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

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Abstract

This paper assesses the impact on the Italian economy of withdrawal of Italy from the Eurozone, by means of the stochastic simulation of a macroeconometric model. The model considers the contractionary effects of devaluation, the evolution of sovereign debt spread 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, it would recover and resume growth at a reasonable pace.

JEL: E11, E12, E42, E58, F32, F33, F34, F36, N24
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1. Introduction

The Eurozone crisis is shedding new light on the long-standing debate between scholars who 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 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 so far increased the degree of divergence among its member countries. This has happened in different ways: by fostering exploitation of each country's comparative advantages (Krugman, 1993; Caporale et al., 2015); by causing allocative distortions that have undermined labour productivity in weaker countries (Fernández-Villaverde et al. 2013; Gopinath et al., 2015); by providing perverse fiscal policy incentives, as envisaged by Tornell and Velasco (1995) and Feldstein (2005). At the same time, since "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 internal devaluation policies, highlighted by Krugman (1998), has had a negative effect on the banking systems of several peripheral Eurozone countries, contributing to an alarming increase in non-performing loans (Notarpietro and Rodano, 2016).

Consequently, even scholars who regard European integration as a sensible goal are now generally seeing adoption of the single currency as having delayed, rather than accelerated, achievement of that goal (Zielonka, 2014; Majone, 2014). Moreover, as recently argued by Stiglitz (2016), in the absence of a coordinated policy response one cannot rule out the possibility of the single currency collapsing, an event that would generate systemic uncertainty at political and institutional levels.

Our contribution is to develop a set of stochastic simulations of an annual structural macroeconometric model to assess the macroeconomic consequences of a withdrawal from the Eurozone. We focus on Italy because the state of its banking system makes it vulnerable to financial shocks and because withdrawal of Italy could precipitate an overall

collapse of the single currency. Most empirical studies devoted to analysing the effects of a withdrawal from the euro concern Greece (Kasimati and Veraros, 2013; Papadimitriou et al. 2014).

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 define different 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, sovereign debt spread is endogenised according to Gödl and Kleinert (2016); 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).

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

2. The model

The scenario analysis is carried out with a medium-sized model of the Italian economy. Equations are estimated in error correction form using annual data from 1960 to 2013. The data is from the OECD statistics database and the Italian National Institute of Statistics. Data on bilateral trade before 1988 was drawn from the CHELEM database (International trade flows, balances of payments and world revenues) (CEPII). Long-run relations allow for the possibility of structural breaks (Gregory and Hansen, 1996; Hatemi-J, 2008).

[Insert Table 1 around here]

Model structure (Table 1) is based on the standard 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 by the Taylor rule (Eq. [24]), keeping the model on its long-run growth path.

Building on this standard structure, the model includes a number of additional features designed to make it 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 (Eurozone core, Eurozone periphery, United States, other European countries, OPEC, BRIC, and rest of the world);[1] 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 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 Eurozone by differentiating the realignments of the new national currency according to partner area; 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.

Additional features incorporated in the model concern the pattern of government debt spread and the possible negative effects of a large devaluation on balance sheets. 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 Eurozone breakup (Canofari et al. 2015). Drawing on Gödl and Kleinert (2016), Eq. [25] expresses government bond spread as a function of three fundamental variables related to public

[1] Disaggregation of the Eurozone into a "core" and a "periphery" follows the findings of Busetti *et al.* (2007), according to which the EZ 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 regarding its inflation rate, we moved the Netherlands to the low inflation club (i.e. to the Eurozone core).

debt sustainability: the real rate of growth ($\dot{y}$), government debt-to-GDP ratio *D/Y* (defined by Eq. [39]) and government 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. 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):

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

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 Eurozone 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 Eurozone 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 by legal definition under local or foreign law. 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. 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 20 percent in 2014 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 Eurozone core. This is why in Equation (1) we included the variable $\dot{RER}_{1,t}$, i.e. the bilateral real rate towards the Eurozone core, rather than the (average) real effective exchange rate. In Italy, sovereign bonds account for about 66 percent of total euro-denominated issues, but only a small share (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 a Eurozone average of 9 percent), while the share of private bonds under foreign law is 53 percent, resulting in an overall proportion of 24 percent of bonds under foreign law. By adding loan-related liabilities to this, Nordvig obtains relevant 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 Eurozone countries, except Germany, according to Céspedes (2005, Table 9) it could be large enough to cause a contractionary effect. It is worth noting that a more recent assessment of the redenomination risk for the Italian economy, carried out by Durand and Villemot (2016) who also considered 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 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 is expected to compensate for the cumulated loss of competitiveness since 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 euro area (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 Eurozone, 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.

The estimated average misalignments are as follows:

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

By weighting these bilateral misalignments with the respective trade shares we find the Italian currency to be overvalued in effective terms by nearly 11 percent, a result consistent with other authors' findings. In our simulation scenarios we assumed that in the first year the new Italian currency would move to compensate for these misalignments, bringing the area-specific real exchange rates into line with their respective equilibrium vales. 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. 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. 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].

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.

4. Empirical Results

4.1 Base case scenario

Table 2 summarizes 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 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.

[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: 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 which 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).

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. [39] 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, 2003), 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 Eurozone, 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.[2] 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 austerity policies 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 the public wage 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, whereas the unemployment rate decreases by 0.7 points. The higher rate of real growth, with respect to the previous scenario, dampens the initial fall in imports. As a consequence, 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

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

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.

As is to be expected, 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 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 offset the 5-point fall experienced since the onset of the global crisis.

5. Concluding remarks

This paper aims to assess the main macroeconomic consequences of re-adoption of a national currency in a large Eurozone 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 are 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.[3]

Some concluding perspectives are in order. First, this paper should not be construed as an action plan for the withdrawal of Italy from the Eurozone, 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 Eurozone member countries. However, recent political developments, both in and outside the Eurozone, 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 sovereign bond yield spread), our simulations consider 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 the 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 performances 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.[4]

[3] 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).

[4] 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 simulations is that the related multipliers are not statistically

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 remarkable. 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 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 which 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 Eurozone 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 (2003). 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.

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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Tables

Table 1 – Model structure

Demand

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

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

[3] $\Delta i_k = f[\ \Delta y\ ]$

[4] $x = \sum_i x_i$

[5] $m = \sum_i m_i$

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

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

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

Wages, prices, interest rates

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

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

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

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

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

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

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

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

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

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

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

Public sector

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

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

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

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

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

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

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

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

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

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

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
GB = government balance	W_g = wage rate, public sector
i_b = private gross fixed capital formation	x = exports of goods and services
i_g = government gross fixed capital formation	x_i = exports of goods and services towards partner i
i_k = changes in inventories	y = gross domestic product, real
IR_f = foreign interest rate	Y = gross domestic product, nominal
IR_g = ex post interest rate on public debt	y_i = real gross domestic product of partner i
IR_l = long-term nominal interest rate	Y_p = self-employment and property income
IR_s = short-term nominal interest rate	y^* = potential output
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 ($z = c_b, i_b, i_g, i_k, x, m, y$)	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: the 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: the deviations are estimated as sample average of the 10,000 replications of the stochastic simulation experiment; bootstrap standard errors are reported in parentheses.

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