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Wage dynamics and worker mobility during deep recessions

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ABSTRACT

We provide empirical evidence of the relationship between downward wage rigidity and unemployment volatility by comparing wage dynamics and worker mobility during the Great Recession in two countries where wages adjusted very differently: Latvia and Spain. Using a panel of social security administrative data, we find that wages in Spain were rigid even during periods of rising unemployment. In contrast, Latvian wages were reduced and wage cuts affected 60 percent of jobs. At the same time, the elasticity of workers' transition rates into and out of unemployment to productivity shocks was four times higher in Spain than in Latvia, and these responses were more persistent in Spain. This evidence is consistent with theoretical models that show that unemployment volatility is higher when wages are rigid.

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1. Introduction

Wage rigidity tends to amplify any shock to the labour market. In a recession, a fall in real wages ameliorates the decline in employment, whereas if wages were to be rigid, any transitory shock to the market would lead to a persistent decline in employment, capital and consumption, generating a jobless recovery (Shimer, 2012b). Furthermore, the importance of wage rigidity is even more apparent in countries with fixed exchange rate arrangements (Schmitt-Grohe & Uribe, 2011).

Understanding the relation between wage rigidity and labour market flows is crucial for designing better employment policies and fostering the post-crisis recovery. Given its importance from many points of view and its widespread presence in different economies, wage rigidity has been extensively analyzed, both theoretically and empirically. The theoretical literature has identified the effects of wage rigidity mostly through frictional labour market models, for example, predicting higher unemployment volatility under rigid wages (Hall, 2005; Pissarides, 2009; Shimer, 2005). The empirical literature has measured the incidence of wage rigidity in different ways, mainly focusing on the distribution of wage changes in the same job to show that there are few wage cuts (Altonji & Devereux, 1999; Goette, Sunde, & Bauer, 2007; Gottschalk, 2005). There is evidence of prevalent resistance to wage cuts, both in nominal and real terms, and both in developed and developing countries.¹

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Some empirical work uses self-reported survey data, such as Eurostat's Labour Force Survey (e.g. Brauksa & Fadejeva, 2013; Jimeno, Casado, & Fernandez, 2015) or Eurosystem's Wage Dynamics Network (e.g. Izquierdo et al., 2017) survey of firms, to analyze wages and worker dynamics. In this paper we exploit a panel of social security administrative data from Latvia and Spain to identify the impact of wage rigidity in employment flows during the Great Recession that followed the financial crisis of 2007–2008. Although the two countries are different according to size and economic development, they had strikingly similar unemployment developments in the pre-crisis period. Additionally, in both countries, while the unemployment rate was lower than 9% at the end of 2007, it jumped to around 20% two years later. The response of wages after this shock was very different: in Spain, wages increased by 3 percent annually; in Latvia, wage cuts affected 60 percent of workers that kept their jobs and nominal wages were reduced by 6 percent.

The aim of this paper is, thus, to provide some empirical facts to link unemployment volatility with wage rigidity. For that purpose, we compare a strongly wage-rigid country, such as Spain, with an economy with exceptionally flexible wage arrangements, such as Latvia, during a period in which this wage rigidity has more of an impact, such as the Great Recession. First, we document the differences in wage dynamics and worker mobility in these two countries, using detailed administrative data. We find clear indicators of downward wage rigidity in Spain and wage flexibility in Latvia. This difference in wage setting between the two countries is observed for workers that stay in the same job, but also for workers that switch jobs, including those that experience non-employment. Second, we analyze workers' transitions into and out of employment. We show that in both countries there was an increase in the flow of workers out of employment and a decrease in the flow into employment. Notably, while in Spain these changes were very persistent, in Latvia they recovered faster. Finally, we take into account that economic activity was much more affected in Latvia compared to Spain. In particular, from 2007 to 2010 GDP dropped by about 20% in Latvia and about 2% in Spain. Thus, unemployment reacted much more strongly and persistently in the rigid-wage country.

Many conditions make the comparison between Spain and Latvia particularly relevant. First, both countries were somewhat limited in their ability to deal with the shock of the financial crisis through nominal devaluation, thus increasing the importance of nominal wage adjustment. Second, these countries had a similar evolution of the employment rate before and at the beginning of the Great Recession. In both countries the unemployment rate rose by more than 10 percentage points. This major shock helps us to identify the differences between the two economies with regard to wage dynamics and worker mobility. Third, both countries stand out in the euro-zone in terms of wage adjustment. In particular, during the crisis, Spain had one of the highest increases in real wages in 2009 (3.5% according to the ILO), while Latvia had one of the largest decreases (–7%). Finally, both countries have detailed administrative data, which we use to construct different measures of wage rigidity and worker mobility.

This paper contributes to the extensive literature on cross-country comparisons of labour market responses to the Great Recession (Izquierdo et al., 2017; Jimeno et al., 2015). It also adds to the studies on the level of wage flexibility in our sample countries (Brauksa & Fadejeva, 2013; Fadejeva & Krasnopjorovs, 2015; Izquierdo & Jimeno, 2015; Messina, Duarte, Izquierdo, Caju, & Hansen, 2010) by exploring comprehensive administrative data and by analyzing beyond those who stay at the same job and providing evidence

of wage rigidity for job changers. Finally, the paper provides important facts for frictional labour market models (Hall, 2005; Pissarides, 2009; Shimer, 2005), relating the different degrees of wage rigidity to unemployment volatility, and providing evidence that suggests that wage rigidity could affect the response of not only the unemployment-to-employment transition rate but also the employment-to-unemployment transition rate, a fact that has not been emphasized in the literature.

The rest of this paper is organized as follows: Section 2 describes the economic context in both countries and their labour market institutions. Section 3 presents the data and methodology that we use in the empirical analysis. Section 4 presents our results and discusses the importance of wage rigidity in accounting for the differences in unemployment volatility in both countries. Section 5 concludes the study.

2. The great recession in Latvia and Spain

In this section, we provide some context for the countries analyzed during the sample period of 2004–2011. Although Latvia and Spain are different in terms of population size and economic development (in 2007, the size of the population was 20 times higher and the GDP per capita (PPP) was 1.7 times higher in Spain), we focus on the striking similarities in the two countries' experience during the Great Recession.

First, both countries were constrained by the euro adoption. Spain has been part of the EMU since its beginning. Latvia has been a member of the EU since 2004 and expected to adopt the euro after January 2014, pegging the lat to the euro from January 2005. Both countries benefited from the higher relative development of their neighbours. Moreover, they received substantial capital inflows that lowered interest rates. After a period of healthy growth, both countries evidenced strong current account deficits as well as overdevelopment of the construction sector, fuelled by low interest rates on mortgages.

The global financial crisis found these countries overexposed to shocks, with high private debt and a high share of employment in the construction sector. The crisis had a huge impact, bringing the GDP down in a few quarters. In both countries, the possibilities to devalue were limited and there were strong pressures calling for an increase in competitiveness through other channels.

Figure 1 shows the comparative evolution of crucial variables. In panel (a) we plot the unemployment rate. Importantly, both countries experienced a rise in unemployment – from less than 10 percent at the end of 2007 to 20 percent after two years – during the peak of the crisis.² Nevertheless, this comparable rise in unemployment was not related to a similar change in GDP. Panel (b) plots the evolution of real GDP in both countries, showing that the shock was much stronger in Latvia. This suggests that elasticity of unemployment with respect to shocks is much higher in Spain.

Why is unemployment more volatile in Spain compared to Latvia? We argue that this could partly be explained by the evolution of real wages. In panel (d) of Figure 1 we plot the evolution of real wages. From the end of 2007 to 2010, mean real wages in Spain increased by 6 percent while in Latvia they decreased by more than 10 percent.³ The evolution of wages suggests strong wage rigidity in Spain and much more flexible wages in Latvia.

To understand these differences, in this section we briefly review the main labour market institutions in both countries and return to this discussion after we present our results. We first analyze collective bargaining.

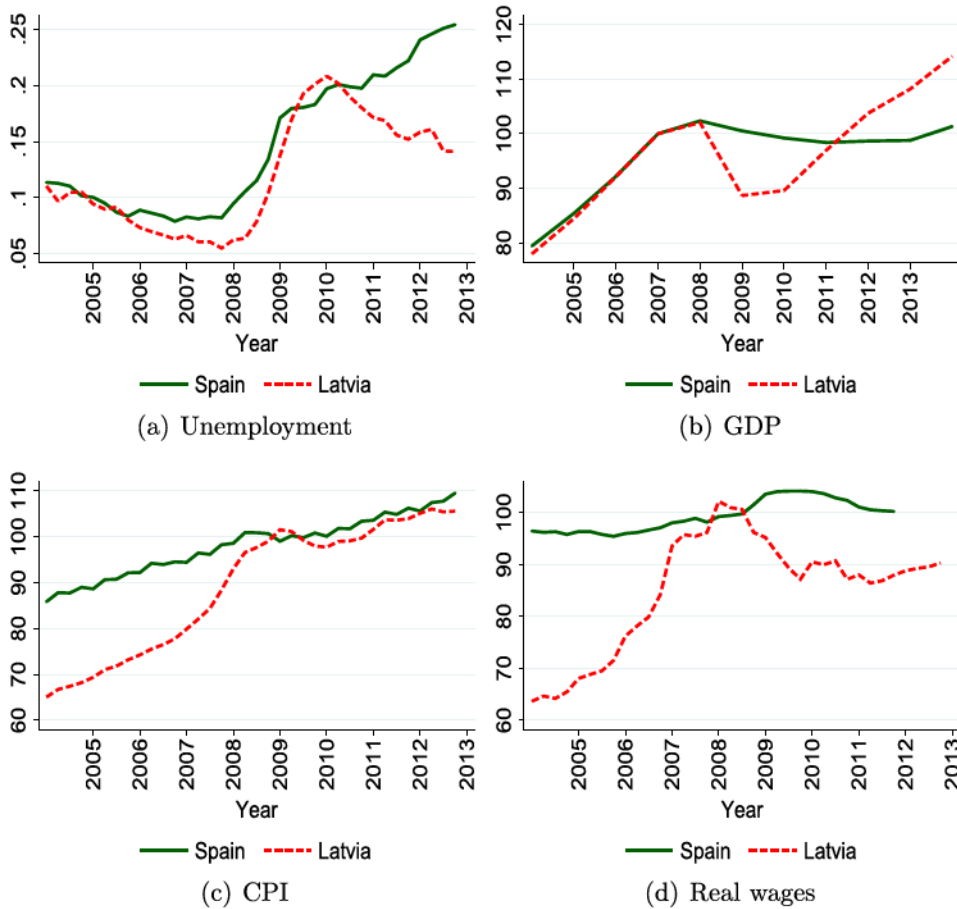


Figure 1. Spain and Latvia during the great recession. Sources: Panels (a) and (c): Spain: *Instituto Nacional de Estadísticas*, INE. Latvia: Central Statistical Bureau of Latvia. Panel (b): Penn World Tables, Output-side real GDP at chained PPPs (index 2007=100). Panel (d): authors' sample from administrative data. Notes: Unemployment rates and real wages are smoothed seasonally adjusted series.

Spanish collective bargaining did not provide instruments for flexibility in any respect. It had an intermediate level of centralization with few chances to modify the main conditions set by particular firms. Before the Great Recession, wages of 55% of workers were established at the provincial industry level according to Izquierdo, Moral, and Urtasun (2003). Furthermore, collective agreements were very persistent given that previous agreements could be extended for two years if no new agreement was reached. Importantly for wage flexibility, wage payments should also comply with the 'inflation safeguard clause', which required that wages should at least adjust to past inflation. This rule covered 73% of workers before the Great Recession (Izquierdo et al., 2003) but this coverage decreased afterwards to about one third of workers (Izquierdo & Jimeno, 2015; Visser, 2016).

The Latvian labour market was characterized by a low minimum wage, weak unions, and decentralized collective bargaining (at the firm level). Furthermore, a tripartite (government, employers and trade unions) dialogue, in place since the 1990s, introduced a

'Committee to Promote Wage Restraint' to reduce nominal wages (and bonuses) in the public and private sectors. During the Great Recession, Latvian collective agreements weakened much more in the private sector (Visser, 2016). Baltic employers reacted by not signing new agreements and by unilaterally changing the contents of agreements (Gonser, 2011).

Thus, Latvian and Spanish collective agreements were very different both before and during the Great Recession. For example, the two countries differ with respect to collective bargaining coverage. Before the crisis, the percentage of employees with the right to bargain was 21.5 in Latvia and 76 in Spain (OECD, 2007). Also, the level of bargaining remained different during the Great Recession. Visser (2016) shows that the share of firm-level bargaining was 80% in Latvia and only 9% in Spain.

Thus, while both countries were affected by a strong increase in unemployment, wages responded in a different way because of the institutional setting, making the comparison of these two countries very interesting in learning about the consequences of wage rigidity.

3. Data and methods

In this section we describe the data and methods used in this paper. We refer to the Appendix for particular issues regarding each source and for details of the variables used.

3.1. Social security data

3.1.1. Spain

Our paper uses the Spanish *Muestra Continua de Vidas Laborales* (MCVL). This is a panel of workers across their labour market history, constructed from social security data. The MCVL is a representative sample of all individuals who paid to or received a transfer from social security in a given year. This means that the individual concerned could be sampled if employed, if receiving unemployment benefits, or if retired and receiving a pension. Each year, the sample is about 4 percent of all individuals in social security registers, which comes to about 1.1 million individuals. All the historical information is compiled for each of the individuals sampled, covering the entire period for which social security records are available.

The MCVL collects information on several variables related to the worker (date of birth, sex, nationality, region); to the job (hiring and separation dates, type of contract and income, etc.); and to the firm (industry, size, location, etc.). The wage reported to social security (that we use in this paper) includes all the concepts that determine social security contributions. For example, it includes overtime payment but excludes in-kind payments. Additionally, wages are constructed so that they represent monthly payments and, as is usual in administrative data, are top and bottom-coded. In practice, this implies that the observed wage is truncated at maximum and minimum levels. These values vary by year and occupation and depend on the minimum and maximum contributions to social security set by the tax authority.

To be explicit, the MCVL follows the worker over different periods, specifying their employment status, wage income and the employer in each period. With this information it is possible to construct a worker's transitions and changes in wages.

For the purposes of this paper, most of the MCVL information is not relevant; a subsample suffices to characterize the transition rates. In our paper, we construct a random subsample of about 40,000 males between the ages of 20 to 60, employed under a general regime (no self-employment or rural labour).⁴

3.1.2. Latvia

The data from Latvia is also generated through contributions from social security. A standardized tax return form is filled in by firms every month and submitted to the Internal Revenue Service. The main purpose of the salary tax return form is the calculation of social security taxes and income taxes.

The Latvian database has information about the worker (year of birth and sex), the job (type of contract/insurance and monthly gross wages and salaries), and the firm (activity and type of institution). As in the previous case, this data provides information on the same worker for different periods, specifying their employment status, the wage and the employer for each period.

The wage is gross monthly salaries. There is some top-coding in this database but it is rarely binding.⁵

Throughout the paper we work with a sample of about 60,000 males between the ages of 20 to 60, sampled at random from those employed during the period of 2004 to 2012 under a general insurance contract, excluding employees in microenterprises and rural labour, such as individual merchants, firms of individuals, fishermen, and farmers.

3.1.3. Consistency, filtering, corrections and samples

In both databases, we have the monthly wage for workers, with almost 3 million observations for Spain and 3.6 million for Latvia (Table 1).⁶ Wages include overtime pay and exclude in-kind payments. In this sense, the definitions from both sources are consistent.⁷

In spite of this, we have developed several corrections to and selections from the original data that do not change the overall results but are worth noting. First, declared wages are bottom and top-coded. In the Spanish data, about 1 percent and 13 percent of wages are affected by bottom and top-coding respectively. For our purposes these cases would not provide any information on wage flexibility since changes cannot be observed. For that reason, we change any truncated wage to missing, and mark the observation as being affected by the bottom or top-coding. In the case of Latvia, the top-coding applies to the annual income, but it is highly uncommon, so no case is affected by top-coding in our sample.

Second, we have found several monthly declarations with zero income within a job (we observe positive wages for the worker in that firm before and after the zero is observed).

Table 1. Sample from the administrative data.

	Spain	Latvia
Number of individuals	43066	64061
Mean number of obs per id.	66.18	56.40
Number of monthly observations (in th.)	2850.11	3612.68
Numb. of filtered monthly wages (in th.)	1973.93	2188.01

Notes: Statistics from the sample used in this paper. The sample is restricted to males between 20 to 60 years of age. Source: Spain: MCVL; Latvia: CSB.

This is more frequent in the Latvian data. Some cases exhibit a pattern, as in a seasonal job. Others could be explained as unpaid leave or zero hours in the month for hourly-paid jobs. Importantly, in Latvia the proportion of zeros more than doubles during the period of 2009–2010, suggesting that they are related to the business cycle. Given that we work mostly with log wages, both in mean wages and in the wage changes analysis, all adjustment through zero wages will be eliminated.

Third, we observe that some workers tend to be paid the same amount repeatedly but with small differences in some periods. These small changes between months are probably due to some component of compensation (differences in hours or days worked between months, overtime pay, commissions, bonuses, etc.) rather than a change in the wage rate. We follow the literature on wage rigidity by correcting for any measurement error or small difference between observations by filtering the data. To do so, we take a centred moving median covering a span of 13 months.⁸

On the whole, the results presented in this paper are for the overall sample, and we concentrate on ‘filtered’ wages, unless otherwise specified. Filtered wages are the moving median of wage over jobs in which we never observe a zero wage or a truncated wage (if we observe a zero or if wages are affected by bottom or top-coding, we drop the entire job). Note that these corrections are important for the analysis of wage dynamics, but not for worker dynamics. We also ensure that the main results of the paper are robust with regard to other definitions of wages (raw wages, for example) and to other samples. In particular, we check that results are similar if we restrict the sample to jobs in the private sector, or if we restrict it to jobs above the minimum wage.⁹ We also divide our sample by job tenure. For brevity’s sake we avoid presenting all these alternative statistics, but we point out any important difference that we may find with the presented ones.

3.2. Employment transitions

Our data allows us to identify different employment transitions of workers. Taking two periods (months) t_0 and t_1 we identify the worker as:

- Stayer (S)** if the worker is employed in the same job (firm and contract) in t_0 and t_1 ,
- Job-to-job (EE)** if always employed between t_0 and t_1 but not in the same job (firm and contract),
- Re-employed (EUE)** if employed in t_0 and t_1 but with some period spent without a job in between,
- Entry (XE)** if employed in t_1 but not in t_0 ,
- Exit (EX)** if employed in t_0 but not in t_1 ,
- New Hire** for short tenure workers, including those workers between t_0 and t_1 (EE, EUE, XE).

This classification of workers based on their transitions in each period allows us to provide a detailed analysis of employment and wage dynamics.

Following the literature we compute the job-finding rate as the proportion of non-employed workers who find a job, and the separation rate as the proportion of employed workers who transit to non-employment.¹⁰ These two transition rates indicate outflow and inflow into non-employment and are computed as monthly rates. Given the strong seasonality, we plot the annual averages or the seasonally adjusted series.

Given that our goal is to analyze unemployment volatility we choose to concentrate on these worker’s transition rates rather than other alternative definitions, such as the hiring

rate, job creation or job destruction. In fact, job-finding and separation rates determine the evolution of the unemployment rate. Let u_t be the non-employment rate in a period. The evolution of u is determined by the flow into non-employment, δ_t , which is the average rate at which employed workers lose the job, and the flow out of non-employment, f_t , which is the average rate at which the non-employed find a job. The change in u rate depends on these two rates in the following way: $u_{t+1} - u_t = (1 - u_t)\delta_t - u_t f_t$. Using this formula, it is straightforward to show that constant transition rates imply $u = \delta/(\delta + f)$, which is the steady state unemployment rate formula. Even if these rates change in time but remain relatively stable, the same formula can be used to approximate the unemployment rate (Pissarides, 2009; Shimer, 2012a). Then, proportional changes in non-employment depend on proportional changes in the two flow rates:

$$d \ln u = (1 - u)(d \ln \delta - d \ln f). \quad (1)$$

This equation provides a simple decomposition formula to explain a change in the unemployment rate. We will use this formula to compute the relative importance of finding and separation flows to changes in u .

3.3. Wage dynamics

In this paper, as in the literature, we analyze wage dynamics from different perspectives. The literature typically analyzes wage rigidity by presenting the histograms of wage changes among stayers.¹¹ We follow this idea to discuss the differences in wage dynamics in both countries.

First, based on the literature on wage rigidity, we analyze the distribution of annual wage changes for workers who do not change jobs. To be explicit, we plot detailed histograms of changes in the log of nominal wages for workers who continue with the same job, i.e. stayers, between the same month of two consecutive years. We analyze, in particular, these distributions before and after the recession to understand the extent to which the worsening of economic conditions and the rise in unemployment alters the wage dynamics. From this information, we can also compute different moments of this distribution, such as the mean by period, the median, the proportion of workers with no wage change (wage freezes) and the proportion of workers with negative wage changes (wage cuts). We present the time series of these statistics to compare them with the evolution of unemployment and productivity.

As emphasized by the theoretical literature, wage rigidity of stayers is not the only or even the most relevant indicator for understanding labour market behaviour. Wages of new hires are also relevant, because job creation would depend on their labour cost rather than on stayers (Haefke, Sonntag, & van Rens, 2013; Pissarides, 2009). For that reason we extend the same analysis to workers with other types of transitions, including job-to-job transitions and workers who suffer some period of unemployment in between two jobs. The distribution of wage changes among these workers is typically more dispersed and shows an important proportion suffering income loss due to unemployment (see Davis & von Wachter, 2011 and Couch & Placzek, 2010 for recent evidence on earnings losses upon displacement and the incidence of recessions).

3.4. Wage change decompositions

We now analyze wage changes among different workers. To do so, we build a decomposition of aggregate log wage changes that borrows from similar analysis applied to productivity changes (Griliches & Regev, 1995). Let us define the mean log wages as

$$w_t = \frac{\sum_{i=1}^{N_t} \ln W_{it}}{N_t} \quad (2)$$

where W_{it} is the nominal wage of worker i in period t and where N_t is the total number of workers in period t . Then, the wage difference is

$$\Delta w_t = w_t - w_{t-1} \quad (3)$$

Another way of computing this same outcome is by defining some groups and computing averages of log wages for each of them and then computing the mean as the weighted average. In particular, we consider different groups of workers according to their transition between the two periods: S for stayers, N for new jobs (grouping both EE and EUE transitions), E for entries, and X for exits. Then, we have

$$\Delta w_t = \theta_{St} w_{St} - \theta_{St-1} w_{St-1} + \theta_{Nt} w_{Nt} - \theta_{Nt-1} w_{Nt-1} + \theta_{Et} w_{Et} - \theta_{Xt-1} w_{Xt-1} \quad (4)$$

where $\theta_{jt} = n_{jt}/N_t$, n_{jt} is the number of employees in group j in period t , and where $w_{jt} = \sum_{i=1}^{n_{jt}} \ln W_{it}/n_{jt}$ is the mean of wages for that group. By adding and subtracting terms, we construct the following decomposition:

$$\begin{aligned} \Delta w_t = & \theta_{St} \Delta w_{St} + \theta_{Nt} \Delta w_{Nt} + \Delta \theta_{St} (w_{St-1} - \bar{w}_t) + \Delta \theta_{Nt} (w_{Nt-1} - \bar{w}_t) \\ & + \theta_{Et} (w_{Et} - \bar{w}_t) - \theta_{Xt-1} (w_{Xt-1} - \bar{w}_t), \end{aligned} \quad (5)$$

where $\bar{w}_t$ is an indicator of an aggregate wage, such as $\bar{w}_t = (w_t + w_{t-1})/2$. The first two terms measure the within contribution of stayers and new jobs to aggregate wage changes, weighted by the proportion of workers in each group. The third and fourth terms add the composition effects (between component) of changes in the proportions of stayers and new jobs in total employment in each period. Finally, the last two terms account for entry and exit effects. Using this formula we will compute the contribution of each effect on the aggregate log wage change.

4. Results

4.1. Employment and wages

We begin by comparing our sample with the aggregate information from national statistics.

Let us first consider the evolution of employment. Figure 2 shows the total number of employed workers at a given quarter in our sample. For example, in Spain we have about 4300 observations of employed workers in 2007, while in Latvia the number reaches 11,000. The evolution of the number of employed in our sample is common to both countries: there is strong employment growth before 2007 and a deep drop from then on until the beginning of 2010. The reduction in employment reaches 20 percent in both countries. Additionally, we plot the number of employees according to the national

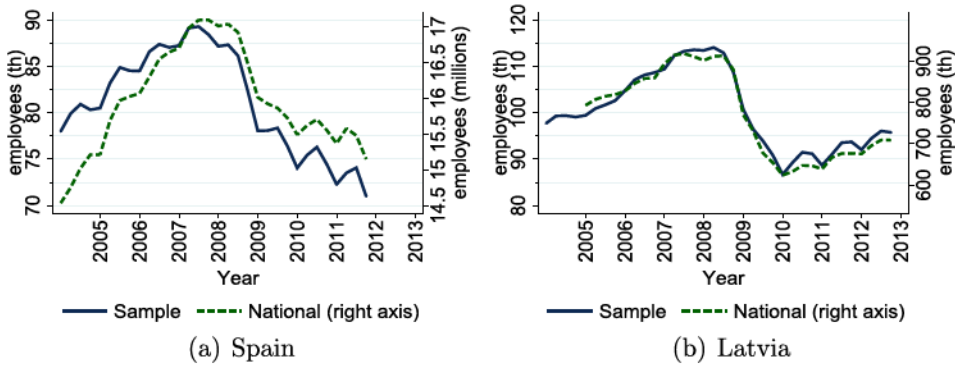


Figure 2. Evolution of the number of employees.

Notes: The series labelled *Sample* is the number of observations with a job using the authors' sample from administrative data. The series labelled *National* shows the number of employees according to national statistics. Spain: *Instituto Nacional de Estadísticas*, INE, number of persons, employees, non-adjusted data. Latvia: Central Statistical Bureau of Latvia, average number of employees in full-time work, units by quarter.

statistics to show that the evolution is similar to the number of observations employed in our sample.

An important difference between both countries is that in Latvia, after 2010, there is a partial recovery of employment while in Spain we find no signs of recovery until 2012.

Figure 3 displays raw mean wages (without any filtering or correction) in nominal terms, in euros for both Spain and Latvia. In Spain, the mean wage in our sample goes from 1500 in 2005 to 1600 euros in 2007. Importantly, mean wage goes up further to 1800 euros in 2010 to finally stabilize at that level. In Latvia, there is a huge increase from 500 to 700 euros between 2007 and 2008, but then wages go down to around 625 euros. Importantly, these figures are very similar to the ones from the national statistics.

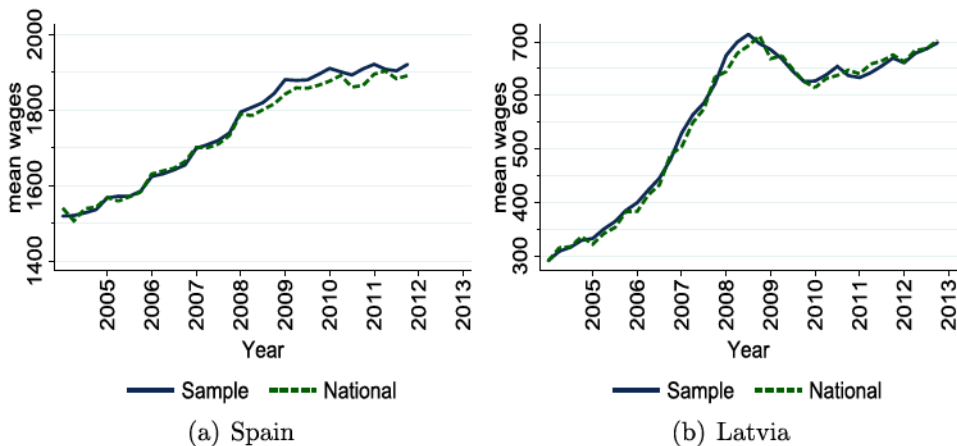


Figure 3. Evolution of mean nominal wages.

Notes: The series labelled *Sample* is the quarterly average of nominal wages (in euros in both countries) using the authors' sample from administrative data. The series labelled *National* shows the average wage according to national statistics. Spain: *Instituto Nacional de Estadísticas*, INE, labour cost per worker, seasonally adjusted by the authors. Latvia: Central Statistical Bureau of Latvia, average monthly wages and salaries of employees.

4.2. Wage changes among stayers

In this section, we concentrate on the annual nominal wage changes of stayers in private jobs. The distribution of the log wage change of stayers and its evolution over time will be the evidence we will provide on wage rigidity.

Figure 4 displays the histogram of the distribution of annual difference in the log of nominal wages for stayers (workers that were continuously employed in the same job between month t and 12 months afterwards). Every bar represents one percentage point. In panels (a) and (b) we show annual wage changes before the recession by stacking the data of all available months between 2005 and the end of 2007. Several observations are in order. First, in the case of Spain we see very compressed wage rises with a mode of 3 percent, which is about one point higher than the inflation rate each year. This is consistent with the wage setting mechanisms that adjust wages according to past inflation, as described in Section 2. Second, it is possible to observe a spike in the distribution at wage freezes. Third, the proportion of wage cuts is very small. Wage changes of -1 percent are far less frequent than wage changes of $+1$ percent.

The analogous figures for Latvia are very different from the Spanish ones. Wage changes are much more dispersed, and it is not uncommon to observe increments of

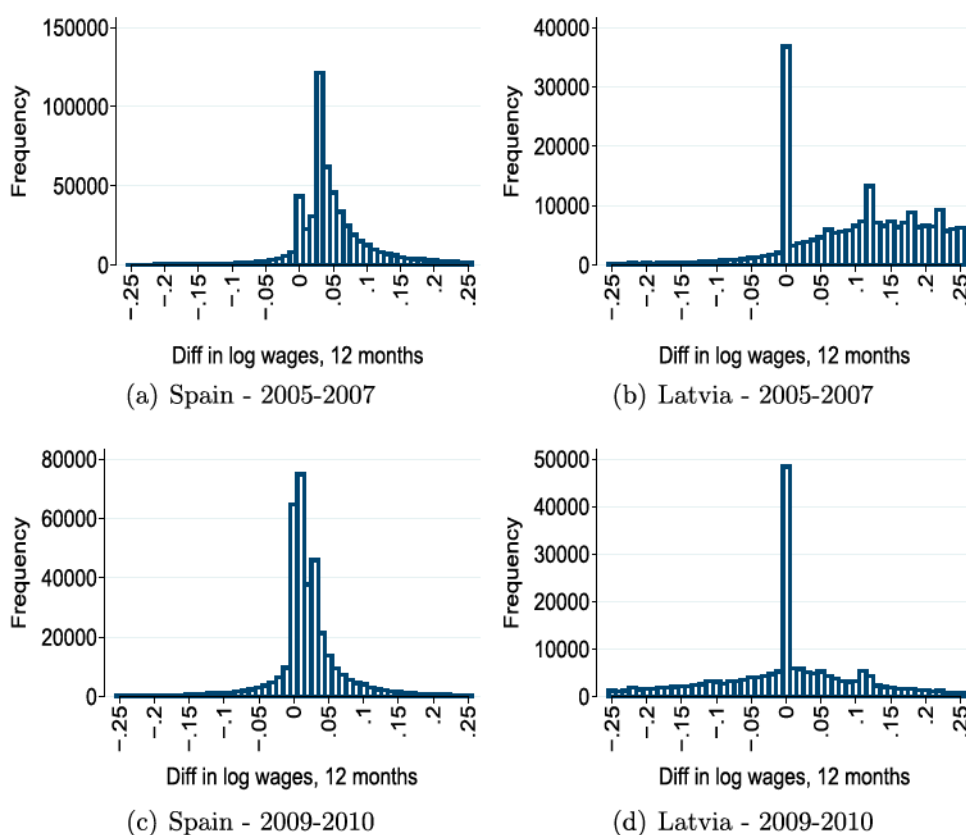


Figure 4. Distribution of wage changes among stayers. Source: authors' sample of administrative data.

Notes: Wage changes are the annual difference in monthly nominal log wages. Wages are filtered by a moving median process, and jobs with zero or truncated wages are not considered. Histograms are truncated to ± 0.25 log points.

25 percent in these changes. Additionally, without taking into account wage freezes, the mode is around 13 percent. In several months the modal wage change is close to the rise in minimum wages, suggesting that this institution is relevant in the wage setting in Latvia.¹² Finally, there is also a spike at wage freezes but wage cuts are rather frequent, showing no appreciable discontinuity.

Panels (c) and (d) of Figure 4 show the same analysis but for high unemployment periods, stacking up all available months from 2009 to 2010. In Spain the distribution is even more compressed. The multimodal distribution could arise simply because we are considering many different periods. The most prominent mode is at a 1 percent rise, which, again, is close to the inflation rate of the periods.¹³ In any case, there are now many more observations with wage freezes and the discontinuity in wage cuts is even more noticeable. In Latvia wage changes are again more widely dispersed and are almost symmetrically distributed at both sides of zero, partly because we are considering periods in which there is fluctuation in mean wages, mostly suggesting some form of wage flexibility. There are again some spikes around 13 percent, probably led by minimum wage rises.

To provide a measure of asymmetry of wage distribution we take the same information presented in Figure 4 and compute three quartiles, excluding wage freezes. We compute the asymmetry of distribution using Yule's coefficient: $B = (Q_1 + Q_3 - 2Q_2)/(Q_3 - Q_1)$. We find that Spain's distribution is positively skewed in both periods (with coefficients of 0.47 and 0.24 for 2005–2007 and 2009–2010, respectively), while the Latvian distribution of wage changes is not strongly asymmetric (with 0.02 and –0.11 in both periods). Similar results arise when using Pearson mode skewness.

These distributions are similar when we analyze all jobs, and when we further restrict the sample to wages above the minimum wage. We find no qualitative difference when analyzing these distributions of wage changes.

Figure 5 displays the empirical cumulative distribution function of wage changes of stayers for Spain in panel (a) and for Latvia in panel (b). This plot allows for a direct comparison between the periods of 2005–2007 and 2009–2010. We find that the distribution

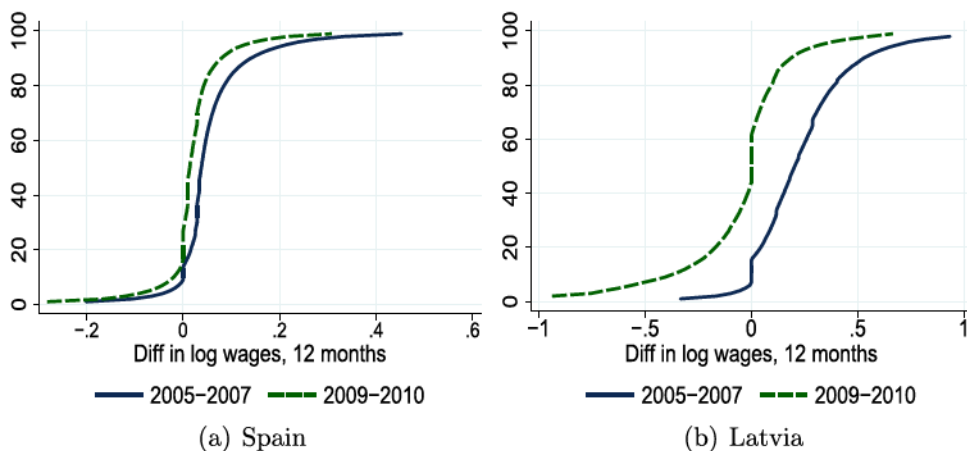


Figure 5. Cumulative distribution of wage changes among stayers. Source: authors' sample of administrative data.

Notes: Empirical cumulative distribution function of the annual difference in monthly nominal log wages.

of log wage changes in low unemployment periods dominates the one in high unemployment periods. This observation is common for both countries. There are important differences, though. The horizontal difference between both lines accounts for the degree of wage adjustment. While in Spain the difference is small and about 0.05 log points at the median, in Latvia it is around 0.2 log points and noticeable through the entire distribution.

The evidence presented so far clearly indicates that wages are affected by the recession and the rise in unemployment, differently in both countries, though. In Spain it appears that the distribution was compressed at zero but with few wage cuts. This discontinuity at zero is even more obvious for the periods of high unemployment. What is striking, though, is that even when unemployment was steadily increasing to 20 percent, the mode of wage change was positive. In Latvia the recession generated a strong shift, affecting many jobs that experienced a reduction in nominal wages. In clear contrast to Spain, wage changes in Latvia seem much more symmetric.

The evidence strongly suggests that Spanish wages are much less flexible than Latvian wages. This conclusion is in line with firm-level data, reported in Izquierdo et al. (2017). According to the WDN survey only 1.5% of firms cut wages in 2010 in Spain, while this number was 10.6% in Latvia, reaching 77% among those that suffered negative economic shocks (defined as a strong decline in demand and credit restrictions). The difference in wage setting between the two countries is clearer in periods during which unemployment is high and rising. This observation is in line with Messina and de Galdeano (2014), who show that wage rigidity gains prominence after disinflation in developing countries, and with Card and Hyslop (1997), who analyze whether inflation can allow for stronger relative wage adjustments.

Figure 6 shows the proportion of wage freezes and wage cuts as a monthly time series for both Spain and Latvia. Importantly, we still restrict the wage changes to stayers. The proportion of wage freezes and wage cuts rises sharply at the beginning of the recession. In wage freezes the jump is of about five percentage points, while wage cuts jump by about 10 percentage points. Notably, in both countries this rise can be identified in a very narrow period, around January 2009, implying that wage setting was strongly and sharply affected by the recession.¹⁴

Besides the common factors there is also a strong difference between the two countries. In Spain the proportion of wage cuts had a peak at 15 percent before starting to fall. From mid 2009 on, less than one-tenth of jobs suffered wage cuts. The proportion of wage freezes continuously increased to represent 25 percent at the end of the series. Such is not the case in Latvia, where the proportion of wage cuts increased to represent more than 60 percent of stayers. In other words, in 2009 and even in 2011 wage cuts were a general practice in Latvia (Gonser, 2011; Visser, 2016).

Had the distribution of wage changes been continuous, the proportion of wage freezes over wage cuts would be very low. Then, one simple way to identify wage rigidity (or resistance to wage cuts) would be by computing the rate of wage freezes to wage cuts; the higher this rate, the stronger the wage rigidity. Figure 6 displays this indicator of wage rigidity in the lower panels, from which it is apparent that wage rigidity tended to increase in the recession and that it was much higher in Spain than in Latvia.

So far we have focused on the wage change among stayers. A concern is whether this group is relevant to the aggregate economy. To analyze this we plot two time series in

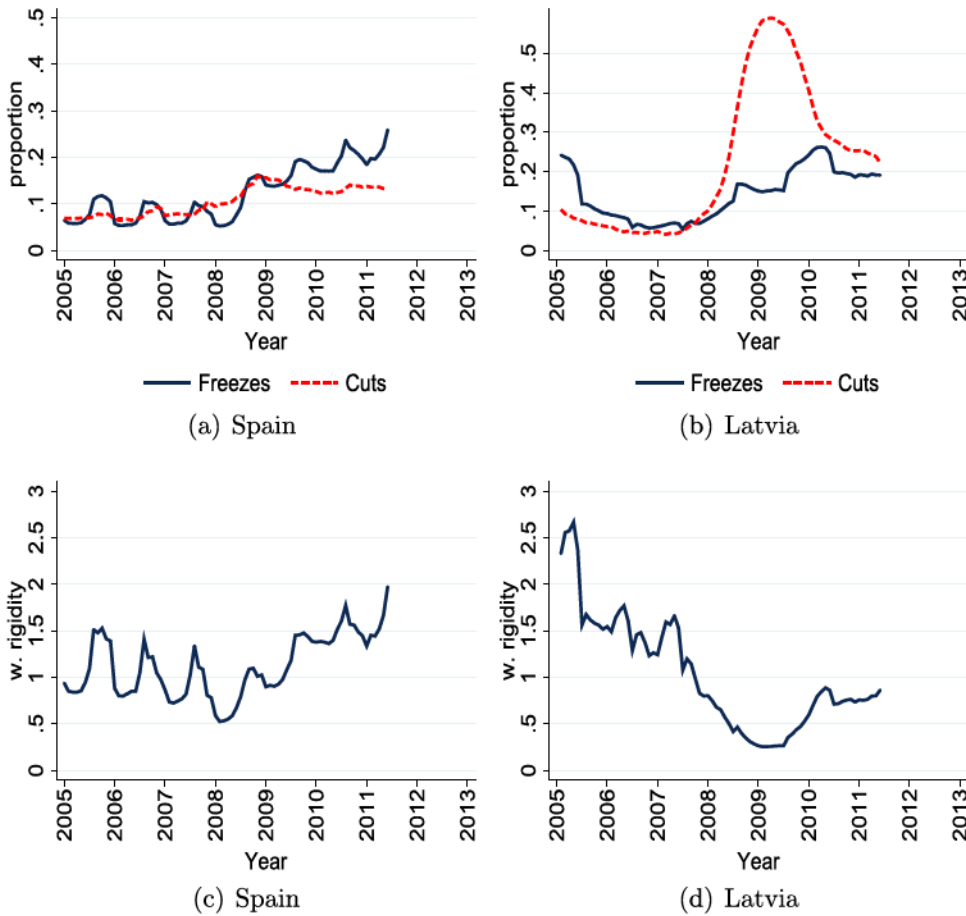


Figure 6. Proportion of wage freezes and wage cuts. Source: authors' sample of administrative data.

Notes: Panels (a) and (b): The proportion of wage freezes is the proportion of stayers for whom wages did not change from month $t-12$ to t . The proportion of wage cuts is the proportion of stayers for whom the wage is lower in t compared to $t-12$. Panels (c) and (d) show the ratio of wage freezes over wage cuts.

Figure 7. The solid line is the overall mean of wage changes, considering only stayers. The dashed line is the change in nominal log mean wages, including all types of workers. It is quite evident that the wage changes of stayers have a high correlation to the change in the aggregate wage.

Different moments of distribution of nominal wage changes show important and substantial differences between the two countries, consistently suggesting that Spanish wages are far less flexible than Latvian wages. We can therefore think of Spain as a rigid-wage economy.

4.3. Wage changes in new jobs

We now extend the typical analysis of wage rigidity, which usually focuses on stayers, and analyze wage dynamics for workers that switch jobs. In particular, we follow workers with

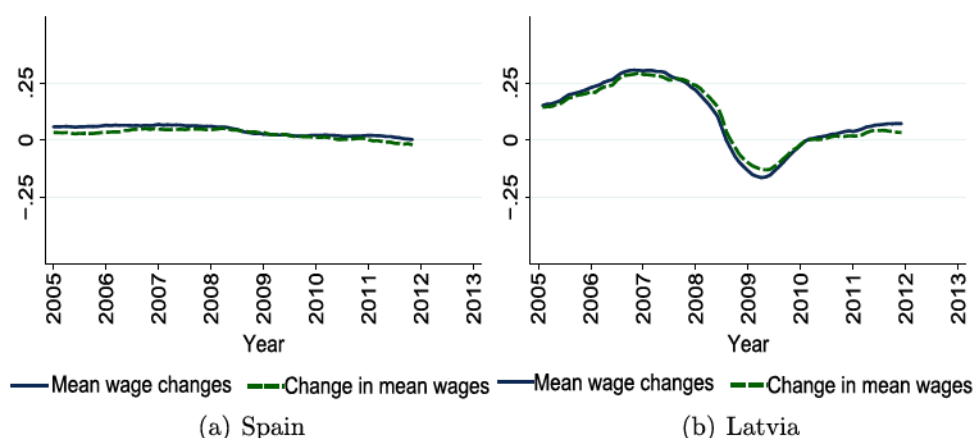


Figure 7. Mean wage annual change. Source: authors' sample of administrative data.

Notes: *Mean wage change* is the average of the annual difference in monthly nominal log wages of stayers. *Change in mean wages* is the annual change in the mean of monthly nominal log wages, including all workers.

wages in t and in $t-12$ but who change jobs in between. These are EE and EUE transitions. We are focusing, then, on new hire wages. We compare the new hire with the previous job and compute the log wage difference.

New hire wages are important because this labour cost is closely related to the incentives to open vacancies. Computing wage changes for the same worker controls for the productivity and idiosyncratic characteristics of the workers.

Figure 8 displays the cumulative distribution of log wage changes of EE (panels (a) and (b)) and EUE (panels (c) and (d)) transitions in low and high unemployment periods. These distributions offer the same qualitative results as in Figure 5, which is the analogous plot for stayers. First, the distributions in low unemployment periods dominate those in high unemployment periods. Second, the distributions in Spain are more compressed than they are in Latvia. Third, the horizontal difference of the distribution is mild in Spain, while in Latvia it is strong.

Particularly striking is the distribution in panel (a), which shows that most workers who changed jobs in Spain improved their wages. In particular, the proportion of workers with EE transitions who suffered wage cuts is no different in low and high unemployment periods. Thus, in Spain the distribution of EE wage changes is also compressed around zero, as in the case of stayers.

This is additional evidence of some form of wage rigidity affecting not only stayers but also new hires. The issue is very important. We come back to it by comparing mean wages of EE and EUE workers and by analyzing the time series of the mean wage change of these transitions.

4.4. Worker flows

We now present the rates of transition of workers from employment to non-employment. Figure 9 displays the job-finding and separation rates. These are annual averages of monthly transition rates. In both countries the recession impacted these rates

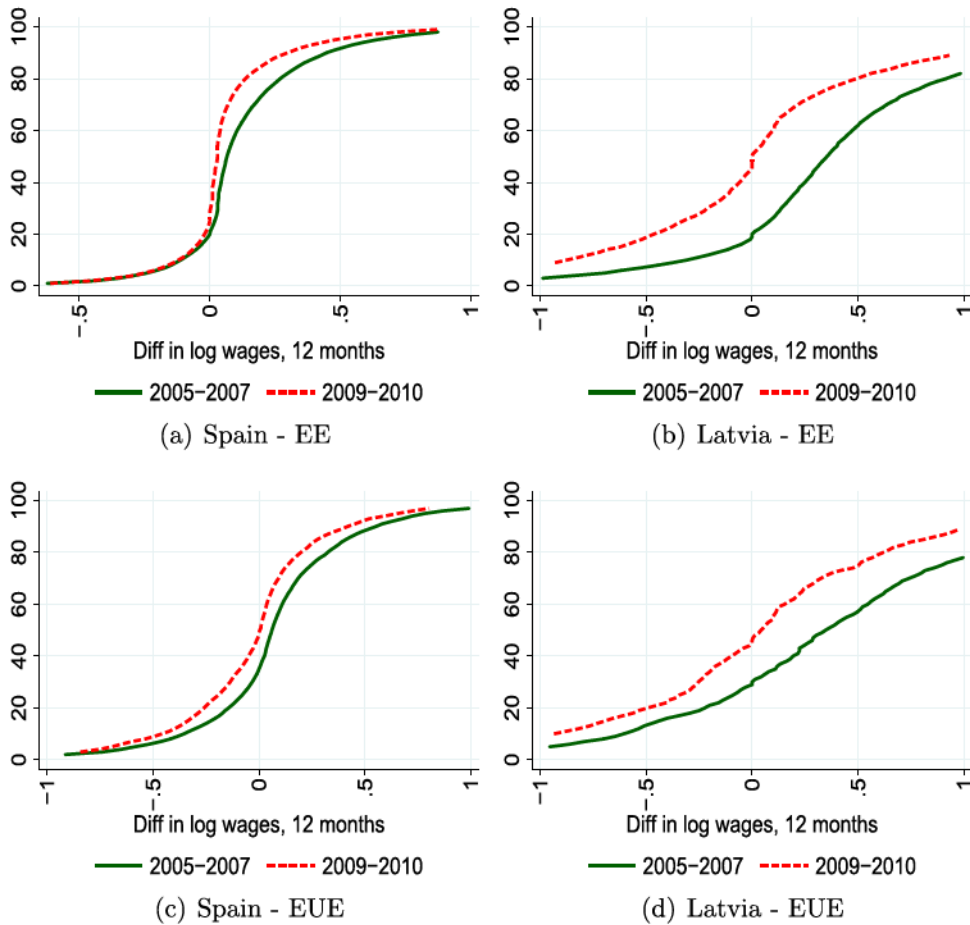


Figure 8. Cumulative distribution of wage change among job changers. Source: authors' sample of administrative data.

Notes: Empirical cumulative distribution function of the annual difference in monthly nominal log wages for job changers, including job-to-job transitions (EE) and those who experienced some periods without a job (EUE).

substantially: it led to a decrease in the finding rate and increase in separation rates. Both changes are important. In Spain the finding rate dropped drastically, by around 25 percent from 2007 to 2009. The analogous drop in Latvia is strong (close to 15 percent from 2007 to 2009), but recovery is quick. Importantly, this rise in the number of new jobs occurred after wages were adjusted.

The separations also changed dramatically, with their number first rising in Spain. In Latvia separations rose substantially, by about 50 percent from 2007 to 2009. Finally, they went down in 2010 to the pre-crisis levels and stayed down until 2012. Again, the improvement in separations occurred after the wages had been adjusted.

The evidence with regard to worker flows is important from several points of view. First, the change in separations can help to determine the employment level. Second, the wage level and adjustment of wages among stayers seem important in understanding the difference in mobility between the two countries. Latvia recovered from the recession through

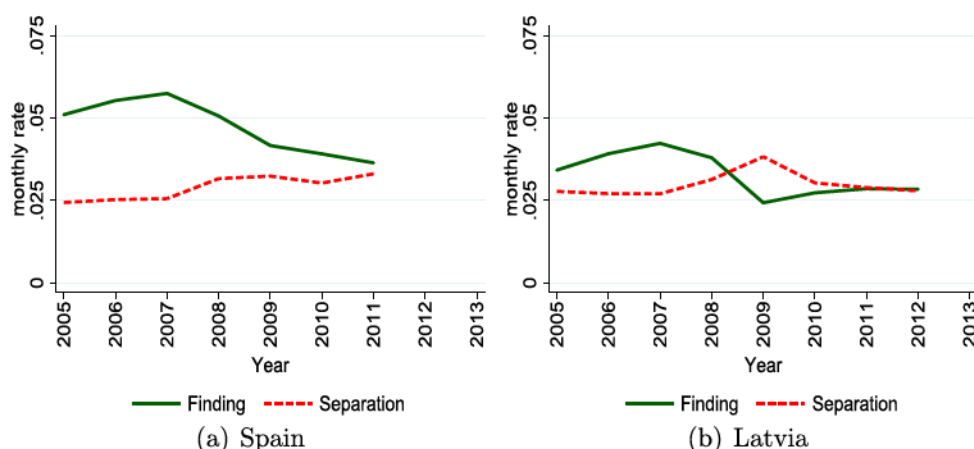


Figure 9. Employment-to-unemployment and Unemployment-to-employment transition rates. Source: authors' sample of administrative data.

Notes: annual mean of monthly finding and separation rates. The finding rate is the average transition probability from unemployment to employment. The separation rate is the average transition probability from employment to unemployment.

an increase in hirings and fewer separations after wages were adjusted. In Spain, on the contrary, the effects on finding and separation rates were persistent, so there was no recovery in employment growth during the period.

To further emphasize the important role of separation we take advantage of the steady state formulas and the decomposition presented in Equation (1). Our aim is to assess the contribution of worker flows into and out of employment to the overall non-employment rate. We focus on the periods of the rise in unemployment, mainly concentrated between the years 2008 and 2009. We therefore compare the average finding, separation and non-employment rates in 2007 with the same averages over the period of 2008 to 2009. The reason for taking averages is to understand the importance of the rates through the entire period. A spike in a rate could have a persistent effect on unemployment that we would miss if we were to consider only a month-to-month comparison. Additionally, we need to include a rather extended period of changes, because our formula rests on the steady state approximation of the unemployment rate, and this steady state rate is relevant to only several periods of constant transition rates. In other words, our decomposition would be accurate if rates were to change and stay constant at the new levels.

Table 2 shows the result of this decomposition exercise. The separation rate effect represents about half of the overall decomposition of the rise in unemployment. In particular, it represents 51 percent of the change of the overall effects in Spain; the analogous value for Latvia is 45 percent.

The evidence then shows that both finding and separation rates are equally important in understanding the rise in unemployment in both countries. We have shown that the changes in these rates are substantial. Moreover, in Latvia the rates recover their pre-recession level, while in Spain the changes seem to be very persistent. Jimeno et al. (2015), using a very different source, the Labour Force Survey for Spain, also show that the employment-to-unemployment (separation) rate increased sharply in 2008 and 2009 and stayed up until 2012, while the unemployment-to-employment (job-finding) rate

Table 2. Unemployment change decomposition.

Effect	Spain		Latvia	
	Contribution	in %	Contribution	in %
Finding: $-(1 - u) \times d \ln f$	0.202	49	0.288	55
Separation: $(1 - u) \times d \ln \delta$	0.207	51	0.237	45
Total: $(1 - u) \times (d \ln \delta - d \ln f)$	0.409	100	0.526	100

Notes: The table implements Equation (1) considering the rates of the average of 2007 and of 2008–2009. Source: authors' sample of administrative data.

fell substantially in 2009 and even more in the following years. Importantly, the persistence of a transitory shock on transition rates is what a model of the labour market would predict if wages were to be rigid (Shimer, 2012b).

4.5. Wage changes and worker flows

In this section we consider the evolution of wages based on the type of transition, showing, in addition, a decomposition of the aggregate wage change. In this sense, we measure how the wages of different workers were affected by the recession and the rise in unemployment. We also provide more evidence on the importance of the wage of stayers.

Figure 10 shows the mean wage by type of worker, according to the transition. For example, the solid green line represents the mean wages of stayers. The evolution of this wage is close to the aggregate wage.

We also consider the mean wage of those workers who were always employed between $t-12$ and t but changed jobs in between (EE transitions). We find that this wage is always increasing in Spain, even more than the wage of stayers, whereas in Latvia, the mean wage is always decreasing. Moreover, while the mean of wages of stayers and of those who changed jobs were similar in January 2008, in January 2012 the gap between these two wages was about 30 percent. In other words, these transitions finally reinforced the difference in wage adjustment in both countries: during the crisis, in Spain, they tended to grow more, whereas in Latvia they were inclined to reduce further.

Figure 10 also shows the average of wages in t of those who are employed at t and were employed at $t-12$ but that were not employed at some period in between (EUE transitions). We consider these workers as suffering some separation and unemployment spell shorter than one year. The mean of wages of the workers who experienced these transitions is much lower compared to the previous groups. In Spain the mean of these wages stopped growing at the beginning of the recession, in mid-2008. In Latvia, the mean wage of workers who recently suffered some non-employment spell went down fast, and after 2010 it stabilized at a level at least 20 percent lower than the level in 2008.

We also consider the case of those workers who are employed in t but not in $t-12$, (XE transitions). In both countries, this wage is very similar to the wage of EUE workers, but after the crisis, these wages tend to be lower. In Spain, in particular, these wages went down by about 10 percent from 2008 to 2010.

Importantly, these last three groups (EE, EUE and XE) can be considered as new jobs. Between both countries, the mean of wages of these workers as a group shows a striking dissimilarity. While in Latvia this group suffered a substantial reduction in wages – even

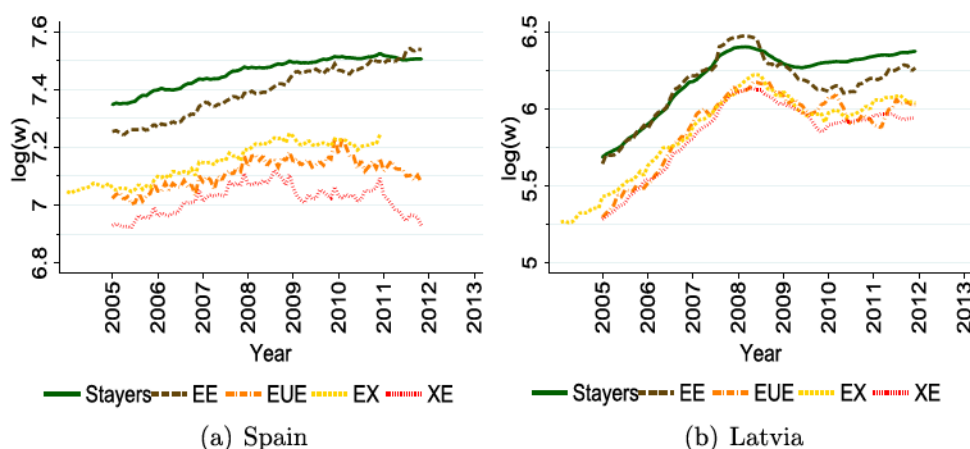


Figure 10. Mean nominal log wages by type of transition. Source: authors' sample of administrative data.

Notes: Each line is the average of nominal log wages by type of transition between month $t-12$ and t , including stayers, job-to-job transitions (EE), re-employed (EUE), and entries (XE). Additionally, the line label (EX) corresponds to workers with a job at t who will not have a job at $t+12$ (exits).

more than the adjustment of stayers – in Spain the wage shows almost no adjustment. This is relevant as an incentive for job creation. If firms face no reduction in wages of new hires the incentives to generate new jobs are diminished, as in the case of Spain. On the other hand, if wages of new jobs go down, opening up vacancies is less costly and job creation is less responsive to a recession (Pissarides, 2009).

Finally, Figure 10 displays the mean of log wages in month $t-12$ of workers who are employed in $t-12$ but not in t (EX). The value of this wage shows that workers who lose their jobs belong to a particular group, with wages lower than the average. In Spain, these wages are not inclined to fall; on the contrary they register a growth until 2009. In Latvia, on the other hand, they decreased during the period of 2008 to 2010, by about 20 percent. Importantly, the evolution of this wage is similar to that of the EUE group.

The analysis above does not take into account any composition effect. For example, wages of XE group could be decreasing because the composition of workers in that group is changing over time. To reduce this composition effect we follow the same workers, compute the annual change in log wages and plot the mean of that variable.

Figure 11 displays the time series graph for the mean of log wage changes for stayers (reproducing the series of Figure 7), for EE and for EUE workers. There is a strong correlation between the three variables in both countries, and in two cases the group of EUE suffered stronger wage cuts. In Spain the changes for stayers and EE are always positive, while only EUE suffered mild wage cuts and only during 2009; for other periods the post-displacement wage is on average no different from the pre-unemployment wage. In Latvia the three groups suffered wage cuts. For example, in 2009 workers who switched jobs as EE suffered a mean wage drop of about 15 percent while stayers suffered a wage cut of about 25 percent; in 2012 mean wage growth among stayers was lower than 10 percent, while for those who switched jobs it was about 15 percent.

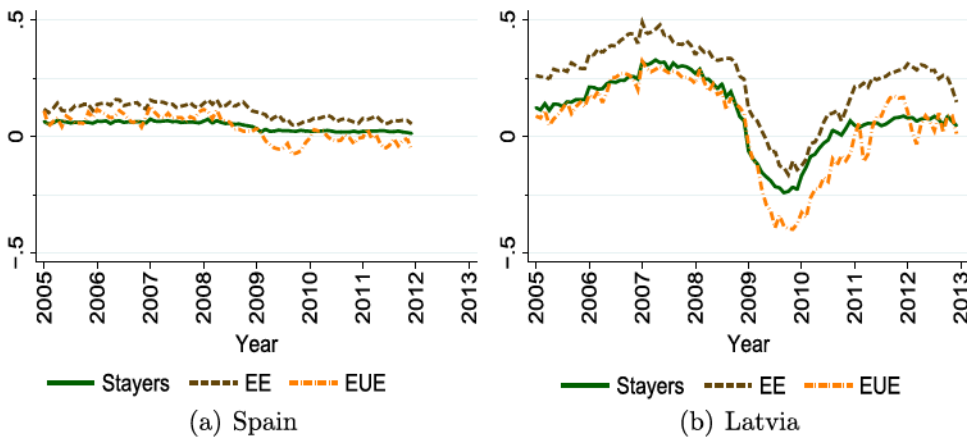


Figure 11. Mean wage annual change. Source: authors' sample of administrative data.

Notes: average annual difference in monthly nominal log wages of stayers, EE and EUE workers.

The evolution of the series in Figure 11 also shows some time series correlation between the wage change of stayers and of workers who changed jobs. It suggests that new hires also tend to be affected by the same wage dynamics as in the incumbent jobs.

Importantly, the comparison between the two countries gives the same overall qualitative results if we were to compare raw wages (without any filtering), or if we focused on private jobs with wages above the minimum, or plotted the median of log wage changes.

We finally apply a wage change decomposition as described in Section 3. We first show some mean wage changes for some groups, and then weigh these changes to build the decomposition. We compare one-year and three-year changes – from July 2008 to July 2009 and from July 2008 to July 2011. These changes are relevant not only because of the differences in wage adjustment, but mostly because the number of transitions increases, and stayers reduce their importance in terms of their proportion of the total number of workers. We also compute the same exercise for all workers in the sample and for private jobs.

Table 3 presents the wage changes for the period of July 2008 to July 2009 by type of transition for the total sample measured in log points. We will refer to these differences in terms of changes in percent (we use the usual formula $e^x - 1$ where x is the change in log points). The difference between the two countries is clear: the mean of wage changes of stayers is +2.6 percent in Spain and about –20 percent in Latvia. The difference for EUE workers is even stronger: a fall of about 5 percent in Spain and a drop of about 33 percent in Latvia. We also show wage changes of private jobs from July 2008 to July 2011 (in this case stayers are those who are in the same job throughout the three years). The main conclusions are maintained. In Spain we find an increase in log wages of both private stayers and EE workers – of about 6 and 10 percent respectively up to July 2011. No wage adjustment occurred for these groups, which represent about two-thirds of workers in Spain. For workers who were separated from private jobs and then re-employed in a private job there is a drop of almost 10 percent. This group represents

Table 3. Wage changes by type of transition from July 2008.

Transition	Spain				Latvia			
	Total 1 year		Private 3 years		Total 1 year		Private 3 years	
	Δw	% wks.	Δw	% wks.	Δw	% wks.	Δw	% wks.
Stayers	0.026	0.731	0.059	0.528	-0.211	0.673	-0.187	0.429
EE	0.067	0.071	0.100	0.104	-0.049	0.101	-0.083	0.103
EUE	-0.050	0.060	-0.096	0.143	-0.394	0.047	-0.398	0.185
Total	0.024		0.036		-0.202		-0.225	

Notes: columns labelled ' Δw ' report the average of annual difference in monthly nominal log wages of stayers, EE and EUE. Columns labelled '% wks.' report the proportion of workers in each group. Source: authors' sample of administrative data.

14 percent of the workers. In Latvia, in contrast, the wage drop is of about 17 percent for private job stayers and 8 percent for EE, where these groups represent about half the number of workers in private jobs. The EUE group (about 20 percent of workers) suffered a wage reduction of almost 33 percent. On the whole, the adjustment in private wages was substantial.

Table 4 shows the decomposition using such wage changes. We use Equation (5) to measure the effect of each transition and the total effect as its sum; the table also shows the proportion of the total explained by each effect. For example, in Spain the within effect for Stayers represents nearly 80 percent of the total change in wages. Latvia shows a similar number. The within effects are more important than the between effects, and while the entry and exit effects are big, they tend to compensate each other. We also present the decomposition for private jobs for the three-year span from July 2008 to July 2011. The wage change in private jobs in Spain is +3.7 percent during this three-year span, most of it (87 percent) explained by the within effect of stayers. The between effects are unimportant while the entry and exit effects have a net effect as important as EUE (representing almost 40 percent of the total change). On the other hand, in Latvia, the total private wage change of -20 percent is mostly due to the within effects of stayers. Additionally, the EUE and entry-exit effect are equally important. The between effects are, again, irrelevant.

To sum up, we have shown that our observations about wage rigidity analyzing stayers are maintained when including other types of transitions and even when extending the time span. We also find that the composition effects are not big. This is remarkable given the strong jump in unemployment.

Table 4. Wage change decomposition from July 2008.

Effect		Spain				Latvia			
		Total 1 year		Private 3 years		Total 1 year		Private 3 years	
		Contr.	in %	Contr.	in %	Contr.	in %	Contr.	in %
Within	Stayers	0.019	0.790	0.031	0.867	-0.142	0.702	-0.080	0.358
	EE	0.005	0.197	0.010	0.289	-0.005	0.025	-0.009	0.038
	EUE	-0.003	-0.124	-0.014	-0.381	-0.018	0.091	-0.073	0.326
Between	Stayers	0.007	0.275	0.012	0.337	0.015	-0.073	0.017	-0.075
	EE	0.000	0.004	0.003	0.085	-0.001	0.005	0.001	-0.003
	EUE	-0.002	-0.090	-0.005	-0.150	-0.003	0.015	-0.005	0.024
Entry and Exit		0.003	0.106	-0.015	-0.420	-0.013	0.065	-0.067	0.298
Total		0.024		0.036		-0.202		-0.225	

Notes: within and between effects from wage change decomposition as presented in Equation (5). The columns labelled '% report the proportion of the effect over the total change in wages. Source: authors' sample of administrative data.

4.6. Unemployment volatility and wage rigidity

In this section we explore the importance of wage rigidity to unemployment volatility. To do this, we connect our results with the theoretical literature that has analyzed the ability of the matching model to generate as much unemployment volatility as observed in the data. We present some evidence with regard to the volatility of unemployment and transition rates in both countries with respect to changes in productivity.

Table 5 provides statistics of changes between the last quarter of 2007 and the same period of 2010 for the main variables. Panel (A) presents the log differences of the variables. Real mean wages of stayers, w_S , increased by 0.03 log points during the period in Spain and fell by 0.07 log points in Latvia. Wages of new hires fell in both countries, but only by 0.02 log points in Spain, while there was a much larger drop of 0.27 in Latvia. We additionally show the changes in real mean wages in quarter t for those who will be displaced in quarter $t+4$, w_{EX} . This wage was stable in Spain, while it fell by 0.22 log points in Latvia. The differences in wage changes are also related to a big difference in shocks. The total factor productivity fell by 0.03 log points in Spain during the period, while in Latvia it dropped by 0.11 log points.¹⁵

While the shocks in productivity rates are stronger in Latvia than in Spain, the changes in finding and separation rates (and, then, in unemployment) are similar in both countries. In Spain, the finding rate dropped by 0.38 log points, while in Latvia it fell by 0.41 log points. The separation rate increased by 0.18 and 0.17 log points in Spain and Latvia, respectively.

This implies that the response of worker flows to shocks was stronger in Spain. Panel (B) of Table 5 displays the elasticities of worker flows to changes in productivity p . The finding rate elasticity is about 14 in Spain and 3.6 in Latvia. Additionally, elasticity of the separation rate is -7 in Spain and -1.5 in Latvia. Finally, the elasticity of unemployment is four times higher in Spain than in Latvia.

Table 5. The effect of the recession on the labour markets: changes between 2007 and 2010.

	Spain	Latvia
(A) Log differences between 2007 and 2010		
w_S	0.03	-0.07
w_N	-0.02	-0.27
w_{EX}	-0.01	-0.22
p	-0.03	-0.11
f	-0.38	-0.41
s	0.18	0.17
u	0.32	0.30
(B) Elasticities		
$\eta_{f,p}$	14.63	3.65
$\eta_{s,p}$	-7.02	-1.51
$\eta_{u,p}$	-12.29	-2.65
$\eta_{w_S,p}$	-1.01	0.62
$\eta_{w_N,p}$	0.82	2.37
$\eta_{w_{EX},p}$	0.27	1.91

Notes: Panel (A) shows the log differences in the variables from the end of 2007 to the end of 2010. Wages w_S , w_N and w_R are real wages of stayers, new hires and EX groups, respectively. Productivity p is TFP at constant national prices from the Penn World Table. Unemployment u is the steady state rate. Panel (B) reports elasticities of variables with respect to p .

On the other hand, the elasticities of wages are much lower in Spain than in Latvia. First, wage elasticity of stayers was negative in the period for Spain, as a result of the high wage rigidity and inertia in wage changes, given the ‘inflation safeguard clause’. In Latvia, on the contrary, wage elasticity is positive, about 0.6. Additionally, the elasticity of wages of new hires was about three times higher in Latvia compared to Spain. These wages are the relevant costs when analyzing vacancy creation and finding rate volatility. In line with a matching model, wage rigidity in these wages is related to higher finding elasticity.

In the same way, the elasticity of w_{EX} , the wages of workers that will be separated, is seven times higher in Latvia compared to Spain. We relate the flexibility of these wages to separation rate volatility: if wages do not adjust after a negative shock because of downward wage rigidity, then separations would be more responsive with respect to shocks. This is what we find in the results of the table: the economy with rigid wages (lower wage elasticity) is the economy with larger separation elasticity.

Thus, this table summarizes our main points: wage rigidity is related to higher unemployment volatility, and wage rigidity could affect both finding and separation rates.¹⁶

The emphasis of this paper is on wage rigidity and its importance for worker flows. Nevertheless, we acknowledge that there are a number of differences between the two countries besides wage rigidity that could help to explain worker dynamics.

To begin with, due to a much smaller population – about 2 million in Latvia vs. more than 40 million in Spain – the labour market frictions in Latvia could be higher. However, these frictions would make the exit from unemployment more difficult, resulting in higher unemployment after a negative shock. What we observe is the opposite. In particular, the finding rate goes back faster to the pre-crisis level. Second, labour market institutions differ between the two countries. Some of them, such as wage bargaining and minimum wage, explain the different degree of wage flexibility. Others could directly affect worker flows into and out of unemployment. Perhaps the most important of these are unemployment insurance and the prevalence of temporary contracts. In what follows, we discuss the relative importance of these institutions.

Unemployment insurance (UI) is different in both countries. The replacement rate of UI before the crisis was 24% in Latvia and 42% in Spain (OECD, 2007). A relevant concern is whether these differences could explain the worker flows during the Great Recession. Previous literature suggests that a more generous UI system would reduce the exit rate from unemployment of those eligible (see, for example, Bover, Arellano, & Bentolila, 2002 and Rebollo-Sanz & Rodríguez-Planas, 2016 for the case of Spain) but is silent about the effects of UI on unemployment volatility during a cycle. Recent studies show that during the beginning of the Great Recession the disincentive effect of UI was stable or even fell in Spain (García-Pérez & Carrasco, 2012) and that the UI replacement rate had no significant effect on the finding rate and a negative but low effect on the separation rate in Europe (Jimeno et al., 2015). According to these results, it is unlikely that UI differences explain the differences in unemployment volatility during the Great Recession.

Another important concern is about the effect of temporary contracts on worker dynamics and unemployment volatility (see Sala, Silva, & Toledo, 2012 and references therein). The share of temporary employment before the crisis was 5.5% in Latvia and 30.5% in Spain (OECD, 2007). Bentolila, Cahuc, Dolado, and Barbanchon (2012) and Costain, Jimeno, and Thomas (2010) analyze the cyclical unemployment volatility in labour markets with both temporary and permanent contracts, focusing on Spain, and

find that temporary contracts increase unemployment elasticity to any negative shock. According to Bentolila et al. (2012), if Spain had more restrictive temporary contracts, halving their incidence, the unemployment rate would have increased by 1.5 percent points less.¹⁷ Thus, while the effect of temporary contracts is relevant, it does not explain all the differences in responsiveness in Spain compared to Latvia.

We also use our data to partially assess the incidence of temporary contracts in wage and worker dynamics during the Great Recession. To allow for a comparison between the two countries, we divide workers according to their tenure on the job, given that most of the jobs with less than twelve months of tenure are temporary contracts in our sample for Spain. In Appendix we show, first, that the distribution of log wage annual changes generates the same qualitative characteristics between the two countries: there is clear evidence of wage rigidity in Spain, with a spike at wage freezes and a low proportion of wage cuts, and wage flexibility in Latvia. Second, we show the separation rate by job tenure. We find that low-tenure workers have a much higher separation rate than those with more than twelve months of tenure, but the separation rate rose in both groups during the Great Recession, in both Spain and Latvia. We also find that in Spain the effect in the separation rate is somewhat more persistent for both groups of tenure.¹⁸ Thus, we conclude that it is unlikely that our main observations are driven by the differences in the incidence of temporary contracts.

5. Conclusions

In theory, during a recession, the number of employed workers would adjust more in a rigid-wage economy compared to a completely flexible economy. In particular, the literature based on the matching model concludes that rigid wages imply a higher finding rate and unemployment volatility with respect to productivity shocks.

An ideal research design to test this theoretical result would be to compare two sets of identical economies affected by the same shocks, allowing one group to flexibly adjust their wages, and imposing wage rigidity on the other group. This experiment, however, is not available. This paper compares the wage dynamics and worker mobility during 2004–2011 in Spain and Latvia. These two economies are similar in their boom, fuelled by the real estate sector, and the global shock of the recession. They are, however, different in wage bargaining and other wage-setting institutions.

The first finding of our paper is that wage dynamics are very different in both countries, with Latvian wages being much more flexible than Spanish wages. This finding is supported not only by the time series of real wages in both countries, but also by very diverse measures of wage rigidity. These measures include the distribution of wage changes of stayers as well as the wage change of workers who switched jobs and of new hires.

The second central finding is that worker flows, both into and out of non-employment, are far more responsive with respect to productivity shocks in the rigid-wage economy. In fact, the elasticity of unemployment to productivity is four times higher in Spain than in Latvia. Additionally, the changes in worker flows are much more persistent in Spain than in Latvia.

The third finding is that the separation rate plays a more important role than was previously documented in explaining the rise in unemployment during a recession. The

finding rate has usually been considered more cyclical than the separation rate. Our results suggest that the changes in the separation rate explain almost half of the rise in unemployment during the Great Recession. We also observe that the elasticity of the separation rate is four times higher in the rigid-wage economy. This suggests that job destruction decisions could be related to wage dynamics, and that wage rigidity tends to amplify the effect of shocks not only through the finding rate, but also through the separation rate.

A relevant concern is whether labour market institutions could partially explain the differences in worker flows between the two countries. In the paper we discuss and provide evidence on unemployment insurance and temporary contracts to conclude that it is unlikely that our main findings are driven by differences in these institutions.

Overall, our paper presents empirical evidence that supports the theoretical conclusions that rigid wages generate higher volatility in worker flows and unemployment. From a policy perspective, it is important to understand the relation between wage rigidity and labour market flows to allow for better labour market policies and a faster post-crisis recovery.

Notes

1. Much of the empirical literature concentrates on European countries (including Barwell & Schweitzer, 2007 and Smith, 2000 for Britain; Devicienti, Maida, & Sestito, 2007 for Italy; and Holden, 1998 for Nordic countries). There is less evidence of this with regard to developing countries. Examples include Castellanos, Garcia-Verdu, and Kaplan (2004) for Mexico and Messina and de Galdeano (2014) for Uruguay and Brazil. Haefke et al. (2013) and De la Roca (2014) explore the cyclicity of wages of new hires.
2. Interestingly, using the synthetic control methods proposed by Abadie and Gardeazabal (2003), Spain still appears to be a reasonable counterfactual for Latvia (see Appendix).
3. We note that prior to 2007, Latvia, as a catching-up economy, experienced convergence with other EU countries both in prices and real wages.
4. See Bonhomme and Hospido (2017) for a description and a similar subsample of the same data.
5. The ceiling for contributions of annual labour income was LVL 23800 in 2007, LVL 29600 in 2008, etc., but no observation in our sample is affected by this type of ceiling.
6. See Bonhomme and Hospido (2017) for a comparable sample size for Spain. Also, Messina, Du Caju, Izquierdo, Duarte, and Hansen (2010) report similar sample sizes for other countries.
7. A possible concern about administrative data is that the undeclared wages could compensate the evolution of declared wages. This does not seem to be the case. Schneider (2013) reports the size of the shadow economy (as percent of GDP) from 2004 to 2013 for 36 countries. Although the size of the shadow economy is higher in Latvia (28% vs. 19% in Spain), the gap remains rather constant over time.
8. Our approach is similar to the one in Messina et al. (2010). In that paper, any wage cut compensated in the next period by a wage increase is assumed to be a measurement error.
9. In our data we cannot identify part-time jobs in Latvia. To partially account for this, we assume that any job whose wage is lower than the minimum is a part-time job, and we analyze the results when we drop jobs for which the wage paid is lower than the minimum wage.
10. Note that the job-finding rate is usually defined over unemployed workers (Shimer, 2012a), but in our case we cannot identify those actively searching for a job, and thus, we consider all the non-employed. We concentrate on males between 20 and 60 years of age, for whom inactivity is less relevant.
11. Altonji and Devereux (1999) developed a much more sophisticated method to identify wage rigidity. It takes into account measurement error and consists of an estimation of notional wage changes, which are the wage changes that could be predicted if these were drawn

from a normal distribution. The incidence of wage rigidity is the proportion of jobs that should have had a wage cut according to the notional wage change model but where observed wages did not fall. Goette et al. (2007) extended this method to estimate wage rigidity in real wages. See also Messina et al. (2010).

12. The effect of minimum wages is not necessarily restricted to workers for whom the minimum wage is binding as there are substantial spill-over effects over other parts of the distribution of wages (see, for example, Ferraro, Merik"ull, & Staehr, 2016 for an analysis of the Estonian minimum wage).
13. During the Great Recession some decrease in wage indexation is observed, partly due to the decrease in inflation (Izquierdo & Jimeno, 2015).
14. The seasonality observed in Spain is partly driven by the fact that bargaining is frequently done once a year. According to Izquierdo et al. (2003) 43% of all collective bargaining agreements are signed around the middle of the year (May to July), with 15% of agreements signed in June.
15. We use the total factor productivity at constant national prices from the Penn World Tables, considering the years 2007 and 2010 for both countries.
16. The results of the table are in line with a matching model of the labour market. In line with Pissarides (2009), in a previous version of this paper (Pajuste & Ruffo, 2017) we formally relate wage elasticity of new hires and separated workers to finding and separation rate elasticities, and we show that, for plausible parameter values, the model would predict similar changes in finding and separation rates. Importantly, we show that the separation rate can also be affected by wage rigidity, and make separations inefficiently high during recessions. Finally, we emphasize the role of interest rates and their effect on unemployment rate volatility. During the recession Latvia suffered substantial increases in interest rates, much higher than those in Spain. Thus, this is an additional strong shock to Latvia, a shock that affects transition rates.
17. We report the exercise in which temporary contracts are restricted both before and after the recession, the relevant counterfactual for our case (see page 182, equation II of the paper).
18. García-Pérez and Carrasco (2012) show that the proportional rise in the separation rate for permanent workers was higher than the one for temporary workers in Spain, even when the level of rates is much higher for temporary workers.
19. See Abadie (2010), Abadie and Gardeazabal (2003), and Doudchenko and Imbens (2016). Also, see Campos, Coricelli, and Moretti (2014) for an application to the European Union.
20. We use data from the Penn World Tables available for download at www.ggdnet.net/pwt (Feenstra, Inklaar, & Timmer, 2013). We considered all the eurozone members as of 2015.
21. Using data for employment by NACE activity from EUROSTAT, we construct the proportion of employment in manufacturing, construction, wholesale and retail, financial intermediation, public administration, defence and compulsory social security, and education and health.
22. For brevity, we do not present the analogous figure for workers with more than twelve months of tenure because it is very similar to Figure 4, the one for our whole sample.
23. We considered the unemployment rate for those aged 15 to 64, from EUROSTAT.
24. García-Pérez and Carrasco (2012), using the same administrative data, compute the exit rate from employment through temporary and permanent contracts before (2000 to 2007) and during the Great Recession (2008–2011) in Spain. The transition rate out of employment for workers with 18 months of tenure increased by about 45% for permanent workers and 32% for temporary workers.

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Appendix

A.1. Comparison between Spain and Latvia

In what follows, we show that Latvia and Spain are reasonable choices among other countries of the eurozone. We concentrate on the eurozone countries (as of 2015, that is, including Estonia and Lithuania) because they were all affected by the evolution of the common currency. For that purpose, we first focus on the evolution of the employment and unemployment rates of the countries in the eurozone. We take the Latvian time series from 1995–2007 and compute a measure of distance for the analogous time series of all the remaining countries. As a measure of distance we choose the root mean square deviation (RMSD). We find that Spain is among the countries with a lower difference to the Latvian series: among 18 countries, Spain has the second lowest RMSD for the employment rate series (after Greece) and the second lowest RMSD for the unemployment rate (after Lithuania).

It is also relevant to show that the countries that we compare are similar not only in the past evolution of employment and unemployment rates, but also in other important variables that could

determine labour market dynamics. For this purpose, we use synthetic control methods.¹⁹ These impact evaluation methods identify the best (weighted) group of countries that can represent a counterfactual for a selected ('treated') country. To do so, the method chooses the country weights by minimizing the distance between k explanatory variables,

$$W^* = \arg \min_W \sum_{m=1}^k v_m (X_{1m} - X_{0m} W)^2 \quad (\text{A1})$$

where W^* is the chosen vector of weights, X_{0m} is the scalar value of variable m for the selected country (Latvia in this application), X_{1m} is the vector of the analogous variable for the remaining countries of the eurozone, and where v_m is a scalar that weights the importance of the variable. Typically, the X variables are explanatory variables of a given outcome (number of employed over the population from 1990 to 2007 in our application). The explanatory variables that we considered were the labour share (share of labour compensation in GDP at current national prices), capital stock (at PPP) per person, and indicators of openness (share of merchandise exports and imports at current PPP).²⁰ All these explanatory variables are averages for the whole period considered. We choose these variables because they are linked with the effects of wage dynamics on employment, but we also present alternative possible explanatory variables. When we apply the synthetic control method in this case, we find that only two countries are relevant as counterfactuals for Latvia: Lithuania and Spain.

We tried a series of alternative specifications to check whether Spain is still selected when changing some conditions. We find that in all the specifications Spain is a relevant component of the synthetic control. In particular, we included the employment rate in 2000 and 2005, following the common practice of the synthetic control literature to include outcomes in previous periods. In this case Spain has a weight of 42%. When we restrict the period to 1995–2007, the weight of Spain increases to 72%. We also added variables related to the structure of employment by sector (as the average in the ten years before the recession).²¹ Adding these explanatory variables to the previous specification results in a weight of 39% for Spain; other selected countries are Lithuania, Estonia and Greece. Table A1 presents the comparison of the variables in the last specification for Latvia and Spain.

When we reverse the exercise and analyze what the relevant counterfactual for Spain would be, we find that the same synthetic control methods select Latvia (62%), Portugal (23%) and Cyprus (15%) as counterfactuals. The results are similar when using the unemployment rate instead of the employment rate.²²

Table A1. Spain and Latvia, previous to the great recession (1995–2007).

	Latvia	Spain
Labor share	0.5653	0.6406
Capital stock PPP (pc)	46816.4	88299.1
Share of merchandise exports	0.1960	0.2065
Share of merchandise imports	−0.3547	−0.2946
Construction employment share	0.0792	0.1184
Financial int. emp. sh.	0.0152	0.0247
Public sector emp. sh.	0.0743	0.0623
Education and health emp. sh.	0.1886	0.1851
Manufacturing emp. sh.	0.1685	0.1766
Wholesale emp. sh.	0.1535	0.1562
Employment rate in 2000	0.3963	0.4112
Employment rate in 2005	0.4488	0.4527

Notes: All variables are averages for 1995–2007 with the exception of employment shares, which encompass the period of 1998–2007.

Source: EUROSTAT and Penn World Table.

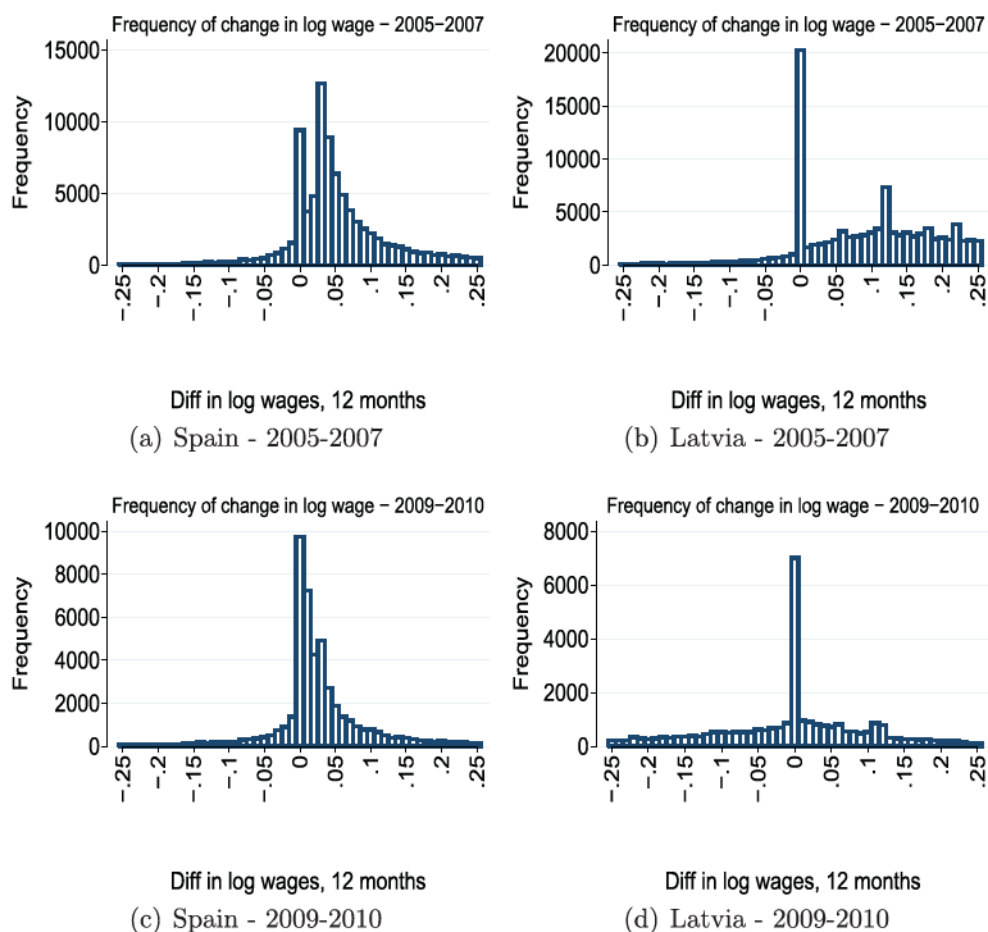


Figure A.1. Distribution of wage changes for low-tenure workers. Source: authors' sample of administrative data.

Notes: See notes to Figure 4. The sample is restricted to stayers for workers with less than twelve months of tenure on the job in the initial period.

A.2. Analysis by tenure

We use our data to partially assess the incidence of temporary contracts in wage and worker dynamics during the Great Recession. Our Spanish administrative data identifies temporary contracts but we do not have the analogous variable for Latvia. To allow for a comparison between the two countries, we divide workers according to their job tenure. In particular, we consider workers as low-tenure if they have twelve months of tenure or less. Tenure is, in fact, very relevant in identifying the effect of temporary contracts. For example, 74% of the jobs with less than twelve months of tenure are temporary contracts in our sample for Spain. At the same time, the median tenure of a temporary contract is less than one year (295 days) in our sample.

In Figure A1 in the appendix we show the distribution of annual log wage changes of low-tenure stayers.²³ To be explicit, we compare monthly wages between t and $t-12$, restricting the sample to workers that had twelve months of tenure or less in $t-12$. There are some noteworthy differences between these distributions and the ones for the whole population (Figure 4). In Spain, the wage change of low-tenure workers is less compressed than in the whole sample. In the 2005–2007 period, for example, while both wage changes present a mode around 3%, low-tenure workers are less concentrated in that particular wage change. Additionally, in the 2009–2010 period, the

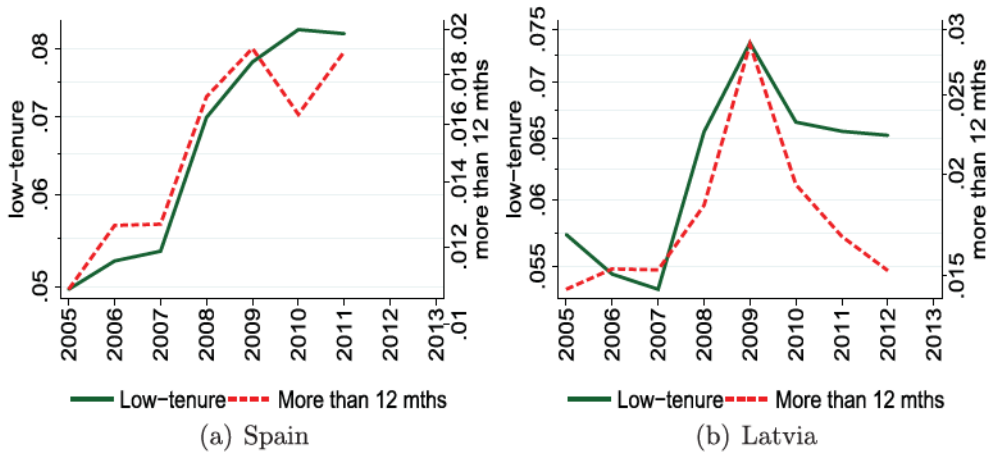


Figure A.2. Employment-to-unemployment and unemployment-to-employment transition rates by tenure on the job. Source: authors' sample of administrative data.

Notes: see notes to Figure 9. Low-tenure workers are defined as workers with twelve months in the job or less. Both axes are in log scale.

mode is 1% for the whole sample and a wage freeze for low-tenure jobs. In Latvia, the wage change of low-tenure workers is more compressed around 12%, but the distribution is very similar to the one for the whole sample. In any case, in both groups, there is clear evidence of wage rigidity in Spain, with a spike at wage freezes and a low proportion of wage cuts, and wage flexibility in Latvia.

We also present the worker dynamics by tenure in Figure A2 of the appendix, where we compare the separation rate. Low-tenure workers had a much higher separation rate. For the years before 2007, the rates in both countries ranged slightly above 1% for workers with more than 12 months of tenure and 5% for low-tenure workers. These rates increase substantially in 2008 to 2009 in both countries. In particular, in Latvia the separation rates were around 7% and 3% for low-tenure workers and workers with more than one year of tenure, respectively, in 2009. In Spain, these rates were 8% and 2%. Importantly, after 2009 there is a fall in the separation rate in Latvia in both groups of workers; in Spain, on the contrary, the separation rate persisted at high levels for both groups of workers. Overall, the rise in separations during the Great Recession is more concentrated on low-tenured workers in Spain compared to Latvia, but in both countries the effect is noticeable in both groups.

We also analyzed both separation rates and wage dynamics, restricting the sample to temporary contracts in Spain (unreported). Unfortunately, we do not have an adequate comparison for Latvia. The analysis by type of contract shares the same conclusions as the analysis by job tenure. The separation rate of permanent contracts is lower and rises in a similar fashion as in the high-tenure group.²⁴ Thus, we conclude that it is unlikely that our main observations are only driven by the differences in the incidence of temporary contracts.