

Banco Central de Chile
Documentos de Trabajo

Central Bank of Chile
Working Papers

Nº 496

Octubre 2008

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Documentos de Trabajo del Banco Central de Chile
Working Papers of the Central Bank of Chile
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MICROECONOMIC EVIDENCE OF NOMINAL WAGE RIGIDITY IN CHILE

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Resumen

Este trabajo presenta evidencia microeconómica sobre el grado de rigidez laboral a la baja en Chile y explora sus consecuencias en términos de empleo. Se utiliza un nuevo panel de datos que comprende información de 440 mil historias de salarios para el período 2001.12-2007.12. Los resultados indican un bajo nivel de flexibilidad laboral, siendo la frecuencia de los ajustes de salarios en la economía de alrededor de nueve trimestres. En cuanto a los determinantes de la rigidez salarial, el grado de flexibilidad depende negativamente del tamaño de la empresa, del porcentaje de trabajadores mujeres, de la edad de los trabajadores y de la participación de trabajadores calificados a nivel de la empresa. Las estimaciones econométricas indican que una consecuencia directa de la rigidez salarial es una mayor fluctuación del empleo a lo largo de los ciclos económicos.

Abstract

This paper presents micro evidence on the degree of downward nominal wage rigidity in Chile and also explores its consequences in terms of employment. The data used corresponds to a new panel based on 440 thousand wage histories for the period 2001.12-2007.12. The results indicate a low degree of wage flexibility, the estimated length of wage adjustment for the whole economy being around nine quarters. In terms of the determinants of wage rigidity, the degree of flexibility depends negatively on the size of the firm, the percentage of female workers, the age of workers and white-collar participation at firm level. The econometric estimations indicate that the direct consequence of wage rigidity is a higher fluctuation of employment through the business cycle.

We would like to thank Roberto Alvarez, Kevin Cowan and Jaime Ruiz-Tagle for discussions and suggestions on this topic. All errors and omissions are our own. E-mail: mcobb@bcentral.cl, lopazo@bcentral.cl.

1. Introduction

This paper provides evidence on the degree of downward nominal wage rigidity in Chile. We use micro data from the *Asociación Chilena de Seguridad* (ACHS)¹ to build a panel of 440 thousand wage histories² for the period 2001.12-2007.12. This database identifies the firm and industry to which workers belong their personal characteristics, gender and age.

To the best of our knowledge, this is the first paper of its kind for the Chilean case³. This situation contrasts with the growing interest in this subject at an international level - based to a large extent on the increasing availability of individual and firm-level data⁴ - and its relevance for monetary policy. With this in mind, this paper aims to provide some insights into wage dynamics for Chile. In terms of the methodology, the potential measurement error of wages is dealt with by using the econometric technique of structural break detection developed by Bai and Perron (2003). This approach has been applied for the labour market in the U.S. by Gottschalk (2005) and it relies on the assumption that nominal wages change in a discrete fashion.

The main result is that Chile shows a relatively low degree of wage flexibility. The average length of time that it would take for the whole economy to adjust its wages is just over nine quarters, with some differences between economic sectors. The econometric estimation of the determinants of downward nominal wage rigidity shows that this depends negatively on firm size, the percentage of female workers, workers ages and white-collar participation at firm level. The impact of downward nominal wage rigidity on employment is a higher contraction of employment during bad times and, in general, a higher co-movement with the economic cycle. In other words, firms use employment to compensate for wage inflexibility.

¹ The *Asociación Chilena de Seguridad* is a private non-profit organization that develops risk prevention programs and gives health coverage to its affiliates in case of a work accident. Workers affiliated to the AChS account for approximately 35% of total wage earning workers.

² We build 440 thousand wage stories, resulting in a monthly average of 336 thousand workers.

³ Jadresic (1992) uses aggregated data to identify wage rigidity for the Chilean case.

⁴ This point is illustrated by the conference on wage dynamics organized by European Central Bank on June 24th and 25th, 2008; and the International Wage Flexibility project – Dickens *et al* (2007) summarizes the main findings of this project.

The rest of the document consists of 4 sections. Section 2 provides a review of the literature available for other countries. Section 3 describes the database used. Section 4 provides estimates of how flexible wages are in Chile, and also provides an analysis of the determinants and consequences of such adjustments. Section 5 summarizes the main findings of the study.

2. International Evidence

The most recent studies on wage rigidities have been addressed primarily through estimations based on microeconomic data⁵. The results, however, are mixed and cover a wide range of possibilities (Table 1). For Mexico, the frequency of wage reductions is 21% during the period 1983-86, while Canada shows a frequency between 0.3% and 0.4%. Also, the estimations can change substantially between different studies for the same country. For example, Blinder and Choi (1990) find evidence of wages being relatively flexible in the U.S., while Altonji and Devereux (1999) conclude that wages are fairly rigid. Moreover, even in cases where the same source of information is used, different authors reach seemingly contradictory conclusions. McLaughlin (1994 and 1999) argues absence of wage rigidities, based on data from the Panel Study of Income Dynamics (PSID), while Card and Hyslop (1997) find evidence to the contrary with the same data.

A reason for such differences may emerge from the lack of comparability across surveys or due to measurement error in data. To deal with the measurement error problem, Gottschalk (2005) corrects the wage reported in the PSID survey with an identification of structural breaks procedure, finding that wage flexibility is reduced substantially, to the level where it is comparable to the estimates obtained directly from administrative information provided by individual firms.

As regards to the survey comparability, it is worth mentioning two important ongoing initiatives. On the one hand, The International Wage Flexibility

⁵ Another line of research corresponds to authors like Fortin and Dumont (2001) and Farès and Lemieux (2001) that use the Phillips Curve along with alternative aggregate measures of wage growth to infer whether there is some evidence of wage inflexibility. Jadresic (1992) follows a similar approach.

Project (IWFP); a network studying wage rigidities from micro data for 17 OECD countries, where the preliminary findings suggest the predominance of real over nominal rigidities for the European countries as opposed to the US and UK (Dickens *et al*, 2007). On the other hand, The Wage Dynamic Network at the European Central Bank (WDN) has recently conducted several surveys referring to aspects such as adjustment margins, synchronization of wages and prices, among others topics⁶, where some of these surveys concluded that wage cuts are extremely rare – i.e., downward nominal rigidity⁷. Even though, at this point in time the studies show heterogeneous results, initiatives such as the IWFP and WDN are a good step towards generating more accurate data to analyze the presence, causes and consequences of wage rigidity.

Table 1
Selected Wage Rigidity Studies

Study	Period	Annual Frequency of Wage Reduction
México <u>Castellanos <i>et al</i> (2004)</u>	1986-2001	24.16%
United States* <u>McLaughlin (1994)</u>	1976-86	17.3%
<u>Card and Hyslop (1996)</u>	1976-93	15%-20%
<u>Kahn (1997)</u>	1970-88	10.6%-24.3%
<u>Akerlof et al (1996)</u>	1994-95	1.6%-5.8%
<u>Altonji and Devereux (1999)</u>	1971-92	0.5%-2.5%
<u>Gottschalk (2005)</u>	1986-93	1.5%-2.0%
Australia <u>Dwyer and Leong (2000)</u>	1987-99	3.5%-8.0%
Canada <u>Faruqui (2000)</u>	1983-86	0.3%-0.4%
	1996-99	0.2%-1.3%
Switzerland <u>Fehr and Goette (2005)</u>	1991-97	6.8%-15.5%

Notes: *= information found in Gottschalk (2005).

⁶ The WDN organized a conference to present the advances of different studies based on these surveys. (Frankfurt, June 24th-25th, 2008)

⁷ Babecky *et al*. (2008) shows that only 398 of the 14.122 (2.82%) respondents declared wages were cut during the previous five years, which suggest the existence of downward nominal rigidity.

3. Data

3.1 General Background

The database consists of the information reported to the ACHS by its affiliated companies during the period 2001.12 - 2007.12. This information is collected from payrolls provided by the companies, containing details such as the taxable remuneration⁸, gender, age, and the firm to which the worker belongs, specifying the economic sector at 1 digit classification – i.e., agriculture; mining, manufacturing; construction; electricity, gas and water.; commerce; transport; and services -.

This data has several advantages over other sources of information. First, the ACHS covers around 35% of wage earning employees and 25% of firms⁹. Second, the alternative source of information would be the Earnings Survey of the National Institute of Statistics (INE), which reports only business level information - basically, total wage cost and number of employees - and hence does not allow a direct approach for assessing labour market flexibility. Third, the information reported by the ACHS would not be subject to serious record problems¹⁰.

The most important limitation of the dataset is the lack of information on hours worked, which means that it is not possible to isolate wage changes from changes in working hours. Second, wage reporting is limited by the maximum taxable monthly income, so wages are truncated at an upper bound. This limit was set at US\$ 2.300 per month in December 2007¹¹, which, according to wage distribution surveys would exclude roughly 5% of Chilean workers. Third, the database only has information from those workers belonging to affiliated companies, which limits the possibility of exploring the flow of workers. Taking all this into account, we believe that even though the information of the ACHS

⁸ The taxable remuneration includes all remuneration that an employee receives, including the basic salary, commissions, bonuses, contributions for transport, etc.

⁹ Based on information from the Inland Revenue Service. The representativity for firms with 10 workers or more is slightly over 35%

¹⁰ Aravena (2006) finds that problems like repetition of identical information from a single worker within the same period or incomplete reporting, among others, are not significant for general purposes – for years 2002-2005-.

¹¹ This ceiling is set in terms of Unidades de Fomento (UF) - an inflation adjusting measure -.

presents some restrictions that limit its use, they are more than offset by the quality and type of information available.

3.2 Panel Construction

The original base was filtered due to the presence of certain inconsistencies in the data -possibly because of the manual input of information, incomplete information¹², the truncated values and the appearance of sporadic workers. Specifically, the following cases were excluded from the whole sample:

- i) Workers whose identification number was not unique within the same period.
- ii) Workers with no specified age or gender.
- iii) Workers over 90 years old and under 15.
- iv) Workers with wages higher than the maximum taxable income and lower than the current minimum wage.
- v) Workers with wages that match the maximum taxable monthly income for more than two consecutive months

Note that criteria (i) to (iv) controls for inconsistencies and partial information on available data, while criterion (v) seeks to eliminate those individuals whose wages are truncated and could therefore underestimate the actual degree of wage flexibility. We find that on average 3.7% of the worker identification numbers appear more than once in the same period. After removing these wage histories, the workers that do not comply with the gender and age criteria add up to 17% of the original base. Workers with wages above the maximum and under the minimum represent a 2%, while truncated wage histories another 3%. Once the data is filtered, following an approach similar to Fehr and Goette (2005), the workers who do not comply with a minimum of 24 consecutive reported months are excluded. This final criterion implies dropping 7% of the unfiltered sample.

¹² In cases where there is no wage information, for no longer than three consecutive periods, and after which the worker remains working for the same employer, we assume that the worker was employed but that the company had failed to report. If the wage doesn't change after the missing period, we assumed that it didn't vary during that time. If it does change, the wage modification is allocated with uniform probability in the missing time period.

As a result of the previous adjustments, the resulting database consists of an average of 336 thousand workers reporting every month. This figure adds up to 8.6% of wage earning Chilean workers (Table 2). In terms of economic sector representation, the manufacturing, electricity, gas and water, and services sector have a representation near 10% of the earning workers. The rest of the sectors have a representation ranging from 3% to 7%, which allows for a reasonable margin of confidence for our estimations.

In terms of the firms contained in the data, the database includes approximately 35 thousand firms (Table 3), which, according to information from the Inland Revenue Service, would be around 17% of the total registered businesses¹³. In terms of distribution by firm size, the participation of small, medium and large corresponds to 38%, 57% and 5% of the sample, while the coverage of firms by size is 9%, 36% and 35%, respectively.

Table 2
Number of Workers in the Sample by Economic Sector

	Number of Workers (*)	Percentage over Earning Workers (**)
Agriculture	29,969	6.9
Mining	1,902	2.6
Manufacturing	70,808	11.1
Construction	11,798	3.3
Electricity, Gas and Water	2,475	9.0
Commerce	43,577	6.8
Transport	14,818	4.5
Services	160,813	11.3
Total	336,445	8.6

Notes: (*) Sample Average. (**) Estimation based on published information from the National Statistics Institute (Instituto Nacional de Estadísticas). Elaborated from ACHS disaggregate data.

¹³ This is over all firms with at least one employee

Table 3
Number of Firms in the Sample by Economic Sector and Firm Size

	Number of Firms	Less than 10 Workers	From 10 to 199 Workers	200 Workers or More
Agriculture	4,759	1,898	2,711	150
Mining	249	66	156	27
Manufacturing	8,762	3,629	4,795	338
Construction	2,979	1,114	1,798	67
Electricity, Gas and Water	286	136	134	16
Commerce	4,979	1,873	2,873	233
Transport	2,818	1,497	1,273	48
Services	10,084	3,122	6,239	723
Database Firms	35,817	13,551	20,615	1,651
Database/Total Chilean Firms	16.5%	8.7%	36.0%	34.8%

Note: Based on Inland Revenue Services and ACHS disaggregate data.

Regarding the sample's representativity, Table 4 compares sample age and gender distribution with the population's figures published by the National Statistics Institute. We find that our sample is not far off from the population's shares when it comes to gender, but young people are under represented. This could be reflect the effect of the minimum number of reports criteria, because of younger workers change jobs more frequently, so excluding workers with histories shorter than 24 months will probably have a bigger impact on this group.

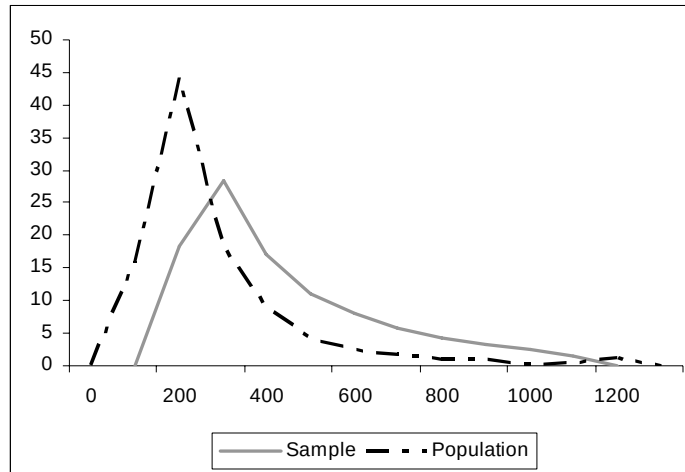
Table 4
Sample Representativity: Age and Gender

	Sample (percentage)	Population (percentage)
Gender		
Female	38.5	35.2
Male	61.5	64.8
Age		
under 30	7.9	27.5
$30 \leq x < 50$	65.3	55.2
over 50	26.8	17.3

Source: National Statistics Institute

With respect to wage's distribution, the sample is upward biased with respect to population distribution derived from the Encuesta de Protección Social (Figure 1). This issue is mainly derived from the database characteristics. The reporting firms to AChS belong to the formal sector and, by legal restrictions they can not pay wages under the minimum, which implies that our sample is truncated at that value. Instead, the sample population is not bounded below. In this sense, the estimations obtained in this study are mostly referred to firms and earning workers that belong to the formal sector.

Figure 1
Sample Representativity: Distribution of Wages
Year=2004

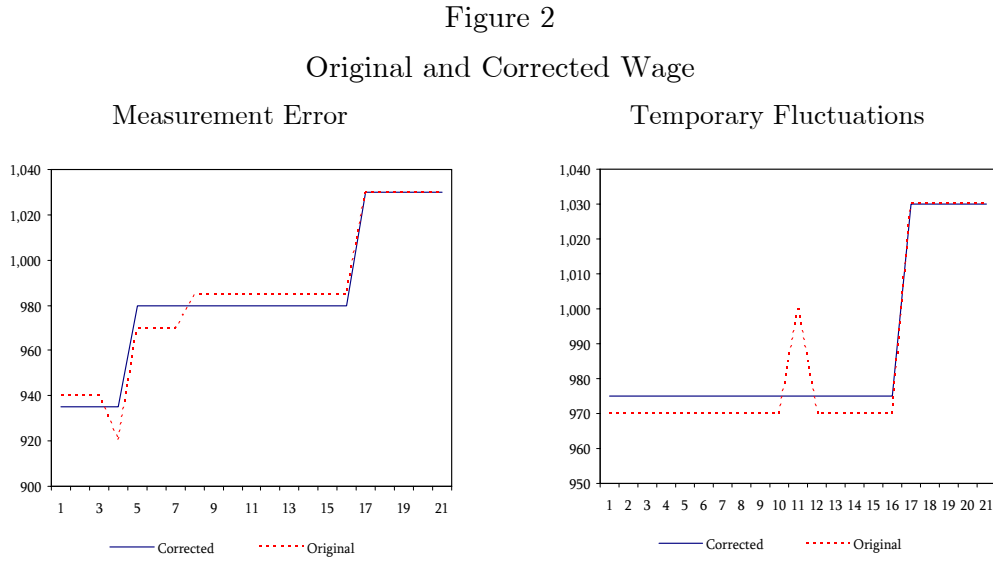


Source: Population distribution based on the Encuesta de Protección Social, Universidad de Chile.

3.3 Wage Adjustments

As it was previously mentioned, wages may be subject to measurement errors and may also include fluctuations that do not necessarily represent changes in wage conditions -for example, one-off bonuses or other transitory elements. Due to this, wages are corrected following Gottschalks (2005) approach. The method relies on the assumption that nominal wages remain constant for a time and only change in a discreet manner, this assumption is implemented through the use of the structural break test developed by Bai and Perron (2003).

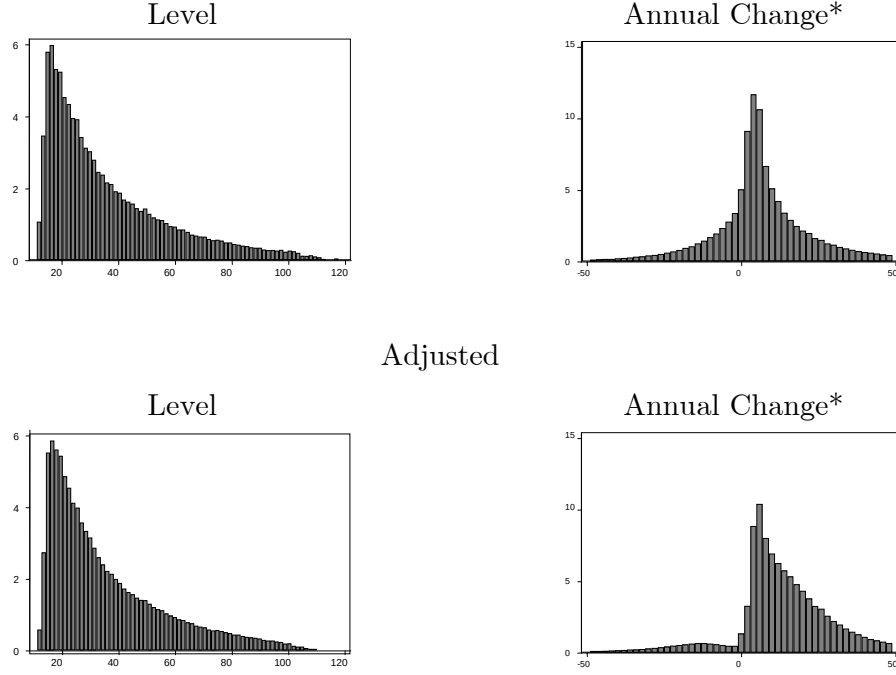
Figure 2 illustrates the application of this methodology. The left panel presents an actual wage history from the database and the simulated wage. As can be seen, the latter remains fairly close to the original one, while ignoring small fluctuations in months 3 and 6. In order to replicate the effect of potential bonuses throughout the year, the right panel presents a simulated wage that shows a temporary peak. The structural brake methodology, as expected, considers that peak as a transient event and not as an effective wage change¹⁴.



The distribution of wages is not changed very noticeably by using Gottschalk's approach. However, it significantly affects the frequency of wage adjustments (Figure 3). Indeed, without adjustment, the frequency of wage changes is more or less symmetrical around a number slightly above zero, while the adjusted series shows a highly unsymmetrical distribution of changes clearly biased towards wage increase. These results imply that, if the proposed methodology were not used, the sample frequency adjustments would reflect a significantly greater wage flexibility compared to the one found in the adjusted data, and considering the results reported by Gottschalk (2005),), the unadjusted results would most certainly be biased upwards.

¹⁴ Annex 1 contains a description of the methodology employed.

Figure 3
Wage Histograms
Originals



Note: * considers only actual wages changes.

4. Wage Adjustments in Chile

4.1 Characterizing the Adjustment Frequency

Table 5 summarizes the main indicators of wage adjustments in Chile. The estimates are divided between those changes not related to a new job – *stayers* – from changes due to a new hire – *movers* -. For the first group, the average adjustment frequency is 3.66% per month, with the increases and reductions being 3.35% and 0.31%, respectively¹⁵. These numbers suggest that the length of time required to adjust wages in the economy would be, on average, slightly over nine quarters. This result is close to estimations obtained from a DSGE model for Chile, where the average length of adjustment is 12.5 quarters with a lower bound of 5.56 quarters at 66% confidence level¹⁶. For those workers switching firms, we find that about 34% receive an increase, 24% a reduction and about 42% do not see a statistically significant change in their wages.

¹⁵ To illustrate the effect of the methodology used – Gottschalk (2005) –, the frequency of wage reductions without adjustment is 30.97%, a figure that far escapes the largest of the available estimates (section 2).

¹⁶ This estimate is obtained through Bayesian methods applied to a DSGE model for Chile. Caputo *et al* (2006).

Table 5
Wage Adjustment Frequency in Chile

Item	Wage Changes (monthly)	Average Total Adjustment (quarters)	Wage Increases (monthly)	Wage Reduction (monthly)
Stayers	3.66%	9.11	3.35%	0.31%
Movers *	58.3%	-	34.2%	24.1%

Note: * Frequency calculated considering the last reported wage in the previous firm. Source: Elaborated from ACHS disaggregate data.

The analysis by firm size indicates that mid-size companies have a slightly lower adjustment frequency than the others (Table 6). However, the magnitude of such differences does not look significant. Considering the frequency of wage reductions as a more direct indicator of wage flexibility, the larger companies would be least flexible, followed by medium and small companies. However, these figures must be considered with caution, because these frequencies can be influenced not only by the firm's size but also by worker characteristics. A formal analysis of the incidence of firm and worker characteristics is shown in the next section.

Table 6
Wage Adjustment Frequency in Chile by Firm Size

Size	Wage Changes (monthly)	Wage Increases (monthly)	Wage Reductions (monthly)
Less than 10 Workers	3.74%	3.36%	0.38%
From 10 to 200 Workers	3.45%	3.13%	0.32%
100 Workers or More	3.79%	3.56%	0.23%

Source: Elaborated from ACHS disaggregate data.

Braking down by economic sector indicates some differences across sectors (Table 7). With respect to the frequency of adjustments, the services sector and construction sector record the highest values in the sample (4.28% and 3.95% monthly, respectively), and the manufacturing sector has the lowest adjustment frequency (3.11%). Focusing on wage reductions, it is interesting to note that the frequency observed is quite similar across sectors, with the only exception

being construction, which shows nearly twice the overall frequency of wage reductions.

Table 7
Wage Adjustments in Chile by Economic Sector

Item	Frequency of Change (monthly)	Average Total Adjustment Period Length (quarters)	Frequency of Increases (monthly)	Frequency of Reductions (monthly)
Total	3.66%	9.11	3.35%	0.31%
Agriculture	3.21%	10.37	2.91%	0.30%
Mining	3.21%	10.37	2.93%	0.28%
Manufacturing	3.11%	10.71	2.81%	0.30%
Construction	3.95%	8.44	3.43%	0.52%
Electricity, Gas and Water	3.23%	10.34	2.94%	0.29%
Commerce	3.29%	10.13	2.95%	0.34%
Transport	3.32%	10.04	2.97%	0.35%
Services	4.28%	7.80	3.98%	0.29%

Source: Elaborated from ACHS disaggregate data.

4.2 Determinants of Wage Flexibility: Econometric Approach

The literature employs both individual and firm characteristics to explain the degree of wage rigidity. Regarding the workforce variables, Campbell and Kamlani (1997) emphasise that variables such as the proportion of blue-white collar workers or skill levels, among others, are crucial to an understanding of labour rigidities¹⁷. Meanwhile, Messina *et al* (2008), and Franz and Pfeiffer (2006) also consider characteristics like firm size or simply sector fixed effects to explain why some firms exhibit different degrees of downward nominal wage rigidity.

In terms of workforce characteristics, we have data on the age and gender of workers. The latter was computed as the proportion of female workers in each firm. The worker's age variable was grouped in two dummy variables: one were it takes the value of one if the average worker age lies between 30 and 50 years, and the other if the average worker age is over 50 years old. Additionally, as a proxy of white collar workers participation, the dataset was complemented with

¹⁷ Du Caju *et al* (2007) also points to the use of this type of variable.

the percentage of workers in each firm with a wage higher than the average wage in each period. In terms of firm variables, we consider firm size, percentage of unionized workers at economic sector level and we control by the economic sector to which each firm belongs¹⁸.

We run a set of regressions where the dependent variable is the percentage of workers in each firm that exhibit a wage reduction each period¹⁹, and the explanatory variables are those mentioned above. Notice that the dependent variable is restricted to the interval $[0,1]$, therefore, the ordinary least square procedure is not appropriate because the predicted values may lie outside this range. For this reason, and following Messina (2008), we use the following logistic function:

$$E(y_{it} | w_{it}, f_{it}) = \frac{\exp(w_{it}\alpha_0, f_{it}\alpha_1)}{1 + \exp(w_{it}\alpha_0, f_{it}\alpha_1)} \quad (1)$$

where y_{it} is the percentage of workers that exhibit a wage cut in firm i , w_{it} is a set of worker characteristics in firm i , and f_{it} represents firm characteristics.

The data covers on a quarterly basis the period 2001-2007. Table 7 presents the marginal effects on the dependent variable – i.e., percentage of wage cuts. Regarding worker characteristics, there is a negative relationship between the share of female workers and wage flexibility. This result may be suggesting that firms avoid wage cuts because women are less attached to the labour market²⁰ - i.e., they are more likely to quit in the presence of wage reductions. The worker's age variables show that firms with older workers exhibit higher flexibility, with a similar coefficient for workers between 30 and 50 years old, and workers over 50²¹. This result and the previous one are consistent with insider-outsider models, where younger and female workers play an outsider role²². Regarding the worker skill measurement, we obtained a positive

¹⁸ We do not have more detailed economic sector classification to account for a higher firm heterogeneity.

¹⁹ We only include stayers, but the results are robust to changing the dependent variable to wage cuts of all workers – stayers and movers –.

²⁰ This is consistent with an anti-cyclical participation of women in labor market.

²¹ The marginal effects of this variable and the others are robust to the use of age as a continuous variable - both its level and its squared value –.

²² Insider-outsider theory considers that firms do not dismiss their current workers (insiders) and hire the unemployed (outsiders) at a lower wage because of the cost of hiring and training new workers. Messina (2008) points out this kind of explanation for similar results.

relationship between wage flexibility and the share of white-collar workers, which could be indicating that contracts for skilled workers are relatively more complex allowing for adjustment mechanisms in the presence of adverse and relatively permanent shocks²³.

Table 8
The Determinants of Downward Nominal Reduction
Dependent Variable: Wage Cuts Percentage at Firm Level
Marginal Effects

Variable	[1]	[2]	[3]	[4]
Female Employment Share	-0.0065	-0.0062	-0.0066	-0.0062
Age>30 & Age ≤50	0.05425	0.0535	0.0543	0.0535
Age>50	0.0565	0.0552	0.0565	0.0552
Firm size: 1-10	-0.1633	-0.1621	-0.1633	-0.1621
Firm size: 10-200	-0.1116	-0.1110	-0.1116	-0.1109
Share of white-collars		0.0075		0.0075
Unionized workers by sector			-0.0002 ^{NS}	-0.0002 ^{NS}
Sector Fixed Effect				
Mining	0.0151**	0.0118*	0.0321*	0.0279*
Manufacturing	0.0219	0.0201	0.0241	0.0228
Construction	0.0289	0.0279	0.0452	0.0438
Electricity, Gas and Water	0.0149**	0.0128**	0.0164**	0.0142**
Commerce	0.0175	0.0162	0.0178	0.0164
Transport	0.0209	0.0196	0.0266	0.0252
Services	0.0339	0.0319	0.0334	0.0314
Time Effect	Yes	Yes	Yes	Yes

Note: All significant at a 1% level except: **=5% significance. *= 10% significance. ^{NS}= not significant at 10%.

Regarding firm characteristics, small and medium-sized firms have higher wage rigidity (with less than 200 workers). An explanation for this result may be related to the fact that large firms may be able to apply more complex payment schemes allowing more flexible salaries. Complementary to this, especially in the case of small firms, these firms could try to avoid cutting wages because, if a couple of workers decide to quit due to a wage cut, the relative incidence is higher for small firms than for bigger ones –i.e., small firms face potentially higher adjustment costs. The level of union membership does not seem to be statistically relevant. Finally, the estimated sector fixed effect indicates that construction and services have higher flexibility than the other economic

²³ This result is at odds with efficiency wage models, because it should be more difficult to monitor skilled workers than unskilled workers.

sectors, while Commerce and Electricity, Gas and Water have the lowest frequency of wage cuts²⁴.

4.3. Effect of Downward Nominal Rigidity on Employment

In order to check the relationship of wage rigidity to employment more formally, we ran a set of regressions relating employment growth by firm to sector growth – i.e., GDP by sector – and wage flexibility of each firm. Table 9 summarises our estimations. Column [1] indicates that a positive shock of 1% of annual growth would imply an employment growth of 0.3%. However, if we control by the degree of wage flexibility (Cols. [2] and [3]), the sensitivity of employment to sector growth would be lower in firms with higher wage flexibility and this effect is stronger when the GDP growth is lower than the average sample growth²⁵.

This finding is consistent with the view that lack of wage flexibility will generate cost in terms of employment, where firms with high wage flexibility can absorb shocks through adjustment in wages instead of employment. More specifically, in the case of a negative shock, if firms cannot adjust wages, they will be forced to fire workers - or shut down in an extreme case. On the other hand, if the shock is positive - i.e., high GDP growth -, firms with higher wage rigidity will increase employment relatively more than firms with high wage flexibility. It is worth mentioning that even in the case of total absence of upward wage rigidity during periods of high growth, the presence of downward nominal rigidity has effects on employment cyclicalities, because of the threat of future negative shocks and the need to rehire the workers fired during the previous low growth episode.

To illustrate the previous point numerically, Table 10 presents a simulation of the impact on employment derived from a positive and negative growth shock. The positive shock is equal to a growth 1% over the historical average and the negative shock is 1% below the average. We considered the following cases: a)

²⁴ The non-linearity of the model implies that the marginal effect of the sector dummy can not be isolated completely.

²⁵ The asymmetry of the coefficients shown in Column [3] could suggest that firms have to make bigger efforts in order to adjust for negative shocks, which could be consistent with the existence of credit constraints to firms during bad times. However, we do not have data to check this point formally.

low flexibility corresponds to zero wage reduction, and b) high flexibility corresponds to the 97.5% highest adjustment frequency and it is equal to 13.15% per month. In the case of an increase of 1%, the quarterly employment growth would fluctuate from 0.35% to 0.26%, and if the shock were negative, the employment growth would range from -0.35% to -0.20%.

Table 9
Dependent Variable: Quarterly Employment Growth

Variable	[1]	[2]	[3]
Sector Growth t	0.3111	0.3504	0.3493
Sector Growth x Percentage of Wage Cuts t		-0.7724	
Low Sector Growth x Percentage of Wage Cuts t			-1.1328
High Sector Growth x Percentage of Wage Cuts t			-0.6809**
Sector Fixed Effect	Yes	Yes	Yes
Time Effect	Yes	Yes	Yes

Note: Low (high) sector growth is defined as the cases when GDP growth is lower (higher) than the average GDP growth of each sector. All values are significant at a 1% level, except for **= significant at 5%.

Table 10
Employment Consequences of Downward Nominal Reduction
Quarterly Employment Growth

Degree of Downward Nominal Wage Rigidity	Shock=1% GDP	Shock=-1% GDP
Low Flexibility	0.35%	-0.35%
High Flexibility	0.26%	-0.20%

5. Conclusions

This paper characterises the wage adjustment dynamic in Chile based on microeconomic data using a panel of 440 thousand work histories for the period 2001.12-2007.12. The main result indicates that the frequency of wage adjustments in Chile is approximately 3.7% per month, with just 0.31% corresponding to wage reductions.

The frequency and magnitude of wage adjustments show some differences across economic sectors. In particular, sectors such as construction and services exhibit a relatively greater frequency, while manufacturing would have the lowest. However, the frequency of wage reductions does not vary significantly between economic sectors, with the exception of the construction sector, which

virtually doubles the estimated frequency in other sectors. This could reflect the fact that construction activities are dominated by temporary projects.

The econometric analysis of the determinants of downward nominal wage rigidity indicates that both employee and firm characteristics are relevant. Regarding worker characteristics, firms with a high concentration of female, younger and unskilled workers will face a lower degree of wage flexibility and viceversa. On the firm's side, small and medium-sized firms exhibit a lower degree of downward flexibility, which could be explained by more complex payment schemes in big firms.

Finally, concerning the consequences of downward rigidity, our estimations indicate that the degree of wage rigidity has higher employment fluctuations as a counterpart. This kind of effect is especially relevant when activity is growing below the historical average. In fact, if growth were 1% less than average, employment would decrease 0.35% at the extreme case of zero flexibility, while it would decrease 0.20% if the firm had a high degree of flexibility.

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Annex 1

Methodology Bai-Perron (2003)

This annex presents a description of the structural break test used to determine the change in wages. For a more rigorous analysis and presentation of this test, see Bai-Perron (2003).

Defining T as the number of periods for which wages are observed for a particular worker, existing m structural breaks that occur in $T_1, T_2, \dots, T_m$. The wages observed in the period is equal to a constant (β) plus a measurement error (μ) as specified below:

$$\begin{aligned} w_t &= \beta_1 + \mu_t & t &= [1, T_1] \\ w_t &= \beta_2 + \mu_t & t &= [T_1 + 1, T_2] \end{aligned} \tag{A.1}$$

$$w_t = \beta_{m+1} + \mu_t \quad t = [T_m + 1, T]$$

Bai and Perron (2003) have proposed a OLS estimator for β 's and T 's. For this purpose, they assume that the number of breaks is known and equal to m . In this case, the idea is to estimate β 's and T 's that minimize the residuals sum of the squares of the System A.1. However, this calculation can be quite demanding computationally, since the duration between breaks is unknown and therefore there are many combinations for T 's. To deal with this problem, Bai and Perron (2003) show that the problem can be reduced via dynamic programming, as follows:

$$SSR(\hat{T}_1, \dots, \hat{T}_m) = SSR(\hat{T}_1, \dots, \hat{T}_{m-1}) + \min_{\hat{T}_m} SSR(\hat{T}_m) \tag{A.2}$$

The algorithm is solved recursively according to the following procedure. Calculate the SSR for the $T - 2h$ possible breaks that divide the T observations in 2 segments of a minimum length h . Choose the break point with minimum

SSR between these $T - 2h$ break points. Take the two remaining segments and repeat until you have m segments. This will return a minimum SSR on all possible combinations of m breaks of a minimum length h .

To determine the optimal m we use a sequential process. First, the sample is divided in two and the null hypothesis of no structural break is tested using an F test of the SSR with and without structural break. In the event that the null hypothesis is rejected, the remaining segment is divided in two and then tested for structural break in both segments. This procedure is repeated until the null hypothesis cannot be rejected.

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