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FISCAL DEVALUATION IN THE EURO AREA

A MODEL-BASED ANALYSIS

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In 2014 all ECB publications feature a motif taken from the €20 banknote.

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Abstract

We assess the effects on trade balance of a temporary fiscal devaluation enacted by Spain or Portugal by simulating EAGLE, a large-scale multi-country dynamic general equilibrium model of the euro area. Social contributions paid by firms are reduced by 1 percent of GDP for four years and are financed by increasing consumption tax. Our main results are the following. First, the Spanish trade balance improves by 0.5 percent of GDP, the (before-consumption tax) real exchange rate depreciates by 0.7 percent and the terms of trade deteriorate by 1 percent. Second, similar results are obtained in the case of Portugal. Third, the trade balance improves when the fiscal devaluation is enacted also in the rest of the euro area, albeit to a lower extent than in the case of unilateral (country-specific) implementation. Fourth, quantitative results crucially depend on the degree of substitutability between domestic and imported tradables.

JEL Classification Numbers: *F32; F47; H20.*

Keywords: *fiscal devaluation; trade deficit; dynamic general equilibrium modeling.*

Non-technical Summary

A country belonging to a monetary union cannot rely on nominal exchange rate devaluation to increase, in presence of nominal price rigidities, its international relative price competitiveness and, hence, improve in the short run its trade balance. An alternative way to increase the short-run international price competitiveness is through a temporary "fiscal devaluation", defined as the combination of two fiscal measures: the decrease in social contributions paid by employers and the increase in consumption tax. The reduction in employers' social contributions reduces the unit labor costs. As long as the latter are passed-through into final prices, the improvement in price competitiveness favors exports and reduces imports. The reduction in contributions is financed by increasing the consumption tax, which is also a destination-based tax. As such, it raises the after-tax price of domestic and imported goods uniformly, but not the price of exported goods. Overall, the combination of lower unit labor costs and higher consumption tax decreases the price of exported goods and increases the after-tax relative price of the imported good.

In this paper we assess the trade balance improvement in correspondence of a temporary fiscal devaluation enacted by a country in the euro area. The analysis is based on EAGLE, a dynamic general equilibrium model of the euro area and the world economy. The euro area is split in two regions, calibrated to Spain (alternatively Portugal) and the rest of the euro area. The fiscal measures are implemented over a four-year horizon and reduce unit labor costs through the reduction in employers' social contributions equal to 1 percent of *ex ante* GDP. The reduction in social contributions is financed by increasing the taxation of consumption equal to 1 percent of *ex ante* GDP, making it *ex ante* neutral in terms of the government budget.

Our main results are as follows. First the fiscal devaluation improves the Spanish external balance, as a ratio to GDP, by 0.5 percentage points. Exports increase because of the improvement in Spanish price competitiveness. Imports decrease only marginally as their loss of competitiveness is compensated by the increase in demand for investment goods. The (before-consumption tax) real exchange rate depreciates by 0.7 percent and the terms of trade deteriorate by 1 percent. Second, Portuguese results are in line with the Spanish ones, as the trade balance improves by 0.5 percent of GDP and the real exchange deteriorates by 0.7 percent. Third, the country-specific trade balance improves also in the case of a euro area-wide fiscal devaluation. The improvement is somewhat lower than in the case on unilateral devaluation, as tradable goods produced in the rest of the euro area are now more competitive than in the case of unilateral devaluation. Ex-

ports towards the euro area still increase, as they benefit from the increase in investment in the rest of the euro area. Fourth, results are robust to changes in the values of some key parameters, such as nominal price and wage rigidities. Quantitative results crucially depend on the elasticity of substitution between domestic and imported tradables.

1 Introduction

A country belonging to a monetary union cannot rely on nominal exchange rate devaluation to increase, in presence of nominal price rigidities, its international relative price competitiveness and, hence, improve in the short run its trade balance. Moreover, it cannot rely on the (common) nominal exchange rate of the monetary union against third countries, as its value depends on the performance of the union as a whole.

One way for increasing its short-run international price competitiveness, often discussed in policy debates and also analyzed in academic work, is through a temporary "fiscal devaluation". In line with contributions to the literature of a quantitative nature (see e.g. Lipinska and von Thadden, 2012, Mooji and Keen, 2012) and policy discussions, we define "fiscal devaluation" as the possibility for fiscal policy to have effects on trade and relative prices in an open economy by appropriately increasing consumption tax and reducing employers' social security contributions.[1] The reduction in social contributions reduces unit labor costs and, as long as they are passed-through into final prices, the relative price of domestic goods. The improvement in price competitiveness reduces producer prices of domestically produced (non-traded and traded) goods and, hence, favors exports and reduces imports. The reduction in contributions is financed by increasing the consumption tax.[2] The latter is a destination-based tax. As such, it raises the after-tax price of domestic and imported goods uniformly, but not the price of exported goods. Overall, the combination of lower unit labor costs and higher consumption tax decreases the price of exported goods and increases the after-tax relative price of the imported good. The terms of trade deteriorate, as in the case of a nominal exchange rate devaluation that is passed-through in the prices of exported and imported goods.

A *temporary* fiscal devaluation can be a relevant measure for two reasons. First, it can speed up the convergence process towards the long-run equilibrium, where all prices are flexible and fully adjust to the fundamentals of the economy. Second, it can make the convergence process smoother and avoid sudden rebalancing of the current account.[3]

[1] Our use of the term fiscal devaluation is different from that used in the more theoretically oriented contributions to the academic literature (see Farhi et al. 2014). In these contributions it is defined in terms of an equivalence, i.e. it is a change in fiscal instruments that implements the same real allocations as a nominal exchange rate devaluation.

[2] In what follows we will use "value added taxes (VAT) " and "consumption taxes" interchangeably. Similary, we will use "social contribution paid by firms" and "payroll taxes" interchangeably.

[3] We do not consider very persistent trade deficits and foreign borrowing, that can create problems of foreign debt sustainability. As the latter are likely to be a structural feature of the deficit economy, a *temporary* fiscal devaluation is not the most appropriate policy measure to deal with it. Structural

In this paper we assess to which extent the trade balance improves in correspondence to a temporary fiscal devaluation enacted by a country in the euro area. The analysis is based on EAGLE (Euro Area and Global Economy model, see Gomes et al., 2010), a large-scale multi-country dynamic general equilibrium model of the euro area and the world economy. The model is new-Keynesian, as it features monopolistic competition in the labor and goods markets and, importantly for the purpose of this paper, nominal price and wage rigidities. The euro area is split in two regions, calibrated to Spain (alternatively Portugal) and the rest of the euro area. They share the monetary policy and the nominal exchange rate against third countries. The monetary policy is conducted at euro area level according to a Taylor-type rule. For the international dimension, the model features incomplete international financial markets (a riskless bond is internationally traded), home bias, international price discrimination and short-run adjustment costs on imports and distinguishes between tradable and non-tradable intermediate goods. As such, the model allows for an exhaustive characterization of the international relative prices and trade balance dynamics.

We initially simulate the implementation of the fiscal devaluation in Spain or Portugal. Subsequently, we consider the case of simultaneously implementing it in the euro area as a whole. The measures are implemented over a four-year horizon and reduce unit labor costs through a reduction in employers' social contributions equal to 1 percent of *ex ante* nominal GDP. The reduction in contributions is financed by the increase in consumption taxation equal to 1 percent of *ex ante* nominal GDP. As such, the measures are *ex ante* revenue-neutral. Tax reforms are announced, immediately implemented and fully credible. We quantify the impact on the trade balance, the real exchange rate and terms of trade under alternative assumptions for nominal wage and price rigidities and elasticity of substitution across goods.[4]

Our main results are as follows. First, in the case of Spain, the fiscal devaluation improves the external balance, as a ratio to GDP, by 0.5 percentage points. Exports increase because of the improvement in Spanish price competitiveness. Imports decrease only marginally as their loss of competitiveness is compensated by the increase in demand for investment goods. The real exchange rate depreciates by 0.7 percent and the terms of

reforms, aiming at improving the competitiveness of the country on a permanent basis, should be more effective. In this paper we take a short-run perspective, as we focus on fiscal devaluation as a tool to overcome the lack of short-run adjustment associated with (short-run) nominal rigidities.

[4]We focus on the trade balance as the model does not allow to capture valuation effects, associated with the net foreign asset position of a country, that can influence the dynamics of current account. Nevertheless, as suggested by Baxter (1995), at business cycle frequency trade balance and current account balance are positively correlated.

trade deteriorate by 1 percent. GDP increases by 1 percent, sustained by the increase in net exports and investment. Second, Portuguese results are in line with the Spanish ones. The Portuguese trade balance improves by 0.5 percent of GDP and the real exchange deteriorates by 0.7 percent. Third, the external balance improves also in the case of a euro area-wide fiscal devaluation. The improvement is somewhat lower than in the case on unilateral devaluation, as tradable goods produced in the rest of the euro area are now more competitive than in the case of unilateral devaluation. However, exports towards the euro area still increase, as they benefit from the increase in investment in the rest of the euro area. Fourth, results are robust to changes in the values of some key parameters, such as nominal price and wage rigidities. Quantitative results crucially depend on the elasticity of substitution between domestic and imported tradables.

The paper is organized as follows. Section 2 overviews related literature. Section 3 shows the model setup, the transmission mechanism of the fiscal devaluation and the calibration of the model. Section 4 reports the results. Section 5 concludes.

2 Related literature

Several papers look at fiscal devaluation as a way to regain competitiveness. Mooij and Keen (2012) present empirical evidence that suggests that revenue-neutral shifts from the employers' social contributions towards the VAT in euro area could improve the trade balance in the short run in a sizable way. Lipinska and Von Thadden (2012) develop a two-country DSGE model of a monetary union to analyze unilateral permanent shifts of the tax structure towards indirect taxes and find usually small long-run effects of this measure that depend crucially on the degree of financial integration between the two countries in the union. The authors show that the short-run impact depends significantly on whether the tax shift is anticipated or not and on the degree of nominal wage stickiness. Focusing on Portugal, Franco (2011) analyses the same type of policy measure by estimating a number of VAR equations with Portuguese data and by simulating its impact on a small-open economy DSGE model. His empirical analysis suggests that these measures imply a gain of competitiveness and an improvement in the trade balance, but the necessary changes in tax rates would have to be large. The author concludes that temporary version of the tax swap achieves a sharper improvement in the current account. The impact of a fiscal devaluation in Portugal is also simulated by Banco de Portugal (2011). A shift from employers' social security contributions to value added tax equivalent to 1 percent of GDP in the first year boosts total exports

by 0.5 percent and improves the trade balance by 0.6 percent of GDP.[5] Jaumotte and Sodsriwiboon (2010) assess causes and consequences of large external deficits in the euro area based on standard current account regressions. Their results suggest that raising labor productivity and moderating unit labor costs could substantially improve current account positions.

Our paper also relates to the strand of international finance literature on the role of international relative prices for external adjustment. Many papers have focused on the US case. The size of the real dollar depreciation required to correct global imbalances differs across contributions. Obstfeld and Rogoff (2005) show that eliminating the US current account deficit of 5 percent of GDP would require that economy's real exchange rate to depreciate between 35 and 50 percent. Other contributions, however, do find that the magnitude of a real depreciation that would insure a sustainable correction of the US external imbalance may well be in the range of 10–20 percent, perhaps even less, in real effective terms. Faruquee et al. (2007) constructed scenarios with real effective dollar depreciation in the range of 15 percent, under the so-called soft-landing scenario. Similar figures are produced by Ferrero et al. (2010). Corsetti et al. (2013) calibrate a model to the US economy and find that real exchange rate movements needed to reduce the external deficit can be quite contained in the long run once net creation and destruction of product varieties are appropriately accounted for. Finally, Dekle et al. (2007) build a multilateral model calibrated to 40 countries using 2004 data on GDP and bilateral trade. In their exercise, closing the US deficit completely requires a very limited adjustment of relative wages (labor costs). For instance, wages in the US (the country with the largest deficit) only fall by 10 percent relative to wages in the Japan (the country with the largest surplus).

3 Model setup

In this section we briefly describe the main theoretical features model, the transmission mechanism of the fiscal devaluation and the calibration.

[5]The fiscal devaluation has been widely discussed in Portugal. In the initial EU/IMF Financial Assistance Programme the implementation of a budget-neutral fiscal devaluation as a way to boost competitiveness was considered.

3.1 General features

We simulate the Euro Area and Global Economy (EAGLE) model, a multi-country dynamic general equilibrium model of the euro area.[6] In EAGLE the world economy is composed of four blocs. Two out of four are members of the euro area, which is formalized as a monetary union. The two countries have a common nominal exchange rate and a common nominal interest rate. Each of the remaining two blocs has its own nominal interest rate and nominal exchange rate. Similarly to the European Central Bank's New Area Wide model (NAWM) and the International Monetary Fund's Global Economy Model (GEM), EAGLE is micro-founded and features nominal price and wage rigidities, capital accumulation, international trade in goods and bonds.[7]

In each country there is a representative household, a representative firm in each production sector and a public sector. The household is infinitely lived, consumes a final good and decides how to allocate her time between work and leisure. She offers a specific kind of labor services to domestic firms (there is imperfect substitution across labor services) in a monopolistic manner, thus she sets her wage by charging a markup over the marginal rate of substitution between labor and consumption. The household owns the portfolio of domestic firms and the domestic capital stock. The latter is rent to domestic firms in a competitive market. Labor and physical capital are immobile internationally. The representative household also buys and sells two bonds: a domestic bond issued by the local public sector denominated in domestic currency and an international bond (denominated in dollars) issued in zero net supply worldwide. When undertaking positions on the international bond, she pays a premium to financial intermediaries, whose size is a function of the aggregate net asset position of the country. Households residing in the monetary union also trade a bond denominated in the common currency.

On the production side, firms produce the non-tradable final goods, an array of differentiated intermediate goods, and provide intermediation services. There are three non-tradable final goods produced by perfectly competitive firms: a consumption good, an investment good and a public good. The public good is produced only with non-tradable intermediate goods while consumption and investment goods are produced using all available intermediate goods (domestic tradable and non-tradable intermediate goods and imported goods), combined accordingly to a constant elasticity of substitution

[6] The EAGLE model code was developed in both TROLL and DYNARE. For a detailed description of EAGLE, see Gomes et al. (2010).

[7] On GEM see Bayoumi (2004), Laxton (2008) and Pesenti (2008); on the NAWM see Coenen et al. (2008a, 2008b).

(CES) technology. There are many varieties of intermediate goods, which are imperfect substitutes. Each variety is produced by a single firm under conditions of monopolistic competition. The market power implies that firms set nominal prices charging a markup over marginal costs. Each intermediate good is produced using domestic labor and capital that are combined according to a Cobb-Douglas technology. Intermediate goods are sold both in the domestic and in the export market. There is international price discrimination as firms set prices in the currency of the importing country (as such, markets are segmented across countries).

As for the monetary authority, the central bank sets the national short-term nominal interest rate according to a standard Taylor-type rule, by reacting to increases in consumer price index (CPI from now on) inflation and real activity. The interest rate rule is specified as follows for each region:

$$\left(R_t^4 - \bar{R}^4\right) = \rho_R \left(R_{t-1}^4 - \bar{R}^4\right) + (1-\rho_R)\,\rho_\pi \left(\pi_{4,t} - \bar{\pi}_4\right) + \rho_y \left(\frac{gdp_t}{gdp_{t-1}} - 1\right) \qquad (1)$$

where R is the (quarterly) nominal interest rate, $\bar{R}$ its steady-state value, π_4 is the year-on-year CPI inflation rate, $\bar{\pi}_4$ is the central bank CPI inflation target (assumed to be constant), *gdp* is the gross domestic product. To capture inertia in the conduct of monetary policy, we assume that the current period policy rate reacts to its one period-lagged value. In the euro area, π is defined as the weighted average of two region-specific CPI inflation rates and *gdp* as the sum of the regional gross domestic products. Note that in the euro area the region-specific inflation rates determine the region-specific real interest rates, because the nominal interest rate is common and set by the central bank of the monetary union.

For fiscal policy, we assume that it is conduced at regional level. Each country sets government consumption expenditures, *lump-sum* taxes, labor and capital income taxes (labor taxes are split in social contributions paid by employers and employees, respectively), consumption taxes. Moreover, in each country the public debt is stabilized through a fiscal rule, that induces *lump-sum* taxes to endogenously adjust. Other taxes are set exogenously. When simulating the fiscal devaluation, we appropriately change the consumption tax rate and the social contribution rate paid by employers.

The model uses standard functional forms, which allows firms and consumers to be aggregated as if they were a representative entity. Adjustment costs for real variables and nominal rigidities enable EAGLE to mimic the typical hump-shaped reaction of macroeconomic variables to shocks observed in more empirically oriented models of the

euro area such as the estimated version of the NAWM (see Christoffel et al., 2008) and the model by Smets and Wouters (2003). There are investment adjustment costs and external habit formation in consumption. Moreover, there are adjustment costs on imports, that slow down the initial response of imports to a given change in international relative prices (as such, the short-run elasticity of imports is lower than its long-run counterpart).

All (intermediate goods) prices and wages are sticky (Calvo, 1983) and indexed to a weighted average of previous period CPI inflation rate and the central bank's inflation target.

3.2 The transmission mechanism of fiscal devaluation

By "fiscal devaluation" we mean the possibility for fiscal policy to favour the depreciation of real exchange rate by appropriately increasing VAT and reducing employers' social security contributions in correspondence of a fixed nominal exchange rate and short-run nominal rigidities. Even though in a monetary union the nominal exchange rate is no longer available as a national (stabilization) policy instrument, fiscal policy can still be used to favor the adjustment in the real exchange rate. In fact, the increase in the consumption tax is *de facto* imposed on imports, because its positive effect on prices of tradable goods that are domestically sold or non-tradable goods is compensated by the negative one of declining payroll tax paid by firms.

In EAGLE there are nominal wage and price rigidities *à la* Calvo (1983). Workers act under monopolistic competition. They set their wage taking labor demand by firms into account and subject to nominal (wage) rigidities. Firms in the intermediate sector act under monopolistic competition. They set prices taking demand for their brand into account and subject to nominal (price) rigidities. In the case of the tradable good sold domestically, the implied optimal price setting equation, here reported in a stylized way, is:[8]

$$\frac{P_{H,t}}{P_t} = E_t \left(\sum_{s=t}^{\infty} MKP_{P_H,s} \frac{MC_s}{P_s} \right) \tag{2}$$

where P_H is the price of the tradable good H and P the price of consumption basket, E is the expectation operator, MKP_{P_H} is the markup on the nominal marginal cost, MC. The marginal cost depends on both labor and capital costs. Neglecting the latter for the sake of simplicity and including employers' social contributions, we get:

[8] A similar mechanism applies to goods produced in the non-tradable sector, as it is assumed that social contributions paid by all firms in the economy are uniformly reduced.

$$\frac{P_{H,t}}{P_t} \approx E_t \left(\sum_{s=t}^{\infty} MKP_{P_H,s} \frac{W_s \left(1+\tau_s^w\right)}{P_s} \right) \tag{3}$$

where $0 \leq \tau^w \leq 1$ is the implicit tax rate associated with employers' social contributions. *Ceteris paribus*, a decrease in τ^w induces the decrease in P_H/P once firms have the possibility to adjust their prices and nominal wages do not change.

For consumption tax $0 \leq \tau^C \leq 1$, suppose it is uniformly imposed on domestically (H) produced and imported goods (F). As such, it would not change the relative prices:

$$\frac{P_{H,t}\left(1+\tau_t^C\right)}{P_t\left(1+\tau_t^C\right)} = \frac{P_{H,t}}{P_t} \tag{4}$$

$$\frac{P_{F,t}\left(1+\tau_t^C\right)}{P_t\left(1+\tau_t^C\right)} = \frac{P_{F,t}}{P_t} \tag{5}$$

However, as soon as the lower employers' social contributions are passed-through into the price of domestically produced goods, the latter should become cheaper than the imported ones (the decrease in social contributions would compensate for the increase in consumption tax). Moreover, lower social contributions should be passed-through into the prices of exported goods and non-tradable goods as well, that, accordingly, should decrease. Overall, the reduction in social contributions, financed by rising consumption tax, should favor the price competitiveness of domestic goods.

Finally, the consumption tax would also affect the inter-temporal relative price of consumption, through the standard Euler equation:

$$C_t^{-\rho} = \beta E_t \left(R_t \frac{P_t}{P_{t+1}} \frac{(1+\tau_{C,t})}{(1+\tau_{C,t+1})} C_{t+1}^{-\rho} \right) \tag{6}$$

Ceteris paribus, an increase in current value of the consumption tax would induce households to postpone consumption, increasing saving. This should further contribute, jointly with the intra-temporal substitution effect, to reduce imports of consumption goods.

3.3 Calibration

We summarize in Tables 1 to 7 the (quarterly) calibration of the model. We illustrate the values of parameters affecting the relevant steady-state great ratios and the dynamics. They are set according to the empirical evidence or existing literature on the NAWM and the GEM.

We calibrate the model to Spain (SP), the rest of the euro area (REA), the United

States (US) and the rest of the world (RW). Alternatively, we calibrate the two euro area regions to Portugal (PT) and the rest of the euro area. Table 1 reports the implied great ratios for Spain and Portugal.[9] In the other tables we report only the case of Spain to save on space (except for Table 6 where we also report the calibration of Portuguese tax rates).[10]

Table 2 shows preference and technology parameters. Preferences are the same across households of different regions. We set the discount factor so that the steady-state annualized real interest rate is about 3 percent, the habit persistence parameter to 0.75, the intertemporal elasticity of substitution to 1.0 and the Frisch elasticity to 0.50. We set the quarterly depreciation rate of capital to 0.025, consistently with an annual depreciation rate of 10 percent.

As for the final goods baskets, the degree of substitutability between domestic and imported tradables is higher than that between tradables and non-tradables. We set the (long-run) elasticity of substitution between tradables and non-tradables to 0.45 while the long-run elasticity between domestic and imported tradables is set to 3.3. The elasticity of substitution between domestic and imported goods is a crucial parameter for our main results. As stated by Corbo and Osbat (2013), little consensus has been reached on the magnitudes of elasticities of substitution. While the earlier time series literature mainly arrives at low, often insignificant values, a newer branch that uses more disaggregated data and panel-based econometric methods tends to obtain considerably higher values.[11] Moreover, even though there is a fair amount of literature on the topic, estimates of the elasticity of substitution for most European countries are scarce. Our calibration is in line with calibration of models similar to EAGLE and with empirical evidence provided by Corbo and Osbat (2013) and Imbs and Méjean (2010). Corbo and Osbat (2013) reports values for Spain and Portugal that are in the 3–4 range, Imbs and Méjean (2010) in the 2–3 range. Note that in EAGLE the short-run elasticity for imported goods is lower than its long-run counterpart because of adjustment costs on imports. This allows us to take a rather conservative approach in evaluating the impact of the relative prices on trade flows. Moreover, we also run sensitivity analysis by appropriately changing the value of long-run elasticity.

[9] National accounts data are from the European Commission AMECO database and from the Statistics Portugal.

[10] Tables for Portugal are available from the authors upon request. We set the same values for markups as in the Spanish version given the lack of estimates for Portugal.

[11] See in particular the contribution from Imbs and Méjean (2009) on elasticity optimism which explains the higher values observed at the micro level by cross-sectoral heterogeneity.

The bias toward the tradable bundle is lower in the consumption basket than in the investment basket. The weight of domestic tradable goods in the consumption and investment tradable baskets is different across countries, to match multilateral import-to-GDP ratios.

Table 3 reports nominal and real rigidities. We set Calvo price parameters in the domestic tradable and non-tradable sectors to 0.9 (on average, firms adjust prices optimally every 10 quarters) in the euro area, consistently with estimates by Christoffel et al. (2008) and Smets and Wouters (2003).[12] Corresponding nominal rigidities outside the euro area are equal to 0.75, implying an average frequency of adjustment equal to 4 quarters, in line with Faruqee et al. (2007). Calvo wage and import price parameters are equal to 0.75 in all regions. The indexation parameters on prices and wages are equal respectively to 0.50 and 0.75 so to get sufficiently hump-shaped response of wages and prices. For real rigidities, we set the parameters of the adjustment costs on investment changes to 6 in the euro area and to 4 in other regions. Adjustment costs on consumption and investment imports are set to 2. We set weights of bilateral imports to match the trade matrix reported in Table 4 (for details see Gomes et al., 2010).[13] In particular, it is interesting to note that intra-euro area trade represents a significant share of total trade in the two euro area regions. The net foreign asset positions and interest rates are exogenously pinned-down, while export and import quantities as well as international relative prices consistently adjust.[14]

Table 5 reports markup values. We identify the non-tradable and tradable intermediate sectors in the model with the service and manufacturing sectors in the data, respectively. Markups in the euro area service and labor markets are higher than the corresponding values in the US and the RW. In each region the markup in the non-tradable sector is higher than that in the labor market. For the euro area, the latter is higher than the markup in the manufacturing sector. Specifically, the (net) price markup in Spain and the rest of the euro area is set to 50, 30, 20 percent in the service, labor and manufacturing sectors, respectively. In the US and in the rest of the world the corresponding markups are set to 28, 16, 20 percent. Our values are in line with other existing similar studies, such as Bayoumi et al. (2004), Faruqee et al. (2007), Everaert and Schule

[12] In fact, given that we assume indexation, prices (and wages) change every period.

[13] The trade matrix covers intra and extra euro area flows of goods and services. Numbers are computed by the authors using AMECO and Eurostat data.

[14] The indeterminacy of steady-state net foreign asset positions is standard in open economy models with representative households and incomplete international financial markets. See, for example, Pesenti (2008). Along the transition dynamics the net foreign asset position endogenously adjusts to the given shock.

(2008). Usually these studies refer to Jean and Nicoletti (2002), Oliveira Martins et al. (1996) and Oliveira Martins and Scarpetta (1999) for estimates of markups.[15] Some additional empirical evidence for the euro area is provided by Christopoulou and Vermeulen (2008). Their estimates suggest that the markup in the Spanish service sector is similar to the corresponding value for the euro area and that the markup in Spanish manufacturing sector is relatively low with respect to that in the Spanish service sector.

Table 6 reports main tax rates for Spain, rest of the euro area, US and Portugal.[16]

Table 7 reports parameters in the monetary policy rules, where the (annualized) interest rate reacts to the its lagged value (inertial component of the monetary policy), annual inflation and quarterly output growth (see equation 1).

4 Results

In this section we report the results of our simulations. The impact on the Spanish economy of a unilateral temporary (4-year long) fiscal devaluation is initially evaluated. The reduction in employers' social contributions, equal to 1 percent of *ex ante* GDP, is financed by a concurrent 1 percent of *ex ante* GDP rise in the consumption tax (the reform is *ex ante* revenue neutral). To make the transmission mechanism clear, we disentangle the contributions of lower social contributions and higher consumption tax. We then run a similar exercise for the case of Portugal and for the case of a euro area wide fiscal devaluation (implemented simultaneously in Spain and in the rest of the euro area). Finally, a sensitivity analysis is performed, by changing the values of parameters regulating nominal wage and price rigidities and the elasticity of substitution between domestic and imported goods.

4.1 Fiscal devaluation in Spain

Figure 1 and Figure 2 show the results of the fiscal devaluation in Spain.[17] The Spanish trade balance improves by 0.5 percent of GDP after two years from the beginning of devaluation. Thereafter, it gradually returns to the steady state. The Spanish (before-consumption tax) real effective exchange rate deteriorate by 0.7 percent and terms of

[15] See also Organization of Economic Co-operation and Development (1997).

[16] To save on space, we do not report calibration for rest of the world, which is the same as the US one, and for the rest of the euro area when Portugal case is simulated. Data are available upon request.

[17] The employers' social security contributions rate decreases from 15.6 to 13.3 percent. The consumption tax rate increases from 7.6 to 9.5 percent.

trade depreciate by 1 percent.[18] (Gross) real exports increase by 2 percent after two years, while gross imports marginally decrease. Net exports increase towards all destinations (rest of the euro area, US and rest of the world).

Spanish exports increase because of the improvement in international competitiveness, associated with the deterioration of Spanish international relative prices. Spanish imports decrease for two reasons. First, they loose competitiveness, as Spanish goods have become cheap. Second, Spanish consumption decreases (see Figure 2), as its after-tax price has increased. The lower consumption (-0.8 percent after 4 years) more than compensates for the increase in investment and, hence, drives down Spanish imports. Investment increases by 2 percent after 3 years. The increase in consumption tax is an incentive to increase saving and, hence, investment. Moreover, lower social contributions favor employment. The latter increases capital productivity and, hence, investment.

Hours worked increase by 1.5 percent after two years. The unit labor cost immediately decreases, by 0.7 percent in nominal terms. The reduction is associated with the lower payroll taxes. Nominal wages (not reported) do not greatly change in the short run, as they are sticky. Subsequently, the unit labor cost continues to stay below the baseline. The low unit labor cost is not fully passed-through, in the short run, into the (nominal) prices of domestically produced goods. The latter are subject to short-run nominal rigidities and, as such, their before-consumption tax component decreases only gradually.[19]

To further understand the transmission mechanism of the devaluation, Figures 3 and 4 report results obtained when the fiscal authority exploits *lump-sum* taxes to finance the reduction in payroll taxes and the increase in the VAT, respectively. The reduction in payroll taxes (Figure 3) has positive effects on Spanish trade balance and economic activity. The trade balance-to-GDP ratio improves by 0.3 percentage points. Exports increase because of the reduction in their relative price (the Spanish terms of trade deteriorate and the real exchange rate depreciates). Spanish imports increase to a lower extent than exports. The increase in imports is due to the higher Spanish consumption and investment (not reported).

As expected, the increase in consumption tax has a positive effect on the trade balance and a negative impact on economic activity (see Figure 4). The trade balance-to-GDP ratio improves. Spanish exports and imports respectively increase and decrease.

[18] An increase in the real exchange rate (terms of trade) corresponds to a depreciation (deterioration).

[19] Spillovers to the rest of the euro area, to the US and the rest of the world are negligible. To save on space we do not report them.

Higher exports are due to the deterioration of the terms of trade. The latter is caused by the drop in Spanish households' consumption (not reported). Given the relatively large home bias, the relative prices of Spanish manufactured goods decrease to clear the excess supply. The drop in Spanish consumption, only partially compensated by the increase in investment, determines the reduction in GDP and imports.

4.2 The case of Portugal

We now assume that policy-makers in Portugal implement a policy measure similar to the one considered for the case of Spain.[20] Figure 5 reports the main results. The trade balance improves by 0.5 percent of GDP after two years. Thereafter, it gradually returns to the steady-state level. The Portuguese real effective exchange rate depreciates by roughly 0.7 percent, the terms of trade deteriorate by slightly less than 1 percent. Gross exports increase in real terms by 2 percent after three years, driven by the favorable movement in the terms of trade. Gross imports are basically unchanged in the short run. Net exports increase towards all destinations (rest of the euro area, US and rest of the world). GDP increases by 1 percent.

Overall, results for Portugal confirm results obtained in the case of Spain. The fiscal devaluation benefits the trade balance in the short run, because of the increase in price competitiveness. As for Spain, the devaluation also favors the increase in investment and GDP.

4.3 Simultaneous fiscal devaluation in the euro area

In the previous section we have shown to which extent the Spanish and Portuguese external trade balances benefit from unilateral fiscal devaluation. In this section we show how results change when the fiscal devaluation is simultaneously implemented in Spain and the rest of the euro area.[21] In each region we assume a cut in employers' social security contributions of 1 percent of *ex ante* GDP and a concurrent rise in consumption tax also equal to 1 percent of *ex ante* GDP so that the reform is *ex ante* revenue-neutral, for a period of 4 years.[22]

Figure 6 reports the results for the main Spanish variables. The trade balance im-

[20] The social security contributions rate decreases from 19.1 to 16.6 percent. The consumption tax rate increases from 17.8 to 19.6 percent.

[21] Results for Portugal are similar to the Spanish ones and are available upon request.

[22] In the rest of the euro area, the implied decrease in social security contributions and increase in consumption tax rate are equal to 2.2 (to 4.9) and 1.7 percentage points (to 9.4), respectively.

proves by 0.15 percentage points as a ratio to GDP. The real exchange rate depreciates by 0.4 percent, while the terms of trade deteriorate by 0.5 percent. Gross exports increase by 1.8 percent, while imports by slightly more than 1 percent. The improvement in the Spanish external position is smaller than in the case of unilateral fiscal devaluation, where the trade balance-to-GDP ratio improves by 0.5 percentage points. Exports now increase less because of the decrease in rest of the euro area aggregate consumption and the low prices of rest of the euro area tradables. The latter also determine the increase in Spanish imports.[23] As in the case of unilateral devaluation, Spanish GDP increases by 1 percent. Figure 7 shows responses of other main variables. Consumption decreases by 0.5 percent (0.8 percent in the case of unilateral devaluation), investment increases by 4 percent (2 percent). The cheap imports from the rest of the euro area favor a larger increase in investment and a smaller drop in consumption than in the case of unilateral devaluation.

Overall, our results suggest that there is an improvement in a country's external position also when the devaluation is implemented simultaneously in the two euro area blocs.

4.4 Sensitivity analysis

In this section we assess how our results change when we change the value of some key parameters. Specifically, we newly run our experiments for the case of Spain under alternative assumptions for the intra-temporal elasticity of substitution and for the degree of price and wage stickiness.

4.4.1 Low elasticity of intra-temporal substitution

In Figure 8 we report results for the case of a low degree of elasticity of substitution between domestic and imported goods. We set it to 1.60 (in the lower end of the range of existing estimates), while it is set to 3.30 in the benchmark calibration. Qualitatively, results do not change with respect to the benchmark simulation. Quantitatively, effects on trade balance are smaller, as now worldwide aggregate demand hardly shifts towards cheaper Spanish tradable goods. Exports increase to a low extent. The trade balance-to-GDP ratio improves by 0.3 percentage points (0.5 in the baseline). The Spanish real exchange rate and terms of trade depreciate and deteriorate more, by 1 and 1.5 percent

[23] The rest of the euro area trade balance improves by 0.2 percent, while the real exchange rate and the terms of trade depreciate by 0.5 percent. To save on space we do not report the corresponding charts.

respectively (0.7 and 1 in the benchmark case, respectively). GDP increases by 0.8 percent (1 percent in the benchmark case).

Results emphasize that the elasticity of substitution between domestic and imported goods is a crucial parameter for the effectiveness of the fiscal devaluation. As discussed in Section 3.3, estimates of this parameter are surrounded by high uncertainty.

4.4.2 Price stickiness

Lower social contributions reduce unit labor costs. The size of labor costs pass-through into domestic and export prices depends on how often prices are adjusted. In the benchmark simulation we consider a Calvo parameter of 0.9 on goods sold to the domestic market (price are reset every 10 quarters) and 0.75 on internationally-traded goods prices (they are reset every 4 quarters). Figure 9 reports results for the case of a Calvo parameter set to 0.5 in both traded and non-traded sectors, which means prices are reset on average every two quarters. The trade balance improves by around 0.5 percent of GDP, as in the benchmark scenario. The Spanish real exchange rate and terms of trade depreciate more in the short term, by roughly 1.3 and 1.8 percent (roughly 1 percent in the benchmark scenario for terms of trade and a bit less for the real exchange rate). By lowering the degree of price stickiness, lower unit labor costs quickly pass-through into lower Spanish tradable prices in the short run. The resulting short-run change in international relative prices is relatively large, enhancing the strength of the intra-temporal substitution effect and the role of terms of trade in shaping the consumption and investment choices of households and firms. The incentive for domestic and foreign households to allocate consumption and investment demand towards Spanish tradables is now stronger, as the larger depreciation makes Spanish goods cheaper after few periods from the beginning of the reform implementation. The decrease in imports is more frontloaded than in the benchmark case, given the initial larger depreciation. The larger increase in (net) exports favors GDP, that in the short run has a larger positive response than in the benchmark calibration.[24]

The results make clear the relevance of nominal price responses for the short-run effectiveness of fiscal devaluation as a tool to gain international price competitiveness and restoring the external equilibrium. The quicker the pass-through into final prices, the larger the short-run beneficial effect on the trade balance. Overall, quantitative results do not greatly change with respect to the benchmark calibration.

[24]Spillovers to the rest of the euro area do not greatly change as well compared to the benchmark simulation. The same is true for spillovers to the US and the rest of the world, which are negligible.

4.4.3 Wage stickiness

We assume wages adjust more frequently, namely once every two quarters (instead of once every four quarters as in the benchmark scenario). Figure 10 reports the results. Responses of the main trade variables and international relative prices are now slightly less strong. The reason is that wages (not reported) increase to a larger extent, limiting the incentive to increase employment. For this reason, the initial increase in GDP is more muted. Overall, results do not greatly change in comparison with the benchmark simulation. Moreover, they suggest that fiscal devaluation can help in stabilizing the short-run economic activity, because it favors the short-run labor cost flexibility when nominal wages are sticky.

5 Conclusions

We quantitatively assessed the short- and medium-run effects of a temporary fiscal devaluation on the trade balance, relative prices and economic activity for Spain and Portugal. We found that the trade balance improves. The terms of trade deterioration does favor the increase in exports, which is larger than the increase in imports, associated with the increase in investment. The latter, jointly with the increase in employment, favors the increase in GDP.

It would be interesting to compare the effects of a fiscal devaluation with those obtained by competition-enhancing reforms in the non-tradable sector. Structural reforms that increase competition in the non-tradable sector can make the external balance sustainable. For example, if non-tradable goods are inputs of the production process of tradables, their competitiveness would benefit from the higher competition in the non-tradables.[25] Moreover, non-price factors can contribute to improve the trade balance as well. A reform that allows to increase the number of firms entering in and exiting from a sector or country can help in augmenting the number of exported varieties (extensive margin), reducing the size of internal devaluation (intensive margin) needed for restoring the external equilibrium of the country. Similarly, policies that favor the reallocation of resources to the high productivity growth sectors can induce a change of the structure of the export sector, changing the specialization of a country in favor of low price-elastic goods. We leave all these interesting topics for future research.

[25] For an analysis of the macroeconomic impact of reforms in the euro area non-tradable sectors see Gomes et al. (2013).

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Table 1: Steady-State National Accounts (percentage of GDP)

	SP	REA	US	RW	*PT*
Private consumption	54.5	60.0	63.2	64.0	*56.3*
Private investment	24.0	20.0	20.0	20.0	*19.7*
Public expenditure	21.3	20.0	16.0	16.0	*21.0*
Imports	28.7	12.2	8.1	8.7	*32.9*
Consumption goods	17.3	7.3	4.8	4.0	*17.0*
Investment goods	11.5	4.9	3.3	4.7	*15.9*
Public debt (% of yearly GDP)	60.0	60.0	60.0	60.0	*60.0*
Share of services sector	56.7	61.7	63.1	64.8	*52.4*
Share of world GDP	2.1	20.9	28.2	48.7	*0.20*

SP=Spain; REA=rest of euro area; US=United States; RW=rest of the world; PT=Portugal.

Table 2: Households and Firms Behavior

	SP	REA	US	RW
Households				
Subjective discount factor	$1.03^{-0.25}$	$1.03^{-0.25}$	$1.03^{-0.25}$	$1.03^{-0.25}$
Depreciation rate	0.025	0.025	0.025	0.025
Intertemporal elasticity of substitution	1.0	1.0	1.0	1.0
Habit persistence	0.75	0.75	0.75	0.75
Inverse of the Frisch elasticity of labor	2.00	2.00	2.00	2.00
Tradable Intermediate Goods				
Bias toward capital	0.30	0.30	0.30	0.30
Non-tradable Intermediate Goods				
Bias toward capital	0.20	0.30	0.30	0.35
Final consumption goods				
Substitution btw domestic and imp. goods	3.30	3.30	3.30	3.30
Bias toward domestic goods	0.20	0.20	0.85	0.20
Substitution btw tradables and non-trad.	0.45	0.45	0.45	0.45
Bias toward tradable goods	0.45	0.45	0.35	0.35
Final investment goods				
Substitution btw domestic and imp. goods	3.30	3.30	3.30	3.30
Bias toward domestic goods	0.20	0.20	0.85	0.20
Substitution btw tradables and nontr.	0.45	0.45	0.45	0.45
Bias toward tradable goods	0.75	0.75	0.75	0.75

SP=Spain; REA=rest of euro area; US=United States; RW=rest of the world.

Table 3: Real and Nominal Rigidities.

	SP	REA	US	RW
Real Rigidities				
Investment adjustment	6.00	6.00	4.00	4.00
Import adjustment (consumption)	2.00	2.00	2.00	2.00
Import adjustment (investment)	2.00	2.00	2.00	2.00
Nominal Rigidities				
Households				
Wage stickiness	0.75	0.75	0.75	0.75
Wage indexation	0.75	0.75	0.75	0.75
Manufacturing				
Price stickiness (domestically produced goods)	0.90	0.90	0.75	0.75
Price indexation (domestically produced goods)	0.50	0.50	0.50	0.50
Price stickiness (imported goods)	0.75	0.75	0.75	0.75
Price indexation (imported goods)	0.50	0.50	0.50	0.50
Services				
Price stickiness	0.90	0.90	0.75	0.75
Indexation	0.50	0.50	0.50	0.50

SP=Spain; REA=rest of euro area; US=United States; RW=rest of the world.

Table 4: International Linkages (percentage of GDP)

	SP	REA	US	RW
Substitution between consumption imports	3.30	3.30	3.30	3.30
Imported consumption goods from				
SP	...	0.9	0.0	0.2
REA	9.6	...	0.6	2.1
US	0.3	0.4	...	1.7
RW	7.3	6.1	4.1	...
Substitution between investment imports	3.30	3.30	3.30	3.30
Imported investment goods from				
SP	...	0.3	0.0	0.1
REA	7.0	...	0.5	1.8
US	0.5	0.7	...	2.8
RW	4.0	4.0	2.8	...
Trade balance (%yearly GDP)	0.05	−0.05	0.20	−0.12
Net foreign assets (%yearly GDP)	−3.75	3.75	0.00	10.0
Financial intermediation cost function	0.01	0.01	0.01	0.01

SP=Spain; REA=rest of euro area; US=United States; RW=rest of the world.

Table 5: (Gross) Price and Wage Markups

	SP	REA	US	RW
Manufacturing (tradables) price markup	1.20	1.20	1.20	1.20
Services (non-tradables) price markup	1.50	1.50	1.28	1.28
Wage markup	1.30	1.30	1.16	1.16

SP=Spain; REA=rest of euro area; US=United States; RW=rest of the world.

Table 6: Tax Rates

	SP	REA	US	*PT*
Consumption	7.6	18.5	7.7	*17.8*
Labor Income	12.8	12.5	15.4	*5.9*
Social security contributions by Employees	3.4	12.5	7.1	*9.0*
Social security contributions by Employers	15.6	21.7	7.1	*19.1*

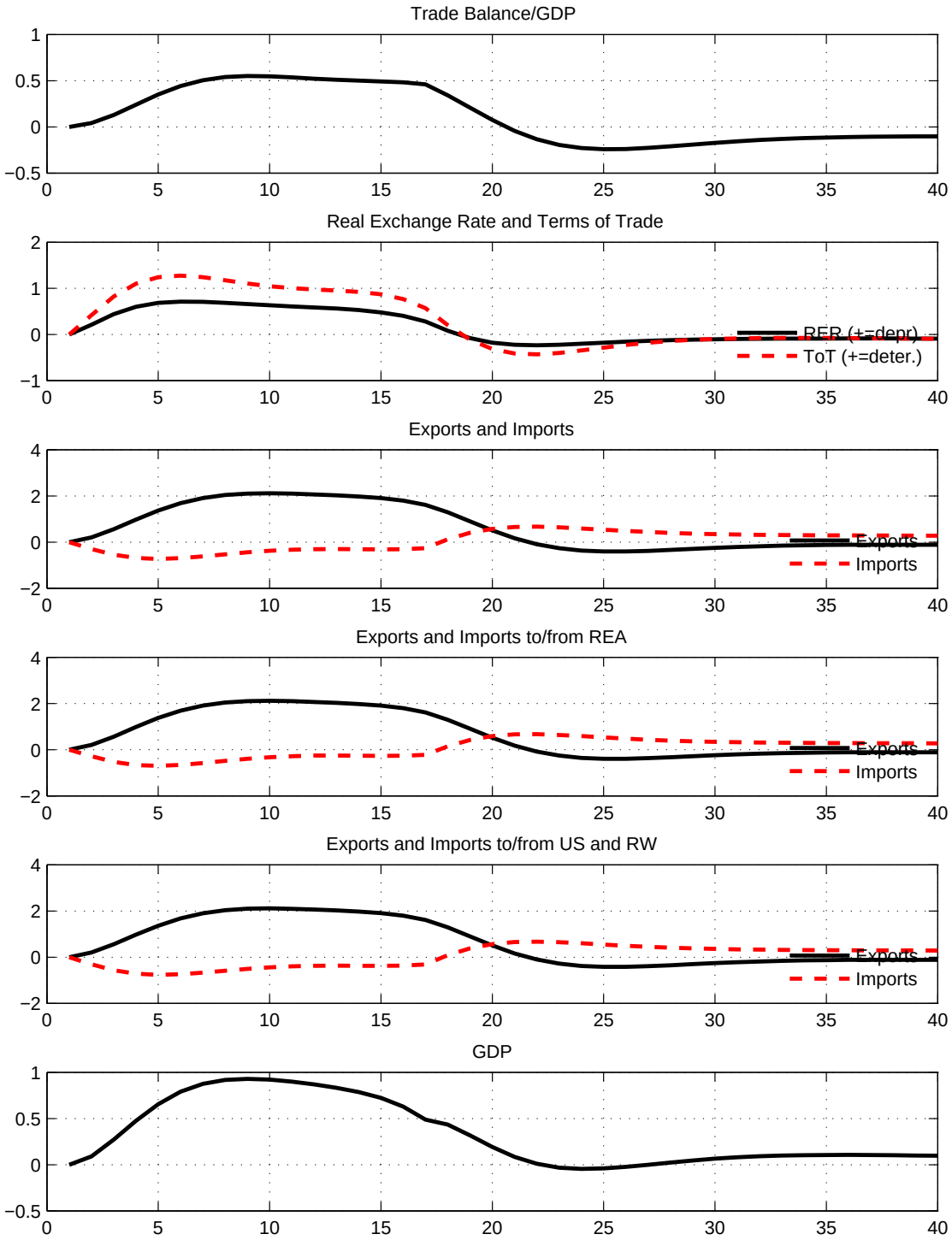
SP= Spain; REA=rest of euro area; US=United States; PT=Portugal.

Table 7: Monetary Policy

	EA	US	RW
Inflation target	1.02	1.02	1.02
Interest rate inertia	0.87	0.87	0.87
Interest rate sensitivity to inflation gap	1.70	1.70	1.70
Interest rate sensitivity to output growth	0.10	0.10	0.10

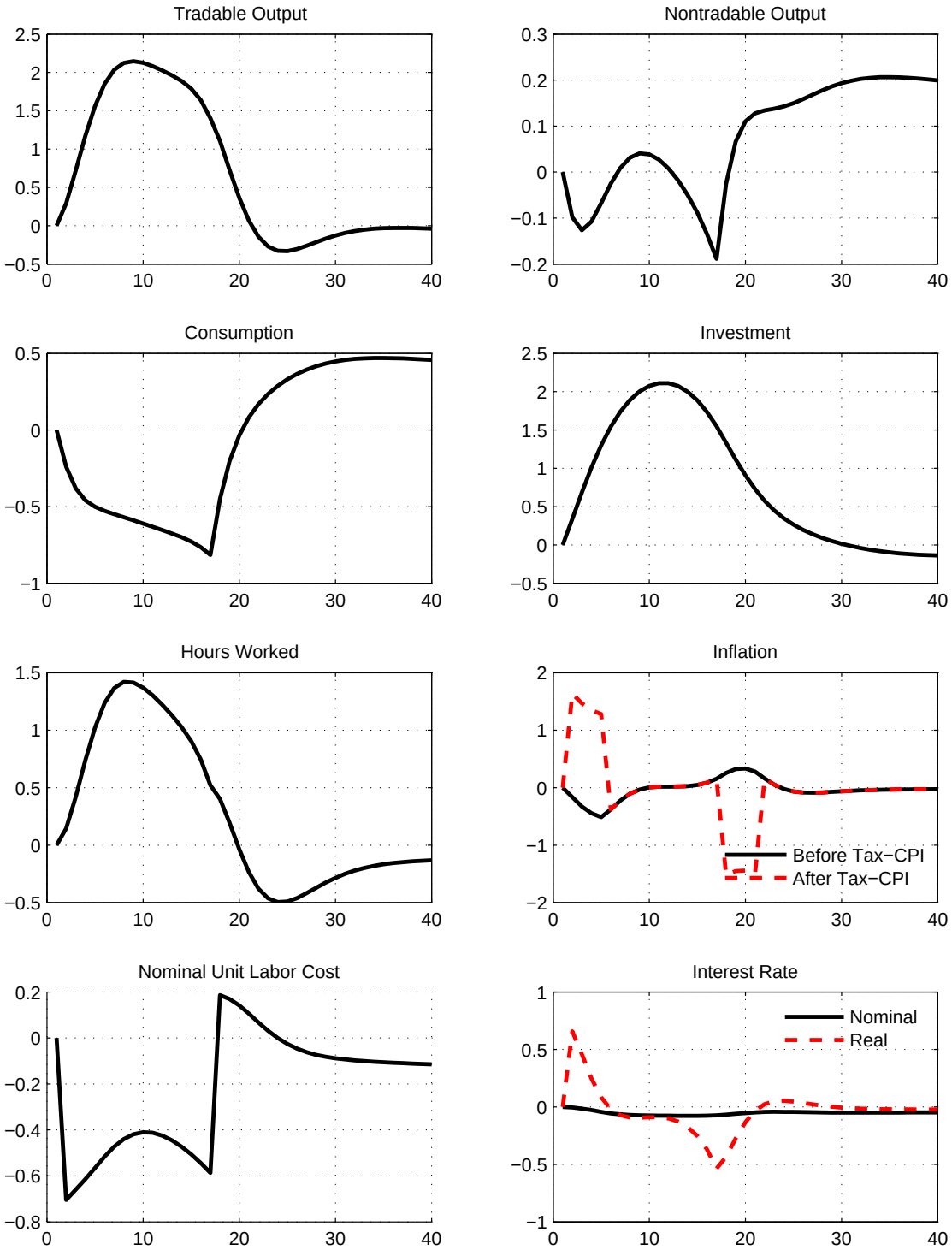
EA=euro area; US=United States; RW=rest of the world.

Figure 1: Spanish fiscal devaluation. Trade variables and GDP



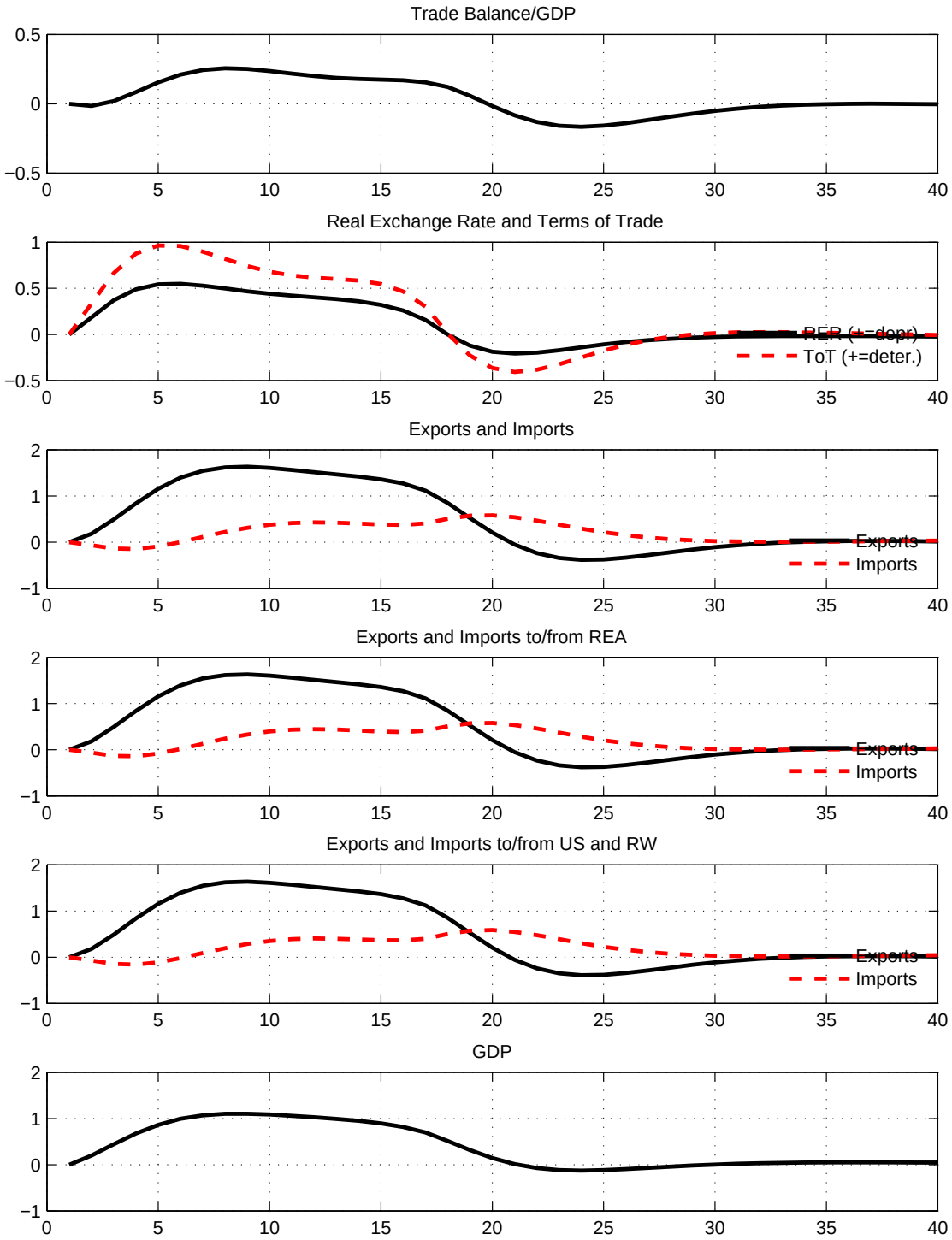
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.

Figure 2: Spanish fiscal devaluation. Other main macroeconomic variables



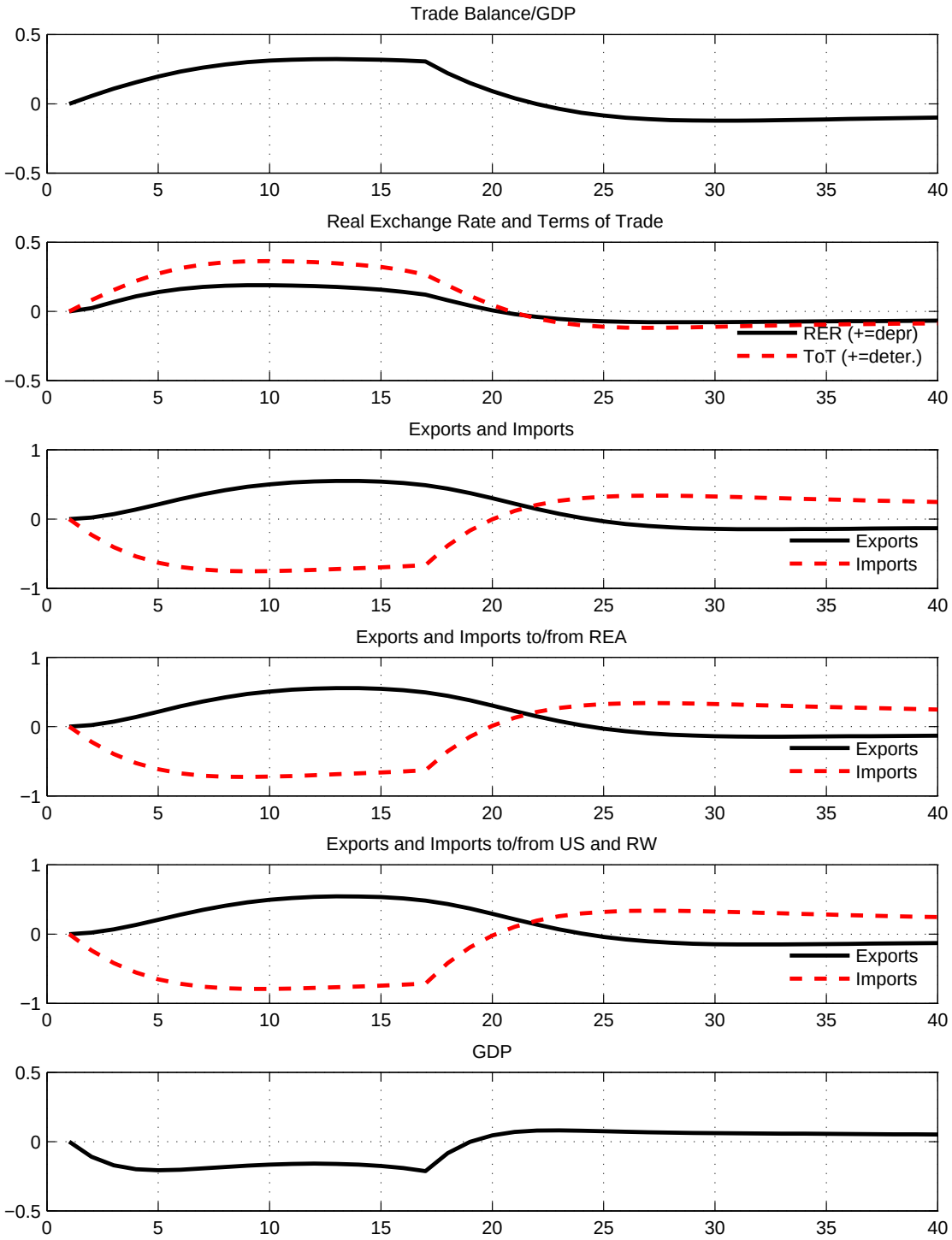
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; inflation and interest rates in annualized percentage point deviations.

Figure 3: Spanish fiscal devaluation. The firms' social contributions



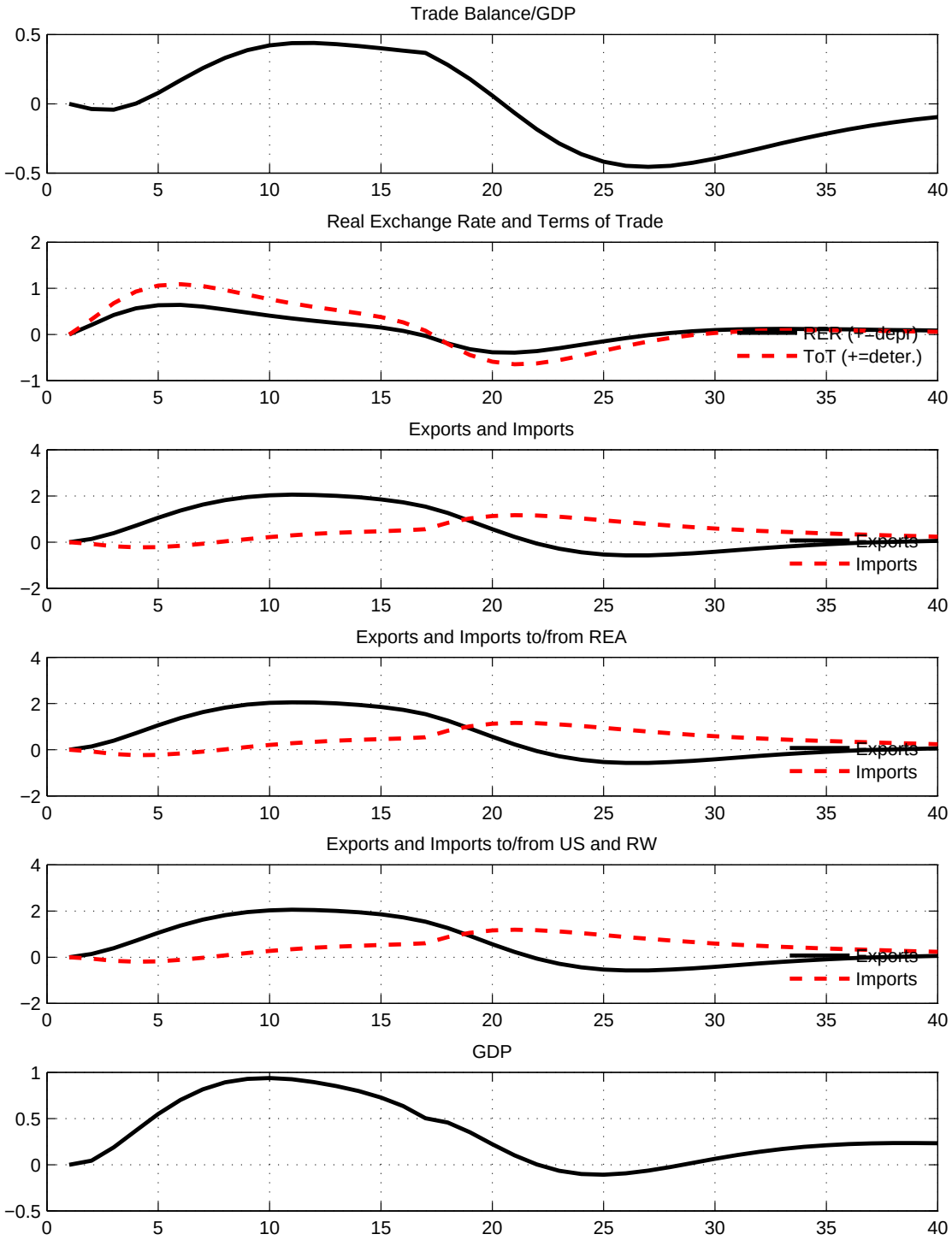
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.

Figure 4: Spanish fiscal devaluation. The consumption tax



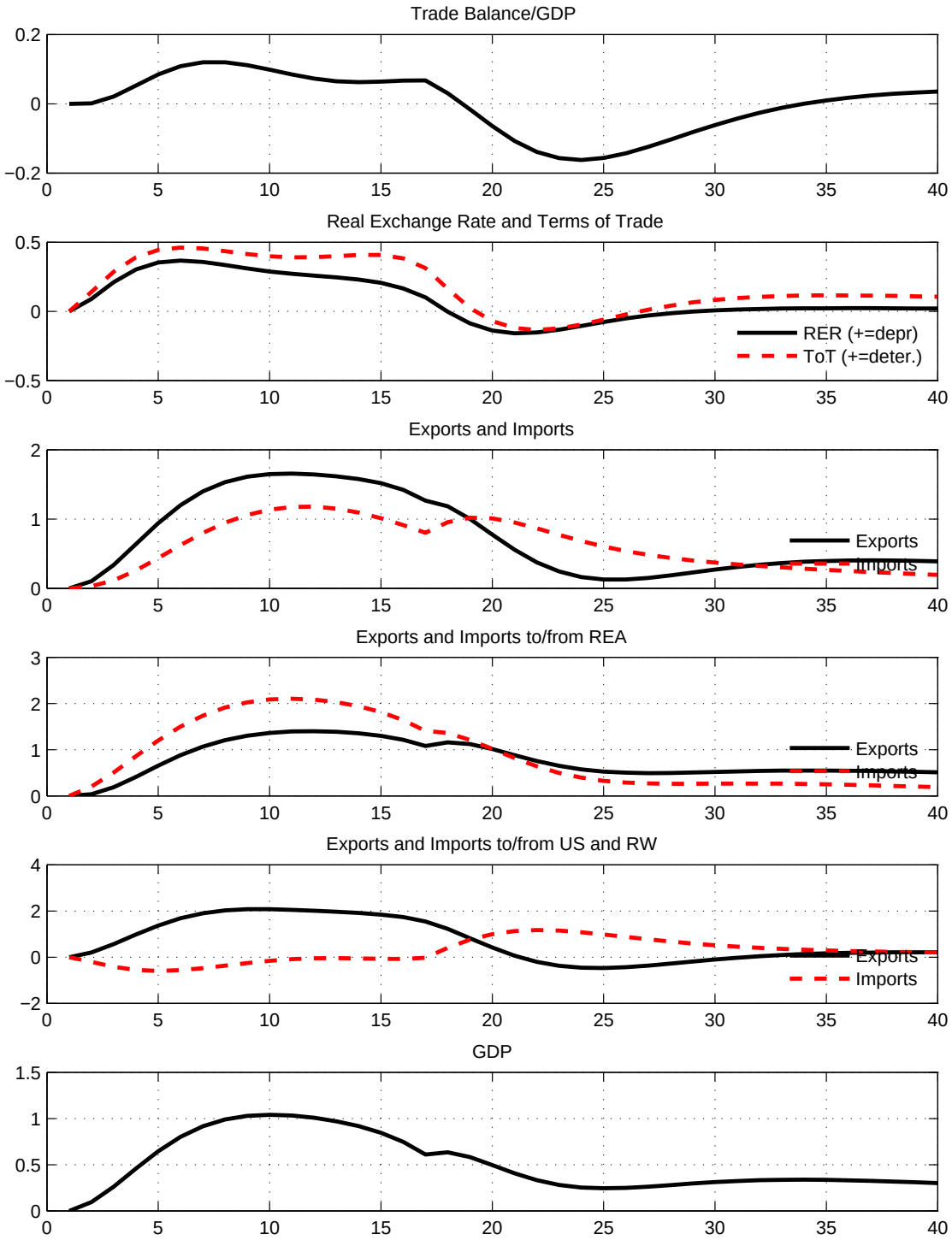
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.

Figure 5: Portuguese fiscal devaluation. Trade variables and GDP



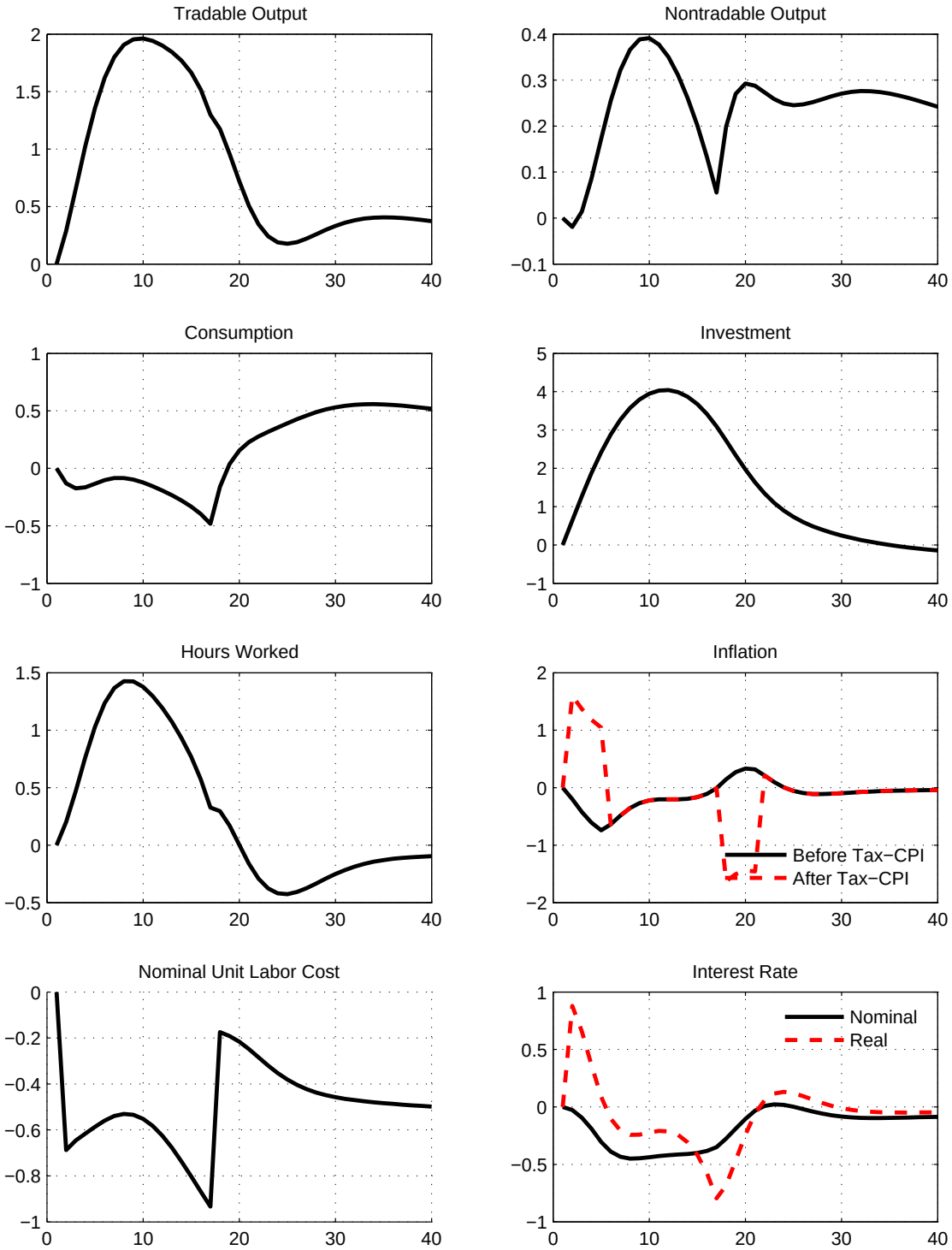
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.

Figure 6: Euro area fiscal devaluation. Spanish trade variables and GDP



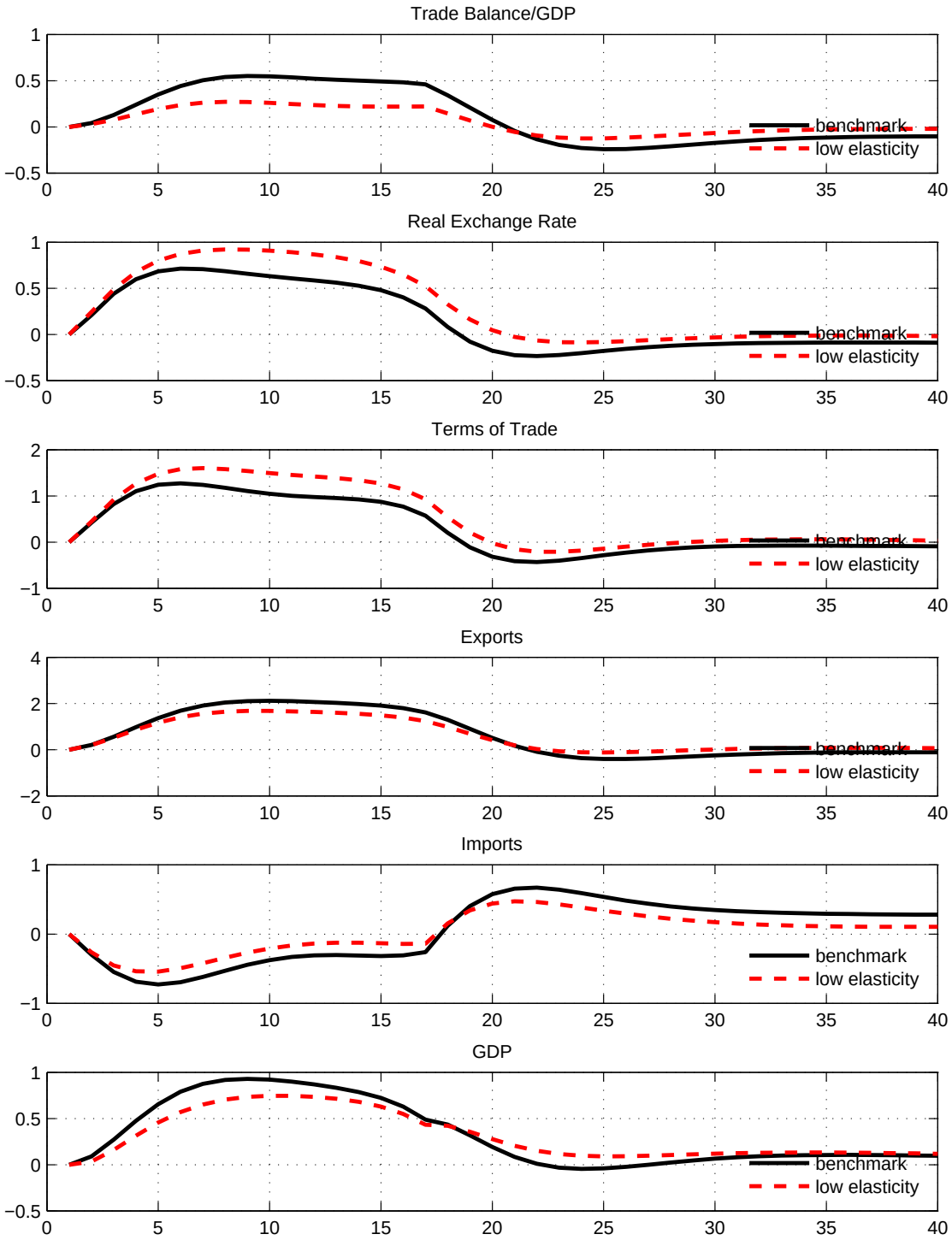
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.

Figure 7: Euro area fiscal devaluation. Other main Spanish variables



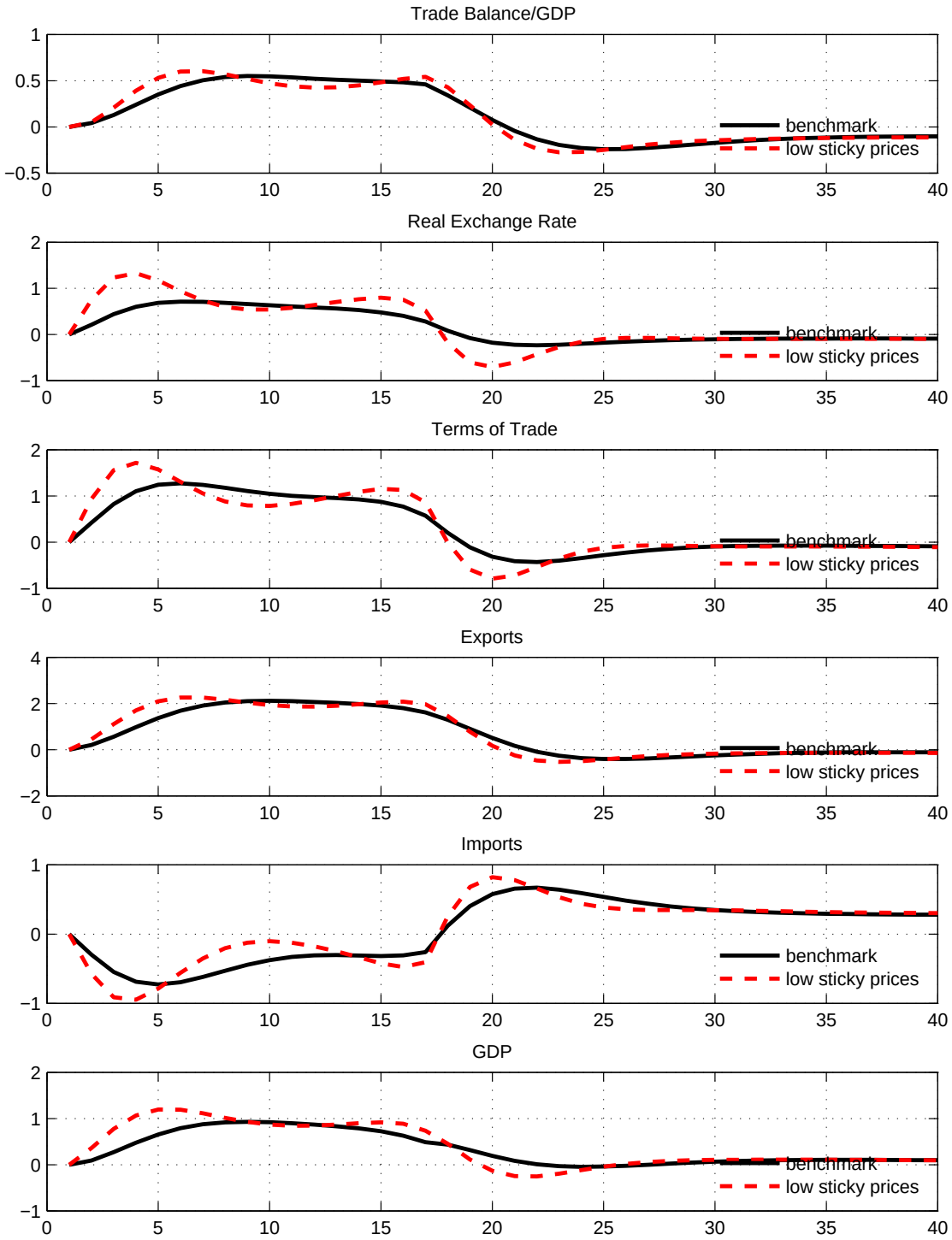
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; inflation and interest rates in annualized percentage point deviations.

Figure 8: Spanish fiscal devaluation and low elasticity. Trade variables and GDP



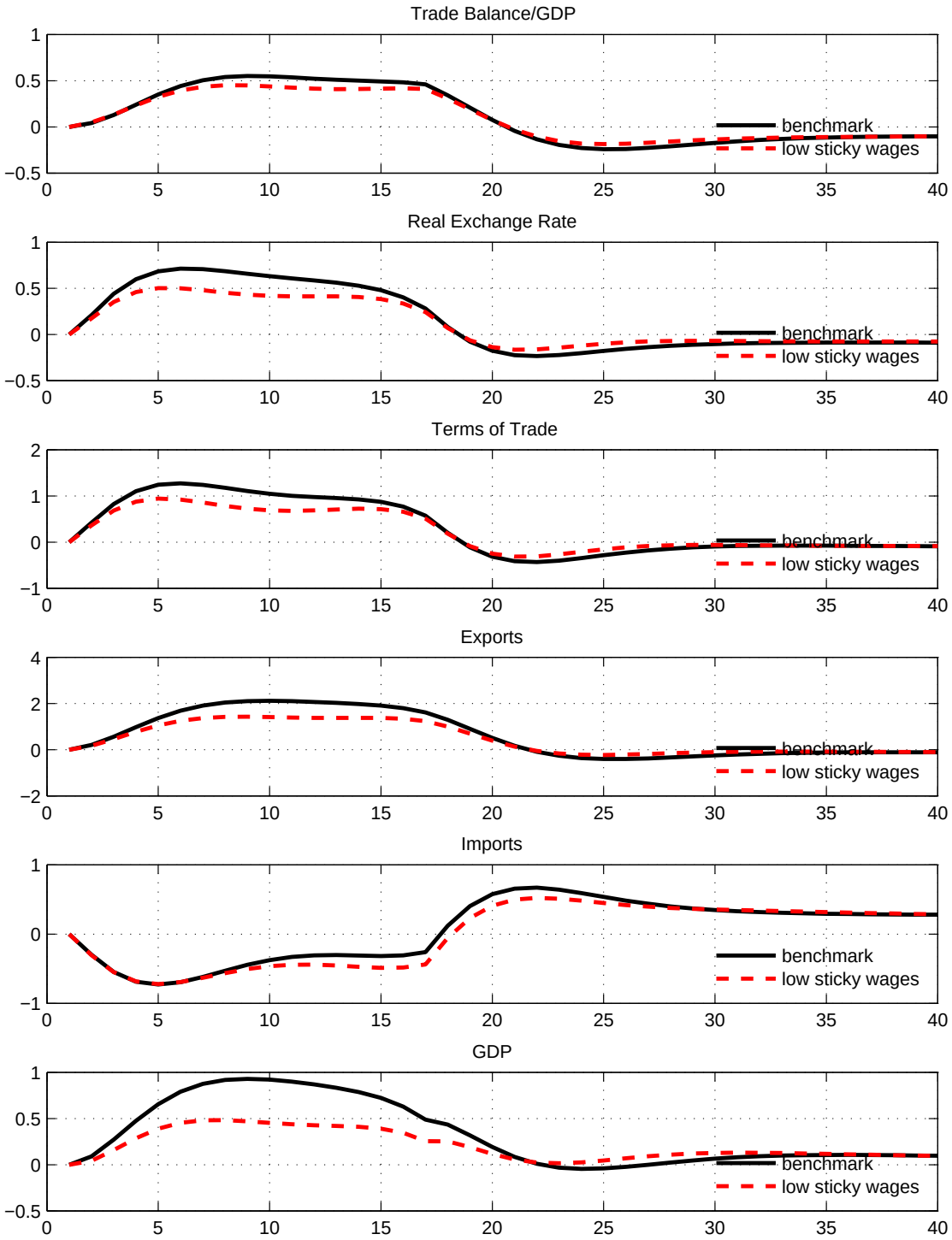
Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.

Figure 9: Spanish fiscal devaluation and low price stickiness. Trade variables and GDP



Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.

Figure 10: Spanish fiscal devaluation and low wage stickiness. Trade variables and GDP



Horizontal axis: quarters. Vertical axis: percentage deviations from the baseline; trade balance-to-GDP ratio in percentage point deviations.