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# WAGE RIGIDITY, COLLECTIVE BARGAINING, AND THE MINIMUM WAGE: EVIDENCE FROM FRENCH AGREEMENT DATA

Sanvi Avouyi-Dovi, Denis Fougère, and Erwan Gautier\*

*Abstract*—Using data sets on wage agreements at both industry and firm levels in France, we document stylized facts on wage stickiness. The average duration of wages is a little less than one year, and 10% of wages are modified each month by a wage agreement. The frequency of wage change agreements is staggered over the year, but the frequency of effective wage changes is seasonal. The national minimum wage has a significant impact on the probability and the seasonality of wage changes. Negotiated wage increases are correlated with inflation, minimum wage increases, and firm profitability.

## I. Introduction

IN most macroeconomic models, the existence of nominal rigidities explains why monetary policy might have an impact on output. Until recently, the microempirical research on nominal rigidities mainly focused on price stickiness (Klenow & Malin, 2011), and evidence on nominal wage rigidity was rather scarce.<sup>1</sup> However, Huang and Liu (2002) and Christiano et al. (2005) have emphasized that wage rigidity might be much more important than price rigidity to replicate the dynamic impact of monetary policy on output.<sup>2</sup> In this paper, we document stylized facts on wage stickiness and the impact of wage-setting institutions on wage rigidity in France using administrative data set on collective wage agreements at industry and firm levels between 1994 and 2005.

Our first contribution is to provide new stylized facts on wage stickiness and to confront them with predictions of

wage rigidity models. We find that the monthly frequency of wage changes implied by wage agreements is a little less than 10%, and the average duration of negotiated wages is ten months. In the United States, wages are a little stickier. Using wage contract or observed wage data, Taylor (1999) and Barattieri, Basu, and Gottschalk (2009) show that the average duration of wages is about one year. In France, contrary to price rigidity, heterogeneity across industries is limited, but longer wage durations are found in small firms. Hazard rates of wage change agreements exhibit large peaks at 12 and 24 months, whereas hazard rates of effective wage changes exhibit peaks at 3, 6, 12, and 24 months. This pattern is consistent with the existence of fixed duration contracts à la Taylor (1980). For other durations, hazard rates are rather flat. This may suggest the existence of a significant proportion of Calvo wage-setting firms in our data. Consistent with the model set forth by Fischer (1977), we find that many wage increases are predetermined: 44% of firm-level agreements and about 20% of industry-level agreements stipulate more than one wage increase. However, a majority of agreements covers only one year. We also find that inflation and national minimum wage increases are correlated with negotiated wage increases. This fact may support the presence of an implicit indexation mechanism in wage agreements. Moreover, firm profitability has a significant positive impact on the size of wage increases, whereas local unemployment has a negative effect on negotiated wage increases at the firm level.

Some papers have recently assessed the seasonal effects of monetary shocks. Olivei and Tenreyro (2010) find that an uneven staggering of wage contracts across quarters in Europe can explain the delayed and persistent effects of monetary policy shocks on output. However, evidence on wage change seasonality is rather scarce. Here we examine evidence on the synchronization of wage agreements and effective wage changes. Wage agreements are synchronized at each level of the wage bargaining process but staggered across the different levels of this process. More than half of industry-level agreements are signed between October and January, whereas about 60% of firm-level agreements occur between December and April. Overall, wage change decisions are rather staggered: the frequency of wage changes is 25% in the first and the second quarters versus 28% and 35% in the third and the fourth quarters, respectively. Dates of effect of wage agreements are more seasonal: a first peak in the frequency of wage changes is observed in January (36.2%) and a second one in July (26.9%).

Finally, our paper provides new evidence on the role of wage-setting institutions on wage rigidity. The French system of wage bargaining is quite representative of European institutional features of wage bargaining: almost all workers

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\* Avouyi-Dovi: Banque de France and Leda-SDFi, Université de Paris-Dauphine; Fougère: CREST, CNRS, LIEPP/Sciences Po, CEPR, IZA, and Banque de France; Gautier: Université de Nantes, LEMNA, and Banque de France.

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<sup>1</sup> Recent exceptions include Le Bihan, Montornès, and Heckel (2012) for France, and Barattieri et al. (2009) for the United States.

<sup>2</sup> On the introduction of wage rigidity in DSGE models, see Erceg, Henderson, and Levin (2000) and Galí (2011) for a recent survey.

are covered by a wage agreement, different levels of wage bargaining coexist, and a significant proportion of workers are paid the minimum wage. Aghion, Algan, and Cahuc (2011) have pointed out the role of public institutions on the quality of labor relations: a binding national minimum wage might crowd out the possibility for agents to negotiate. We find that the higher the percentage of minimum-wage workers, the less frequently that firms negotiate.<sup>3</sup> Industry-level agreements are more likely to cover small firms and to be binding for low-paid workers, whereas firm-level agreements concern larger firms and higher-paid workers. Systematic links between industry- and firm-level agreements are difficult to observe. However the national minimum wage plays a key role in the wage bargaining calendar, and it modifies the patterns of wage changes over the year.

Our paper is organized as follows. Section II presents the main institutional features of the wage-setting process in France and describes our data sets and how we measure wage rigidity. Section III documents evidence on the frequency of wage changes and wage durations. Section IV provides results on the timing of wage agreements. Finally, the distribution of wage changes in collective agreements and its determinants is examined in section V. Section VI concludes.

## II. Wage-Bargaining Institutions and Data

### A. Institutions of Wage Bargaining

Four institutional principles govern collective bargaining in France. First, the Auroux Law, voted in 1982, stipulates that every firm and every industry must negotiate wages with unions every year even if an agreement cannot be reached at the end of the bargaining process.

Second, there is a strict hierarchy between the different levels of wage bargaining. In France, wages are bargained at three levels: at the national level, a binding minimum wage is set by the government according to an official formula (see below); at the industry level, employers' organizations and unions negotiate pay scales, and wages are negotiated occupation by occupation; and at the firm level, employers and unions usually negotiate wage increases. The hierarchy between bargaining levels implies that a collective agreement must set forth, broaden, or enhance an agreement that has been previously signed at a higher bargaining level. At the industry level, if the wage bargaining fails, the previous pay scale prevails until a new agreement is signed. At the firm level, if there is no collective agreement on wages in a given year, there is no collective wage increase, but individual wage increases are possible. On average, around 66% of workers are covered by an industry-level wage agreement each year. Firm-level wage agreements cover a smaller proportion of workers (about 20%; see supplementary online appendix, table A).

<sup>3</sup> On the effect of the minimum wage on prices, see, for instance, Fougère, Gautier, and Le Bihan (2010).

The third principle is the wide use of extension procedures, which guarantee a large coverage of collective agreements. In France, there is a gap between the low unionization rate (less than 10%) and the large coverage of wage agreements.<sup>4</sup> This gap may have two causes: a firm-level agreement usually covers all workers within the firm and not only unionized workers (as in the United States and the United Kingdom), and at the industry level, extension procedures permit agreements to apply to all workers within an industry. At first, an industry-level wage agreement applies to all firms represented by the employers' associations signing the text. Then an extension of the agreement to the whole industry can be requested by either the government, employers' associations, or unions. Once extended, the agreement applies to all workers within the industry. Extension procedures are common in France, and no specific criterion is needed to obtain an extension.

Finally, the national minimum wage (NMW) is set at the national level and applies to all workers and all firms.<sup>5</sup> Minimum wage increases are binding. Until 2010, the NMW was raised every year in July according to a legal formula based on indexation to past inflation and past wage growth.<sup>6</sup> In addition, the government may decide on a discretionary basis to increase the raise. Over our sample period, the average NMW increases were higher than the average overall wage growth. On average, 13% of workers were paid the NMW, whereas in most European countries where a NMW exists, less than 5% of workers are paid the NMW (Du Caju et al., 2009).

### B. Data

We use three original data sets containing precise information on both the agreements signed at the different levels of the wage bargaining process and the share of minimum wage earners at the local and industry levels. A fourth data set helps us to provide a full characterization of firms and identify firms not covered by a firm-level agreement.

*Industry-level agreements.* In France, at the aggregate level, the bargaining system is made up of about 700 *branches*. These *branches* do not exactly or systematically match industries of the usual classification of economic sectors or products.<sup>7</sup> Some of them cover a very limited number of workers, while others cover thousands of workers.<sup>8</sup> Moreover, in a given firm, some workers can be covered by

<sup>4</sup> In the United States or the United Kingdom, unionization is equal to the coverage of wage agreements.

<sup>5</sup> In France, the NMW is called *Salaires Minimum Interprofessionnel de Croissance*.

<sup>6</sup> Except in 1996, when the NMW was also increased in May.

<sup>7</sup> For instance, due to historical reasons, collective agreements in the metalworking industry signed at the local level may cover workers who are not actually working in metalworking industries.

<sup>8</sup> For example, collective agreements in the leather industry cover around 3,000 workers, whereas collective agreements in the bakery industry cover approximately 115,000 workers.

one *branche*, others by another one. However, we often observe that a majority of workers in a firm are covered by only one *branche* and that *branches* often cover a whole industry. So in our study, we use the term *industry* for *branche*.

We have collected data on industry-level agreements from annual reports published by the Ministry of Labor over the period 1994 to 2005 (*Rapports annuels sur la négociation*). These reports list all wage agreements signed in a given year in industries with more than 10,000 workers. Slightly fewer than 2,000 wage agreements are reported, which corresponds to 206 industries: 123 industries have nationwide coverage, while 83 cover regional or local areas (this mainly concerns agreements in the metalworking and construction industries). All in all, the agreements contained in our data set cover around 12 million workers in 2005, approximately 75% of workers employed in the private sector. The main variables include an identifying number for the industry, the geographical coverage of the agreement, the number of workers in the industry, the date of signature of the wage agreement (day, month and year), and the date at which it becomes effective (hereafter, this date is called the *date of effect*). For the period 1999 to 2005, the average wage increase contained in the agreement is also available. For a majority of industries, pay scales deal with monthly or annual base wages. One of the limitations of this data set is that the complete pay scales are not available. These scales are different across industries, and their comparison is thus difficult to undertake.

*Firm-level agreements.* We also use an administrative data set containing information on all firm-level agreements collected by the Ministry of Labor. By law, firms must report to the Ministry of Labor all agreements they conclude. About 350,000 agreements (covering different topics) were collected over the period 1994 to 2005. The main variables include the scope of the agreement (for example, wages, bonuses, workweek reduction, employment, discrimination) and the date of signature of the agreement (month and year). We restrict our sample to agreements dealing with wages. The date of effect and the wage increase reported in the agreement are also available but only for the period 1994 to 2001.<sup>9</sup> In most firm-level wage agreements, collective wage increases refer to monthly base wages.

To match this data set with the industry-level wage agreements, we assume that all workers of a given firm are covered by only one industry wage agreement. We also assume that if a firm-level agreement is signed in a given firm, all workers of this firm are covered by the agreement.

*National minimum wage.* On average, over the sample period, 13% of workers are paid the NMW. To measure the

role of the NMW in the bargaining process, we build a data set containing the proportion of workers paid around the NMW simultaneously in a given industry and a given *département*.<sup>10</sup> For that purpose, we use exhaustive administrative files on wages (Déclarations Annuelles des Données Sociales, DADS), which contain base wages and number of days paid each year to every worker. These data sets enable us to compute the proportion of days paid around the minimum wage (between 0.9 and 1.2 the hourly minimum wage) in a disaggregate industry (classification NES 114) and in a given *département* each year over the period 1994 to 2005. We thus compute a variable describing the importance of the NMW in the wage distribution at a disaggregate level.

*Firm data.* Finally, we use a data set containing firm-level information to identify firms that negotiate but also firms that never agree on wages over the sample period. These latter firms are by definition not reported in the agreement data set. The firm-level data set, Fichier Bancaire des Entreprises (Fiben hereafter), is produced by the Banque de France. It contains annual information on the balance sheet of hundreds of thousands of firms. Some industries like financial activities, education, health, and administration, are excluded from it. The main variables used in our study include the number of workers in the firm, its geographical localization, and firm profitability. Following Guertzgen (2009), we measure firm profitability as quasi rents per capita:

$$\pi_{it} = \frac{Y_{it} - \text{Mat.Costs}_{it} - N_{it}\bar{w}_t}{N_{it}},$$

where  $Y_{it}$  is annual sales of firm  $i$  in year  $t$ ,  $\text{Mat.Costs}_{it}$  is annual material costs for firm  $i$  in year  $t$ ,  $N_{it}$  is the number of employees in year  $t$  in firm  $i$ , and  $\bar{w}_t$  is the average labor cost per capita at the industry level. This average industry wage bill is introduced to tackle a possible endogeneity issue due to the presence of an accounting relationship between profit and wages. We use a two-digit industry producer price index to deflate all monetary values. When conducting the statistical analysis of wage changes and agreements, we compute the annual log variation of this performance indicator.

Our final sample comes from the matching of the four data sets presented above. It contains all the firms in the Fiben data set, excluding firms belonging to industries not reported in the data set containing industry-level agreements. Our sample contains around 1.5 million individual observations (230,000 firms). The distribution of firms according to their size or to their economic activities is similar to the one in the whole economy (see supplementary online appendix, table B).

<sup>9</sup> Because of important methodological changes in the collection of information concerning agreements.

<sup>10</sup> A *département* is an administrative zone. There are 96 *départements* in France. Each of them has approximately the same geographical size (6,000 square kilometers), but different population sizes.

### C. *Measuring Wage Rigidity*

In macroeconomic models with nominal rigidities, key parameters are the probability of observing a wage change and the length of periods in which wages remain fixed. Using wage contract data, our aim here is to measure the frequency of wage changes and the distribution of wage durations. The wage rate of a given worker can be modified because of a firm-level agreement, or an industry-level agreement, or an increase in the NMW. Ideally, for each worker, we would like to measure the distribution of durations between two wage change decisions or two wage changes implied by wage agreements.

To measure the elapsed duration since wages were last agreed on (even if an agreement implies no wage increase), we have constructed, for all workers in a given firm, a dummy variable equal to 1 when a firm-level wage agreement or an industry-level agreement is signed and concerns this firm. This variable is supposed to capture wage changes agreed for workers paid above the minimum wage. For workers paid close to the minimum wage, the variable is also equal to 1 when the minimum wage is increased (usually in July). In each firm, the proportion of employees whose wage is close to the minimum wage is supposed to be equal to the proportion of days paid the minimum wage simultaneously at both the local and industry levels. Using the number of workers in each firm, we are then able to measure the number of workers whose wages are affected by a firm-level agreement, an industry-level agreement, or an increase in the NMW.

In France, there is usually no expiration date in wage agreements since firms must negotiate wages every year. So in a given year, if no agreement is signed at the firm level or the industry level, workers are not covered by any contract and there is no collective wage increase.<sup>11</sup> Consequently, the duration of wages in a firm is computed as the difference between two successive agreements, whatever the type of agreement (either an industry- or a firm-level agreement or an increase in the NMW). We are then able to measure how many months a wage remains fixed and provide some basic statistics on the distribution of wage durations. We also compute the frequency of wage changes as the ratio of the number of workers concerned by a wage agreement to the total number of workers.

In macroeconomic models with wage rigidity, one generally tries to estimate the speed at which agents incorporate specific or common shocks into their wages. One interesting property of our data is that we are able to distinguish between the dates at which wage changes are agreed and the dates at which wage changes are actually implemented. As Cecchetti (1987) noted, the observation of actual wage changes can be misleading when assessing the degree of

wage rigidity. For instance, let us consider two firms in which wages are modified every month. In the first firm, wages are negotiated every month based on the current information on shocks, whereas in the second firm, all wage changes were predetermined one year ago based on the information available at that date. In the first case, wages are considered flexible; in the second case, shocks would be more persistent.<sup>12</sup> In this paper, we compute the frequency of agreed wage changes and the frequency of actual wage changes.<sup>13</sup> Since we observe dates of effect at the firm level only for the period 1994 to 2001, we restrict the computation of these two indicators over this subperiod.<sup>14</sup>

Using wage contract data allows us to have accurate information on the date at which a wage change is decided and is implemented in each firm. Many studies on wage rigidity use survey data collected once a year, and they cannot provide direct evidence on the average duration of wage contracts at a high frequency. Moreover, most of the papers dealing with wage rigidity have to correct for measurement error in reported wages. Our data are more immune to this type of measurement error.

### III. Frequency and Duration of Wage Agreements

In this section, using microdata, we provide some estimates of the key parameters used in macromodels with wage rigidity. Then we apply our empirical findings to the main predictions of these models. Three models are often used in macroeconomics. First, Taylor (1980) assumes that wages are set for a constant period of time. His model is mainly motivated by the existence of wage contracts in the U.S. manufacturing sector (Cecchetti, 1987, and Taylor, 1983, for the United States, and Christofides and Wilton, 1983, for Canada). Taylor (1999) finds that one year is a good approximation of the average length of a wage contract. Second, Calvo (1983) assumes that the duration of wages is random, the probability of a wage change being exogenous and constant over time. This model is widely used in macroeconomic models but is not motivated by strong institutional reasons. However, Fougère, Le Bihan, and Sevestre (2007) show that, for prices, a Calvo model is a rather good approximation for the distribution of observed price durations. Third, in menu cost models, the probability of a wage change depends on the state of the economy and can vary over time.

<sup>12</sup> Fischer (1977) shows that predetermined wage changes play a role in explaining why monetary policy is nonneutral in the short run. Even if all firms decide to change their wages in every period, monetary policy would still have an impact on the product in the presence of wage pre-termination.

<sup>13</sup> For the national minimum wage, we assume that the decision and the effective date are the same. Firms know that the minimum wage will be modified in July, but they can forecast only the size of NMW increases.

<sup>14</sup> As a robustness exercise, we have computed the same variables assuming that over the period 2001 to 2005, firm-level agreements are implemented (are “effective”) at the date of the agreement. Results remain very similar.

<sup>11</sup> For the same reason, it is difficult to compute and analyze delays in renewal of labor contracts, as in Gu and Kuhn (1998) or Danziger and Neuman (2005).

TABLE 1.—DURATION AND FREQUENCY OF WAGE AGREEMENTS

	Mean	First Quartile	Median	Third Quartile
Duration (in months)				
Agreements	9.4	4	8	12
Effects	8.7	3	6	12
Frequency (in percent)				
Agreements	9.6	7.9	9.5	12.4
Effects	9.9	8.3	9.6	12.8
Implied duration (in months)				
Agreements	10.4	8.1	10.5	12.6
Effects	10.1	7.8	10.5	12.1

The variable used for computing these statistics is equal to 1 if workers in a given firm are covered by a wage agreement (resp., by the effect) at the firm or industry levels or by the NMW increase. All statistics are weighted by the number of workers in each firm and the number of workers paid close to the NMW. The frequency of wage changes is reported in percentages per month and is first calculated at the disaggregate industry level. Durations are computed as the difference between two successive agreements or two successive effects (either an industry- or a firm-level agreement or an increase in the NMW). Statistics on durations are reported in months and are computed only for noncensored observations. Implied durations are computed as the inverse of the monthly frequency of wage changes. Statistics concerning agreements are computed over the period 1994 to 2005, whereas statistics concerning effects are calculated for the period 1994 to 2001.

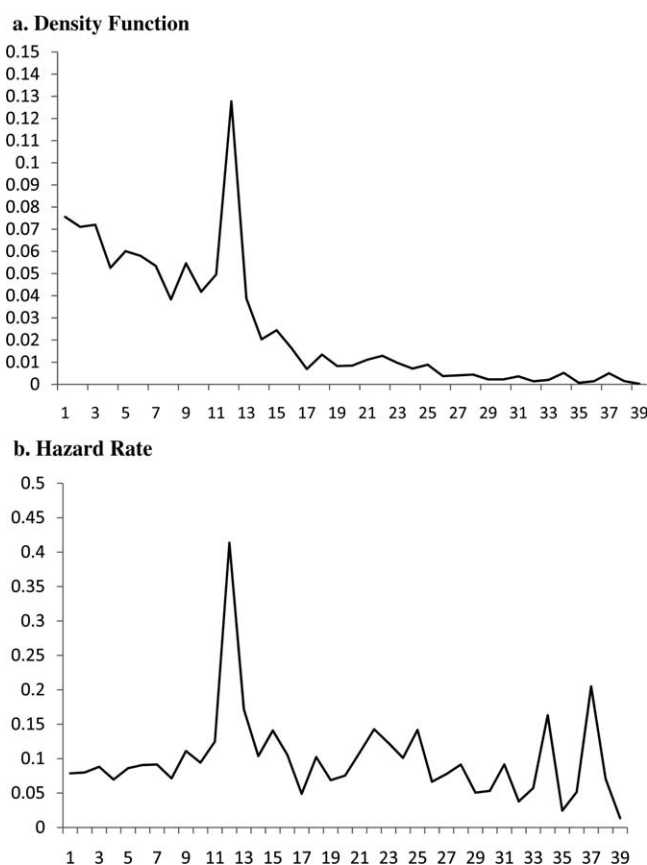
### A. Frequency and Durations of Wage Change Decisions

Table 1 reports some descriptive statistics concerning the duration of wages, the frequency of wage changes (agreed and effective), and implied durations of wages (defined as the inverse of the frequency of wage changes). Each month, about 10% of wages are modified by a wage agreement (either a firm- or an industry-level agreement or an increase in the NMW level). The average duration of wages is close to ten months. For the United States, using a macroeconomic model, Christiano et al. (2005) estimate that the average wage duration is about eight months, whereas, using individual wage data, Barattieri et al. (2009) find a longer average duration (about eighteen months).

Figure 1a displays the distribution of durations between two decisions of wage changes. First, we find that most of the wage durations are lower than one year and that only 10% of durations are longer than eighteen months. Second, the distribution exhibits a peak at twelve months: about 13% of wage durations are equal to one year. These two findings reflect both the legal obligation in France to negotiate wages every year and the regularity of the bargaining calendar (see section IV). If we refer to wage rigidity models, the peak at one year is in line with the predictions of a Taylor (1980) model, where firms set their wages for a given and constant period of time (twelve months). For durations different from twelve months, the distribution can be approximated by an exponential distribution, which suggests the existence of Calvo-type wage-setting firms.

Figure 1b plots the hazard rate of wage agreement durations—the instantaneous conditional probability of a wage agreement given that no agreement has been signed since the last wage change. A basic Calvo model would predict a constant hazard rate, whereas a Taylor model would predict that the hazard rate is equal to 1 when the contract is renewed (this date being defined *ex ante*) and 0 elsewhere. We find that the hazard rate shows a peak above 40% at twelve months and remains flat below 10% elsewhere.

FIGURE 1.—DURATION OF WAGE AGREEMENTS (IN MONTHS)



The variable used for calculating durations is equal to 1 if workers in a given firm are affected by a wage agreement (decision) signed at either the firm or the industry levels or by an NMW increase. Durations are computed as the difference between two successive agreements (an industry- or a firm-level agreement or an increase in the NMW). Statistics are weighted by the number of workers in each firm and the number of workers paid close to the NMW.

Contrary to prices, the hazard of wage changes is not decreasing. This nondecreasing pattern in the hazard function may suggest a small degree of heterogeneity in wage-setter behaviors (Fougère et al., 2007). Table 2 examines two possible sources of heterogeneity: industry effects and firm size. First, differences across industries are rather small; the frequency of wage change decisions is slightly smaller in the manufacturing sector than in services (10.8% versus 8.8%). The degree of heterogeneity is larger when we consider the size of firms. For firms with fewer than 100 employees, the average wage duration is about thirteen months, whereas for firms with more than 500 workers, the average duration is closer to eight months. This firm-size effect can be linked to the frequent absence of unions in firms with fewer than 50 workers. In small firms, less than 20% of workers are represented by a union, compared with 80% in firms with more than 500 workers (Amossé & Pignoni, 2006). In smaller firms, negotiating wages is more costly; thus, the frequency of wage changes is lower.

### B. Frequency and Duration of Effective Wage Changes

Firms or industries may decide to predetermine wage changes in a wage agreement. Wage agreements can come

TABLE 2.—FREQUENCY AND DURATION OF WAGE AGREEMENTS BY FIRM SIZE AND BY INDUSTRY

	Agreement		Effect	
	Frequency (in percent)	Implied Duration (in months)	Frequency (in percent)	Implied Duration (in months)
Size (number of workers)				
0–20	7.3	13.7	8.9	11.2
20–50	7.6	13.2	9.3	10.8
50–100	7.8	12.8	9.3	10.7
100–200	8.4	12.0	9.7	10.3
200–500	9.4	10.7	10.1	9.9
More than 500	12.2	8.2	10.7	9.4
Industry				
Agriculture	8.7	11.5	8.3	12.0
Manufacturing	10.8	9.3	10.4	9.6
Construction	8.3	12.0	7.4	13.6
Services	8.8	11.4	10.2	9.8

The variable used for computing these statistics is equal to 1 if workers in a given firm are covered by a wage agreement (resp. the effect of a wage agreement) at the firm or industry levels or by the NMW increase. All statistics are weighted by the number of workers in each firm and the number of workers paid close to the NMW. The frequency of wage changes is reported in percentages per month and is first calculated at the disaggregate industry level. Implied durations are computed as the inverse of the monthly frequency of wage changes. Statistics for agreements are computed over the period 1994 to 2005, whereas statistics for effects are calculated over the period 1994 to 2001.

TABLE 3.—DURATION BETWEEN THE DATE OF SIGNATURE OF THE WAGE AGREEMENT AND THE DATE AT WHICH IT TAKES EFFECT, IN MONTHS

	Number of Wage Increases	Proportion of Agreements	Mean	First Quartile	Median	Third Quartile
<i>Industry-level agreement</i>	1	1.00	−0.1	−1	1	2
	2	0.18	5.9	4	6	8
	3	0.02	10	5	8	12
<i>Firm-level agreement</i>	1	1.00	0.1	−1	0	1
	2	0.44	5.2	4	6	7
	3	0.09	7.8	5	7	9

The first column reports the number of wage increases stipulated in the wage agreement. The second column is the proportion of wage agreements containing at least one, two, or three wage increases; for instance, 44% of firm agreements contain at least two wage increases. Other columns report some statistics on the duration between the date of agreement and the different dates of effect. For firms, results are obtained for the period 1994 to 2001, whereas for industries, they are obtained for the period 1994 to 2005.

into force at several dates in the future, and wage increases are staggered over time. At both industry and firm levels, there may be a delay between the date of signature and the date at which the agreement actually comes into force.<sup>15</sup>

In table 3, we compute the proportion of agreements stipulating a given number of dates of effect. Twenty percent of industry-wage agreements contain more than one date of effect. However, the delay between the signature and the implementation of the agreement is often short. If the agreement contains a second date of effect, the duration between the decision of wage change and the effective wage change is six months on average. For firm-level agreements, the proportion of agreements containing more than one date of effect is larger (about 45%). The duration between the date of a wage change decision and the date at which the agreement becomes effective is short for the first effect (close to 0), and durations are about six and eight months for the second and the third effects, respectively. Overall, the length of time between the date of signature and the last date of effect rarely exceeds twelve months. For this reason, staggering usually occurs over the course of the year. Therefore, predetermination at a given level of bargaining may have rather limited effects.

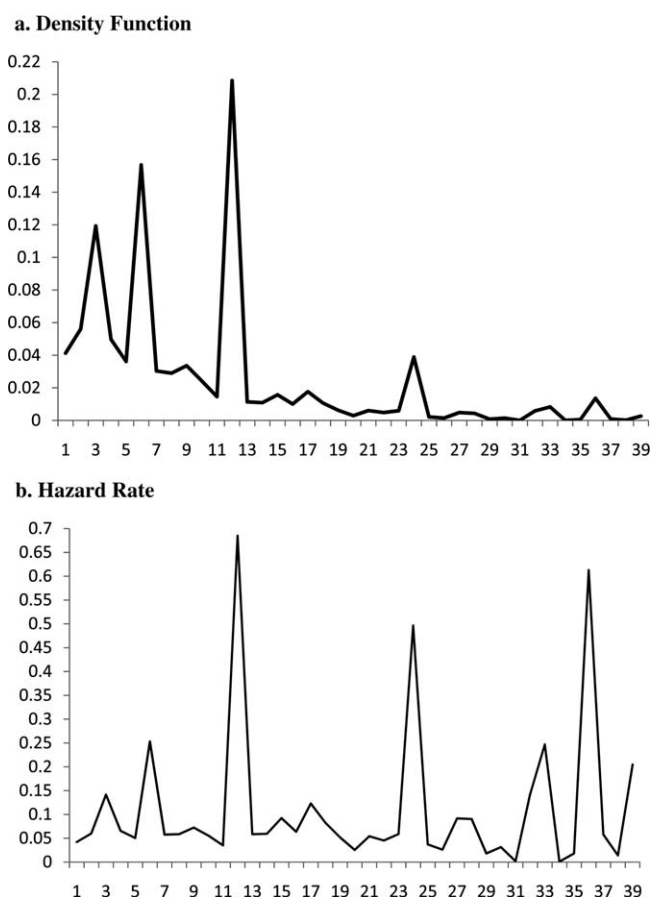
<sup>15</sup> Using Canadian wage agreements, Christofides and Laporte (2002) analyze what they call “intracontract wage profile”.

We now compare the distribution of durations of effective wage changes with our findings on wage change agreements. First, the average monthly frequency of effective wage changes is similar to the average frequency of wage change decisions, close to 10% (see table 1). There is some heterogeneity in the frequency of effective wage changes across industries and across firm sizes, but it is smaller than for wage agreements (see table 2).

Figure 2a plots the distribution of durations between two effective wage changes. The peak at twelve months is larger than for the distribution of wage change decisions (more than 20% of wage durations are exactly equal to one year). Moreover, two other peaks in the distribution are observed at three and six months: around 16% of wage durations are equal to six months, and 12% are equal to three months. This pattern may have two different causes: a given agreement could contain several dates of effect, or a wage rate could be modified by different agreements at different levels, and implementations of wage agreements (whatever the level of wage bargaining) are gathered in some specific months (see section IV), which leads to peaks at some specific durations.

On figure 2b, we plot the hazard rate of effective wage durations. This hazard rate exhibits large peaks at 12, 24 and 36 months and two smaller ones at 3 and 6 months. Elsewhere, the hazard rate is flat—close to 5%. The large

FIGURE 2.—DURATION BETWEEN EFFECTS OF WAGE AGREEMENTS, IN MONTHS



The variable used for calculating durations is equal to 1 if workers in a given firm are affected by a wage agreement (effect) signed at either the firm or the industry levels or by an NMW increase. Durations are computed as the difference between two successive effects (either an industry- or a firm-level agreement or an increase in the NMW). Statistics are weighted by the number of workers in each firm and the number of workers paid close to the NMW.

peak at 12 months reflects the importance of one-year Taylor contracts, whereas the peaks at 24 and 36 months are due to the failure of negotiations in a given year. Smaller peaks at 3 and 6 months may indicate some staggering between the different levels of wage bargaining.

### C. Some Determinants of the Probability of a Wage Change

A state-dependent model assuming wage adjustment cost would predict that state-dependent variables could explain the probability of wage changes. Here we examine determinants of the probability that a wage agreement is signed at either the industry level or the firm level in a given year. Tables 4 and 5 report estimates of probit models applied respectively to industry-level and firm-level agreements. In both cases, the dependent variable is a dummy variable taking the value 1 if an agreement is signed (or becomes effective) in a given year  $t$ , 0 otherwise. Both models incorporate unobserved individual effects.

First, at the firm level, we find a significant effect of the firm size on the probability of a firm-level agreement. Lar-

ger firms are more likely to sign a wage agreement than are small firms. At the industry level, this firm-size effect is reversed: the higher the proportion of small firms within the industry, the more likely an agreement is. Small firms may find it difficult and costly to negotiate on wages every year. Thus, they prefer a common agreement at the industry level, which is less costly to obtain. Gray (1978) shows that the length of contracts is positively related to negotiation costs; this may explain the heterogeneity of wage change frequencies across firm sizes.<sup>16</sup>

At the industry level, the proportion of days paid the NMW has a positive but not significant effect on the probability of an industry-level agreement in a given year. This finding may seem counterintuitive. In fact, some studies show that the existence of a minimum wage reduces the level of social dialogue between workers and employers (see, for instance, Aghion et al., 2011). The causality seems to be reversed in some industries where bargaining occurs frequently because the NMW overtakes the bottom of the wage scales. This catching-up phenomenon forces industries to renegotiate quickly, but new agreements merely adjust the lower end of wage scales to the new value of the NMW. At the firm level, the impact of the number of minimum wage earners on the probability of a wage agreement is negative. When the proportion of minimum-wage workers is high in a given firm, wage agreements are less frequent since wage increases are set at the national level for many of its workers. This finding is consistent with the conclusions of Aghion et al. (2011). Annual NMW increases allow smaller firms for which cost of negotiation is large to have longer and less frequent firm agreements because their wages are partly determined by the NMW changes. This finding is consistent with Gray (1978), who shows that contract length is positively correlated with the cost of contracting and indexation.

Finally, the signature of an industry-level agreement has a positive effect on the probability of a firm-level agreement. However a systematic relationship between the frequency of industry-level and firm-level agreements cannot be easily established (see below). It seems that small firms are more likely to be covered by an industry-level agreement, while larger firms are more often covered by a firm-level agreement. Besides, firm-level wage agreements are more frequent in firms where we observe an increase in profitability, all other things being equal. However, real uncertainty (approximated by the variance of the firm profitability over time) has a significant negative impact on the probability of negotiating on wages.<sup>17</sup> An increase in the

<sup>16</sup> Christofides and Wilton (1983), and Murphy (1992, 2000) find similar evidence on firm size using Canadian and U.S. data, respectively.

<sup>17</sup> Danziger (1988) shows theoretically that real uncertainty should increase contract duration, whereas nominal uncertainty should decrease contract length. However, in the French context, this prediction is difficult to test: multiyear contracts are very rare since firms must negotiate by law on wages every year, and in a large majority of agreements, the contract duration is one year.



TABLE 4.—DETERMINANTS OF THE OCCURRENCE AND AVERAGE WAGE INCREASE NEGOTIATED IN INDUSTRY-LEVEL WAGE AGREEMENTS (PARAMETER ESTIMATES)

	Probit		Tobit	
	Agreement	Effect	Agreement	Effect
Intercept	0.499** (0.219)	-0.413* (0.215)	-6.721** (0.740)	-6.457** (0.714)
Duration since the last agreement				
1 year	0.252** (0.122)	0.430** (0.117)	1.252** (0.539)	1.217** (0.505)
2 years	0.379** (0.125)	0.398** (0.124)	1.853** (0.528)	1.699** (0.500)
3 years	0.216 (0.150)	0.410** (0.149)	1.919** (0.585)	1.831** (0.562)
More than 3 years	Ref.	Ref.	Ref.	Ref.
Proportion of days paid the minimum wage	0.001 (0.005)	0.004 (0.005)	0.033** (0.014)	0.030 (0.014)
Proportion of firms with fewer than 50 workers	0.005** (0.002)	0.003 (0.002)	0.016** (0.006)	0.012** (0.006)
Manufacturing	Ref.	Ref.	Ref.	Ref.
Services	-0.217* (0.129)	-0.107 (0.121)	-0.869** (0.352)	-0.600* (0.344)
$\sigma_u$	0.498** (0.053)	0.466** (0.050)	0.750** (0.275)	0.875** (0.224)
$\sigma_\varepsilon$			3.798** (0.114)	3.643** (0.107)
$\rho$			0.038 (0.027)	0.055 (0.027)
Sample period	1994–2005	1994–2005	1999–2005	1999–2005
Observations	2,436	2,639	1,896	1,747

The proportion of days paid the minimum wage is calculated as the number of days paid around the minimum wage in each industry and in each *département* for a given year, divided by the total number of days paid in the same industry and in the same *département* the same year, whatever the wage level. The proportion of firms with fewer than fifty workers is calculated as the number of firms with fewer than fifty workers divided by the total number of firms in the industry. Other control variables include year and size dummies and a dummy variable indicating whether the agreement stipulates a reduction in the number of workweek hours. Significant at \*10% and \*\*5% (otherwise, statistically nonsignificant). Standard errors are in parentheses.

local unemployment rate significantly increases the frequency of firm-level agreements. The probability of a firm-level wage agreement is partly explained by state variables, which is in line with the predictions of state-dependent models.

#### IV. The Timing of Wage Agreements

In most macroeconomic models, wage changes are supposed to be staggered (Taylor, 1980, Calvo, 1983). The staggering or the synchronization of wage changes is shown to have an impact on the real effects of the monetary policy.<sup>18</sup> In this section, we investigate the degree of staggering or synchronization, of wage changes by examining the seasonality of wage agreements.

##### A. Seasonality of Wage Change Decisions

Table 6 reports the monthly proportion of wage agreements at both the industry and firm levels and the monthly frequency of wage change decisions (including minimum wage changes).

<sup>18</sup> For the United States, Olivei and Tenreyro (2007) find that the output responds more quickly to a monetary policy shock occurring in the first months of the year, and they explain this finding by a strong seasonality of wage agreements. For the euro area, De Walque et al. (2010), Juillard, Le Bihan, and Millard (2012), and Olivei and Tenreyro (2010) obtain mixed evidence on the link between wage staggering and the timing effects of monetary policy shocks.

First, industry-level agreements are highly seasonal. About 55% of agreements are signed between October and January with a maximum (20%) in December. By contrast, only a few industry-level agreements are signed in February, March, August, and September (a little more than 4% of agreements each month on average). The timetable of firm-level agreements is delayed compared to the timetable of industry-level agreements. Firm-level agreements are most frequently signed between December and April (more than 60% of agreements are signed during this five-month period), with a peak between March and April (more than 25% of wage agreements). The proportion of wage agreements is only 27.5% between May and July and less than 15% between August and November. This sequence of wage agreements is explained by the hierarchy between the two levels of wage bargaining. Industry-level wage agreements are more likely to be signed at the end of the year, and once the industry-level agreement is observed, firms agree on wages at the beginning of the following year.

These two slightly different timetables make wage change decisions staggered over the year. The frequency of wage change decisions is close to its average (9.5%) over the year. Two exceptions are December and July, where the frequency of wage changes is about 20%. The first seasonal peak is linked to wage changes implied by industry- and firm-level agreements, whereas the second is linked to the NMW annual revision. We also observe wage changes in August and September.

TABLE 5.—DETERMINANTS OF THE OCCURRENCE AND OF THE AVERAGE WAGE INCREASE NEGOTIATED IN FIRM-LEVEL WAGE AGREEMENTS (PARAMETER ESTIMATES)

	Probit	Tobit
Intercept	-1.728** (0.050)	-6.589** (0.308)
Annual variation of profitability between years $t - 1$ and $t$	0.001** (0.000)	0.005** (0.001)
Annual variation of profitability between years $t - 2$ and $t - 1$	0.002** (0.000)	0.005** (0.001)
Variance of the annual growth of profitability	-0.006** (0.002)	-0.016** (0.001)
Proportion of days paid around the minimum wage	-0.008** (0.000)	-0.025** (0.003)
Variation of the annual local unemployment rate	0.008** (0.000)	0.014** (0.007)
<i>Size of the firm</i>		
Between 50 and 100 workers	Ref.	Ref.
Between 100 and 200 workers	0.553** (0.021)	1.688** (0.081)
Between 200 and 500 workers	1.089** (0.025)	2.967** (0.093)
More than 500 workers	1.603** (0.031)	3.986** (0.113)
<i>Occurrence of an industry-level agreement</i>		
The same year	0.094** (0.029)	0.303** (0.122)
Last year	0.025 (0.031)	0.332** (0.128)
Two years ago	0.087** (0.036)	0.338** (0.145)
More than two years ago	Ref.	Ref.
$\sigma_u$	0.980** (0.013)	2.596** (0.049)
$\sigma_\varepsilon$		2.346** (0.026)
$\rho$		0.550** (0.009)
Sample period	1994-2005	1994-2001
Observations	141,959	97,478

The proportion of days paid the minimum wage is calculated as the number of days paid around the minimum wage in each industry and in each *département* of a given year, divided by the total number of days paid in the same industry and in the same *département* the same year, whatever the wage level. The variance of the annual growth of profitability is calculated at the firm level over the sample period. The local unemployment rate variation is computed at the *département* level each year. Year dummies, industry dummies, and a dummy variable indicating that the agreement concerns also the reduction of the workweek duration are included. Significant at \*10% and \*\*5% (otherwise statistically nonsignificant). Standard errors are in parentheses.

### B. Seasonality of Effective Wage Changes

Many wage agreements come into force in specific months of the year, and the frequency of wage agreement effects is more seasonal (table 6). At the industry level, a little less than 40% of wage agreements come into force in January. Two smaller peaks are observed in July and October, where about 15% and 12% of wage agreements are implemented, respectively. In other months, on average, only 4% of wage agreements come into force. At the firm level, the synchronization of wage changes shows similar patterns, with peaks in January (20.6% of wage agreements becoming effective during this month), July, and October (10% and 11%, respectively). However, another peak is observed between March and April (23.5% of wage agreements become effective during this two-month period).

The frequency of wage changes reflects this strong seasonality (table 6). The frequency of effective wage changes is much higher than its average in January and July (36.2%

and 26.9% of wage changes versus 10% on average). Two smaller peaks are observed in April and October (about 10% of wage changes), whereas in other months, the frequency of wage changes is on average less than 5%.<sup>19</sup> The seasonality of observed wage changes is slightly different from the one that could be inferred from the seasonality of wage agreements. Effective wage changes are less staggered than wage change decisions. Interestingly, this seasonality in wage changes translates in aggregate wage series. The quarterly aggregate wage growth in France is seasonal. On average, it is larger in the first quarter (0.75%) where wage changes are more frequent, the aggregate wage growth being slightly smaller in the second and the third quarters (0.58% and 0.61%)<sup>20</sup> and much lower in the fourth quarter (0.35%).<sup>21</sup> By comparison, Barattieri et al. (2009) find no significant seasonality in wage changes in the United States.

Another noticeable finding is that the seasonality of wage bargaining also mirrors the seasonal pattern of producer price adjustments. Gautier (2008) finds that in France, the proportion of producer price changes is larger in January and, to a lesser extent, in July and April.<sup>22</sup> This may suggest simultaneous price- and wage-setting decisions at the firm level.

### C. Interplays of Timetables at the Different Levels of Wage Bargaining

We examine in this section the links between the timetables of the different stages of wage bargaining. In theory, the links between industry- and firm-level agreements are clearly defined, according to the principle of the most favorable settlement. This hierarchy should have an impact on the degree of synchronization of agreements since industry-level agreements should come first, before firm-level agreements. In practice, however, bargaining calendars are not systematically linked.

Figure 3 represents the timetables of wage agreements in two industries: the chemical products and trucking. We plot on the same graph the dates of signature and the dates of implementation of industry-level agreements (vertical lines) and the number of firm-level wage agreements (gray histograms). In the chemical products industry, the link between industry- and firm-level agreements is quite clear. The

<sup>19</sup> Using survey evidence from firms in the euro area, Druant et al. (2009) find that wage changes are clustered in some specific months (January, July, and April).

<sup>20</sup> The difference in average aggregate wage changes between the second and the third quarters is stronger for blue-collar workers (0.72% in the third quarter versus 0.65% in the second quarter). This larger difference may be explained by the change in the minimum wage at the beginning of the third quarter.

<sup>21</sup> Using additional linear regressions (available on request), we have tested for seasonal differences in the aggregate wage change. We find that the quarterly average wage changes in the first and the fourth quarters are significantly different from the average wage changes in other quarters.

<sup>22</sup> Similar findings are obtained at the euro-area level by Vermeulen et al. (2012).

TABLE 6.—TIMING OF INDUSTRY-LEVEL AND FIRM-LEVEL WAGE AGREEMENTS AND THEIR EFFECTS

	Agreement			Effect		
	Proportion of Agreements		Frequency of Wage Changes	Proportion of Agreements		Frequency of Wage Changes
	Industry	Firm		Industry	Firm	
January	9.5	10.6	9.4	37.5	20.6	36.2
February	4.9	12.1	7.6	3.7	6.1	4.6
March	6.0	13.6	8.4	5.0	10.0	7.0
April	8.3	13.0	9.8	6.8	13.5	10.2
May	6.7	8.7	8.7	3.1	5.1	4.6
June	6.5	9.2	7.8	3.4	6.0	3.9
July	7.5	6.6	21.5	14.5	11.7	26.9
August	0.2	1.1	1.0	2.0	1.3	2.9
September	5.6	2.8	5.7	3.1	9.6	3.9
October	11.9	5.6	10.7	11.8	10.3	11.5
November	12.8	5.3	7.7	6.6	3.0	4.8
December	20.2	11.4	17.8	2.6	2.8	2.7

The first two columns report the proportion of wage agreements signed in a given month (the number of agreements signed in a given month divided by the total number of agreements). The third column reports the frequency of wage change decisions by month, for instance, 9.4% of wages are modified by a wage agreement in January. Columns 4 and 5 report the proportion of agreements stipulating a wage change in a given month. The sixth column reports the frequency of effective wage changes by month, for instance, 36.2% of wages are modified in January. All these statistics are weighted by the number of workers in each firm. Statistics for agreements are computed over the period 1994 to 2005, whereas statistics concerning effects are calculated over the period 1994 to 2001.

majority of industry agreements are negotiated in November or December and take effect at the beginning of the following year, often in January. In this industry, most of the firm-level agreements are signed between February and March. In 2005, the absence of an industry-level agreement leads to a higher frequency of firm-level agreements. This example is quite typical of the seasonality that we have documented in the previous section. In the trucking industry, the majority of industry-level agreements take effect in July and August, whereas firm-level agreements do not follow any regular timetable. This reflects the influence of the annual updating of the minimum wage level in this industry. So at the end of the observation period, when the minimum wage rose significantly, the number of firm-level agreements increased even though there were no industry agreements.

The annual increase in the NMW level has also a significant impact on the industry- and firm-level bargaining calendars. To assess the effect of the NMW on the wage agreement timetable, we use the following random-effect probit models:

$$y_{it}^m = 1 \text{ if } y_{it}^{m*} > 0, \quad y_{it}^m = 0 \text{ otherwise,}$$

$$\text{with } y_{it}^{m*} = \gamma x_{it} + v_i + \varepsilon_{it}^m,$$

where  $y_{it}^m$  is a dummy variable taking the value 1 if an agreement is signed in the firm (respectively, in the industry)  $i$  in year  $t$  and in month  $m$ , and the value 0 if the agreement is signed in a different month ( $m' = m$ ). For a given industry or firm  $i$ ,  $x_{it}$  is a set of covariates including the proportion of days paid the NMW in year  $t$  at both the local and industry levels, and other controls. The  $v_i$ 's are industry- or firm-specific random effects, and  $\varepsilon_{it}$  are random exogenous shocks normally distributed with mean 0 and variance 1. We estimate a model for each month of the year, separately for the dates of signature and the dates of effect of agreements.

Table 7 reports the marginal effects of the proportion of days paid the NMW. At the firm level, agreements are less often signed at the beginning and end of the year if the NMW covers a large share of the labor force. When the NMW covers a large part of the labor force, agreements are more likely to be signed between June and September.<sup>23</sup> If we now consider the dates of effect of firm-level agreements, we obtain similar results: a higher frequency of wage agreements in July, when the NMW is revised, and a lower frequency in January and March. The results are relatively less significant for industry-level agreements, but the proportion of days paid the NMW also affects the agreement calendar: when this proportion is higher, agreements are more often signed in September and take effect more frequently at the end rather than at the beginning of the year. Since 2010, the NMW has been revised in January, which might increase the number of agreements signed at the beginning of the year.

## V. Size of Wage Changes in Collective Agreements

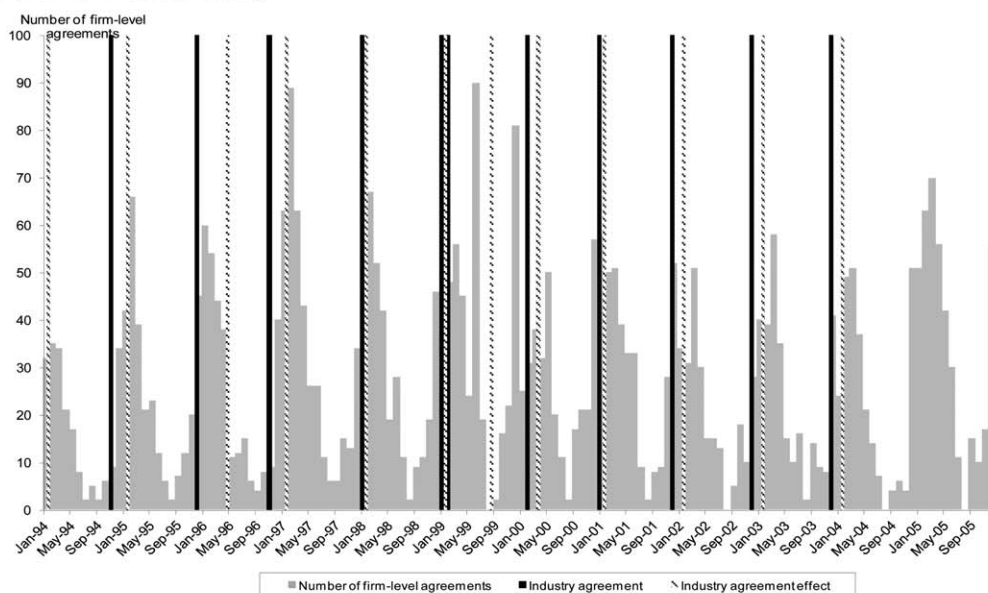
We here provide some stylized facts on the size of wage changes in industry- and firm-level agreements. The main objective of this section is to identify some of the determinants of the size of nominal wage changes. To assess the key variables driving the distribution of wage changes, we use a downward nominal wage rigidity model (that is, we account for the large proportion of zero wage changes in the distribution) following Dickens et al. (2007), Christofides and Stengos (2003), and Christofides and Li (2005).<sup>24</sup>

<sup>23</sup> Further regressions show that this effect is even stronger between 2003 and 2005 when the NMW rose significantly.

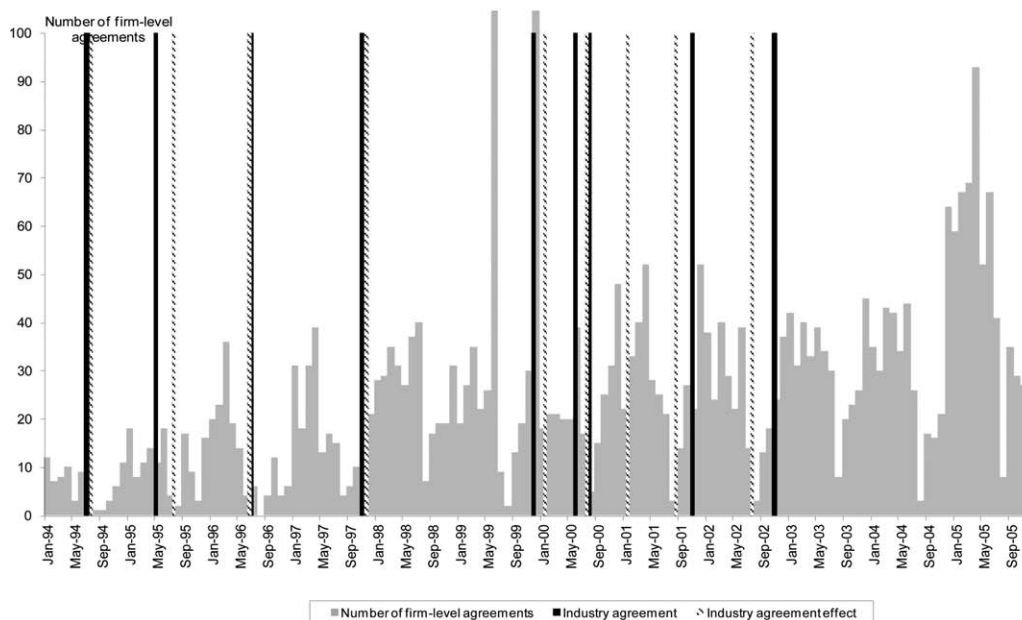
<sup>24</sup> In our data set, information on wage increases negotiated in firm-level agreements is available for the subperiod 1994 to 2001. At the industry level, the only available data cover the subperiod 1999 to 2005. In this case, the increases are calculated as the averages of the different increases negotiated for the industry wage grid.

FIGURE 3.—NUMBER OF FIRM-LEVEL AND INDUSTRY-LEVEL WAGE AGREEMENTS

**a. Chemical Products Industry**



**b. Trucking Industry**



Gray histograms represent the number of firms signing a wage agreement in a given industry each month. Vertical black lines represent the dates of signature of industry-level agreements while vertical dotted black lines correspond to the dates of effect of these agreements.

By law, collective wage decreases are impossible in France: they can be decided at the firm level only in case of strong difficulties. Thus, we focus here on the distribution of negotiated wage increases.

*A. Cross-Section Analysis of Negotiated Wage Increases*

Table 8 reports descriptive statistics on the average wage increase negotiated in both industry- and firm-level agreements. The annual negotiated wage increase is quite high

(close to 3.5%), whereas the aggregate average wage increase in the private sector is closer to 2.5% during the same period. At the industry level, wage bargaining frequently deals with monthly or annual wage scales. So if in a given year no agreement is signed, the previous pay scale still applies and the next agreement should catch up, taking into account past inflation or past NMW increases. As a result, the observed negotiated increases depend on the duration between two successive agreements and the catching-up constraint. The average wage change increase per

TABLE 7.—MARGINAL EFFECTS ( $\times 10^{-2}$ ) OF THE PROPORTION OF DAYS PAID THE MINIMUM WAGE ON THE TIMING OF INDUSTRY- AND FIRM-LEVEL WAGE AGREEMENTS (OR ON THEIR DATES OF IMPLEMENTATION)

	Firm-Level Agreement		Industry-Level Agreement	
	Agreement	Effect	Agreement	Effect
January	-0.08**	-0.22**	-0.13	-1.42**
February	-0.11**	0.00	-0.05	0.02
March	-0.09**	-0.14**	0.11	-0.01
April	-0.05*	0.01	0.04	0.17**
May	0.02	-0.01	-0.02	0.06*
June	0.08**	-0.06*	0.09	0.05
July	0.06**	0.17**	0.09	0.28**
August	0.00	0.00	-	0.00
September	0.02**	0.04	0.18**	0.05
October	0.01	0.04	0.07	0.14**
November	-0.01	0.01	-0.12	0.02
December	-0.05**	0.00	-0.07	0.03*

Each cell of the table reports the marginal effect of the share of days paid at the minimum wage on the probability of signing an agreement or on the probability that an agreement takes effect in a given month. The share of days paid the minimum wage is computed in industries for industry-level agreements and at a disaggregate level (both the industry and local geographical levels for firm-level agreements). The estimated model is a probit model with random effects; the endogenous variable is a dummy variable equal to 1 if an agreement is signed in a given month (or if an agreement comes into force in a given month) and 0 otherwise. Year dummies, industry dummies, and indicators of the size of the firm are included as control variables in these twelve different estimations. The marginal effect is significant at \*10% and \*\*5%.

TABLE 8.—SIZE OF WAGE INCREASES NEGOTIATED AT THE INDUSTRY LEVEL AND THE FIRM-LEVEL (IN PERCENT)

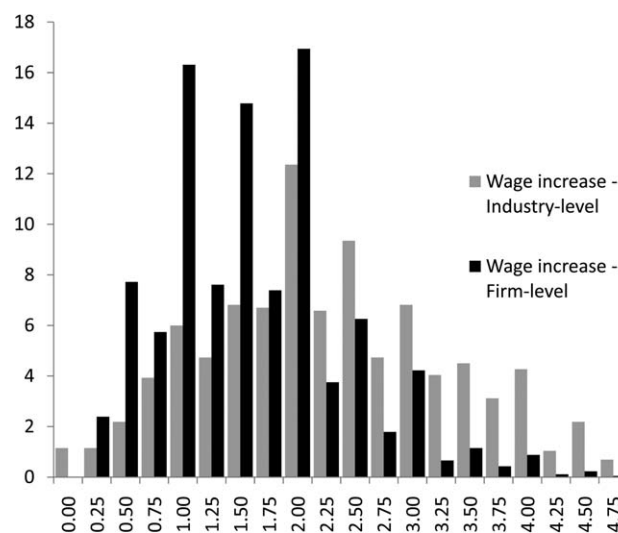
	Mean	Standard Deviation	First Quartile	Median	Third Quartile
<i>Industry level</i>					
Observed	3.37	2.41	2.00	2.80	4.10
By year of effect	2.59	1.60	1.57	2.30	3.30
<i>Firm level</i>					
General wage increases	1.61	0.84	1.00	1.50	2.00
Wage increases by occupation:					
Blue-collar workers	1.78	0.98	1.00	1.63	2.25
White-collar workers	1.64	0.87	1.00	1.50	2.00
Managers	1.71	0.91	1.00	1.50	2.25

Average wage increases at the industry level are reported in percent and are calculated using the wage grid modified by the new wage agreement. Those average wage increases are extracted from the reports of the Ministry of Labor ("Rapports annuels sur la négociation"), available for the period 1999 to 2006. Average wage increases at the firm level are computed for the period 1994 to 2001 using the wage increase in percentages contained in firm-level agreements. In some agreements, wage increases could be different across occupations. "By year of effect" means that negotiated wage increases are divided by the number of years since the last date of effect of the agreement.

year since the last agreement is close to 2.5%. Figure 4 displays the distribution of wage increases in industry-level agreements. The distribution is rather widespread and modes are observed at 2.0% and 2.5%. Large wage increases are not rare: 25% of industry agreements contain wage increases above 3.3% (table 8).

At the firm level, the average wage increase is smaller (about 1.5%). Most agreements stipulate wage increases that are expressed in percentages rather than in terms of grid thresholds specific to firms. Moreover, some agreements can imply a different wage increase for each occupation. For those agreements, wage increases for blue-collar workers are slightly higher than for other workers. On figure 4, the distribution of wage changes at the firm level exhibits a smaller dispersion than at the industry level. Besides, 14.9%, 10.4%, and 16% of wage changes are exactly equal to 1%, 1.5%, 2%, respectively. This may

FIGURE 4.—WAGE INCREASES NEGOTIATED IN INDUSTRY AND FIRM-LEVEL AGREEMENTS (IN PERCENT)



Average wage increases at the industry level are reported in percent and are calculated using the wage grid modified by the new wage agreement. Those average wage increases are extracted from the reports of the Ministry of Labor ("Rapports annuels sur la négociation"), available for the period 1999 to 2006. Average wage increases at the firm level are computed over the period 1994 to 2001 using the wage increase (in percentage), which is specified in firm-level agreements. Negotiated wage increases are divided by the number of years since the last date of effect of the agreement.

reflect psychological-threshold wage increases, which are less significant in industry-level agreements.

### B. Negotiated Wage Increases over Time

We also test the cyclical and the degree of indexation of wage changes. For that purpose, we compute the average wage change (when wages are actually negotiated) for each year over the period 1994 to 2001 at the firm level and each year over the period 1999 to 2006 at the industry level. Then we regress these two variables separately on inflation, past inflation, unemployment rate, minimum wage changes, and aggregate wage growth.

At the industry level, the NMW has a significant positive effect (the corresponding elasticity is close to 0.2). In several industries, negotiated increases correspond exactly to raises in the minimum-wage level, and a catch-up phenomenon is observed in several collective agreements.<sup>25</sup> Increases in the highest parts of the pay scales are lower. Since minimum wage increases are indexed to past inflation, industry-level wage increases appear to be correlated with other wages and past inflation (see columns 2 and 3 in table 9A). We also find some cyclical pattern in average wage changes since the unemployment rate has a negative significant effect.

At the firm level, we find that inflation and lagged inflation have a significant positive impact on wage changes; the degree of indexation is close to 0.55. For wage increases

<sup>25</sup> For example, in the Soil, Products and Fertilizer or Fast Food industries, which negotiated regularly between 2003 and 2005, the lower part of the wage scale is equal to the minimum wage level, and the negotiated increase at this lower part is equal to the rise in the minimum wage level.

TABLE 9.—DETERMINANTS OF THE ANNUAL AVERAGE WAGE INCREASE

A. Negotiated in Firm-Level Wage Agreements, 1994–2001				
	General wage change	Wage Changes by Occupation		
		Blue-Collar Workers	White-Collar Workers	Managers
Inflation ( $t$ )	0.369** (0.061)	0.317** (0.108)	0.250** (0.096)	0.211* (0.102)
Inflation ( $t - 1$ )	0.176** (0.056)	0.274** (0.100)	0.283** (0.089)	0.166 (0.093)
Intercept	0.829** (0.091)	0.998** (0.161)	0.929** (0.143)	1.227** (0.151)
B. Negotiated in Industry-Level Wage Agreements, 1999–2006				
	(1)	(2)	(3)	
Inflation	-	0.707 (0.450)	-	
Unemployment rate	-0.507** (0.145)	-0.200 (0.321)	-0.371 (0.188)	
Minimum wage Increase	0.218** (0.058)	-	-	
Aggregate wage increase	-	-	0.846** (0.302)	
Intercept	6.125** (1.294)	3.098 (3.346)	3.788 (1.945)	

Average wage increases at the firm level are computed using the wage increase (in percentage) specified in firm-level agreements. In some agreements, wage increases could be different across occupations. The endogenous variable is the average of wage increases negotiated in firm-level agreements calculated year by year. We use OLS regressions. Significant at \*10% and \*\*5% (otherwise, statistically nonsignificant). Standard errors are in parentheses.

Average wage increases at the industry level (in percent) are calculated using the wage grid modified by the new wage agreement. Those average wage increases are extracted from the reports of the Ministry of Labor ("Rapports annuels sur la négociation"), they are available for the period 1999 to 2006. Negotiated wage increases are divided by the number of years since the last date of effect of the agreement. The endogenous variable is the average of wage increases negotiated in industry-level agreements calculated year by year. We use OLS regressions. Significant at \*10% and \*\*5% (otherwise statistically nonsignificant). Standard errors are in parentheses.

negotiated by occupation, the degree of indexation is higher for blue-collar workers (close to 0.6) and white-collar workers (0.53) than for managers (0.37) (see table 9B). However, unemployment, the NMW, or other wages have no significant effect.

### C. Some Determinants of Wage Increases

We now estimate a simple model of downward nominal wage rigidity to identify the main determinants of negotiated increases at the firm and industry levels. For that purpose, we use a Tobit 1 model. The dependent variable  $\Delta w_{it}$  is the negotiated wage increase stipulated by the firm- or the industry-level agreement. By definition, it is equal to 0 if there is no wage agreement or if the negotiated wage increase is equal to 0 (as in many agreements dealing simultaneously with wages and working time reduction). We assume that the wage increase  $\Delta w_{it}$  in year  $t$ , in the firm or industry  $i$ , is generated by the following latent variable:

$$\Delta w_{it}^* = \beta x_{it} + u_i + \varepsilon_{it},$$

where  $x_{it}$  is a vector of covariates that includes (a) for industry  $i$ , the elapsed duration since the last agreement, the proportion of days paid the NMW in this industry, the proportion of firms with fewer than 50 workers in this industry, a dummy for services versus manufacturing sector; (b) for a firm  $i$ , it includes the annual growth of profitability per worker, the annual variation in the local unemployment rate at the *département* level, the proportion of days paid the NMW in the industry and in the *département* where the firm

is located, dummy variables indicating if an industry-level agreement has been signed the same year, the year before, and so on and the size of the firm.  $\beta$  is a vector of parameters associated with  $x_{it}$ ,  $u_i$  is a random effect specific to firm or industry  $i$  (normally distributed with mean 0 and variance  $\sigma_u^2$ ), and  $\varepsilon_{it}$  is normally distributed with mean 0 and variance  $\sigma_\varepsilon^2$ .  $\rho$  is the correlation coefficient between  $u_i$  and  $\varepsilon_{it}$ . The model is

$$\Delta w_{it} = \Delta w_{it}^* \text{ if } \Delta w_{it}^* > 0,$$

$$\Delta w_{it} = 0 \text{ if } \Delta w_{it}^* \leq 0.^{26}$$

Table 4 reports the estimation results for industry-level agreements. First, we find that the duration since the last agreement has a large positive effect on the wage change, which may capture a catching-up effect. Contrary to estimates obtained for the probit model, we here obtain that the proportion of small firms in the industry has a clear significant positive effect on the negotiated pay raise. Moreover, the larger the proportion of days compensated close to the minimum wage level, the higher the increase negotiated in the industry. These last two observations reinforce our previous findings. Industry-level agreements deal mostly with low wages close to the minimum wage. Most of the low-paid workers are in small firms, and small firms are particularly concerned with industry-level negotiations because they are less costly than firm-level agreements. As a result,

<sup>26</sup> We assume here that there is no measurement error as we observe the average wage increase stipulated by the agreement.

NMW increases have an impact on wage increases at the industry level and could create a significant indexation mechanism (Gray, 1978). However, the largest quantitative effects are associated with the duration since the last agreement and with an industry dummy.

Table 5 reports the estimation results for firm-level agreements. A significant determinant of wage increases is the firm's performance, but its impact is quite weak (see Manning, 2010, for a survey). However, our findings are consistent with those obtained by Biscourp, Fourcade, and Dessy (2005), who estimate a similar model using data on actual wages. Moreover, we find that a larger variance of the firm profitability over time has a negative effect on wage increases. The variation of the local unemployment rate has an unexpected positive significant effect, but this effect is negative during the period 1994 to 1997. The proportion of working days paid close to the NMW has a significant negative impact on wage changes. The size of the firm has a positive effect on the negotiated wage increase, and its effect is large. Contrary to industry-level agreements, firm-level agreements are more likely to cover high-wage workers and large firms. A previous industry-level wage agreement has a positive impact on the firm-level wage increases. Since there is a hierarchy between the different levels of wage bargaining, a firm-level wage increase adds to the already negotiated industry-level wage increase. The largest quantitative effects on wage changes are associated with the size of the firm and with industry dummies (which are not reported in the table but included in the control covariates).

## VI. Conclusion

Using unique data sets on wage agreements at both firm and industry levels in France, we document some stylized facts on wage rigidity. We also assess the empirical validity of usual wage rigidity models. We finally examine to what extent the French institutional wage setting framework has an impact on the degree of wage rigidity.

Our main results are the following. First, 10% of wages are modified by a wage agreement each month, and the average duration between two wage changes is around 10 months. The distribution of durations between two wage decisions shows a large peak at 12 months, whereas the distribution of effective wage changes exhibits two peaks at 3 and 6 months. Except at 6, 12, and 24 months, the hazard rate is rather flat. A simple Calvo (1983) model cannot replicate such distributions of wage durations. We need to assume some heterogeneity in wage-setting models across firms. The peak at 12 months supports the existence of fixed-duration wage contracts à la Taylor (1980), whereas the flatness of the hazard rate is consistent with the predictions of a model à la Calvo (1983). Moreover, we find some evidence in favor of the predetermination of wage setting: 44% of firm-level agreements and 18% of industry-level agreements contain more than one wage increase. This find-

ing is consistent with predictions set forth by Fischer (1977). However, these predetermined wage changes take effect mostly during the year following the signature of the agreement, which makes the impact of predetermination on macrodynamics rather limited. Third, the wage change decisions are staggered over the year: industries bargain on wages between October and January, and firms negotiate during the first months of the year, which implies a rather flat frequency of wage change agreements over the year. Effective wage changes are more synchronized in January and July and, to a lesser extent, in April and October. Finally, the distributions of negotiated wage increases depend on the inflation rate for firms and on the aggregate wage and NMW increases for industries, which might indicate the existence of indexation mechanisms.

Wage-setting institutions have a significant impact on wage rigidity. There are complex interactions between the different levels of the bargaining process. It appears that the industry-level agreements are more likely to be binding for low-paid workers and for small firms. The firm-level agreements more frequently cover larger firms and high-wage workers. The NMW plays a significant role in explaining the occurrence of a wage agreement. Its impact is negative on firm-level agreements and positive on industry-level agreements. The NMW has also a significant effect on the timing of the wage agreements and the frequency of wage changes.

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