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External Imbalances and the Wage Curve: The Role of Labour and Product Market Regulation

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The Role of Labour and Product Market Regulation

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Abstract

This paper proposes a method to identify how labour market institutions and product market regulation interact with economic shocks, and affect unemployment and wage dynamics during periods of external imbalances corrections. This is done using a general equilibrium model of trade, external imbalances and unemployment that incorporates labour market frictions via a structural wage equation, and implies equilibrium cross-sectional dispersion of unemployment rates. We apply the method to study the role of macroeconomic shocks, labour market institutions and product market regulation in the correction of external imbalances in the European Monetary Union (EMU) over the last decade, and the concurrent heterogeneous unemployment dynamics.

JEL Classification: F40, J30, J60

Keywords: wage curve, external imbalances, unemployment, labour market wedges.

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1. INTRODUCTION

Following the build-up of large external imbalances in the European Monetary Union (EMU) and their correction starting in 2007, rebalancing has made progress but is still taking place and has produced large cross-sectional unemployment dispersion in the EMU. To be sure, reversing the divergent nominal wage and unit labour cost trajectories that contributed to the build-up of these large imbalances requires substantial adjustments in the labour market. But little is known about how differences in labour market institutions shape each country's adjustment path. The purpose of this paper is to develop a general equilibrium model of trade and external imbalances that includes labour market frictions, and to identify how macroeconomic shocks, labour market institutions and product market regulation have combined to influence the aggregate labour market outcomes resulting from the recent EMU rebalancing.

To do this, we develop a multi-country structural model of trade, imbalances and the labour market to study the nexus between wages, productivity and the current account imbalances within the EMU. The analysis builds on the quantitative Ricardian model developed in Eaton and Kortum (2002) and Alvarez and Lucas (2007), and its recent extensions by Dekle et al. (2008), allowing for current account imbalances, and by Eaton et al. (2013), allowing for equilibrium unemployment. Our main contribution is to include in this model labour market frictions explicitly. Specifically, the labour market is modelled using the framework in Blanchard and Katz (1999), that is based on a structural wage equation postulating a negative relation between the real wage and unemployment. This relationship is shown to be consistent with the international empirical evidence of a wage curve, carefully documented in Blanchflower and Oswald (1995). Moreover, the distinctive feature of the structural wage equation that we use, is that it is consistent with diverging price and productivity levels across countries, and it implies an equilibrium long-run unemployment rate. The latter, allows us to solve for an equilibrium cross-country distribution of unemployment rates, once the wage curve is embedded in the multi-country general equilibrium model.

The framework proposed in this paper should help understand wages and nominal and real unit labour cost differentials in the EMU based on a general equilibrium model of trade and production that allows for rich wage dynamics across countries and which can be used to construct policy counterfactuals and sustainability scenarios. We use the model to investigate the heterogeneous unemployment dynamics in the global economy, and the EMU in particular, over the last decade. Specifically, given an estimated structural wage equation and the observed evolution of current account balances in the global economy over the period going from 2006 until 2014, the general equilibrium model allows us to identify labour market wedges, corresponding to the latent factors required to exactly match the observed unemployment rates in the cross-section of countries. Given the way that they are defined, the labour market wedges are large for the countries for which the baseline model underpredicts the unemployment rate. Based on the estimated cross-country distribution of labour market wedges, we apply the seminal approach in Blanchard and Wolfers (2000), and recently updated by Bertola (2016), to examine the joint role of labour market institutions, product market regulation and observable macroeconomic shocks in determining the heterogeneous unemployment dynamics in the EMU.

In particular, we investigate the hypothesis that the labour market wedges obtained using our baseline model result from the interaction between macroeconomic shocks with labour and product market regulation. We find that the labour market wedge increases more following adverse macroeconomic shocks in countries that have more stringent product market regulation. At the same time, labour market protection (measured by the unemployment insurance and employment protection), is found to have a small but beneficial impact on unemployment outcomes, by attenuating the impact of macroeconomic shocks on the labour market wedge. These findings are consistent with recent studies of the European unemployment experience and, in particular, with work by Griffith et al. (2007), who show that less restrictive product market regulation improve labour market outcomes, in particular in countries with labour market institutions that raise workers bargaining power.

The most important advantage of incorporating a structural wage equation and including the labour market wedges within a general equilibrium model of trade and trade deficits, is that it allows us to construct policy counterfactuals which are conditional on the predicted labour market wedges. In particular, conditional on the labour wedges, we may solve for the resulting distribution of unemployment rates across countries. To illustrate the use of the model for this kind of scenario analysis, we investigate how the evolution of unemployment in the EMU would have been different over the period of external imbalances corrections, had the level of product market regulation in the countries most affected by the European debt crisis been less stringent. We find that the unemployment rates in Italy, Ireland and Spain would not have changed too much compared to the baseline, but the effects in Greece and in Portugal would have been substantial, with the unemployment rate in Portugal predicted to have stayed below 10% and that in Greece below 15%. This result highlights the potential benefits from implementing reforms that promote competition in the goods market and less stringent product market regulation.

Our work is related to at least two different strands of literature. First of all, this paper is related to the pioneering work of Obstfeld and Rogoff (2007) and Dekle et al. (2008), who study the global implications of the unwinding of external imbalances, using a general equilibrium model of trade. In a paper closely related to ours Eaton et al. (2013) augment the Dekle et al. (2008) analysis by incorporating unemployment in their model, but do not model the labour market explicitly. In particular, in their approach the relationship between unemployment and wage dynamics is unspecified. Without the structural wage equation, only a limited number of counterfactual experiments are possible, implying either full wage rigidity or full flexibility. By introducing a structural wage equation, we are able to consider different degrees of wage rigidity and also identify the labour market wedges.

The second important strand of literature that this works contributes to are the studies that look at competing explanations for the heterogeneous labour market performances across countries and, in particular, the role of shocks and institutions to explain the different unemployment experiences. Theoretical models looking at the role of labour and product markets regulation to explain the heterogeneity in macroeconomic performance include Blanchard and Giavazzi (2003) seminal work showing how market power in product markets restricts employment, and more recently, work by Felbermayr and Prat (2011) showing that, in labour markets combining search frictions and firm heterogeneity, higher competition may increase productivity through a positive selection effect. On the empirical side, pioneering work by Blanchard and Wolfers (2000) established the importance of considering the interaction between macroeconomic shocks and labour market institutions, emphasising how common shocks may be propagated differently depending on the institutional environment. Recently, Bertola (2016) updates the empirical work of Blanchard and Wolfers (2000) and finds that in the most recent decade the asymmetric current account dynamics in the EMU are important to explain the divergence in unemployment rates. Our work is also related to recent research by Griffith et al. (2007) and Fiori et al. (2012), who use panel data to look at the interactions between product market regulation and labour market institutions to explain aggregate labour market outcomes and, in particular, the level of unemployment. Our main contribution to this set of literature is to focus on how shocks and institutions explain the labour market wedge, which is obtained from a general equilibrium model of trade and trade deficits. Therefore, we are able to perform counterfactual exercises that look at the behaviour of unemployment conditional on an alternative profile of labour and product market regulation, acting directly through the labour market wedges.

The remainder of the paper is organised as follows. Section 2 presents the model, developing its equilibrium conditions. Section 3 examines the baseline model empirical performance and identifies the implied labour market wedges. Section 4 looks at the role of observable country-specific shocks and institutions, and considers their interaction to explain the cross-country distribution of labour market wedges and resulting unemployment dynamics. It also presents simple policy counterfactuals. Finally, Section 5 summarises our findings and concludes.

2. MODEL

In this Section we introduce the structural model of trade flows, trade imbalances and equilibrium unemployment. First, we look at the general equilibrium model which builds on the static model of trade and trade imbalances in Dekle et al. (2008), and next we introduce the structural wage equation and show how this allows one to solve for the equilibrium cross-country distribution of unemployment rates.

2.1. TRADE FLOWS AND TRADE IMBALANCES

We consider a global economy composed of n countries and two sectors of production (manufactures and non-manufactures), and our starting point is a structural gravity equation for bilateral trade flows in manufactures, of the form

$$\pi_{ji} = \frac{T_i \left(C_i \tau_{ji}\right)^{-\theta}}{\sum_{k=1}^{n} T_k \left(C_k \tau_{jk}\right)^{-\theta}}, \tag{1}$$

where, following the framework in Eaton and Kortum (2002), π_{ji} is country i's share in country j's spending, C_i is the unit-value input cost in country i, T_i is a measure of country i's productivity, and $\tau_{ji} \geq 1$ are bilateral trade costs. The latter follow the standard iceberg cost formulation meaning that to successfully deliver in country j one unity of any manufactured commodity produced in country i, τ_{ji} units need to be shipped (or, more likely inside the EMS, trucked). Finally, the parameter $\theta > 0$ controls the sensitivity of trade shares to changes in relative prices.

The labour income share in the manufactured goods sector (corresponding to the share of value added in the manufacturing sector's gross output) is equal to $\beta \in (0,1)$. Thus, assuming a Cobb-Douglas production function that combines labour and an intermediate input bundle of manufactures, the unit value input cost of production is given by

$$C_i = W_i^{\beta} P_i^{1-\beta}, \tag{2}$$

where W_i denotes the wage rate and P_i denotes the price in country i of the intermediate composite commodity. The latter is given by

$$P_i = \kappa \left[\sum_{j=1}^{n} T_j \left(W_j^{\beta} P_j^{1-\beta} \tau_{ij} \right)^{-\theta} \right]^{-1/\theta}, \tag{3}$$

where the constant of proportionality κ depends on preferences and, in particular, the elasticity of substitution across goods, but plays no relevant role and may be omitted. In Appendix A, we show carefully how Eaton and Kortum (2002) obtain equations (1) and (3) by assuming a probabilistic formulation of technological heterogeneity, where θ controls the degree of heterogeneity across countries and, hence, comparative advantage. Finally, using (2) and (3) to substitute in equation (1) yields

$$\pi_{ji} = T_i \left(\frac{W_i^{\beta} P_i^{1-\beta} \tau_{ji}}{P_j/\kappa} \right)^{-\theta}, \tag{4}$$

a formula relating the manufacturing bilateral trade shares to prices, preferences and technology parameters.

Next, given π_{ji}, market clearing conditions in the n country global economy are given by

$$\begin{aligned} Y_i^m &= \sum_{j=1}^{n} \pi_{ji} X_j^m, \\ &= \sum_{j=1}^{n} \pi_{ji} \left(Y_j^m + D_j^m \right), \end{aligned} \tag{5}$$

where we made use of the fact that $X_j^m = (Y_j^m + D_j^m)$, with Y_i^m denoting country i's gross output in manufactures, X_j^m the total expenditure by country j in manufactures, and D_j^m the country j's trade deficit in manufactures. In turn, building on basic accounting relationships, total expenditure in manufactures in country i is

$$X_i^m = \alpha X_i + (1 - \beta) Y_i^m, \tag{6}$$

with $\alpha \in (0,1)$, the share of manufactures in final expenditure. Notice that, letting X_{ij} denote the total expenditure by country i in manufactured goods produced in country j, we have that $\pi_{ij} = X_{ij}^m / X_i^m$.

Final expenditure obtains adding together GDP, denoted Y_i, and the trade deficit, denoted D_i, as follows

$$\begin{aligned} X_i &= Y_i + D_i, \\ &= W_i L_i + D_i, \end{aligned} \tag{7}$$

with L_i denoting total employment in country i, and where we use the fact that total value added corresponds to total income, implying $Y_i = W_i L_i$.

Combining equations (4), (5), (6) and (7), yields

$$W_i L_i + D_i - \frac{D_i^m}{\alpha} = \sum_{j=1}^{n} \pi_{ji} \left[W_j L_j + D_j - \frac{(1 - \beta) D_j^m}{\alpha} \right], \tag{8}$$

a set of equations representing equilibrium in each national labour market, given a vector of total trade deficits and trade deficits in manufactures.

2.2. LABOUR MARKETS AND THE STRUCTURAL WAGE EQUATION

Without labour markets frictions, the $2n$ system of equations defined by (3) and (8) implies a set of equilibrium wage rates consistent with full employment. However, in frictional labour markets there will be unemployment in equilibrium and we need to establish the relationship between wages and unemployment. This is what we do next.

In most theoretical models of wage setting, including bargaining models, efficiency wage models and search models, a tighter labour market and superior outside options cause a higher real wage. Following the approach in Blanchard and Katz (1999), this leads us to postulate a structural wage equation for country i, sector s and date t, as follows

$$\ln\left(W_{is,t}/P_{i,t}\right) = \mu b_{is,t} + (1-\mu)\, z_{is} + \rho u_{i,t} + \epsilon_{is,t}, \tag{9}$$

with $\rho < 0$, and where $b_{is,t}$ denotes the log reservation wage for workers in country i and sector s, z_{is} is log productivity assumed to be constant, $u_{i,t}$ denotes the unemployment rate in country i, and $\epsilon_{is,t}$ is a random disturbance. The parameter μ varies between 0 and 1 and controls how productivity affects the real wage. For example, in the efficiency wage model of Shapiro and Stiglitz (1984), the wage curve is decoupled from productivity and μ is 1, while in bargaining models μ is typically less than unity, since productivity affects the match surplus and, therefore, the real wage.

The chosen functional form for the wage equation (9) is consistent with extensive empirical work demonstrating the stability of a wage curve with this functional form across regions and over time (see Blanchflower and Oswald, 1995). Notice that wages in sector s depend on overall labour market conditions and, thus, on the overall domestic unemployment rate, which implies some mobility of workers across sectors. Moreover, as in Blanchard and Katz (1999), we assume some form of dependence of the outside option on the lagged real wage and on productivity, as follows

$$b_{i,t} = b + \lambda \log\left(W_{i,t-1}/P_{i,t-1}\right) + (1-\lambda)\, z_{is}, \tag{10}$$

where λ is between 0 and 1.

Combining equations (9) and (10) yields a structural wage equation written in error-correction form, as follows

$$\Delta \ln\left(W_{is,t}\right) = (\mu\lambda - 1) \ln\left(W_{is,t-1}\right) + \gamma_{i,t} + \delta_{is} + \rho u_{i,t} + \epsilon_{is,t}, \tag{11}$$

where the parameters $\gamma_{i,t} = \ln\left(P_{i,t}\right) - \mu\lambda \ln(P_{i,t-1})$ and $\delta_{is} = (1-\mu\lambda)$ are, respectively, a “year \& country” factor and a “sector \& country” factor. They are identified using a combination of time effects, sector effects and random effects, as explained in Section 3. We wish to estimate the structural parameters λ, μ and ρ, using sectoral level panel data on wages across countries and, following that, to use the estimated parameters to calibrate our baseline model. As we show next, these three structural parameters determine the long-run relationship between wages and unemployment, and are, therefore, key for the quantitative evaluation of the labour market impact of correcting the current account imbalances in the EMU.

2.3. THE CROSS-COUNTRY DISTRIBUTION OF EQUILIBRIUM UNEMPLOYMENT RATES

Notice that unless $\mu\lambda = 1$, equation (11) yields a long-run relationship between wages and the unemployment rate. Instead, if $\mu\lambda = 1$, equation (11) yields the familiar wage Phillips curve, which leaves the long-run equilibrium unemployment undetermined. However, this knife-edge case only occurs if neither the wage nor the reservation wage are related to productivity, implying respectively, $\mu = 1$ and $\lambda = 1$. Although Blanchard and Katz (1999) do not rule out this pathological case to represent the United States data, they reject it for European countries. In what follows, we proceed under the assumption that $\mu\lambda < 1$ as we are especially interested in wage adjustments in the EMU, and in Section 3 we report substantial empirical evidence in support of this assumption.

With $\mu\lambda < 1$, the stable solution of equation (11) yields an equilibrium relationship between wages in country i in sector s, and the unemployment rate, given by

$$W_{is,t} = \exp\left(\frac{\delta_{is} + \rho u_{i,t}}{1-\mu\lambda}\right) P_{i,t}. \tag{12}$$

In what follows, we will make use of equation (12) to solve for the rate of change in the equilibrium wage across two steady states, at date t and t'. In particular, denoting the gross growth rate of a given variable X as $\hat{X} = (X_{t'}/X_t)$ and assuming that between dates t and t' we are comparing two different long-run equilibra, we obtain

$$\hat{W}_i = \exp\left[\frac{\rho\left(u_{i,t'} - u_{i,t}\right)}{1-\mu\lambda}\right]\hat{P}_i, \tag{13}$$

where $u_{i,t}$ and $u_{i,t'}$ are, respectively, the old and the new steady state unemployment rates, and where $\rho/(1-\mu\lambda)$ may be interpreted as the slope of a long-run wage curve of the kind that has been successfully proposed by Blanchflower and Oswald (1995) to represent data for a wide cross-section of countries and regions.

2.4. CONSTRUCTING EQUILIBRIUM COUNTERFACTUALS

Our purpose is to use the framework just developed to investigate the heterogeneous unemployment dynamics in the EMU and other OECD countries over the last decade. In particular, given an estimated structural wage curve and the observed evolution of current account imbalances in the global economy over the period going from 2006 until 2014, we wish to use a calibrated version of our model to evaluate the heterogeneous unemployment dynamics across the EMU and to perform policy counterfactuals. We stop in 2014 due to data availability, as the data used to construct trade deficits in manufactured goods is only available until then.

For this purpose, it is very convenient to follow the approach proposed by Dekle et al. (2008), and reformulate the equilibrium conditions (3) and (9) in terms of baseline levels of the relevant macroeconomic aggregates and gross growth rates of these aggregates.

Then the $2n$ system of equilibrium conditions defined by (3) and (9) may be expressed as

$$\hat{P}_i = \left[\sum_{j=1}^{n}\pi_{ij,t}\left(\hat{W}_j^{\beta}\hat{P}_j^{1-\beta}\right)^{-\theta}\right]^{-1/\theta}, \tag{14}$$

$$\hat{W}_i\hat{L}_iY_{i,t} + D_{i,t'} - \frac{D^m_{i,t'}}{\alpha} = \sum_{j=1}^{n}\pi_{ji,t'}\left[\hat{W}_j\hat{L}_jY_{j,t} + D_{j,t'} - \frac{(1-\beta)\,D^m_{j,t'}}{\alpha}\right], \tag{15}$$

with

$$\pi_{ji,t'} = \left[\frac{\left(\hat{W}_i^{\beta}\hat{P}_i^{1-\beta}\right)^{-\theta}\pi_{ji,t}}{\sum_{k=1}^{n}\left(\hat{W}_k^{\beta}\hat{P}_k^{1-\beta}\right)^{-\theta}\pi_{jk,t}}\right], \tag{16}$$

$$\hat{L}_i = \exp\left(-\Delta u_i\right), \tag{17}$$

and where $\Delta u_i = (u_{i,t'} - u_{i,t})$ is the change in unemployment across the two steady states.

The algorithm for computing the equilibrium cross-country distribution of unemployment rates for a given change in the countries' external balance is as follows. Take as given the overall trade deficits and the trade deficits in manufacturing in date t' (the new long-run equilibrium), $[\boldsymbol{D}_{t'}, \boldsymbol{D}_{t'}^{m}]'$ and consider a candidate vector of changes in unemployment rates $\boldsymbol{\Delta u}$, a n-dimensional vector. Given this vector, we obtain the n-dimensional vectors of price changes, wage changes and employment changes, $[\widehat{\boldsymbol{P}}(\boldsymbol{\Delta u}), \widehat{\boldsymbol{W}}(\boldsymbol{\Delta u}), \widehat{\boldsymbol{L}}(\boldsymbol{\Delta u})]'$ using the set of equations (13), (14) and (17). Finally, verify that the set of equations (15) is satisfied and, if it is not, choose a different candidate for $\boldsymbol{\Delta u}$. In Alvarez and Lucas (2007), this algorithm is shown to converge to a unique solution given a choice of numéraire.

3. EMPIRICAL EVALUATION

The empirical evaluation of the model proceeds in two parts. First, we estimate the parameters of the structural wage equation proposed in Section 2, using panel data on sectoral level wages and salaries for a panel of EU countries. Second, using the estimated wage equation, we develop a calibrated version of our multi-country general equilibrium model to account for the recent heterogeneity in unemployment dynamics in the global economy. All the data used in this exercise is reported in detail in Appendix B.

3.1. ESTIMATING THE STRUCTURAL WAGE EQUATION

Based on equation (11), the baseline structural wage equation that we estimate is

$$w_{is,t} = \phi w_{is,t-1} + \rho u_{i,t} + \overline{\psi}_i + \overline{\delta}_s + \overline{\gamma}_t + \widetilde{\gamma}_{i,t} + \widetilde{\delta}_{is} + \epsilon_{is,t}, \tag{18}$$

with $w_{is,t}$ the logarithm of the wage rate at date t, in sector s and country i, and where we have assumed $\delta_{is} = \bar{\psi}_i + \bar{\delta}_s + \tilde{\delta}_{is}$ and $\gamma_{i,t} = \bar{\gamma}_t + \tilde{\gamma}_{i,t}$. The main explanatory variable of interest is the unemployment rate in country i at date t, $u_{i,t}$. This equation is estimated using data for 27 EU countries (all EU members except Cyprus), obtained from the Eurostat. Based on the statistical classification of economic activities in the European Community (NACE), the three sectors considered are "manufacturing", "construction" and "accommodation & food". The model is estimated using data between 2012 and 2015. The coefficients of interest are $\phi = \mu\lambda$ and ρ, corresponding to the structural parameters in the wage curve (13).

The structure of our panel, that includes sectoral wage data across countries and over time, allows to control for a full set of "time" effects included in $\overline{\gamma}_t$, capturing changes in the price level and other aggregate shocks common across countries, a full set of "sector" fixed effects included in $\overline{\delta}_s$ capturing sector specific differences in productivity, and a full set of "country" fixed effects in $\bar{\psi}_i$, that account for permanent differences in productivity across countries and any additional compensating differentials. Furthermore, the wage equation includes the random effect, $\tilde{\delta}_{is} + \tilde{\gamma}_{i,t} + \epsilon_{is,t}$, capturing country specific random disturbances. To achieve identification of this random effects model, we require the assumption that $\tilde{\gamma}_{i,t}$ and $\epsilon_{is,t}$ are not serially correlated and that $\tilde{\delta}_{is}$, $\tilde{\gamma}_{i,t}$ and $\epsilon_{is,t}$ are mutually independent, and independent from $\boldsymbol{x_t} = [w_{is,t}, u_{i,t}, \bar{\psi}_i, \bar{\delta}_s, \bar{\gamma}_t]'$, the list of regressors.

Of course, it is well know that the problem with either fixed effect or random effect estimation of equation (18) is that it contains the lagged dependent variable among the explanatory variable. Thus, the random effects estimator is not consistent when the time dimension is small, even as the number of countries n turns asymptotically large. To resolve this, we use the Arellano and Bond (1991) estimator that considers the equation (18) in first differences, as follows

$$\Delta w_{is,t} = \phi \Delta w_{is,t-1} + \rho \Delta u_{i,t} + \mu_t + \eta_{is,t}, \tag{19}$$

With $\mu_t = \Delta\bar{\gamma}_t$ and $\eta_{is,t} = \Delta\tilde{\gamma}_{i,t} + \Delta\epsilon_{is,t}$. An important advantage of this estimator is that it permits to treat the unemployment rate as endogenous and potentially correlated with the random effects. In particular, equation (19) is estimated by generalised method of moments (GMM), treating $\Delta\, u_{i,t}$ as endogenous, and using $\boldsymbol{z_t} = \left[w_{is,t-2}, w_{is,t-3}, u_{i,t-2}, u_{i,t-3}\right]'$ as instruments.

Table 3.1. **The wage curve (long-run semi-elasticity)**

	(1)	(2)	(3)	(4)	(4)
	$\widetilde{w}_t$	$\widetilde{w}_t$	$\widetilde{w}_t$	$\widetilde{w}_t$	$\widetilde{w}_t$
u_t, coef. ρ	-1.722^{***}	-1.712^{***}	-0.933^{**}	-1.741^{**}	-1.875^{***}
	(0.565)	(0.441)	(0.374)	(0.866)	(0.685)
$\widetilde{w}_{t-1}$, coef. ϕ			0.918^{***}	0.866^{**}	0.766^{***}
			(0.035)	(0.437)	(0.158)
constant	3.206^{***}	3.204^{***}	0.350^{***}		0.883^{*}
	(0.047)	(0.063)	(0.111)		(0.524)
$\rho/(1-\mu\lambda)$	×	×	-11.380^{*}	-12.994	-8.007^{**}
s.e.			(6.262)	(37.943)	(4.069)
Sargan test (p-value)	×	×	×	0.38	0.87
country FE	yes	yes	yes	×	yes
sectoral FE	yes	yes	yes	×	yes
time effects	yes	yes	yes	yes	yes
random effects	×	yes	yes	yes	yes
arellano-bond	×	×	×	yes	yes
system GMM	×	×	×	×	yes
observations	312	312	231	152	231

The results in: column 1 are obtained with OLS; columns 2 and 3, random effects; column 4, GMM; and column 5, system GMM.
Robust standard errors reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
The standard error of the long-run semi-elasticity, $\rho/(1-\mu\lambda)$, is computed using the Delta method.
The internal instrument list for the Arellano-Bond estimator includes $\mathbf{z}_t^1 = \left[\tilde{w}_{t-2}, \tilde{w}_{t-3}, u_{t-2}, u_{t-3}\right]'$.
In addition, the internal instrument list for the system GMM estimator includes $\mathbf{z}_t^2 = \left[\Delta\tilde{w}_{t-1}, \Delta\tilde{w}_{t-1}, \Delta u_{t-2}, \Delta u_{t-2}\right]'$.
The external instruments for the difference GMM and system GMM include country and sector fixed effects, and a time trend.

Source: See Appendix B for details about the dataset.

Table 3.1 reports the estimated coefficients for equations (18) and (19) using the OLS, random effects and GMM estimators. The model is estimated for a nearly balanced panel of 27 countries, 3 sectors and 4 years (thus, $N = 81$ and $T = 4$, although the number of observations is 312, just under 324, as observations on some sectors are missing for a handful of countries). In columns 1 and 2, we report the estimated coefficient ρ for the model that excludes the lagged wage from the list of regressors, using the OLS and the random effects estimators, respectively. The coefficient on the unemployment rate is found to be negative and highly significant, consistent with the wage curve literature. The OLS and random effect estimates are similar, implying roughly a -1.7 semi-elasticity of the wage to changes in the unemployment rate. Since the average unemployment rate in our sample is around 10\%, this implies an elasticity of -0.17. This value is remarkably similar to that reported in Blanchflower and Oswald (1995) using UK regional level data, which is -0.15.

In columns 3 and 4, we turn to the baseline dynamic specification. Column~3 reports the estimated standard random effects model, while column 4 reports the estimated GMM model. While the two estimators yield different coefficients ρ and ϕ, the implied long-run semi-elasticity of the real wage $\rho/(1-\mu\lambda)$ is very similar, equal to -11.380 in the random effects model and -12.994 in the GMM model. In Table 3.1 we also report the p-values for the Sargan test for overidentifying restrictions, which is comfortably not rejected. Turning to the autoregressive coefficient in the wage equation, $\phi = \mu\lambda$, it is estimated to be very close to unity. In particular, in the random effect specification it is estimated to be 0.918, while in the GMM specification in column 4 it is estimated to be 0.866, but within less than half a standard deviation of unity. At any rate, the GMM coefficients are not precisely estimated, exhibiting large standard errors.

Table 3.2. **Initial conditions and baseline calibration**

	GDP 2006 (% W GDP)	CA 2006 (% GDP)	CA 2014 (% GDP)	U 2006	U 2014	α	β
AU	0.66	3.43	4.91	5.24	5.62	0.15	0.33
BE	0.81	3.73	1.16	8.25	8.52	0.04	0.23
CA	2.58	2.69	-1.24	6.32	6.92	0.15	0.30
CZ	0.31	2.74	8.89	7.14	6.11	0.18	0.22
DK	0.56	3.92	7.42	3.90	6.59	0.13	0.32
ET	0.03	-10.14	5.32	5.90	7.32	0.38	0.24
FL	0.43	4.16	-0.97	7.64	8.52	0.10	0.29
FR	4.58	-0.84	-2.24	8.45	10.29	0.11	0.25
DU	5.91	5.30	8.68	10.29	4.98	0.11	0.32
GR	0.54	-10.50	-2.20	9.01	26.49	0.19	0.30
HU	0.23	-1.10	8.76	7.50	7.73	0.17	0.23
IR	0.46	8.05	19.83	4.63	11.79	0.03	0.30
IS	0.30	0.37	3.26	10.71	5.89	0.09	0.27
IT	3.83	-0.84	3.33	6.78	12.68	0.13	0.26
JP	8.58	1.26	-3.28	4.10	3.61	0.16	0.33
KO	1.99	0.78	7.44	3.44	3.53	0.13	0.22
LX	0.08	30.36	50.13	4.73	5.85	0.23	0.27
ME	1.90	-1.25	-1.22	3.14	4.89	0.22	0.32
NL	1.43	8.73	13.80	4.32	6.82	0.05	0.26
NZ	0.22	-0.39	1.27	3.86	5.75	0.18	0.33
NO	0.68	16.94	13.30	3.43	3.52	0.18	0.28
PL	0.68	-1.90	2.04	13.84	8.99	0.17	0.25
PT	0.41	-8.24	0.42	7.65	13.89	0.17	0.26
SR	0.11	-3.99	6.43	13.30	13.18	0.17	0.24
SL	0.08	-0.05	9.84	5.95	9.67	0.23	0.29
SP	2.49	-5.92	2.73	8.45	24.44	0.18	0.26
SW	0.83	7.59	4.97	6.97	7.93	0.11	0.29
CH	0.85	8.50	18.50	3.99	4.54	0.15	0.34
UK	5.10	-2.57	-2.20	5.37	6.22	0.15	0.34
US	27.29	-5.56	-3.83	4.62	6.17	0.16	0.34
ROW	26.08	5.80	5.19	-	-	0.17	0.28

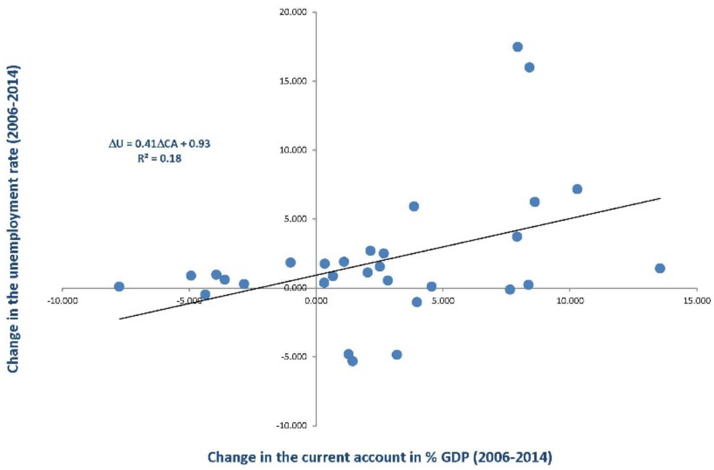
Source: Authors calculations. See Appendix B for details about the dataset.

However, in dynamic panel data models where the autoregressive parameter is near unity and the time-series dimension of the panel is small, the GMM estimator based on (19) is known to have large finite sample bias and poor precision, because the lagged levels of the endogenous variables provide only weak instruments for the same variables in differences (Blundell and Bond, 1998). Therefore, in column 5 of Table 3.1, we consider the Arellano and Bover (1995) system GMM estimator, that uses lagged differences of the endogenous variables as instruments for equation (18), in addition to lagged levels of the same variables used as instruments for equation (19). This estimator has been shown to offer substantial efficiency gains (Blundell and Bond, 1998) and, indeed, the coefficients in column 5 are much more precisely estimated. In particular, the autoregressive coefficient is estimated to be 0.766, and the standard error is 0.158. Thus, the coefficient is reasonably far from unity and we are able to determine the level of wages in the long-run as a function of the unemployment rate. Specifically, the implied long-run semi-elasticity of the real wage is estimated to be $\rho/(1-\mu\lambda) = -8.007$, and is statistically significant. Given the good properties of the system GMM estimator for panels with short time series, we favour this specification in the calibration of the general equilibrium model of trade and the current account that follows.

3.2. BASELINE CALIBRATION

The next step is to use the estimated structural wage equation to evaluate a calibrated version of the general equilibrium model presented in Section 2. We wish to study the long-run impact of the adjustment in external imbalances that took place starting from 2006, in particular on the cross-country distribution of unemployment rates. We build a model of the global economy with 31 countries, including almost all the OECD countries, and a block of countries labelled Rest of the World (RoW), that includes China. The list of countries is shown in Table 3.2, together with information on the evolution of the current accounts and the unemployment rates over the period considered. Graph 3.1 shows that the change in the current account between 2006 and 2014 is a strong predictor of the change in the unemployment rate over the same period, with improvements in the current account associated with worsening labour markets. Thus, the reversal of capital flows in the EMU may have contributed substantially to the asymmetric unemployment dynamics. In the analysis that follows, we consider the changes in the current account as exogenous, and investigate if our multi-country general equilibrium model is able to match the observed unemployment dynamics. This exogeneity assumption is motivated by the view that the reversal in the current account positions observed in the global economy after the eruption of the financial crisis in late 2007 is not predicted by the initially observed unemployment rates in 2006.

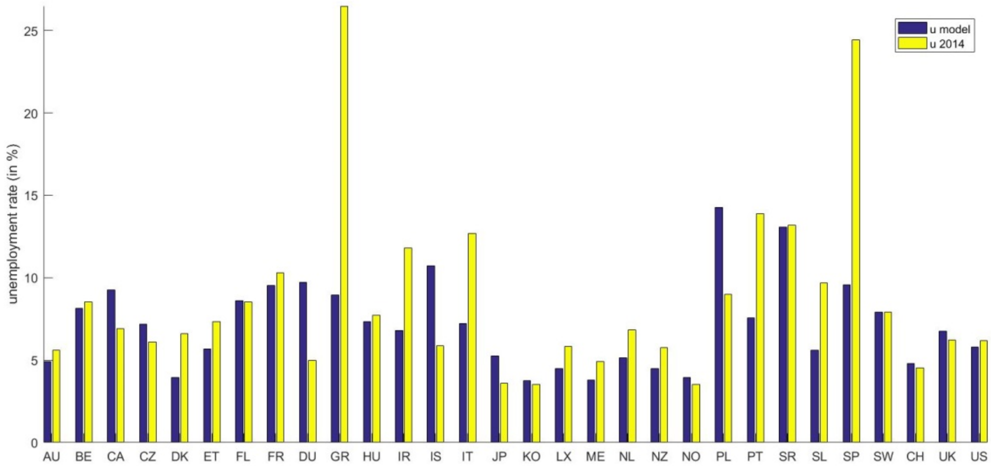
Graph 3.1. **Unemployment and the current account**



Source: See Appendix B for details about the data used.

Therefore, we take as given the overall trade deficits and the trade deficits in manufacturing that are observed in 2014, $[\boldsymbol{D}_{2014}, \boldsymbol{D}_{2014}^{m}]'$, and treat the new external balances as the new long-run equilibrium trade balances. Next, we make equations (13), (14) and (15) operational by considering the initial conditions observed in 2006 for nominal GDP, $\boldsymbol{Y}_{2006}$, and the $n \times n$ matrix of bilateral trade shares, $\boldsymbol{\Pi}_{2006} = [\pi_{ij,2006}]_{\forall i,j}$, to predict the cross-country distribution of unemployment rates that are observed in 2014, and that are assumed to correspond to the new long-run equilibrium unemployment rates (in the absence of new shocks, of course). To obtain the matrix of bilateral trade share, we combine data on manufacturing bilateral trade flows, X_{ij}^{m}, from the OECD structural analysis (STAN) database, and data on the overall expenditure in manufactures, X_{i}^{m}, from the national product and expenditure accounts based on equation (6). Trade flows between countries are obtained based on the reports of the importing country, and to measure a given country's value of purchases from domestic producers, X_{ii}^{m}, we subtract that country's total manufacturing exports from the total manufacturing output in the same country, using data from the OECD STAN database.

Graph 3.2. **The distribution of unemployment (data and model)**



Source: Author's calculation. See Appendix B for details about the data used.

Next, in the baseline calibration we allow for the share of value added in manufacturing, β, and the share of manufacturing in final demand, α, to vary for each country i. The former is obtained as the ratio of value added in manufacturing to total manufacturing production, also based on the 2006 OECD STAN database. In turn, the share of manufacturing production in final demand for each country is obtained using the formula $\alpha_i = (\beta_i\, Y_{i,2006} + D_{i,2006}^{m})/X_{i,2006}$. The values α_i and β_i for each country are reported in Table 3.2. We the set the value of the parameter θ to 8.28, based on the estimate in Eaton and Kortum (2002).

Finally, as in Alvarez and Lucas (2007) and Eaton et al. (2013), we make world GDP the numéraire by imposing the normalisation

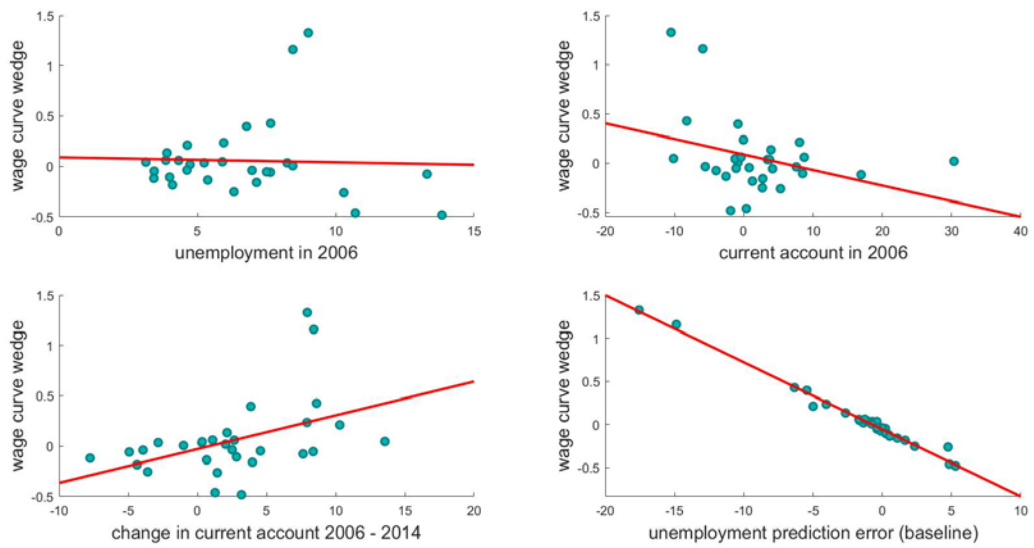
$$\sum_{i=1}^{n} \hat{W}_i \hat{L}_i Y_{i,2006} = 1, \tag{20}$$

and thus all trade deficits $[\boldsymbol{D}_{2014}, \boldsymbol{D}_{2014}^{m}]'$ are measured relative to the world GDP.

3.3. QUANTITATIVE BASELINE MODEL EVALUATION

We are now ready to conduct our baseline model evaluation. In particular, we are interested in the ability of the model to account for the cross-country distribution of unemployment rates in the global economy in 2014. Graph 3.2 compares the realised distribution of unemployment rates to the predicted distribution. The model does reasonably well in matching the unemployment rates for most countries in the sample, but there are some countries for which we find clear discrepancies. In particular, the model underpredicts the unemployment rates in Greece, Italy, Ireland, Portugal and Spain (GIIPS), the group of EMU countries most affected by the European sovereign debt crisis. This implies that, given the observed adjustments in the external balance position of those countries, the model is not predicting such large economic downturns and, therefore, other factors that are omitted from the baseline model have contributed to raise unit labour costs, forcing a larger adjustment in the unemployment rate. On the other hand Germany and Poland stand-out as the two countries for which the model overpredicts the unemployment rate. Overall, the goodness of fit of the model can be summarised using the $\boldsymbol{R}^2$ coefficient for the linear regression of the realised unemployment rates on the predicted ones, which is 19%. Thus, our baseline model explains roughly one-fifth of the cross-country distribution of unemployment rates.

Graph 3.3. **The conditional distribution of the labour market wedges**



Source: Author's calculations. See Appendix B for details about the data used.

The next step in the analysis is to exploit the deviations between the data and the model to identify latent factors that represent differences in wages that are unaccounted for by the current account dynamics. To do this, we again make use of equations (14) and (15) to solve for prices and wages changes, $\widehat{\boldsymbol{P}}$ and $\widehat{\boldsymbol{W}}$, but this time constraining the model to match exactly the unemployment rates that are observed in the data. We identify the labour market wedge for each country i, ω_i, as the log difference between the wage obtained using the constrained model and that obtained using the unconstrained model, as follows

$$\omega_i = \ln \hat{W}_i - \ln \hat{W}_i^{\text{baseline}}. \tag{21}$$

The labour market wedges thus obtained constitute latent factors that raise the unit labour costs for a given unemployment rate. By construction, they explain the entirety of the gap between the unemployment rates observed in the data and the unemployment rates predicted by the baseline model.

This is illustrated in Graph 3.3 and, in particular, the last panel showing the relationship between the unemployment prediction errors and the labour market wedges. The method used to obtain the wedges, implies an almost exact relationship between the prediction errors and the wedges, with positive labour market wedges when the model underpredicts the unemployment rate. In the first panel of Graph 3.3, the wedges are plotted against the unemployment rates in 2006, and no discernible relationship is found between the initial labour market conditions and the wedges. Instead, the labour market wedges seem to be larger in countries that have experienced large current account adjustments. This result is consistent with Bertola's (2016) finding that in the most recent decade the asymmetric current account dynamics in the EMU are important to explain the divergence in unemployment rates.

In Section 4, we consider a set of observable shocks and variables capturing labour and product market regulation, to understand which of the two matter most to explain the labour market wedges, shocks or institutions.

4. THE ROLE OF SHOCKS AND INSTITUTIONS

In an important paper that studies the unemployment experience in Europe over a period covering four decades, starting in the 1960s until the late 1990s, Blanchard and Wolfers (2000) consider three kinds of explanations for the evolution of unemployment in Europe: those that focus on the role of adverse economic shocks; those that focus on the role of labour market institutions; and, lastly, those that emphasize the interaction of adverse shocks with heterogeneous labour market institutions across countries. Blanchard and Wolfers (2000) reject the first two classes of explanations on the grounds that, on the one hand, the shocks hitting the European economies have not been sufficiently dissimilar to explain the cross-country dispersion of unemployment rates and, on the other hand, the improvement in the quality of institutions in the 1980s and 1990s is not consistent with the increase in unemployment rates in Europe over the same period. Instead, looking at panel data evidence for 20 OECD countries over 8 time periods (overlapping 4 decades, from 1960 to 1999), they favour the third explanation: that the rise in unemployment rates over that period and the heterogeneity in the evolutions of unemployment across countries is consistent with common shocks being amplified too different degrees, across countries with different labour market institutions.

In this Section we follow in the footsteps of Blanchard and Wolfers (2000), and consider the role of shocks and institutions to explain the level of the labour market wedges that we have computed in the previous Section. We depart from their original work by considering both the labour and product market regulation among the set of institutional determinants. Moreover, we do not seek to explain unemployment directly, but instead the labour market wedge. Subsequently, we use the determinants of the labour market wedge to construct policy counterfactuals regarding the heterogeneous unemployment dynamics in the global economy, conditional on the observed current account levels but allowing for a more benign configuration of labour market institutions and product market regulations.

4.1. THE INTERACTION BETWEEN INSTITUTIONS AND MACROECONOMIC SHOCKS

We begin by looking at the ability of shocks in isolation to explain the labour market wedges. As we work with cross-sectional data, we cannot identify common macroeconomic shocks using time effects, as is done in Blanchard and Wolfers (2000) baseline specification. Instead, we use a set of three observable macroeconomics shocks with country specific realisations, and that are of clear relevance between 2006 and 2014, the period that we are studying. The three shocks considered are: the real long-term interest rates (IR), measured by the 10-year government bond yields minus the CPI inflation rate at the peak of the European sovereign debt crisis in 2012; the change in the effective real exchange rate (ΔEER) between 2006 and 2014; and the change in the consumer price index (ΔCPI) over the same period.

The regression equation that we estimate is the following

$$\omega_i = \varphi_0 + \varphi_1 \mathrm{IR}_i + \varphi_2 \Delta\mathrm{EER}_i + \varphi_3 \Delta\mathrm{CPI}_i + e_i. \qquad (22)$$

The results are shown in Table 4.1, where several specifications are considered, including different combinations of macroeconomic shocks. In column 1, we consider first the real interest rate shock in isolation. Unsurprisingly, its effect on the labour market wedge is positive and highly statistically significant, confirming the importance of the European sovereign debt crisis, and the reversal of capital flows, to explain the heterogeneous unemployment trajectories in the global economy and the EMU, in particular. The adjusted $\boldsymbol{R}^2$ for this regression is high at 50%, indicating the importance of this shocks alone to explain the labour market wedge.

Table 4.1. **Shocks and the labour market wedge**

	(1) ω_i	(2) ω_i	(3) ω_i	(4) ω_i	(5) ω_i
long-term interest rates	6.720***	6.753***	6.665***	6.700***	3.364**
	(1.244)	(1.260)	(1.268)	(1.287)	(1.450)
change in effective ER		−81.640		−77.948	−24.119
		(137.531)		(140.031)	(118.120)
change in CPI			−94.813	−87.603	93.972
			(204.312)	(207.484)	(181.364)
giips					55.711***
					(16.241)
constant	−6.917	−7.291	−1.185	−1.977	−15.863
	(5.580)	(5.683)	(13.589)	(13.847)	(12.264)
observations	29	29	29	29	29
adjusted R^2	0.502	0.489	0.487	0.473	0.631

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author's calculations. See Appendix B for details about the data used.

This finding is also consistent with the work of Blanchard and Wolfers (2000), who argue that the transmission of real interest rate shocks to the labour market are likely to involve a reduction in capital accumulation and, consequently, raise unit labour costs. Indeed, these mechanisms are likely to have played a central role in the recent European slump, as argued recently by Kollmann et al. (2016), who using an estimated Open Economy Dynamic Stochastic General Equilibrium (DSGE) model find that adverse shocks to capital investment risk premia linked to the poor health of the Eurozone banking system were very detrimental to the economic recovery and prolonged the economic downturn.

Next, in columns 2 and 3 of Table 4.1 we add, in turn, the change in the effective real exchange rate and the change in the CPI level between 2006 and 2014. Although both coefficients have the expected sign, none of these two shocks is found to help explain the labour market wedge and, instead, result in a lower adjusted $\boldsymbol{R}^2$. These finding are consistent with movements in the RER and the CPI transmitting to the labour market via its effects on the current account, which are already taken into account in the multi-country general equilibrium model and, thus, should not affect the labour market wedge. The same result is found in column~4, where the three shocks are included simultaneously and only the 2012 real interest rate shock is found to help explain the labour market wedge. Finally, column 5 adds a dummy variable for the five countries most affected by the European sovereign debt crisis, denoted GIIPS (Greece, Italy, Ireland, Portugal and Spain), to the set of explanatory variables. The purpose of adding this variable is to confront the possibility that the real interest rate shock matters only as a proxy for the European debt crisis. But, although the size of the real interest rate coefficient is halved by the introduction of the GIIPS dummy variable, it remains large and statistically significant. In addition, the adjusted $\boldsymbol{R}^2$ coefficient increases to 63%, suggesting the independent importance of the two explanatory variables. Thus, we henceforth consider the GIIPS dummy variable and the long-term real interest rate as the two relevant shocks to explain the labour market wedge.

Next, we turn to the role of institutions and, in particular, labour institutions and product market regulation to explain the labour market wedge. The measures of labour market institutional environment that we use are: the OECD strictness of employment protection legislation index (EPL), that measures the procedures and costs involved in individuals or collective dismissal and the procedures involved in hiring workers on fixed-term contracts; and the unemployment insurance index (UI), that is calculated as the product of the coverage and replacement rates of public transfers to the unemployed. The measure of product market regulation index (PMR) used is also constructed by the OECD and measures the intensity of state control, barriers to entrepreneurship and barriers to trade and investment in the overall economy. The PMR index ranges from 0 to 6, from least to most restrictive. These measures are computed by the OECD every 5 years and, hence, we work with the 2008 vintages, which is the nearest date to the start of the period that we are studying.

Table 4.2. **Institutions and the labour market wedge**

	(1) ω_i	(2) ω_i	(3) ω_i	(4) ω_i	(5) ω_i
product market regulation	18.440	9.898	8.205	−3.951	−0.446
	(23.851)	(28.060)	(24.790)	(29.267)	(19.830)
unemployment insurance		−0.295		−0.390	−0.085
		(0.495)		(0.490)	(0.337)
employment protection			15.145	16.431	1.550
			(11.520)	(11.714)	(8.377)
giips					76.568***
					(13.861)
constant	−23.026	3.836	−42.366	−8.517	−6.450
	(37.926)	(59.132)	(40.212)	(58.725)	(39.770)
observations	29	29	29	29	29
adjusted R^2	−0.015	−0.039	0.012	−0.002	0.540

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author's calculations. See Appendix B for details about the data used.

We estimate the following regression equation

$$\omega_i = \vartheta_0 + \vartheta_1 \text{PMR}_i + \vartheta_2 \text{UI}_i + \vartheta_3 \Delta\text{EPL}_i + e_i. \quad (23)$$

The results are shown in Table 4.2 and, similarly to what we did for the macroeconomic shocks, we consider several combinations of regressors. However, the results are stark. Labour market institutions and product market regulation in isolation do not help explain the labour market wedge. None of the coefficients is significant and the variance explained by the regressors is negligible. The final specification introduces the GIIPS dummy variable to investigate if the findings are biased by the European debt crisis, but still none of the three measures of institutional environment are found to be significant and the standard errors are extremely large. The finding that differences in labour market institutions and product market regulation are unable to explain the heterogeneous unemployment dynamics in the EMU resonates well with the results of Blanchard and Wolfers (2000).

Finally, we turn to the hypothesis that the labour market wedge is best explained through the interaction of shocks and institutions. We postulate the following non-linear regression model

$$\omega_i = \psi_0 + \psi_1 \text{IR}_i + \Psi_i^{\text{PMR}} + \Psi_i^{\text{UI}} + \Psi_i^{EPL} + e_i, \tag{24}$$

with

$$\Psi_i^{\text{PMR}} = \Big[\psi_{21}\text{PMR}_i + \psi_{22}\left(\text{PMR}_i \times \text{Shock}_i\right)\Big],$$

$$\Psi_i^{\text{UI}} = \Big[\psi_{31}\text{UI}_i + \psi_{32}\left(\text{UI}_i \times \text{Shock}_i\right)\Big],$$

$$\Psi_i^{\text{EPL}} = \Big[\psi_{41}\text{EPL}_i + \psi_{42}\left(\text{EPL}_i \times \text{Shock}_i\right)\Big],$$

and where the two macroeconomic shocks that we use to construct the interaction terms are, in turn, the GIIPS dummy variable and the real interest rate. We estimate (24) via the non-linear least squares method.

Table 4.3. **Interaction between shocks and institutions**

	(1) ω_i	(2) ω_i	(3) ω_i	(4) ω_i	(5) ω_i
long-term interest rates		−3.195	−1.958		40.728*
		(2.087)	(2.561)		(22.174)
giips				51.846	
				(124.007)	
product market regulation	−19.943		−12.761	−18.540	
	(15.429)		(18.191)	(16.080)	
unemployment insurance	0.111		0.136	0.131	
	(0.268)		(0.273)	(0.278)	
employment protection	2.473		1.809	2.543	
	(6.681)		(6.801)	(6.812)	
shock × PMR	121.729***	161.111***	150.495***	106.696**	−17.816*
	(27.912)	(43.373)	(47.014)	(45.851)	(8.644)
shock × UI	−1.001**	−1.145**	−1.191**	−1.302	−0.306*
	(0.446)	(0.459)	(0.515)	(0.852)	(0.166)
shock × EP	−29.956	−43.735**	−39.403*	−35.206	3.707
	(17.645)	(19.801)	(21.682)	(21.936)	(3.215)
constant	12.289	−5.663	2.728	8.972	−6.843
	(29.772)	(4.061)	(32.557)	(31.367)	(5.694)
observations	29	29	29	29	29
Adjusted R^2	0.749	0.761	0.744	0.739	0.535

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In columns 1 to 4 the "shock" variable in the interaction term is the dummy GIIPS, and in column 5 it is the real interest rate.

Source: Author's calculations. See Appendix B for details about the data used.

The results are shown in Table 4.3, where again several different specifications are considered, and each is nested in equation (24). In column 1 we include the interaction terms and control only for product market regulations and labour market institutions, in column~2 we introduce the same interaction terms but control only for the macroeconomic shock, and in column 3 we control for both shocks and institutions.

Table 4.4. **Labour and product market regulation across countries**

	EPL	UI	PMR
Austria	0.388	57.669	1.373
Belgium	2.995	58.715	1.520
Canada	1.506	49.599	1.532
Czech Republic	2.751	48.877	1.498
Denmark	2.275	63.109	1.351
Estonia	2.328	11.015	1.370
Finland	2.167	64.676	1.343
France	2.870	61.106	1.517
Germany	2.842	55.751	1.412
Greece	2.850	17.685	2.214
Hungary	2.265	48.406	1.539
Ireland	1.978	68.259	1.350
Israel	2.216	39.888	2.228
Italy	3.032	26.623	1.488
Japan	2.085	34.809	1.431
Korea	2.168	33.949	1.943
Luxembourg	2.735	65.667	1.437
Mexico	2.710	0.000	2.051
Netherlands	2.930	67.967	0.962
New Zealand	1.102	38.420	1.228
Norway	2.310	55.756	1.538
Poland	2.391	22.623	2.044
Portugal	3.512	45.292	1.692
Slovak Republic	2.635	21.448	1.620
Slovenia	2.703	57.366	1.889
Spain	2.660	37.545	1.595
Sweden	2.517	54.178	1.606
Switzerland	2.104	66.070	1.547
United Kingdom	1.759	31.284	1.208
United States	1.171	35.234	1.110
Min	0.388	0.000	0.962
Max	3.512	68.259	2.228
Median	2.359	48.642	1.519

Source: Author's calculations. See Appendix B for details about the data used.

In all three specifications the first two interaction terms in Ψ^{PMR} and Ψ^{UI} are found to help explain the labour market wedge. In particular, the macroeconomic shock is found to raise the labour market wedge by more in countries with more restrictive product market regulation. This may be because more stringent product market regulation acts as an impediment to entry and reallocation and, thus, makes the correction of external imbalances more difficult. At any rate, a more competitive environment should lead less efficient firms to exit and, through this channel, lead to a reallocation of resources to higher productivity firms, raising efficiency and aggregate productivity, with a beneficial impact on the labour market. In addition, we find that in countries with stronger unemployment insurance protection the labour market wedge reacts less strongly to the macroeconomic shock. In all three specifications, the empirical fit is very good with an adjusted $\boldsymbol{R}^2$ around 75%. In the specification with best fit, in column 2, the interaction between the shocks and employment protection, Ψ^{EPL}, is also found to be negative and statistically significant, implying that the detrimental effect of the recent macroeconomic shocks was less amplified in countries with stronger employment protection. This finding seems consistent with work by Bentolila et al. (2012), who compare the evolution of unemployment in Spain and in France during the Great Recession, and find that the greater prevalence of a two-tier labour market in Spain was responsible for the high increase in unemployment and divergence from France.

Finally, to test the robustness of our findings we consider two additional specifications. First, in column 4 we add the GIIPS dummy variable instead of the real interest rate as a control variable, and the results remain very similar although the coefficient in the Ψ^{UI} interaction term is less precisely estimated. Second, in column 5 we use the real interest rate as the shock variable in the interaction terms, instead of the GIIPS dummy variable. In this final specification, the result concerning Ψ^{UI} remains the same but the interaction term in Ψ^{PMR} switches sign and becomes much less precisely estimated. However, this last specification yields a substantially lower adjusted $\boldsymbol{R}^2$ and, therefore, we favour selecting the previous specifications.

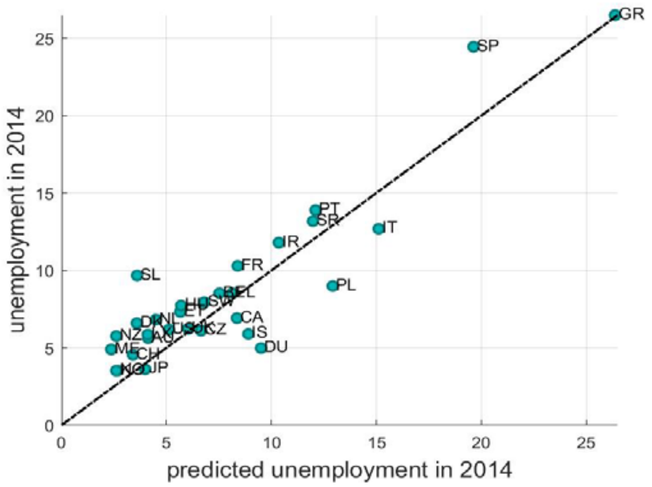
In summary, we have found that a model including interactions of macroeconomic shocks with the stringency of product market regulation, employment protection and the extent of unemployment insurance accounts for roughly 75% of the variation in the labour market wedge. In particular, macroeconomic shocks are amplified differently conditional on both the stringency of the product market regulation and the extent of unemployment insurance protection. Less competitive product markets are found to amplify the macroeconomic shocks and, thus, raise the labour market wedge. This result is consistent with the theoretical interpretation of the labour market wedge. The labour market wedge captures latent factors that raise unit production costs for a given unemployment rate. In countries with restrictive product market regulation aggregate efficiency and productivity are lower and, thus, a larger increase in the unemployment rate is required to lower unit labour costs. the importance of product market regulation for labour market outcomes is also consistent with Murtin and Robin (2016), who combining reduced form estimates with a dynamic model of search and matching in the labour market, find evidence that a reduction in the stringency of product market regulation improves labour market outcomes by lowering the cost of job creation.

At the same time, better unemployment insurance and stronger employment protection is found to dampen the reaction of the labour market wedge to macroeconomic shocks. Although this result is less easy to interpret, it seems coherent with the findings by Griffith et al. (2007), who show that less restrictive product market regulation lowers unemployment, especially in countries with labour market institutions that raise workers bargaining power. Similarly, Fiori et al. (2012) present evidence that product market deregulation is more effective to improve labour market outcomes when labour market regulation is high.

The next step in our analysis is to use the empirical model of the labour wedge just developed to predict the levels of the wedge in each country and incorporate their predicted levels into the general equilibrium model of Section 2. Using this extended model, we may again predict the cross-country distribution of unemployment rates and confront the predictions of the model with the data. The results are shown in Graph 4.1, and the fit is extremely good, with all the countries located tightly around the 45^o line, including the countries in the GIIPS group which the baseline model did not explain well. The extended model performs very well to predict the unemployment rate in each country in our sample, without any noticeable outlier.

Indeed, by exploiting the prediction errors we have identified labour market wedges which, by construction, account for the entirety of those errors. It follows that, if we are able to predict the labour market wedge well, we are also able to predict the unemployment rate The good predictive ability of the extended model is important, as it offers credibility to the construction of policy counterfactuals that we propose in this paper. Specifically, using the empirical model just described to predict the labour market wedge, we may obtain counterfactual predictions for the labour market wedge conditional on an alternative set of labour market and product market institutions. With those predictions, we use the general equilibrium model of Section 2 to predict the resulting distribution of unemployment rates.

Graph 4.1. **Unemployment (data and extended model)**



Source: Author's calculations. See Appendix B for details about data.

POLICY COUNTERFACTUALS

The advantage of developing the structural model in Section 2 is that it allows us to construct policy counterfactuals. Therefore, we can construct policy scenario analysis such as what would have been the cross-country distribution of unemployment in the EMU conditional on the external rebalancing taking place between 2006 and 2014, if the labour market institutions and product market regulation had been different. Of course, to be able to provide credible policy counterfactuals, the model needs to predict well in sample, and although the fit of the baseline model was shown in Section 3 to be reasonably good, its prediction errors haven been shown to be large for a set of countries, noticeably those most affected by the European debt crisis.

Given the good predictive ability of the extended model, we may with confidence construct policy counterfactuals. To do this, we first obtain the labour market wedge conditional on an alternative set of product and labour market regulation levels, and next use the general equilibrium model to predict the implied cross-country distribution of unemployment rates. To see the importance of using the general equilibrium model, consider what happens if labour and product market reforms change the labour market wedge in, for example, Spain. With an alternative wage rate in Spain, the trade pattern with every other country will change and, thus, those other countries will see their own trade patterns change, causing a sequence of shifts in relative prices and unemployment rates that depend on the initial distribution of labour market wedges. Table 4.4 shows the distribution of labour and product market regulation across countries. To illustrate the kind of counterfactuals that our approach allows for, we obtain the counterfactual cross-country distribution of unemployment rates assuming that the countries in the GIIPS group have levels of product market regulation (PMR) at the lowest and, thus, most competitive level in the distribution (that achieved by the Netherlands). The results are shown in

Graph 4.2 that compares the counterfactual unemployment rates to the predicted unemployment rates under the baseline.

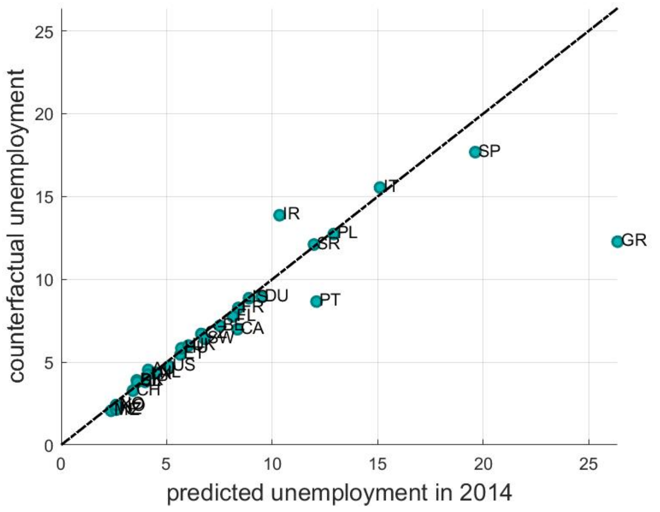
Setting the level of PMR to that of the Netherlands leads to a substantial reduction in the counterfactual unemployment rates in Greece and Portugal, compared to the unemployment rate implied by the baseline model. The model implies that the unemployment rate in Portugal would have been below 10% and that in Greece below 15%. The counterfactuals for Spain and Italy are less dramatic, since in those two countries the baseline PMR is near the median level in the sample. Finally, for Ireland the counterfactual actually implies a larger unemployment rate, partially because the PMR is already very low in Ireland, but also due to the general equilibrium effects. Overall, less stringent product market regulation in the GIIPS country, and in particular Greece and Portugal, would have led to very improved labour market outcomes and, consequently, less costly external adjustment.

5. SUMMARY AND CONCLUSIONS

This paper has developed a multi-country general equilibrium model of trade and trade deficits that allows for equilibrium unemployment. Motivated by the seminal work of Blanchard and Katz (1999), the labour market is modelled using a structural wage equation, estimated using dynamic panel data methods, and including sector, time and country specific effects, and random effects. Therefore, the estimated wage equation accommodates diverging price and productivity levels across countries and also other compensating differentials. The structural wage equation is estimated using GMM methods, and the existence of a long-run relationship between the unemployment rate and the equilibrium level of wages is established, with the data shown to be consistent with the existence of a wage curve of the kind documented in Blanchflower and Oswald (1995).

Armed with the estimated structural wage equation, we have constructed and calibrated a multi-country general equilibrium model of trade and trade deficits similar to that developed by Dekle et al. (2008), and used their methodology to obtain predictions for the equilibrium adjustments in the terms-of-trade and relative wages consistent with observed changes in the balance of trade positions of the countries in our sample. We have applied this methodology to a sample consisting of 31 countries, including almost all the OECD countries, and study the adjustment period from 2006 until 2014. We depart from the work of Dekle et al. (2008) by assuming that there are rigidities in the labour market and, consequently, equilibrium unemployment. By modelling wage rigidities using the estimated structural wage equation, we are able to solve for the equilibrium cross-country distribution of unemployment rates. When the predicted unemployment rates are confronted with the actual unemployment rates, the model is found to perform reasonably well for most countries but to fall short for the group of countries most affected by the European sovereign debt crisis.

Graph 4.2. **Policy counterfactuals**



Source: Author's calculations. See Appendix B for details about data.

Therefore, the next step in our analysis was to extend the baseline model with the introduction of the labour market wedges. These are latent factors that raise the unit production costs for a given unemployment rate. They can be identified through the combination of the wage curve with the general equilibrium model of trade and trade deficits, as the wage shifters in each country that are required for the model to match exactly the cross-country distribution of unemployment rates. Given the way they are defined, the labour market wedges are large for the countries for which the baseline model underpredicts the unemployment rate. However, the labour market wedge is found to be uncorrelated with the initial unemployment rates, while it is correlated with the current account adjustments undergone during the adjustment period that we consider.

The next step in our analysis, is to search for the factors that explain the size of the labour market wedge in each country. Inspired by the seminal work of Blanchard and Wolfers (2000), we investigate the hypothesis that the cross-country dispersion in the labour market wedge is best explained with the interaction between macroeconomic shocks, possibly common across countries, and heterogeneous labour and product market regulation and institutions. We found that the interaction between the macroeconomic shocks and the level of product market regulation is very successful at explaining the labour market wedges obtained from the general equilibrium model. Stringent product market regulation that lowers competition, is found to amplify the detrimental impact on the labour market of macroeconomic shocks and is an important predictor of the size of the labour market wedge. This suggests that less competition in product markets may raise unit labour costs, for a given unemployment rate. This finding is consistent with work from Griffith et al. (2007) that has shown that improved product market regulation leads to better aggregate employment outcomes. Although the effects are less strong, the level of unemployment insurance and employment protection has also been found to matter and, in fact, to mitigate the impact of macroeconomic shocks on the labour market wedge.

The model used to fit the labour market wedge explain most of its cross-country dispersion. Consequently, once we augment the general equilibrium model of trade and trade deficits with the predicted labour market wedge, the model performs very well in explaining the cross-country distribution of unemployment rates. Therefore, it becomes possible to construct pertinent policy counterfactuals, asking what would have been the behaviour of the unemployment rate in each country in our sample, had the labour and product market regulation been different. In particular, we look at the consequences of lowering the stringency of product market regulation in the countries most affected by the European debt crisis – Greece, Italy, Ireland, Portugal and Spain – to a level similar to that in the country with the most favourable level of PMR (the Netherlands). We find that although the unemployment rates in Italy, Ireland and Spain would not have changed too much compared to the baseline, the effects in Greece and in Portugal would have been substantial, with the unemployment rate in Portugal predicted to have stayed below 10% and that in Greece below 15%.

APPENDIX A

To obtain equation (1) in the main text, we follow the multi-country Ricardian framework developed in Eaton and Kortum (2002). It is assumed that in the manufacturing sector a continuum of traded differentiated goods indexed $z \in [0,1]$ is produced. Each variety is obtained using a Cobb-Douglas production function that combines labour and a composite intermediate commodity. The labour income share in the manufactured goods sector (corresponding to the share of value added in the manufacturing sector's gross output) is equal to $\beta \in (0,1)$. Thus, the cost of the input bundle for country i firms is

$$C_i = W_i^{\beta} P_i^{1-\beta}, \tag{A.1}$$

where W_i denotes the wage rate and P_i denotes the price in country i of the intermediate composite commodity.

Countries differ in the efficiency with which they produce each manufactured variety. In particular, producing one unit of the intermediate commodity z in country i requires $\varphi_{i,z}^{-1} > 0$ units of the input bundle. Moreover, trade in manufactures between countries is subject to trade barriers that take the form of an iceberg cost: to successfully deliver in country j one unity of any manufactured commodity produced in country i, $\tau_{ji} \geq 1$ units need to be shipped, with $\tau_{ii} = 1$. Therefore, the cost for firms in country i to deliver one unit of the manufactured commodity z to country j is

$$p_{ji,t}(z) = \left(\frac{C_i}{\varphi_{i,z}}\right)\tau_{ji}. \tag{A.2}$$

The variable $\varphi_{i,z}$ determines the efficiency of country i to produce the manufactured good z. We follow Eaton and Kortum (2002) and model firms' efficiency using a probabilistic approach: it is assumed that country i's efficiency in producing commodity z is the realisation of a random variable φ, which is drawn independently for each z from a Fréchet distribution

$$F(\varphi) = \exp\left(-\varphi^{-\theta}\right), \tag{A.3}$$

where $\theta > 1$ controls the degree of heterogeneity across firms, with a lower θ corresponding to greater heterogeneity. The commodity is purchased from the lowest-cost supplier and there's perfect competition in the product market. Hence, the price of commodity z in country i is given by

$$p_i(z) = \min_{j=1,\ldots,n}\left[p_{ij}(z)\right]. \tag{A.4}$$

The upshot is that the probability π_{ij} that country j is the lowest-cost supplier to i for any particular manufactured commodity is given by

$$\pi_{ij} = \frac{C_j \tau_{ij}}{\sum_{k=1}^{n} (C_k \tau_{ik})^{-\theta}}. \tag{A.5}$$

This probability is obtained by computing $\pi_{ij} = Prob\left(p_{ij}(z) \leq \min_{k \neq j}[p_{ik}(z)]\right)$. Since there are a continuum of manufactured goods, π_{ij} yields the fraction of manufactured goods that country i buys from j. Moreover, the price distribution of the goods purchased by country i is the same irrespectively of the source country. Thus, π_{ij} also corresponds to country i's expenditure on country j's manufactures as a fraction of country i's total expenditure on manufactures.

APPENDIX B

In this Appendix we describe in greater detail the data used in the paper. We describe first the data used in Section 3 and, in particular that used for the estimation of the structural wage equation, and the data used for the quantitative work carried out using the multi-country general equilibrium model of trade. Lastly, we describe the indicators of product and labour market regulation used in Section 4.

Data for the structural wage equation

To estimate the structural wage equation we use data on "total wages and salaries" available from the Eurostat, based on a harmonised definition of labour costs and broken down by economic activity. The three sectors considered are "manufacturing", "construction" and "accommodation & food", from 2012 and until 2015. The data is available for the EU Member States (NACE Rev 2). The unemployment rate used to estimate the structural wage equation is "average annual unemployment rate", also available from the Eurostat.

Data for the general equilibrium model

The data on nominal GDP, Exports and Imports come from the United Nations statistics and are measured at market prices in current US dollars. The unemployment data is available from the OECD Labour Force Survey. The annual values of gross manufacturing production for each country are taken from the OECD Structural Analysis Database (STAN).

To obtain the matrix of bilateral trade shares we use the STAN bilateral trade in goods database. In particular, the values for the bilateral trade flows, X_{ij}^{m}, are obtained based on the reports of the importing country. To measure a given country's value of purchases from domestic producers, X_{ij}^{m}, we subtract that country's total manufacturing exports from the total manufacturing output in the same country. The trade deficits in manufactures, D_{i}^{m}, are obtained using the STAN bilateral trade data for 2014, the most recent year for which we could obtain the complete data.

Data for the product and labour market regulation measures

The measure of product market regulation (PMR) used in Section 4 is obtained from the OECD Indicators of Product Market Regulation, a comprehensive and internationally-comparable set of indicators that measure the degree to which policies promote or inhibit competition. The PMR index ranges from 0 to 6, from least to most restrictive. We use the indicator measured in 2008.

The measure of unemployment insurance (UI) is obtained from the OECD Labour Market Programmes database. Effective unemployment insurance is defined as the coverage rate of unemployment insurance (UI) times its average net replacement rate among UI recipients plus the coverage rate of unemployment assistance (UA) times its net average replacement rate among UA recipients. The measure of employment protection legislation (EPL) is the overall measure of employment protection strictness obtained from the OECD Labour Force Survey, based on synthetic indicators of the strictness of regulation on dismissals and the use of temporary contracts.

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