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**WAGE DYNAMICS
NETWORK**

WORKING PAPER SERIES

NO 1225 / JULY 2010

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**PRICE AND WAGE
FORMATION IN
PORTUGAL**

by Carlos Robalo Marques,
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and Pedro Portugal



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**WAGE DYNAMICS
NETWORK**

PRICE AND WAGE FORMATION IN PORTUGAL

by Carlos Robalo Marques¹, Fernando Martins²
and Pedro Portugal³



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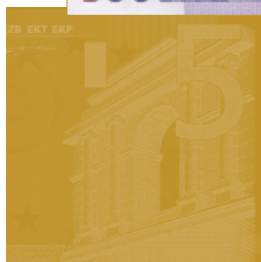
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Wage Dynamics Network

This paper contains research conducted within the Wage Dynamics Network (WDN). The WDN is a research network consisting of economists from the European Central Bank (ECB) and the national central banks (NCBs) of the EU countries. The WDN aims at studying in depth the features and sources of wage and labour cost dynamics and their implications for monetary policy. The specific objectives of the network are: i) identifying the sources and features of wage and labour cost dynamics that are most relevant for monetary policy and ii) clarifying the relationship between wages, labour costs and prices both at the firm and macro-economic level.

The WDN is chaired by Frank Smets (ECB). Giuseppe Bertola (Università di Torino) and Julián Messina (World Bank and University of Girona) act as external consultants and Ana Lamo (ECB) as Secretary.

The refereeing process of this paper has been co-ordinated by a team composed of Gabriel Fagan (ECB, chairperson), Philip Vermeulen (ECB), Giuseppe Bertola, Julián Messina, Jan Babecký (CNB), Hervé Le Bihan (Banque de France) and Thomas Mathä (Banque centrale du Luxembourg).

The paper is released in order to make the results of WDN research generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the author's own and do not necessarily reflect those of the ESCB.

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Abstract

This paper brings together empirical research on price and wage dynamics for the Portuguese economy based both on micro and macro data. As regards firms' pricing behaviour the most noticeable finding is that prices in Portugal are somewhat less flexible than in the United States but more flexible than in the Euro Area. Regarding firms' wage setting practices, we uncover evidence favouring the hypothesis of aggregate and disaggregate wage flexibility. Despite the existence of mandatory minimum wages, the presence of binding wage floors and the general use of extension mechanisms, the firms still retain some ability to circumvent collective agreements via the mechanism of the wage cushion. The evidence also suggests that Portuguese wages behave in a fashion consistent with the wage curve literature, but the responsiveness of real wages to unemployment changes may have declined over the last decade.

JEL classification: C42, D40, E31, J30.

Key words: Survey data, wage and price rigidities, persistence, wage cushion.

Non technical summary

The existence of wage and price rigidities is widely recognised as a critical issue for macroeconomics and, most notably, for monetary policy design. On the theoretical front, recent literature - of which Erceg et al. (2000), Christiano et al. (2005), Levin et al. (2005) and Blanchard and Galí (2007) are sensible examples - has emphasized the importance of price and wage rigidities for the evolution of the macro economy in response to shocks. On the empirical front, there is now a large bulk of evidence on the existence of price and nominal wage rigidities, for which the economic theory provides several explanations (existence of *menu costs*, *explicit and/or implicit contracts*, *coordination failure*, etc.).

This paper brings together empirical evidence on price and wage dynamics for the Portuguese economy based both on micro and macro data. The analysis involves recent findings on price and wage setting practices, as well as evidence on persistence of wage and price inflation. The paper starts by documenting the main features of firms' price and wage setting practices employing the quantitative individual price data underlying official consumer (CPI) and producer (PPI) price indices, as well as qualitative information from surveys of firms. In particular, the monthly frequency of price changes, the duration of wage and price spells, the speed of price reaction to demand and cost shocks, the synchronisation of price and wage changes, and the main explanations behind infrequent wage and price adjustments are investigated.

The paper then proceeds by addressing different aspects concerning the process of wage formation in Portugal resorting to econometric evidence based on micro data. In the process of wage formation, wages are determined through a bargaining process between firms and employees (or the labour unions) and the leeway for negotiations is determined by the conditions underlying company survival and by the workers' reservation wage. In general, it is the bargaining power of the parties that ultimately determines the final outcome. But, the bargaining power depends on a variety of factors, among them risk aversion (say, with respect to income fluctuations), the capacity to inflict costs on employers (for example, through industrial action), the composition of the workforce (e.g., in terms of insiders and outsiders), or the existence of asymmetric information (for example about the company's economic performance). Against this background, some features of the Portuguese labour market deemed to be relevant for wage setting, such as the characteristics of the wage bargaining system, the impact of minimum wages on employment, the determinants of the wage cushion (the difference between the actual wage and the bargained wage), the consequences for wages stemming from firm closures or the treat of unemployment, and the cyclical behaviour of real wages are investigated. Despite the rigidity imposed by the existence of mandatory minimum wages, the presence of binding wage floors determined by collective agreements, and the general use of extension mechanisms, the firms still retain the ability to circumvent wage agreements via the mechanism of the wage cushion.

Finally, the paper focuses on the dynamics of aggregate wages and prices. In the real world, the existence of price and wage rigidities is expected to translate into

persistent responses of real wages, as well as of price and wage inflation to the shocks hitting the economy. Thus, this section reports the evidence on persistence of the responses of wages and prices to different types of shocks by comparing the evidence for Portugal with similar evidence for the euro area (EA) and the United States (US). As regards firms' pricing behaviour the most noticeable finding is that, in the Portuguese economy, prices are somewhat less flexible than in the US but more flexible than in the EA. Regarding firms' wage setting practices, we uncovered evidence favouring the hypothesis of aggregate wage flexibility. Portuguese wages behave in a fashion consistent with the Wage Curve literature. In its static interpretation, a 10 percent increase in the unemployment rate generates a 1 percent decrease in real wage. Recent evidence from both aggregate and disaggregate wage data, however, suggests that the responsiveness of real wages to unemployment changes may have declined over the last decade. The indication of a fall in the cyclical sensitivity of wages may be associated to the nature of the current mechanisms for wage determination in a low-inflation environment (in particular under severe nominal downward rigidity of wages).

1 Introduction

The existence of wage and price rigidities is widely recognised as a critical issue for macroeconomics and, most notably, for monetary policy design. On the theoretical front, recent literature - of which Erceg et al. (2000), Christiano et al. (2005), Levin et al. (2005) and Blanchard and Galí (2007) are sensible examples - has emphasized the importance of price and wage rigidities for the evolution of the macro economy in response to shocks. On the empirical front, there is now a large bulk of evidence on the existence of price and nominal wage rigidities, for which the economic theory provides several explanations (existence of *menu costs*, *explicit and/or implicit contracts*, *coordination failure*, etc.).

This paper brings together empirical evidence on price and wage dynamics for the Portuguese economy based both on micro and macro data. The analysis, conducted from different but complementary standpoints, involves recent findings on price and wage setting practices, as well as evidence on persistence of wage and price inflation.

The paper starts by documenting the main features of firms' price and wage setting practices by using evidence based on individual price data underlying official consumer (CPI) and producer (PPI) price indices, as well as qualitative information from surveys of firms. In particular, the monthly frequency of price changes, the duration of wage and price spells, the speed of price reaction to demand and cost shocks, the synchronisation of price and wage changes, and the main explanations behind infrequent wage and price adjustments are investigated.

The paper then proceeds by addressing different aspects concerning the process of wage formation in Portugal resorting to econometric evidence based on micro data. The Portuguese labour is characterised by a number of distinctive features. First and foremost, we confirmed an extreme level of nominal wage rigidity (see, for instance, Dickens et al. (2007)). This nominal rigidity is associated with barriers to a nominal fall in wages (legal, contractual and others). Indeed, since the 1950s, nominal wage cuts are forbidden in Portugal. This restriction, however, does not create insurmountable restrictions for companies seeking real wage concessions below the inflation rate. In such a case it will be enough to ensure that a nominal wage up-date is below inflation. The higher the inflation rate, the more leeway on wages is available for companies. Another interesting characteristic of the Portuguese labour market is that firms often pay their workers above the contractual wage, ensuring a wage cushion which has served as an important mechanism for wage flexibility (Cardoso and Portugal (2005)). However, in the context of the current low-inflation regime, nominal wage rigidity may stop companies from adjusting to negative product demand shocks. The smaller the wage cushion (the difference between the wage actually paid and the wage agreed in collective pay bargaining) the more difficult this manipulation will become. In addition, the Portuguese labour market is also characterised by a widespread use of compulsive extension mechanisms which expands an existing collective agreement to other workers initially not covered by it or it can create a new one, if it is not viable to extend the

application of an existing document. In a low-inflation-regime, this may act as an additional difficulty for firms seeking to adjust their real wages.

Against this background, some features of the Portuguese labour market deemed to be relevant for wage setting, such as the characteristics of the wage bargaining system, the impact of minimum wages on employment, the determinants of the wage cushion (the difference between the actual wage and the bargained wage), the consequences for wages stemming from firm closures or the treat of unemployment, and the cyclical behaviour of real wages are investigated. It is worth mentioning that among the external factors conditioning wage movements, the economic cycle plays a decisive role. Leaving aside compositional effects, real wages for Portuguese workers are highly pro-cyclical, especially for starting wages (Carneiro et al. (2009))

Finally, the paper focuses on the dynamics of aggregate wages and prices. In the real world, the existence of price and wage rigidities is expected to translate into persistent responses of real wages, as well as of price and wage inflation to the shocks hitting the economy. Thus, this section reports the evidence on persistence of the responses of wages and prices to different types of shocks by comparing the evidence for Portugal with similar evidence for the euro area (EA) and the United States (US).

The last section of the paper summarises and discusses the main conclusions concerning the processes of wage and price formation in the Portuguese economy.

2 Micro evidence on price and wage rigidities

This section summarises the evidence recently obtained for Portugal on price and wage setting at the micro level. We consider studies with micro data on consumer and producer prices, as well as information on price and wage setting based on survey data.

The evidence presented in this section is based mainly on two datasets. The first of these sources is the individual price data underlying the official consumer (CPI) and producer (PPI) price indices collected by the Portuguese *Instituto Nacional de Estatística* (INE). The CPI database covers the period from January 1992 to December 2001 and contains information on consumer prices at the outlet and product levels, whereas the PPI database contains information on producer prices at the firm and product level covering the period from January 1995 to August 2002. These are longitudinal datasets: firms or outlets are followed over time on a monthly or quarterly basis. The study of these data was pioneered by Dias et al. (2008). In order to ensure the comparability of the results for Portugal, the EA and the US, the micro CPI evidence reported in this section was based on a narrowly defined sample of 50 products, which are considered to be approximately representative of the full CPI basket (see Dhyne et al. (2006)).

The second dataset contains information obtained from a survey conducted by the Banco de Portugal in 2008 in the context of its participation in the Wage Dynamics Network (WDN) - a Eurosystem research network set up in 2006 aimed at studying more in depth the features and sources of wage and labour cost dynamics in the EA

and their implications for monetary policy. Details on the survey design and sample selection can be found in Martins (2009).

2.1 Some stylised facts on price-setting in Portugal

This subsection describes the pattern of individual price adjustments in Portugal, summarised in a number of stylised facts¹. This evidence is compared to the extent possible to the results obtained with survey data even though this should be made with some caution as the nature of the latter information is very different from the micro quantitative data.

Table 1

Monthly frequency of price changes and durations of price spells		Portugal	EA	US
Monthly frequency of price changes	CPI	0.21	0.15	0.25
	PPI	0.23	0.21	–
Duration of price spells (in months)	CPI ⁽¹⁾	8.5	10.6	4.6
	Survey ⁽²⁾	10.3	9.6	8.3

Source: alvarez2006; bils2004; blinder1998;

Dhyne et al. (2006); druant2009; and Martins (2009).

⁽¹⁾ Median; ⁽²⁾ Unweighted average.

Fact 1 - Changes in consumer prices are rather infrequent. The monthly frequency of price changes in Portugal is equal to 0.21, which means that about 1 out of 5 prices is changed on average every month (Table 1). This figure compares to 0.15 and 0.25 in the EA and in the US, respectively². These figures translate into a median duration of price spells of 8.5 months in Portugal, 10.6 months in the EA and 4.6 months in the US. However, producer price data show that differences in the frequency of producer price changes between Portugal and the EA are much smaller (0.23 in Portugal compared to 0.21 in the EA).

¹The facts presented take the micro CPI evidence as the benchmark given that the results for PPI for the EA are less representative as only six countries had that information available (see Gautier et al. (2007))

²It is worth mentioning that despite the effort made to produce comparable statistics, the figures presented in Dhyne et al. (2006) do not fully account for some national specificities in the collection of price reports. One of the remaining major cross-country differences is related to the treatment of sales. For some countries, national statistical institutes report sales prices while in other countries the prices that are reported during the sales period are prices without rebates. Typically, price changes will appear to be less frequent and smaller in countries where sales prices are not reported. Therefore, this methodological difference has to be kept in mind when analysing the aggregate results for the EA.

Table 2

Monthly frequency of price changes by type of goods

CPI	Unprocessed food	Processed food	Non-energy indus. goods	Energy goods	Services
Portugal	0.55	0.25	0.14	0.16	0.14
EA	0.28	0.14	0.14	0.78	0.06
US	0.48	0.27	0.22	0.74	0.15
PPI	Food	Durable goods	Non-durable goods	Energy goods	Intermediate goods
Portugal	0.21	0.18	0.05	0.66	0.12
AE	0.27	0.10	0.11	0.72	0.22

Source: Álvarez et al. (2006); Dhyne et al. (2006); Bils and Klenow (2004) and Gautier et al. (2007)

Fact 2 - The frequency of price adjustments is rather heterogeneous across products and across sectors. CPI data show that price changes are very frequent for unprocessed food, while they are relatively infrequent for non-energy industrial goods, services and energy goods (Table 2). Unlike most of other EA countries, changes in energy prices in Portugal at the consumer level emerge as relatively infrequent (16 percent of the items change every month), but this is due to the fact that gasoline prices were administered during the sample period. On the other hand, evidence based on PPI data reveals that there is a substantial degree of heterogeneity in the frequency of price changes across industries, which can be classified in three broad classes. Price changes are very frequent for energy products, relatively frequent for food and durable products and relatively infrequent for intermediate and non-durable non-food products. Several factors may drive this heterogeneity. One important factor found both in micro quantitative and qualitative data is the variability of input costs (Altissimo et al. (2006)). In particular, prices seem to change less frequently for products with a higher labour cost share and for products with a smaller fraction of intermediate energy inputs. This suggests that wage rigidity can be a cause for price stickiness. In addition, as shown in Dhyne et al. (2006) larger competition seems to reduce price stickiness.

Fact 3 - There is no evidence of widespread downward price rigidity. Indeed, even though positive price changes are more frequent than negative price changes, price decreases are far from being uncommon. On average, 40 percent of the price changes are price reductions, though in services this number stands at 20%. Results obtained with survey data are a bit lower (32 percent) even though the share of price decreases in services is virtually the same (Martins (2010))³.

³These results are based on the information obtained from a survey conducted by the Banco de Portugal in 2004 in the context of its participation in the Inflation Persistence Network (IPN) – a Eurosystem research network which, for three years from the beginning of 2003 to the end of 2005, undertook a joint research on inflation persistence in the EA and in its member countries. The main objective of that survey was to investigate the pricing behaviour of Portuguese firms with a particular

Table 3

Price increases and price decreases: frequencies and magnitudes by type of good						
Monthly frequencies	Total	Unprocessed food	Processed food	Non-energy indus.	Energy indus.	Services
Increases	0.13	0.29	0.14	0.08	0.11	0.09
Decreases	0.08	0.26	0.11	0.06	0.02	0.08
Magnitudes	Total	Unprocessed food	Processed food	Non-energy indus.	Energy indus.	Services
Increases	0.10	0.17	0.07	0.11	0.05	0.09
Decreases	0.11	0.17	0.07	0.14	0.03	0.09

Source: Dhyne et al. (2006).

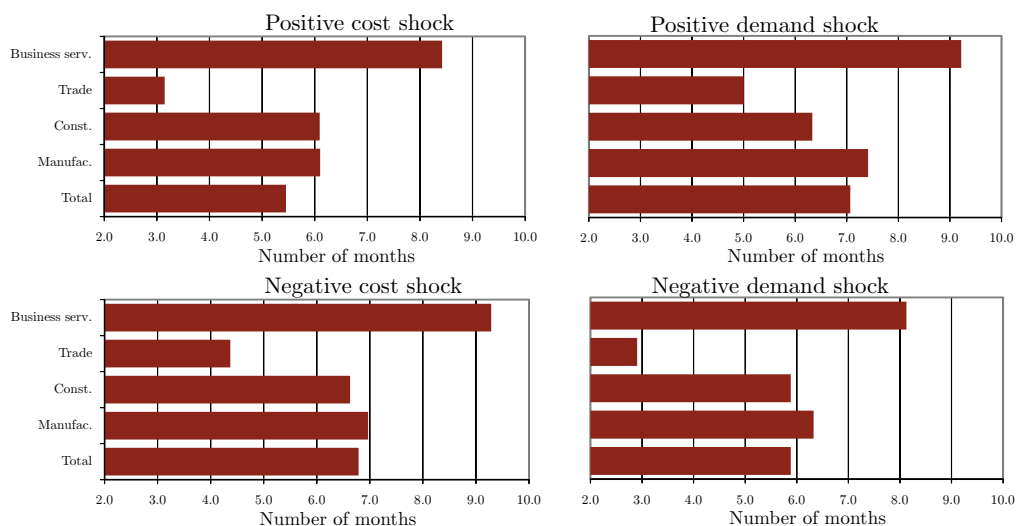
Fact 4 - Price increases and price decreases have in general the same order of magnitude but they are sizeable compared to the prevailing inflation rate during the sample period. Although price increases are on average more frequent than price decreases, which is quite natural in an economic environment of moderate inflation, this asymmetry does not carry over to the magnitude of price changes. In the common sample of 50 products, the magnitude of consumer price decreases is on average actually slightly larger than the magnitude of price increases (Table 3). This result is in line with findings for the EA as a whole where the magnitude of price decreases is on average two percentage points larger than that of price increases (10.0 versus 8.2 percent). With regard to the sectoral dimension, it can be observed that price changes for unprocessed food are not only very frequent (as illustrated in Table 2) but also very large in size, even though price increases and decreases tend to offset each other.

Fact 5 - Survey evidence points to the presence of asymmetries in the adjustment of prices in response to cost versus demand shocks. Survey evidence provides information not only on the relative importance of various factors driving price changes and whether there are asymmetries in price reactions to different types of shocks but also on the speed of those reactions. Regarding the former, cost shocks are more relevant in driving prices upwards than downwards, while changes in market conditions (in demand and competitors' prices) matter more for price decreases. Martins (2010) provides evidence that changes in the price of raw materials is the most important factor driving prices both upwards and downwards, whereas changes in demand and the wages costs are the second most important factors for, respectively, price decreases and price increases. Concerning the speed of price responses, survey results do not show any evidence that prices move faster upwards than downwards (Figure 1). However, firms seem to respond faster to positive cost and negative demand shocks (5.5 and 5.9 months on average, respectively) than to negative cost and positive demand shocks (6.8 and 7.1 months on average, respectively). These reactions tend to be faster in trade and slower in non-financial services.

emphasis on the sources and extent of price rigidities. Details on the sample and survey design as well as a discussion of the main results can be found in Martins (2010).

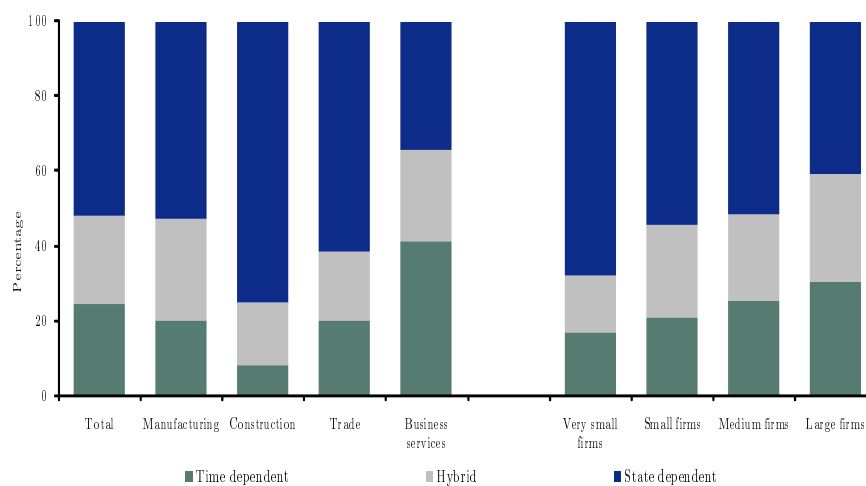


Figure 1: Speed of price reaction to significant changes in costs and demand (excluding firms that follow time-dependent pricing rules strictly; unweighted results)



Source: Martins (2009a).

Figure 2: Price setting strategies: time vs state dependent price setting (as a share of total employment in the sample; results weighted by employment)



Source: Martins (2009a).

Fact 6 - Survey evidence supports the existence of firms with time and state dependent pricing strategies. In contrast to the assumption made in many popular micro-founded macroeconomic models of inflation dynamics that firms only change their price as a function of time and in a staggered fashion, survey results uncovered ample evidence of state-dependence in price setting. In the presence of shocks, state dependent pricing rules lead in principle to greater price flexibility. When asked directly, firms declaring that under normal circumstances they follow state-dependent rules account for 52 percent of total employment in the sample, whereas those that declare that they follow time-dependent pricing rules under normal circumstances but change to state dependent rules in the event of specific shocks represent 24 percent of total employment in the sample (Figure 2). These results are consistent with the econometric evidence in Dias et al. (2007) who, using quantitative micro data, find strong statistical evidence of state-dependent behaviour by Portuguese firms, with inflation and demand pressure emerging as relevant determinants of the frequency of price changes. Survey results also point to the presence of important differences across sectors: in business services, time-dependent rules have a clear dominance as opposed to construction, trade and manufacturing where most firms follow state-dependent rules.

2.2 Wage bargaining in Portugal: evidence from survey data

In this subsection, we describe some of the main institutional characteristics of the wage bargaining process in Portugal. This characterisation is important to a better understanding of the evidence presented in the remaining of the paper concerning firms' wage setting practices and more generally the operation of the labour market.

The Portuguese Constitution provides the juridical principles of collective bargaining and grants unions the right to negotiate. The effects of the agreements are formally recognized and considered valid sources of labour law.

Concerning the bargaining mechanisms, a distinction should be made between the conventional regime and the mandatory regime. Conventional bargaining results from direct negotiation between employers' and workers' representatives. A mandatory regime, on the other hand, does not result from direct bargaining between workers and employers, being instead dictated by the Ministry of Labour. The Ministry can extend an existing collective agreement to other workers initially not covered by it or it can create a new one, if it is not viable to extend the application of an existing document. A mandatory regime is applied when workers are not covered by unions, when one of the parties involved refuses to negotiate or bargaining is obstructed in any other way.⁴ Therefore, the impact of collective bargaining goes far beyond union membership and the distinction between unionized and non-unionized workers or firms becomes unimportant.

⁴Beyond the existence of compulsive extension mechanisms, voluntary extensions are also possible, when one economic partner (workers' representative or employer) decides to subscribe to an agreement which it had initially not signed.

Collective negotiations are usually conducted at the industry or occupation level. The law does not establish mechanisms of coordination between agreements reached in different negotiations. However, preference is given to vertical over horizontal agreements, and the principle of the most favourable condition to the worker generally applies.

Since most collective agreements are industry-wide, covering companies with very different sizes and economic conditions, their contents tend to be general, setting minimum working conditions, in particular the base monthly wage for each category of workers, overtime pay and the normal duration of work. Underlying the bargaining process there is a mandatory minimum monthly wage which sets the minimum floor for wage negotiations⁵.

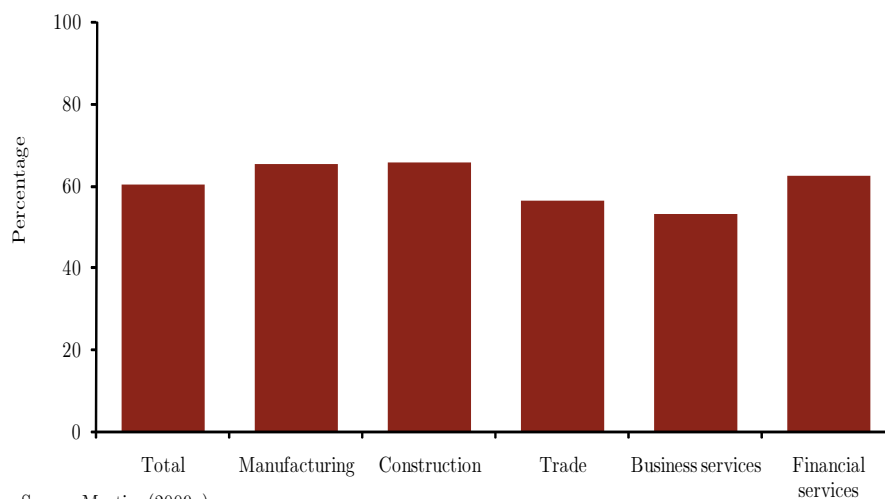
The Portuguese system of industrial relations apparently presents features of a centralized wage bargaining system⁶. Massive collective agreements, often covering a whole industry, predominate in the economy, while firm-level collective bargaining covers a low proportion (close to 10 percent) of the workforce. Moreover, trade union confederations, employers' federations and the Government meet at the national level each year to set a guideline for wage increases (the so-called social concertation). However, this guideline is not mandatory and merely guides the collective bargaining that follows.

On the other side, the fragmented nature of the trade union structure, the fragmented employers' associations and the multiplicity of bargaining units provides the system with a certain degree of decentralization. Even though collective bargaining in Portugal takes place at a sectoral level and most workers are covered by the bargaining system due to the existence of mandatory extensions, the coordination between bargaining units is rather limited. In fact, the right to negotiate is given upon every employer or employers' association and to every trade union (regardless of the number of affiliated members they represent), and the parties have the possibility of choosing the level of negotiation - regional, occupational, industrial or national. This leads to

⁵Currently, there is a unique legal minimum wage that applies to all workers. Workers formally classified as apprentices receive just 80% of the full rate. The minimum wage is updated annually by the parliament, under government proposal. Decisions on the level of the minimum wage are taken on a discretionary basis, usually taking into account past and predicted inflation and after consulting the social partners.

⁶Caju et al. (2008) perform a cluster analysis and identify three groups of countries using information collected following a questionnaire to national central banks. The first group (Austria, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Sweden) mainly consists of countries with a broadly regulated system of wage bargaining. This group is characterized by the existence of extension procedures and a high level of collective agreement coverage, a dominance of sectoral wage bargaining and the general absence of coordination. The second group (Belgium, Cyprus, Finland, Luxembourg, Slovenia and Spain) exhibits the same general wage setting characteristics as the previous group, but, in addition, some form of indexation, intersectoral agreements and the role of government are all more important. Finally, the third group (Czech Republic, Estonia, Hungary, Japan, Lithuania, Poland, the UK and the US) gathers the countries where the wage bargaining system is largely deregulated.

Figure 3: Share of firms with wages set under sectoral collective wage agreements
(as a share of all surveyed firms; unweighted results)



Source: Martins (2009a).

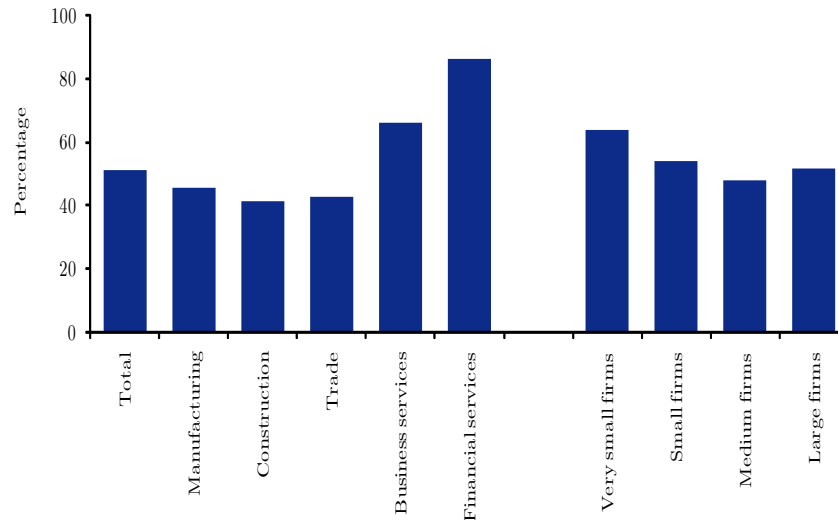
the existence of a diffuse and complex system of wage bargaining with negotiation fragmented and agreements multiplied.

Wage setting institutions are usually seen as playing an important role in the determination of the dynamics of wages and more generally for the operation of labour markets. For instance, Druant et al. (2009) show that bargaining institutions are correlated with the frequency and timing of wage changes whereas Babecký et al. (2008) and Dickens et al. (2007) show that they are also an important determinant of the degree of downward wage rigidity. In addition, they seem to influence the reaction of firms in the aftermath of shocks, as shown in Bertola et al. (2008) or the extent to which firms use different margins of adjustment to reduce their wage bill, as documented in Babecký et al. (2008). More generally, there is a vast literature about the role of wage bargaining institutions in shaping labour market outcomes, wage levels, wage dispersion and wage flexibility. Despite the importance assigned to the role of wage bargaining institutions, their measurement is far from being easy and comparable information at an international level is rather limited⁷. The survey conducted in 2008 uncovered information at the firm level on several institutional features affecting wage setting in individual firms, such as the degree of centralization, the coverage of wage bargaining and the presence of indexation mechanisms.

According to these results, in about 60 percent of the firms (52 percent of total employment in the sample) wages are set in the context of sectoral collective wage

⁷The most comprehensive time series of quantitative information on union density, minimum wages, and indices of union coverage, coordination and corporatism for a number of OECD countries is available from the OECD (see for example Elmeskov et al. (1998))

Figure 4: Share of workers with base wages above the wage scale
(as a share of workers in the sample covered by collective wage agreements; results weighted by employment)



Source: Martins (2009a).

agreements, even though only 30 percent of these firms participate directly in the wage setting process (Figure 3). Furthermore, in 10 percent of the firms wages are set in the context of firm-level agreements: in 7 per cent firm-level and sectoral agreements coexist, whereas in 3 per cent firm-level agreements are exclusive. However, whatever the wage floor agreed upon for each category of workers at the collective bargaining table (the bargained wage), firms are free to pay higher wages, and they often deviate from that benchmark, adjusting to firm-specific conditions (see Cardoso and Portugal (2005)). To the difference between the actual wage and the bargained wage we call wage cushion⁸. Survey results confirm that a significant share of firms pays wages above the ones that were contracted (Figure 4). The share of firms paying a wage cushion is remarkably high in financial services and generally decreases with firm size. Cardoso and Portugal (2005) estimate that the effective wages in 1999 exceed contracted wages in amount that varies between 20 and 50 per cent. The figure obtained in the survey is 25 per cent. From the point of view of the firms, the way this cushion is handled makes it a strategic buffer against adverse shocks, in particular in a context where downward nominal wage rigidity turns out to be an active constraint.

⁸This is distinct from the notion of wage drift, which is usually employed for differences in wage variations, rather than levels.

2.3 Wage rigidity and price rigidity: a comparative analysis

As mentioned before, one important result from the analysis with micro data is that those sectors with higher labour cost share tend to exhibit higher price rigidity which, in turn, could reflect wage rigidity. This evidence is also supported by the survey results (see Martins (2009)). In an attempt to complement these findings, this subsection presents additional evidence based on how firms set and adjust their wages and on the relationship between wage and pricing policies. In particular, based on the information collected from the survey analysis, the aim is to provide answers to the following questions: (i) What is the frequency of wage changes in Portugal? ii) Are prices and wage changes synchronized or not; iii) Do they tend to take place in specific months of the year? iv) Are there significant differences across firms and sectors regarding the frequency and timing of wage and price changes? The frequency of wage changes was investigated through three separate questions: those due to factors unrelated to tenure and/or inflation, those due to tenure and those due to inflation. A synthetic variable for the frequency of wage changes for any of the three listed reasons was also computed, defined as the highest frequency of wage change at the firm level independently of the reason behind it⁹¹⁰.

Table 4

Average duration of price and wage spells (in months)		
	Prices	Wages
Total	10.3	12.8
Manufacturing	10.1	12.6
Construction	7.4	13.7
Trade	8.4	12.5
Business services	11.4	13.2
Financial services	6.8	12.1
Very small firms	9.6	14.6
Small firms	10.0	14.3
Medium firms	9.4	13.8
Large firms	10.5	12.5
Memo:		
EA	9.6	14.7

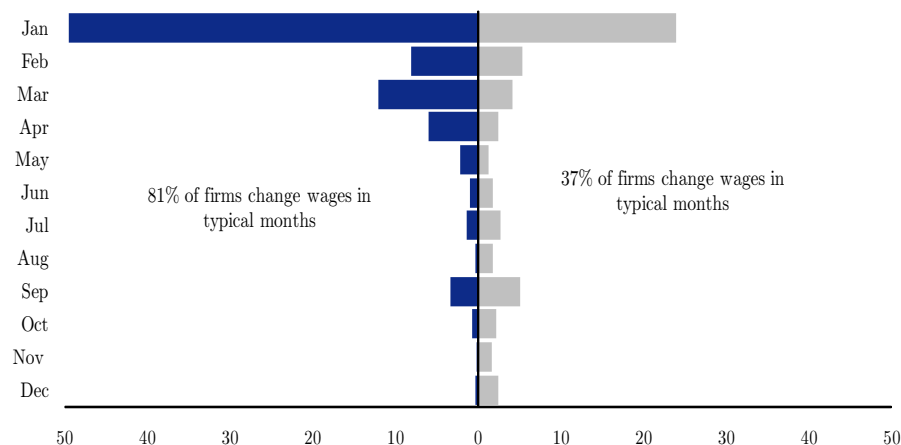
Source: Druant et al. (2009) and Martins (2009).
Results weighted by employment.

Table 4 shows that financial services, construction and trade tend to have shorter price spells than those of manufacturing and business services. However, it should be noted

⁹In order to make comparisons easier, frequencies of price and wage changes were converted into average durations of price and wage spells by simply multiplying each category (defined in terms of months) by its relative frequency. For those categories expressed in terms of time intervals the mid-point was assumed.

¹⁰All the results are weighted according to the number of employees in each firm. Results were also rescaled for non-responses.

Figure 5: Concentration of price and wage changes
(as a share of all surveyed firms with valid responses; unweighted results)



Source: Martins (2009a).

that when interpreting the results concerning financial services, a note of caution has to be made not only because the concept of price might be difficult to capture, but also because the interviews were carried out in a period of exceptional turbulence in international financial markets¹¹. As regards wages, there is little variation across sectors: wage spells tend to vary between 12 and 14 months, with business services and construction being the sectors where wages seem to be more rigid. Moreover, the average wage spell in Portugal is two months shorter than the average wage spell in the EA. All in all, most of the firms (85 percent) change their wages only annually (the corresponding figure for prices is 67 percent). Druant et al. (2009) show that cross-country variation is substantial in the case of wage changes but almost irrelevant in terms of price changes while, in contrast, cross-sector variation is significant in terms of price changes but little relevant in terms of wage changes.

Besides the frequency of adjustments, the degree of price and wage synchronisation is another factor affecting the degree of firms' flexibility to changes in their economic environment. With a view to obtain empirical evidence on this issue, firms were asked to specify whether their price and wage changes take place with no predefined time pattern or are concentrated in particular month(s). As far as prices are concerned, this latter option was chosen by about 37 percent of the firms (Figure 5), which is somewhat lower than the share of firms following time-dependent pricing strategies under normal circumstances (i.e. in the absence of special events) reported before (48 percent).

¹¹The questionnaire sent to the banking institutions contained some changes compared to the main questionnaire. In particular, in the price-setting section firms were asked to take as their reference price the interest rate applied to the main credit product assuming a medium-risk customer.

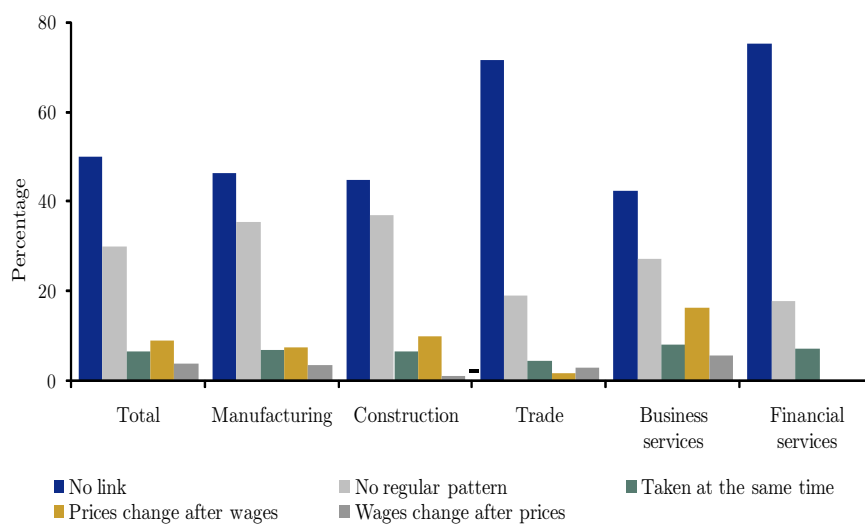
Looking at the month in which adjustments typically take place, there appears to be a considerable degree of synchronisation among firms, as about 65 percent of those reporting the presence of some time regularity change their prices (not necessarily only but also) in January. However, the degree of concentration of wage changes is much higher than that of price changes as 81 percent of firms seem to change their wages in particular month(s), with January being the month with the highest frequency. The large concentration of wage changes may reflect institutional arrangements at the sectoral or firm levels, in the form of collective bargaining agreements. Finally, another important issue to investigate is the relationship between price and wage changes, i.e. whether firms' wage and price adjustments are related and the extent to which inflation feeds into wage adjustments. In order to assess the existence and direction of a link between wage and price changes, firms were asked about the link between the timing of price changes and the timing of wage changes. The intensity, as well as the direction of the relationship between the two strategies is summarized in Figure 6. Results point to the presence of some synchronisation between price and wage changes at the firm level as around 50 percent of firms, when asked directly, acknowledge the existence of some relationship between the timing of price and wage revisions within their company. However, only 20 percent state that this relationship is quite strong: decisions are taken simultaneously for 7 percent of the firms, prices follow wages in 9 percent of the cases and wages follow prices in the remaining 4 percent. In contrast, for about 50 percent of the firms, no link exists between the timing of price and wage changes. This figure is particularly high in financial services and trade. However, it is worth mentioning that the lack of synchronization in many firms in terms of price and wages changes does not necessarily mean that the general inflationary outlook is disregarded in wage setting decisions. One important source of information available from the survey on how inflation developments may affect firms' wage decisions is the frequency of wage adjustments due to inflation. Figure 7 shows that inflation indeed stands out as the most important factor triggering frequent wage adjustment (at an annual or infra-annual frequency).

2.4 What could drive price and wage rigidities

Whereas the preceding subsections have analysed the stylised facts of price and wage setting, this subsection focuses on the potential reasons why prices and wages are sluggish. The most direct evidence on this issue can be obtained from the survey information.

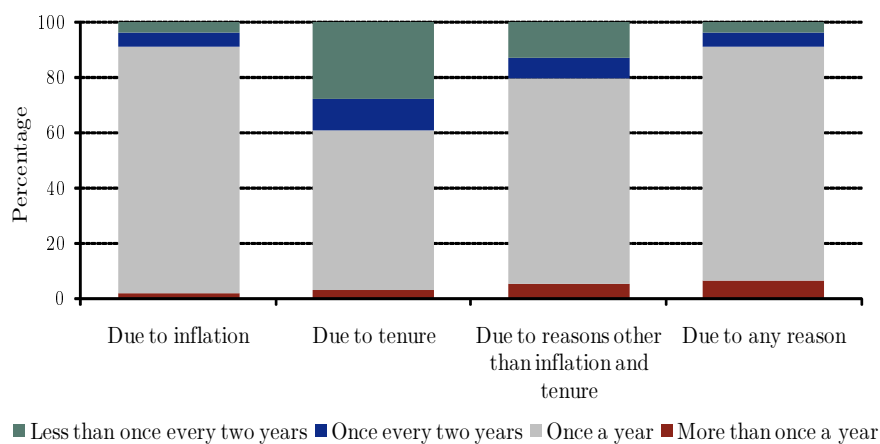
The survey conducted in 2004 on firms' price setting (see footnote 3) contained a question which directly addressed the reasons for price stickiness: If there are reasons for changing the price of your main product, which of the following factors may well prevent an immediate price adjustment? The list following this question offered a series of statements, expressed in simple terms, based on different economic theories of price rigidities. The respondents could indicate their degree of agreement with each

Figure 6: Synchronisation between price and wage setting decisions
(as a share of all surveyed firms; unweighted results)



Source: Martins (2009a).

Figure 7: Frequency of wage changes
(as a percentage of total employment in the sample; results weighted by employment)



Source: Martins (2009a).

Note: Change in wages due to "any reason" means the highest frequency for the other three listed reasons.

statement, choosing among four categories: unimportant (1), of minor importance (2), important (3) and very important (4), where the numbers in brackets indicate the scores attached to each category. Implicit and explicit contracts, cost-based pricing and co-ordination failure are the most relevant explanations for sticky prices, while menu costs, pricing thresholds and costly information are not recognised as important by the respondents (Table 5). The theory of implicit contracts, which emerges as the most important explanation for sticky prices, is based on the idea that firms establish long-run relationships with customers in order to make future sales more predictable; in other words, they try to win customer loyalty simply by changing prices as little as possible. Co-ordination failure as an explanation for sticky prices is the second most important factor, with an average score of 2.8. The idea is that firms prefer not to change their prices unless one of their competitors moves first. Cost-based pricing, which assumes that prices do not change if costs do not change, and explicit contracts (firms have to re-negotiate their contracts to change their prices) are third and fourth in the ranking of explanations, with an average score of 2.7 and 2.6, respectively.

Table 5

What explains price stickiness?

Most important factors		Less important factors	
Factors	Average score	Factors	Average score
Implicit contracts	3.14	Judging quality by price	2.28
Coordination failures	2.84	Menu costs	1.89
Cost-based pricing	2.70	Pricing thresholds	1.78
Explicit (formal) contracts	2.63	Information costs	1.70

Source: Martins (2009).

Inspired by the analysis made for prices in 2004, the survey conducted in 2008 contained a question which tried to obtain information about the main reasons that may prevent firms from cutting or freezing their wages in a context where they need to reduce labour costs. The list following this question offered a series of possible reasons, expressed in simple terms, based on different economic theories of wage rigidities. Once again, respondents could indicate their degree of agreement with each statement, choosing among four categories: unimportant (1), of minor importance (2), important (3) and very important (4).

Table 6

What could prevent firms from cutting or freezing wages?

Reasons	Average score	Reasons	Average score
Wage agreements and legislation ⁽¹⁾	3.58	Impact on firm's reputation	2.93
Impact on workers' motivation	3.44	Wages could become non competitive	2.92
Impact on workers' performance	3.39	Difficulties in attracting workers in the future	2.83
Impact from unpredictable changes in wages	3.37	Hiring and training costs of new workers	2.73
Risk of losing the best workers	3.29		

Source: Martins (2009); Results weighted by employment.

⁽¹⁾This is only applicable to wage cuts.

Table 6 shows that legislation stands as the most important factor preventing firms from cutting their wages. However, internal factors such as the impact on workers' motivation and performance also play an important role as obstacles to wage cuts or freezes. This result is in line with the evidence in other empirical studies (see for instance Blinder and Choi (1990) or Franz and Pfeiffer (2006)). Martins (2009) shows that a very small share of the firms included in the survey report that, in the absence of legal or contractual constraints, they would consider the possibility of cutting their workers' base wages in 2006 (the reference year of the survey). These firms account for 1.6 percent of total employment in the sample. In addition, those firms that would consider the possibility of increasing their base wages in 2006 below the inflation rate in the absence of legal or contractual constraints account for 4.4 percent of total employment in the sample.

3 Wage Formation

The debate about the Portuguese economy frequently ignores the essential fact that the formation of wages plays a fundamental role in determining unemployment. The few studies available on the estimation of labour demand function point to high wage elasticities of labour demand (Varejão and Portugal (2007b)). Here, we report investigations on how exogenous changes in minimum wages impact on worker flows and how exogenous wage fluctuations affect firm closures and, thus, worker displacement. In a labour market with Portugal's level of sclerosis, where the likelihood of finding a suitable job is very low, being unemployed is an extremely dramatic event (Blanchard and Portugal (2001)). Hence, painful unemployment decreases the bargaining power of workers. This link from unemployment rates to wages is also very relevant and

is explored in a number of studies of wage formation by Carneiro and Portugal. In this section, the cyclical nature of real wages will also be discussed below in a novel way, one which isolates the compositional bias arising from (permanent) worker and firm heterogeneity.

3.1 The Conspicuous Nature of the Portuguese Labour Market

The Portuguese labour market is disfunctional, with very weak flows between employment and unemployment. The explanation given by Blanchard and Portugal (2001) for this conspicuous characteristic labour mobility is that it stems from the strong protection of employment embedded in Portuguese labour legislation, above all in terms of the legal framework for firings. Fundamentally, very long unemployment spells – a painful way of experiencing unemployment – are the counterpart of job protection.

There is abundant empirical evidence that there is a greater prevalence of long unemployment spells in countries with greater job protection (Blanchard and Portugal (2001)). Fundamentally, the high costs of firings increase production costs, bringing down feasible wages (the wage that guarantees zero profits). Job protection in turn increases workers' bargaining power, and this means higher bargaining wage (the wage to which the worker aspires). In this model, the equilibrium is re-established by making unemployment more painful, that is, by reducing the arrival rate of job offers. This brings down the transition rate from unemployment to employment, and increases the expected duration of unemployment¹².

There is direct and indirect evidence on the job arrivals rate in the European Household Panel, where Portugal has the lowest arrival rate of job offers among all the countries represented on the panel (Jolivet et al. (2006)). Franco and Torres (2008) calculated the probability of a worker leaving a job and finding a new one, using data from the Employment Survey¹³. They concluded that those probabilities are very low, and show that job separations are almost acyclical and that the finding probabilities are strongly cyclical. In the work of Varejão and Portugal (2007a) there is documented evidence that only 25% of establishments change the composition of their work force. Ejarque and Portugal (2007) solve a dynamic model of labour demand, using relevant sample moments of the Portuguese labour market, to show that the presence of adjustment costs can lead to a significant reduction in the flow of jobs.

3.2 The Impact of Minimum Wages on Employment

Changes in the legislation effective in 1987 in Portugal provide remarkably good conditions for analysis of the employment effects of mandatory minimum wages, as the

¹²In this setting, unemployment protection will tend to cushion the penalty associated with the joblessness experience, and generate an ever steeper fall in the transition from unemployment to employment.

¹³Elsby et al. (2008) offer a revealing international comparison based upon the computation of job finding and job separating probabilities from suitable Employment surveys.

minimum wage increased sharply for a very specific group of workers. Relying on a matched employer-employee panel data set from Quadros de Pessôal, Portugal and Cardoso (2006) modeled gross worker flows —accessions and separations —in continuing firms, as well as in new firms and those going out of business, using a count regression model applied to proportions. Employment trends for teenagers, the affected group, are contrasted to those of older workers, before and after the raise in the youth minimum wage. Decomposition of the changes in employment by its sources can help reconcile some of the evidence that has previously been presented in the literature as contradictory, helping to disentangle the minimum wage puzzle. The results provided in Table 7 show that the share of teenagers among newly hired workers, both in continuing firms and in new firms, decreased, following the increase in the youth minimum wage. These flows would thus point towards the reduction of the relative demand for teenagers. On the other hand, the share of teenagers in job separations in continuing firms decreased sharply following the rise in their minimum wage.

Table 7
 Employment Effects of Increasing the Youth Minimum Wage
 Poisson Regression with random effects
 Dependent variable: Share of employed teenagers

	Coefficient	Standard error
Hires by continuing firms (n=99 608 firms)		
year 1988	-0.036	0.010
year 1989	-0.043	0.010
Separations by continuing firms (n=125 397)		
year 1988	-0.150	0.010
year 1989	-0.140	0.010
Hires by new firms (n=38 138)		
year 1988	-0.042	0.018
year 1989	-0.041	0.018
Separations by closing firms (n=19 203)		
year 1988	0.050	0.023
year 1989	0.025	0.023

Note: Firm size, market concentration and a set of industry dummies were also included.

From a worker perspective, the authors found that teenagers subject to a high wage increase resulting from the change in the minimum wage are more prone to keep their job than comparable groups of workers. This result points to the relevance of supply

side factors, as job attachment for low-wage youngsters may rise following an increase in their minimum wage, reducing the high job turnover that is characteristic of low-wage workers. In synthesis, in Portugal, the main short-term impact of the 1987 minimum wage change was the reduction of separations from the employer, which compensated for the reduction of job accessions. It should be noticed, however, that these results reflect solely the short-run response to a minimum wage hike. In competitive labour markets, long-run employment effects are likely to be negative. Cardoso (2009) investigates long-run wage effects and shows tenure-wage profiles are flatter for individuals that benefit from the minimum wage increase.

3.3 The Wage Cushion

Which are the determinants of the contractual wages agreed upon with trade unions, and how do these differ from the determinants of the actual wage that is paid? Do collective bargaining outcomes reflect the bargaining power of the partners involved, whereas wage cushion reflects market conditions? In the study of Portugal and Cardoso (2006) the information contained in the Quadros de Pessoal dataset is explored to analyse, at the microeconomic level, the wage bargaining process in the Portuguese labour market. The regressions presented in Table 8 explore the impact of worker attributes, firm attributes and the collective bargaining system on bargained wages and on the wage cushion. On the worker and employer side, the usual determinants of wages have been considered: the worker gender, schooling, age and tenure; the firm size, age, average gross labour productivity and gross job flow. Controls for the industry and the region have been included in every regression. The variables that characterize the institutional setting are less often found in the empirical literature. The degree of coordination of employers in wage bargaining and the degree of trade union power will deserve particular attention in the interpretation of the results. The degree of coordination of employers results simply from the definition of the types of collective agreements existing in Portugal: single-firm agreement; multi-firm agreement, signed by several employers, though not organized into a formal association; sector agreement, signed between employers' association(s) and trade union(s), often covering an economic sector. Also, the government can impose a mandatory regime.

The degree of union bargaining power is captured by the concentration of bargaining within an occupation, firm or region. These proxies are based on the idea that, if the labour force is more united in the bargaining process, it will have stronger bargaining power. The Herfindhal index was used to evaluate the degree of concentration of bargaining within an occupation, firm or region. If one single collective agreement covers the entire workforce in the occupation, the firm or the region, the index reaches the value one, interpreted as a high degree of union power within that occupation, firm or region. On the contrary, a fragmented bargaining process, with workers represented by several trade unions bargaining separately, leads to a low value on the Herfindhal index and suggests less union strength. We have estimated Tobit models on the wage

bargained, the wage cushion and, a result of the two previous forces, the actual wages paid. This choice is justified by the fact that contract wages cannot fall below the national minimum wage and actual wages cannot fall below the contract wage defined for the worker category.

Table 8
Determinants of bargained wages and the wage cushion

	wage bargained		wage cushion		wage actual	
	(coef.)	(marg.)	(coef.)	(marg.)	(coef.)	(marg.)
gender	-.109	-.062	-0.128	-0.79	-0.204	-.177
schooling	0.027	.016	0.030	.019	0.053	.047
age	0.034	.020	0.018	.011	0.038	.034
agesquared	-0.0003	-.0002	-0.0002	-.0001	-0.0004	-.0003
tenure	0.007	.004	0.002	.001	0.007	.006
tenurelessly	-0.033	-.019	-0.038	-.024	-0.058	-.051
firm.size(log)	0.048	.028	0.012	.008	0.041	.036
firm age	-0.0004	-.0003	-0.0002	-.0001	-0.0005	-.0005
log.product.	0.044	0.026	0.033	.021	0.064	.057
firm gross job flow rate	0.002	.001	0.012	.007	0.016	.014
ag.multi-firm	0.093	.058	-0.025	-.016	-0.017	-.015
ag.sectoral	-0.036	-.022	-0.024	-.016	-0.145	-.132
ag. mandat. regime	-0.150	-.078	0.179	.127	-0.023	-.020
conc.ag.within occup.	0.112	.065	-0.092	-.058	-0.025	-.022
conc.ag.within firm	0.263	.153	-0.214	-.135	-0.013	-.011
conc.ag.within region.	-0.032	-.019	-0.063	-.040	-0.183	-.161
geog.scope	-0.005	-.003	0.010	.006	0.002	.002
sizecol.agr(log)	-0.035	-.021	0.008	.005	-0.008	-.007
Obs.	1134427		1134427		1134427	
R ²	0.54		0.30		0.59	

It is interesting to note, first of all, that wage cushion reinforces the impact of worker and firm attributes on wages. Note that the signs of those coefficients are the same, in the bargained wage and the wage cushion regressions. In other words, wage cushion stretches the returns to education, gender, age, tenure, firm size, firm productivity or firm-level worker turnover (rate of job creation or destruction). On the contrary, variables that capture the bargaining power of trade unions have a high impact on

bargained wages, but that impact is partly offset by wage cushion. In fact, the concentration of bargaining within an occupation or within a firm becomes less relevant in the determination of actual wages than it was in the determination of bargained wages. In other words, wage cushion shrinks the returns to union bargaining power. The previous results lend support to the hypothesis that wage cushion works as a mechanism to overcome the constraints imposed by collective bargaining, allowing firms wide scope for action in their wage policy. The impact of the extent of union power deserves further comment. Higher coordination on the side of the workers along occupation or firm lines is associated with higher wages. If the degree of concentration of bargaining within an occupation increases by ten percentage points, the bargained wage increases by about 0.65 percent. Similarly, a more united labour force bargaining within the firm raises bargained wages: an increase of ten percentage points in the degree of concentration of bargaining within a firm raises bargained wages by 1.53 percent. These results suggest that the fragmentation of bargaining reduces union capacity to extract rents. However, as mentioned before, these returns on union bargaining power are offset by firm-specific wage arrangements, in the form of wage cushion. In the end, the concentration of bargaining within the occupation or the firm has a very low impact on the actual wages paid. On the employer side, higher coordination when bargaining over wages is associated with lower wages. Single-firm or multi-firm agreements yield higher bargained wages than sector-level agreements. Even though the rank of the type of agreement changes after wage cushion operates, it is still the case that single-firm and multi-firm agreements yield higher wages than sector agreements. The positive impact of the firm's gross job creation rate and its average labour productivity on the bargained wage is consistent with the results by Christofides and Oswald (1992) who analyzed the impact of industry and regional variables on wages bargained in a sample of labour contracts in Canada and found evidence that wage determination is a rent-sharing mechanism. Their work found that higher profits in the industry enable unions to extract a higher rent in the form of higher bargained wages, whereas a depressed labour market, with a higher regional unemployment rate, decreases bargained wages.

3.4 Insider Power and Insider Forces

A considerable branch of the literature focuses on the internal factors of the company in setting wages. Again we must consider the situation of monopolistic competition which allows for the generation of rents that will be shared between owners and workers, modified by the negotiating power of the two sides. In this theoretical framework, it makes sense to tie wages to company performance indicators (profits, productivity, cash flow, etc). Once the distinction between insider and outsider factors in a company is established, there is scope for an interesting analysis of the distinction between insider and outsider workers. The idea is that wages are fundamentally set by incumbent workers (insiders) while those not on contract (outsiders) have a relatively minor role to play. There are costs associated with selection, recruitment and training of insiders,

making it economically in-viable to replace them with jobless at lower wages. The rent associated with replacement costs guarantees insider bargaining power in wage negotiations. The insider-outsider theory of wage setting allows us to put forward an explanation for setting wages above the market equilibrium level. Wage insensitivity to labour market conditions, and above all unemployment, can entail hysteresis caused by the power of insiders. In this case, contemporary unemployment depends on past unemployment, leading to a negative relation between contemporary wage levels and past employment levels.

Table 9: Measuring Insider Power and Insider Forces
 SYS-GMM Estimates of Wage Equation (1994-99)
 Dependent variable: Wages ($w_{it} - \bar{w}_{jt}$)

Explanatory Variables	
Wages lagged	0.227 (7.4)
Nominal productivity	0.143 (6.1)
Growth permanent employment	-0.096 (-5.8)
Proportion of temporary employees	-0.019 (-0.6)
Layoff rate	-0.022 (-5.3)
Labour utilization rate	0.318 (2.5)
Market share	0.018 (4.3)
Regional unemployment rate	-0.123 (-5.9)

Notes:
 Education, qualification, and time dummies were also included.
 t-statistics in parenthesis

In this section, we summarize the study by Carneiro and Portugal (2008a) who employed longitudinal data from large firms collected in the *Balanço Social* dataset, to analyse the role of insider and outsider forces in the process of wage formation. The main results are exhibited in Table 9. The Generalized Method of Moments (GMM) results report a value of the insider weight of 18%, estimated with precision. The long-run value of the insider weight is calculated by dividing the nominal productivity coefficient (the short-run coefficient) by one minus the coefficient on the lagged wages. This value is considerably higher than those obtained for other European Countries such as Spain and the U.K. using firm-level data. In fact, the short-run effect of nominal productivity on wages is strong and significant, suggesting that in Portugal wages are

highly responsive to the firm's performance. This is also consistent with one of the predictions of the insider-outsider theory that the greater the hiring and firing costs, the more the insider wage will depend on the "inside factors" relative to the "outside factors".

Other evidence is revealed by the results. First, market share exerts a positive and significant impact on wages, suggesting that monopoly power generates monopoly rents that are captured by the employees in the form of higher wages. Second, with respect to the dismissal threat variables, we obtain the expected signs for the coefficients on both the labour utilization rate and on the layoff rate. Hence, workers in firms with higher labour utilization rates have higher insider power and, thus, earn more. An increase in the layoff rate decreases significantly wages, in the short-run. This finding seems to suggest that when the employment perspectives of employed workers worsen, they tend to restrain wage demands. Another interpretation is possible if the layoff rate is viewed as a proxy for labour adjustment costs. In firms with high (low) adjustment costs the risk of being fired is lower (higher) and thus insider workers are in a better position to extract rents in the form of higher wages. In fact, besides the high dismissal costs that Portuguese employers have to bear, conditions in which a termination of contract is admissible are also regulated quite strictly. These factors appear to work together to strengthen the bargaining position of incumbent workers and their power to claim for higher wages. Third, the regional unemployment rate has a negative and significant impact on wages. This result reveals that outsiders' forces have an important role in wage determination in the sense that they affect the alternative options to the bargaining parties. Finally, a small negative effect of the proportion of temporary employees on average wages was found, although not statistically different from zero. On balance, the results presented in this subsection show that firms where insider workers have more labour market power tend to pay higher wages, *ceteris paribus*. In particular, in firms with low layoff rates and high rates of labour utilization within the firm, workers seem to extract rents in the form of higher wages.

3.5 Wages and the Risk of Displacement

The extent of job destruction and, in particular, firm closing and job loss due to sector reallocation, has been a matter of great concern in recent years, with empirical research on gross job flows experiencing a tremendous growth in the past decade. The studies on the decomposition of net employment flows emphasize the importance of job creation and job destruction through the entry and exit of firms. In Portugal, annual job flows produced by both plant births and plant deaths account for almost half of total gross employment flows (Blanchard and Portugal (2001)). However, the literature on flows of jobs is mostly employment accounting, without any direct information about the magnitude of the wage or output elasticities of employment changes through the births and deaths of establishments, or growth or contraction in existing establishments. Few studies have yet analyzed how that wage variation affects the probability of displace-

ment. In fact, the theoretical and empirical research on the role of wages on plant closings is remarkably sparse. Most of the empirical literature on plant closings has been concentrated on the effect of unions in the probability that a firm (plant) shuts down. Based on the theoretical framework of Hamermesh's model, Carneiro and Portugal (2008b), using panel data from *Quadros de Pessoal* for workers displaced between 1994 and 1996, estimate a simultaneous failure-wage model to show how wages adjust to a negative demand shock that raises the risk of displacement through firm closing and to what extent a wage change affects the exit likelihood. The role of a mandatory minimum wage on the firm's exit decision was also analyzed.

Table 10: Failure Equation

Two-step Probit Results (N=266,024 workers)

Dependent variable: displaced=1

Variables	Coefficient	Marginal Effect
Past sales growth	-0.327 (-31.1)	-0.049
Firm size	-0.242 (-77.2)	-0.037
Market share	-1.436 (-29.0)	-0.217
Multi-plant firm	-0.066 (-6.9)	-0.010
Proportion of foreign capital	-0.206 (-11.4)	-0.031
Sales per worker	-0.055 (-13.8)	-0.008
Regional unemployment rate	0.055 (7.3)	0.008
Predicted monthly reservation wage	0.063 (3.2)	0.010
Probability of being a minimum wage earner	0.192 (5.9)	0.029
Constant	0.741 (3.4)	0.112
Log-likelihood	-88628.6	

Notes: A set of firm age, industry, regional and time dummies are included. t-ratios are in parentheses.

The parameter estimates of the simultaneous probit-tobit regression model of firm closing and wage formation are presented in Tables 10 (structural failure equation) and 11 (structural wage equation). The estimation strategy consists of having, as far as possible, a complete set of controls to examine whether a robust association

between wages and the probability of firm closing (and *vice-versa*) can be identified. Table 3.10 report results (coefficients estimates and marginal effects, respectively) for a specification in which the probability of firm closing depends on an extensive set of firm characteristics, the regional unemployment rate, monthly reservation wage (predicted) and the estimated probability of being a minimum wage earner. A set of dummy variables for industries, regions and years are also included. Past sales growth, firm size, age, market share, multi-plant firm, proportion of foreign capital and sales per worker are significantly correlated with the probability of firm closing. In particular, the results reveal that firms experiencing a decline in sales growth are clearly more likely to close. This seems to imply that sales contraction can be used as a strong predictor of firm failure. Indeed, the fact that a firm has grown in the past signals that it has been performing well. Moreover, the estimates reported in Table 3.10 show that small firms are clearly more likely to close than large firms. This result is conventional enough and, in particular, is in line with the one obtained for Portugal in the study of Mata et al. (1995) using a sample of newly born manufacturing plants. The variable market share has a strong negative effect on the probability of closing, suggesting that monopoly power generates rents that may function as a buffer that cushions against negative shocks. Workers that are part of a multi-plant firm are less likely to be displaced due to firm closing than workers that are part of a single-plant firm. The same is true for workers that are part of firms with a large proportion of foreign-owned capital. Sales per worker, a proxy for productivity, have a negative impact on the probability of firm closing. Thus, low productivity firms, all else being equal, are more likely to close down. The coefficient estimate of the regional unemployment rate is positive and statistically significant, suggesting that local economic conditions may affect the viability of some types of firms. High-wage paying firms face higher hazard rates than low-paying firms. After controlling for an extensive set of employers' characteristics and for local labour market conditions, the results reveal that firms that pay higher entry-level wages, holding revenue per employee fixed, are less likely to survive. A 1 percent wage increase is associated with a 0.16 percent increase in the probability of job displacement through firm closing. Finally, the two-step probit results report a positive and significant effect of the probability of receiving the minimum wage on the failure rate, suggesting that firms with a higher incidence of minimum wage workers face higher exit rates than those with a smaller incidence. A 10 percent increase in the proportion of minimum wage earners increases the probability of displacement through firm closing by 0.6 percent. In fact, the possibility of wage concessions is precluded if workers are paid legal minimum wages. Thus, firms with a higher proportion of minimum wage earners may have lower chances of survival due to their inability to adjust wages downward in the face of a negative demand shock.

Table 11: Wage Equation

Two-step Tobit Results (N=266,024 workers)		
Dependent variable: log of real monthly wage		
Variables	Coefficient	Marginal Effect
Female	-0.170 (-86.5)	-0.162
Education	0.054 (118.4)	0.051
Age/100	2.873 (44.0)	2.745
Age/100 squared	-2.712 (-33.8)	-2.592
Tenure/100	0.331 (7.9)	0.317
Tenure/100 squared	-0.093 (43.9)	-0.088
Regional unemployment Rate	-0.058 (-25.1)	-0.056
Predicted probability of displacement	-0.933 (-75.7)	-0.892
Log-likelihood	-82468.0	
$\hat{\sigma}$	0.32	

Notes: A set of firm age, industry, regional and time dummies are included. t-ratios are in parentheses.

Table 3.11 reports the two-step tobit results of the wage equation. The basic specification includes a set of controls for workers' characteristics, the regional unemployment rate and the instrumented probability of displacement due to firm closing. A set of industry, regional and time dummies are also included in the specification. All the exogenous variables (excluding tenure squared) are statistically significant at the 1 percent level of significance and have the expected signs. The effect of the probability of closing on monthly wages is negative and also statistically significant. This implies that a worker employed in a firm that will close earns less in the year prior to displacement than a similar worker employed in a non-closing firm. Workers in a firm that has the average probability of failure in the population (6.3 percent), earn (one year prior to closing) 5.6 percent less than workers in a firm with zero probability of failure (a useful artificial benchmark). This empirical result indicates that average wages grow less rapidly in firms that will soon close, suggesting that firms' adjustment to negative shocks are partially absorbed into wages.

3.6 Measuring Post-Displacement Earnings Losses

Do displaced workers in Portugal suffer pre- and post-displacement wage losses? If so, what are the magnitude and persistence of these losses? What are the main sources of earnings losses? The main goal of the study by Carneiro and Portugal (2006) is to analyze the costs of worker displacement in terms of earnings losses in the Portuguese labour market. Two main objectives drive their investigation. The first objective is to analyze the long-term impact of a displacement on the earnings evolution of displaced workers in Portugal. The possibility to link workers with their employers constitutes a tremendous advantage of the *Quadros de Pessoal* data set, reinforced by the fact that recent empirical work on wage determination has been showing that employers' characteristics are an important determinant of workers' wages. The second objective is to decompose the earnings losses according to their sources/causes.

Wage loss equations, estimated from a comparison between displaced and non-displaced workers in the *Quadros de Pessoal* dataset are given in Tables 12 and 13. The first column in Tables 12 and 13 provides results for a parsimonious specification in which average real hourly earnings depend on the displacement dummies and a set of individual characteristics that do not change with the job, such as age (and its square) and education. Education is defined as the number of years of schooling completed. Two dummy variables were added to the model. One that takes the value one if the worker has a part-time job in the post-displacement period and the other that takes the value one for displaced workers who left the firm one or two years before closing - the early-leavers (zero otherwise). A set of time dummies is also included in order to account for aggregate shocks.

Men displaced in year zero earn, three years before separation, 12.6 percent less than their non-displaced counterparts, conditional on age, education, and macroeconomic conditions. In these same conditions women earn 8.7 percent less. This gap increases for both male and female with the approximation of the displacement event. Two years after the displacement year, Portuguese men earn 24.8 percent less than their non-displaced counterparts, and women earn 19.2 percent less. Only in the latter years does a slower recovery in earnings seems to emerge. In any event, three years after displacement men's earnings differential has risen by around 12.8 percentage points (p.p.) and women's differential by around 10.4 p.p., when compared to the earnings differential three years before displacement.

Table 12: Post-Displacement Earnings Losses
Weighted least squares regressions: men (N=773 104)

Dependent variable: log of average real hourly earnings				
	(1)		(2)	
Variables	Coefficient.	t-ratio	Coefficient.	t-ratio
Disp ₋₃	-0.126	(-14.0)	0.011	(1.5)
Disp ₋₂	-0.151	(-17.7)	-0.006	(-0.9)
Disp ₋₁	-0.193	(-22.9)	-0.029	(-4.1)
Disp ₀	-0.203	(-10.8)	-0.073	(-4.6)
Disp ₊₁	-0.234	(-15.6)	-0.087	(-7.0)
Disp ₊₂	-0.248	(-17.8)	-0.109	(-9.4)
Disp ₊₃	-0.254	(-16.2)	-0.114	(-8.7)
Disp ₊₄	-0.252	(-12.6)	-0.113	(-6.7)
Age	0.066	(195.3)	0.046	(161.8)
Age squared ^a	-0.059	(-141.1)	-0.042	(-120.1)
Education	0.103	(679.4)	0.069	(479.1)
Part-time job	0.101	(27.7)	0.091	(29.9)
Early-leaver	-0.012	(-1.4)	-0.025	(-3.4)
Size			0.063	(254.5)
Sales per worker			0.113	(254.9)
\overline{R}^2	0.44		0.61	

Notes:

^a variables divided by 100.

All specifications include a set of time dummies.

The coefficient estimates of the early-leaver dummy variable are negative but not statistically different from zero. Differences in earnings between displaced and similar non-displaced workers may be explained by differences in employer characteristics where the individuals work (see column 2). The first variable is size, which is measured as the natural log of total employment in the firm. Sales per worker is defined as the ratio of annual real sales and total employment (in logs). Finally, eight industry (one-digit level) and six regional dummies were added to the model.

Table 13: Post-Displacement Earnings Losses
 Weighted least squares regressions: women (n=501494)
 Dependent variable: log of average real hourly earnings

Variables	(1)		(2)	
	Coefficient	t-ratio	Coefficient.	t-ratio
Disp ₋₃	-0.087	(-9.7)	0.012	(1.7)
Disp ₋₂	-0.103	(-12.2)	0.004	(0.6)
Disp ₋₁	-0.130	(-15.8)	-0.006	(-0.9)
Disp ₀	-0.151	(-7.5)	-0.044	(-2.7)
Disp ₊₁	-0.174	(-11.4)	-0.056	(-4.5)
Disp ₊₂	-0.192	(-13.5)	-0.084	(-7.2)
Disp ₊₃	-0.191	(-12.1)	-0.089	(-6.9)
Disp ₊₄	-0.185	(-9.4)	-0.083	(-5.1)
Age	0.040	(108.2)	0.026	(85.8)
Age squared ^a	-0.031	(-63.4)	-0.020	(-50.2)
Education	0.102	(587.8)	0.069	(408.4)
Part-time job	0.144	(41.8)	0.108	(38.0)
Early-leaver	-0.011	(-1.2)	-0.026	(-3.5)
Size			0.059	(231.3)
Sales per worker			0.098	(200.4)
\overline{R}^2		0.46		0.63

Notes:

^a variable divided by 100.

All specifications include a set of time dummies.

The effects of size and sales per worker on average hourly earnings are positive and highly significant. The results reveal that a large part of the relative annual earnings differential may be explained by differences in employers observed characteristics. Three years before separation the earnings gap between displaced workers and the reference group is almost negligible and not statistically different from zero (+1.1% for men and +1.2% for women). Indeed, after controlling for firms' characteristics, it is still possible to observe a very similar pattern on earnings evolution over the entire period of analysis. A pre-displacement dip in earnings is observed, followed by a drop in earnings in the displacement year. Not surprisingly, three years after displacement the relative earnings differential (the earning loss) has risen by around 12.5 p.p. for men and 10.1 p.p. for women. Overall, the results for the male sample reveal that the increase (three years after displacement) in the earnings gap of 12.5 p.p. is mainly due to the loss of tenure in the job and to joblessness. According to our calculations, tenure accounts for around 40-46 percent to the deepening in the earnings gap and joblessness for around 33-43 percent. Changing industry explains only 14 to 24 percent of the increase in the earnings gap. For female workers, the increase in the earnings gap of 10.1 p.p. is mainly due to the loss of accumulated returns to tenure (45-52 percent), joblessness accounts for 16 to 34 percent of that increase and changing industry

accounts for 16-31 percent.

3.7 The Falling Cyclicity of Real Wages

The Portuguese Labour market was for decades conspicuous for its low and strongly counter-cyclical rates of unemployment, with clear evidence of a very weak mobility in the labour factor. Researchers pointed quite naturally to the flexibility of real wages as the main reason for this. Throughout this period, convincing evidence was gathered suggesting strong cyclical sensitivity of aggregate wages in the behaviour of the unemployment rate (Luz and Pinheiro (1993), Gaspar and Luz (1997), Dias et al. (2004) and Marques (2008)). One decade on from the change in the monetary regime, with the emergence of the EA, in the presence of historically high rates of unemployment, it is important to revisit the relationship between wages and the unemployment rate. One important dimension of flexibility in wages is rooted in the way that real wages react to changes in economic activity. Either adjustments to employment along the aggregate labour demand curve will trigger a counter-cyclical reaction in real wages; or, the intertemporal substitution of leisure for labour along the dynamic labour supply curve will lead to real wages synchronized with the economic cycle (see also section 4). A description of the cyclical behaviour of wages may, however, be partly obscured by changes in the composition of the labour force over the economic cycle. Indeed, the use of aggregate wage indicators causes intractable confusion as to the effect of changes in wage dispersion, in the distribution of hours worked and in the composition of the workforce. There is an additional factor in the use of aggregate data, with the implicit assumption that the relationship between real wages and the economic cycle is common to all workers or groups of workers. In this context there is an array of evidence on the bias introduced by the greater tendency to retain qualified workers during the recession (and recruit unskilled workers during periods of expansion). In the absence of any control over this type of heterogeneity of workers, there is the illusion of counter-cyclical behaviour in wages. In turn, the emergence of better-paid jobs during the expansionist phase of the cycle will tend to create an artificial impression that wage behavior is adjusted to the economic cycle. The aim of this inquiry is to reassess the cyclical behaviour of real wages in Portugal, bearing in mind the heterogeneity of the work force, of jobs and of pay practices. This endeavour requires access to longitudinal data bases with an unusually rich content and the use of estimation techniques that are specifically suitable to cope with the presence of various types of heterogeneity (Carneiro et al. (2009)). With this in mind, use was made of the individual records in the *Quadros de Pessoal* from 1986 to 2005. This involved 23,234,558 workers/year and 521,563 enterprises/year. The treatment of heterogeneity was complex. Firstly, the sampling procedure involved separating the workers by type. Secondly, a distinction was established between workers joining and staying on at the enterprise. This meant taking into account the sorting process emphasised in economic theory between the behaviour of wages for newly-arrived workers and for the job stayers. Thirdly, the

analysis was undertaken in such a way as to allow for conditional interference in the observed characteristics of individuals (specifically age, schooling and qualifications). Finally, the estimation technique used made it possible to isolate the effect of features of workers that were unknown but remained constant over time (such as motivation, discipline, creativity or leadership) and those of the enterprise (such as technological intensity, entrepreneurial skill, organisational structure, market position or product specialisation). To this end, an algorithm was specially devised to ensure an accurate solution to the estimation problem in a regression model with two types of fixed effects (Guimarães and Portugal (2009)). The cyclical sensitivity of real wages can be condensed into the reaction of wages to the unemployment rate. Table 14 exhibits the semi-elasticities of real wages in relation to the unemployment rate, with control exercised only on the observed heterogeneity. Given this, a one percentage point increase in the unemployment rate will lead to a 2.19 percent fall in the real wages of male workers who stay in the same enterprise in consecutive years (between 1986 and 1995). The estimates presented in Table 14 show generic evidence of wage flexibility in the period between 1986 and 1995, above all for recently recruited workers. There is, however, a clear indication that the cyclical sensitivity of wages has fallen off significantly over the past decade.

Table 14

Sensitivity of real wages to the unemployment rate				
OLS				
Period	1986-1995		1996-2005	
	Stayers	New hires	Stayers	New hires
Men	-2.19	-2.81	-0.81	-2.11
Women	-1.44	-2.68	-0.61	-2.10

Source: Quadros de Pessoal (1986-2005)

Table 15

Sensitivity of real wages to the unemployment rate				
Worker fixed effects				
Period	1986-1995		1996-2005	
	Stayers	New hires	Stayers	New hires
Men	-1.91	-2.94	-1.22	-2.29
Women	-1.35	-2.71	-1.12	-2.27

Source: Quadros de Pessoal (1986-2005)

Table 16

Sensitivity of real wages to the unemployment rate				
Worker and firm fixed effects				
Period	1986-1995		1996-2005	
	Stayers	New hires	Stayers	New hires
Men	-1.77	-2.67	-1.30	-2.44
Women	-1.39	-2.51	-1.13	-2.25

Source: Quadros de Pessôal (1986-2005)

This development may, of course, stem from a change in the composition of employment, either from the modification of unemployment or from modification of wage reaction when a homogeneous labour force is taken for the whole of the period under consideration. If account is taken of the effects associated with the persistent characteristics of workers, it is possible to show that a significant part of the loss of cyclical sensitivity in real wages is in fact associated to changes in the composition of employment (Table 15). There remains, however, a clear indication of the fall in cyclical sensitivity of wages even when the findings are filtered for the presence of individual permanent heterogeneity.

A comparison between the two tables also shows that the dynamics of labour force recomposition along the economic cycle led to pro-cyclical bias during the period from 1986 to 1995 (above all for men) and a counter-cyclical bias for 1996 to 2005. Curiously, with inclusion of the worker effects, the behaviour of men and women is very similar.

Nothing essential changes with the additional control for firm constant heterogeneity (Table 16). Interestingly, the same happens when control of the heterogeneity of workers is added to control of the heterogeneity of enterprises. This finding seems to indicate that the fixed component of job recomposition follows a cyclical path identical to the one of the workforce recomposition component.

The indication of a fall in the cyclical sensitivity of wages may be associated to the inadequate nature of the mechanisms for wage determination in low-inflation environments, in particular the severe downward nominal rigidity of wages and the widespread use of extension mechanisms applied to collective agreements. In turn, the growing generosity of the unemployment benefit system, especially with respect to the potential duration of the benefit, made unemployment less painful, favouring the emergence of reservation wages less sensitive to the rise in unemployment rates. Under these circumstances, one may assist to higher unemployment rate increases in order to overcome the macroeconomic imbalances in the Portuguese economy (Blanchard (2007)).

4 Aggregate wage and price dynamics

The existence of wage and price rigidities, as documented in section 2, is widely recognised as a crucial issue for macroeconomics and notably for monetary policy. In the real world, the existence of price and nominal wage rigidities is expected to trans-

late into persistent responses of wages and prices to shocks hitting the economy so that evaluating the degree of persistence of such responses is an issue of paramount importance.

In this section we investigate the wage and price dynamics in Portugal with a special focus on the persistence of real wages, wage and price inflation, and compare the results with similar evidence for the US and the EA.

More specifically, in this section we will try to give an answer to the following questions: 1) how do wages and prices react to different shocks that may hit the Portuguese economy? 2) how persistent are the responses of real wages, wage and price inflation to those shocks and how they compare with similar evidence for the US and the EA? and 3) how important were the different shocks in accounting for wages and prices fluctuations in the Portuguese economy in the 1995-2007 period?

The analysis draws on previous work for the Portuguese economy (see Marques (2008)), the US and the EA (see Duarte and Marques (2009))¹⁴. The approach is conducted within a structural error-correction model which allows comparing the persistence of real wages, wage and price inflation across shocks for different economies.

The rest of this section is organized as follows. Sub-section 4.1 presents a simple theoretical model of wages and prices, which will be used to identify the long-run wage and price equations, as well as the permanent structural shocks. Sub-section 4.2 presents the econometric analysis with a special emphasis on the estimation and identification of the long-run wage and price equations. Sub-section 4.3 focus on the identification of the structural shocks and sub-section 4.4 on the dynamic response of wages and prices to these shocks, including some measures of short and long-run persistence. Sub-section 4.5 discusses the main sources of wages and prices fluctuations.

4.1 A macroeconomic model for wages and prices in an open economy

This sub-section presents a simple model for the determination of wages and prices, which will be used further below to identify the long-run wage and price equations, as well as the permanent structural shocks. The model consists of a production function, a wage setting equation, an equation describing price formation, an equation for the unemployment rate and an equation for the import prices in domestic currency. The equations contain a minimum of dynamics in order to simplify the discussion about

¹⁴The results for the US and the EA used here for comparison purposes are taken from Duarte and Marques (2009), but the results for the Portuguese economy differ significantly from the ones presented in Marques (2008). The differences stem from three main sources: 1) The sample period was updated to include data for 2007; ii) there was a major revision of the data on labour productivity which implied important changes on the coefficients, as well as on some properties of the estimated model and iii) a different assumption underlying the identification of some of the shocks was introduced in order to ensure full comparability with the results for the US and the EA, reported in Duarte and Marques (2009).

the long-run properties of the model¹⁵.

We assume that production in the economy may be described by a constant returns to scale Cobb-Douglas function (with lower case letters denoting logs):

$$y - e = \eta + (1 - \gamma)(k - e) \quad (1)$$

where y is output, e is employment, k is the stock of capital and η a stochastic technology variable. We may further simplify the production function and simply write:

$$h = y - e = \xi_h \quad (2)$$

where h stands for labour productivity and ξ_h for a stochastic technology trend (technical progress and capital accumulation) that shifts labour productivity in the long-run. It is assumed that technology is exogenous and follows a stochastic random-walk process, i.e., $\xi_h = \xi_{h-1} + \phi_h$ where ϕ_h is a pure technology innovation.

As regards the wage formation, we assume that wages are determined through a bargaining process between firms and employees (or the labour unions). This type of models predicts that the bargaining solution will depend on the real producer wage and productivity on the firm side, and on the real consumer wage on the workers side. A simple log-linear form of the wage equation corresponding to the bargaining solution can be written as:

$$w - q = k_1 + \mu(p - q) + \delta h - \theta u, \quad 0 \leq \mu, \delta \leq 1, \theta \geq 0, \quad (3)$$

where w is the nominal wage rate, q is the producer price level, p is the consumer price level and u is the unemployment rate.

According to (3), the real wage faced by firms (real producer wage) is affected by $(p - q)$, h and u . The relative price $(p - q)$, which measures the difference between the producer real wage and the consumer real wage, is usually referred to as the *price wedge*, and plays an important role in theoretical wage bargaining models. Its coefficient, μ , can be interpreted as a measure of "real wage resistance", which measures the unions ability to obtain higher wages to compensate for exogenous changes in workers' living standards (increases in p brought about, for example, by increases in indirect taxes). The bargaining solution (3) also implies that an increase in labour productivity, h , will increase wages, since higher productivity increases the profitability of firms, making them more likely to accept higher wage claims from the unions. The unemployment rate, u , represents the degree of tightness in the labour market, which influences the outcome of the bargaining process through the relative bargaining power of the labour unions and employers organizations.

For the process of price formation we assume an economy with imperfect competition where producers target their prices, q , as a mark up, ω , over marginal costs. If

¹⁵For further details on the model presented in this section, see Duarte and Marques (2009) and the references therein.

there are constant returns to scale, marginal costs are constant and therefore prices are set as a mark-up over unit labour costs:

$$q = \omega + (w - h). \quad (4)$$

The mark-up is not necessarily constant and, in an open-economy, it may be a function of the level of international competitiveness. Here, we assume that the mark-up may be written as:

$$\omega = k_2 + \lambda(z - q), \quad k_2, \lambda \geq 0, \quad (5)$$

where z is the domestic currency price of imports and λ reflects the exposure of domestic firms to international competition. The smaller is λ the smaller is the pass-through from foreign price or exchange rate shocks to domestic producer prices.

If we further assume that consumer prices are a weighted average of producer and import prices:

$$p = (1 - \rho)q + \rho z, \quad 0 < \rho < 1, \quad (6)$$

we may solve the model for wages and consumer prices obtaining the so-called long-run wage and price equations (ignoring the constants for simplicity):

$$w = (1 + \alpha)p - \alpha z + \delta h - \theta u + \tau_w, \quad (7)$$

$$p = \beta(w - h) + (1 - \beta)z + \tau_p, \quad (8)$$

where $\alpha = \rho(1 - \mu)/(1 - \rho)$ and $\beta = (1 - \rho)/(1 + \lambda)$. Under the assumption that the two relations are stationary, the stochastic variables τ_w and τ_p can be interpreted as exogenous wage and price shocks that follow stationary stochastic processes, i.e., $\tau_i = \sigma_i \tau_{i-1} + \epsilon_i$ with $0 \leq \sigma_i < 1$ ($i = w, p$).

For the unemployment rate, we assume that it is the result of the difference between the labour supply and labour demand, so that in the long run unemployment may be affected both by real wages, $(w - p)$, and productivity, h :

$$u = \pi_1(w - p) + \pi_2 h + \xi_u, \quad (9)$$

where ξ_u is an exogenous stochastic variable. Equation (9), being a reduced form equation, has the implication that ξ_u is a combination of labour supply and demand shocks. If equation (9) turns out to be a cointegrating relation, ξ_u would be interpreted as a stationary shock, while in the absence of cointegration, ξ_u would be seen as stochastic random-walk process, i.e., $\xi_u = \xi_{u-1} + \phi_u$ where ϕ_u is a pure unemployment shock.

Finally, we assume that import prices in domestic currency may depend on unemployment, as well as on productivity:

$$z = \gamma_1 u + \gamma_2 h + \xi_z \quad (10)$$

This way we allow for the possibility of unemployment and productivity/technology shocks to have long-run impacts on import prices through changes in the exchange

rate¹⁶. The stochastic variable ξ_z would be a stationary process if equation (10) is a cointegrating relationship. In the absence of cointegration, it will be assumed to follow a random-walk process, i.e., $\xi_z = \xi_{z-1} + \phi_z$ where ϕ_z is a pure exogenous import price shock.

Thus, our theoretical model expressed in terms of the variables we consider in the empirical analysis (w, p, u, h, z) is composed of equations (2),(7),(8),(9) and (10).

4.2 Econometric Analysis

To estimate the model above for the Portuguese economy we use quarterly seasonally adjusted data for wages (w), labour productivity (h), the unemployment rate (u) and consumer (p) and import prices (z), for the period 1992q2 to 2007q4. Wages refer to nominal compensation per employee for the whole economy, whereas labour productivity is measured as real GDP per employed person. Consumer prices are measured by the consumer price index (CPI) and import prices, are measured by the total imports deflator. For the analysis that follows we assume that w, p, h, z and u are all integrated of order one, $I(1)$. This assumption seems to be broadly supported by the Augmented Dickey-Fuller (ADF) unit-root tests (see Marques (2008)). According to the model outlined in sub-section 4.1, we expect two stationary relationships or, in other words, two cointegrating vectors, one corresponding to the wage equation and the other to the price equation. Even though the model also allows for some endogeneity of unemployment and import prices, we do not expect these two equations to give rise to additional cointegration relations because the model does not include all the variables we believe might help explain unemployment or import prices long-run behaviour. In order to investigate whether this assumption is consistent with the data we start by estimating a full-system unrestricted VAR model in the five variables w, p, u, h , and z and test for the existence of cointegration¹⁷.

Based on the evidence from the cointegration tests for the model without the dummy variables (see Table 17), the hypothesis of two cointegrating vectors emerges as the natural choice that reconciles the empirical evidence with the theoretical features of the model.

As the unrestricted cointegrating vectors are hardly given any economically meaningful interpretation, we proceed by using information derived from the underlying

¹⁶The emergence of the EA in 1999, with the introduction of a single currency, implied a significant change in the monetary policy regime at the country level, as the possibility of an independent monetary policy was lost. As a consequence the reaction of the nominal exchange rate to some of the shocks that hit the Portuguese economy during the sample period is likely to be different for the periods before and after the emergence of the EA. In particular, this is the case of idiosyncratic shocks (the ones that hit the Portuguese economy and not the EA as whole), which are not expected to bring about significant changes in the nominal exchange rate in the period after the emergence of the EA.

¹⁷Since the data are trending the VAR includes an unrestricted constant. In addition, four dummy variables (one step and three impulse dummies) are introduced to allow for special events (namely VAT rate changes) occurred during the sample period.

theoretical model developed in sub-section 4.1 to identify the two cointegrating relationships. In our framework, the identification of the long-run wage and price equations depends on the number of cointegrating vectors of the system. Under the assumption of two cointegrating vectors, it can be shown that the order condition for identification of the wage and price equations (7) and (8) is met, but the rank condition does not hold. In order to overcome this problem, we impose $\alpha = 0$ in equation (7) such that z drops from the wage equation. In this case it is possible to show that the two equations do meet the necessary and sufficient condition for identification, so that the system becomes over-identified with three over-identifying testable restrictions.

Table 17: Cointegration Trace Tests

Rank	Corrected trace test ^a	Corrected trace test ^b	90% quantile	95% quantile	99% quantile
0	78.27***	70.67**	64.74	68.68	76.37
1	48.42**	42.36	43.84	47.21	53.91
2	26.38	22.29	26.70	29.38	34.87
3	11.49	5.44	13.31	15.34	19.69
4	0.20	0.10	2.71	3.84	6.64

Note: *** and ** mark significance at 1% and 5% respectively;

(a) Small sample corrected trace test using the Reinsel-Ahn correction (Cheung and Lai, 1993);

(b) Small sample corrected trace test using the Bartlett correction factors (Johansen, 2002).

Once we estimate the model imposing these three over-identifying restrictions we realise that the coefficient of productivity, δ , becomes close to one. If we further impose this restriction we get the following two long-run relationships (with asymptotic standard errors in parenthesis):

$$w = p + h - \frac{0.097u}{(0.008)} \quad (11)$$

$$p = \frac{0.499(w - h)}{(0.049)} + \frac{0.501z}{(0.049)} \quad (12)$$

where it is worth noticing that the wage equation is such that it implies cointegration between unemployment and the wage share (or real unit labour cost, $w - p - h$), which is a result often found in the empirical literature.

As regards the coefficient of the unemployment rate we note that the estimate -0.097 , is in line with the standard elasticity estimates obtained in the literature for other countries, which usually stand close to -0.10 (see, for instance, Blanchflower and Oswald (1994)). The estimate for Portugal is significantly lower than the ones obtained in Duarte and Marques (2009) for the US (-0.327 , for 1993q1-2007q4) and the EA (-0.157 , for 1989q1-2007q4), but close to the estimate obtained in Carneiro and Portugal (2008a), as shown in section 3.

The estimated coefficients for the price equation suggest that the long-run coefficients on unit labour costs ($w - h$) and import prices z are basically similar. The estimate for the coefficient on import prices (-0.501) is significantly higher than the corresponding estimates obtained in Duarte and Marques (2009) for the US (0.128) and the EA (0.374).

4.3 Identification of the structural shocks

In a VAR model with I(1) variables it is known that cointegration imposes restrictions on the matrix of the long-run effects of the shocks to the system, which must be taken into account for the identification of the structural innovations. Our system has five variables and two cointegrating vectors and this has the implication that there must be three structural shocks with permanent effects and two structural shocks with transitory effects. It can be shown that the identification of the three permanent shocks may be achieved by imposing three restrictions on the long-run impact matrix and the identification of the two transitory shocks may be obtained by imposing one restriction on the matrix of the contemporaneous effects¹⁸.

To discuss further the economic identification of the permanent shocks in the context of our theoretical model, we may express the endogenous variables as a function of the exogenous shocks. Ignoring the two transitory shocks, the general solution of the economic model presented in sub-section 4.1, under the assumption of $\alpha = 0$, is given by

$$\begin{bmatrix} w \\ p \\ u \\ h \\ z \end{bmatrix} = \begin{bmatrix} \Omega_{11} & \Omega_{12} & 1 \\ \Omega_{21} & \Omega_{22} & 1 \\ \Omega_{31} & \Omega_{32} & 0 \\ 0 & 1 & 0 \\ \Omega_{51} & \Omega_{52} & 1 \end{bmatrix} \begin{bmatrix} \xi_u \\ \xi_h \\ \xi_z \end{bmatrix} \quad (13)$$

where the Ω_{ij} are functions of the model parameters: $\beta, \gamma_1, \gamma_2, \delta, \theta, \pi_1, \pi_2$. From equation (13) we see that an import price shock, ξ_z , has a zero long-run impact on unemployment and productivity and that an unemployment shock, ξ_u , has a zero long-run impact on productivity. On the other hand, productivity or technology shocks, ξ_h , may have a non-zero long-run impact on all the variables of the model. According to the discussion above, these three zero restrictions allow the exact identification of the three permanent shocks.

In terms of our theoretical model, the permanent import price shock is expected to have an equal long-run impact on nominal wages and prices, thus leaving the real wage unchanged in the long run and having no long-run impact on unemployment

¹⁸For further details on the econometric identification of the structural shocks, see Marques (2008) and Duarte and Marques (2009) and the references therein.

or productivity. Such a shock may stem from an unexpected change in the prices of imported goods or from an unexpected change in the nominal exchange rate. The permanent unemployment shock is identified by the condition that it has a zero long-run effect on productivity and is interpreted as a shock that may stem from an unexpected increase in labour supply or labour demand. The permanent productivity shock is interpreted as a technology shock (technical progress and capital accumulation) and is allowed to have permanent effects on all the variables of the system. Notice that this identification conforms to the restriction satisfied by a broad range of models, where only technology shocks have a permanent effect on labour productivity (see, for instance, Gali (1999)).

Finally, to identify the two transitory shocks we impose the restriction on the matrix of the contemporaneous impacts that the transitory price shock is not allowed to have a contemporaneous effect on wages. Thus, the transitory wage shock is the shock that may have contemporaneous effects on both wages and prices. The interpretation of the transitory shocks is not as intuitive as that of the permanent shocks, as in the context of our model they may stem from a variety of alternative sources with different implications for the dynamics of the model. For this reason, the discussion below focus mainly on the three permanent shocks.

4.4 Impulse responses

The impulse response functions of model variables, as well as the responses of real wages, the labour share and wage and price inflation to the three permanent shocks are depicted in Figures 4 to 6¹⁹. Table 18 presents two measures of persistence for real wages, wage and price inflation for Portugal, the US and the EA²⁰. The two measures of persistence are defined as the proportion of the total disequilibrium that dissipates in the two years after the shock, and the number of periods required for 99 percent of the total disequilibrium to dissipate. We see the first measure as a simple way of quantifying the speed of reaction in the short-term, so that we will loosely denote it as "short-term persistence" and the second as a way to measure "long-run persistence". When the speed of adjustment to the new equilibrium varies throughout the convergence period, we will need to look at both measures to better characterize the adjustment process. Figure 8 depicts the impulse responses to a permanent positive import price shock. As expected, given the property of long-run nominal homogeneity of the estimated model, an unexpected import price shock brings about a permanent increase in nominal wages and prices of the same magnitude in the long run. As a result, real wages, as well as the labour share remain unchanged in the long run.

¹⁹The impulse response functions for the five original variables of the system are depicted together with 80 percent confidence bands.

²⁰The figures for the US and the EA are from Duarte and Marques (2009).

Figure 8: Responses to a permanent import price shock

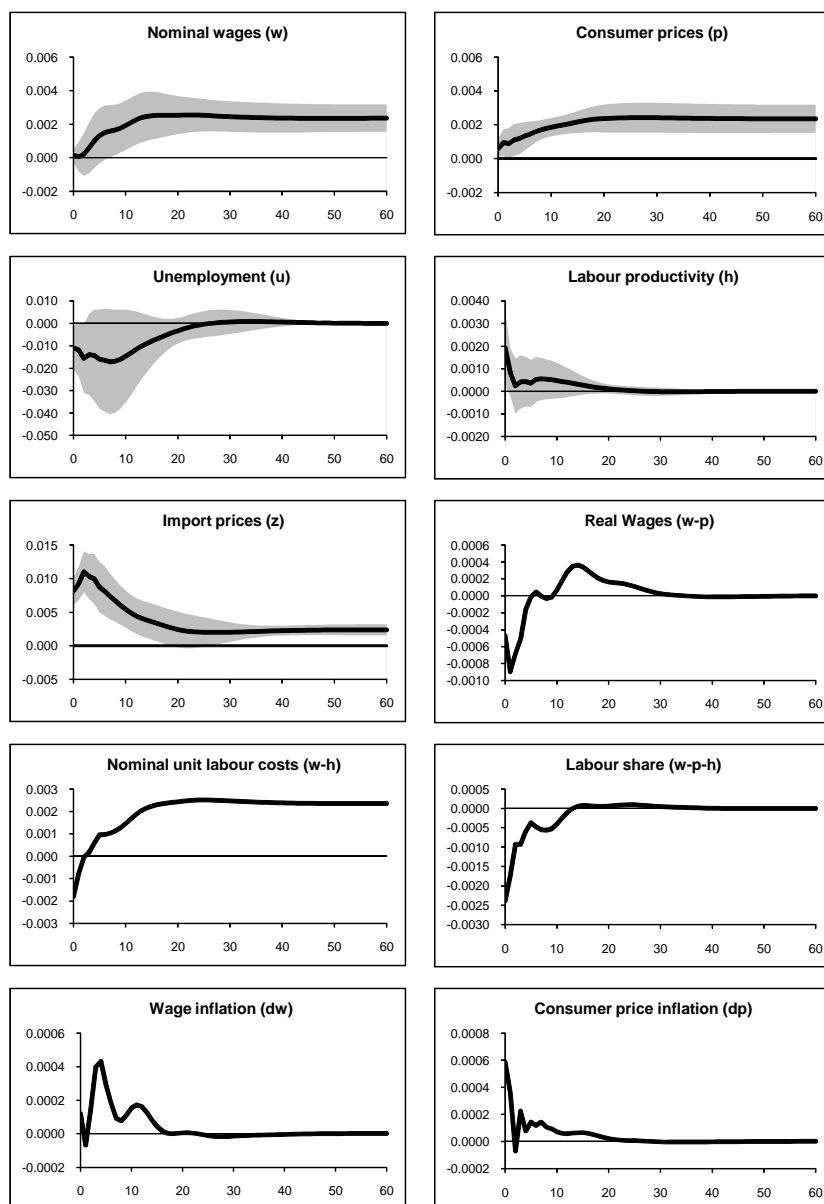


Table 18: Persistence of real wages, wage and price inflation

	Δw			Δp			$w - p$		
	PT	US	EA	PT	US	EA	PT	US	EA
Share of total disequilibrium dissipated after 8 quarters									
Permanent shock									
Imp. prices	0.62	0.80	0.42	0.70	0.80	0.55	0.42	0.28	0.60
Unemploy.	0.58	0.58	0.25	0.52	0.65	0.40	0.75	0.50	0.64
Productiv.	0.66	0.54	0.63	0.72	0.58	0.64	0.69	0.55	0.44
Transitory shock									
Wage	0.82	0.90	0.87	0.74	0.83	0.59	0.72	0.73	0.72
Prices	0.54	0.57	0.48	0.81	0.85	0.75	0.72	0.34	0.51
Number of quarters required for 99 % of the total disequilibrium to dissipate									
Permanent shock									
Imp. prices	39	42	44	39	40	43	45	43	40
Unemploy.	40	41	48	43	37	47	35	35	41
Productiv.	39	39	42	39	35	42	35	41	47
Transitory shock									
Wage	31	29	34	37	40	41	35	44	38
Prices	36	45	44	27	36	40	33	38	46

However, in the short run prices increase faster than nominal wages so that real wages decrease during the first year or so, and the labour share decreases during the first three years, after the shock. A noteworthy result is that the adjustment of real wages displays a hump-shaped response type to this shock, before starting to return to the previous equilibrium level²¹. While the largest impact on inflation occurs contemporaneously, the largest impact on wage changes only occurs after one year.

From Table 18 we can see that after two years (8 quarters) only 42 percent, 62 percent and 70 percent of the total disequilibrium has dissipated for real wages, wage inflation and price inflation, respectively. The larger short-term persistence of wages following an import price shock comes hardly as a surprise. On the one hand, the import price shock is expected to impact directly on prices and only indirectly on wages. On the other hand, as we have seen in section 2, wages in Portugal are adjusted once a year on average, while prices change more frequently, thus allowing a much faster short-term response of consumer prices to an import price shock.

As regards long-run persistence, we conclude that real wages emerge as somewhat more persistent in Portugal compared to the US and the EA, while wage and price inflation emerge as somewhat less persistent than in those two economies.

Figure 9 displays the impulse responses to an unexpected permanent positive unemployment shock. The shock seems to affect mainly wages with no significant impact on consumer prices in the long run. The explanation for this result may be found in

²¹Interestingly, the same pattern is displayed by real wages in the US and the EA, following an import price shock. See Duarte and Marques (2009).

the response of import prices. This variable increases permanently in the long run (eventually following a currency depreciation induced by higher unemployment) and, therefore, partly offsets the expected effect of higher unemployment on prices through lower wages²². As a result of the shock, real wages and the labour share decrease permanently to a lower equilibrium level.

Two years after the shock 75 percent of the total disequilibrium in real wages has already dissipated, which means that these are less persistent in face of an unemployment shock than in face of an import price shock. In the short-run, real wages also emerge as somewhat less persistent in Portugal than in the US or in the EA (where only 50 and 64 percent of the disequilibrium dissipates in the two first years after the shock). This accords with the idea that in Portugal real wages react very quickly and significantly to negative news coming from the labour market. Thus, if anything, real wages emerge as adjusting very quickly to shocks to unemployment, suggesting that wage flexibility, understood as the reaction of real wages to changes in unemployment, is very high in the Portuguese labour market. In the long-run the speed of adjustment of real wages in Portugal is similar to that of the US but faster than in the EA.

As regards wage and price inflation, both variables emerge as more persistent in the EA than in Portugal or the US, regardless whether one looks at the short or the long-term adjustment. The speed of adjustment of wage inflation is basically the same in Portugal and the US, but significantly faster than in the EA. Price inflation is also less persistent in Portugal than in the EA, but somewhat more persistent than in the US.

Figure 10 depicts the impulse responses to a permanent positive technology shock that shifts productivity in the long run and, by definition, may impact on the long-run level of all the variables of the model.

In the context of our estimated model all productivity gains are absorbed by nominal wages in the long run ($\delta = 1$ in equation (7)). Thus, in the long run, under a *ceteris paribus* assumption, we could expect nominal wages to increase in line with productivity and the labour share to remain constant. However, in our model the productivity shock causes a decline of import prices and of unemployment, which translate into an additional increase in wages implying a permanent increase not only in real wages, but also in the unit labour costs and the labour share²³. Consumer prices are negatively affected, but not significantly so.

In line with the behaviour of nominal wages and consumer prices, an unexpected positive shock in productivity has a temporary positive impact on wage inflation and a negative impact on price inflation. In either case, the short-term response of wage and price changes is rather fast given that after two years more than 60 percent of the

²²This result should be interpreted very cautiously, as the emergence of the EA is likely to have brought about significant changes in the reaction of the nominal exchange rate to unemployment shocks. See also the comments to equation (10) above.

²³Interestingly, a similar result for the technology shock is obtained for the US (see Duarte and Marques (2009)).

Figure 9: Responses to a permanent unemployment shock

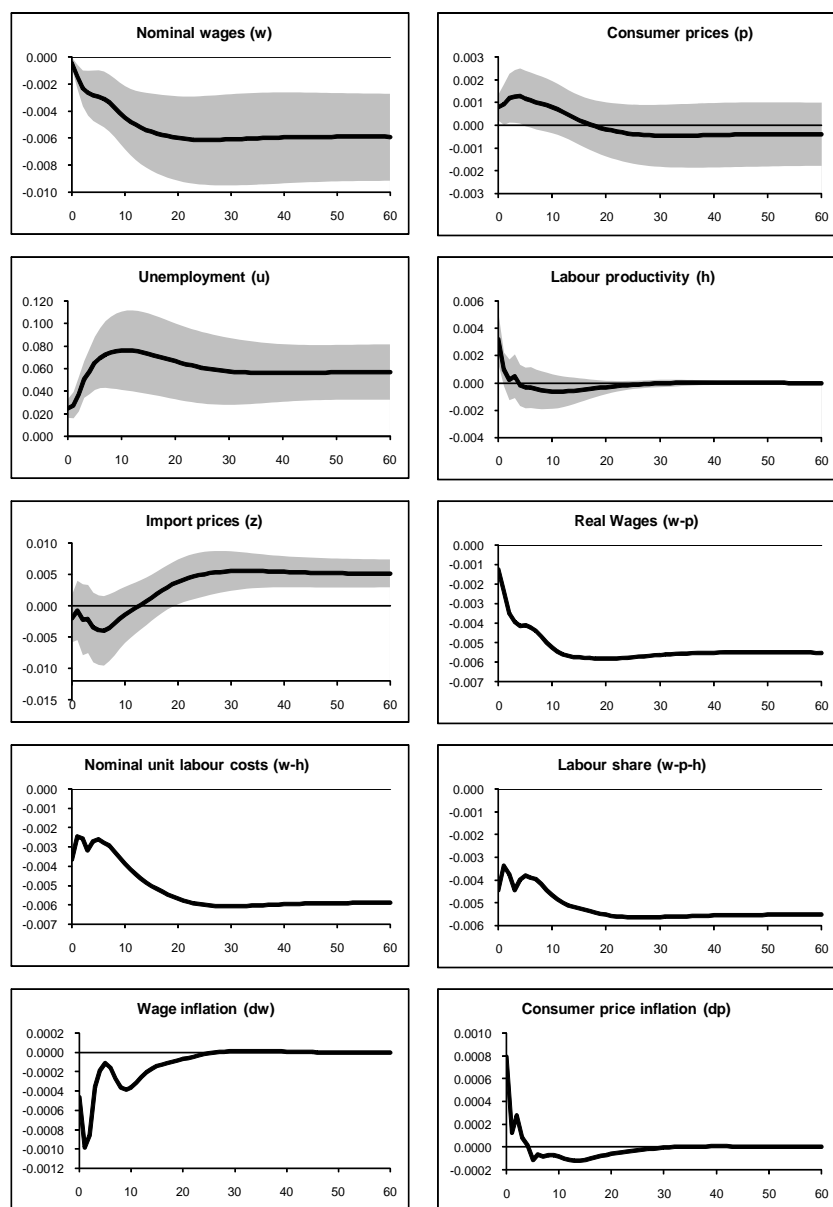
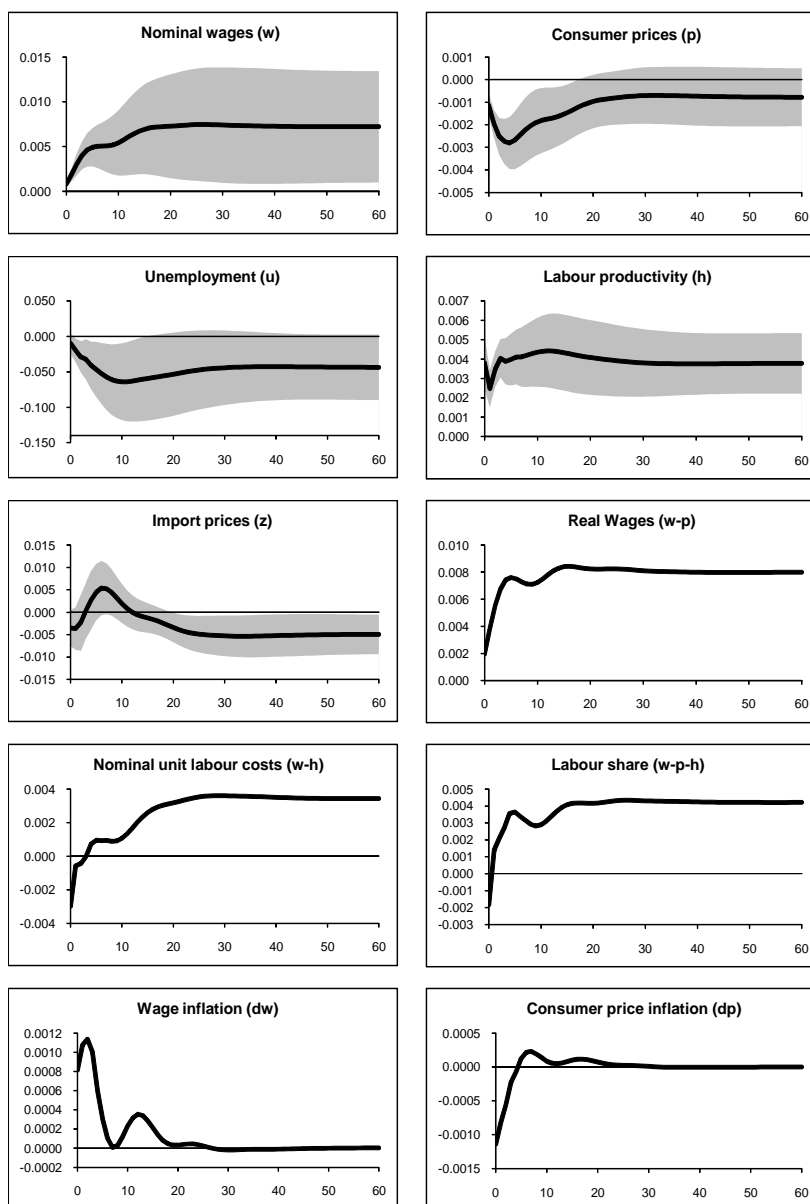


Figure 10: Responses to a permanent productivity shock



disequilibrium has already dissipated.

As regards long-run persistence, real wages display the same persistence as in the case of the permanent unemployment shock, but emerge as clearly less persistent than in the case of the permanent import price shock. Wage and price inflation display the same long-run persistence as in the case of the import price shock, but somewhat lower than in the case of the permanent unemployment shock.

Compared to the US and the EA real wages appear as less persistent in Portugal (it takes between 8 and 9 years in Portugal, compared to about 10 years in the US, and almost 12 years in the EA, for the full adjustment to take place). Persistence of wage and price inflation in Portugal is similar to that in US and somewhat smaller than in the EA.

4.5 Sources of wage and prices fluctuations

We now investigate how important were the different shocks in accounting for the observed fluctuations in wages and prices, by looking at the forecast-error variance decompositions for the variables of the model. As expected, the two transitory wage and price shocks explain a significant amount of the variation in the corresponding variables forecast errors in the very short run (up to 2 or 3 quarters), whereas permanent shocks play a more predominant role at longer horizons (see Table 19).

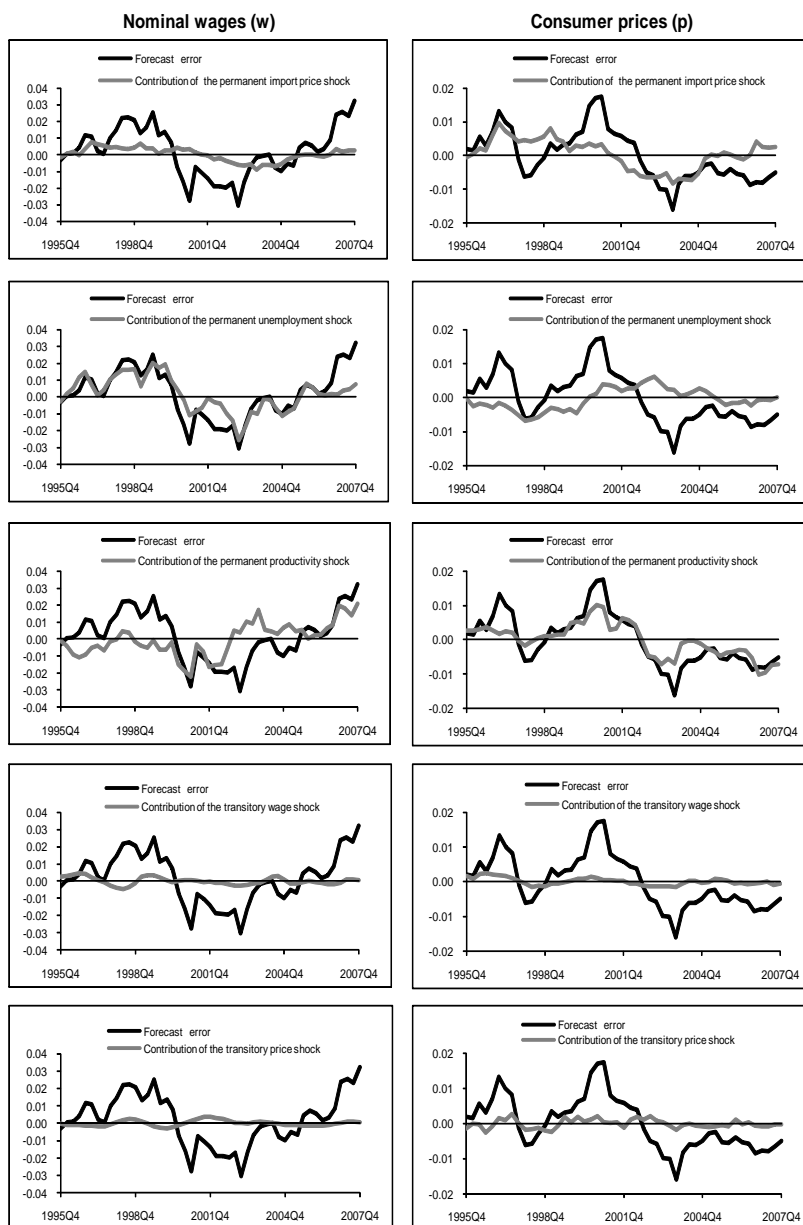
Table 19: Forecast error variance decomposition at the business cycle frequencies^(a)

Shocks	Wages			Prices		
	PT	US	EA	PT	US	EA
Permanent import price shock	0.06	0.15	0.24	0.32	0.15	0.57
Permanent unemployment shock	0.33	0.41	0.40	0.11	0.17	0.26
Permanent productivity shock	0.59	0.31	0.12	0.54	0.63	0.10
Transitory wage shock	0.01	0.10	0.20	0.02	0.01	0.01
Transitory price shock	0.01	0.03	0.03	0.02	0.04	0.07

^(a) Average contribution of each shock in the 12th, 16th and 20th quarter.

Permanent productivity shocks are the main driver of price and wage developments, being responsible for approximately 60 percent of the variation of wages' and 54 percent of the variation of prices' forecast errors, at the business cycle horizons (3-5 years). Shocks to import prices are not important for wage developments but are very important for price developments. For those periods, on average around 30 percent of the variation in the forecast errors in prices is attributable to import price shocks. Unemployment shocks play an important role in explaining wage fluctuations at the business cycle horizon, accounting for 33 percent of the variation in wages' forecast errors, but a minor role in explaining price dynamics (only 11 percent of the variation

Figure 11: Historical decompositions of 12 quarter ahead forecast errors in w and p



in the corresponding forecast errors is attributable to this kind of shocks). The reason for this minor role stems from the fact that the effect on lower prices through lower wages is partly offset by the effect of higher import prices.

Figure 11 illustrates the roles played by the different shocks during the sample period, by plotting the forecast-error at the three-year horizon (12 quarters) and the portion attributable to each shock for wages and prices. Looking at specific episodes, we see that the forecast errors in wages are mainly attributable to permanent unemployment shocks for most of the sample period, but productivity/technology shocks emerge as playing an important role in the most recent years of the sample (from late 2006 onwards). As regards price developments, import price shocks emerge as very important at the beginning of the sample (1995-1997) while productivity shocks seem to play the prominent role afterwards. Finally, the comparison of the main sources of wage and price fluctuations between Portugal, the US and the EA show that the results for Portugal are closer to the ones for the US. Productivity/technology shocks are the main driver of prices in Portugal and the US, while in the EA price developments are mostly explained by import price shocks. Wage developments are mostly explained by unemployment and productivity shocks in Portugal and the US, but in the EA productivity shocks do not play a significant role (see Duarte and Marques (2009)).

5 Conclusions

This paper documents the main features of price and wage setting practices in the Portuguese economy, investigates the salient features of wage formation, and evaluates the consequences for the persistence of real wages, wage and price inflation stemming from wage and price rigidities.

As regards firms' pricing behaviour the most noticeable finding is that, in the Portuguese economy, prices are somewhat less flexible than in the US but more flexible than in the EA. The evidence from the distribution of price changes gathered from micro data indicates that about 1 out of 5 prices is changed on average every month and that the median duration of a price spell is about 8.5 months (10.6 months in the EA and 4.6 months in the US). There is no evidence of general downward rigidity, as price decreases are not uncommon. Reassuringly, the evidence on both producer and consumer prices is quite similar.

Regarding firms' wage setting practices, we uncovered evidence favouring the hypothesis of aggregate and idiosyncratic wage flexibility. Changes in wages occur with less frequency than changes in prices though. If frequency is converted into duration, it can be seen that the average duration of wages is 13 months – 2.5 months longer than the average duration of prices, but about 2 months less than in the EA. Most wages are defined with the behaviour of inflation borne in mind, above all expected inflation, though the relationship is not a formal one.

Despite the rigidity imposed by the existence of mandatory minimum wages, the presence of binding wage floors determined by collective agreements, and the general

use of extension mechanisms, the firms still retain the ability to circumvent wage agreements via the mechanism of the wage cushion. The wage cushion can serve as a buffer against the negative product demand shocks to provide firms room to adjust to both internal and external factors. In the Portuguese case, rent sharing between employers and workers gives a relatively high importance to internal factors, in comparison with other European countries. But wages also react strongly to local labour market conditions. In a sclerotic labour market, where the loss of a job can be a dramatic event because of the low arrival rate of job offers, wages are conditioned by fears of dismissal (among these the possibility of displacement due to firm closure). The sensitivity of real wages to the unemployment rate is fairly high in the Portuguese labour market.

The evidence provided by macroeconomic models confirms the indication that Portuguese wages behave in a fashion consistent with the Wage Curve literature. In its static interpretation, a 10 percent increase in the unemployment rate generates a 1 percent decrease in real wage. The relative persistence of real wages, wage and price inflation varies with the type of shock hitting the economy. Real wages emerge as specially persistent following an import price shock, while wage inflation displays similar persistence in the face of import price, unemployment or productivity shocks. In turn, price inflation appears somewhat more persistent in the case of unemployment shocks. Overall, in terms of long-run persistence, wage and price inflation emerge as less persistent in Portugal and the US than in the EA, consistently with the micro evidence on the frequency of price adjustments.

Recent evidence from both aggregate and disaggregate wage data, however, suggests that the responsiveness of real wages to unemployment changes may have declined over the last decade. The indication of a fall in the cyclical sensitivity of wages may be associated to the nature of the current mechanisms for wage determination in a low-inflation environment (in particular under severe nominal downward rigidity of wages). Furthermore, the generosity of the unemployment benefit system, in particular with respect to the maximum potential duration of the benefits, by making unemployment less painful, favours reservation wages which are less sensitive to the rise in unemployment rates. In this setup, the weaker the effect of unemployment, the smaller will be the decrease in wages for a given unemployment gap, and the higher will be the level of unemployment needed to overcome the macroeconomic imbalances.

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