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Abstract
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Keywords
exchange rates, trade unions, wage bargaining, worker-firm data

Cover Page Footnote
The data used in the paper, the Quadros de Pessoal, is proprietary. Researchers may apply to use the data and should contact: Gabinete de Estudos e Planeamento, Ministerio do Trabalho e da Seguranca Social, Rua Castilho, no. 24, 1250-069 Lisboa, Portugal (dados@gep.mtss.gov.pt). All of the command files needed to replicate the results here can be obtained from Paulo Bastos, World Bank, 1818 H Street, N.W. Washington, DC 20433, USA. Acknowledgements: We thank the editor, two anonymous referees, and participants at the World Bank/IZA conference in Cape Town, 2010, for valuable comments. Paulo Bastos would like to thank Fundação para a Ciência e a Tecnologia for financial support. The views expressed in this paper are those of the authors only and do not represent those of the World Bank.

EXCHANGE RATES AND WAGES IN UNIONIZED LABOR MARKETS

PETER W. WRIGHT AND PAULO BASTOS*

The authors investigate the impact of exchange rate movements on wage determination in unionized labor markets. Using a simple model of international oligopoly, the authors show that organized labor has a rational incentive to accept lower wages in the face of a currency appreciation. They examine this proposition empirically using a matched worker-firm data set for Portugal and, though the impact varies considerably with worker characteristics, find results consistent with the predictions of the model.

The theoretical literature examining the impact of globalization on unionized labor markets has grown steadily in recent years.[1] But empirical studies have been more limited. Revenga (1992) examines the impact of increased import competition on wages in U.S. manufacturing in a study in which she instruments import penetration with source-weighted real exchange rates. She finds a negative impact of increased international competition, though one that is relatively small in magnitude. Bertrand (2004) employs a similar instrumental variable strategy using a panel of U.S. workers and finds that, besides lowering average wages, increased foreign competition also increases the sensitivity of wages to the local unemployment rate. Campa and Goldberg (2001), using industry-level data for the United States, explicitly focus on the effect of real exchange rate fluctuations on

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[1]See, for example, Brander and Spencer (1988); Mezzetti and Dinopoulos (1991); Huizinga (1993); Piperakis, Hine, and Wright (2003); Straume (2003); Lommerud, Meland, and Straume (2006); Bastos and Kreickemeier (2009); and Bastos, Kreickemeier, and Wright (2009).

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wages. Their estimates point to a wage elasticity with respect to the real exchange rate of 0.06, in line with the estimates of Revenga (1992).

This relative lack of studies and the fact that their focus has been on the U.S. manufacturing sector, where only a small fraction of workers are covered by union agreements, have led to both researchers and policymakers alike calling for further micro-level analyses of the role of collective bargaining arrangements in shaping wage adjustment to external shocks (OECD 2004; Blanchard 2006; Freeman 2010). Two important difficulties, however, have hampered progress: First, in the real world, collective bargaining arrangements are complicated. Examining their role in wage formation requires institutional information that is unavailable in most data sets.[2] Second, the study of wage adjustments requires the identification of a source of external shocks that can be plausibly regarded as exogenous to the wage setting process.

Our study examines the impact of exchange rate fluctuations on unionized wages in the Portuguese manufacturing sector. We argue that we are able to overcome the two principal problems because, first, Portugal is a small open economy and hence fluctuations of import-weighted exchange rates constitute an important source of industry-specific external shocks to firms and workers.[3] Second, its labor market is characterized by both a high level of union coverage and a great degree of uniformity in the institutional arrangements for bargaining. Finally, it has a uniquely rich administrative worker-firm data set that enables us to distinguish between sectorwide collective agreements and adjustments subsequently made at the level of the firm.

Exchange Rates and Union Wage Demands

In order to provide a framework for our empirical analysis, we develop a simple model of unionized international oligopoly that allows us to study the effect of exchange rate fluctuations on the wage demands of industry-level trade unions. The model builds on Dornbusch (1987), who analyses the effect of exchange rate movements on key industry variables in an international oligopoly model. The innovation we introduce is to set home wages by a monopoly union model rather than assume they are given exogenously. This approach to wage setting has been popular in studies examining the implications of other aspects of globalization (e.g., Naylor 1998, 1999; Lommerud, Meland, and Sørgard 2003).

[2]In many countries sectorwide union agreements are supplemented with idiosyncratic adjustments at the level of the firm, and hence these two forms of wage adjustment need to be distinguished in the analysis (Flanagan 1999).

[3]As emphasized by Campa and Goldberg (2001), it is also interesting in its own right to pin down the specific impacts of exchange rates for the real economy. Moxnes and Ulltveit-Moe (2010) examine the impact of a rapid appreciation of the Norwegian krone on a firm's product mix and found that exposed firms reduced their rate of product churning.

Model Setup

Product Market

We consider a two-country, single-industry model with n identical domestic suppliers and n^* identical foreign firms with production facilities located overseas. For simplicity, we assume that both domestic and foreign firms sell all their output in the home country, where product demand is described by the following linear function[4]:

$$p = a - bQ = a - b(nq + n^* q^*) \tag{1}$$

where, a, $b > 0$, p is the home product price expressed in local currency, and Q denotes total sales by home (q) and foreign firms (q^*). The exchange rate (ε), is defined as the number of units of foreign currency that are needed to buy one unit of the home currency. Domestic suppliers receive p, while foreign firms receive εp per unit of commodity sold.

The firms produce an homogeneous commodity under constant returns to scale, with labor as the only input and output per worker normalized to unity.[5] This implies an equivalence in the choice of employment and output in the firm's optimization problem. Hence the profit function of the representative firm in each country is given by:

$$\pi = [p - w]q \tag{2}$$

$$\pi^* = [\varepsilon p - w^*]q^* \tag{3}$$

We will further assume that Cournot competition characterizes the product market.[6]

Labor Market

In the labor market, there is a single trade union representing all workers employed by the domestic oligopoly suppliers. The union cares about both wages and employment, which we capture using the following utility function:

$$U = (w - \bar{w})nq \tag{4}$$

[4]The model could readily be extended to allow the firms to sell in both markets, as for instance in Brander (1981). This would add complexity without changing any of its qualitative results. It can also be verified that the key results generalize beyond linear demand.

[5]The model could be amended to allow for a fixed cost of production, entering the profit function linearly. This assumption would approximate the short-run conditions of an industry operating with excess capacity of a fixed-capital stock (Dowrick 1989). This would not make a substantive difference to the results derived.

[6]By allowing strategic interaction between home and foreign firms, the Cournot model allows us to explicitly examine the pro-competitive effects of an exchange rate appreciation on union wage setting. Similar qualitative results would ensue, however, if an increase in the degree of product market competition were captured by a greater degree of product substitutability in a monopolistic competition model; see, for example, Lommerud, Meland, and Straume (2009).

where, w is the wage rate and $\overline{w}$ is the wage that a union worker can earn in the nonunion sector. To determine the bargained wage level, we adopt a formulation in which the monopoly union sets the wage and the firms subsequently have the *right to manage* in setting employment at the profit maximizing level. Foreign firms recruit workers from a competitive labor market at the wage rate w^*, which is expressed in units of the foreign currency.

Solving the Model

The model is solved as a two-stage game: in stage one, the union makes its wage demand, taking the exchange rate and the wage of the foreign competitor as given; in stage two, each firm chooses its profit maximizing level of employment and output, taking as given the wage set by the union in the previous period. We solve for the sub-game perfect Nash equilibrium by backwards induction.

Product Market Equilibrium

Assuming that competition in the product market is described by a Cournot model, then solving the first order conditions for profit maximization yields the following best-reply functions for each of the firms:

$$q = \frac{a - w}{b(1+n)} - \frac{n^*}{1+n} q^* \tag{5}$$

$$q^* = \frac{a - w^*/\varepsilon}{b(1+n^*)} - \frac{n}{1+n^*} q \tag{6}$$

Solving Equation (5) and Equation (6) gives equilibrium sales and, equivalently employment, of:

$$q = \frac{a - (1+n^*)w + n^*(w^*/\varepsilon)}{b(1+n+n^*)} \tag{7}$$

$$q^* = \frac{a + nw - (1+n)(w^*/\varepsilon)}{b(1+n+n^*)} \tag{8}$$

Union Wage Setting

The monopoly union will maximize utility (Equation [4]) subject to optimal response of the domestic firm (Equation [7]). Note that this implies that the wage demands of the monopoly union will be affected, *ceteris paribus*, by the elasticity of labor demand with respect to the wage rate. The more elastic is labor demand, the higher the trade-off the union will face between wages and employment and the lower the wage that will be set.

Solving gives the equilibrium wage rate in the home country:

$$w = \frac{\bar{w}}{2} + \frac{[a + n^*(w^*/\varepsilon)]}{(2 + 2n^*)} \tag{9}$$

A number of things are worthy of note. First, one can see that union wage demands are positively associated with the reservation income of union workers, as would be expected. Second, an appreciation in the exchange rate will lead to the union setting lower wages. The mechanism for this can be seen by examining Equation (7): a rise in ε will make home firms less competitive with respect to their foreign rivals, and this will increase the elasticity of labor demand with respect to the wage rate. The home union therefore faces a higher trade-off between wages and employment, and so has an incentive to set a lower wage rate. This result will be the main focus of our empirical analysis.[7]

Additional Theoretical Mechanisms

For simplicity, the model we present here abstracts from several important features of unionized labor markets. To further motivate the empirical analysis, we discuss additional theoretical mechanisms whereby exchange rate movements might be expected to impact wage formation.

The magnitude of wage adjustments after a currency appreciation might be expected to depend on external labor market conditions. In a depressed local labor market, a rent-maximizing union would rationally lower its wage demands in order to defend employment levels. This would put wages closer to workers' reservation level of income (determined, for example, by the national minimum wage or the disutility of work), thereby leaving less room for further wage adjustments due to a currency appreciation. Hence, the sensitivity of wages to exchange rate fluctuations might be expected to fall in the presence of high regional unemployment.

In centralized wage setting systems, collective bargaining typically sets minimum standards for working conditions and wages, leaving room at the local level for idiosyncratic wage adjustments reflecting specific conditions of workers and firms (Flanagan 1999; Cardoso and Portugal 2005). The model presented above abstracts from heterogeneity of workers and firms and emphasizes solely the role of trade union incentives in shaping wage adjustments to exchange rate fluctuations. Relaxing these assumptions would likely yield a richer set of predictions about the impacts of exchange rate movements on wage formation, particularly with regard to potential heterogeneity of wage effects.[8]

[7]It is worth noting that, in this setup, the exchange rate effect operates like a change in technology. In particular, an appreciation is equivalent to a loss of domestic productivity, a gain in the productivity of the foreign firm, or both.

[8]The theoretical implications of firm heterogeneity under such two-tier arrangements have been examined by Bastos, Monteiro, and Straume (2009) in a closed-economy setting. They develop a model of a unionized Cournot oligopoly in which an industrywide monopoly union sets a wage floor common to all producers, and then a second rent-sharing process at the local level determines firm-specific wages

Here an interesting issue is the impact of increased international competition on the returns to skill. On the one hand, Guadalupe (2007) argues theoretically that a within-industry increase in the degree of product market competition increases the demand for higher skill. Provided that labor is imperfectly mobile across sectors, stronger product market competition would thereby lead to an increase in the returns to skill. She finds empirical evidence for these contentions using earnings data for the United Kingdom. Anticipating these market-driven pressures for increased wage inequality, trade unions with egalitarian aims might seek to offset this increase in inequality by negotiating lower cuts in contractual wages for the less skilled.[9] The net effect on actual paid wages would then depend on the relative strength of the effects of increased competition on industrywide contractual wages and on firm-specific wage adjustments.

On the other hand, given that collective bargaining wages set minimum conditions of pay for a given worker category, workers further from the minimum would be expected to be less affected by factors that alter the negotiated outcome. The impact of exchange rate appreciation might therefore plausibly differ by gender. Blau and Kahn (2003) examine microdata for 22 countries and suggest that, because females are on average lower in the wage distribution, factors that impact on the wage floor will have a greater impact on women than men. Hence, we would expect an exchange rate appreciation to have a particularly deleterious impact on female pay.

By similar reasoning, sectorwide collective agreements applying to all firms in a given industry would be expected to be more binding for less productive firms. Accordingly, negative wage adjustments following an appreciation might be expected to be larger among this subset of firms.

Collective Bargaining in Portugal

Portugal provides an interesting case for studying the impact of exchange rate movements on collectively bargained outcomes, first, because of the high level of union coverage, and second, because of the uniformity of institutional arrangements. The primary level of bargaining in Portugal is at the sectoral level,[10] with the agreements published in legal documents, normally between January and April. These agreements typically establish the minimum working conditions for each category or group of workers, including the monthly base wage, the overtime pay, and the normal hours of work. The wage clauses are ordinarily updated annually and are valid, often retrospectively, for the whole of the calendar year.

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and employment. They argue that local level bargaining may partially reverse the impact of a change in firm heterogeneity, but the response of the wage floor will dominate that of the wage cushion.

[9]The hypothesis that trade unions are characterized by egalitarian aims is supported by a large body of evidence (see, e.g., Cardoso and Portugal 2005 and the references therein).

[10]More than 80% of the workforce was covered by a collective agreement in 2000 (OECD 2004, Table 3.3). In contrast to some other OECD countries, firm-level bargaining covers only a small proportion of workers in the private sector and is virtually nonexistent in manufacturing (Cardoso and Portugal 2005).

Workers will be covered by a collective agreement if they are affiliated with a trade union that has signed an agreement with their employer or with the corresponding employers' association; however, voluntary extensions whereby workers' or employers' associations voluntarily subscribe to an agreement to which they were not original signatories are widespread. For these reasons, most workers in Portuguese manufacturing are covered by some type of collective agreement, irrespective of their union membership status.[11]

A further interesting feature of the Portuguese industrial relations system is that, although sectoral agreements are not ordinarily supplemented by further local collective bargaining, a significant proportion of workers actually receive wages above the level that is set via the collective bargaining process (Cardoso and Portugal 2005). This occurs when firms adjust wages upwards to reflect their specific conditions and generate a *wage cushion*. Such firm-specific mark-ups on top of wage floors set in centralized bargaining is a feature of other European countries (see Flanagan 1999 for a survey).

Data

Our empirical analysis is based on the Quadros de Pessoal (QP). This is a compulsory, annual, administrative census collected by the Portuguese Ministry of Employment, which covers all firms with employees in manufacturing and services. It contains unique, time-invariant identifiers which allow workers to be matched to their employers and to be tracked over time. The rich nature of this data set permits us to examine not just how exchange rate fluctuations impact the contractual wage but also how they impact the wage cushion and the actual wage paid.

Because the data are used by the Ministry of Employment to monitor compliance with labor law, stress is placed on the reliability of the information supplied by the employers. Portuguese law also makes it compulsory for firms to display this information publicly in the establishment. We restrict our analysis to full-time wage earners, ages 16 to 65, who work at least 25 hours a week in a firm located in mainland Portugal. Firm-level information includes sales, number of employees, equity, industry code, geographical location, and date of establishment. Information on workers includes base wage and other components of pay, gender, schooling, start date of employment, occupation, and hours worked. The data also include identifiers for the collective bargaining agreement covering the worker, as well as an indication of whether the contract is firm, multifirm, or sector specific.[12]

Because our primary goal is to investigate the effect of movements in ε, we supplement the information from the QP with source-weighted, indus-

[11]For a more detailed description of the institutional setting of collective bargaining in Portugal, see Cardoso and Portugal (2005).

[12]For further information on the data set and details on sample selection, please see the Appendix.

Table 1. Summary Statistics

Variable	*Mean*	*Standard deviation*
Actual wage (ln)	11.51	0.31
Contractual wage (ln)	11.31	0.31
Wage cushion	0.19	0.31
Age	35.53	11.00
Male	0.53	0.50
Schooling (years)	5.65	2.88
Tenure	9.54	8.90
Tenure < 1 year	0.08	0.28
Firm size	4.60	1.60
Firm age	23.20	20.60
Firm average labor productivity (ln)	8.78	1.11
Firm capital intensity	2688.84	72599.37
Market share	0.02	0.08
No. of workers in agreement (ln)	10.74	1.15
No. of districts in agreement	24.68	5.54
Employment rate (ln)	4.85	0.11
Unemployment rate	5.40	1.87
Observations	3,664,006	
Workers	938,060	
Firms	54,481	
Collective agreements	168	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.

try-specific, real exchange rates for the years 1991 to 2000. The data are classified according to the Portuguese classification of economic activities (CAE) into 74 industries.[13] Finally, as is standard in the literature (e.g., Card 1995; Bertrand 2004), we use the regional unemployment rate as an inverse proxy for $\overline{w}$, the fallback position of the union workers in the bargain.[14]

Table 1 presents summary statistics from the QP for the main variables used in the analysis over the 1991–2000 period. The average wage cushion in Portuguese manufacturing over this period was 0.19 log points. This confirms the importance of firm-specific arrangements in addition to industry-level collective bargaining. The table also illustrates the high proportion of females (47%) and the low general level of education (5.65 years) in the workforce.

Figure 1 shows the movements in the exchange rate of the Portuguese Escudo against the currencies of a number of major trading partners from 1990 to 2000. As evident in the figure, real exchange rate movements exhibit substantial heterogeneity across trading partners. The cross-industry variation in the relative importance of each partner in each industries trade is reflected in the variation in the industry real exchange rate from 1990 to 2000 (Figure 2). Such heterogeneity will be critical for identifying the wage effects of real exchange rate movements in our econometric analysis.

[13]For previous use of comparable measures see, for example, Revenga (1992); Gourinchas (1999); Campa and Goldberg (2001); Bertrand (2004); and Cuñat and Guadalupe (2009).

[14]These data are classified by NUTS-II regions, which divides mainland Portugal into North, Centre, Lisbon and Vale do Tejo, Alentejo, and the Algarve.

Figure 1. Portuguese Real Exchange Rate by Major Trading Partners, 1990–2000

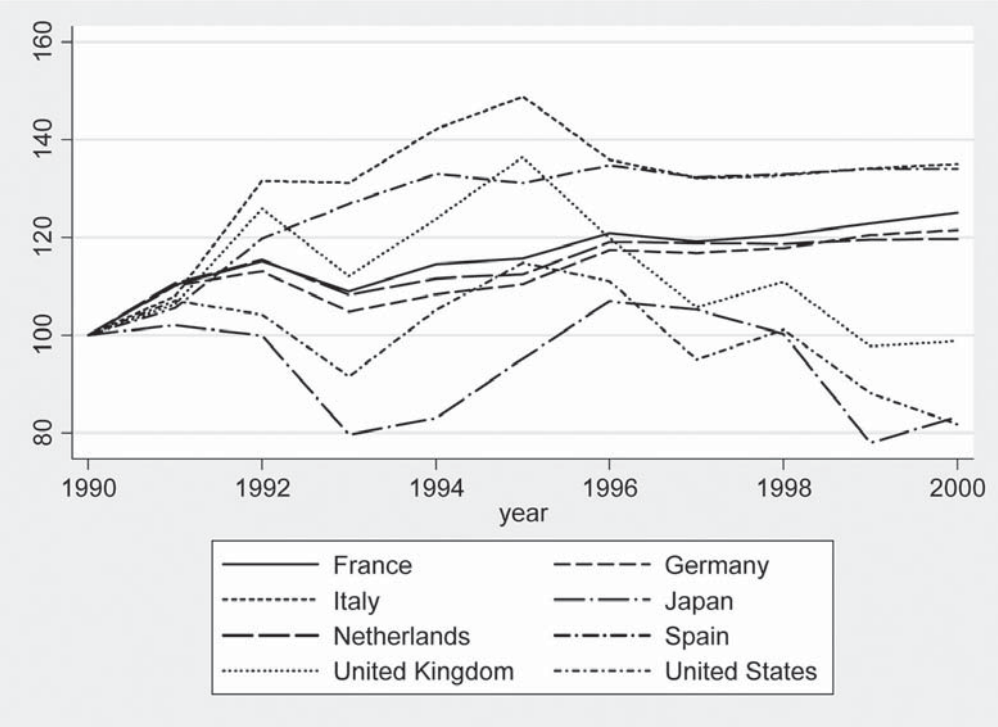


Figure 2a. Industry Real Exchange Rate, 1990–2000

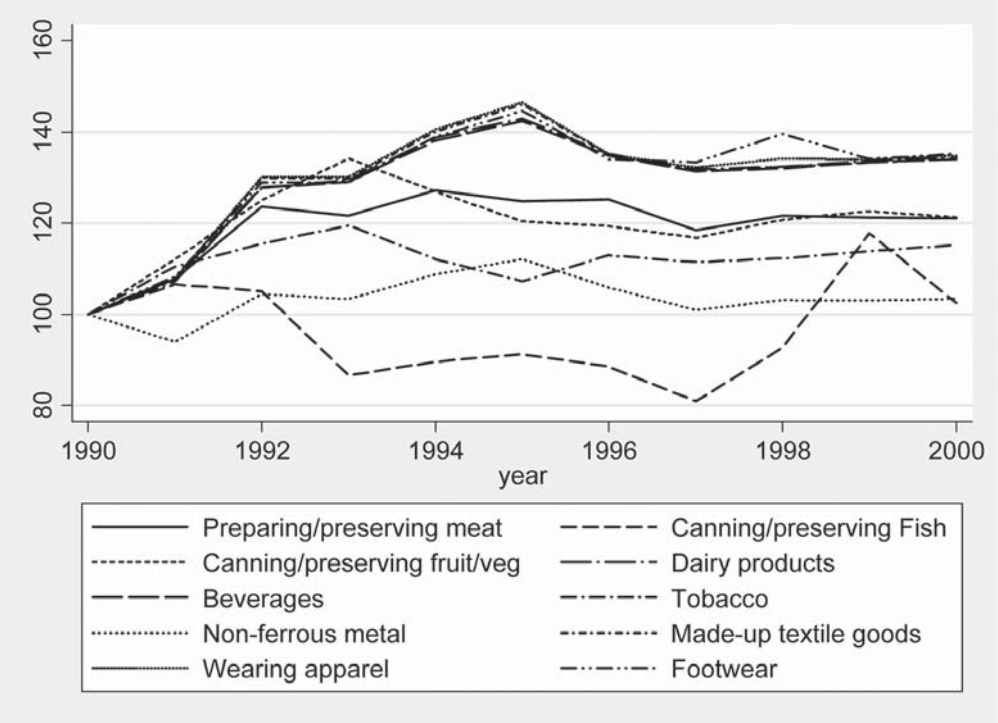
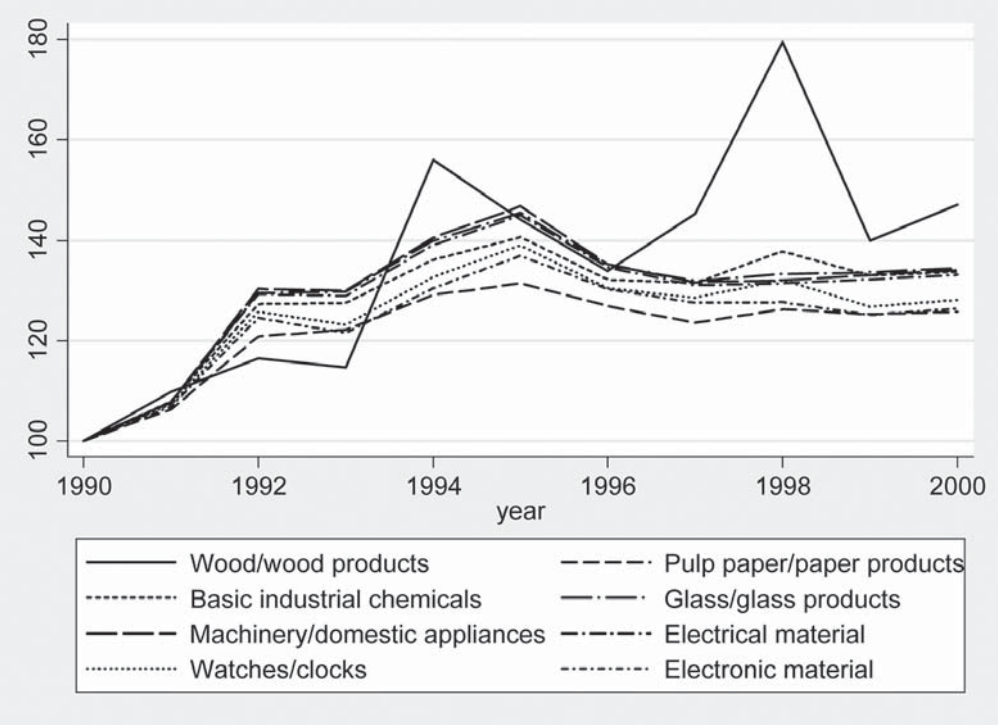


Figure 2b. Industry Real Exchange Rate, 1990–2000



Econometric Specification and Results

To investigate the impact of exchange rate fluctuations on wage determination, we use the baseline specification

$$\ln w_{it} = \alpha.\mathbf{x}_{it} + \beta.\mathbf{y}_{jt} + \gamma.\mathbf{z}_{at} + \delta.\ln \text{exch}_{k(t-1)} + \eta.\text{unemp}_{r(t-1)} + \phi_i + \theta_j + \lambda_k + \psi_r + \rho_t + \mu_{it} \quad (10)$$

where w_{it} is the wage for worker i in year t; $\mathbf{x}_{it}$ is a vector of individual characteristics; $\mathbf{y}_{jt}$ is a vector of characteristics for firm j at which worker i is employed in year t; $\mathbf{z}_{at}$ is a vector of characteristics of the collective agreement a that covers worker i in year t; ϕ_i is a person fixed effect; θ_j is a firm fixed effect; λ_k an industry-fixed effect; ψ_r is a region fixed effect; ρ_t is a time period fixed effect; and μ_{it} is an exogenous disturbance. In order to obviate from possible simultaneity problems, we lag the source-weighted real exchange rate index of industry k ($exch_{k(t-1)}$) and the unemployment rate in the region ($unemp_{r(t-1)}$).

For the dependent variable, we consider in turn the contractual wage, the wage cushion, and the actual wage. In order to split the actual wage into the contractual wage and the wage cushion, we follow the methodology of Cardoso and Portugal (2005). They argue that the mode of the distribution of the base wage for each job category, within each collective agreement, corresponds with remarkable accuracy to the contractual wage that is set through

collective bargaining.[15] The wage cushion is then defined as the ratio of overall monthly earnings actually received by the individual (including the base wage and tenure-related and other regularly paid components) to the contractual wage for the worker's professional category in the collective agreement that covers the worker.[16]

The vector of worker attributes includes age, age squared, gender, years of schooling, and tenure. The 1988 International Standard Classification of Occupations (ISCO-88) allows us to define four skilled levels, based on the level of general education and the job-related formal training required to perform a job (International Labour Office 1990).

The vector of firm characteristics includes firm size (number of employees), age since establishment, labor productivity (ratio of firm sales to the number of employees), capital intensity (equity relative to number of employees), and market share (firm sales relative to total industry sales). The vector of agreement characteristics includes the number of workers and the number of districts covered by the collective agreement.

For each specification we estimate three variants: controlling first for industry-fixed effects; second, industry and worker-fixed effects; and third, spell-fixed effects. This is made possible by the richness of our data and is helpful in determining the relative importance of industry, individual, and spell unobserved heterogeneity. Because the variable of primary interest, the exchange rate, is defined at the industry level, the tables report standard errors clustered at the industry level.

Table 2 reports the baseline results for the contractual wage, the wage cushion, and the actual wage. The results show consistent impacts of worker attributes across all three wage variants. This confirms the earlier cross-sectional evidence of Cardoso and Portugal (2005) that the wage cushion magnifies the returns to personal characteristics. Older workers have higher contractual wages, benefit from a higher wage cushion, and as a consequence, have higher actual wages. Those with higher education and those in higher skill groups also have higher contractual wages and higher wage cushions. Those of low job tenure face lower contractual wages and wage cushions. The results that omit worker-fixed effects also demonstrate the higher wages that men receive. The 20% wage premium that they command comes partially through a higher contractual wage (8%) and partially through a higher wage cushion (12%). The introduction of worker-fixed effects reduces the magnitude of the impact of schooling, though the variable retains statistical significance.

[15]To support this claim, they examine the relationship between the contractual wage for each worker category, obtained directly from published collective agreements, and the corresponding modal base wage in some preselected industries.

[16]Only categories consisting of at least 50 workers and agreements with at least 1,000 workers were included in the analysis. The final panel comprises information on 938,060 workers, 54,481 firms, and 168 sectoral agreements for the years 1991 to 2000. This amounts to about 3.6 million worker-year observations.

Table 2. Wage Effects of Real Exchange Rate Movements: Baseline Model

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Exchange rate (ln)	–0.0335	–0.0487	–0.0501	0.0037	–0.0169	–0.0165	–0.0298	–0.0657	–0.0667
	(0.0600)	(0.0511)	(0.0507)	(0.0475)	(0.0441)	(0.0443)	(0.0214)	(0.0357)*	(0.0368)*
Regional unemployment rate	–0.0046	–0.008	–0.0083	0.004	0.0023	0.002	–0.0006	–0.0057	–0.0063
	(0.0023)**	(0.0015)***	(0.0016)***	(0.0022)*	(0.0018)	(0.0016)	(0.0026)	(0.0017)***	(0.0016)***
Age	0.0117	0.0109	0.0096	0.0094	0.013	0.007	0.021	0.0239	0.0166
	(0.0024)***	(0.0036)***	(0.0033)***	(0.0013)***	(0.0024)***	(0.0022)***	(0.0033)***	(0.0046)***	(0.004)***
Age, squared	–0.0001	–0.0001	–0.0001	–0.0001	–0.0001	–0.0001	–0.0002	–0.0002	–0.0002
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Male	0.0844			0.1154			0.1997		
	(0.0076)***			(0.0096)***			(0.0085)***		
Schooling	0.018	0.0028	0.0019	0.0145	0.0054	0.0046	0.0325	0.0082	0.0065
	(0.0015)***	(0.0004)***	(0.0005)***	(0.0012)***	(0.0005)***	(0.0005)***	(0.0019)***	(0.0006)***	(0.0006)***
Tenure	0.0026	0.0014	–0.0009	0.0004	–0.0016	0.0003	0.003	–0.0002	–0.0005
	(0.0004)***	(0.0003)***	(0.0006)	(0.0003)	(0.0003)***	(0.0005)	(0.0005)***	–0.0003	(0.0003)**
Tenure < 1 year	–0.0183	–0.0057	–0.0073	–0.0086	–0.0044	–0.0116	–0.0269	–0.0101	–0.0189
	(0.0042)***	(0.0018)***	(0.0016)***	(0.0041)**	(0.0022)*	(0.0024)***	(0.0073)***	(0.0025)***	(0.0027)***
First skill group	–0.4121	–0.1810	–0.1803	–0.3630	0.0372	0.0720	–0.7751	–0.1437	–0.1083
	(0.0457)***	(0.0228)***	(0.02)***	(0.0443)***	(0.025)	(0.0214)***	(0.0175)***	(0.0084)***	(0.0082)***
Second skill group	–0.2848	–0.0867	–0.0896	–0.3938	–0.0174	0.0145	–0.6786	–0.1041	–0.0751
	(0.0418)***	(0.0145)***	(0.0118)***	(0.0416)***	(0.0202)	(0.0155)	(0.0198)***	(0.0080)***	(0.0073)***
Third skill group	–0.0189	0.0413	0.0273	–0.3638	–0.0975	–0.0663	–0.3827	–0.0562	–0.0390
	(0.0434)	(0.0186)**	(0.0147)*	(0.0384)***	(0.0223)***	(0.0178)***	(0.0178)***	(0.0063)***	(0.0067)***

continued

Table 2. Continued

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Firm size	0.0073	0.0102	0.011	0.033	0.0223	0.027	0.0404	0.0326	0.038
	(0.003)**	(0.0020)***	(0.0030)***	(0.0028)***	(0.0023)***	(0.0035)***	(0.0051)***	(0.0031)***	(0.0039)***
Firm age	–0.0002	–0.0003	0.0051	–0.0001	0.0002	0.01	–0.0003	–0.0001	0.0152
	(0.0001)	(0.0001)***	(0.0018)***	(0.0002)	(0.0002)	(0.0014)***	(0.0002)	(0.0001)	(0.0017)***
Firm labor prod (ln)	0.0086	0.001	0.0007	0.0237	0.0042	0.0034	0.0323	0.0052	0.0041
	(0.0024)***	(0.0008)	(0.0007)	(0.0035)***	(0.0011)***	(0.0012)***	(0.0054)***	(0.0015)***	(0.0015)***
Firm capital intensity	0.0112	0.0039	0.0022	–0.0003	–0.0105	–0.0102	0.0109	–0.0067	–0.008
	(0.0066)*	(0.0034)	(0.0026)	(0.0054)	(0.006)*	(0.0056)*	(0.0079)	(0.0043)	(0.0043)*
Firm market share	0.2109	0.0554	0.0166	0.066	–0.0326	–0.0062	0.2768	0.0229	0.0105
	(0.0945)**	(0.0256)**	(0.0394)	(0.0862)	(0.0501)	(0.0642)	(0.1154)**	(0.0518)	(0.0621)
No. workers in agreement (ln)	–0.0186	–0.0152	–0.0152	0.0145	0.0174	0.0221	–0.0041	0.0021	0.007
	(0.0122)	(0.0103)	(0.0123)	(0.0054)***	(0.0076)**	(0.0096)**	(0.0102)	(0.0037)	(0.0039)*
No. districts in agreement	–0.0006	–0.0003	–0.0003	0.0007	0.0002	0.0001	0.0001	–0.0001	–0.0002
	(0.0012)	(0.001)	(0.0011)	(0.0006)	(0.0004)	(0.0005)	(0.001)	(0.0008)	(0.0009)
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker-fixed effects		Yes			Yes			Yes	
Spell-fixed effects			Yes			Yes			Yes
R-squared	0.56	0.84	0.86	0.17	0.66	0.71	0.58	0.88	0.89
Observations		3,654,006			3,654,006			3,654,006	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.
Notes: Robust standard errors clustered by industry in parentheses. The period of analysis is 1991–2000. Year dummies included.
* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

The characteristics of the firm are also important with, in general, the wage cushion magnifying the impact where the effect is statistically significant. Those in larger and more productive firms earn more than smaller, less productive firms, where the impact through the wage cushion is larger in magnitude. Although workers appear to gain an additional premium if their firm has a larger market share, this effect loses its numerical and statistical significance once individual and then spell unobserved heterogeneity are controlled for.

Workers also appear to be able to obtain higher wages if the number of workers covered by the collective agreement is higher, though this impact is weak and felt only via the wage cushion and not in the contractual or actual wage paid.

As might be expected, actual wages paid are negatively associated with the regional unemployment rate. Interestingly, however, our results suggest that this association is largely driven by the negative response of contractual wages.

Turning to the primary focus of this paper, we see that a higher real exchange rate leads to a fall in actual wages, as predicted by our theoretical framework. Specifically, the estimates point to an average real wage elasticity with respect to the exchange rate of about 0.07. This is very much in line with the estimated elasticity obtained by Campa and Goldberg (2001) for U.S. manufacturing (0.06). The impact of the exchange rate emerges through a change in both the contractual wage and the wage cushion, and their joint impact is to cause reductions in the actual wage paid, although this is only statistically significant at the 10% level. The magnitude of the effects remains very similar when spell-fixed effects models are used to control simultaneously for worker and firm unobserved heterogeneity.[17]

Heterogeneity of Effects

We have suggested that the wage impacts of exchange rate fluctuations are likely to depend on external labor market conditions and to be heterogeneous across groups of workers and firms. We investigate this possibility by augmenting the baseline model in a number of ways. The role that regional unemployment plays in moderating the impact of exchange rate movements is investigated in Table 3, panel A. This table shows that the sensitivity of wages to a real currency appreciation decreases with the level of regional unemployment and has an elasticity of 0.18 if the level of unemployment is two standard deviations below the mean. This finding is consistent with the theoretical mechanisms we have advanced here and does not appear to

[17]The fact that the impact of exchange rates is less precisely measured in specifications that do not account for unobserved worker or spell effects is expected, given our argument about the importance of controlling for heterogeneity. Since the number of workers and the number of districts covered by the agreement are themselves likely to be affected by exchange rates, we have verified that the results are robust to the exclusion of these controls.

Table 3. Wage Effects of Real Exchange Rate Movements: The Role of Regional Unemployment

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
A: All workers									
Exchange rate (ln)	–0.0552	–0.1344	–0.1384	–0.0423	–0.0971	–0.0968	–0.0975	–0.2315	–0.2352
	(0.0807)	(0.0723)*	(0.0728)*	(0.0563)	(0.0427)**	(0.0421)**	(0.0523)*	(0.0571)***	(0.0575)***
Regional unemployment rate	–0.0237	–0.0847	–0.0872	–0.0367	–0.0696	–0.0697	–0.0604	–0.1543	–0.1568
	(0.0334)	(0.0296)***	(0.0307)***	(0.0289)	(0.0195)***	(0.0206)***	(0.0393)	(0.0322)***	(0.0323)***
Exchange rate (ln) * reg unemp rate	0.004	0.016	0.0164	0.0085	0.015	0.0149	0.0125	0.0309	0.0313
	(0.0068)	(0.006)***	(0.0062)**	(0.0060)	(0.0040)***	(0.0042)***	(0.0081)	(0.0066)***	(0.0066)***
R-squared	0.56	0.84	0.86	0.17	0.66	0.70	0.59	0.88	0.89
Observations		3,654,006			3,654,006			3,654,006	
B: High-tenure workers(> 5 years)									
Exchange rate (ln)	–0.0721	–0.1338	–0.1321	–0.0727	–0.0638	–0.0695	–0.1448	–0.1977	–0.2017
	(0.0979)	(0.0794)*	(0.0801)	(0.0670)	(0.0524)	(0.0537)	(0.0657)**	(0.0539)***	(0.0543)***
Regional unemployment rate	–0.0318	–0.0852	–0.0848	–0.0863	–0.0525	–0.0547	–0.1181	–0.1377	–0.1395
	(0.044)	(0.0330)**	(0.0333)**	(0.0351)**	(0.0224)**	(0.0231)**	(0.0503)**	(0.0324)***	(0.032)***
Exch rate (ln) * reg unemp rate	0.0057	0.0163	0.0163	0.0188	0.0116	0.0119	0.0245	0.0279	0.0281
	(0.0088)	(0.0067)**	(0.0068)**	(0.0073)**	(0.0047)**	(0.0048)**	(0.0103)**	(0.0066)***	(0.0065)***
R-squared	0.58	0.86	0.87	0.18	0.71	0.72	0.61	0.90	0.91
Observations		2,049,591			2,049,591			2,049,591	
C: Low-tenure workers(≤ 5 years)									
Exchange rate (ln)	–0.0274	–0.1208	–0.1097	–0.0045	–0.1038	–0.1107	–0.0319	–0.2246	–0.2204
	(0.0719)	(0.0623)*	(0.0600)*	(0.0568)	(0.0427)**	(0.0391)***	(0.0593)	(0.062)***	(0.0623)***
Regional unemployment rate	–0.0129	–0.0671	–0.051	0.0303	–0.081	–0.0934	0.0174	–0.1481	–0.1443
	(0.0270)	(0.0278)**	(0.0274)*	(0.0328)	(0.0252)***	(0.0282)***	(0.0327)	(0.0337)***	(0.0343)***
Exch rate (ln) * reg unemp rate	0.0018	0.0118	0.0084	–0.0053	0.0174	0.02	–0.0035	0.0292	0.0285
	(0.0056)	(0.0056)**	(0.0056)	(0.0069)	(0.0052)***	(0.0058)***	(0.0068)	(0.0068)***	(0.0069)***
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker-fixed effects		Yes			Yes			Yes	
Spell-fixed effects			Yes			Yes			Yes
R-squared	0.53	0.85	0.88	0.15	0.70	0.75	0.53	0.87	0.90
Observations		1,604,415			1,604,415			1,604,415	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.

Notes: Robust standard errors clustered by industry in parentheses. The period of analysis is 1991–2000. Year dummies included.

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

depend in a systematic way with worker tenure (Panels B and C). Interestingly, this result contrasts with related estimates obtained by Bertrand (2004) that reveal increased sensitivity in the U.S. labor market, where trade unions have considerably less influence in wage setting.

In Table 4 we investigate the interaction of the exchange rate with our measure of schooling. We find that the negative wage impact of appreciation is higher for those with lower schooling (an elasticity of 0.20 for levels of schooling two standard deviations below the mean level). Perhaps more important, the negative relationship is exclusively driven by adjustments in the wage cushion, which offset contrary movements in contractual wages. This finding is consistent with the theoretical explanation proposed by Guadalupe (2007), who emphasizes the role of firm-specific incentives and market forces, as opposed to collective bargaining, in determining the causal effect of international competition on returns to skill. The contrary movement in the negotiated wage is also in line with the hypothesis that trade unions have egalitarian aims and seek to offset this effect by means of collective wage bargaining.[18]

As can be seen in Table 5, the impact of exchange rate appreciation for those with low levels of tenure mirrors the impact for those with low levels of schooling. Again the negative wage impact of appreciation is driven primarily by movement in the wage cushion, and those with low levels of tenure appear to be somewhat protected by contrary movements in the negotiated wage.

Table 6 examines the differential impact of exchange rate movement by gender and shows a sizable differential. The negative impact of exchange rate appreciation (an elasticity of 0.13 for females) is almost negated for males. Interestingly, this comes about almost equally by a more favorable reaction of the contractual wage and of the wage cushion.

Earlier we noted that sectorwide collective agreements applying to all firms in a given industry would be expected to be more binding for less productive firms, and we argued that the impact of a currency appreciation was therefore likely to be more pronounced among this subset of firms. We investigate this proposition in Table 7. The estimates suggest that the deleterious impact of exchange rate appreciation on wages (an elasticity of 0.19 for those firms with productivity two standard deviations below the mean) is indeed less negative in firms with higher levels of labor productivity.

The theoretical model we have presented emphasizes the role of union incentives in determining negative wage adjustments. We might therefore expect these effects to be more pronounced in the presence of stronger unions. To examine this hypothesis empirically, we consider whether the size of the collective agreement plays a role in determining the magnitude

[18]Empirically, Guadalupe (2007) finds for the United Kingdom and Falvey, Greenaway, and Silva (2008) find for Portugal that harsher international competition (as measured by a real currency appreciation) leads to higher returns to skill, but do not distinguish between contractual wages and the wage cushion.

Table 4. Wage Effects of Real Exchange Rate Movements: The Role of Schooling

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Schooling	0.1791	0.0425	0.0399	–0.1585	–0.1697	–0.1664	0.0205	–0.1272	–0.1266
	(0.0301)***	(0.0230)*	(0.023)*	(0.0242)***	(0.0205)***	(0.0217)***	(0.0174)	(0.0135)***	(0.0134)***
Exchange rate (ln)	0.1412	–0.0069	–0.0101	–0.184	–0.2014	–0.1968	–0.0428	–0.2083	–0.2069
	(0.0656)**	(0.0547)	(0.0535)	(0.0522)***	(0.0478)***	(0.0484)***	(0.0315)	(0.0417)***	(0.0424)***
Exch rate (ln) * schooling	–0.0332	–0.0082	–0.0078	0.0357	0.0361	0.0352	0.0025	0.0279	0.0274
	(0.0062)***	(0.0047)*	(0.0047)	(0.0049)***	(0.0042)***	(0.0045)***	(0.0037)	(0.0028)***	(0.0028)***
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker-fixed effects		Yes			Yes			Yes	
Spell-fixed effects			Yes			Yes			Yes
R-squared	0.56	0.84	0.86	0.17	0.66	0.70	0.59	0.88	0.89
Observations		3,654,006			3,654,006			3,654,006	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.
Notes: Robust standard errors clustered by industry in parentheses. The period of analysis is 1991–2000. Year dummies included.
* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

Table 5. Wage Effects of Real Exchange Rate Movements: The Role of Tenure

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Tenure	–0.007	–0.0006	–0.0021	–0.0144	0.0007	0.0026	–0.0215	0.0001	0.0006
	(0.0067)	(0.0054)	(0.0054)	(0.0056)**	(0.0047)	(0.0042)	(0.0079)***	(0.0046)	(0.0044)
Tenure <1 year	–0.2806	–0.3671	–0.1789	0.3751	0.4485	0.3525	0.0945	0.0814	0.1736
	(0.1136)**	(0.1044)***	(0.0964)*	(0.0863)***	(0.06)***	(0.0592)***	(0.1166)	(0.0864)	(0.0806)**
Exchange rate (ln)	–0.0581	–0.0576	–0.0552	–0.0211	–0.0063	–0.0064	–0.0792	–0.0639	–0.0616
	(0.0642)	(0.0527)	(0.0523)	(0.0485)	(0.0451)	(0.0455)	(0.0258)***	(0.0351)*	(0.0362)*
Exch rate (ln) * tenure	0.0019	0.0004	0.0003	0.0031	–0.0005	–0.0006	0.0051	–0.0001	–0.0003
	(0.0014)	(0.0011)	(0.0011)	(0.0012)**	(0.0008)	(0.0009)	(0.0017)***	(0.0009)	(0.0009)
Exch rate (ln) * tenure < 1 year	0.0541	0.0746	0.0354	–0.0793	–0.0935	–0.0751	–0.0252	–0.0189	–0.0397
	(0.0236)**	(0.0214)***	(0.0198)*	(0.0180)***	(0.0124)***	(0.0122)***	(0.0252)	(0.0179)	(0.0168)**
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker-fixed effects		Yes			Yes			Yes	
Spell-fixed effects			Yes			Yes			Yes
R-squared	0.56	0.84	0.86	0.17	0.66	0.70	0.59	0.88	0.89
Observations		3,654,006			3,654,006			3,654,006	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.

Notes: Robust standard errors clustered by industry in parentheses. The period of analysis is 1991–2000. Year dummies included.

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

Table 6. Wage Effects of Real Exchange Rate Movements: The Role of Gender

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Male	0.1529			0.0238			0.177		
	(0.1048)			(0.112)			(0.1043)*		
Exchange rate (ln)	–0.0261	–0.0875	–0.0877	–0.0062	–0.0459	–0.0459	–0.0323	–0.1335	–0.1336
	(0.0621)	(0.0482)*	(0.0485)*	(0.0503)	(0.0482)	(0.0486)	(0.0251)	(0.0371)***	(0.0384)***
Exch rate (ln) * male	–0.0141	0.0721	0.0688	0.0189	0.0539	0.0538	0.0047	0.1261	0.1226
	(0.022)	(0.031)**	(0.0319)**	(0.0231)	(0.0158)***	(0.0165)***	(0.0215)	(0.0243)***	(0.0245)***
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker-fixed effects		Yes			Yes			Yes	
Spell-fixed effects			Yes			Yes			Yes
R-squared	0.56	0.84	0.86	0.17	0.66	0.70	0.58	0.88	0.89
Observations		3,654,006			3,654,006			3,654,006	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.
Notes: Robust standard errors clustered by industry in parentheses. The period of analysis is 1991–2000. Year dummies included.
* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

Table 7. Wage Effects of Real Exchange Rate Movements: The Role of Productivity

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Firm labor productivity (ln)	–0.1619	–0.1464	–0.1357	–0.2776	–0.1147	–0.1028	–0.4395	–0.2611	–0.2385
	(0.0477)***	(0.0342)***	(0.0319)***	(0.0809)***	(0.0271)***	(0.0268)***	(0.0993)***	(0.0281)***	(0.0265)***
Exchange rate (ln)	–0.3478	–0.323	–0.3056	–0.5515	–0.2382	–0.2154	–0.8993	–0.5613	–0.5211
	(0.1067)***	(0.085)***	(0.082)***	(0.1668)***	(0.0672)***	(0.0681)***	(0.1952)***	(0.0609)***	(0.06)***
Exch rate (ln) * firm labor prod (ln)	0.0355	0.0307	0.0284	0.0627	0.0248	0.0222	0.0982	0.0556	0.0506
	(0.0102)***	(0.0071)***	(0.0067)***	(0.017)***	(0.0056)***	(0.0056)***	(0.0212)***	(0.0058)***	(0.0055)***
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker-fixed effects		Yes			Yes			Yes	
Spell-fixed effects			Yes			Yes			Yes
R-squared	0.56	0.84	0.86	0.17	0.66	0.70	0.59	0.88	0.89
Observations		3,654,006			3,654,006			3,654,006	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.

Notes: Robust standard errors clustered by industry in parentheses. The period of analysis is 1991–2000. Year dummies included.

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

Table 8. Wage Effects of Real Exchange Rate Movements: The Role of Agreement Size

	Contractual wage			*Wage cushion*			*Actual wage*		
Variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
No. workers in agreement (ln)	0.2416	0.2858	0.292	–0.151	–0.1195	–0.1242	0.0906	0.173	0.1617
	(0.0858)***	(0.0775)***	(0.0798)***	(0.0581)**	(0.0491)**	(0.0524)**	(0.063)	(0.0885)*	(0.0875)*
Exchange rate (ln)	0.5382	0.6096	0.628	–0.36	–0.3184	–0.3372	0.1783	0.31	0.2724
	(0.2078)**	(0.1967)***	(0.1997)***	(0.1376)**	(0.1202)***	(0.1266)***	(0.1453)	(0.2008)	(0.199)
Exch rate (ln) * no. workers in agreem. (ln)	–0.0538	–0.0622	–0.0636	0.0342	0.0283	0.0303	–0.0196	–0.0352	–0.032
	(0.0182)***	(0.0174)***	(0.0177)***	(0.0121)***	(0.001)***	(0.0106)***	(0.0134)	(0.0188)	(0.0185)*
Industry-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker-fixed effects		Yes			Yes			Yes	
Spell-fixed effects			Yes			Yes			Yes
R-squared	0.56	0.84	0.86	0.17	0.67	0.70	0.59	0.88	0.89
Observations		3,654,006			3,654,006			3,654,006	

Source: Ministry of Employment, Quadros de Pessoal, 1991–2000.

Notes: Robust standard errors clustered by industry in parentheses. The period of analysis is 1991–2000. Year dummies included.

* Statistically significant at the .10 level; ** at the .05 level; *** at the .01 level.

of wage adjustment to a currency appreciation. The underlying assumption is that trade unions negotiating wages on behalf of a larger number of workers should have greater influence over wage formation. The estimates in Table 8 suggest that negative adjustments in contractual wages are indeed more pronounced in agreements covering a larger number of workers (an elasticity of 0.14 for those agreements with size two standard deviations above the mean), although this effect is largely offset by contrary adjustments in the wage cushion.

Conclusions

Using uniquely rich worker-firm panel data for the Portuguese manufacturing sector, we have been able to distinguish between changes in industry-wide collective wages and subsequent adjustments at the level of the firm. Our estimates point to an average real wage elasticity with respect to real exchange rate changes of about 0.07, most of which reflects adjustments in industry-level collective wages. The magnitude of this estimate is close to related estimates for the U.S. labor market (Revenga 1992; Campa and Goldberg 2001). This is an interesting finding, considering the important differences that characterize the two labor markets. On the one hand, Portugal is a small open economy and hence a given variation in the exchange rate might be expected to represent a stronger shock to firms and workers than in the United States. On the other hand, the Portuguese labor market features a stronger union presence, national minimum wages, and more rigid employment protection legislation, which might be expected to lead to lower wage flexibility than in the United States.

Our results reveal, however, that wage responses vary considerably by worker characteristics. Specifically, the negative wage effects of exchange rate appreciations tend to be felt by newcomers to the firm, the low skilled, and women. Finally, we find that a currency appreciation tends to decrease the sensitivity of wages to the local unemployment rate, a result that contrasts with related estimates obtained by Bertrand (2004) for the U.S. labor market.

Appendix

Longitudinal Linked Employer-Employee Data Set

The primary source of data in the paper is the Quadros de Pessoal (QP). Our sample consists of full-time workers in manufacturing, 16 to 65 years old, earning at least the national minimum wage. Records with inconsistencies in worker gender, date of birth, and the highest level of schooling are removed.[19]

Because we compute the contractual wage as the mode of the distribution of base wages for each job category within each collective agreement for each year (as in Cardoso and Portugal 2005), we only keep job categories with at least 50 workers and agreements with at least

[19]Details of procedures used to correct inconsistencies follow Cardoso (2006) and are available from the authors on request.

1,000 workers. The final worker-firm panel contains information on 938,060 workers, 54,481 firms, and 168 sectoral agreements for the years 1991 to 2000, yielding a total of 3,654,006 observations.

Exchange Rate Data

The real exchange rates are the product of the nominal exchange rates (expressed in units of foreign currency per unit of local currency) and the ratio between the Portuguese Consumer Price Index (CPI) and foreign CPI. The weights used are the shares of each trade partner in Portuguese imports in the 1990–91 period. For each industry, we have normalized the real exchange rate index to 100 in 1990. The nominal exchange rates and CPI come from the International Financial Statistics of the International Monetary Fund.

Industry-Level Data

The industry-level data are classified according to the Portuguese classification of economic activities (CAE); however, since the CAE classification was revised in 1994, the resulting data set comprises 74 industries. Of the 99 manufacturing industries in CAE-Rev.1, 56 had direct equivalents in CAE-Rev.2. The remaining 46 industries were aggregated into 18 sectors to provide an equivalence. The concordance used is available from the authors on request.

Definition of Skill Groups

Among the vector of individual attributes we include a group of dummy variables to control for the skill level associated with the worker's occupation, as defined in the ISCO-88 classification. Table A.1 presents the definition of skill groups and sample proportions.

Table A.1. The ISCO Classification System

Occupational group	*Percentage of total*	*Description*	*ISCO major group*
First skill level	16.66	Competence associated with general education usually acquired by completion of compulsory education	(9) Elementary occupations
Second skill level	76.41	Requires knowledge as for first skill level, but in addition typically have a longer period of worker-related training or work experience	(4) Clerks (5) Service workers and shop and market sales (6) Skilled agriculture and fishery (7) Craft and related workers (8) Plant and machine operators and assemblers
Third skill level	4.89	Requires a body of knowledge associated with a period of post-compulsory education but not to degree level	(3) Technicians and associate professionals
Fourth skill level	2.05	Normally requires a degree or an equivalent period of relevant work experience	(1) Legislators, senior officials, and managers (2) Professionals
Observations	3,664,006		

Source: International Labour Office (1990), p. 23; Elias, McKnight, and Kingshott (1999).

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