wages and unit labour cost differentials in the EMU

integrated labour markets, imbalances and the wage curve

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motivation

labour market institutions for sustainable rebalancing in the EMU

Following the build-up of large imbalances in the EMU and the correction which started in 2007, rebalancing has made progress but is still taking place, and we see large unemployment dispersion in the EMU.

We propose a methodology to identify labour market institutions (taxation, unemployment insurance mechanisms, EP legislation) and economic shocks that affect wages and employment, to support the sound correction of external imbalances.

The method is based on a general equilibrium model of trade and deficits, that incorporates labour market frictions and implies equilibrium cross-sectional dispersion of unemployment rates.

Figure: rebalancing in the EMU, 2006 – 2015.

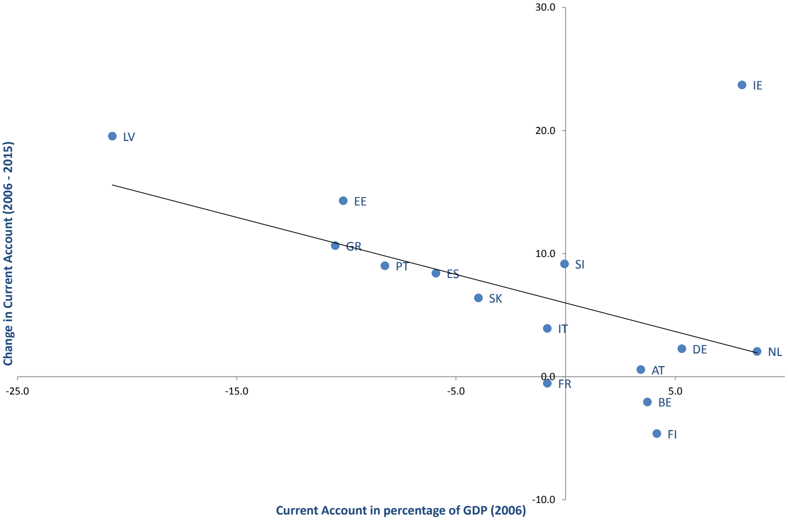
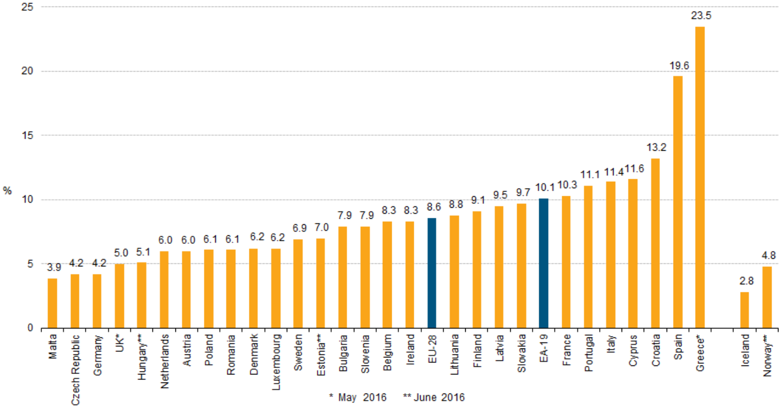


Figure: unemployment rates, seasonally adjusted, July 2016.



related work

Rebalancing in a quantitative general equilibrium model of trade:

- Obstfeld and Rogoff (2005);
- Dekle, Eaton and Kortum (2007);
- Eaton, Kortum and Neiman (2008);
- Eaton, Kortum, Neiman and Romalis (2016).

The wage curve and unemployment and wage dynamics across regions:

- Blanchflower and Oswald (1988, 1995);
- Freeman (1988);
- Blanchard and Katz (1999);
- Blanchard and Wolfers (2000).

model

equilibrium trade flows and trade imbalances

Our starting point is a structural gravity equation of trade, of the form

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

where, following the Eaton and Kortum (2002) framework:

- π_{ji}, is country i's share in country j's spending;
- c_i, are input costs in country i;
- T_i, is a measure of country i's productivity;
- τ_{ji}, are bilateral trade costs;
- θ, controls the sensitivity of trade shares to changes in relative prices.

Notice that π_{ji} is measurable empirically using bilateral trade data.

Market clearing conditions in the n country global economy are given by

$$Y_i^m = \sum_{j=1}^{n} \pi_{ji} X_j^m, = \sum_{j=1}^{n} \pi_{ji} \left(Y_j^m + D_j^m \right),$$

where:

- Y_i^m, is country i's gross output in manufactures;
- X_j^m, is country j's total expenditure in manufactures;
- D_j^m, is country j's trade deficit in manufactures.

The value added share in manufactures gross output is $\beta \in (0, 1)$, so that

$$\pi_{ji} = \frac{T_i \left(w_i^{\beta} p_i^{1-\beta} \tau_{ji} \right)^{-\theta}}{\sum_{k=1}^{n} T_k \left(w_k^{\beta} p_k^{1-\beta} \tau_{jk} \right)^{-\theta}} = \frac{X_{ji}^m}{X_j^m}.$$

Total expenditure in manufactures is given by

$$X_i^m = \alpha X_i + (1-\beta)\, Y_i^m,$$

with $\alpha \in (0,1)$ the share of manufactures in final expenditure. In turn, final expenditure obtains adding together GDP and the trade deficit, as

$$X_i = Y_i + D_i = w_i L_i + D_i.$$

Combining with the market clearing conditions yields

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

Finally, assuming a CES aggregator for manufactures, the price index is

$$p_i \propto \left[\sum_{j=1}^{n} T_j \left(w_j^{\beta} p_j^{1-\beta} \right)^{-\theta} \right]^{-1/\theta}.$$

model

rebalancing and counterfactuals (the $\hat{x}$ transformation)

Denote the gross growth rate of x as $\hat{x} = x'/x$.

Suppose we consider the external rebalancing between dates t and t'.

Then the previous $2n$ system of equilibrium conditions may be written as

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

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

with

$$\pi_{ji,t'} = \frac{\left(\hat{w}_i^{\beta} \hat{p}_i^{1-\beta} \right)^{-\theta} \pi_{ji,t}}{\sum_{k=1}^{n} \left(\hat{w}_k^{\beta} \hat{p}_k^{1-\beta} \right)^{-\theta} \pi_{jk,t}}.$$

model

wage setting and the labour market (Blanchard and Katz, 1999)

In most theoretical models of wage setting (bargaining models, efficiency wage models,...), a tighter labour market and superior outside options lead to a higher real wage, as follows

$$\widetilde{w}_{is,t} = b_{is,t} + p_{i,t} + \delta_{is} + \rho u_{i,t} + \epsilon_{is,t},$$

with $\rho < 0$, and where:

- $\widetilde{w}_{is,t}$, is the log wage rate in country i, sector s, and date t;
- $b_{is,t}$, is the worker's outside option;
- $p_{i,t}$, is the price level;
- δ_{is}, is productivity in country i and sector s;
- $u_{i,t}$, is the unemployment rate in country i and date t.

We follow Blanchard and Katz (1999) approach, and assume some form of dependence of outside options on lagged wages, as follows

$$b_{is,t} = \lambda \left(\widetilde{w}_{is,t-1} - p_{i,t-1} \right).$$

Combining with the wage setting equation, we obtain

$$\widetilde{w}_{is,t} = \lambda \widetilde{w}_{is,t-1} + \gamma_{i,t} + \delta_{is} + \rho u_{i,t} + \epsilon_{is,t},$$

with $\gamma_{i,t} = p_{i,t} - \lambda p_{i,t-1}$, captured by a year/country fixed effect.

Finally, this model can be written in error correction form, as follows

$$\Delta \widetilde{w}_{is,t} = (\lambda - 1)\, \widetilde{w}_{is,t-1} + \gamma_{i,t} + \delta_{is} + \rho u_{i,t} + \epsilon_{is,t},$$

which we estimate using panel data on sectoral level wages, to identify the structural parameters, λ and ρ.

Notice that only if $\lambda = 1$ this formulation yields a wage phillips curve, and no long-run relationship between wages and unemployment exists.

If instead $\lambda \neq 1$, wages and unemployment will have a long-run equilibrium relationship, given by the wage curve

$$\widetilde{w}_{is} = \left[\frac{\gamma_i + \delta_{is} + \rho u_i}{1 - \lambda} \right],$$

that we plug in the structural model of trade deficits, as follows

$$\hat{w}_i = \exp\left(\widetilde{w}_{i\bar{s},t'} - \widetilde{w}_{i\bar{s},t}\right) = \exp\left(\frac{\rho u_{i,t'} - \rho u_{i,t}}{1 - \lambda}\right) = \exp\left(\phi\left(u_{i,t'} - u_{i,t}\right)\right),$$

$$\hat{L}_i = \left(1 - u_{i,t'}\right) / \left(1 - u_{i,t}\right),$$

with $\phi = \rho / \left(1 - \lambda\right)$ a new structural parameter (wage curve slope).

model

system of equilibrium conditions

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

$$\hat{p}_i = \left[\sum_{j=1}^{n} \pi_{ij,t} \left(\hat{w}_j{}^{\beta} \hat{p}_j^{1-\beta} \right)^{-\theta} \right]^{-1/\theta}, \quad (2)$$

$$\pi_{ji,t'} = \frac{\left(\hat{w}_i{}^{\beta} \hat{p}_i{}^{1-\beta} \right)^{-\theta} \pi_{ji,t}}{\sum_{k=1}^{n} \left(\hat{w}_k{}^{\beta} \hat{p}_k{}^{1-\beta} \right)^{-\theta} \pi_{jk,t}}, \quad (3)$$

$$\hat{w}_i = \exp\left(\phi \left(u_{i,t'} - u_{i,t} \right) \right), \quad (4)$$

$$\hat{L}_i = \left(1 - u_{i,t'} \right) / \left(1 - u_{i,t} \right). \quad (5)$$

baseline results

data sources and baseline calibration

The data used are from the following sources:

- wages & salaries by NACE (eureka, construction, manufactures), from the eurostat (2012 – 2015);
- bilateral trade in goods by industry & gross manufactures production, from the OECD STAN database (including 30 countries and assuming 2006 initial conditions);
- rebalancing "shocks" based on 2014 current account levels;
- the demand elasticity parameter is set to $\theta = 8.280$, and the share of expenditure in manufactures α and value added in manufactures β, are obtained for each country using the OECD STAN database.

	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

baseline results

estimated wage curves

Table 1: the wage curve (semi-elasticity)

	(1)	(2)	(3)	(4)	(5)
	$\widetilde{w}_t$	$\widetilde{w}_t$	$\widetilde{w}_t$	$\widetilde{w}_t$	$\widetilde{w}_t$
u_t, coef. ρ	-1.722^{***}	-1.711^{***}	-0.933^{***}	-7.502^{***}	-1.685^{**}
	(-3.04)	(-4.07)	(-3.10)	(-13.48)	(-2.27)
$\widetilde{w}_{t-1}$, coef. λ			0.918^{***}	0.930^{***}	0.732^{***}
			(29.04)	(33.90)	(2.98)
constant	3.206^{***}	2.541^{***}	0.350^{***}	0.670^{***}	
	(67.88)	(57.06)	(3.48)	(7.58)	
$\phi = \rho/(1-\lambda)$	×	×	-11.378^{**}	-106.426^{**}	-6.286
	×	×	(-2.01)	(-2.43)	(-1.50)
country fixed effects	yes	yes	×	×	×
sectoral fixed effects	yes	yes	×	yes	×
time effects	yes	yes	yes	×	yes
country/sector effects	×	×	yes	×	yes
country/time effects	×	×	×	yes	×
arellano-bond GMM	×	×	×	×	yes
observations	312	312	231	231	152

t statistics in parentheses, based on robust standard errors.

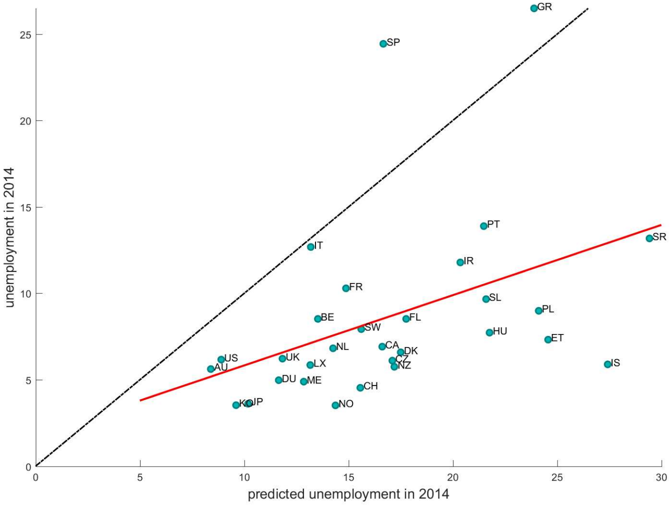
Instrument list for the Arellano-Bond estimator includes $\widetilde{w}_{t-2}$ and u_{t-2}. Covariate u_t is treated as endogenous.

For the Arellano-Bond estimator standard errors are clustered at the country and sector level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

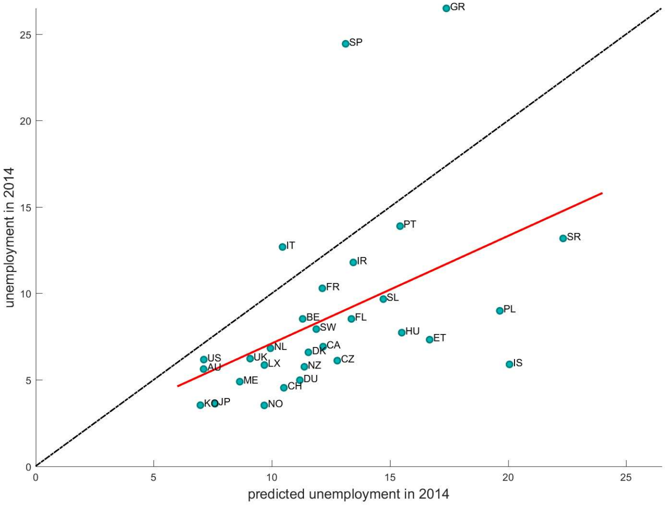
baseline results

calibration 1: low semi-elasticity, $\phi = -6.286$



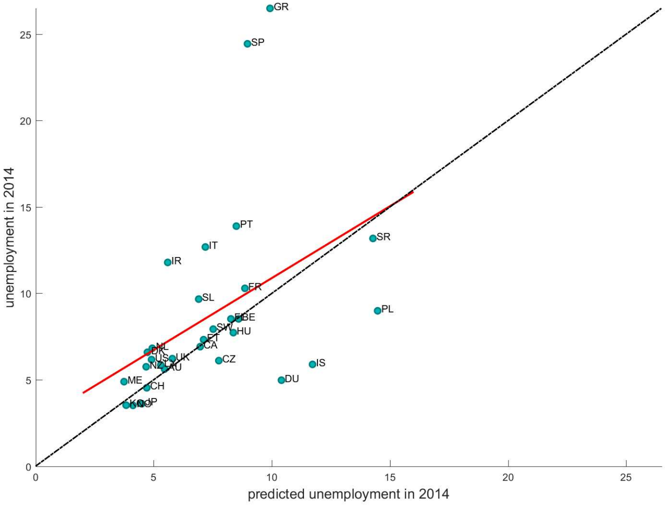
baseline results

calibration 2: medium semi-elasticity, $\phi = -11.378$



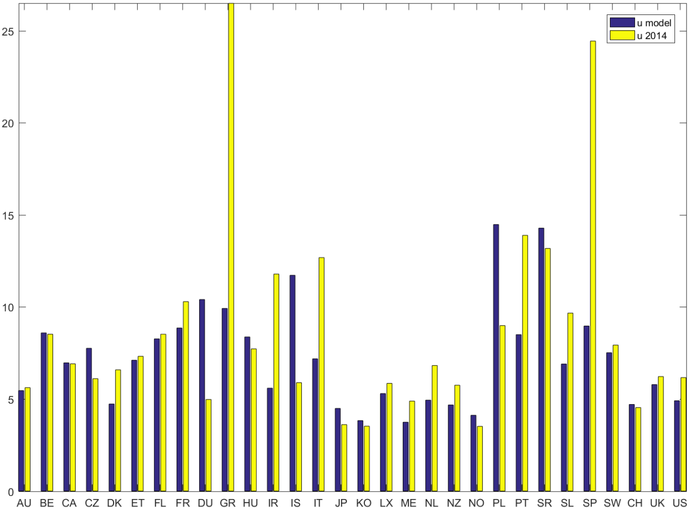
baseline results

calibration 3: high semi-elasticity, $\phi = -106.426$



baseline results

unemployment levels (2014): model vs data



the wage curve wedges

labour market institutions and shocks

We construct wage curve wedges by computing the factor ω_i, required for the model to match the unemployment data exactly.

We identify ω_i by augmenting the structural wage equation as follows

$$\hat{w}_i = \exp\left(\omega_i + \phi\left(u_{i,14} - u_{i,06}\right)\right).$$

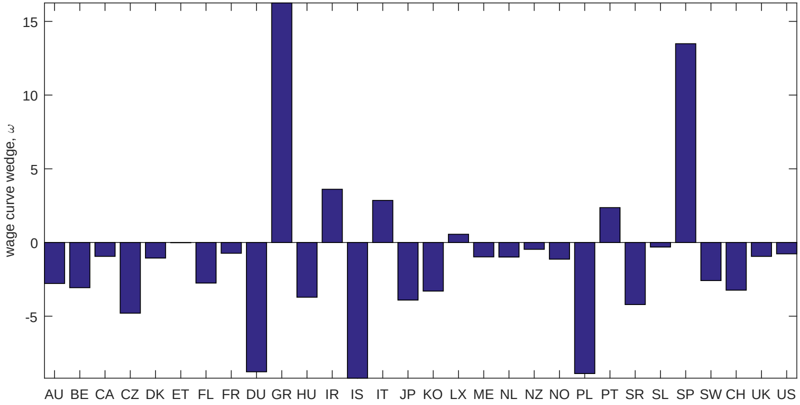
Thus, the wedge ω_i is a factor that decouples wages and unit labour costs trajectories.

We interpret the wage curve wedges as shocks that affect unit labour costs and the labour market: labour market institutions, product markets shocks, and other factors.

If the wedges represent transitory shocks, then we may interpret our model based unemployment predictions as equilibrium long-run unemployment rates.

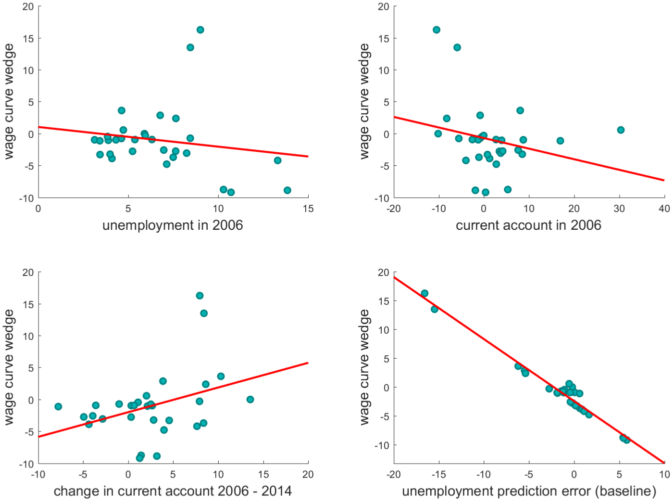
the wage curve wedges

cross-country dispersion in labour market rigidities and shocks



the wage curve wedges

initial conditions and the wage curve wedges



Conclusion

We have proposed a structural model of trade that includes unemployment and current account imbalances.

If the semi-elasticity of wages to changes in unemployment is high (as supported by the data), the structural model is successful at predicting the cross-sectional dispersion in unemployment.

We identify wage curve wedges as the shocks required to exactly match the observed unemployment rates in the cross-section of countries.

These wedges may be interpreted as either permanent differences in labour market institutions or as transitory economic shocks.