The effect of a tax shift on the real effective exchange rate

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Abstract

The literature has long recognized that the effects of a devaluation of the nominal exchange rate might be indirectly achieved through a revenue neutral tax shift, which is usually referred to as “internal” of “fiscal” devaluation.

The existing literature focuses mainly on the effect of such a fiscal policy on the trade balance of a country or on growth. However, a change in the tax mix may affect trade and growth through different channels. The aim of this paper is to provide evidence on the effects of a revenue neutral tax shift, such as the fiscal devaluation, on a country’s real exchange rate.

Keywords: fiscal devaluation, exchange rate, external competitiveness

JEL: E62, F45, H87

1. Introduction

Within a Monetary Union, governments cannot purse an autonomous exchange rate policy. This implies that they cannot rely on a devaluation of the nominal exchange rate to increase their international competitiveness and improve their trade balance.

The literature has long recognized that the effects of a devaluation of the nominal exchange rate might be indirectly achieved through a revenue neutral tax shift that is usually referred to as "internal" of "fiscal" devaluation. It generally takes the form of a budget neutral reduction in employers' social security contributions (SSCs) matched by an increase in the value added tax (VAT) rate.

This policy concept plays an important role in the Commission's reform recommendations to Member States in context of European Semester. Moreover, as the United States recently considers moving to a destination-based cash-flow tax, there is growing concern about the impact of the proposed border adjustment on trade. Border adjustment on sales taxes, which tax imports and exempt exports, is a common way of taxing only goods consumed in a country. Most country perform such border adjustment on VAT taxes. More recently, Auerbach et al. (2017) have argued that, a destination based-income tax would be equivalent to the tax shift suggested by fiscal devaluations.

The idea behind a fiscal devaluation is to improve external competitiveness by lowering the relative price of exports and raising the relative consumer price of imports.

As noted by Calmfors (1993, 1998) in the short run with nominal wages rigidity, a cut in social security contributions paid by employers lowers the labour cost relative to foreign prices measured in domestic currency in the same way as a nominal exchange-rate devaluation. If the government budget is kept balanced by raising the tax burden on workers and households or by reducing public expenditure, there are no direct effects on aggregate demand and the final outcome is a devaluation of the real exchange rate. The similarity between an “external” and an “internal” exchange rate devaluation is most clear when the reduction in social security contributions is financed by an increase in taxes on labour income such as an employee contributions, personal income tax, or VAT. Employees will experience in both cases a loss in purchasing power in terms of imports. At the same time, to the extent that lower labour costs are reflected in lower prices for domestically produced commodities, the purchasing power in terms of domestic goods will remain unchanged.

More recently, Fahri et al. (2014) have clarified the conditions under which tax shifts of this kind can exactly replicate a nominal devaluation. They allow for fixed nominal exchange rate and nominal wage rigidity, investigating both expected and unexpected devaluations. Using a dynamic New Keynesian open economy environment, they show that there may be two kind of fiscal instruments that can robustly replicate the real allocation reached under a nominal exchange rate devaluation - a uniform increase in import tariff and export subsidy, and second, a value-added tax increase and a uniform payroll tax reduction. Furthermore, they find that, when the devaluations are anticipated, these policies need to be supplemented with a consumption tax reduction and an income tax increase.

The large body of literature on the economic effects of fiscal devaluations focused mainly on the effects on GDP, employment and trade balance, looking at both, the short- and the long run effects.

Most studies are simulation-based, meaning that they rely on a theoretical, general equilibrium model. Annicchiarico, et al. (2014) study the potential effect of fiscal devaluation policies on the Italian economy using IGEM, a dynamic general equilibrium model developed at the Italian Department of the Treasury. Engler et al. (2013) calibrate a DSGE model to the euro area and show that a fiscal devaluation carried out in “Southern European countries” has strong positive effect on output, but a mild effect on their trade balance, while there is a weak negative effect on output of “Central-Northern countries”. Lipinska and von Thadden (2012) use a two-country

New Keynesian model of a monetary union, to show that the effectiveness of a fiscal devaluation depends on the degree of financial integration between the two countries. They find that in a region whose size is half of monetary union, fiscal devaluations tend to be ineffective.

More recently, Erceg et al. (2017) find that the conditions under which a shift from SSCs to VAT reaches the same effects as a nominal exchange rate devaluation, are very restrictive and unlikely to hold in practice.

From the empirical side, some studies document a correlation between the tax mix and trade. Lane and Perotti (1998, 2003) analyse the effect of labour taxes on net export and output, but they disregard consumption taxes. Keen and Sayed (2006) estimate the impact of VAT and corporate taxes on net exports, finding that the mix between the two matters significantly for the trade balance in the short-run, however they do not look at labour taxation.

However, few studies try to directly asses the effects of fiscal devaluations on trade performance. One of the earliest work in this sense is Arachi and Alworth (2010). They empirically assess the effects of domestic taxes on the trade balance and find that the responsiveness of net exports to taxes, mainly the corporate tax and employers' social contributions, increases for country that joined the Euro Area.

De Mooij and Keen (2013) estimate a regression of the single equation error correction form for a panel of thirty OECD countries between 1965 and 2009. Their empirical analysis suggests that a revenue-neutral shift from employers' social contribution towards the VAT in Euro Area could improve the trade balance in the short run. In the long run, the positive effect on the trade balance vanishes and can even turn into negative. Focusing on Portugal, Franco (2013) analyses the same type of policy by estimating a number of VAR equation, and by simulating its impact on a small-open economy DSGE model. Overall, the benefits of a fiscal devaluation are likely to be small relative to the size of macroeconomic imbalances.

Analysing the relationship between tax structure and income, Arachi et al. (2015) provide support for fiscal devaluations; they find strong evidence of a positive short run effect on per capita income of a tax shift from labour and capital taxation towards consumption taxation.

Although from a theoretical point of view the effects of a fiscal devaluation have been investigated in more detail, there is still little empirical analysis. Thus, from an empirical point of view the argument requires further scrutiny. Furthermore, focusing mainly on the effects on output or trade, the existing studies fail to uncover which is the role played by the impact of tax policy on the price competitiveness of a country.

A measure of the price competitiveness is usually the real effective exchange rate (REER) of its currency. The REER is a weighted geometric average of nominal exchange rates of a country's main trading partners, deflated by relative price deflators. According to the type of deflator used, REERs may be either price or unit labour cost based; the most commonly deflators used are: consumer price indices (CPIs), GDP deflators, unit labour costs in manufacturing (ULCMs) and unit labour cost in total economy (ULCTs). Giordano and Zollino (2015) test the ability of alternative REERs to explain the trade performance of the four-largest Euro Area countries. They provide evidence that gains in price competitiveness support exports.

There is large consensus in the empirical research on the fact that REER behaviour at medium to long horizons can be at least partly explained by fundamentals. A growing set of this research uses panel data techniques and considers various measures as REER determinants, ranging from the supply-side (productivity measures) to demand-side (government expenditure). Starting from the idea that the knowledge of real exchange rate determinants may be of help in assessing the readiness of a country to move to the EMU, Candelon et al. (2007) estimate bilateral equilibrium exchange rates against the euro for the eight countries that have joined the EU as of May 2004. They document a significant positive link between productivity and the REER and a negative impact of trade openness. For the demand indicators they find less robust results, in particular the coefficient for the government consumption is not statistically significant. Ricci et al. (2013) find slightly different results. They apply the dynamic ordinary least squares (DOLS) methodology to estimate the equilibrium cointegrating relationship between the price competitiveness indicator and the set of its fundamentals for a group of advanced and emerging markets. They show that an increase in government consumption expenditure causes a significant appreciation of the real effective exchange rate. Another stream of research focused on the effect of public spending shocks on price competitiveness using VAR models. Bénétrix and Lane (2013) look at the composition of government expenditure for a panel of Euro Area countries, finding that the effects on the REER differ across different types of spending with shocks to public investment generating larger and more persistent real appreciation than shocks to government consumption. De Castro and Garrote (2015) find that an expansionary fiscal policy in the Euro Area leads to real exchange rate appreciation and to a fall in net exports, jointly with lower primary budgetary surpluses, in line with the "twin deficit" hypothesis.

The existing literature on the determinants of the dynamic of the REER, however, disregard which may be the role played by taxation. The aim of this paper is to bridge this gap by providing evidence on the effects of a revenue neutral tax shift, such as the fiscal devaluation, on the price competitiveness indicator. In particular, we focus on the impact of tax shocks on the real effective exchange rate computed for a panel of Euro Area countries vis-à-vis the rest of EMU economies.

The aim of this paper is to track the role of a shift in the tax mix, in affecting the country's trade balance, and thus its external competitiveness, investigating the interactions between tax rates, public spending, productivity and competitiveness in an EMU perspective.

We asses this issue by applying a panel vector autoregression (panel VAR) setup on a sample of 15 EMU countries over the period 2002-2015, with quarterly frequency. We run a homogeneous VAR model following Cagala and Glogowsky (2014), which fits a multivariate panel regression of each dependent variable on lags of itself and on lags of all the other variables using the least square dummy variable estimator. This is the most suitable estimator having a panel with a small cross-sectional dimension and a long time dimension.

Thus, in this paper we follow up on the line of empirical works focusing on the determinants of a country competitiveness and extend it into some directions. First, although the literature focuses on public spending shocks, we look at tax rates shocks, investigating if a 1% shock in the tax mix in a country affects its external competitiveness relative to trading partners. We find that this policy causes an appreciation of the real effective exchange rate and a deterioration in the trade balance. This result is robust to different models specification. We also complement the analysis of the real exchange rate, in which its determinants are treated as exogenous, by considering all the variables in the model as endogenous and interdependent. We relax this assumption as a robustness check.

The remainder is organized as follows. In Section 2 we describe the data. Section 3 provides the empirical framework for the panel VAR. Section 4 analyses the results. Finally, Section 5 concludes the paper.

2. Data

We combine different data sources to obtain a balanced panel data set and perform the analysis for a panel of 15 Euro Area countries[1] over the period ranging from 2002Q1 to 2015Q4. Our sample consists of a group of Euro Area member countries, since our

[1] The 15 countries are: Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, Netherlands, Portugal, Slovakia and Spain.

interest here is the relation between tax rates shocks and the real exchange rate for countries that shared a common currency. The empirical model looks at the response of the CPI deflated real effective exchange rate (REER_CPI) vis-à-vis the EMU countries to tax shocks, controlling for a set of fiscal and non-fiscal determinants, some of them suggested by the literature. The real effective exchange rates data come from the Eurostat's Price and Cost Competitiveness Data Section. Non-fiscal data are taken from OECD Quarterly National Accounts. Finally, the source for fiscal variables is the Quarterly Non-Financial Accounts for General Government database provided by Eurostat.

Since we are interested in evaluating the forces driving the structure of relative prices, and in particular, how tax policy deviations affect real exchange rates among the EMU countries, it is important to measure variables in relative terms. Accordingly, variables for each country are expressed relative to a weighted average across the set of the rest EMU economies. Aggregation is done by geometric average, using overall time varying trade weights (taking into account third market effects) provided by Eurostat.[2]

As previously stated, the main contribution of this paper is to consider a tax variable in order to catch if a tax shift in the sense described by the fiscal devaluation, affects the real effective exchange rate behaviour. Most of the literature focused on the effects of tax rates, relies mainly on aggregate measures of the average tax burden, such as the ratio between tax revenue and GDP or the share of one type of tax in total revenue (tax ratios). Mendoza et al. (1997) proposed alternative measures. They calculate macro-level effective tax rates, also called "implicit tax rates" by European Commission (2013), by taking the ratio between the revenue derived from a particular type of tax and its potential tax base, the latter estimated from national accounts. Two are the main advantages of this approach. First, effective (or implicit) tax rates can be immediately interpreted as they represent the wedge distorting optimizing behaviour in a

[2] The same weights are used to construct the real effective exchange rate.

representative agent setting. The implicit tax rate on consumption measures the percentage difference between post-tax consumer prices and pre-tax prices at which firms supply consumer goods, whereas the implicit tax rate on labour corresponds to the percentage difference between post and pre-tax income. Second, compared to tax ratios, they are less directly affected in the long run by the development of factor shares. This can be illustrated by means of a simple decomposition: the share of tax on factor *i* in total revenue (i.e., the *i* tax ratio) is equal to the implicit tax rate on *i*, multiplied by the share of factor *i'*s compensation on GDP, multiplied by GDP over total revenue. Thus, given the total tax burden on GDP and the implicit tax rate on *i*, the *i* tax ratio is correlated to the evolution of factor *i*'s share. The choice between tax ratios and implicit tax rates is not without consequences. In the analysis of the relationship between tax structure and long run income, Arachi et al. (2015) find that their results partially change when they adopt tax ratios instead of implicit tax rates. In our empirical strategy, we focus on an aggregate measure of the tax system computed using implicit tax rates. We first calculate the implicit tax rates for consumption and social security contributions, and then, we take the ratio between them.[3] An increase in this variable, called *tax mix* (Boscá et al., 2013), is referred to as a fiscal devaluation. At least in the short term, it can make home exports cheaper relative to foreign exports, inducing an improvement in net exports and boosting output and employment.

In our baseline, we include two variables usually considered by the literature as key determinants for the real effective exchange rate movements, the productivity differential and the government spending differential.

The impact of productivity differential is expected to follow the Balassa-Samuelson mechanism, which states that relatively larger increases in productivity in the traded goods sector in a country should be associated with a real appreciation of the currency

[3] The implicit tax rate on VAT is computed as the ratio of VAT revenues and the sum of private and government consumption. The implicit tax rate on social security contributions is given by the sum of revenues from social security contributions divided by labour income.

of that country. Alternative measures can be used to consider diverging productivity trends. Here we focus on the logarithm of the total labour productivity differential between each country in the panel and its trading partners. Productivity (*y*) is measured as real GDP divided by the number of employees and is expected to lead to a real appreciation.

The relationship with the fiscal balance is also considered to be of interest, as it constitutes one of the key components of national savings. A fiscal tightening causes a permanent increase in the net foreign assets position of a country and, consequently an appreciation of its equilibrium exchange rate in the longer term, given that the fiscal consolidation is considered to have a permanent character. (Maeso-Fernandez et al., 2001). Due to these considerations, the government expenditure differential (*g*) between each country in the panel and the rest of the Euro Area has also been included.

Finally, we assess the reaction of the trade balance to tax mix shocks in order to check if an increase in the country's external competitiveness is translated into a trade balance improvement. Thus, we include in the analysis net exports (*nx*) for Euro Area countries, relative to the rest of EMU.

In our baseline VAR specification, we also control for global factors, proxied by the real world GDP growth rate (*wrdgdp*), as in Comunale (2017). This helps us to weaken in part the possible cross-sectional dependence. This concern is particularly salient in our setting, since in the period considered here, the sample countries were hit by several common economic shocks, like the financial crisis.

We try other VAR specifications aiming to better understand the responses of certain variable to fiscal shocks. In particular, we replace the analysis using different REER measures, according to the deflator used, i.e. the nominal unit labour cost in total economy (*nulc*), the nominal unit labour cost in the manufacturing sector (*nuwc*) and gross domestic product price deflator (*gdp*). These data come from the Eurostat's Price and Cost Competitiveness Data Section. A further, theoretically attractive deflator refers to exports prices, which by definition are attached solely to traded goods. However, we decide to not include it in the analysis because it is subject to significant limitations as they are often measured in terms of exports unit values, thus resulting poorly comparable across partners owing to their dependence on the country-specific pattern of trade (Giordano and Zollino, 2015).

Table 1 reports the descriptive statistics for the variables introduced above.

[Insert Table 1 here]

3. Empirical model specification

The aim in what follows is to look on the response of the Euro Area countries' competitiveness to tax rate shocks, in order to test if this supports the idea behind fiscal devaluations, in a panel VAR framework.

Our sample consists of 15 EMU countries over the period 2002Q1-2015Q4. We use quarterly data, as is common in much of the literature; this allows us to investigate the within-year responses. To increase the precision of our estimates, we apply the VAR model in panel format, including all countries in the sample.

In VAR models all variables are treated as endogenous and interdependent, both in a dynamic and static sense. In our setup, we have a set of endogenous variable, however in a VAR framework some exogenous variables could also be included (Ciccarelli and Canova, 2013). The baseline is a vector auto-regression specification based on the vector of the following variables, $(wrdgdp, tax\_mix,\ g,\ y, nx, reer\_cpi)$. $wrdgdp$ is the real global GDP growth rate; tax_mix is the ratio between VAT and SSCs implicit tax rates. g is public spending (measured as the sum of government consumption and government investment), y is our productivity measure, nx

represents the net exports. All these variables, except $wrdgdp$, are measured in relative terms with respect to the rest of EMU. Finally, $reer\_cpi$ represents the competitiveness indicator, i.e. the real effective exchange rate deflated by the consumer price index.[4] g, y, nx and $reer\_cpi$ enter the model in natural logarithm; the other two variables are expressed in percentage form. In the analysis below, we will look at Impulse Response Functions (IRFs), in order to investigate the percentage response of the sample countries' competitiveness after a one-percentage shock in the tax variable.

One of the key point in VAR analysis is to identify the direction of the transmission across the variables. Our identifying scheme is based on a lower-triangular Cholesky decomposition, which assumes that each variable in the vector is allowed to react contemporaneously to all variables above it, but not to any of the variables below it. Variables that are lower in the ordering are assumed to affect previous ones only with lags. In our case, we want to identify how tax rates influence competitiveness, therefore the tax mix is assumed to be more exogenous in the baseline setup. As regards net exports and reer, the identification is not that straightforward. Following Beetsma et al. (2008), we decide to order net exports first. However, the main results do not change if we replace net exports with reer in the ordering[5].

As a preliminary analysis, we perform some diagnostic tests. We first test for the non-stationarity of the (logarithmic) of the real effective exchange rates and the various explanatory variables. Table 2 shows the statistics from two alternative panel unit root tests. The first column reports the results from the Im, Pesaran and Shin (2003) (IPS hereafter) unit root test, which test the null hypothesis that all panels contain unit root. Since we cannot exclude the presence of cross-section dependence across the units in the panel, we perform a panel unit root test that takes into account this feature. We, thus check for the stationarity of our variables using a second-generation t-test

[4] An increase in reer means a real domestic appreciation.

[5] Results are available upon request.

proposed by Pesaran (2007). This is the cross-sectionally augmented panel unit root test, also called CIPS, designed for analysis of unit root in heterogeneous panel setups with cross-sectional dependence.

[Insert Table 2 here]

Both tests find a clear non-stationarity property for the REER_CPI and NX. Divergent results are, instead, suggested as regards the different REER measures. IPS (2003) test seems to conclude for a non-stationarity in the series; while looking at the CIPS (2007), we cannot accept the null. For the remaining variables, both tests conclude for stationary. Given the apparent mixture of stationarity and nonstationary data, as a robustness check we analyse the data using a cointegration framework.

We also perform a causality test as in Dumitrescu and Hurlin (2012), who propose a simple test of homogeneous non-causality hypothesis. Under the null, there is no causal relationship of any of the units in the panel. The alternative hypothesis states that there is a causality relationship from X to Y for at least one cross-sectional unit. The results from the test confirm the presence of a causal relationship among the variables considered.[6]

Having performed the test, we can now describe the main structure of the VAR model. Consider a first-order panel VAR for K variables given by:

$$Z_{i,t} = A_{0i}(t) + A_i(L)Z_{i,t-1} + u_{i,t}, \tag{1}$$

where the subscript $i \in \{1,2,\dots,N\}$ refers to the cross-sectional dimension and $t \in \{1,2,\dots,T\}$ to the time dimension of the panel of observations. $Z_{i,t}$ is the (K x 1) vector of the endogenous variables described in the preferred identification scheme as $Z_{i,t} = (wrdgdp, tax\_mix, g, y, nx, reer\_cpi)$. A_{0i} is defined to include all deterministic components of the data. To deal with possible heterogeneity, we include country fixed

[6] The full set of results are available upon request.

effects and country specific time trends. To reduce cross-country contemporaneous residual correlation we also include time-fixed effects. $A_i(L)$ is the (K x K) matrix polynomial in the lag operator L that captures the relations between the endogenous variables and their lags. Restrictions are typically imposed on the coefficient matrices A_i to make variance of $Z_{i,t}$ bounded and to make sure that $A_i(L)^{-1}$ exist. The standard way to derive finite order, fixed coefficients VARs, is to use the Wald theorem and assume linearity, time invariance and invertibility of the resulting moving average representation. Under these assumptions there exist an (infinite lag) VAR representation for any Z_{it}. Lags of all endogenous variables of all units enter the model for i, thus we allow for "dynamic interdependence" (Canova and Ciccarelli, 2013). We set the lag length of each model to 1, according to the Schwarz Bayesian information criterion. $u_{i,t}$ is the (K x 1) vector of random disturbances, which are assumed to be identically and independently distributed $u_{i,t} \sim iid(0, \sum_u)$. As an extension we replace the analysis using different deflators for the real effective exchange rate.

We run these estimations with a homogeneous balanced panel VAR, using the method and command developed by Cagala and Glogowsky (2014). They provide a Stata routine which fits a multivariate panel regression of each dependent variable on lags of itself and on lags of all the other dependent variables using the least square dummy variable estimator (LSDV) as in Bun and Kiviet (2006). The choice of this method is based on the fact that LSDV techniques have been designed for panels with a large time dimension relative to the cross-sectional dimension. The main drawback of this approach is that one main assumption is that errors are serially uncorrelated, thus we do not count for cross-sectional dependence.

Standard error bands are generated by Monte Carlo with 1000 simulations with confidence bands at 95%, the IRFs are considered to a one-unit shock, and the forecast horizon is computed at 30 quarters.

Finally as a robustness check, we apply a single equation error correction model with slope heterogeneity, which takes into account explicitly other possible common factors as a means to address the cross-sectional dependence across the unit. In particular, in order to control for unobservable as well as omitted elements of the cointegrating relationship, we follow the Common Correlated Effects (CCE) approach suggested by Pesaran (2006), in the mean group version (CMG). To weight down outliers in the computation of the averages we employ robust regression (Eberhardt and Presbitero 2015). The main drawback of this approach is that it does not allow us to take into account dynamic interdependences across the variables in each unit.

4. Results

For a means of a comparison with previous studies, we initially report the IRFs for a simple, 4 variables model *(g, y, nx, reer_cpi),* similar to the Bénétrix and Lane (2013) setup[7]. In Figure 1 we show the responses of net exports and the CPI deflated REER, after a shock of a 1% of GDP in the public spending variable. Our results indicate that the *reer_cpi* appreciates in responses to a public spending shock, even if this effect lasts only for few periods. This result is similar to that found in Bénétrix and Lane (2013), although they show a more persistent effect. However, it should be stressed out that our results are not directly comparable to those of previous studies because of the different definition of the variables used.

From Figure 2 to 5 we report the IRFs for our baseline model, and the results obtained considering different measures of the real effective exchange rate.

[7] However they do not include net exports.

[Insert Figure 1-5 here]

The figures report the responses of net exports and the real effective exchange rate to a one percent shock in the tax variable, measured here by the ratio between VAT and SSCs implicit tax rate (*tax_mix*), in the EMU. The tax mix shock dies out very fast. It causes an appreciation of the real effective exchange rate and a deterioration in the trade balance. Both these effects are small in magnitude and tend to fade out quite quickly. In particular, the CPI deflated REER appreciates on impact by about 0.005 percent keeping a peak response in the first quarter, when it appreciates by 0.012 percent. From this point onwards, it starts shrinking, becoming statistically insignificant starting from the 12th quarter, while the reaction of net exports to the tax rates shock lasts for 8 quarters.

These results are very robust even if we try to run the exercise with different identification schemes. For instance, the results remain unchanged if we replace net exports and REER in the ordering. Moreover, in our identification strategy, we are making a strong assumption, that tax rates do not react contemporaneously to the public spending shock. Still, the results do not change even if we relax this assumption.[8]

Figures 3 to 5 show the IRFs when we replace the analysis using the different REER measures. The REER appreciation and the net exports deterioration is very robust even if we use different price deflators. In particular, the results remains almost equal to those obtained considering reer_cpi when we use the GDP deflated REER (reer_gdp). Something change when we consider the labour cost deflators, not in the direction of the response but on its magnitude and persistence. A one percentage shock in the tax mix causes a larger and more persistent appreciation of both, the nominal unit labour cost (which refers to the total economy) and nominal unit wage cost (focused on the manufacturing sector) deflated REER.

[8] Results are available upon request.

Finally as a robustness check, we apply an error correction model to our data. In particular, in order to control for unobserved common factors we use the standard Common Correlated Effect (CCE) estimator, suggested by Pesaran (2006), in the Mean Group version (CMG). To weight down outliers in the computation of the averages (see Eberhardt and Presbitero, 2015) we employ robust regression. The main drawback for the comparison between these and the previous results is that this approach does not allow us to consider the dynamic interdependences across the variables in each unit, thus each variable cannot influence each other. The results are summarized in Table 3.

[Insert Table 3 here]

We run two separate estimation, the first takes as dependent the CPI deflated REER (reer_cpi), in order to investigate the relation between this competitiveness measure and its determinants (column 1). In the second column, we report the results for a regression of the macroeconomic variables on the log of net exports (nx).

The results seem to confirm the finding of our VARs estimation. In the short-run an increase in the tax mix appreciates the CPI deflated REER and has a negative effect on the trade balance, even though the latter is not statistically significant. In the bottom of table 3 we also report the statistics and p-values for the Pesaran (2004) CD test for cross sectional independence in macro panel data. This statistic suggests that in both the specifications we remove the cross-sectional dependence.

5. Conclusions

Differences in taxation structures are of particular relevance for countries belonging to the Euro Area, which share a fixed nominal exchange rate. This feature makes it elusive to affect the competitiveness of economies through nominal exchange rate adjustments. This issue has been in the last years, at the heart of government debates of whether those Euro Area countries, which need to improve their competitiveness, may mimic the effects of the devaluation of the exchange rate through an appropriate use of fiscal instruments, in particular, by rebalancing the tax structure away from direct taxes towards indirect taxes.

In our analysis, we have investigated this issue by looking at the effects on the real effective exchange rate, of a tax shift in the sense described above in order to test if it can positively affects Euro Area countries' competitiveness, even if a nominal exchange devaluation is not achievable.

The theory suggests that a fiscal devaluation might, at least in the short-run, have a positive impact on the external competitiveness of a country. However, this conclusion is valid under some restrictive conditions. More recently, Erceg et al. (2017), show that the equivalence between an import tariff-export subsidy policy, and an increase in value-added taxes accompanied by a reduction in employer payroll contributions (VP), and thus, its ability to mimic a nominal exchange devaluation, is not taken for granted as much as previous papers suggest. They show that VP policies are likely to be contractionary rather than expansionary under a wide range of assumptions. First, they assume that pre-tax prices are sticky, meaning that VAT increases are immediately passed through to consumer prices. Second, they assume that agents perceive that VP policies will be reversed. Thus, consumer would face a higher real interest rate if policy rates and pre-tax goods prices were unchanged, since households would expect the prices of goods to be lower at some point in the future. This implies that, policy rates would have to decline to keep aggregate demand at its pre-shock level, and the exchange rate to depreciate. Since a standard Taylor rule does not provide enough accommodation to stabilize the economy, output contracts, and this effect is much more severe under a pegged exchange rate. Thus, one may conclude that results presented by previous literature depend substantially on the specification studied and the assumptions underlying each model.

Our results seem to show that the studied fiscal policy worsens the EMU countries' external competitiveness, at least in the short-run. Although the specification of our model is quite different from those in the existing studies, it may be useful to compare our results with those of previous researches.

Figure 1 suggests that a shock in public spending causes an appreciation in the REER, although not as persistent as the previous literature suggests (See Beetsma et al. 2008; Bénétrix and Lane, 2013, among others). However, these quite different results could be due to the variables included in the specification. Beetsma et al. (2008), for instance, include imports and exports as separate variables, instead of focusing on net exports. Furthermore, we include a productivity measure in our model, whereas the cited studies looks at output.

The study most closely related to ours, in its main intention, is by De Mooij and Keen (2013). They find that a fiscal devaluation have large short-term positive effect on trade balance, especially in Eurozone countries.

Thus, our results seem somewhat surprising in light of the quoted literature. We find that a 1% shock in the tax mix appreciate on impact the real effective exchange rate and worsen the trade balance of goods and services. Both of these effects lasts only in the short-run. These results are confirmed also by the cointegrating analysis; the tax mix has a positive effect on the CPI_REER in the short-run, which turn to be negative in the long-run. The opposite effects can be seen for net exports, since the fiscal variable causes a negative effect in the short-run and a positive one in the long-run, even if these latter effects are not statistically significant. However, our results are not directly comparable with the existing ones. One of the main difference stems from the variables considered. Here we focus mainly at the REER's effect of tax rates shocks, measured by implicit tax rates. De Mooij and Keen (2013), focus on tax ratios, and looks only at their effects on the OECD's counties trade balance. They use annual, rather than quarterly data; finally, we measure the determinants in relative terms while they look at country-level variables.

The interpretation of our findings is not obvious and requires further scrutiny. Future works should investigate if the results are valid even under different model settings. Furthermore, we plan to extend our analysis considering also other instruments of the fiscal system, mainly the corporate income tax (CIT). In fact, the VAT is not the only way in which a SCR reduction might be financed, so that a range of alternative forms of fiscal devaluation could be investigated.

Finally, another possible extension of this work could be to investigate if the effects of a tax shift are driven by some spillover mechanisms among the member countries. This can be done using an empirical framework explicitly designed to identify shocks according to their geographical origin. In order to assess the presence of fiscal spillovers, future works should rely on a Global Vector Autoregression (GVAR) model (Dees *et al.* 2007, Pesaran *et al*. 2004). This approach allows consistent modelling of international interdependences and transmission channels across countries and the evaluation of different policies in counterfactual analysis. A GVAR model consists of a number of individual country VAR models describing the country's environment treating all variables as endogenous. These countries are then stacked into a single multi-country model using weights related to international linkages, allowing to assess the interrelationship among countries.

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Table 1. Descriptive statistics

Variables	Description	*Mean*	*Std. Dev.*	*Min*	*Max*
REER_CPI	CPI deflated Reer	4.630	0.076	4.354	4.908
REER_NULC	NULC (total economy) deflated Reer	4.637	0.110	4.256	5.106
REER_NUWC	NUWC (manufacturing sector) deflated Reer	4.641	0.132	3.853	5.166
REER_GDP	GDP deflated Reer	4.636	0.086	4.398	4.939
NX	Net exports differential	-0.055	0.158	-0.564	0.262
Y	Productivity differential	-0.145	0.563	-1.832	1.033
G	Government spending differential	0.005	0.137	-0.538	0.303
TAX_MIX	Tax mix differential (vat_itr/ssc_itr)	0.096	0.236	-0.228	1.569
WRDGDP	Real world GDP growth	2.815	1.533	-1.977	5.261

Note*: Each variable is measured as a deviation from the rest of EMU. REERs, Y G and NX are expressed in natural logs, the remaining variables enter in percentage terms. The 15 countries included in the data set are: Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, Netherlands, Portugal, Slovakia and Spain. The observation period is 2002Q1-2015Q4.*

Table 2. Panel Unit Root Tests

Variables	**Description**	***Im, Pesaran and Shin (2003) - IPS***	***Pesaran (2007) - CIPS***
REER_CPI	CPI deflated Reer	0.332	0.113
REER_NULC	NULC (total economy) deflated Reer	0.928	0.000
REER_NUWC	NUWC (manufacturing sector) deflated Reer	0.758	0.000
REER_GDP	GDP deflated Reer	0.964	0.000
NX	Net exports differential	0.267	0.832
Y	Productivity differential	0.082	0.000
G	Government spending differential	0.000	0.000
TAX_MIX	Tax mix differential (vat_itr/ssc_itr)	0.000	0.000

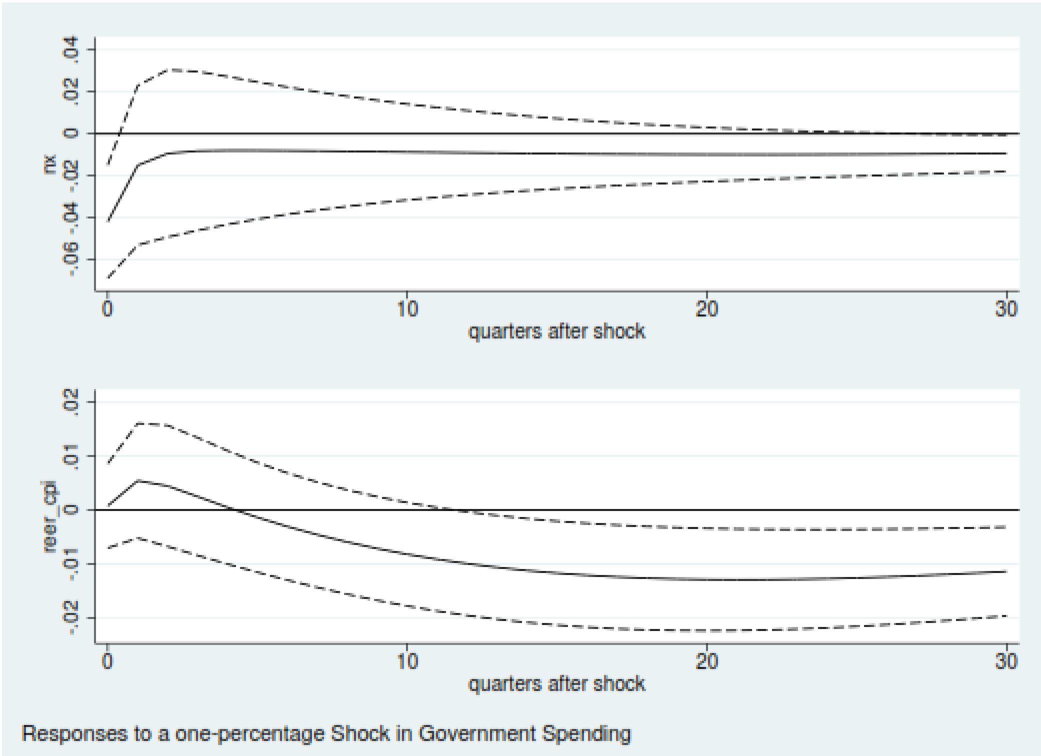
Note*: The numbers represent the p-values for the unit root test. Each variable is measured as a deviation from the rest of EMU. reer, y, g and nx are expressed in natural logs, tax_mix enters in percentage. The null for IPS(2003) is that all panels contain unit roots. The CIPS(2007) tests the null hypothesis that series are integrated of order 1, assuming cross-section dependence in the form of a single unobserved common factor. The 15 countries included in the data set are: Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Luxembourg, Netherlands, Portugal, Slovakia and Spain. The observation period is 2002Q1-2015Q4.*

Table 3. CMG estimates

Long-run Coefficients	***REER_CPI*** ***(1)***	***NX*** ***(2)***
TAX MIX	-0.1251* (0.0506)	0.0117 (0.0612)
G	0.0031 (0.0668)	-0.2701* (0.1332)
Y	0.1451* (0.0714)	-0.2815 (0.1519)
Short-run Coefficients		
ΔTAX_MIX	0.0080* (0.0036)	-0.0021 (0.0181)
ΔG	-0.0067 (0.0069)	-0.0213 (0.0085)
ΔY	0.0070 (0.0138)	-0.1392* (0.0432)
Convergence rate	**-0.1336*** (0.0117)**	**-0.2421*** (0.0263)**
CD (p-value)	**0.42 (0.677)**	**-1.20 (0.231)**

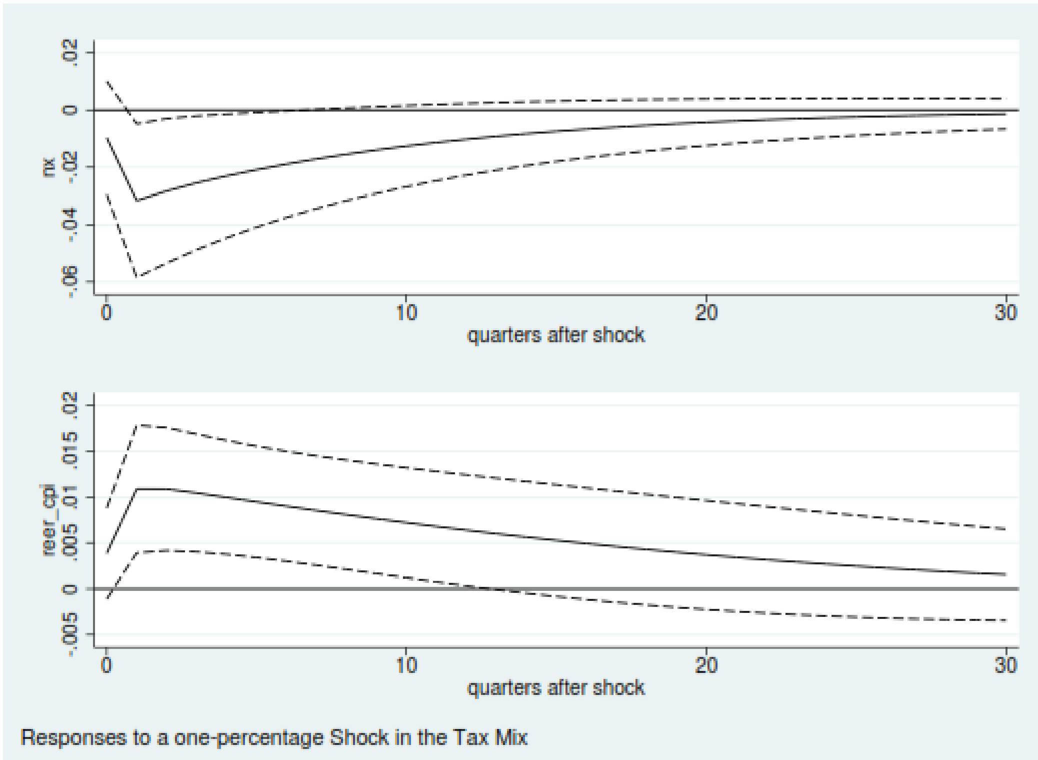
Note: *Results for a sample of 15 countries covering the period 2002Q1-2015Q4. Estimation performed using the standard CCE estimator (Pesaran, 2006) in the Mean Group version (CMG), employing robust regression (Eberhardt and Presbitero, 2015).*, **, *** means, respectively, significance at 10%, 5% and 1%. In brackets, we report standard errors. Column (1) reports the results for the model with the log of reer_cpi as dependent variable and as regressors the lagged value of the independent variables. In column (2) we replace the analysis considering the log of net exports as dependent. CD test reports the Pesaran (2004) test for cross section dependence based on the residuals.*

Figure 1. IRFs after a shock in Government Spending



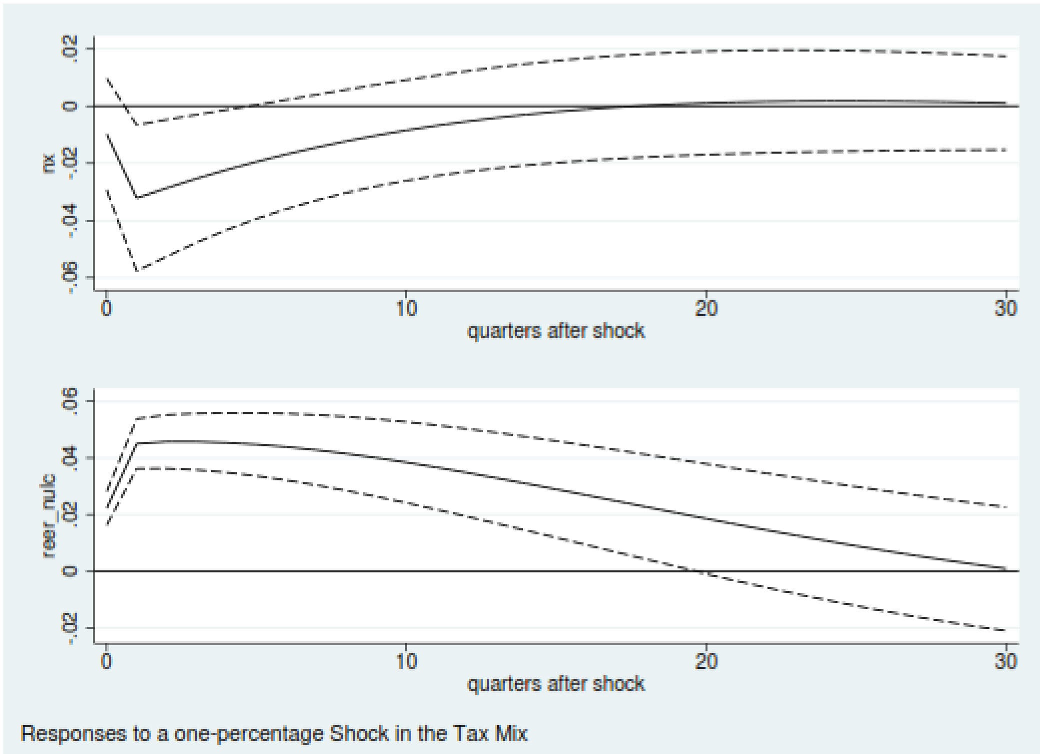
***Note**: Solid lines are the point estimates of the Impulse-Response. Dotted lines are the 5th and 95th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for net exports (nx) and the percentage appreciation of the real effective exchange rate (reer_cpi).*

Figure 2. IRFs – Baseline Model -



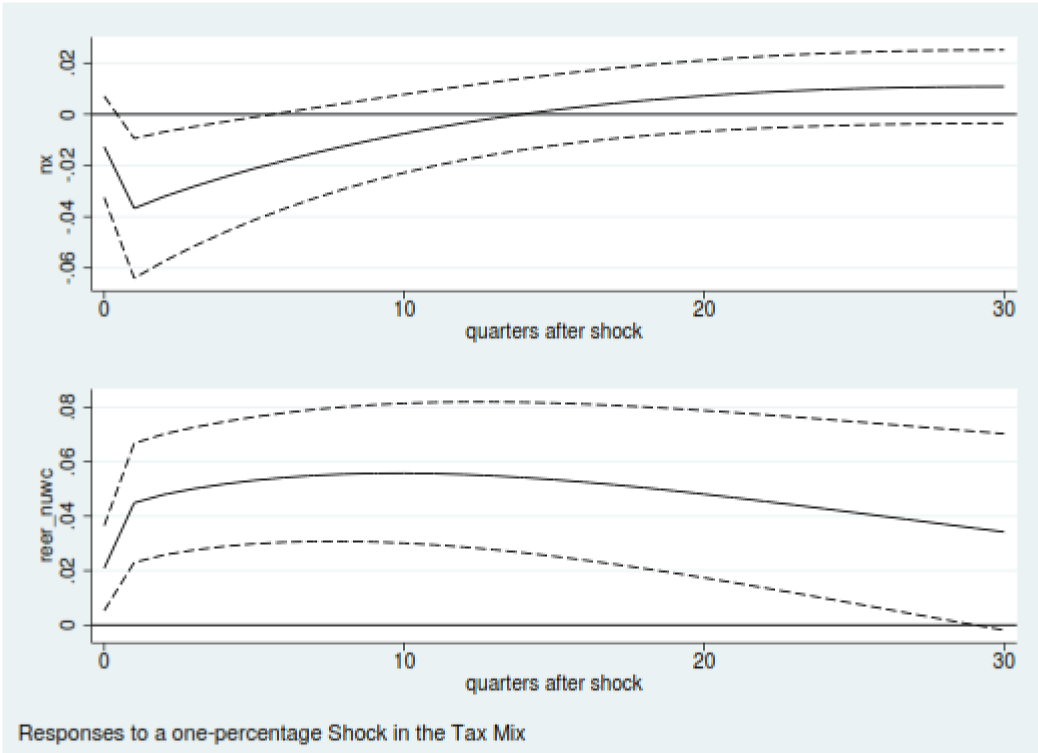
Note*: Solid lines are the point estimates of the Impulse-Response. Dotted lines are the 5th and 95th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for net exports (nx) and the percentage appreciation of the real effective exchange rate (reer_cpi).*

Figure 3. IRFs – with NULC (total economy) deflated REER -



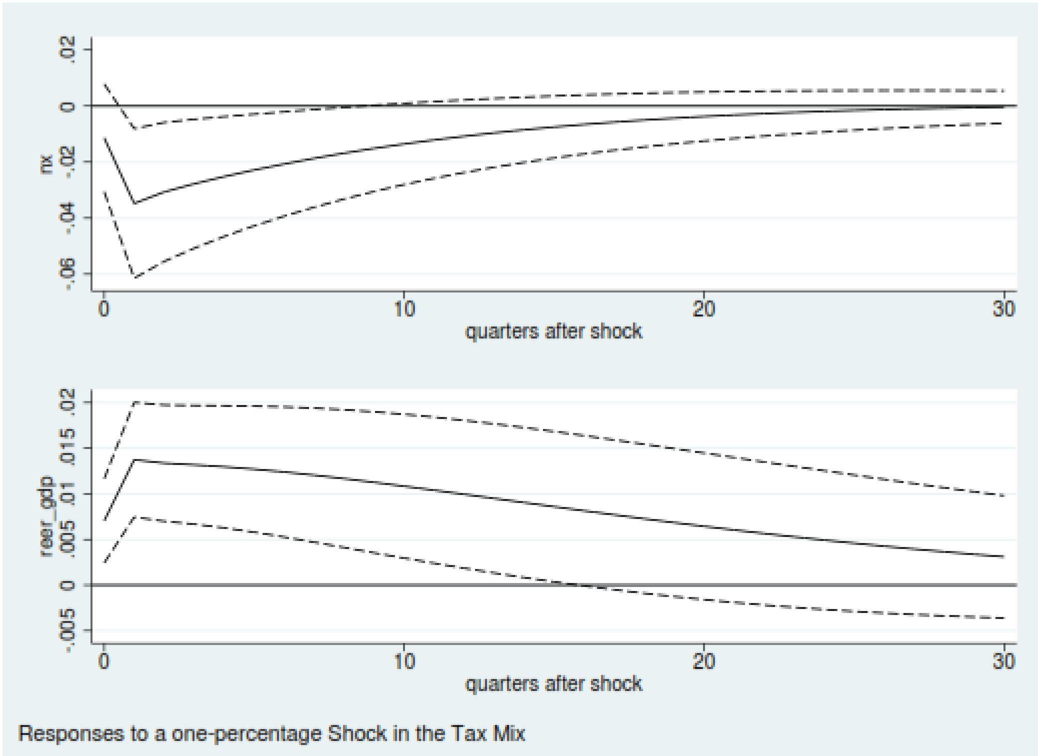
***Note**: Solid lines are the point estimates of the Impulse-Response. Dotted lines are the 5th and 95th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for net exports (nx) and the percentage appreciation of the nominal unit labour cost (total economy) deflated real effective exchange rate (reer_nulc).*

Figure 4. IRFs – with NUWC (manufacturing sector) deflated REER -



Note*: Solid lines are the point estimates of the Impulse-Response. Dotted lines are the 5th and 95th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for net exports (nx) and the percentage appreciation of the nominal unit wage cost (manufacturing sector) deflated real effective exchange rate (reer_nuwc).*

Figure 5. IRFs – with GDP deflated REER -



Note*: Solid lines are the point estimates of the Impulse-Response. Dotted lines are the 5th and 95th percentiles from Monte Carlo simulations based on 1000 replications. Vertical axis indicates the percentage deviation from the rest-of-EMU for net exports (nx) and the percentage appreciation of the nominal GDP deflated real effective exchange rate (reer_gdp).*