Employment, exchange rates and labour market rigidities

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Outline

- Motivation
- The model
- A test of the theory using sector and country level data
- The case of a small open economy: Portugal
- An index of sectoral labour market flexibility
- Results
- Conclusions

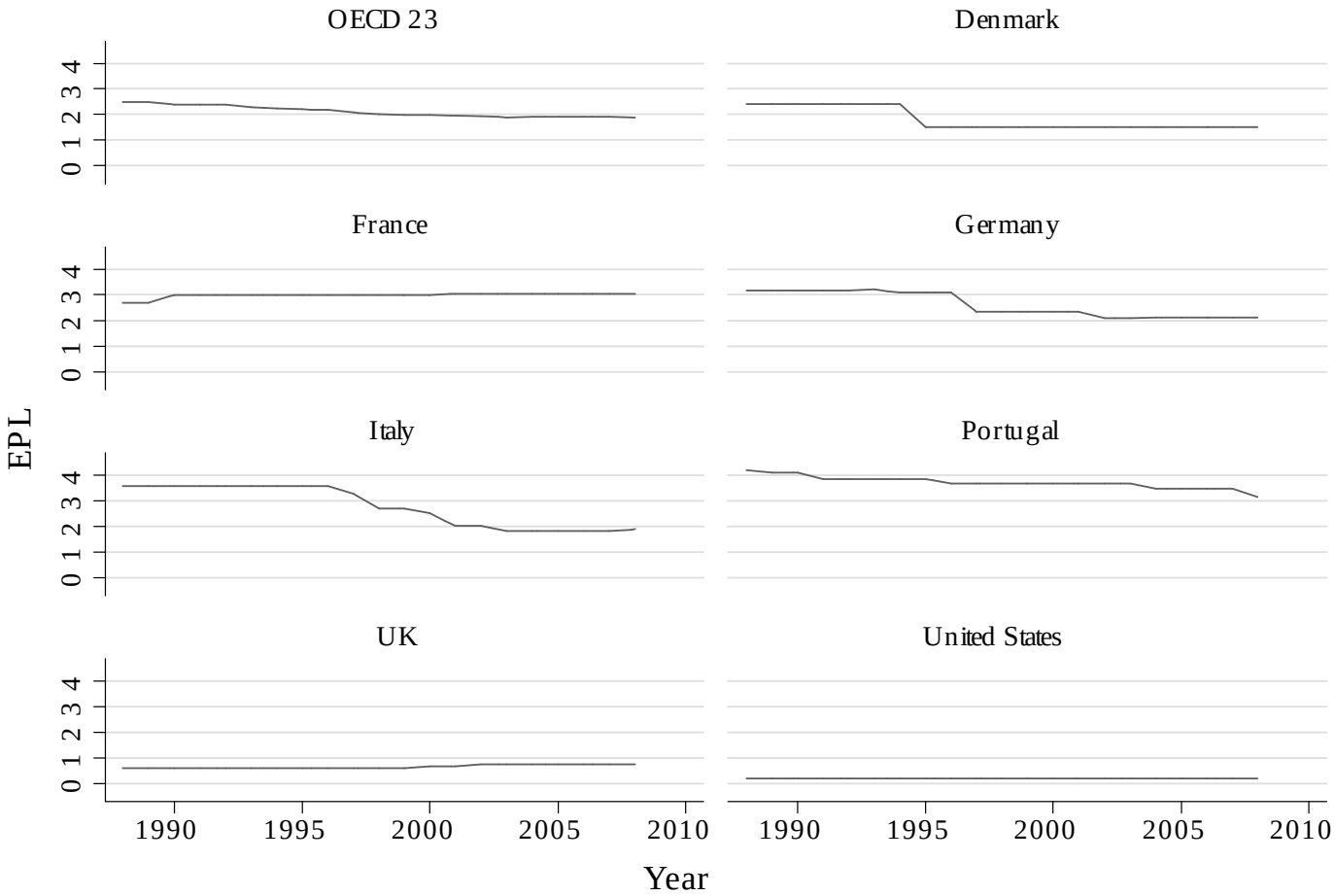
Motivation

- Globalization induced a higher exposure to external shocks
- Interaction between shocks and labour market institutions is crucial to understanding the dynamics of employment (e.g. Blanchard, Bertola, and others)
- We show that inclusion of labour market adjustment costs in a trade model affects the impact of exchange rate movements on employment:

  - higher labour market rigidities reduces the impact of external shocks

- We also look at the interaction between labour market rigidities, the degree of openness to trade and the technology level/productivity

Employment Protection Legislation



Source: OECD Employment Outlook

The model

Representative consumer in country i:

$$\max U = E_0 \sum_{t=0}^{\infty} \theta^t u(C_{it}) \tag{1}$$

$$u\left(C_{it}\right) = \left[\int_{\Phi} x_{it}\left(\varphi\right)^{1-\frac{1}{\sigma}} \mathrm{d}\varphi\right]^{\frac{1}{1-\frac{1}{\sigma}}} \tag{2}$$

$$x_{it}(\varphi) = C_{it}\left[\frac{p_{it}(\varphi)}{P_{it}}\right]^{-\sigma} \tag{3}$$

The model (cont.)

Monopolistic producer of variety φ (exporting to country i):

$$p_{it}(\varphi) = \frac{p_t}{\varepsilon_{it}} + \eta_i w_{it} \tag{4}$$

$$y_t(\varphi) = \varphi L_t \tag{5}$$

$$c_t(\varphi) = w_t L_t + F_t(\varphi) + w_t A(\Delta L_t) \tag{6}$$

asymmetric convex costs

$$A(\Delta L_t) = -1 + \exp(\beta \Delta L_t) - \beta \Delta L_t + \frac{1}{2}\gamma(\Delta L_t)^2 \tag{7}$$

The model (cont.)

$$\max E_0 \sum_t^{\infty} \delta^t \left[p_t y_t(\varphi) - c_t(\varphi) \right] \tag{8}$$

$$p_t = \frac{\sigma}{\sigma - 1} \left(1 + \frac{q_{it} \eta_i \varphi}{\sigma} + B_t \right) \frac{w_t}{\varphi} \tag{9}$$

$$y_t = C_{it} P_i^{\sigma} w_{it}^{-\sigma} \left(\frac{\sigma - 1}{\sigma} \right)^{\sigma} \left(\frac{1 + B_t}{q_{it} \varphi} + \eta_i \right)^{-\sigma} = \varphi L_t \tag{10}$$

The model (cont.)

$$y_t = C_{it} P_i^{\sigma} w_{it}^{-\sigma} \left(\frac{\sigma - 1}{\sigma} \right)^{\sigma} \left(\frac{1 + B_t}{q_{it} \varphi} + \eta_i \right)^{-\sigma} = \varphi L_t$$

$$q_{it} = \frac{\varepsilon_{it} w_{it}}{w_t} \tag{11}$$

$$B_t = M_t - \delta E_t \left[\frac{w_{t+1}}{w_t} M_{t+1} \right] \tag{12}$$

$$M_t = \beta \left[\exp \left(\beta \Delta L_t \right) - 1 \right] + \gamma \Delta L_t = M_t(y_t, y_{t-1}) \tag{13}$$

Complex non-linearity $\longrightarrow$ log-linearization around the steady state of the part involving q_{it}

The model (cont.)

$$y_t = X_t \left(\frac{1 + B_t}{q_{it}\varphi} + \eta_i \right)^{-\sigma} \tag{14}$$

log-linearizing the equation:

$$\begin{aligned} \hat{y}_t \approx & \hat{X}_t + \frac{\sigma}{zq}\hat{q}_{it} - \frac{\sigma}{zq}\frac{(1+\delta)y}{\varphi}(\beta^2+\gamma)\hat{y}_t \\ & + \frac{\sigma}{zq}\frac{y}{\varphi}(\beta^2+\gamma)\hat{y}_{t-1} + \frac{\sigma}{zq}\frac{\delta y}{\varphi}(\beta^2+\gamma)E_t\hat{y}_{t+1} \end{aligned} \tag{15}$$

Assuming

$$\hat{X}_t = \rho_X \hat{X}_{t-1} + \epsilon_t^X \tag{16}$$

$$\hat{q}_{it} = \rho_q \hat{q}_{it-1} + \epsilon_t^q \tag{17}$$

Solution:

$$\hat{y}_t = \alpha_0 \hat{X}_t + \alpha_1 \hat{q}_{it} + \alpha_3 \hat{y}_{t-1} \tag{18}$$

The model (cont.)

Reaction of output (and labour) to the real exchange rate:

$$\hat{y}_t = \alpha_0 \hat{X}_t + \alpha_1 \hat{q}_{it} + \alpha_3 \hat{y}_{t-1} \tag{19}$$

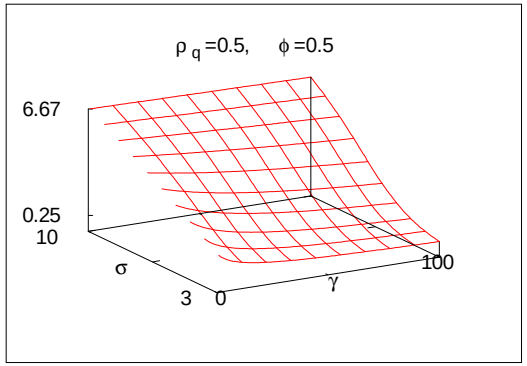
$$\alpha_1 = \frac{\alpha_3}{\left[1 + \alpha_3 \frac{\gamma y (1+\delta)}{\varphi}\right]\left[1 - \kappa(\alpha_2 + \rho_q)\right]} \tag{20}$$

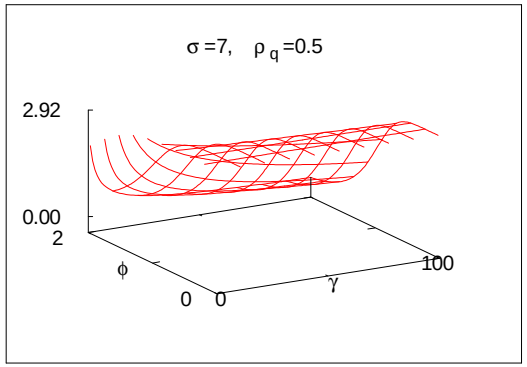
$$\alpha_3 = \frac{\sigma}{1 + \eta\varphi q} \tag{21}$$

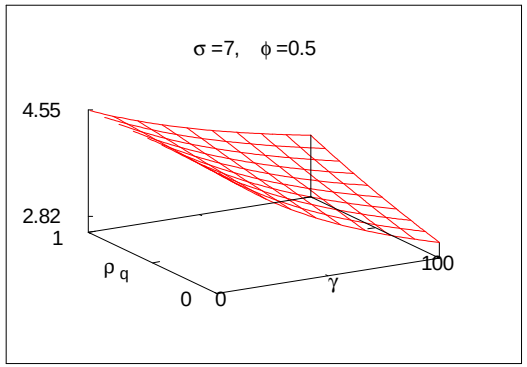
$$\kappa = \frac{\alpha_3 \frac{\delta\gamma y}{\varphi}}{1 + \alpha_3 \frac{(1+\delta)\gamma y}{\varphi}} \tag{22}$$

$$\alpha_2 = \frac{1 - \sqrt{1 - 4\kappa^2\delta^{-1}}}{2\kappa} \tag{23}$$

Employment exchange rate elasticity







Data at the country level

- We use data for 22 manufacturing industries and 23 OECD countries covering the years 1988-2006
- Data for nominal exchange rates, defined as national currency per US dollar at the end of the period, and for the consumer price index are from the IMF International Financial Statistics
- Data on employment, international trade and control variables comes from OECD STAN
- EPL is provided in OECD Employment Outlook

Observations per country and technology level

Country	Low-Tech	High-Tech	Country	Low-Tech	High-Tech
Austria	118	100	Hungary	48	6
Belgium	198	106	Italy	202	170
Canada	195	153	Japan	192	159
Switzerland	81	54	South Korea	48	40
Czech Republic	40	39	Netherlands	153	112
Germany	176	142	Norway	185	147
Denmark	193	137	Poland	40	5
Spain	197	158	Portugal	151	110
Finland	202	159	Slovakia	44	40
France	202	170	Sweden	202	168
United Kingdom	136	17	United States	180	150
Greece	112	86			

	Low-Tech	High-Tech
Total observations	3295	2428

List of industries used in the analysis

ISIC Rev. 3	Descritpion	Technology Classification
15-16	Food products, beverages and tobacco	Low and Medium Low Technology
17-19	Textiles, textile products, leather and footwear	Low and Medium Low Technology
20	Wood and products of wood and cork	Low and Medium Low Technology
21-22	Pulp, paper, paper products, printing and publishing	Low and Medium Low Technology
23	Coke, refined petroleum products and nuclear fuel	Low and Medium Low Technology
24 less 2423	Chemicals excluding phamaceuticals	High and Medium High Technology
2423	Pharmaceuticals	High and Medium High Technology
25	Rubber and plastics products	Low and Medium Low Technology
26	Other non-metallic mineral products	Low and Medium Low Technology
271+2731	Iron and steel	Low and Medium Low Technology
272+2732	Non-ferrous metals	Low and Medium Low Technology
28	Fabricated metal products, except machinery and equipment	Low and Medium Low Technology
29	Machinery and equipment, n.e.c.	High and Medium High Technology
30	Office, accounting and computing machinery	High and Medium High Technology
31	Electrical machinery and apparatus, n.e.c.	High and Medium High Technology
32	Radio, television and communication equipment	High and Medium High Technology
33	Medical, precision and optical instruments	High and Medium High Technology
34	Motor vehicles, trailers and semi-trailers	High and Medium High Technology
351	Building and repairing of ships and boats	Low and Medium Low Technology
352+359	Railroad equipment and transport equipment n.e.c.	High and Medium High Technology
353	Aircraft and spacecraft	High and Medium High Technology
36-37	Manufacturing n.e.c. and recycling	Low and Medium Low Technology

Description of the variables

Variable	Description	Source
y	Number of employees (full and part-time) in logs.	OECD STAN: EMPN.
$ExRate$	$ExRate_{jc,t} = \log \left[\prod_{c=1}^{N(t)} \left(rer_{c,t}^{i} \right)^{w_{c,t}^{i,j}} \right]$	Own computation.
$Open$	Exports plus imports over gross output plus exports and imports; all variables measured in national currency, current prices.	OECD STAN: EXPO, IMPO and PROD.
EPL	OECD's employment protection legislation index.	OECD Indicators on Employment Protection — annual time series data 1985-2008: unweighted average of version 1 sub-indicators for regular contracts (EPR_{v1}) and temporary contracts (EPT_{v1}).
$ShareChina_j$	Share of imports from China in sector j's own country imports.	OECD STAN Structural Analysis Database.
$ShareChinaW_{j,c,t}$	Weighted average of the share of Chinese imports in OECD countries, where the weights are defined as the share of each country i in country c exports ($X_{c,t}^{i,j}$ ($M_{c,t}^{i,j}$) stands for exports (imports) from country c to country i, in sector j, in year t): $ShareChinaW_{jc,t} = \sum_{i=1}^{N(t)} \left(\frac{X_{c,t}^{i,j}}{\sum_{i=1}^{N(t)} X_{c,t}^{i,j}} \right) \left(\frac{M_{i,t}^{China,j}}{\sum_{k=1}^{N(t)} M_{i,t}^{k,j}} \right)$, where $X_{c,t}^{i,j}$ ($M_{c,t}^{i,j}$) stands for exports (imports) from country c to country i, in sector j.	OECD STAN Structural Analysis Database.
ULC	Real unit labour costs measure the average cost of labour per unit of output and are calculated as the ratio of total labour costs to real output.	OECD STAN Database, variable: "ULC — total economy, annual". ULC was deflated using OECD's consumer price indexes (2005=100).
GDP	Gross Domestic Product (in logs), constant prices.	OECD STAN Database.
$IntRate$	Long-term real interest rates, per cent per annum.	OECD STAN Database, variable: "Interest Rates, Long-term government bond yields".

Estimation and results

$$\begin{aligned}\Delta y_{jct} = {} & \beta_0 + \beta_1 \Delta ExRate_{jc,t-1} + \beta_2 Open_{jc,t-1} + \beta_3 EPL_{c,t-1} \\ & + \beta_4 \Delta ExRate_{jc,t-1} \times Open_{jc,t-1} + \beta_5 \Delta ExRate_{jc,t-1} \times EPL_{c,t-1} \\ & + \beta_6 \Delta ShareChina_{jc,t-1} + \beta_7 \Delta ShareChinaW_{jc,t-1} + \beta_8 \Delta ULC_{c,t-1} \\ & + \beta_9 \Delta GDP_{c,t-1} + \beta_{10} \Delta IntRate_{c,t-1} + \lambda_t + \theta_{jc} + \varepsilon_{jct}, \end{aligned} \quad (24)$$

- y_{jct} : log employment in sector j and country c in year t
- $ExRate_{jc,t-1}$: lagged real sectoral effective exchange rate
- $Open_{jc,t-1}$: degree of openness
- $EPL_{c,t-1}$: Employment Protection Legislation index
- $ShareChina_{jc,t-1}$: share of China in sector j own country' imports
- $ShareChinaW_{jc,t-1}$: share of China in sector j foreign markets
- $ULC_{c,t-1}$: Unit Labour Costs (real)
- $GDP_{c,t-1}$: log Gross Domestic Product (real)
- $IntRate_{c,t-1}$: Real Interest Rate, long term
- λ_t : time dummies; θ_{jc} : sector/country dummies

Estimation and results

	No-EPL			EPL	
	No-Tech	Low-Tech	High-Tech	Low-Tech	High-Tech
Model	(1)	(2)	(3)	(4)	(5)
$\Delta ExRate_{t-1}$	-.2316*	-.2531**	-.4782	-.0920	-.2613
	(.1255)	(.1071)	(.3396)	(.1255)	(.3595)
$\Delta ExRate * Open_{t-1}$	.8851**	1.2085***	1.1815	1.0611***	1.0035
	(.3999)	(.3981)	(.7586)	(.3910)	(.7655)
$\Delta ExRate * EPL_{t-1}$				-.0697	-.0792
				(.0428)	(.0986)
$Open_{t-1}$	.2257***	.0995*	.3426**	.0993*	.3435**
	(.0815)	(.0570)	(.1389)	(.0562)	(.1377)
EPL_{t-1}				-.0158***	-.0227**
				(.0043)	(.0091)
$\Delta ShareChinaWeight_{t-1}$	.0141	-.0626	.2435	-.0638	.2178
	(.2000)	(.1636)	(.4529)	(.1652)	(.4487)
$\Delta ShareChina_{t-1}$	-.1243**	-.0815	-.3486	-.0820*	-.3237
	(.0606)	(.0498)	(.2276)	(.0498)	(.2242)
ΔULC_{t-1}	.0163	-.1323**	.2003	-.1211*	.2128
	(.0879)	(.0626)	(.1786)	(.0627)	(.1750)
ΔGDP_{t-1}	.5959***	.7599***	.3965	.7800***	.4123
	(.1269)	(.0958)	(.2569)	(.0939)	(.2606)
$\Delta InterestRate_{t-1}$	-.0010	-.0013	-.0008	-.0012	-.0005
	(.0012)	(.0009)	(.0026)	(.0009)	(.0026)
Observations	5723	3295	2428	3295	2428
Adj. R^2	.0504	.1068	.0422	.1137	.0444
LogLikelihood	6421.615	5417.503	1975.572	5431.425	1979.432

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Robust standard errors in parentheses. All regressions are estimated by fixed-effects at the sector/country level.

Employment exchange rate elasticities

		Low-Tech		High-Tech	
Open(+)	EPL(+)	0.6148***(0.0020)	0.4259** (0.0499)	0.3703(0.1596)	0.1820 (0.6152)
			0.5221*** (0.0084)		0.2914 (0.2971)
	EPL(-)		0.6177*** (0.0016)		0.3999 (0.1089)
Open(-)	EPL(+)	0.0193(0.6981)	-0.0969 (0.3399)	-0.2118(0.2707)	-0.3124 (0.3119)
			-0.0006 (0.9904)		-0.2031 (0.3493)
	EPL(-)		0.0949 (0.1030)		-0.0945 (0.6174)

Notes: $p - values$ in parenthesis. Significance levels: $*$: 10% $**$: 5% $***$: 1%.

Highlights from country data

- Empirical evidence supports the model's predictions:

  - low-technology sectors
  - very exposed to international competition
  - located in countries with more flexible labour markets

  are more sensitive to exchange rate changes

- Importance of interacting external shocks and labour market institutions to understand the dynamics of employment
- Policy dilemma:

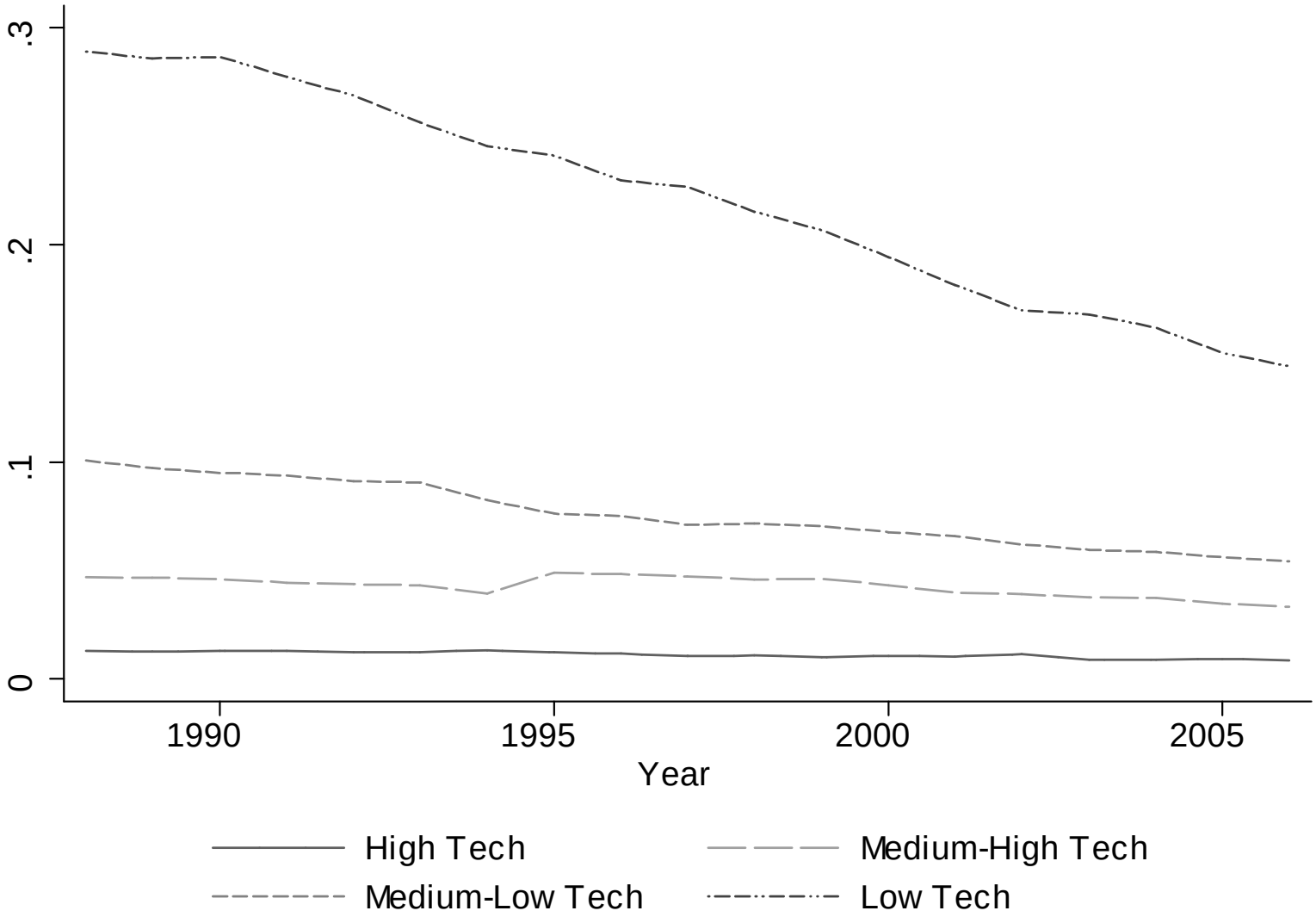
  - high EPL reduces impact of adverse shocks
  - but might delay benefits from reallocation

The case of a small open economy

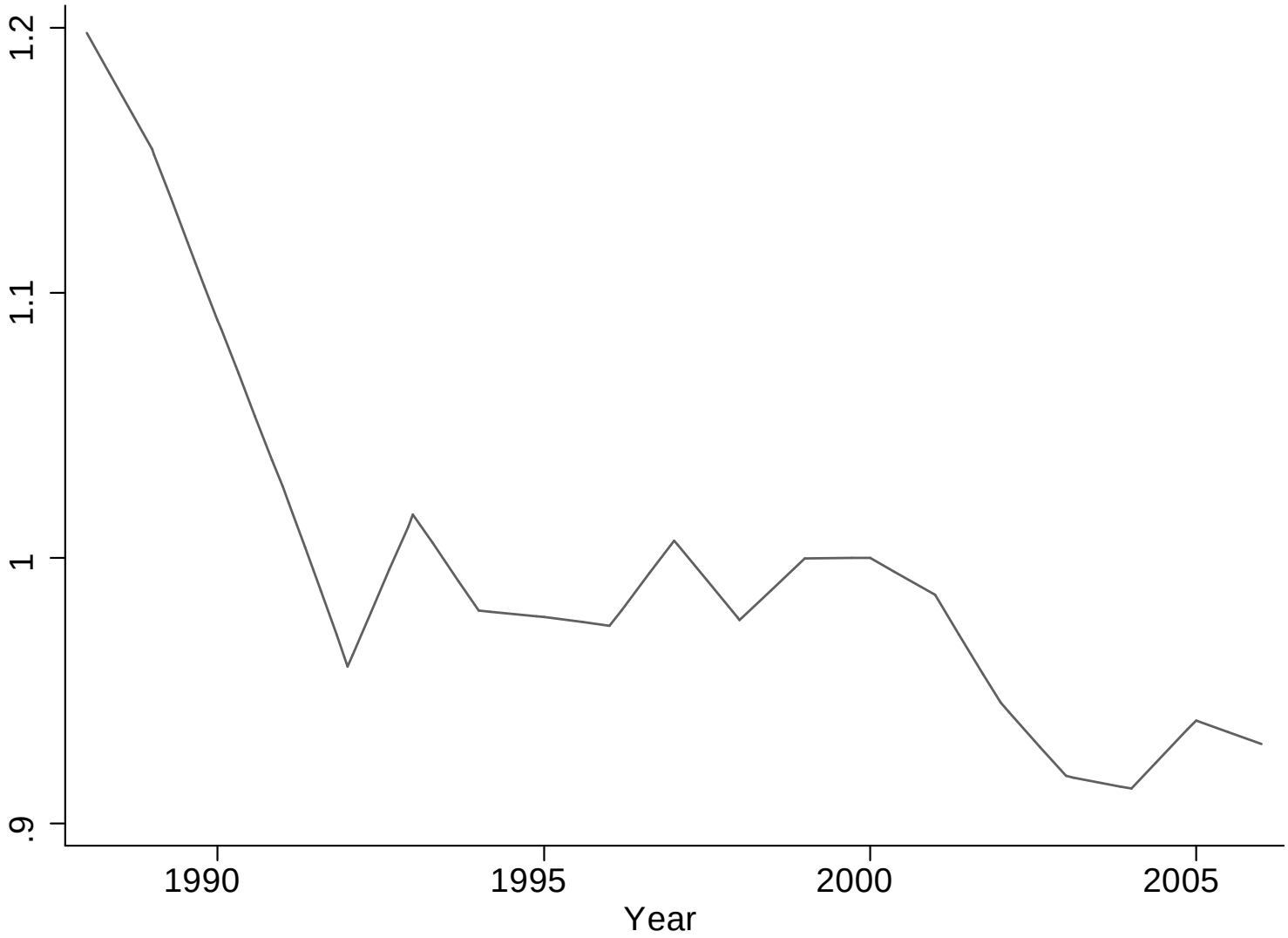
Why Portugal?

- High labour market rigidity
- Economy specialized in low technology products
- Currency management has played a central role in shaping macroeconomic policy and outcomes

Share of employment by technology level



Real effective exchange rate

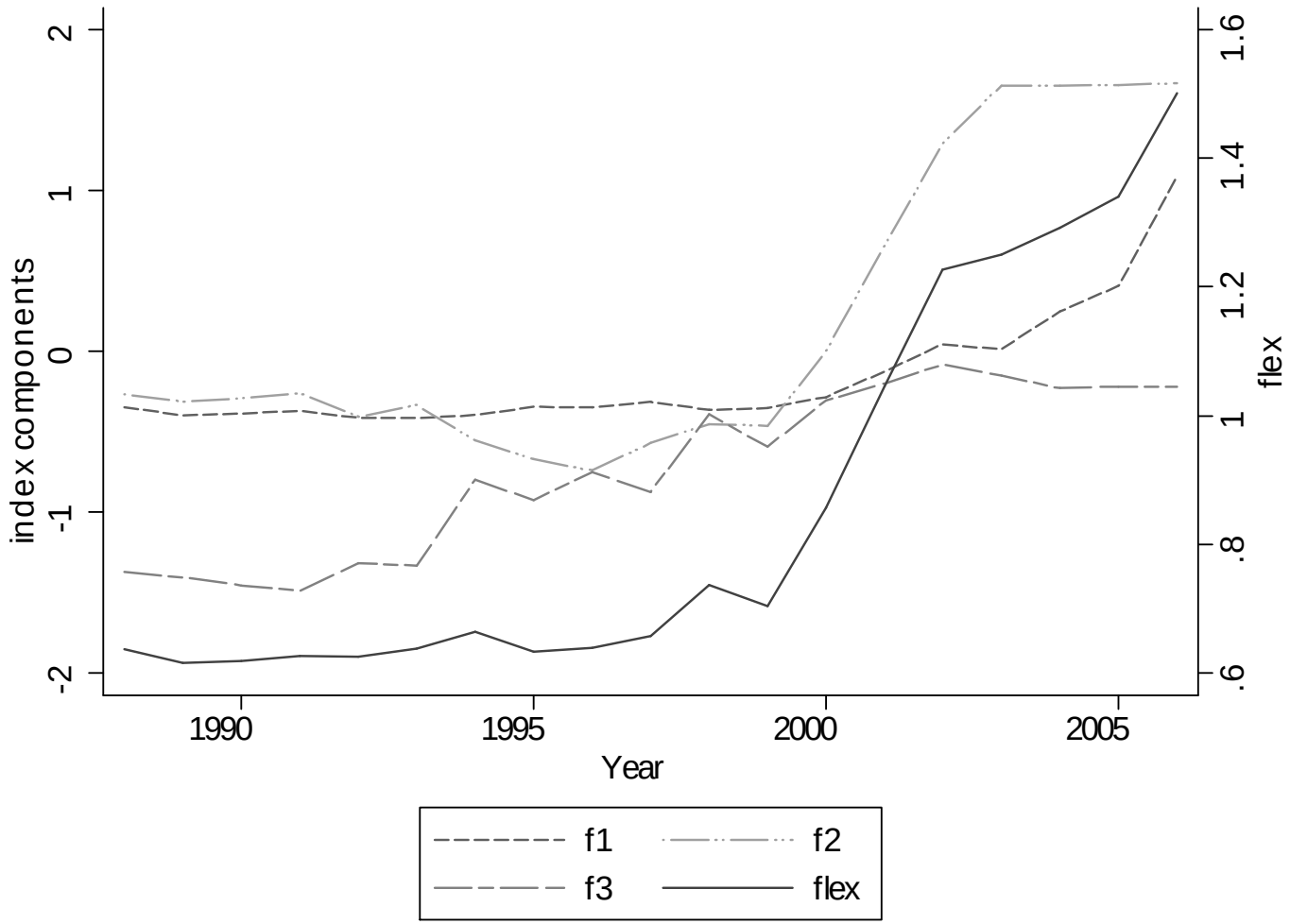


An index of sectoral labour market flexibility

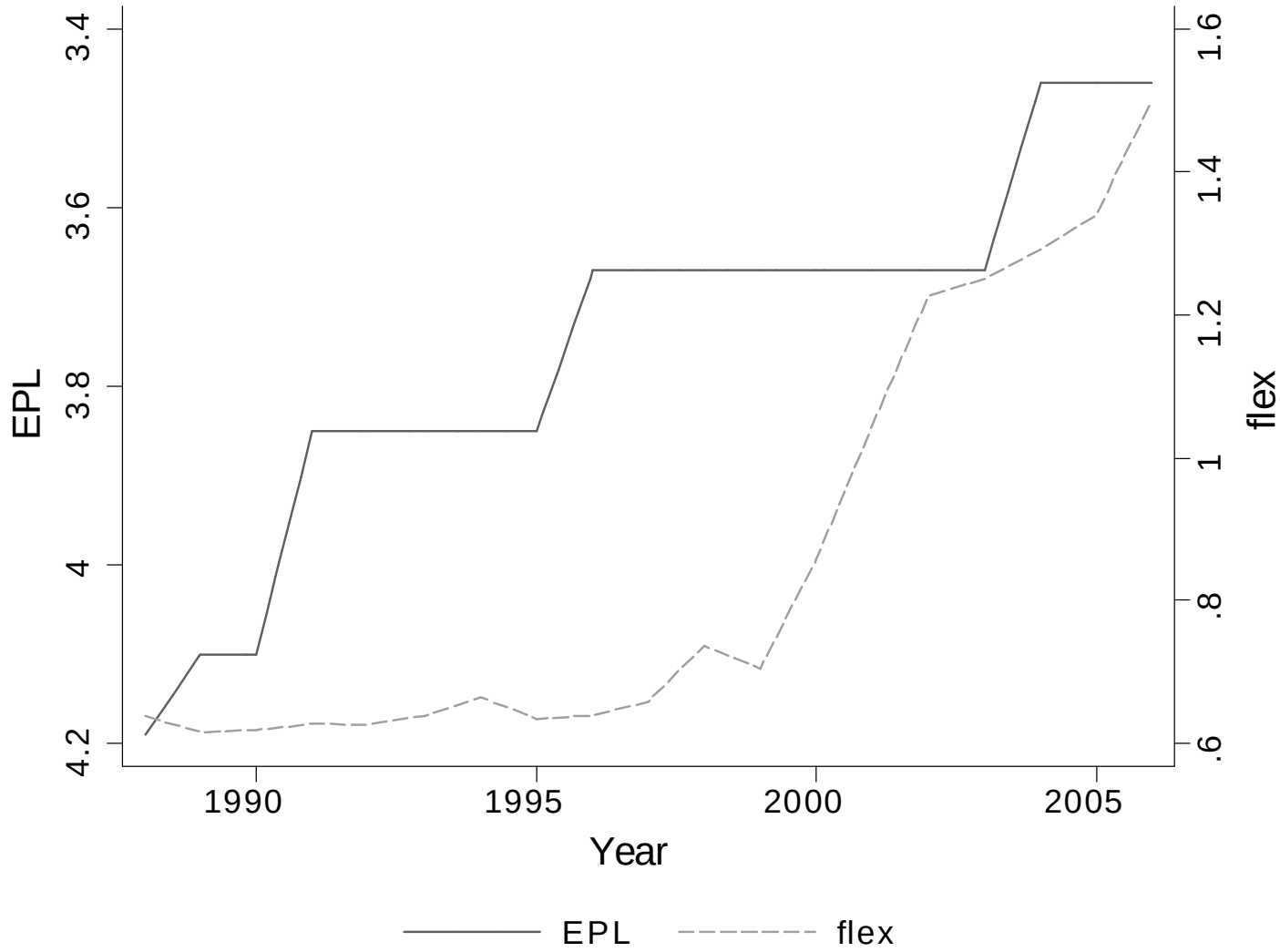
$$flex_{jt} = \left(0.5 + \frac{\exp(f_{1,jt})}{1+\exp(f_{1,jt})}\right) \times \left(0.5 + \frac{\exp(f_{2,jt})}{1+\exp(f_{2,jt})}\right) \times \left(0.5 + \frac{\exp(f_{3,jt})}{1+\exp(f_{3,jt})}\right) \quad (25)$$

- $f_{1,jt}$: share of workers in sector j and period t not covered by some form of collective agreement
- $f_{2,jt}$: share of workers without a full-time contract
- $f_{3,jt}$:share of workers earning above minimum wage within those with full-time working contract

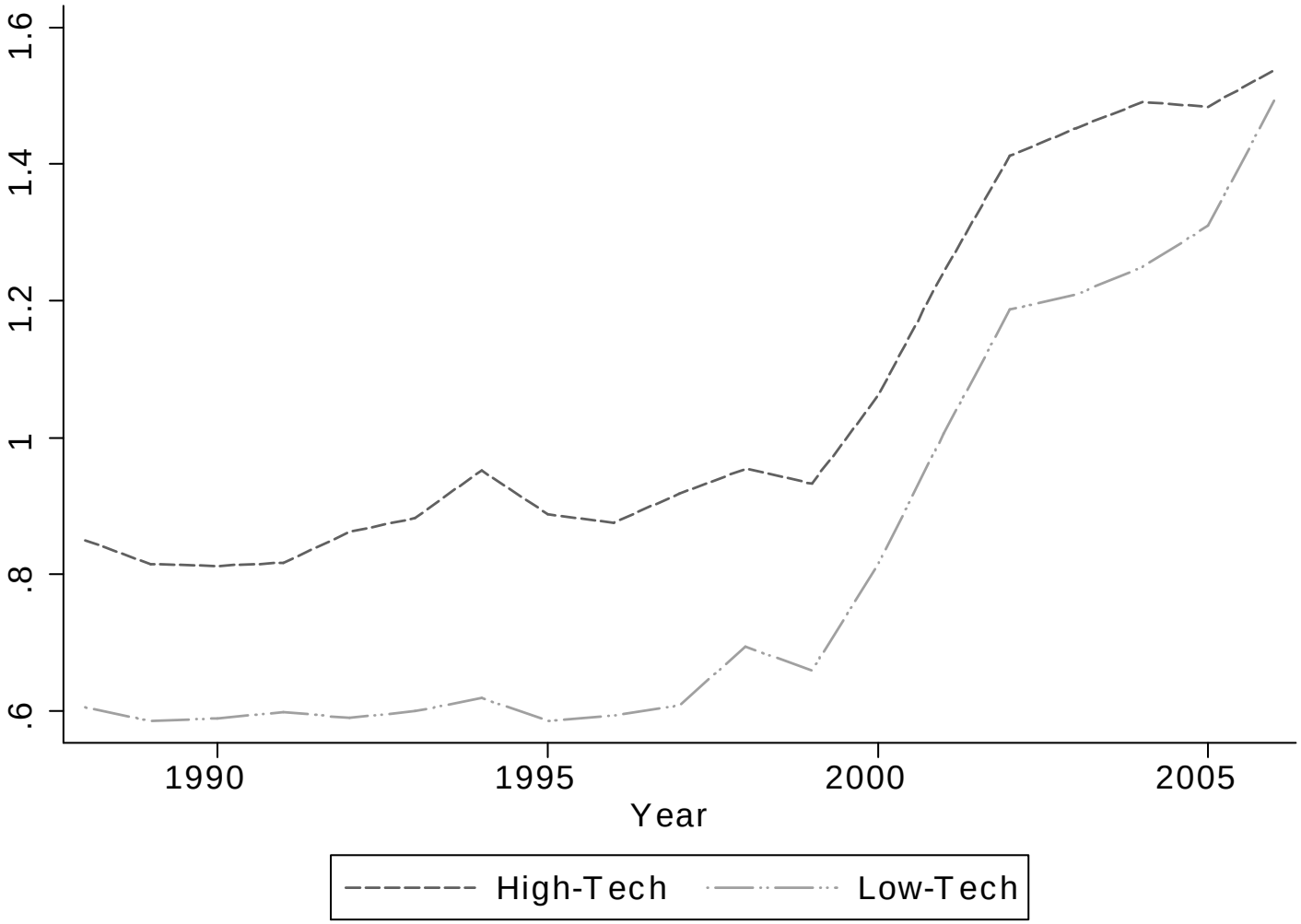
Aggregate flexibility index and its components



Time pattern: EPL vs. flex



Aggregate flexibility index for high and low technology sectors



The data

- Employment from the linked employer-employee dataset "*Quadros de Pessoal*", 1988-2006
- 1988: 122,774 firms and 1,996,933 workers, covering 44.6% of total employment
- 2006: 344,024 firms and 3,099,513 workers, covering 60.5% of total employment
- 20 manufacturing industries
- This data is used to compute the index of sectoral labour market flexibility

Econometric model

$$
\begin{aligned}
\Delta y_{jt} \quad = \quad & \beta_0 + \beta_1 \Delta ExRate_{j,t-1} + \beta_2 \Delta ExRate_{j,t-1} \times Open_{j,t-1} \\
& + \beta_{1L} \Delta ExRate_{j,t-1} \times Low_j + \beta_{2L} \Delta ExRate_{j,t-1} \times Open_{j,t-1} \times Low_j \\
& + \beta_3 \Delta ExRate_{j,t-1} \times flex_{j,t-1} + \beta_{3L} \Delta ExRate_{j,t-1} \times flex_{j,t-1} \times Low_j \\
& + \beta_4 \Delta ShareImp_{j,t-1} + \beta_5 Open_{j,t-1} + \beta_6 flex_{j,t-1} + \lambda_t + \theta_j + \varepsilon_{jt}, \qquad (26)
\end{aligned}
$$

- y_{jt} : log employment in sector j in year t
- $ExRate_{j,t-1}$: lagged real sectoral effective exchange rate
- $Open_{j,t-1}$: degree of openness
- $flex_{j,t-1}$: flexibility of sector j lagged 1 period
- $ShareImp_{j,t-1}$: share of emerging countries in sector j OECD countries' imports
- λ_t : time dummies; θ_j : sector dummies

Employment regressions

Model	ALL		FULL	
	(1)	(2)	(3)	(4)
$\Delta ExRate_{t-1}$	-2.345	-1.472	-.354	-2.858
	(2.686)	(2.995)	(2.365)	(2.537)
$\Delta ExRate_{t-1} \times Low$			-4.202**	-.635
			(1.771)	(1.914)
$\Delta ExRate_{t-1} \times Open$	2.645**	3.518**	2.057	7.201***
	(1.301)	(1.621)	(2.257)	(2.695)
$\Delta ExRate_{t-1} \times Open \times Low$			8.071**	.506
			(3.478)	(4.121)
$Open_{t-1}$	.105**	.205	.099**	.299*
	(.041)	(.164)	(.039)	(.159)
$\Delta ExRate_{t-1} \times Flex$	1.386	.901	-.050	-.784
	(1.567)	(1.926)	(1.478)	(2.107)
$\Delta ExRate_{t-1} \times Flex \times Low$			2.564*	3.212
			(1.457)	(2.240)
$Flex_{t-1}$	-.0005	.021	-.009	.016
	(.024)	(.050)	(.025)	(.052)
$\Delta ShareImp_{t-1}$	-1.482***	-1.839***	-1.723***	-1.969***
	(.434)	(.620)	(.490)	(.661)
Sectoral dummies	no	yes	no	yes
Observations	360	360	360	360
$Adj.R^2$	.068	.069	.084	.078

Employment regressions (cont.)

Model	HighTech		LowTech	
	(5)	(6)	(7)	(8)
$\Delta ExRate_{t-1}$	-5.457*	-2.859	-3.074*	-2.869
	(2.976)	(4.909)	(1.790)	(2.161)
$\Delta ExRate_{t-1} \times Low$				
$\Delta ExRate_{t-1} \times Open$	7.949***	8.065***	8.291***	7.227***
	(2.564)	(2.682)	(2.370)	(2.739)
$\Delta ExRate_{t-1} \times Open \times Low$				
$Open_{t-1}$	.333***	.362*	.034	.148
	(.064)	(.214)	(.028)	(.150)
$\Delta ExRate_{t-1} \times Flex$	-2.300	-4.001	2.349***	2.407**
	(2.328)	(2.706)	(.904)	(1.048)
$\Delta ExRate_{t-1} \times Flex \times Low$				
$Flex_{t-1}$	-.014	-.037	-.033	-.020
	(.054)	(.061)	(.029)	(.048)
$\Delta ShareImp_{t-1}$	-2.502**	-2.722	-1.509***	-1.621***
	(1.058)	(1.732)	(.556)	(.493)
Sectoral dummies	no	yes	no	yes
Observations	162	162	198	198
$Adj.R^2$	.092	.051	.196	.201

Exchange rate elasticity of employment (cont.)

Sectors	Flexibility, percentile	ALL (1)	ALL (2)	FULL (3)	FULL (4)	HighTech (5)	HighTech (6)	LowTech (7)	LowTech (8)
				Openness, percentile 90					
ExRate	10	1.449	2.285						
	50	1.663	2.425						
	90	2.297	2.837						
HighTech	10			1.052	1.232	-2.905	-2.552		
	50			1.044	1.111	-3.260	-3.171		
	90			1.021	.753	-4.312	-5.001		
LowTech	10			6.148**	5.357*			6.087**	5.608*
	50			6.536***	5.732**			6.450**	5.980**
	90			7.686***	6.843**			7.524***	7.081**
F-test	10			7.112**	3.281*				
	50			10.398***	4.500**				
	90			6.394**	3.126*				

F-test null: equal elasticities for HighTech and LowTech sectors.

Key results

- Increasing trend in flexibility, more pronounced after 1999
- Reduction of the share of workers covered by collective agreements and working full time
- The sectoral index of flexibility reveals that high technology sectors tend to face more flexible labour markets
- The level of flexibility in high and low technology sectors has been converging
- Employment in low technology sectors, with a high degree of trade openness and facing more flexibility in the labour market has been the most affected by the evolution of the exchange rate since the late 1980s

Conclusions

- As predicted by the theoretical model, our empirical results, both for a small open economy, as well as for a set of countries, indicate that labour market protection reduces the impact of exchange rate shocks on employment
- Increasing labour market flexibility seems to be a bane when the economy is hit by external shocks
- Future research: implement the analysis for the three components of EPL and the sectoral flexibility index