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The EAGLE. A model for policy analysis of macroeconomic interdependence in the euro area ☆

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ABSTRACT

We develop a 4-region macroeconomic model of the euro area and the world economy. The model (EAGLE, Euro Area and Global Economy model) is microfounded and designed for conducting quantitative policy analysis of macroeconomic interdependence across regions in the euro area and between the euro area and the world economy. Specifically, we simulate a permanent reduction in labor tax rates in the euro area. The effects on real activity are expansionary in both the short run and long run. Implementing reforms simultaneously across regions would produce extra benefits and make the macroeconomic performance in the euro area more even.

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1. Introduction

International macroeconomic interdependence is a relevant topic in a monetary union such as the euro area, where monetary policy is set according to euro area-wide performance, while fiscal and structural policies are mainly conducted at the country level. As such, understanding the transmission mechanism of region-specific or common shocks across euro area countries and the related role of country-specific structural economic features is crucial for properly assessing the appropriate stabilization policy responses. To analyze such issues we develop a new model for the euro area, named EAGLE (Euro Area and Global Economy). It is a large-scale microfounded model for the quantitative analysis of spillovers and macroeconomic interdependence across the different countries belonging to the euro area and between them and other countries outside the monetary union. Thanks to the microfoundations, the analysis can be conducted in a fully coherent, disciplined and internally consistent framework. In this paper we calibrate EAGLE to four regions: Germany, rest of the euro area, United States (US), and rest of the world.[3] Germany and rest of the euro area share, consistently with the monetary union framework, the monetary policy and the nominal exchange rate against other regions. Each region is characterized by a rich fiscal setup, consisting in public purchases and transfers, different types of tax rates (on labor and capital income, on consumption), public debt (appropriately stabilized through a fiscal rule). Moreover, EAGLE has all the features needed to realistically characterize the short-run dynamics of the adjustment to shocks (habit formation in consumption, adjustment cost on investment, sticky wages and prices *à la* Calvo, 1983). Finally, home bias in tradables, local currency pricing, nontradable goods and incomplete market at international level allow for a realistic international transmission of a country-specific shock through movements of trade flows and international relative prices (terms of trade and real exchange rate).[4]

In this paper we simulate EAGLE to assess the macroeconomic effects of one type of structural reforms, namely a permanent reduction in labor tax rate in the euro area. The reform is relevant for three reasons. First, the well known historical relatively bad performance of the

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[3] EAGLE can be calibrated to any region or country. Moreover, it is not difficult to change the number of countries, as the codes, available in TROLL or DYNARE, are extremely flexible.

[4] To get international incomplete financial markets we assume that only one riskless nominal bond is internationally traded.

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European labor markets can be at least partially explained in terms of relatively high labor tax rate.[5] Second, reducing distortions in the labor market can help in rising the long run potential output of the euro area.[6] Third, euro area countries are highly integrated through trade and financial flows. As such, cross-country spillovers of country-specific tax reforms through changes in trade quantities and relative prices can be relevant.

We run two counterfactual scenarios: in one case, we simulate a permanent and gradual reduction in Germany firms' social contributions to the levels of the US over a period of 5 years. In the second, both Germany and the rest of the euro area simultaneously reduce their corresponding firms' social contributions to the US levels.

Our main results are as follows. First, there are benefits from unilaterally cutting labor wedges. A reduction in firms' social contributions in Germany by 11.5 percentage points (p.p.) would induce an increase in the long-run German output equal to 4.4%. As the tax cut is implemented gradually over a period of 5 years, the output would smoothly reach its new long-run level in 7 years. Second, cross-country coordination of reforms in the euro area would add extra benefits to each region, by limiting the deterioration of relative prices and purchasing power that a country faces when implementing reforms unilaterally. Specifically, in the long run, German output would increase by 4.7%. Third, cross-country coordination would make the macroeconomic performance of the different regions belonging to the euro area more homogeneous, both in terms of prices and real activity. Overall, results suggest that reforms implemented individually by each country in the euro area produce positive effects, cross-country coordination produces larger and more evenly distributed positive effects. Results are in line with those obtained by Coenen et al. (2008) that analyze the impact of a euro area-wide reduction in labor tax wedge using the New Area Wide Model calibrated to the euro area as a whole and to the US. Different from their contribution, we are able to characterize the multi-country dimension of the euro area and international spillovers thanks to the EAGLE setup.

The paper is organized as follows. The next section describes the model setup. Section 3 reports the calibration of the model. Section 4 contains some illustrative simulations for understanding the transmission mechanisms operating in EAGLE. Section 5 reports the macroeconomic effects of reducing labor tax rates. Some concluding remarks are reported in the final section. Given that EAGLE is a relatively new model, in the Appendix A we lay down the transmission mechanism of some shocks to better characterize its main dynamic properties.

2. The model

The EAGLE setup builds on the New Area Wide Model (NAWM, Coenen et al., 2008).[7] As in the case of the NAWM, in EAGLE the open economy dimension is the key feature. However, EAGLE innovates along the following dimensions. First, the euro area is formalized as a monetary union. The latter is composed of two regions sharing a common monetary authority that sets the common nominal interest rate according to euro area-wide variables. As such, the model allows to assess the implications of the common monetary policy and country-specific characteristics (such as the size and the bilateral trade flows) for the transmission of country-specific or common shocks in the euro area. Second, EAGLE includes two countries outside the euro area. This feature allows to analyze the role of euro nominal exchange rate and extra-euro area trade in transmitting shocks originating outside or inside the euro area. Third, the model includes tradable and nontradable intermediate goods in all regions.[8] The distinction (jointly with other features such as home bias, local currency pricing and incomplete international financial markets) allows to fully characterize the dynamics of the real exchange rate and the current account. To sum up, the three dimensions imply a rather exhaustive assessment of the macroeconomic interdependence across euro area countries and between them and countries not belonging to the union. Moreover, they make EAGLE relatively new as compared to the existing large scale micro-founded models of the euro area. [9] Finally, the rich set of nominal and real frictions as well as implementable fiscal and monetary policy measures make the model well suited for conducting realistic policy analysis.

Other features of the model setup are rather standard. In each country there are two types of firms. One type produces final nontradable goods under perfect competition using domestic tradable, imported tradable and nontradable intermediate goods. The final goods can be used for private consumption and for private investment. The intermediate goods are produced by firms under monopolistic competition using domestic labor and capital. Hence, they set nominal prices to maximize profits. Nominal prices are sticky, so that there is a non trivial stabilization role for monetary policy. For tradable intermediate goods, prices are set in the currency of the destination market (the local currency pricing assumption holds). As a consequence, pass-through of the nominal exchange rate into import prices is incomplete in the short run, consistently with empirical evidence.

There are two types of households in each country. The *I*-type households have access to financial and money markets, accumulate physical capital (they rent it to domestic firms), supply labor to domestic firms. They trade domestically a riskless bond denominated in domestic currency and internationally a riskless bond denominated in US dollars. So for *I*-type agents an uncovered interest parity condition holds, linking the interest rate differential to the expected change in the exchange rate of the domestic currency against the worldwide core currency (we assume it is the US dollar). The other households, *J*-type, are liquidity constrained and have access only to the domestic money market. Their only source of income is the labor supplied to domestic firms. Depending on the calibration, *J*-type households allow to introduce Keynesian effects of public expenditure in the model, as they increase consumption in corresponding a positive public expenditure shock. Both types of agents supply labor under monopolistic competition. So they set their nominal wages, that we assume to be sticky.

Finally, in each country there is a monetary authority and a fiscal authority (as said, in the case of the euro area there is a common monetary authority). The monetary authority sets the nominal interest rate according to a standard Taylor rule, reacting to domestic inflation rate, output growth rate and, possibly, to the nominal exchange rate. The fiscal authority sets public expenditure for purchases (fully biased towards domestic nontradable intermediate goods, consistent with empirical evidence) and lump-sum transfers. It is financed by rising taxes or public debt, issued on domestic financial markets. Taxes can be lump-sum or distortionary (the latter are raised on labor income, capital income and consumption expenditures). A fiscal rule guarantees the stability of public debt. In the case of the two regions belonging to the monetary union, the monetary and nominal exchange rate policies

[5] Several contributions have emphasized the relatively high labor tax rate as a crucial distortion of the euro area labor market. Over the period 1999–2007, the average rate of social contributions paid by firms in Germany is 17.3% (27.7% in the rest of the euro area). The corresponding figure in the US is 5.8%. Among others, Prescott (2004) argues that the existing large differences in the overall tax wedge across the euro area and the US can crucially explain the poor performance of the euro area.

[6] For a quantitative analysis of the impact on euro area potential output of competition-friendly structural reforms in the euro area based on EAGLE see Gomes et al. (2011).

[7] See also the IMF's Global Economy Model (GEM, Laxton and Pesenti, 2003; Pesenti, 2008), the Bank of Canada's version of GEM (Lalonde and Muir, 2007), the Federal Reserve Board's SIGMA (Erceg et al., 2006). See also Cova et al. (2009), the European Commission's QUEST (Ratto et al., 2009), Alves et al. (2007) and IMF's Global Integrated Monetary Fiscal Model (GIMF, Kumhof and Laxton, 2007).

[8] See also Jacquinot and Straub (2008) for a two-sector/four-country extension of the NAWM without monetary union.

[9] Andrés et al. (2006) build a three-country DSGE model including a two-bloc monetary union, namely Spain and the rest of euro area, and the rest of the world. However, the rest of the world is rather stylized, while in EAGLE all regional blocks are fully structural. Pytlarczyk (2005) builds and estimates a two-region model of the euro area, calibrated to Germany and rest of the euro area.

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