Withdrawal of Italy from the euro area: stochastic simulations of a structural macroeconometric model♥

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Abstract

This paper assesses the impact on the Italian economy of Italy withdrawing from the euro area by means of the stochastic simulation of a macroeconometric model. The model considers the effect of devaluation on output, sovereign debt valuation, and the development of bilateral economic relations between Italy and its major trade partners. The simulation results are consistent with the findings of recent applied research: the Italian economy would follow the V-shaped pattern observed in most currency crises. After an initial period of stress, and provided an appropriate set of countercyclical policy measures is implemented, real GDP would recover and resume growth at a reasonable pace. In particular, while the expected positive impact of nominal exchange rate realignment on external balance would be transitory, higher nominal growth would bring about a persistent reduction in unemployment and the public debt-to-GDP ratio. These results are robust to a set of sensitivity checks, considering a number of adverse circumstances such as exchange rate overshooting, financial panic, supply-side constraints, and the application of retaliatory tariffs.

Keywords: economic integration, foreign exchange, monetary union, sovereign debt

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I. Introduction

The economic performance of the euro area (EA) has so far been disappointing. Eurostat (2017) reports that from 1999 to 2015 real annual growth averaged 1.3% in the EA12 countries, and 2.3% in the other European Union (EU) countries. Dreyer and Schmid (2016) show that while EU membership has had a positive impact on growth, membership in the EA has no additional effect on growth, except during economic crises, when it affects growth negatively. Average growth in the EA has been 0.2% since 2008, while the other EU countries have achieved a real growth rate of 1.3%. These outcomes are consistent with the findings of Bohl et al. (2016) that exchange rate regimes and financial crises interact in a way that makes recovery harder under pegged exchange rates, of which a monetary union is the most extreme case.

The difficulty experienced by a currency union in coping with external shocks in the absence of a federal government is a standard prediction of optimum currency area (OCA) theory (Krugman, 2013). As a consequence, the persistence of the EA crisis is shedding new light on the long-standing debate between scholars who have advocated the need to build a political union before adopting a single currency in order to make the latter sustainable (Meade, 1957; Kaldor, 1971), and those who have claimed that the single currency would become endogenously sustainable without any need for major institutional changes before its adoption (Scitovsky, 1958; Frankel and Rose, 1997). A growing body of evidence supports the hypothesis that the single currency has fostered divergence among its member countries, thus leading to the underperformance of the EA and undermining its resilience to external shocks. This has happened in different ways. Economic and financial integration has encouraged the exploitation of EMU member's comparative advantages, as anticipated by Krugman (1993) and confirmed by Caporale et al. (2015), increasing the occurrence of idiosyncratic shocks, and hence making a one-size-fits-all monetary policy unsuitable. Rafiq and Mallick (2008) argue that since the response to monetary policy in the three largest EA countries is not homogenous, a common monetary policy may amplify misalignment of national business cycles. This asymmetry is confirmed by, among others, Barigozzi et al. (2013), while van Ewijk and Arnold (2015) stress the pro-cyclical role of financial integration on member countries' output gaps, both in the short and in the long run. These findings explain the recent results of Granville and Hussain (2017), who demonstrate that adoption of the euro has actually lowered the concordance among member countries' business cycles.

Another finding of recent research is that monetary union has not only affected business cycle synchronization, but also trend productivity, because the fall in real interest rates has caused allocative distortions that have undermined labour productivity in weaker countries (Gopinath et al., 2015, Cette et al., 2016). On the other hand, the windfall of low interest payments provided perverse fiscal policy incentives that undermined sovereign debt sustainability in peripheral countries, as anticipated among others by Feldstein (2005) and confirmed by Fernández-Villaverde et al. (2013) and Ciżkowicz et al. (2015). At the same time, since in a monetary union "the task of adjusting for competitiveness and relative prices" is transferred to the labour market (Dornbusch, 1996), the single currency tends to deny its users the benefits of a larger common market. The reason for this is that the cushion against external shocks afforded by the common market is impaired by the pro-cyclical effect of internal devaluation policies, as argued among others by Bofinger (2015). The deflationary bias of these policies, highlighted by Krugman (1998), has had a negative effect on the banking systems of several peripheral EA countries, contributing to an alarming increase in non-performing loans (Notarpietro and Rodano, 2016).[4]

The idea that the single currency could come to an end is creeping into the debate: euro-sceptic political parties are gaining momentum in EA member countries[5] and can provoke mainstream parties to be less supportive of European integration (Meijers, 2015); the flaws of the EMU were cited by Brexit advocates in their successful campaign to persuade a majority (51.9 percent) of voters in the United Kingdom to support their cause in the EU membership referendum that took place on 23 June 2016; the largest EU countries that do not yet belong to the EA and did not negotiate an opt-out clause, as the United Kingdom and Denmark did, are postponing their entry into the ERM-II mechanism (a prerequisite for joining the euro).[6]

[4] Italy has experienced one of the most severe banking sector crises: non-performing loans to total gross loans reached 18 percent 2015 compared to 7 percent in 2006 (source: World Bank http://data.worldbank.org/indicator/FB.AST.NPER.ZS).

[5] See, e.g., The Economist (2015), or the special issue of the *International Political Science Review* (vol 36, issue 3, June 2015) recently devoted to the analysis of the rise of critical positions towards the euro: "Euroscepticism, from the margins to the mainstream".

[6] These countries include Sweden (which enjoys a *de facto* opt-out since the referendum held in 2003), Poland, the Czech Republic and Hungary.

Consequently, several scholars who regard European political integration as a sensible goal have now come to regard the adoption of the single currency as having delayed, rather than accelerated, the achievement of that goal (Zielonka, 2014; Majone, 2014), as foreseen by Kaldor (1971). At the same time, as recently argued by Stiglitz (2016), in the absence of a political union (as advocated by the "Five presidents' report"; Juncker et al., 2015), or at least of a coordinated policy response, there is a possibility of the single currency collapsing, an event that would generate systemic uncertainty at the political and institutional level.

Against this backdrop, an analysis of the macroeconomic impact of such an event becomes increasingly relevant. We contribute to such an analysis by developing a set of stochastic simulations of an annual structural macroeconometric model to assess the macroeconomic consequences of a withdrawal of Italy from the EA. We focus on Italy because the weakness of its banking system makes it extremely vulnerable to financial shocks, and because, since Italy is the third largest country in the EA, its withdrawal could precipitate an overall collapse of the single currency.[7] In assessing the macroeconomic stress caused by withdrawal, we identify the following four channels of potential uncertainty: first, our model disaggregates the trade relations of Italy among seven partner areas, allowing us to distinguish between realignments of the new Italian currency with respect to the currencies of its main trading partners, estimated using the behavioural equilibrium exchange rate (BEER) approach of Clark and McDonald (1998); second, the sovereign debt spread is endogenised by relating it to macroeconomic fundamentals according to Gödl and Kleinert's (2016) approach; third, the model considers the possible contractionary effects arising from the balance sheet effects of a large devaluation (Krugman and Taylor, 1978), i.e. the real consequences of the financial stress that some categories of agents would incur because of their exposures in foreign currencies regulated by contracts under foreign law; finally, the simulations control for the possibility of a banking crisis by drawing on the results of Céspedes (2005).

[7] Most empirical studies devoted to analysing the effects of a withdrawal from the euro concern a much smaller country, Greece, whose withdrawal would not necessarily endanger the overall existence of the single currency (Kasimati and Veraros, 2013; Papadimitriou et al. 2014).

The next section describes the model used in the scenario analyses. Section 3 describes the counterfactual scenarios. Section 4 presents the simulation results. Section 5 is devoted to sensitivity analyses. In Section 6, we formulate some concluding remarks.

2. The model

The scenario analysis is carried out with a medium-sized structural econometric model of the Italian economy. Structural models are often used to assess the macroeconomic consequences of major institutional changes (see e.g. Pain and Young, 2004; Baker et al., 2016; Ebell et al., 2016). As with every econometric methodology, they have strengths and weaknesses as shown for instance by Bacchini et al. (2013). However, as far as the EMU is concerned, the main criticism of the structural approach, namely, its potential vulnerability to Lucas's (1976) critique, was found to be empirically irrelevant by Smith (2009). Granger and Newbold's (1974) criticism that estimated structural equations may reflect spurious correlations can be dealt with by using cointegration techniques, as we have done in estimating our equations. Finally, another major criticism, Sims's (1980) claim that structural models impose "incredible" overidentifying restrictions, must be gauged against the fact that the VAR approach, proposed to overcome this potential shortcoming, can be applied to a relatively limited set of variables, and as a consequence does not allow the researcher to design detailed scenarios. This may explain why central banks of EA member countries rely on structural models (among others) for forecasting and policy analysis (Fagan and Morgan, 2005).

[Insert Table 1 around here]

Table 1 summarizes the model's structure (a complete description of the model's equations, data sources, estimates, and simulation properties is provided by Bagnai and Mongeau Ospina, 2014). The model adopts the AS/AD framework as in the case of models of comparable size (Welfe, 2013): potential output is defined using Cobb-Douglas technology with labour-augmenting technical progress (Eq. [8]); labour demand follows from the same technology (Eq. [9]); capital accumulation is a function of the gap between marginal productivity and user cost of capital (Eq. [10]); aggregate demand is modelled through a standard IS block (Eq. [1] to [7]); the output gap feeds back on price dynamics

(Eq. [19]) and on interest rates according to the Taylor rule (Eq. [25]), keeping the model on its long-run growth path. Although national reaction functions such as the Taylor rule are inconsistent with the EA monetary policy implementation, some models run by EA national central banks use national Taylor rules for running counterfactual analyses (Fagan and Morgan, 2005, p. 13). The two other solutions adopted by national models, namely taking interest rates as exogenous, or specifying an area-wide reaction function, are ruled out by the design of our experiments. Indeed, considering the interest rate as exogenous would prevent us from examining its evolution in the counterfactual scenarios. Moreover, the withdrawal of Italy would be likely to precipitate the end of the single currency, in which case an area-wide reaction function would become meaningless.

Equations are estimated in error correction form using annual data from 1960 to 2013. Long-run relations allow for the possibility of structural breaks at unknown dates (Gregory and Hansen, 1996; Hatemi-J, 2008). Interestingly enough, about a half of the structural breaks in the long-run parameters occur in the Nineties, and six of them, including a fall in the rate of labour augmenting technical progress, in the run-up to the launch of the euro between 1996 and 1999. Estimates of the long-run equations are reported in Appendix 1 along with the cointegration test statistics.[8]

The structure of its trade block makes the model particularly suitable for the simulations undertaken in this study: Eq. [13] and [14] disaggregate import and export flows among Italy's seven main trade partner areas (EA core, EA periphery, United States, other European countries, OPEC, BRIC, and rest of the world). Disaggregation of the EA into a "core" and a "periphery" follows the findings of Busetti *et al.* (2007), according to which the EA is split into three "inflation clubs": the low-inflation countries (Austria, Belgium, France, Finland and Germany), the high-inflation countries (Greece, Ireland, Netherlands, Portugal and Spain), and a medium-inflation country, Italy. In the light of subsequent developments of its inflation rate, we moved the Netherlands to the low inflation club (i.e. to the EA core).

These bilateral trade flows depend on a set of bilateral real exchange rates, RER_i, defined by Eq. [16] as the ratio of domestic export prices P_x (expressed in foreign currency using a suitable nominal exchange rate index E_i) to the i-th partner's export

[8] Full estimation outputs are reported in the Appendix 5 of Bagnai and Mongeau Ospina (2014).

prices P_{xi} (taken as a proxy for the price of Italian imports from the *i*-th partner). This makes it possible to assess the consequences for Italy of leaving the EA by differentiating the realignments of the new national currency according to partner area.

Additional features incorporated in the present version of the model concern the response of the other countries' output, the pattern of government debt spreads and the possible negative effects of a large devaluation on balance sheets.

Eq. [15] defines a set of dynamic equations, which express the rate of real growth of partner $i = 1, \ldots, 7$ as a function of the rate of change of the bilateral real exchange rate and of the real growth rate of Italy. These equations provide a parsimonious and data-congruent representation of partners' growth dynamic response to a shock to the Italian economy, taking both price and quantity effects into account.

Several studies have analysed the behaviour of sovereign bond yield spreads by focusing on the role of fundamental variables (Cimadomo et al., 2016), market sentiment and contagion (Gómez-Puig and Sosvilla-Rivero, 2016), and expectations of a EA breakup (Canofari et al. 2015). Drawing on Gödl and Kleinert (2016), Eq. [26] expresses the government bond spread as a function of three fundamental variables related to public debt sustainability: the real rate of growth ($\dot{y}$), the public debt-to-GDP ratio *D/Y* (defined by Eq. [38]) and the government budget's primary balance-to-GDP ratio (*PB/Y*). In particular, we use the parameters drawn from Gödl and Kleinert (2016; Table 1, "Eurozone crisis country" column).

Since the seminal paper by Krugman and Taylor (1978), it is known that large devaluations may have a nonlinear impact: assuming that the Marshall-Lerner condition is met, once devaluation passes a given threshold, the positive effect of trade on growth is more than offset by the negative supply-side effects determined by the financial distress of domestic agents indebted in foreign currency or in contracts regulated by foreign law (see Kearns and Patel, 2016, for an updated survey and recent evidence). Since our model does not feature a detailed specification of private sector financial accounts, we allowed for possible contractionary balance-sheet effects by supplementing the model with a reduced-form representation based on Céspedes (2005):

$$\dot{y}_t^{loss} = \alpha_1 R\dot{E}R_{1,t}\, ed_t\, os_t + \alpha_2 I^{bank} \quad \textbf{(1)}$$

where $\dot{y}_t^{loss}$ is the estimated loss in real output growth, $R\dot{E}R_{1,t}$ the variation in bilateral real exchange rate towards the EA core, ed_t the external debt-to-GDP ratio, os_t the measure of "original sin" of Eichengreen *et al.* (2003) (i.e. the ratio of foreign liabilities issued in foreign currency to total foreign liabilities), I^{bank} a dummy variable that takes value 1 if a banking crisis occurs in the year before the devaluation, and α_1 and α_2 estimated coefficients.

Equation (1) feeds back into the definition of real GDP, thus affecting the overall model response to an exchange rate realignment. Several features of Equation (1) are worth noting.

Firstly, Céspedes (2005) provides various estimates of the interaction parameter α_1, ranging from 0.09 to 0.20. We chose the estimate provided in his Table 8, equal to 0.183, because it accommodates the possibility of a banking crisis, an event which is likely to take place in Italy before any decision about EA membership is made. According to Céspedes's estimates, $\alpha_2 = -0.014$, which implies that if devaluation occurs after a banking crisis, another 1.4 points need to be subtracted from the real rate of growth.

Secondly, in the case of Italy, the "original sin" variable refers to foreign exposures in euros governed by foreign law, which in the event of dismantling of the single currency would not be redenominated in the new national currency under the *Lex monetae* principle (Proctor, 2010). The aggregate size of these exposures was estimated by Nordvig (2014), whose method involves two steps: in the first step, aggregate external liabilities are divided into those that are under local or foreign law by legal definition. Liabilities under foreign law by legal definition include Bank of Italy Target 2 balances, whose nature is the object of an ongoing debate initiated by Sinn and Wollmershäuser (2012). In the second step, the proportion of liabilities under foreign law in the other categories (basically sovereign and private bonds) is estimated using microdata on bond issues. In Italy euro-denominated bonds (under both foreign and local law) account for about 95 percent of the outstanding stock. The minor share of USD denominated bonds explains why the large devaluation of the euro by about 30 percent against the USD between 2014 and 2015 did not cause any significant balance sheet effects. Hence, the exchange rate realignment likely to trigger contractionary balance sheet effects is that with respect to the EA core. This is why in Equation (1) we included the variable $R\dot{E}R_{1,t}$, i.e. the bilateral real rate towards the EA core, rather than the (average) real effective exchange rate, that would underestimate the potential balance sheet stress. In Italy, sovereign bonds account for about 66 percent of total euro-denominated issues, but only a small share of them (5 percent) is regulated by foreign law. Considering non-euro denominated sovereign bonds as well, which on the contrary are mostly under foreign law, the share of sovereign bonds under foreign law is 7 percent (against an EA average of 9 percent). On the other hand, the share of private bonds under foreign law is 53 percent. Putting these numbers together gives an overall proportion of 24 percent of sovereign and private bond contracts being governed by foreign law. By adding loan-related liabilities to this, Nordvig obtains relevant gross external liabilities for the Italian economy (the $ed_t \times os_t$ variable) equal to 49 percent of GDP (Nordvig, 2014, Appendix B). While this value is the lowest of all EA countries, except Germany, according to Céspedes (2005, Table 9) it could be large enough to cause a contractionary effect. A more recent assessment of the redenomination risk for the Italian economy, carried out by Durand and Villemot (2016), that considers net (rather than gross) foreign exposures under foreign law, by taking into account also the asset side of the different institutional sectors, concludes that this risk is virtually absent. We prefer, however, to adopt the more conservative methodology proposed by Nordvig (2014), which focuses on gross foreign liabilities, because even in cases where foreign liabilities are matched by foreign assets at the macroeconomic level, and hence the net international investment position of a country, or of a country's sector, is relatively reassuring, there may still be relevant mismatches in the balance sheets of individual agents (households, firms, government agencies), which could bring them to default.

3. Counterfactual scenarios and simulation methodology

The first major consequence of withdrawal from a monetary union would be realignment of the new national currency. According to the "general relativity" approach developed by Coakley *et al*. (2005), as well as to the literature on exchange rate forecasting (Lee *et al*., 2011), this realignment would be expected to compensate for the accumulated loss of competitiveness since the adoption of the euro. Both the expansionary consequences (through trade) and contractionary impacts (through balance sheet effects) of the realignment, as well as its net impact on the Italian economy, would depend on its size.

A reliable estimate of the realignment is therefore crucial for setting up the simulation scenarios.

There is now a large body of literature on real effective exchange rate (REER) misalignments in the EA (Salto and Turrini, 2010). Different approaches provide broadly consistent results. In particular, they indicate an appreciation of the "Italian euro" (to paraphrase a term used by Jeong et al., 2010) in real effective terms, ranging from 4 percent (Jeong et al., 2010) to 7 percent (Coudert et al., 2013). However, these estimates refer to the real effective exchange rate, while the model features bilateral exchange rates for each of the seven trade partner areas considered. The new Italian currency is unlikely to experience equal realignments towards each partner area: in other words, the expected depreciation in real *effective* terms could emerge as the net result of appreciations and depreciations in *bilateral* terms. In order to define a set of bilateral realignments consistent with model structure, as well as with economic theory and the available evidence, we followed Coudert et al. (2013) in applying Clark and McDonald's (1998) BEER approach to our database. For this purpose, the standard equation of the equilibrium real effective exchange rate was reformulated as follows:

$$\ln(RER_{i,t}) = \alpha_i + \beta_1 \ln(PROD_{i,t}) + \beta_2 NFL_{i,t} + \varepsilon_{i,t} \qquad \textbf{(2)}$$

where $RER_{i,t}$ is the *i*-th area-specific real exchange rate defined by Eq. [16] in Table 1, $PROD_{i,t}$ is Italian average productivity relative to area *i*, calculated as the ratio of the index of Italian labour productivity to the GDP-weighted average of the productivity indices in area *i*, $NFL_{i,t}$ is the GDP-weighted average of the net foreign *liabilities* to GDP ratio in partner area *i* (taken as a proxy for Italy's bilateral net financial assets in relation to area *i*), and α_i is a country-specific fixed effect. The equation was then estimated using the DOLS cointegrating panel estimator on the four major trade partner areas (the core and periphery of the EA, the United States and other European countries, jointly accounting on average for about 65 percent of Italian trade), considering annual data ranging from 1970 to 1998, and the area-specific $RER_{i,t}$ equilibrium values were forecasted over the sample 1999-2013 and compared with actual values in order to estimate the average misalignment since the onset of the euro.[9]

[9] Estimation results are available upon request.

The estimated average misalignments, used in our counterfactual scenario, are as follows:

- 24 percent *overvaluation* with respect to the EA core;
- 28 percent *undervaluation* with respect to the EA periphery;
- 8 percent *overvaluation* with respect to other European countries;
- 12 percent *overvaluation* with respect to the US dollar.

In order to check the plausibility of these estimates, we expressed them in effective terms by weighting them with the respective trade shares. The effective misalignment is an overvaluation by nearly 11 percent, an order of magnitude consistent with previous findings mentioned above, although rather on the high side especially in view of more recent studies. El Shagi *et al*., (2016) confirm that the euro is overvalued for Italy but find the misalignment to be negligible in effective terms (2.35 percent) while Durand and Villemot (2016) estimate that the euro is actually undervalued in real effective terms for Italy. We prefer however to consider more prudential scenarios where the Italian currency would depreciate against the core of the EA.

In our scenarios we apply to the pattern of the adjustment the same prudential attitude that we apply to its size, by assuming that in the first year the new Italian currency would move to compensate immediately for the misalignments, bringing the area-specific real exchange rates into line with their respective equilibrium vales. This pattern contrasts with the historical experience of the most recent European currency crises, where the adjustment has occurred over two years gradually, or with a very moderate degree of overshooting (see e.g. Kim and Kim, 2007). We also test the sensitivity of the results with respect to two alternative patterns of realignment, the first one, more consistent with the historical evidence, featuring a gradual adjustment, and the second one featuring a sizeable overshooting. We assume that nominal realignments towards the three remaining blocks (OPEC, BRIC and ROW) will be of the same size as realignment towards the USD. Even this is a rather conservative assumption, because owing to the large devaluation carried out by the ECB between 2014 and 2015 it is unlikely that the major emerging countries would allow a "euro legacy" currency to fall any further. Finally, it is worth noting that by hypothesizing a revaluation towards the EA periphery we are actually investigating the macroeconomic consequences of a dissolution of the single currency.[10]

Summing up, the realignment is implemented by decreasing E_1 by 24 percent, E_3, E_5, E_6 and E_7 by 12 percent, E_4 by 8 percent, and by increasing E_2 by 28 percent in Eq. [16]. Again, we will test the sensitivity of the results by allowing the two alternative patterns of realignment (i.e., gradual and overshooting) to be applied only to the core and to all partners.

The bilateral realignments are analysed by implementing two scenarios:

1. *base case scenario*, where we take into account a banking crisis occurring in the year preceding dismantling of the single currency, thus setting $I^{bank} = 1$ in Eq. (1);
2. *countercyclical policy scenario*, with respect to the previous scenario we introduce a possible set of countercyclical policy measures to counteract the possible recessionary impact of devaluation, exploiting the fiscal space opened by nominal realignment. The policy mix is defined as:
    a) a one percentage point increase in government employment, n_g, each year, reaching 5 percent above baseline in the last year of the simulation horizon;
    b) a permanent increase in nominal government investment, I_g, equal to 5 percent of the baseline value;
    c) a 5 percent increase in government wage rate, W_g, above the baseline.

The size of the countercyclical policies is such as to bring the affected variables back to their pre-crisis trends (for instance, by offsetting the impact of public sector wage freezes).

The scenarios were assessed against the medium-run out-of-sample baseline projections of the model, constructed using the IMF's (2014) global macroeconomic scenario as reference point. All simulations were stochastic and 10,000 replications with bootstrapped innovations were carried out for each scenario. The impacts were estimated as averages of the replications, and each estimate is accompanied by its standard error.

[10] The model's structure allows investigating also "two-speed euro" scenarios by considering a realignment of the Italian currency only towards the EA core. However, while routinely discussed in the public debate, this hypothesis seems unlikely for political reasons.

4. Empirical Results

4.1 Base case scenario

Table 2 and the first column of Figure 1 summarize the evolution of the Italian economy following the currency realignment described in the previous section. The results are presented as percentage deviations from baseline for flow or index variables, and as absolute deviations for rates of change and ratios to GDP. Here we only comment on the main features of the scenarios, by assessing their consistency with respect to the relevant empirical literature.[11]

[Insert Table 2 around here]

Despite a significant boost to the trade balance (which would improve by 1.6 percent of GDP in the first year), our simulation confirms Céspedes's (2005) finding that a devaluation has short-run contractionary effects in countries whose relevant exposure exceeds 35 percent of GDP, like Italy: owing to balance sheets effects, in the first year of the simulation real GDP growth falls 0.7 points below the baseline. The pattern in the following years confirms the results of Teimouri and Brooks (2015), according to which real GDP follows a "V-shaped" pattern after a large devaluation: the fall in real GDP continues in the second year, but is then followed by a recovery that brings GDP above the baseline by 1.4 percent in the fifth year after the realignment. It is worth noting, however, that while the recessionary impact is statistically significant in the first two years, over time dispersion of the simulation outcomes increases. In other words, while the short-run recession is statistically significant, medium-run recovery is not, much as in Figure 3 of Teimouri and Brooks (2015). This pattern is apparent in the top-left graph of Figure 1.

[Insert Figure 1 around here]

[11] Complete results of the simulations of the scenarios are available upon request.

The impact on inflation is significant but not devastating (in the first year consumer price inflation rises 2.9 points above baseline), confirming a well-known stylized fact (Burstein *et al*., 2002). This increase affects nominal growth, with a number of consequences. Firstly, the public debt-to-GDP ratio falls by 5.2 percent of GDP, a result consistent with the debt accumulation equation (Eq. [38] in Table 1). Indeed, since the public debt-to-GDP ratio at the beginning of the simulation horizon is close to 133 percent, a 3.7-point increase in nominal GDP growth, *ceteris paribus,* brings about a decrease in *D/Y* by 4.9 percentage points of GDP. This positive evolution is favoured by the response of the real interest rate: nominal interest rates increase less than the inflation rate, bringing about a fall in the real interest rate. It is worth noting that a similar pattern emerges as a stylized fact in empirical analyses using annual data (Nitsch, 2004), where the inflationary consequences of a breakup are usually larger and more statistically significant than the increase in the interest rate spread. Moreover, Italy has historically the third largest government balance primary surplus in the EA, with an average of 1.6 percent of GDP from 1999 to 2016. This should allow the Italian government to restore market confidence relatively quickly. The fall in real interest rates, as well as the boost to foreign demand, bring about an increase in investment growth by 1 percentage point above the baseline. However, the rise in inflation has an adverse impact on real wages that fall by -1.7 percent below their baseline value, with a negative effect on consumption. This shock is progressively absorbed starting in the second year, and at the end of the simulation horizon real wages are 2.3 percent above the baseline, while unemployment is -0.4 points below the baseline.

4.2 Countercyclical policy scenario

Since Italy is currently running a current account surplus, after examining the previous scenario one may wonder whether it would be worthwhile trading a significant increase in the trade balance for an uncertain increase in real GDP.[12] Yet, contrary to what happened after the 1992 EMS crisis, in 2011 the current account balance adjustment was achieved mostly on the imports side, by repressing domestic demand through internal devaluation policies. This implies that while an uncoordinated reversal of such policies

[12] The Italian current account balance is projected by the IMF to stay above one percent of GDP until 2020 (IMF, 2015).

would again compromise external equilibrium, a nominal realignment would provide some fiscal space, by allowing expansionary budget policies to be carried out without compromising external equilibrium. The scenario depicted in Table 3 explores this hypothesis by assessing the consequences on the withdrawal scenario of a partial undoing of some austerity policies implemented in the last decade, from public wages freeze to cuts in public investment.

[Insert Table 3 around here]

The progressive implementation of expansionary budget policies brings about a steady increase in the public deficit-to-GDP ratio, up to one point in the fourth year of the simulation. However, this adverse outcome does not compromise public debt sustainability because the measures considered are able to offset the contractionary impacts of devaluation. Contrary to what happens in the base case scenario, in the first two years of the simulation there is no significant drop in real GDP, while starting in the third year, GDP rises significantly above baseline. The unemployment rate decreases immediately by 0.7 points, and falls progressively by 1.8 points towards the end of the simulation sample. The higher rate of real growth compared with the previous scenario dampens the initial fall in imports. Consequently, the impact of realignment on the trade balance-to-GDP ratio is reduced by almost half (from 1.6 in the previous scenario to 0.9 percentage points), and at the end of the simulation the external balance posts a negative, though not statistically significant, deviation from the baseline. However, along with this adverse effect on external equilibrium, which is not particularly worrying given the current situation of current account surplus, the higher growth has a positive impact on the public debt-to-GDP ratio, that experiences a sharper decrease (-7.0 percentage points) because expansionary policies bring about a larger increase in nominal growth (5.2 points above baseline in the first period). This result may seem counterintuitive, yet it is consistent with recent research and historical evidence. For instance, using a model with state-dependent financial frictions, Canzoneri *et al*. (2016) show that fiscal multipliers in depressed economies may be larger than two, though much smaller during expansions. This model explains why implementation of austerity policies in Italy since 2012 brought about an increase in the public debt-to-GDP ratio of about 16 points in three years, and supports the idea that reversing those policies could actually foster fiscal consolidation.

The expansionary policy stance brings about a higher inflationary impact, with consumer price inflation 3.7 points above baseline in the first year. However, owing to the termination of the public wage freeze, the adverse impact on the real wage is smaller than in the previous scenario, and at the end of the simulation real wages are 3.6 percentage points above the baseline. At the end of the simulation horizon, the inflation rate is 1.4 points above the baseline, and the unemployment rate 1.8 points below. Moreover, the increase in public investment boosts aggregate investment, which at the end of the simulation is 8 percentage points above the baseline, with an improvement of 2.5 percentage points in the investment-to-GDP ratio, which partially offsets the 5-point fall experienced since the onset of the global crisis.

5. Sensitivity analyses

Although the stochastic simulation method accounts for a major source of uncertainty (the equations' random shocks), it cannot account fully for the systemic and political uncertainty that a withdrawal scenario is likely to trigger. For instance, the pattern of the exchange rate realignment, as well as the extent of financial panic, will be heavily affected by the relations among central banks, and the effectiveness of the realignment could be impaired by the adoption of retaliatory tariffs. Moreover, since the estimation sample ends in 2013, the estimated parameters could not reflect fully the consequences of the ongoing deindustrialization and banking crisis in the Italian economy. These could translate in a slower reaction to the exchange rate adjustment (due to supply-side bottlenecks), and in larger balance sheet effects (due among other things to the deterioration of loan quality). In order to take into account these features, we performed a set of sensitivity analyses of the scenario set out in Table 3. Firstly, we investigate the consequences of alternative patterns of exchange rate realignment. Then, we bring into the picture a number of other possible adverse shocks, including a larger contractionary impact of balance sheet effects, an exogenous increase in the sovereign spread due to an outburst of financial panic, a slowing down of trade adjustment in response to exchange rate realignment, and the application by core countries of a retaliatory tariff on Italian products.

5.1 Alternative patterns of exchange rate realignment

As mentioned in Section 3 above, the hypothesis that the realignment occurs fully within a year is conservative in comparison with the historical experience of European countries, where adjustments following the last major currency crisis (that of the EMS in 1992-93) were usually gradual and staged over about two years. The literature on currency crises distinguishes actually between "European style" crises, with very small or no overshooting even in the presence of relatively large realignments, and "Asian style" crises, with large overshooting (Cavallo *et al*., 2005). However, the fact that no overshooting occurred in Europe in the past does not imply that it could not occur in the future.

Previous explanations of overshooting shed some light on the likelihood of such an event. Cavallo *et al*. (2005) relate overshooting to balance sheet effects. Depreciation of the exchange rate in excess of the new equilibrium value would be triggered by the fire sales of domestic assets needed to buy back some the country's external debt denominated in foreign currency. The key variable in this respect is the level of net foreign assets denominated in foreign currency, which was on average around 15 percent of GDP in European countries, and almost twice as large in Asian countries (Cavallo et al., 2005, Table 1). Durand and Villemot (2016) estimate that the relevant net position of Italy including the Target2 liabilities of the Italian national bank at the end of 2015 was about 30 percent of GDP, which points to the likelihood of some overshooting in case of a major realignment.

Another explanation of overshooting stresses the role of financial panic (Kim and Kim, 2007). While in a number of recent experiences, including Brexit in June 2016 (Gudgin et al., 2016), the election of Donald Trump in November 2016, and the Italian constitutional referendum in December 2016, the expected wave of financial panic did not materialize, an event such as the withdrawal of Italy, to the extent that it brings about a dissolution of the euro, as assumed in our scenarios, would be surrounded by considerable uncertainty, and this increases the possibility of some panic.

Building on these considerations, we assess the sensitivity of our results by examining the countercyclical policies scenarios under two further pattern of nominal realignment. The first one mimics the historical experience of "European style" crises, by considering a gradual pattern, where 75 percent of the realignment occurs in the first year, and the remaining 25 percent in the second year. The second pattern considers a 10 percent overshooting in the first year, with the exchange rate reverting to the estimated adjustment in the second year. The overshooting was calculated with respect to the new equilibrium value defined by the realignment set out in Section 3. For instance, since the misalignment towards the core is equal to 24 percent, the new equilibrium exchange rate is 0.76. In the scenarios presented in Section 4 this value is reached immediately, whereas in the "gradual" scenario the exchange rate drops only to 0.82 in the first year (75 percent of the total adjustment), and in the overshooting scenario it drops to 0.68 (exceeding by -10 percent the new equilibrium value). The size of the overshooting was estimated by looking at the historical experience of countries with a comparable size of net foreign assets. Our sensitivity analysis considers an extreme scenario as overshooting is usually a short-run phenomenon, and the estimates provided in the literature usually consider monthly data, while our model is specified in annual data. Therefore, a 10 percent overshooting in annual terms actually corresponds to a much larger overshooting in monthly terms.

We implement these different patterns of adjustment in two ways: first, we apply the alternative adjustment patterns only towards the core of the EA, then we apply them towards all the partner countries. The scenario where adjustment is gradual only towards the core corresponds to the hypothesis that monetary authorities would cooperate within the EA, in the presence of some turmoil in the international financial markets. On the contrary, the scenario in which overshooting occurs only towards the EA core corresponds to the case in which the dissolution of the euro causes a wave of regional financial contagion. The scenario in which the adjustment is gradual towards all the major partner countries reflects the historical experience of Italian currency crises.

Table 4 and Figure 2 summarize the main results of the sensitivity analysis.[13] The main stylized fact emerging from the analysis is that in the medium term the macroeconomic impact would not change dramatically under different patterns of adjustment. At the end of the simulation sample real GDP would come out in a range between 3 percent and 3.4 percent above the baseline, against 3.2 percent in the previous scenario. Interestingly enough, the most growth-friendly environment is the one in which the realignment is

[13] In order to save space, in Tables 4 and 5 we report results only for some variables. The full set of results of the sensitivity analyses is available upon request.

gradual only towards the EA core, while the worst outcome occurs when the exchange rate overshoots only towards the EA core.

[Insert Table 4 around here]

[Insert Figure 2 around here]

On the other hand, while some divergences exist in the short term, they do not seem to be dramatic. As shown in Table 4 and Figure 2, the main difference is that in the presence of overshooting, the response of GDP is V-shaped, with a trough in the second year, despite the implementation of countercyclical policies. This is mostly due to the fact that in the overshooting scenarios higher inflation in the first year erodes some of the competitiveness gains, a development reinforced in the second year when the bilateral exchange rate revaluates to reach its new long-run equilibrium. When the overshooting occurs with respect to all partners, this behaviour is even more noticeable. As mentioned above, these differences tend to get reabsorbed in the medium term.

5.2 Other sensitivity analyses

Table 5 and Figure 3 present the results of other sensitivity analyses, whose design and major results will be briefly discussed in this section. Firstly, we accounted for the occurrence of larger balance sheet effects, implemented by increasing by one standard error in absolute value the coefficients in Eq. (1).[14] Secondly, we simulated a slower adjustment speed in response to the nominal realignment, implemented by reducing by one standard error in absolute value the impact elasticities to the real exchange rate as well as the coefficient of the lagged cointegrating residuals in all the trade equations. Thirdly, we simulated an outburst of financial panic, by assuming that there would be an exogenous increase in the sovereign spread equal to 200 basis points in the first year, implemented as an add factor in equation [25] in Table 1. Fourthly, we simulated the application of a retaliatory tariff on Italian products by core countries, equal to 5% for the

[14] In other words, we put $\alpha_1 = 0.228$ and $\alpha_2 = -0.021$.

first two years of the simulation sample, implemented by increasing by 5% the variable RER_1 in the equation of x_1 (Eq. [13] in Table 1).

The medium term outcomes, in particular in terms of real GDP, do not differ dramatically under different hypotheses. In the event of severe financial distress, either in the form of larger balance sheet effects or of a surge in the sovereign spread, real GDP will be only 2.6% above the baseline after five years (0.6 points lower than in the reference scenario). In three out of the four additional scenarios GDP decreases in the first year, although this decrease is statistically significant only in case of larger balance sheets effects and of retaliatory tariffs. Interestingly enough, under all the hypotheses considered higher nominal growth would bring about a decrease of public debt-to-GDP ratio by about 18 percentage points.

[Insert Table 5 around here]

[Insert Figure 3 around here]

6. Concluding remarks

This paper aims to assess the main macroeconomic consequences of the re-adoption of a national currency in a large EA peripheral country, taking Italy as a case study. The simulation outcomes are consistent with recent research. While a realignment of the nominal exchange rate *per se* would not bring about any statistically significant benefit in terms of growth in the medium run, it would open fiscal space. Supplemented with an expansionary policy stance, the realignment would contribute to a significant increase in output and employment, and hence to effective fiscal consolidation. If the real growth rates proposed by the last IMF scenario were corrected with the upward deviations in real GDP growth resulting from our "counterfactual policies" scenario, the Italian economy would recover its pre-crisis GDP level by 2020, i.e. five years before the year currently assumed by the IMF.[15] Robustness checks show that these results hold also in case of extreme events such as a sizeable overshooting in the currency realignments, an event

[15] According to the IMF, output levels will return to pre-crisis levels "only by the mid-2020s" (Source: https://www.imf.org/external/np/sec/pr/2016/pr16329.htm).

that could materialize in case of a disorderly fragmentation of the single currency, as well as in the presence of other possible adverse shocks.

Some concluding perspectives are in order. First, this paper should not be construed as an action plan for the withdrawal of Italy from the EA, nor does it advocate this event as a desirable outcome. A more growth-friendly environment, compliant with member countries' external constraints, could be achieved by a joint fiscal effort undertaken in a coordinated way by all EA member countries. However, partly as a result of the endogenous economic divergence described in the introduction, the recent political developments, both in and outside the EA, have led to an increasingly confrontational attitude among the member countries which makes this first best scenario more and more unlikely. Despite the considerable systemic and political uncertainty involved in a breakup of the euro, it is therefore worth trying to quantify its macroeconomic consequences.

Second, while taking into account some major sources of macroeconomic stress (from contractionary balance sheet effects to the sovereign bond yield spread), our main simulation considers an extremely stylized counterfactual: a once-and-for-all nominal realignment of the Italian national currency, which brings it back into line with its equilibrium value in real terms in about a year, leaving nominal exchange rates substantially stable thereafter. In conceptual terms, our simulation experiments therefore amount to analysing the effects of realignment within a system of fixed exchange rates. A more realistic scenario would consider the move to a different monetary system, such as a target zones regime. A thorough comparison of the long-run performance of different monetary systems would, however, exceed the scope of the present research, which focuses on the short- to medium-run consequences of a realignment. The L-shaped pattern of nominal exchange rate adjustment considered in our counterfactuals is consistent with quite a number of historical experiences, where large realignments were followed by periods of relative stability (see e.g. Burstein et al., 2002). On this basis, we believe that our assumption on the stability of bilateral nominal exchange rates after the realignment provides a reasonable approximation, underpinning the usefulness of the insights provided by our results.[16]

[16] We carried out an additional simulation in which the bilateral exchange rates between Italy and the three groups of European countries (Eurozone core, Eurozone periphery, others) adjusted to the respective inflation differential. The main outcome of the

Third, contrary to some previous assessments of the consequences of a euro breakup, such as Belke and Verheyen's (2013) "doomsday" scenario, the results of our simulations show that the short-term costs of the breakup, while non-negligible, would be manageable, and in the case of active policy intervention, the advantages over a five-year horizon would be substantial. The difference between previous analyses and our results reflects some fundamental changes in the macroeconomic framework, as well as some recent theoretical developments, which affect the evaluation of both the baseline and counterfactual scenarios.

As regards changing macroeconomic conditions, since the time of Belke and Verheyen's analysis quantitative easing policies have drawn the euro exchange rate much closer to parity with the dollar (in 2016 it has so far averaged 1.11, down from an average of 1.33 in 2013), while failing to reanimate inflation. This has two major consequences. First, it is unlikely that Italy would experience a further major depreciation against the dollar, reducing the likelihood of the counterfactual scenarios leading to severe inflationary consequences. Second, the Italian economy is currently in a deflationary environment that compromises both private and sovereign debt sustainability, making the baseline scenario look increasingly risky, and some imported inflation much more desirable than it appeared before.

As for theoretical developments, Gödl and Kleinert's (2016) analysis, implemented in our model, suggests that fundamental variables might play a much more significant role than is commonly assumed in explaining the sovereign debt spread, especially in EA crisis countries, where the public debt-to-GDP ratio has a large and extremely significant impact on the spread, while real growth has a negative impact. Easing of the public debt burden as a result of higher nominal growth would therefore mitigate the consequences of the breakup on the average cost of government debt. This result disproves the narrative that public finances would be threatened by an "explosion" of the interest rate spread, while confirming the stylized facts collected by Nitsch (2004). Furthermore, recent developments in the analysis of fiscal multipliers in recessions (Canzoneri *et al.*, 2016) suggest that moderately expansionary policies may be a more effective way of achieving public debt sustainability than harsh austerity measures.

simulations is that the related multipliers are not statistically different from the ones obtained without taking nominal exchange rate flexibility into account. The results of this simulation are available on request.

Although exit from a currency union involves further technical and political challenges, our results confirm the historical experience of these events summarized by Rose's (2007) statement: "there are typically no sharp macroeconomic movements before, during or after exits". The results also confirm, as was the case with entry into the single currency area, that exit from the single currency is not a panacea and considerable uncertainty surrounds its consequences. If the monetary union should eventually prove politically unsustainable, confirming Kaldor's (1971) intuition, re-adoption of a national currency would only be a necessary condition for recovery and definitely not a sufficient one.

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Table 1 – Model structure

Demand

[1] $c_p = f[\,(Y - DT)\ /\ P_{cp}, FPR]$

[2] $i_b = k - k_{-1}\,(1 - \omega)$

[3] $i_k = f(\,y\,)$

[4] $x = \sum_i x_i$

[5] $m = \sum_i m_i$

[6] $y = c_p + C_g / \overline{P}_g + i_b + \bar{I}_g / P_{ig} + i_k + {} + x - m$

[7] $Y = c_p \times P_{cp} + C_g + i_b \times P_{ib} + \bar{I}_g + {} + i_k \times \overline{P}_{ik} + x \times P_x - m \times P_m$

Supply

[8] $\frac{y^*}{n} = A\left(\frac{k}{n}\right)^a e^{\lambda t(1-\alpha)}$

[9] $n_b = \left(\frac{1-\alpha}{a}\,\frac{P_{ib}}{W}\right)^{\alpha} \frac{y}{A}\, e^{-(1-\alpha)\lambda t}$

[10] $\dot{k} = f\left[\alpha\frac{y}{n} - (r + \omega + \varsigma)\right]$

[11] $n = n_b + \bar{n}_g$

[12] $u = 100 \times \left(1 - \frac{n}{\overline{lf}}\right)$

Trade

[13] $x_i = f(y_i, RER_i)$ $i = 1, ..., 7$

[14] $m_i = f(y, RER_i)$ $i = 1, ..., 7$

[15] $\dot{y}_i = f_i(\dot{y}, \dot{RER}_i)$ $i = 1, ..., 7$

[16] $RER_i = \frac{\overline{E}_i \times P_x}{\overline{P}_{xi}}$ $i = 1, ..., 7$

Wages, prices, interest rates

[17] $\frac{W}{P_{cp}} = f\left(\frac{y}{n}, EPL, u\right)$

[18] $ULC = W / (y/n)$

[19] $P_{cp} = f(\,ULC, P_m, y - y^*\,)$

[20] $P_{ib} = f(\,ULC, P_m\,)$

[21] $P_{ig} = f(\,ULC, P_{ib}\,)$

[22] $P_x = f(\,ULC, P_m\,)$

[23] $P_m = \prod_i \left(\frac{\overline{P}_i}{\overline{E}_i}\right)^{\mu_i}$

[24] $P_y = \frac{Y}{y}$

[25] $IR_s = f(\dot{P}_{cp}, y - y^*)$

[26] $IR_l - \overline{IR}_f = f\left(\frac{D}{Y}, \frac{GB}{Y}, \dot{y}\right)$

[27] $r = IR_l - 100 \times \dot{P}_y$

[28] $IR_g = f(\,IR_s, IR_l\,)$

Public sector

[29] $DT = \tau \times (W \times n_b + \overline{W}_g \times \bar{n}_g + Y_p + SB)$

[30] $IT = \delta \times (c_p \times P_{cp} + i_b \times P_{ib})$

[31] $SC = \sigma \times (W \times n_b + \overline{W}_g \times \bar{n}_g)$

[32] $SB = f(Y, \overline{AGE}, u)$

[33] $C_g = \overline{W}_g \times \bar{n}_g + \overline{CI}_g$

[34] $GR = DT + IT + SC$

[35] $PB = GR - C_g - \bar{I}_g - SB$

[36] $GB = PB - IR_g \times D$

[37] $D = D_{-1} - GB$

[38] $\Delta\left(\frac{D}{Y}\right) = -\frac{GB}{Y} - \frac{\dot{Y}}{1 + \dot{Y}}\left(\frac{D}{Y}\right)_{-1}$

Table 1 (continued) – Model structure

Variables	
A = total factor productivity	r = long-term real interest rate
AGE = age dependency ratio	RER_i = real exchange rate with respect to partner i
c_g = government final consumption	SB = social security benefits
c_p = households final consumption	SC = social security contributions
CI_g = government intermediate consumption	t = time trend
D = public debt	u = unemployment rate
DT = direct taxes	ULC = unit labour cost
E_i = index of the nominal exchange rate towards the i-th partner area	W = wage rate, private sector
EPL = index of employment protection legislation	W_g = wage rate, public sector
FPR = female participation rate	x = exports of goods and services
GB = government balance	x_i = exports of goods and services towards partner i
i_b = private gross fixed capital formation	y = gross domestic product, real
i_g = government gross fixed capital formation	Y = gross domestic product, nominal
i_k = changes in inventories	y_i = real gross domestic product of partner i
IR_f = foreign interest rate	Y_p = self-employment and property income
IR_g = ex post interest rate on public debt	y^* = potential output
IR_l = long-term nominal interest rate	
IR_s = short-term nominal interest rate	
IT = indirect taxes	
k = stock of physical capital, private sector	**Parameters**
lf = labour force	α = Capital share
m = imports of goods and services	δ = Indirect tax rate
m_i = imports of goods and services from the i-th trade partner	λ = Rate of labour augmenting technical progress
n = total employment	μ_i = Import share from partner i
n_b = Employment, private sector	σ = average social security contribution rate
n_g = Employment, public sector	ς = Risk premium
P_{xi} = deflator of the exports of goods and services of the i-th partner	τ = average direct tax rate
P_z = deflator of variable z ($z = c_p, i_b, i_g, i_k, x, m, y$)	ω = Scrap rate

Notes: Lower cases indicate the corresponding real value of the variables in upper case; a dot over a variable indicates its rate of variation; exogenous variables are indicated with a bar above the name of the variable.

Table 2 – Base case scenario

		1	*2*	*3*	*4*	*5*
Percentage deviations from the baseline						
[1]	real GDP	-0.7	-1.1	-0.5	0.7	1.4
		(0.17)	(0.32)	(0.51)	(0.72)	(0.93)
[2]	average labour productivity	-1.1	-1.5	-0.9	0.3	0.9
		(0.14)	(0.27)	(0.44)	(0.61)	(0.78)
[3]	real wage rate	-1.7	-1.6	-0.3	1.3	2.3
		(0.09)	(0.20)	(0.34)	(0.48)	(0.63)
Absolute deviations from the baseline						
[4]	unemployment rate	-0.3	-0.4	-0.4	-0.4	-0.4
		(0.03)	(0.04)	(0.05)	(0.06)	(0.08)
[5]	long term interest rate	1.2	1.6	1.7	1.5	1.3
		(0.27)	(0.25)	(0.15)	(0.07)	(0.07)
[6]	public debt-to-GDP ratio	-5.2	-8.2	-10.5	-12.2	-13.0
		(0.23)	(0.34)	(0.49)	(0.70)	(0.91)
[7]	public deficit-to-GDP ratio	-0.2	0.0	0.7	1.1	0.9
		(0.09)	(0.15)	(0.17)	(0.16)	(0.16)
[8]	trade balance-to-GDP ratio	1.6	1.9	1.3	0.7	0.6
		(0.09)	(0.07)	(0.08)	(0.13)	(0.17)
Absolute deviations between the counterfactual and baseline growth rates						
[9]	private consumption	-0.9	0.0	1.7	2.2	1.0
		(0.15)	(0.19)	(0.20)	(0.25)	(0.29)
[10]	private investment	1.0	0.6	0.9	1.3	0.1
		(0.39)	(0.29)	(0.32)	(0.42)	(0.40)
[11]	exports	4.1	-1.3	0.9	1.8	0.9
		(0.30)	(0.27)	(0.28)	(0.32)	(0.31)
[12]	imports	-6.0	0.5	3.7	3.8	1.0
		(0.45)	(0.45)	(0.52)	(0.51)	(0.49)
[13]	real GDP	-0.7	-0.4	0.6	1.2	0.7
		(0.17)	(0.16)	(0.19)	(0.21)	(0.21)
[14]	nominal GDP	3.7	2.2	2.1	2.0	1.2
		(0.14)	(0.12)	(0.11)	(0.13)	(0.13)
[15]	consumption price index	2.9	2.6	2.1	1.4	0.8
		(0.06)	(0.08)	(0.09)	(0.09)	(0.10)

Notes: deviations are estimated as sample average of the 10,000 replications of the stochastic simulation experiment; bootstrap standard errors are reported in parentheses.

Table 3 – Countercyclical policy scenario

		1	*2*	*3*	*4*	*5*
	Percentage deviations from the baseline					
[1]	real GDP	0.3	0.4	1.2	2.5	3.2
		(0.15)	(0.32)	(0.52)	(0.76)	(1.01)
[2]	average labour productivity	-0.5	-1.0	-0.5	0.5	1.0
		(0.13)	(0.26)	(0.44)	(0.63)	(0.84)
[3]	real wage rate	-1.6	-1.1	0.6	2.4	3.6
		(0.08)	(0.21)	(0.38)	(0.54)	(0.71)
	Absolute deviations from the baseline					
[4]	unemployment rate	-0.7	-1.1	-1.4	-1.7	-1.8
		(0.02)	(0.04)	(0.06)	(0.08)	(0.10)
[5]	long term interest rate	1.2	1.8	2.1	2.1	1.9
		(0.26)	(0.24)	(0.15)	(0.08)	(0.07)
[6]	public debt-to-GDP ratio	-7.0	-11.4	-15.0	-17.8	-19.6
		(0.31)	(0.49)	(0.72)	(1.03)	(1.35)
[7]	public deficit-to-GDP ratio	0.0	0.0	0.6	1.0	0.8
		(0.09)	(0.15)	(0.16)	(0.15)	(0.16)
[8]	trade balance-to-GDP ratio	0.9	1.1	0.5	-0.1	-0.3
		(0.08)	(0.07)	(0.10)	(0.14)	(0.18)
	Absolute deviations between the counterfactual and baseline growth rates					
[9]	private consumption	-0.2	0.6	1.9	2.3	1.2
		(0.18)	(0.24)	(0.25)	(0.29)	(0.36)
[10]	private investment	3.5	1.8	1.4	1.3	0.0
		(0.36)	(0.34)	(0.50)	(0.65)	(0.69)
[11]	exports	4.7	-1.2	0.8	1.6	0.8
		(0.30)	(0.29)	(0.30)	(0.33)	(0.34)
[12]	imports	-2.9	1.0	3.8	3.7	1.1
		(0.45)	(0.44)	(0.46)	(0.49)	(0.56)
[13]	real GDP	0.3	0.1	0.8	1.3	0.7
		(0.15)	(0.16)	(0.21)	(0.23)	(0.24)
[14]	nominal GDP	5.2	3.3	3.1	2.7	1.8
		(0.15)	(0.12)	(0.11)	(0.13)	(0.14)
[15]	consumption price index	3.7	3.3	2.8	2.1	1.4
		(0.06)	(0.08)	(0.09)	(0.10)	(0.10)

Notes: deviations are estimated as sample average of the 10,000 replications of the stochastic simulation experiment; bootstrap standard errors are reported in parentheses.

Table 4 – Alternative patterns of nominal exchange rate realignment

		1	*2*	*3*	*4*	*5*
	Gradual adjustment towards the core					
[1]	real GDP	0.2	0.6	1.4	2.6	3.4
		(0.14)	(0.29)	(0.49)	(0.72)	(0.97)
[2]	% change in consumption price index	3.1	3.2	2.8	2.1	1.4
		(0.05)	(0.08)	(0.08)	(0.09)	(0.10)
[3]	real wage rate	-1.4	-1.0	0.3	2.0	3.2
		(0.08)	(0.20)	(0.36)	(0.51)	(0.68)
[4]	public debt-to-GDP ratio	-5.7	-10.2	-14.2	-17.3	-19.4
		(0.26)	(0.47)	(0.71)	(1.01)	(1.33)
[5]	trade balance-to-GDP ratio	0.6	0.7	0.4	-0.1	-0.2
		(0.08)	(0.07)	(0.09)	(0.13)	(0.17)
	Overshooting towards the core					
[6]	real GDP	0.7	-0.2	0.8	2.2	3.0
		(0.21)	(0.39)	(0.63)	(0.89)	(1.15)
[7]	% change in consumption price index	4.9	3.5	2.8	2.0	1.3
		(0.09)	(0.09)	(0.09)	(0.10)	(0.10)
[8]	real wage rate	-2.0	-1.1	1.1	3.2	4.5
		(0.11)	(0.26)	(0.44)	(0.61)	(0.81)
[9]	public debt-to-GDP ratio	-9.9	-14.1	-16.9	-19.2	-20.2
		(0.44)	(0.56)	(0.78)	(1.10)	(1.41)
[10]	trade balance-to-GDP ratio	1.7	1.9	0.7	-0.2	-0.4
		(0.10)	(0.10)	(0.13)	(0.17)	(0.20)
	Gradual adjustment towards all partners					
[11]	real GDP	-0.2	0.7	1.7	2.7	3.1
		(0.15)	(0.31)	(0.52)	(0.77)	(1.04)
[12]	% change in consumption price index	2.4	2.6	2.5	2.1	1.6
		(0.04)	(0.06)	(0.08)	(0.09)	(0.10)
[13]	real wage rate	-1.2	-0.2	1.6	3.5	4.8
		(0.08)	(0.20)	(0.35)	(0.51)	(0.69)
[14]	public debt-to-GDP ratio	-5.7	-9.7	-13.4	-16.4	-18.3
		(0.21)	(0.39)	(0.63)	(0.95)	(1.29)
[15]	trade balance-to-GDP ratio	1.1	1.0	0.6	0.1	0.0
		(0.07)	(0.08)	(0.12)	(0.16)	(0.20)
	Overshooting towards all partners					
[16]	real GDP	1.0	-0.4	0.7	2.4	3.3
		(0.21)	(0.40)	(0.63)	(0.90)	(1.17)
[17]	% change in consumption price index	5.3	3.4	2.6	1.9	1.1
		(0.10)	(0.09)	(0.09)	(0.10)	(0.10)
[18]	real wage rate	-2.0	-1.4	0.8	3.1	4.5
		(0.11)	(0.27)	(0.44)	(0.61)	(0.80)
[19]	public debt-to-GDP ratio	-10.0	-14.5	-17.1	-19.3	-20.4
		(0.48)	(0.58)	(0.79)	(1.10)	(1.42)
[20]	trade balance-to-GDP ratio	1.4	2.0	0.7	-0.3	-0.4
		(0.12)	(0.11)	(0.13)	(0.17)	(0.21)

Notes: real GDP and real wage are expressed as percentage deviations from the baseline; change in consumption price index, public debt-to-GDP ratio and trade balance-to-GDP ratio are expressed as absolute deviations from the baseline; deviations are estimated as sample average of the 10,000 replications of the stochastic simulation experiment; bootstrap standard errors are reported in parentheses.

Table 5 – Other sensitivity analyses

		1	*2*	*3*	*4*	*5*
	Larger balance sheet effects					
[1]	real GDP	-0.8	-0.8	0.3	1.8	2.6
		(0.18)	(0.35)	(0.58)	(0.82)	(1.07)
[2]	% change in consumption price index	3.9	3.5	3.0	2.3	1.5
		(0.06)	(0.08)	(0.09)	(0.10)	(0.10)
[3]	real wage rate	-2.2	-1.5	0.5	2.7	4.1
		(0.10)	(0.23)	(0.40)	(0.57)	(0.75)
[4]	public debt-to-GDP ratio	-7.4	-11.4	-14.6	-17.2	-18.5
		(0.30)	(0.46)	(0.70)	(1.03)	(1.36)
[5]	trade balance-to-GDP ratio	1.6	1.5	0.6	-0.2	-0.3
		(0.09)	(0.08)	(0.11)	(0.16)	(0.19)
	Slower trade response					
[6]	real GDP	-0.1	0.1	1.0	2.2	2.9
		(0.14)	(0.29)	(0.48)	(0.69)	(0.92)
[7]	% change in consumption price index	3.7	3.3	2.7	2.0	1.3
		(0.06)	(0.07)	(0.08)	(0.09)	(0.09)
[8]	real wage rate	-1.8	-1.3	0.3	2.1	3.2
		(0.08)	(0.20)	(0.36)	(0.51)	(0.68)
[9]	public debt-to-GDP ratio	-6.5	-10.9	-14.4	-17.2	-18.8
		(0.30)	(0.46)	(0.67)	(0.95)	(1.23)
[10]	trade balance-to-GDP ratio	0.8	1.0	0.4	-0.2	-0.3
		(0.09)	(0.07)	(0.10)	(0.14)	(0.18)
	Financial panic					
[11]	real GDP	0.4	0.3	0.9	1.9	2.6
		(0.16)	(0.31)	(0.50)	(0.72)	(0.96)
[12]	% change in consumption price index	3.5	3.2	2.8	2.2	1.4
		(0.06)	(0.08)	(0.08)	(0.09)	(0.10)
[13]	real wage rate	-1.5	-1.0	0.4	2.0	3.1
		(0.09)	(0.21)	(0.36)	(0.51)	(0.68)
[14]	public debt-to-GDP ratio	-6.4	-10.6	-13.9	-16.6	-18.2
		(0.30)	(0.47)	(0.67)	(0.95)	(1.24)
[15]	trade balance-to-GDP ratio	0.9	1.1	0.7	0.2	-0.0
		(0.08)	(0.07)	(0.09)	(0.13)	(0.17)
	Retaliatory tariffs					
[16]	real GDP	-0.3	-0.5	0.7	2.2	3.1
		(0.14)	(0.29)	(0.50)	(0.74)	(0.98)
[17]	% change in consumption price index	3.8	3.3	2.7	2.0	1.3
		(0.06)	(0.08)	(0.08)	(0.09)	(0.10)
[18]	real wage rate	-1.9	-1.6	0.1	2.0	3.3
		(0.08)	(0.20)	(0.36)	(0.52)	(0.69)
[19]	public debt-to-GDP ratio	-6.5	-10.4	-13.8	-16.7	-18.4
		(0.28)	(0.42)	(0.66)	(0.99)	(1.32)
[20]	trade balance-to-GDP ratio	0.8	0.9	0.4	-0.2	-0.3
		(0.08)	(0.07)	(0.10)	(0.14)	(0.18)

Notes: real GDP and real wage are expressed as percentage deviations from the baseline; change in consumption price index, public debt-to-GDP ratio and trade balance-to-GDP ratio are expressed as absolute deviations from the baseline; deviations are estimated as sample average of the 10,000 replications of the stochastic simulation experiment; bootstrap standard errors are reported in parentheses.

Figures

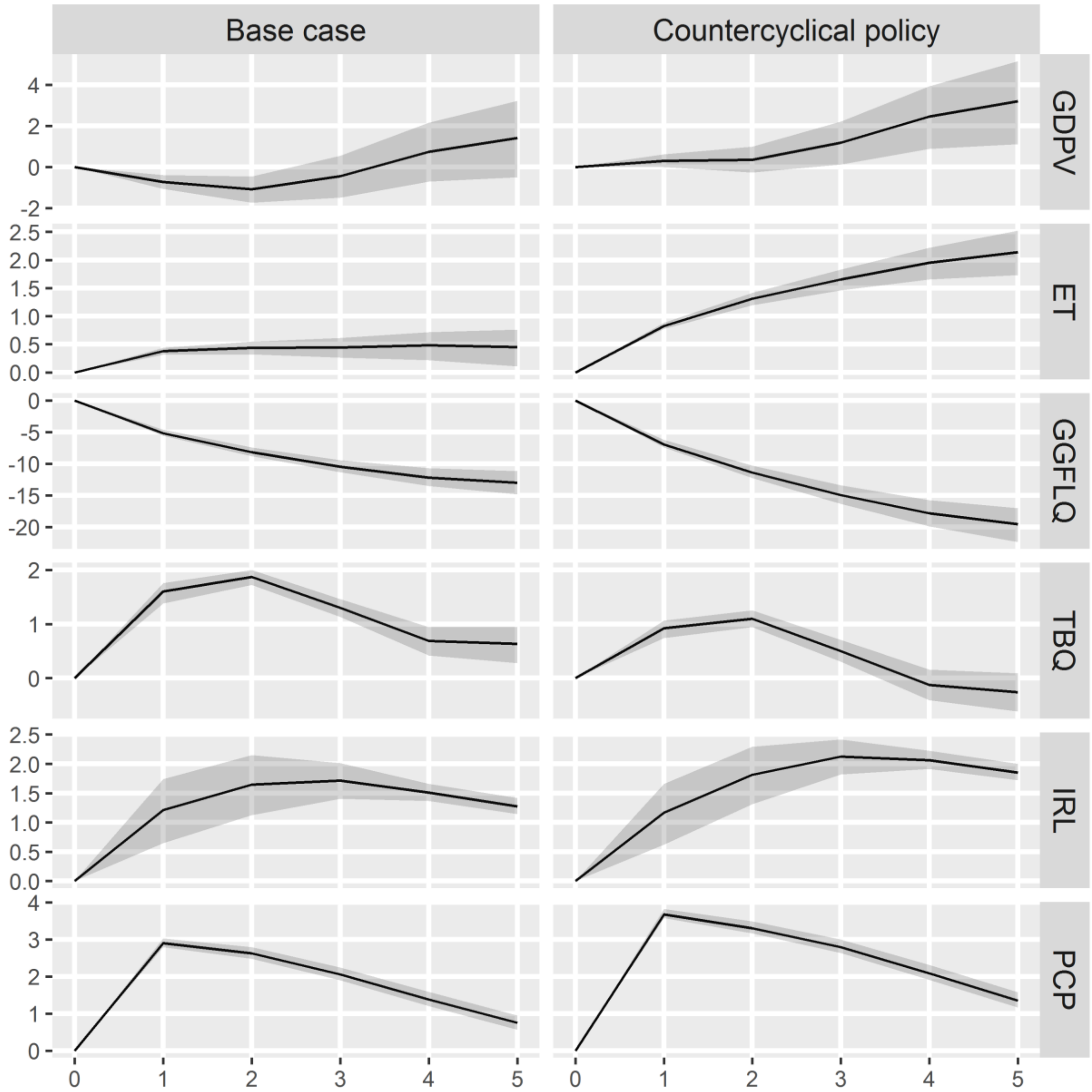

Figure 1 – Average percentage deviation of real GDP (*GDPV*) and total employment (*ET*), and absolute deviations of the debt-to-GDP ratio, trade balance-to-GDP ratio, long-term interest rate, and consumer price inflation (*GGFLQ*, *TBQ*, *IRL* and *PCP*) with respect to the baseline under different counterfactual scenarios. Note: shaded areas represent confidence intervals at 95%.

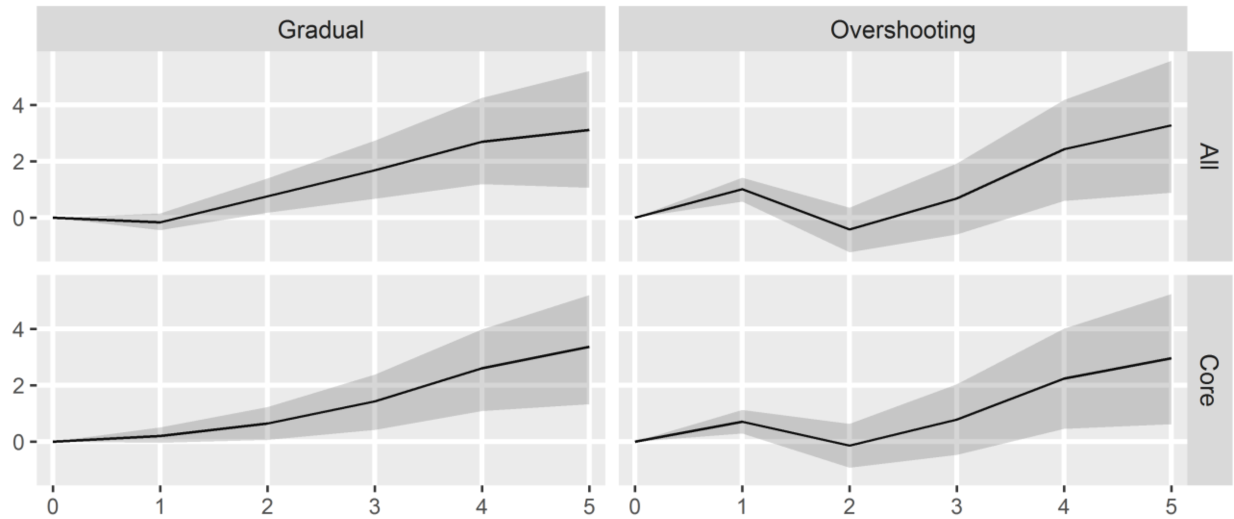

Figure 2 – Percentage deviation of real GDP from the baseline in the sensitivity analyses under alternative adjustment patterns of the nominal exchange rates. The graphs in the first column show the consequences of a gradual adjustment occurring over two years, while the second column considers an adjustment with overshooting. In the first row these patterns apply to all partner countries, in the second one only to the euro area core countries.

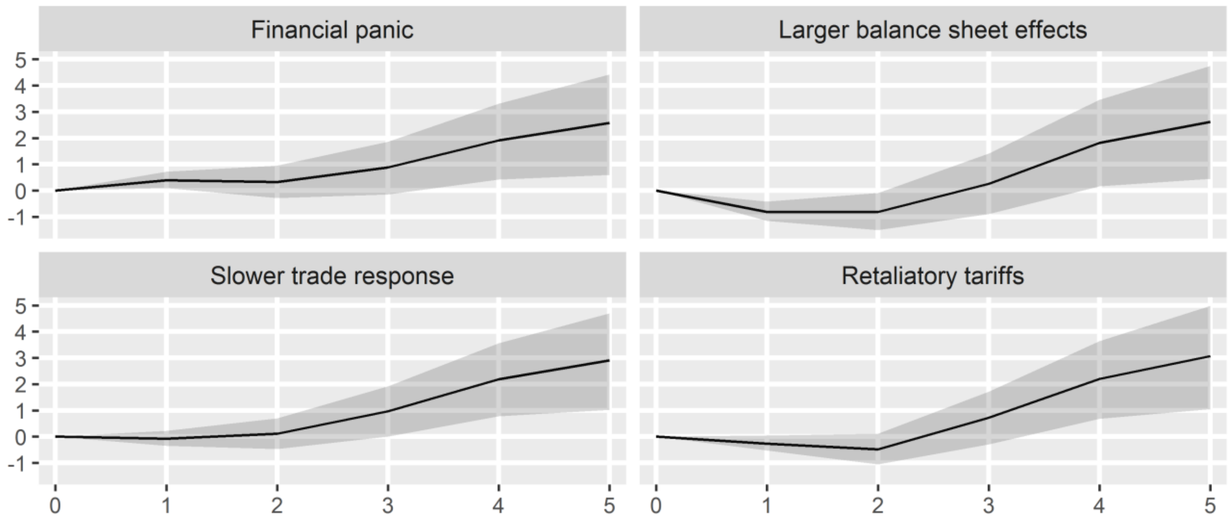

Figure 3 – Percentage deviation of real GDP from the baseline in the sensitivity analyses. The four hypotheses are described in Section 5.2.

Appendix: the estimated long-run equations[a]

1. Consumption function

$\ln(c_p) = -1.21_{(3.48)} + 0.06 \times (t{>}1994)_{(2.65)} + 1.01 \times \ln[(Y - DT)/P_{cp}]_{(32.06)} + 2.07 \times FPR_{(5.18)}$

$R^2 = 0.99$; $CRADF = -2.67$; $GH = -5.51^{***}$

2. Changes in inventories

$i_k = -33682.62_{(12.12)} - 13855.23 \times (t{>}1976)_{(6.40)} + 0.04 \times y_{(9.62)}$

$R^2 = 0.75$; $F = 31.55^{***}$

3. Production function

$\ln(y^*/n) = 0.82_{(1.21)} + [0.46_{(2.67)} + 0.07 \times (t{>}1971)_{(3.92)} + 0.12 \times (t{>}1997)_{(4.55)}] \times \ln(k/n)$

$+ [0.04_{(3.70)} - 0.03 \times (t{>}1971)_{(4.18)} - 0.01 \times (t{>}1997)_{(4.39)} - 0.001 \times (t{>}2008)_{(6.91)}] \times t$

$R^2 = 0.99$; $CRADF = -2.91$; $GH = -4.10$; $ADF^* = -5.83^*$

4. Labour demand[b]

$\ln(n_b) - \ln(y) + \alpha \times \{\ln[(1-\alpha)/\alpha] - \ln(W/P_{ib})\} = -3.54_{(627.23)} - 0.24 \times (t{>}1971)_{(9.60)}$

$- 0.78 \times (t{>}1997)_{(23.11)} + [-0.029_{(25.81)} + 0.015 \times (t{>}1971)_{(9.29)} - 0.021 \times (t{>}1997)_{(20.88)}] \times t$

$R^2 = 0.99$

5. Capital accumulation[c]

$\dot{k} = 0.05_{(16.60)} - 0.02 \times (t{>}1971)_{(6.31)} - 0.02 \times (t{>}1997)_{(11.13)} + [0.16 \times (t{>}1971)_{(9.58)}$

$$+ 0.27 \times (t{>}1997)_{(6.18)}] \times \left[\alpha \frac{y}{n} - (r + \omega + \varsigma)\right]$$

$R^2 = 0.89$

6. Exports towards euro area core

$\ln(x_1) = -17.24_{(18.76)} + 1.84 \times \ln(y_1)_{(31.42)} - [0.57_{(2.89)} + 0.69 \times (t{>}1986)_{(4.59)}] \times \ln(RER_1)$

$R^2 = 0.99$; $CRADF = -2.56$; $GH = -5.53^{**}$

[a] When the variables were all integrated of order one, the existence of a long-run relation was first tested using the cointegrating regression augmented Dickey-Fuller (*CRADF*) test (Engle and Granger, 1987); if this test failed to reject the null hypothesis of no cointegration, we performed the Gregory and Hansen (1996) test (*GH*), which allows for one parameters shift at unknown dates; if even the GH test failed to reject, we applied Hatemi J (2008) cointegration test (ADF^*), which allows for two parameters shifts. The equations were specified accordingly, by modelling the shifts in parameters through the dummy ($t > t_0$), which takes value zero from the beginning of the sample to year t_0, and value one onwards. Absolute values of t-statistics for the individual parameters are in parentheses. As a rule, insignificant parameters shifts were dropped from the final equation. In two cases in which the variables involved might not be of the same order of integration (Eq. 2 and 25), we used the Pesaran *et al*. (2001) ARDL estimator, which allows for the estimation of long-run relations among variables of different order of integration, and reported the statistics of the bounds test for the null hypothesis of no long-run relationship. One, two or three asterisks indicate a statistic significant at the 10%, 5% and 1% significance level respectively.

[b] The parameter α in the left-hand side of the conditional labour demand equation is the estimate of the capital share obtained from equation 3, equal to 0.46 from 1960 to 1971, 0.53 from 1972 to 1997, 0.64 from 1998 onwards. The equation was estimated by OLS conditional on the structural breaks found in the underlying production function (Eq. 3).

[c] Since its variables turn out to be $I(0)$, also this equation was estimated by OLS conditional on the structural breaks found in the production function.

7. Exports towards euro area periphery

$\ln(x_2) = -16.79_{(25.81)} - 12.25 \times (t>1985)_{(10.42)} + 1.98 \times (t>1999)_{(17.78)} + [1.86_{(38.90)}$

$+ 0.92 \times (t>1985)_{(10.93)}] \times \ln(y_2) - [0.43_{(2.80)} + 1.48 \times (t>1985)_{(5.35)}] \times \ln(RER_2)$

$R^2 = 0.99$; $CRADF = -0.68$; $GH = -4.51$; $ADF^* = -5.53^{**}$

8. Exports towards the USA

$\ln(x_3) = -47.65_{(7.82)} + 0.30 \times (t>1982)_{(4.47)} + 3.69 \times \ln(y_3)_{(9.04)} - 1.03 \times \ln(RER_3)_{(8.05)} - 0.06 \times t_{(5.0)}$

$R^2 = 0.97$; $CRADF = -2.06$; $GH = -5.12^{*}$

9. Exports towards other European Union countries

$\ln(x_4) = -17.11_{(20.78)} + 1.85 \times \ln(y_4)_{(34.07)} - 1.52 \times \ln(RER_4)_{(3.54)}$

$R^2 = 0.98$; $CRADF = -3.81^{*}$

10. Exports towards OPEC countries

$\ln(x_5) = 6.10_{(3.83)} + 0.26 \times \ln(y_5)_{(2.31)} - 0.67 \times \ln(RER_5)_{(7.08)}$

$R^2 = 0.85$; $CRADF = -4.25^{**}$

11. Exports towards the BRIC countries

$\ln(x_6) = -11.09_{(15.50)} - 0.27 \times (t>1977)_{(2.74)} + 1.34 \times \ln(y_6)_{(26.49)} - 1.20 \times \ln(RER_6) \times (t>1993)_{(2.49)}$

$R^2 = 0.95$; $CRADF = -2.06$; $GH = -5.18^{**}$

12. Exports towards the rest of the world

$\ln(x_7) = -14.49_{(9.59)} + 0.44 \times (t>1993)_{(9.65)} + 1.55 \times \ln(y_7)_{(16.58)} - 0.47 \times \ln(RER_7)_{(2.64)}$

$R^2 = 0.98$; $CRADF = -2.06$; $GH = -5.48^{***}$

13. Imports from the euro area core

$\ln(m_1) = -18.35_{(13.67)} - 0.21 \times (t>1978)_{(3.04)} + 2.11 \times \ln(y)_{(21.60)} + 1.03 \times \ln(RER_1)_{(9.39)}$

$R^2 = 0.99$; $CRADF = -2.78$; $GH = -5.51^{***}$

14. Imports from the euro area periphery

$\ln(m_2) = -35.97_{(24.19)} + 0.17 \times (t>1987)_{(3.23)} + 0.23 \times (t>1994)_{(5.82)} + 3.17 \times \ln(y)_{(29.49)}$

$+ 1.97 \times \ln(RER_2)_{(9.82)}$

$R^2 = 0.99$; $CRADF = -2.54$; $GH = -5.49^{***}$

15. Imports from the USA

$\ln(m_3) = -10.38_{(4.95)} - 0.31 \times (t>1981)_{(5.61)} + 1.40 \times \ln(y)_{(9.44)} + 0.39 \times \ln(RER_3)_{(3.08)}$

$R^2 = 0.94$; $CRADF = -3.08$; $GH = -4.76^{*}$

16. Imports from other European Union countries

$\ln(m_4) = -16.09_{(18.12)} + 0.23 \times (t>1984)_{(6.67)} + 1.82 \times \ln(y)_{(28.49)} - 0.45 \times \ln(RER_4)_{(3.03)}$

$R^2 = 0.99$; $CRADF = -2.28$; $GH = -5.03^{**}$

17. Imports from OPEC countries

$\ln(m_5) = 12.69_{(9.61)} - 0.17 \times \ln(y)_{(1.84)} + 0.16 \times \ln(RER_5)_{(4.01)}$

$R^2 = 0.49$; $CRADF = -5.20^{***}$

18. Imports from the BRIC countries

$\ln(m_6) = -5.34_{(0.75)} - 1.85 \times (t>1999)_{(3.03)} + 0.93 \times \ln(y)_{(1.77)} + 0.74 \times \ln(RER_6)_{(3.18)}$

$+ [0.04_{(3.22)} + 0.05_{(3.37)} \times (t>1999)] \times t$

$R^2 = 0.99$; $CRADF = -5.49^{*}$

19. Imports from the rest of the world

$\ln(m_7) = -11.52_{(4.61)} - 0.43 \times (t>1985)_{(5.73)} + 0.33 \times (t>1998)_{(5.59)} + 1.55 \times \ln(y)_{(8.33)}$

$+ 1.19 \times \ln(RER_7)_{(5.04)} + 0.01 \times t_{(3.25)}$

$R^2 = 0.99$; $CRADF = -1.17$; $GH = -3.78$; $ADF^{*} = -5.10$

20. Wage rate in the private sector[d]

$\ln(W/P_{cp}) - \ln(y/n) - \ln(1-\alpha) = -3.73_{(30.10)} + 0.50 \times (t>1971)_{(17.00)} - 0.49 \times (t>1997)_{(5.84)}$

$+ 0.07_{(2.10)} \times EPL + [0.008_{(3.25)} - 0.02 \times (t>1971)_{(6.78)} + 0.02 \times (t>1997)_{(8.94)}] \times t$

$R^2 = 0.96$

21. Deflator, private consumption

$\ln(P_{cp}) = -0.58_{(20.13)} + 0.42 \times (t>1978)_{(13.72)} + [0.29_{(13.12)} - 0.14 \times (t>1978)_{(1.58)}] \times \ln(P_m)$

$+ [0.59_{(33.07)} + 0.37 \times (t>1978)_{(5.83)} - 0.27 \times (t>1998)_{(9.49)}] \times \ln(ULC)$

$R^2 = 0.99$; $CRADF = -2.36$; $GH = -4.10$; $ADF^{*} = -6.35^{*}$

22. Deflator, private gross fixed capital formation

$\ln(P_{ib}) = -0.18_{(8.76)} + 0.02 \times (t>1986)_{(1.01)} + [0.36_{(11.19)} - 0.09 \times (t>1986)_{(9.39)}] \times \ln(P_m)$

$+ 0.66 \times \ln(ULC)_{(18.69)}$

$R^2 = 0.99$; $CRADF = -1.14$; $GH = -5.70^{**}$

23. Deflator, public gross fixed capital formation

$\ln(P_{ig}) = -0.16_{(8.80)} + 0.17 \times (t>1977)_{(9.30)} + [1.00_{(129.95)} + 0.08 \times (t>1977)_{(8.83)}] \times \ln(P_{ib})$

$R^2 = 0.99$; $CRADF = -2.30$; $GH = -5.44^{**}$

24. Deflator, exports

$\ln(P_x) = -0.36_{(16.75)} + 0.39 \times (t>1978)_{(17.04)} - 0.03 \times (t>1997)_{(3.15)} + [0.72_{(26.53)}$

$- 0.20 \times (t>1978)_{(4.53)}] \times \ln(P_m) + [0.09_{(3.43)} + 0.39 \times (t>1978)_{(10.58)} - 0.30 \times (t>1997)_{(8.48)}] \times$

[d] The equation was estimated by OLS conditional on the structural breaks found in Eq. 3.

$\ln(ULC)$

$R^2 = 0.99$; $CRADF = -2.07$; $GH = -3.45$; $ADF^* = -6.18$

25. Short-term interest rate

$IR_s = -0.54_{(0.26)} + 1.44_{(15.20)} \times \dot{P}_{cp} + 1.10 \times (y - y^*)_{(2.34)}$

$R^2 = 0.83$; $F = 23.49^{***}$

26. Ex-post interest rate on public debt

$IR_g = 0.98_{(3.12)} + 1.85 \times (t > 1983)_{(2.72)} + [0.43_{(9.96)} + 0.17 \times (t > 1983)_{(1.70)}) \times [(IR_s + IR_l)/2]$

$R^2 = 0.92$; $CRADF = -2.56$; $GH = -4.61^{**}$

27. Social security benefits

$\ln(SB) = -3.45_{(11.91)} + 0.09 \times (t > 2004)_{(2.87)} + 1.10 \times Y_{(96.63)} + 0.72 \times AGE_{(2.03)} + 1.75 \times u_{(4.51)}$

$R^2 = 0.99$; $CRADF = -3.43$; $GH = -5.63^{**}$