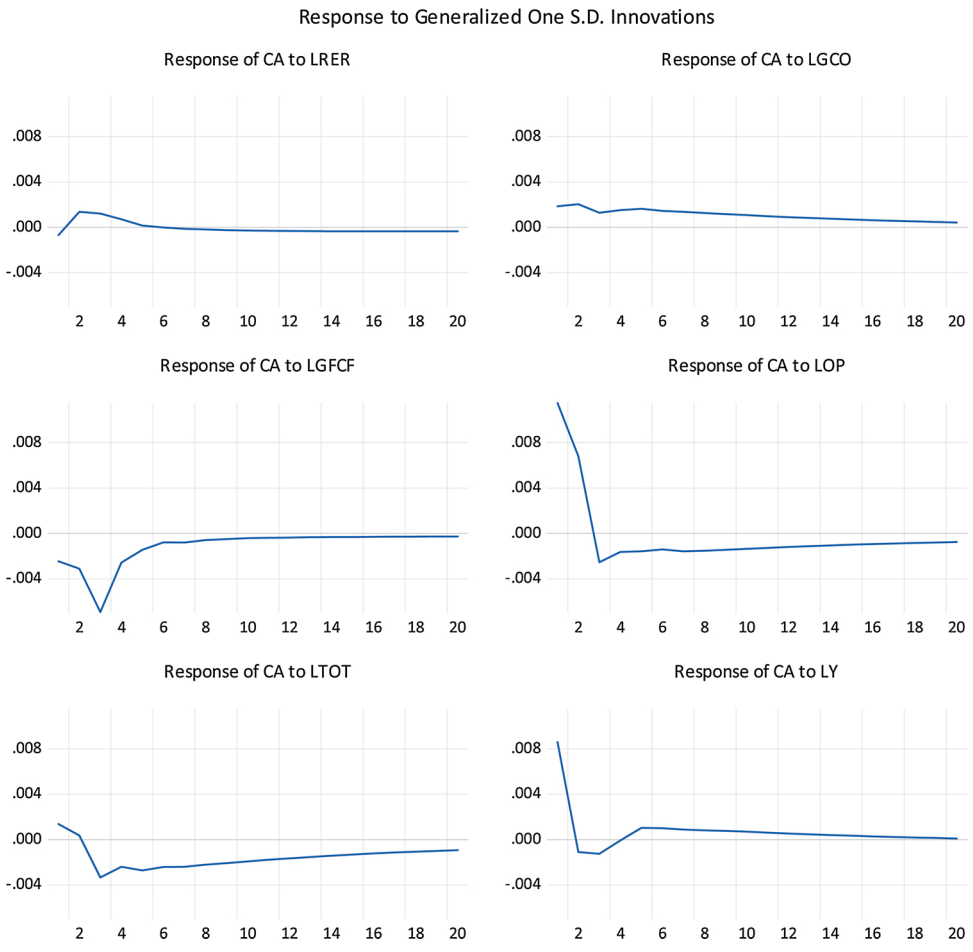

Fig. 3. BVAR Impulse Response Functions (for EU28, pre-2008*q*1).

Staehr, 2020; the latter for central and eastern European countries).

As an initial step, prior to any estimations, it is instructive to determine the order of stationarity of the variables, since for situations where the variable is non-stationary, i.e. *I*(1), shocks to the variable will have permanent effects and empirical analyses of the determinants should rely on, say, cointegration techniques. By applying unit-root tests, Cuestas (2013) finds that for the CEECs, the *CA*s are nonstationary processes, underscoring the importance of establishing the order of stationarity of the variable for appropriate modelling (see also Cunado et al., 2010). Since the *CA* is a record of a nation's transactions with the rest of the world, it is intuitive to expect that *RER* will be a key determinant in the evolution of the *CA*.[2] Intuitively, the expected relationship between the *RER* and the *CA* will be negative, since an appreciation of the currency should make national products more expensive and hence negatively impact the competitiveness of the country's exports. In reality, however, capital inflows into a country depend on *expectations* of movements in a currency over the maturity of investments, i.e. an *expected* appreciation should decrease the *CA*, and *vice versa*. However, since *realised* movements in *RER* do not always mimic the *expected* changes in the *RER* in the next period, we consider it best to err on the side of caution and consider the sign of the relationship to be ambiguous. By its very definition, the current account informs regarding the value of imports relative to exports, and thus factors that influence exports (and imports) are likely to influence the current account. In relation to the RER, the relative elasticity of imports and exports is likely to be instrumental in determining the current account balance, as posited by the theoretical J-Curve. Next, *Government Consumption* serves as a proxy of the size and impact of the public sector in economies where public spending is key in the catching-up process. For a major market such as the EU, a sizable proportion of the products/services consumed by the public sector is imported, which has implications for the *CA*. We note, however, that in practice, the sign of its relationship with the *CA* will depend on the proportion of *tradeables* and *non-tradeables* in the EU governments' expenditure. Studies including Bouakez and Kano (2008) consider the relationship between the *CA* and the terms of trade (*tot*). Intuitively, the *tot* proxies the relative price of exports versus imports from the main trade partners, and changes in the *tot* will affect

[2] The current account is here defined as a country's net trade in goods and services, its net earnings on cross-border investments, and its net transfer payments over a defined period.

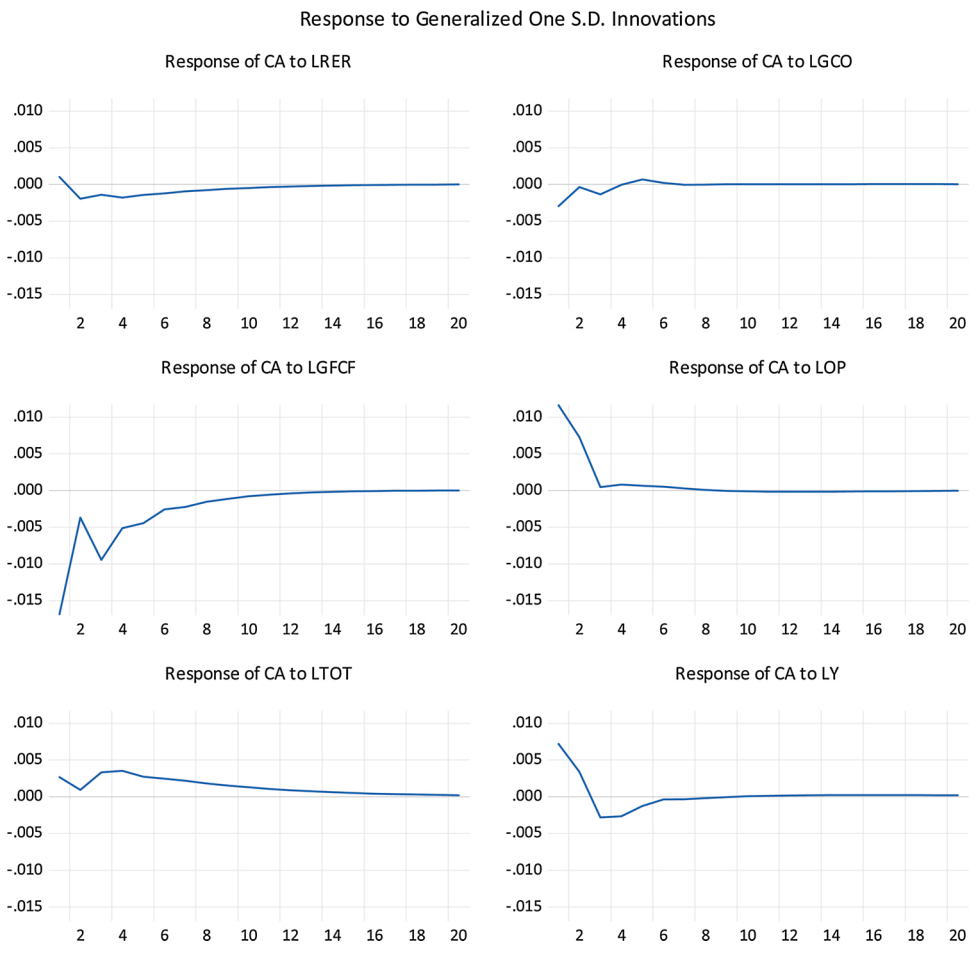

Fig. 4. BVAR Impulse Response Functions (for EU28 group, post-2008*q*1).

import demand and exports (see for example, Cashin and McDermott, 1998). Typically, the effects of the *tot* on the *CA* may be disaggregated into *income* and *substitution* effects. For completeness, therefore, it is instructive for empirical studies including ours to incorporate the *tot* into the empirical modelling of the *CA*. Since the size of the income and substitution effects is not known *a priori*, i.e., depends on whether the income effect dominates the substitution effect, the expected effects and direction of the relationship between the *CA* and *tot* are also ambiguous. The role of financial and trade openness in determining the effect of current account reversals on economic performance (i.e., GDP growth) has also been explored by Edwards (2004). Following on from the variables considered in some of the extant literature, this study includes *Investment* (proxied by the *Gross Fixed Capital Formation*, *gfcf*) and *Real Income* (*y*) in our model to control for their potential effects in the evolution of the *CA*. The expected signs of the relationship between the *CA* and these two variables depend on whether *gfcf* and *y* have dominant demand or supply effects on the given economy.[3] Both of these variables have the potential to affect a country's marginal propensity to import. Although in theory an increase in income is likely to result in an increase in imports, the observed effects will be dependent on the country's marginal propensity to import. The higher this is, the more likely it is that income growth will be associated with a current account deficit. Another consideration is what may be driving real income changes, particularly whether they are driven by export, like in China and Germany, or by investment. Intuitively, export-driven income growth will be associated with a current account surplus, but not necessarily with investment-driven growth – at least not in the short run due to time lags between investment, capacity expansion and the realisation of output increases.

[3] For the sake of brevity, we refer the interested reader to Genberg and Alexander (1992) for a detailed description of the savings and investment current account nexus. The paper also provides evidence to support the stance of the strong correlation between national savings and investment rates. Table B1 presents a list and descriptions of the determinants considered in this study.

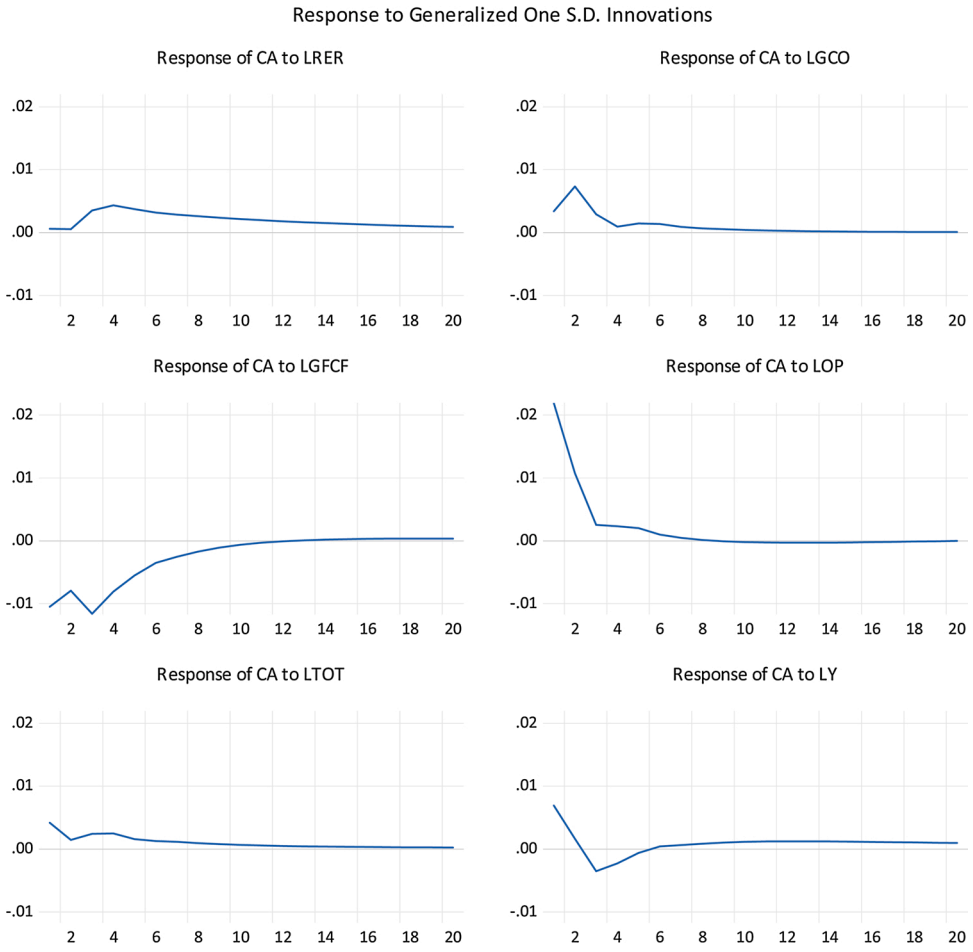

Fig. 5. BVAR Impulse Response Functions (for CEEC group).

3. Empirical approach

3.1. Data

We use quarterly data for the EU28 countries for the log of the real effective exchange rate, deflated by the consumer price index for the main 37 trading industrial country partners, with an increase indicating an appreciation in real terms (*q*), the current account as a proportion of GDP (*CA*), the log of real government consumption (*gco*), the log of real gross fixed capital formation (*gfcf*), the log of trade openness defined as the sum of exports and imports as a proportion of GDP (*op*), the log of the terms of trade, calculated as the ratio between export prices and import prices (*tot*), and the log of the real GDP (*y*). The *CA* data for our target countries are displayed in Fig. 1. All our data is sourced from *Eurostat* and, 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. Due to some country-level data limitations our dataset, spanning 1995*q*1–2019*q*2, is unbalanced.[4]

3.2. Methodological approaches

This section provides a brief description of the estimation methods we employ to examine the relationships between the *CA* and the fundamentals across the EU28 countries. In addition, we also analyse the significance of the fundamentals for two groups of countries – the CEECs and the EU15 + 2 countries.[5] First, our long-run relationships are estimated by means of the dynamic OLS (DOLS) approach,

[4] Appendix A1 presents some definitions of the groupings used in this study. A2 shows the specific time periods for each country.

[5] Given the issue of the UK's exit from the EU (Brexit), we conducted the analyses without including the UK to determine whether exclusion of the UK from the analyses makes any significant difference, and the results were qualitatively similar. The authors will be happy to provide these results if required.

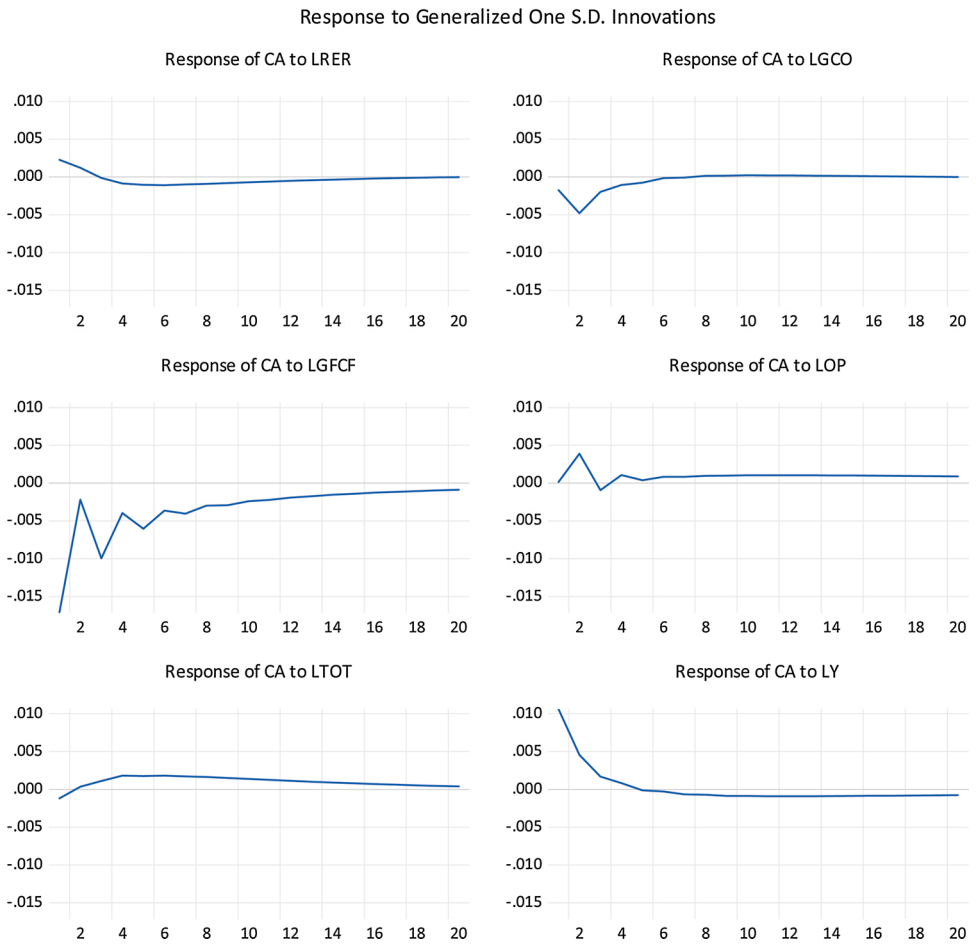

Fig. 6. BVAR Impulse Response Functions (for EU15 + 2 group).

proposed by Stock and Watson (1993). The approach estimates panel cointegrated relationships with contemporaneous levels of the explanatory variables and includes leads and lags of the explanatory variables in first differences to control for endogeneity.[6] Second, we assess the relationship by employing the Bayesian VAR (BVAR) approach and obtain impulse response functions (IRFs) based on a structural BVAR. Since in such cases the inferences are not based on the *t*-ratios, the order of integration of variables is not relevant in Bayesian analysis (Sims, 1988). As a final step, we estimate quantile regressions that allow us to obtain estimated coefficients, conditional on quantiles of values of the dependent variable. A notable advantage of this approach is that it allows us to estimate the long-run equation for even relatively large deviations from the mean.

3.2.1. *Econometric specification*

Our cointegrated baseline relationship is specified as follows:

$$CA_{i,t} = c + \beta_1 q_{i,t} + \beta_2 gco_{i,t} + \beta_3 gfcf_{i,t} + \beta_4 op_{i,t} + \beta_5 tot_{i,t} + \beta_6 y_{i,t} + leads\ and\ lags + \varepsilon_{i,t} \quad (1)$$

where $CA_{i,t}$ is the current account as a proportion of GDP, q_{ti} is the log of the REER, $gco_{i,t}$ is the log of government consumption in real terms, $gfcf_{i,t}$ is the log of the gross fixed capital formation in real terms as a proxy for investment, $op_{i,t}$ is the log of the sum of exports and imports over GDP, $tot_{i,t}$ is the log of the ratio of export prices over import prices, and $y_{i,t}$ is real income.

Next, we also estimate a model account for the effect of the Great Recession of the form:

$$\begin{aligned} ca_{ti} &= d2008 * (\beta_1 q_{ti} + \beta_2 gco_{ti} + \beta_3 gfcf_{ti} + \beta_4 op_{ti} + \beta_5 tot_{ti} + \beta_6 y_{ti}) + \\ & d2008on * (\beta_7 q_{ti} + \beta_8 gco_{ti} + \beta_9 gfcf_{ti} + \beta_{10} op_{ti} + \beta_{11} tot_{ti} + \beta_{12} y_{ti}) \\ & + c_i + \gamma_t d2008on + leads\ and\ lags + \varepsilon_{i,t} \end{aligned} \quad (2)$$

[6] Kao and Chiang (2001) show that the DOLS estimation method performs better than fully modified ordinary least squares (FMOLS) or ordinary least squares (OLS).

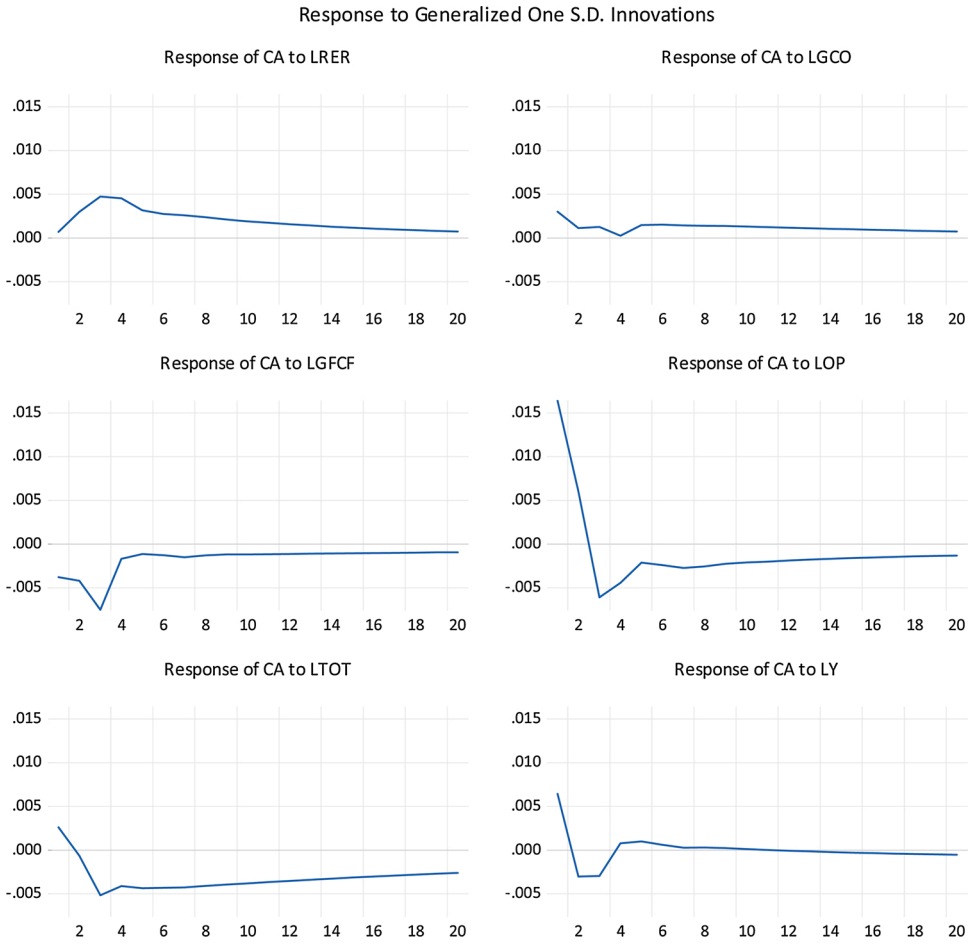

Fig. 7. BVAR Impulse Response Functions (for CEECs): pre-2008q1.

where $d2008$ is an indicator function that takes the value 1 if the date is before 2008q1 and zero otherwise and $d2008on$, which takes the value one if the date is posterior to 2007q4. In this way we can assess how the crisis may have changed the relationship between the CA and its fundamentals.

Finally, in order to account for the effect of appreciations and depreciations of the RER, we estimate the following asymmetric model:

$$\begin{aligned} ca_{ti} = {} & apre * (\beta_1 q_{ti} + \beta_2 gco_{ti} + \beta_3 gfcf_{ti} + \beta_4 op_{ti} + \beta_5 tot_{ti} + \beta_6 y_{ti}) \\ & + depre * (\beta_7 q_{ti} + \beta_8 gco_{ti} + \beta_9 gfcf_{ti} + \beta_{10} op_{ti} + \beta_{11} tot_{ti} + \beta_{12} y_{ti}) \\ & + c_i + \pi_i apre + leads\ and\ lags + \varepsilon_{i,t}, \end{aligned} \tag{3}$$

where *apre* is an indicator variable that takes the value 1 if the RER appreciated in t-1 and 0 otherwise and *depre* is an indicator variable that takes the value 1 if the RER depreciated in t-1 and 0 otherwise. The estimation methods we employed in this study are briefly described in what follows:

3.2.1.1. The DOLS model. In brief, the DOLs model can be represented as:

$$y_t = \beta_0 + \vec{\beta}_i X + \sum\nolimits_{j=-q}^{p} \vec{\alpha}_j \Delta X_{t-j} + \varepsilon_t \tag{4}$$

where y_t represents the dependent variable, X is the vector of explanatory variables, $\vec{\beta}_i$ is the cointegrating vector, and p and q are the lag and lead lengths, respectively. In our study, we account for the heterogeneity of the panel by using different methods, namely pooled regressions, pooled weighted and group mean.

3.2.1.2. Bayesian VAR approach. To account for the crisis and the asymmetric model in Eqs. (2) and (3), we here estimate the panel BVARs and use the Normal-Wishart prior, which is a standardization of the Litterman (1986) Minnesota prior. The assumption is that

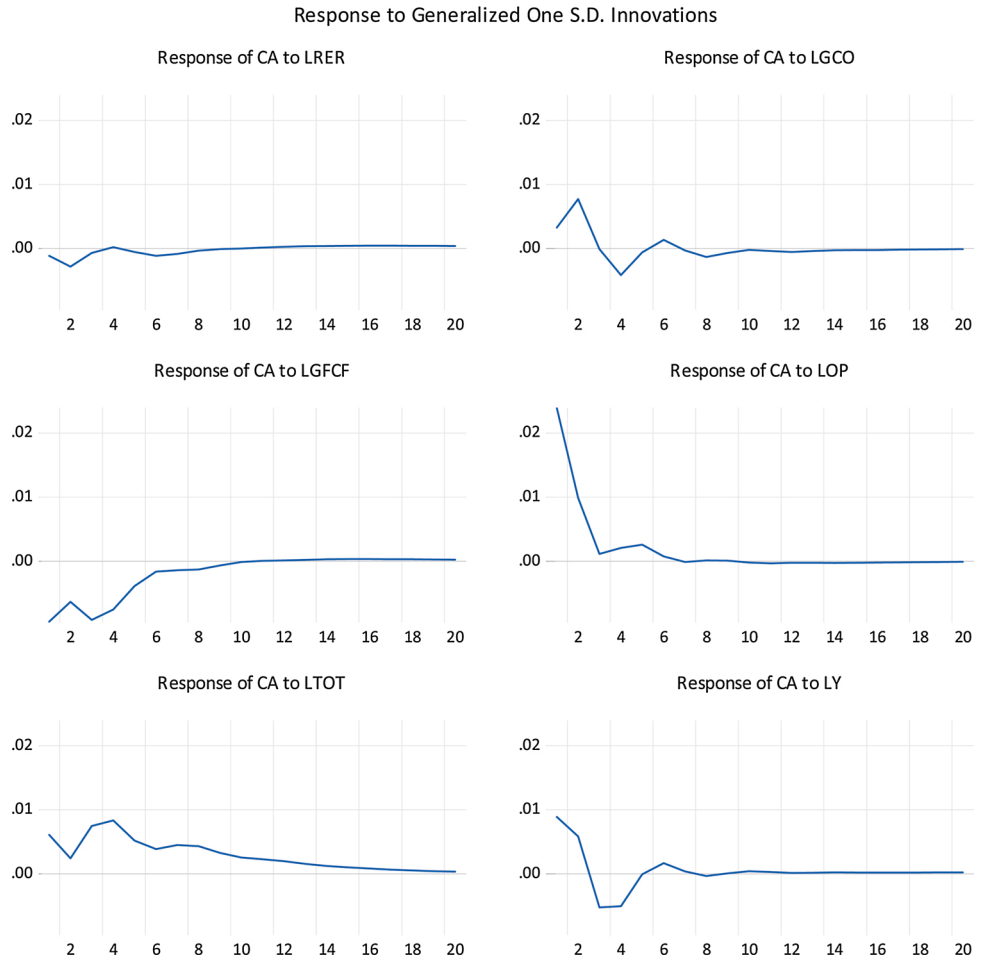

Fig. 8. BVAR Impulse Response Functions (for CEECs): post-2008*q*1.

the variables are *I*(1) and that the variance-covariance is unknown. Hence, the coefficients' variance is obtained as follows,

$$\sigma_{\delta_{ii}}^2 = \left(\frac{\lambda_1}{l^{\lambda_3}}\right)^2 \tag{5}$$

and

$$\sigma_{\delta_{ij}}^2 = \left(\frac{\sigma_i^2}{\sigma_j^2}\right)\left(\frac{\lambda_1\lambda_2}{l^{\lambda_3}}\right) \tag{6}$$

with $\lambda_1 = 0.1$, $\lambda_2 = 1$ *and* $\lambda_3 = 1$.

3.2.1.3. Quantile regressions analyses. The method to estimate the coefficients for a given quantile minimises the following function:

$$Q(\beta_q) = \sum_{i:y_i \geq x_i'\beta}^{N} q|y_i - x_i'\beta| + \sum_{i:y_i < x_i'\beta}^{N} (1-q)|y_i - x_i'\beta|, \tag{7}$$

where β_q are the estimated parameters for a regression conditional to *y,* and the quantile *q* splits the data into proportions *q* below and 1-*q* above. The coefficients are obtained so they minimise a sum that gives asymmetric penalties (1-*q*)$|e_i|$ for overprediction and *q*$|e_i|$ for underprediction, where e_i is the model prediction error.

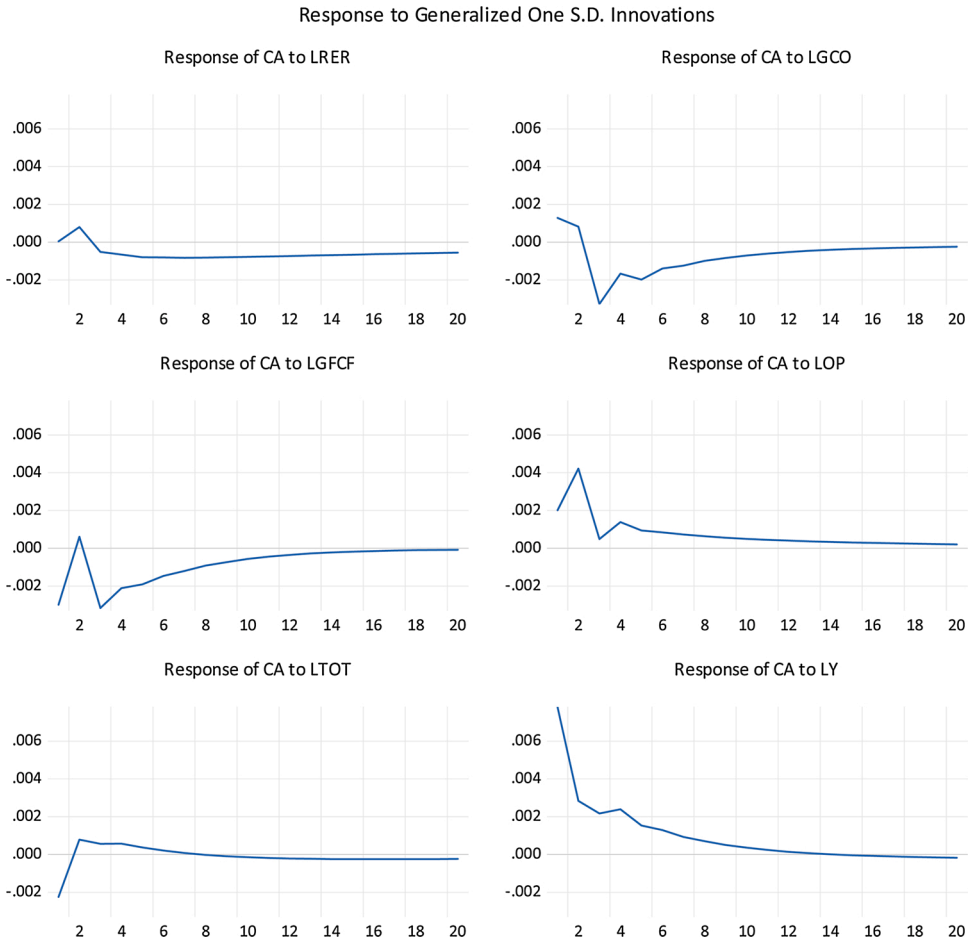

Fig. 9. BVAR Impulse Response Functions (for EU15 + 2 group): pre-2008*q*1.

4. Results and discussion

Our preliminary analysis suggests that most of the variables are $I(1)$[7] and the panel cointegration techniques suggest that there is cointegration amongst them.[8] All models include three centred seasonal dummies to account for seasonal effects in the variables.

4.1. DOLS analyses

We begin with a few clarifications. In estimating the parameters of Eq. 1, the number of leads and lags are obtained by the Bayesian Schwarz information criterion and used heteroskedasticity and autocorrelation corrected (HAC) Newey and West (1987) residuals. The estimated coefficients for the long-run equilibrium equation for the base line model, Eq. (1), are reported in Table 1 and show the estimations performed for three groupings, i.e. the EU28 (All), CEECs and EU15 + 2 groups, and by different methods to account for heterogeneity, i.e. Pooled, Pooled-weighted and Grouped. First, although we do not find statistical significance for the *real exchange rate* at the 10 % level for the EU28 grouping (All) and EU15 + 2 groups, there is evidence of positive statistical significance for the CEECs. The result for the CEEC group is corroborated by other recent studies, including Coleman and Cuestas (2019), who also find that appreciations tend to improve the current account.[9] Second, we find that *government consumption* has a negative effect on the current account for two groups, i.e. the EU28 group and the EU15 + 2 group, but a positive effect for the CEEC group. A plausible

[7] Bohn (2007) shows that the transversality condition for the fiscal balance, which can also be applied to the current account, can be fulfilled for any order of integration of the variable.

[8] We have applied the Levin et al. (2002) and Im et al. (2003) panel unit root test and the Fisher-type Johansen test for cointegration. The results are not shown here for brevity, but are available upon request. Our reason for including tree dummies is due to some variables having seasonal effects, so instead of applying the X12 filter, we include these dummies for the remaining seasonal effects in the residuals.

[9] Harkmann and Staehr (2020) find that the effect of the real exchange rate on the current account for CEECS depends on whether the countries are fixers or floaters.

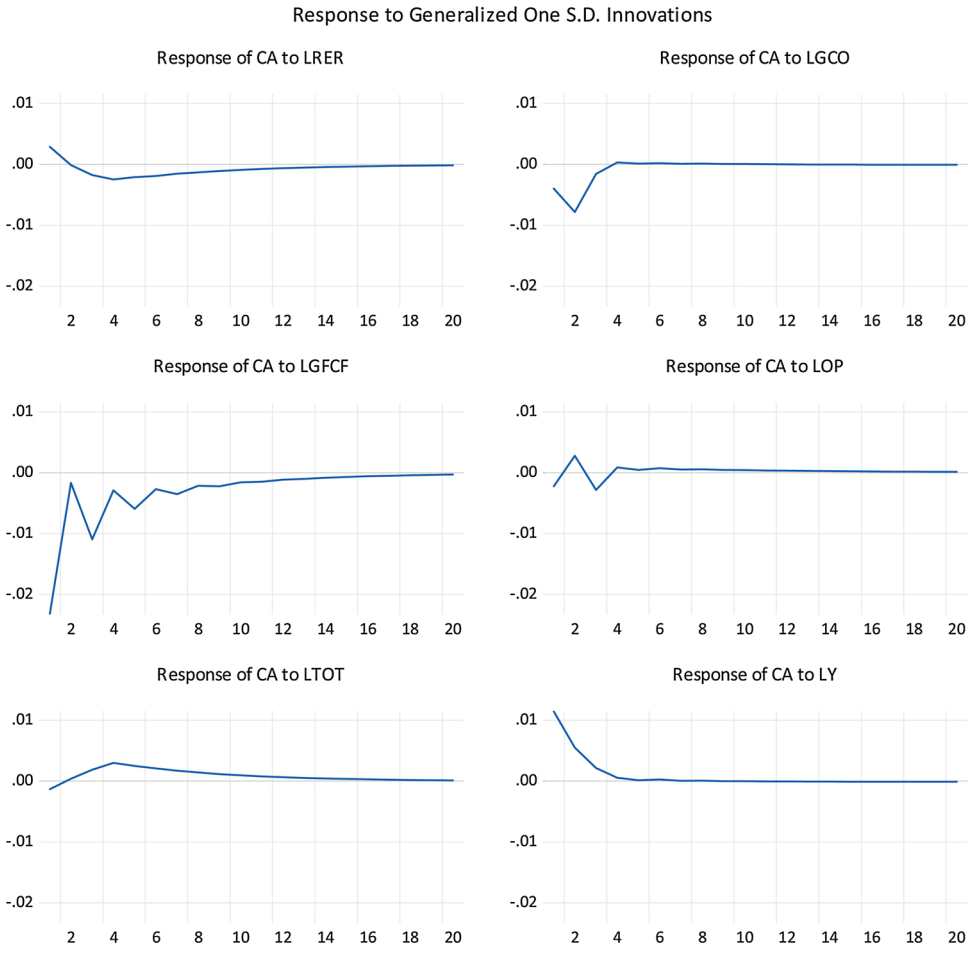

Fig. 10. BVAR Impulse Response Functions (for EU15 + 2 group): post-2008*q*1.

explanation is that whereas the EU15 + 2 group of countries tend to use accrued foreign capital to fund government expansionary policies, the CEECs use foreign funds to increase their productive capabilities. Third, we find *Investment* to have a negative effect on the current account, and this result is homogenous both in sign and size across all three groups, implying that *investment* has acted as a pull factor of foreign capital irrespective of the group considered. Fourth, notwithstanding several empirical and theoretical studies that highlight the importance of Trade Openness in determining a country's vulnerability to capital flows, in this study we do not find evidence that *openness* by itself has a significant impact on the current account in the country groups analysed. On the role of trade openness, Romelli et al. (2018) find that it is indeed significant *with* domestic currency devaluations. The interpretation is that trade openness on its own is not significant; however, when coupled with currency devaluations, it becomes significant. Next, we find that both the *terms of trade* and *real income* improve the *CA* balance.[10] In both scenarios, a plausible explanation is that the income effect dominates the substitution effect in both cases and increases capital inflow into these countries.

Next, we estimate Eq. 2, where we account for potential changes in the fundamental relationship in the pre- and post-2008 periods, aiming to determine the statistical relevance of the Great Recession of 2008 for these countries' current accounts. The results reported in Table 2 highlight the significance or otherwise of the 2008 recession, whereas Table 3 tests and reports the equality of the coefficients before and after that date. The results reported in Table 3 suggest that the relationships have changed in the pre- and post-2008 samples, typically with the size of the coefficients smaller in the post-2008 samples for the EU15 + 2 but larger for the CEECs. However, looking at the standard deviations, these differences may not be significant.

Tables 4 and 5 report the results of our analyses regarding the impact of periods of currency appreciation and depreciation on the current account. Estimating Eq. 3 for all three groupings, with the *CA* as the dependent variable, we find that the relationships differ for periods of currency appreciation compared to periods of currency depreciation. For example, our results suggest that for periods of currency depreciation, the effects of *investment* and *openness* are smaller in magnitude compared to periods of currency appreciation. Also, the effect of the *exchange rate* level is larger during depreciating preceding periods.

[10] Comunale (2018) also finds a positive sign for GDP over US GDP on the current account.

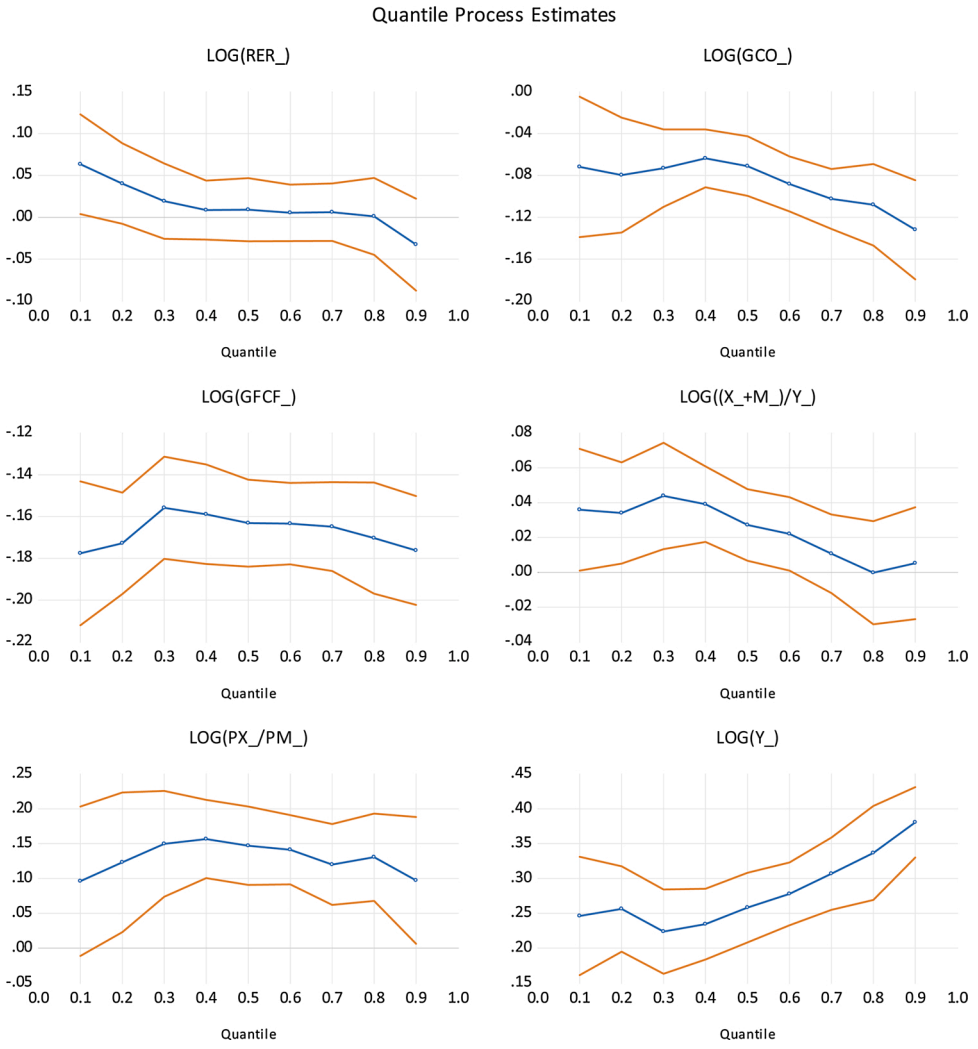

Fig. 11. Quantile Regression estimates (for EU28 group).
Note: Outer lines represent the 95 % confidence interval bounds.

4.2. Robustness analyses

4.2.1. BVARs

As a robustness check and to gain further insights into the current account dynamics of adjustment, we analyse the relationship between the *CA* and the fundamentals for the three groups (EU28, CEECs, EU15 + 2) by employing BVARs, and present the generalised impulse response functions (IRFs) in Figs. 2–13, using two lags in all cases. For the EU28 group, as shown in Fig. 2, while both the impact effects of *RER*, *government consumption* and *terms of trade* shocks are fairly muted, the impact effects of *investment*, *openness* and *income* are more pronounced and have the same sign as found earlier using the DOLS approach (see Table 2). However, the differences in the long-term dynamics are less pronounced compared to those highlighted earlier with the DOLS approach. Comparing Figs. 3 and 4, one can infer that, as mentioned before, the effect of shocks on the current account appear to be less pronounced in the period following the Great Recession of 2008. Confirming the robustness of our results, there is significant agreement between the results reported in Table 2 and the dynamics shown in Figs. 3 and 4.

Figs. 5 and 6 highlight some of the differences in the effects on the *CA* between the CEEC group and the EU15 + 2 group, which are also observable in Table 2 and present in the posterior distributions of the response functions. The *openness* innovation seems to have a permanent effect on the EU15 + 2 group's current account, whereas the effect on the CEECs' current accounts phases out after about two years. Furthermore, the response of the *CA* to *income* shocks, though positive on impact in the CEECs, tends to become positive and

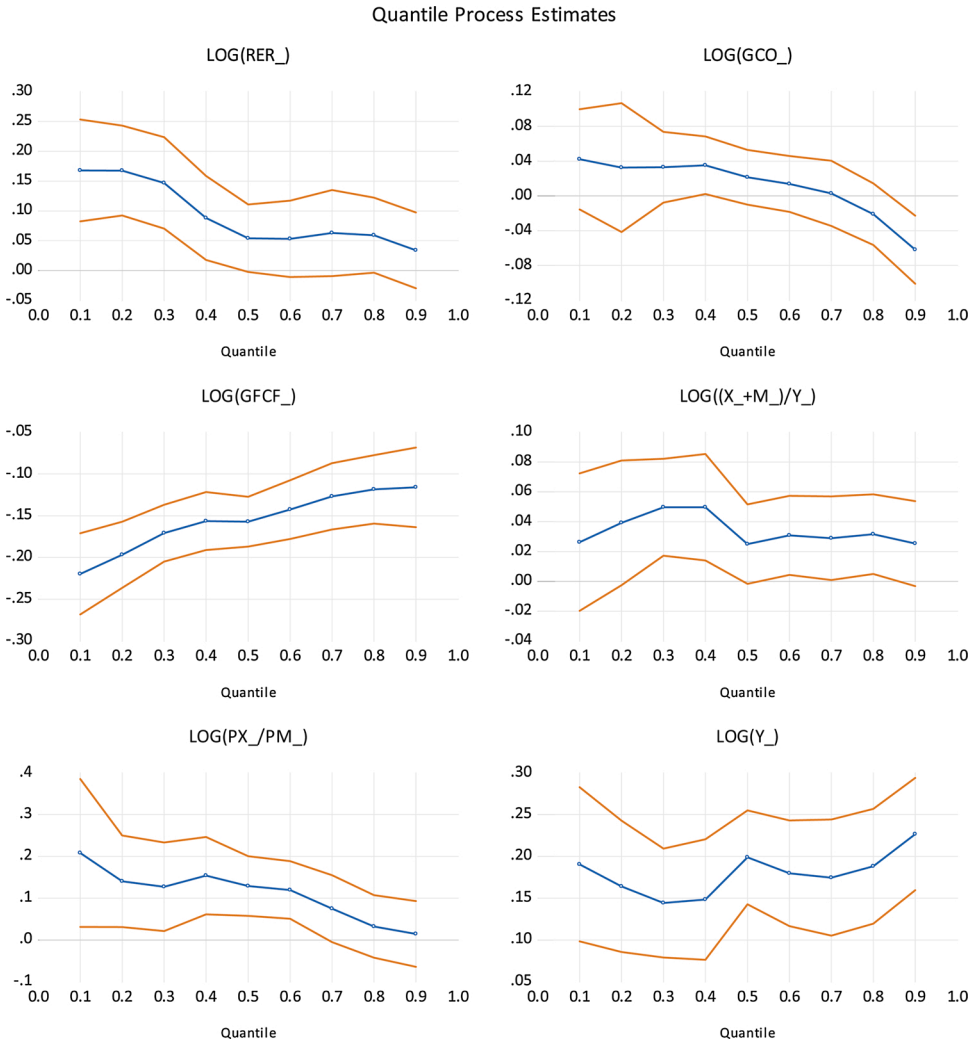

Fig. 12. Quantile Regression estimates (for CEEC group).
Note: Outer lines represent the 95 % confidence interval bounds.

have a long-lasting effect, whereas for the EU15 + 2, it tends to become negative and long-lasting. In both groups, the *investment* shocks tend to have a long-lasting effect, similar to that inferred from the DOLS estimations. Next, Figs. 7–10 trace and illustrate the effect of shocks to the fundamentals on the *CA* for two subperiods, i.e. pre- and post-2008*q*1, for the CEEC group and the EU15 + 2. Similar to the results reported in Table 2, the IRFs show that the effect of the shocks becomes less pronounced in the period post-2008*q*1. Again, it becomes obvious that some differences exist in the relationships between the *CA* and the fundamentals between the CEEC and the EU15 + 2 groups of countries.

4.2.2. *Quantile regressions*

The results of the quantile regressions are presented in Tables 6–11, and graphically in Figs. 11–13. Some observations are noteworthy. First, although from Table 6 and 7 our estimates do not indicate a significant difference in the estimated coefficients for the different quantiles of the *CA*, when the sample is split between CEECs and EU15 + 2, i.e. Tables 8–11, some noticeable differences emerge. It appears that for the CEECs, the coefficients of *RER*, *government consumption* and the *terms of trade* decrease, whereas for *openness* and *income*, the results are similar and do not change significantly. Second, for the EU15 + 2 group of countries, although there is not much difference between the 0.25 and 0.5 quantiles, the elasticities of *investment* and *openness* decrease significantly for quantiles 0.5 and 0.75, whereas the elasticity of *income* increases.

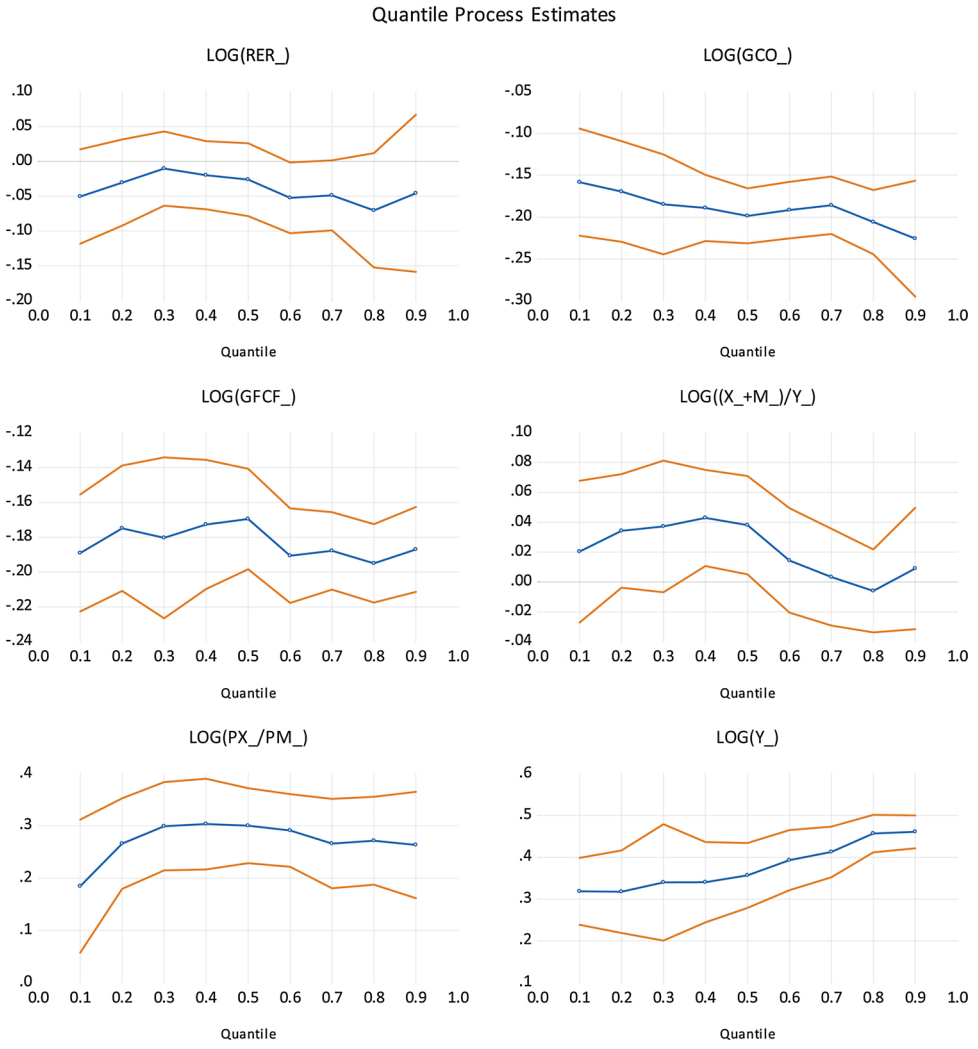

Fig. 13. Quantile Regression estimates (for EU15 + 2 group).
Note: Outer lines represent the 95 % confidence interval bounds.

Table 6
Equality test quantile regression.

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		13.41	12	0.34
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25, 0.5	*q*	0.02	0.02	0.50
	gco	0.00	0.02	0.99
	gfcf	0.01	0.01	0.63
	op	0.01	0.02	0.51
	tot	−0.02	0.04	0.58
	y	−0.03	0.03	0.34
0.5, 0.75	*q*	0.01	0.02	0.65
	gco	0.03	0.02	0.08
	gfcf	0.00	0.01	0.66
	op	0.02	0.01	0.13
	tot	0.01	0.03	0.64
	y	−0.06	0.03	0.03

Table 7
Symmetry test quantile regression.

Test Summary		Chi-Sq, Statistic	Chi-Sq, d,f,	Prob,
Wald Test		2.74	6	0.84
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25, 0.75	*q*	0.01	0.03	0.84
	gco	−0.03	0.03	0.26
	gfcf	0.00	0.02	0.96
	op	−0.01	0.02	0.70
	tot	−0.04	0.05	0.49
	y	0.04	0.05	0.44

Table 8
Equality test quantile regression CEECs.

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		25.86	12	0.01
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25, 0.5	*q*	0.10	0.04	0.01
	gco	0.01	0.03	0.80
	gfcf	−0.03	0.02	0.09
	op	0.03	0.02	0.17
	tot	0.00	0.05	0.92
	y	−0.03	0.04	0.39
0.5, 0.75	*q*	0.00	0.03	0.98
	gco	0.04	0.02	0.03
	gfcf	−0.03	0.02	0.07
	op	0.00	0.01	0.88
	tot	0.08	0.04	0.02
	y	0.01	0.03	0.87

Table 9
Symmetry test quantile regression CEECs.

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		11.69	6	0.07
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25, 0.75	*q*	0.10	0.05	0.05
	gco	−0.03	0.03	0.32
	gfcf	0.00	0.03	0.93
	op	0.03	0.02	0.24
	tot	−0.09	0.06	0.16
	ca	−0.04	0.05	0.46

5. Concluding remarks

In this paper, we investigate the significance of several current account fundamentals for the EU28 bloc of countries. In doing so, we also assess whether there are significant differences between the relationships for subgroups within the bloc, specifically the EU15 + 2 group of countries and the CEEC group. Our analysis identifies and compares the significant determinants for each of the two sub-groups, and checks whether the relationships observed for the EU28 group are similar to those for the two sub-groups. In the main, we employ the DOLS estimation approach to investigate the relationships, and as a robustness check we use the BVAR and quantile regression approaches. In line with the predictions of the theoretical models proposed in the extant literature, we find that the *real exchange rate*, *government consumption*, *investment*, the *terms of trade*, *openness*, and *real income* are all relevant determinants of the current account. In addition to establishing this for the EU28 countries, a main contribution of this study is that it uncovers some differences in the relationships across sub-groups within the EU28. Hence, an *a priori* expectation of similar responses to shocks in the fundamentals for countries in economic blocs will be misplaced and potentially misleading. This study therefore underscores the need for policy formulation on the current account in economic blocs to consider the specific region they need to impact.

Table 10
Equality test quantile regression EU15 + 2.

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		24.16	12	0.02
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25, 0.5	*q*	0.00	0.03	0.98
	gco	0.03	0.03	0.23
	gfcf	−0.01	0.02	0.76
	op	0.00	0.02	1.00
	tot	−0.01	0.04	0.82
	y	−0.04	0.06	0.52
0.5, 0.75	*q*	0.03	0.03	0.37
	gco	0.00	0.02	0.81
	gfcf	0.03	0.01	0.04
	op	0.04	0.02	0.01
	tot	0.02	0.04	0.69
	y	−0.09	0.03	0.01

Table 11
Symmetry test quantile regression EU15 + 2.

Test Summary		Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Wald Test		5.16	6	0.52
Quantiles	Variable	Restr. Value	Std. Error	Prob.
0.25, 0.75	*ca*	−0.03	0.04	0.57
	gco	0.03	0.03	0.38
	gfcf	−0.03	0.02	0.17
	op	−0.04	0.03	0.13
	tot	−0.03	0.06	0.67
	y	0.06	0.07	0.40

Acknowledgements

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Appendix A. Definitions

The **European Union (EU)** was established on 1 November 1993 with 12 member states, i.e. the EU12 (*1 November 1993−31 December 1994*) comprising Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and the United Kingdom.

EU15 (*1 January 1995−30 April 2004*) comprises the EU12 *plus* Austria, Finland and Sweden and the **EU15 + 2** group adds Cyprus and Malta to this EU15 group of countries.

The **EU28** comprises the EU-15 + Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia, Bulgaria and Romania and Croatia.

CEEC Countries: According to the Organisation for Economic Co-operation and Development (*OECD*), the Central and Eastern European Countries (CEECs) comprises Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Slovenia, and the three Baltic states: Estonia, Latvia and Lithuania.

Appendix B. Sample periods for each country in the sample (specific sample periods)

- Austria: for gco, gfcf, tot and y, data starts in 1996q1;
- Belgium, the ca data starts in 2003q1;
- Bulgaria, the ca starts in 1998q1;
- Croatia, all variables, except the q, start in 2000q1.
- Cyprus, the ca starts in 2008q1;
- Denmark, the ca starts in 2005q1.
- France, the ca starts in 1999q1;
- UK, the ca starts in 1997q1.

- Greece and Ireland, the ca starts in 2002q1.
- Italy, the gco, gfcf, op, tot and y start in 1996q1.
- Latvia, the ca starts in 2000q1.
- Malta, all variables start in 2000q1, except for the q which starts in 1995q1 and the ca which starts in 2004q2.
- Netherlands, the ca starts in 2003q2;
- Poland and Slovakia, the ca starts in 2004q1.
- Portugal, the ca starts in 1996q1. For Romania, the ca starts in 1999q1;
- Sweden, the ca starts in 1995*q*2.

Table B1
Variable list and description.

Variable	Description
ca (Dependent variable)	Current account balance in % of GDP
q	Log of the real effective exchange rate (*REER*) deflated by the consumer price index for the main 37 trading industrial country partners, with an increase indicating an appreciation in real terms.
gco	Log of real government consumption
gfcf	Log of real gross fixed capital formation
op	Log of openness defined as the sum of export and imports as a proportion of the GDP
tot	Log of the terms of trade, which is calculated as the ratio between export prices and import prices
y	Log of the real GDP

Source: *Eurostat.*

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