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What Type of Contracts Underlie Aggregate Wage Dynamics?*

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Abstract

This paper shows that it is possible to estimate the importance of different types of wage contracts at the aggregate level using the same data used to estimate standard Phillips curves. It finds that the behavior of the Chilean private aggregate wage during the 1980s is well described by two-year contracts that are revised every six months according to 100 percent of past inflation. The estimates also show that the unemployment rate was a strong determinant of the contract's target real wage and that most wage negotiations were carried through during the first half of every year. The results prove robust to a variety of tests and fit the data better than standard Phillips curves.

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Contents

SUMMARY

Two decades after the rational expectations revolution, the Phillips curve continues to be a main pillar of applied research. In contrast, the theoretical macroeconomic models that emphasize the role played by nominal wages have shifted toward structural specifications that consider explicit wage contracts. This approach allows for the separation of the dynamics coming from contract rigidities and from the formation of expectations and offers a promising formula to resolve the instabilities shown by empirical Phillips curves.

This paper estimates and tests econometrically a model for Chilean aggregate wages that considers explicitly the aggregate implications of alternative types of wage contracts. Methodologically, the main contribution of the analysis is to show that it is possible to gauge the importance of different types of wage contracts using the same data regularly used to estimate Phillips curves. Furthermore, the paper shows that the same data contain information on several other parameters that are important for characterizing aggregate wage behavior.

Empirically, the main finding of this paper is that the behavior of the Chilean private aggregate wage during the 1980s is well described by two year contracts that are revised every six months according to 100 percent of past inflation, as suggested by the data on collective wage bargaining. The estimates also show that the unemployment rate was a strong determinant of the contract's target real wage, that the minimum wage had a small effect on the aggregate wage, that most wage negotiations were carried through during the first half of every year, and that there was a transitory increase in private wages during the last quarter of every year. The results prove robust to a variety of tests and fit the data better than standard Phillips curves.

I. Introduction

Two decades after the rational expectations revolution, the Phillips curve continues to be a main pillar of applied research. Macroeconometric models, comparative studies of the macroeconomic performance of different countries, evaluations of the cost of disinflation, and other related applications, regularly make use of regressions of aggregate wage changes on lagged inflation, unemployment, and some other variables.[1] Although now the techniques are more sophisticated, and analysts are more careful at interpreting the results they obtain, the basic approach used to model aggregate wage behavior has not changed significantly. The persistence of the Phillips curve, however, should not be taken as a measure of empirical success: it is well known that the estimated equations have been quite unstable across time and countries.

In contrast with the continued practice of estimating Phillips curves in applied research, the theoretical macroeconomic models that emphasize the role played by nominal wages have shifted toward structural specifications that consider explicit wage contracts. This approach was first developed by Fischer (1977) and Taylor (1979, 1980), who showed that monetary policy can affect real output in spite of rational expectations, and that the staggering of contracts can make that impact long lasting. Subsequently, this concept has been used in the study of disinflation policies, exchange rate management, and several other issues where nominal wage behavior is thought to be important. The edge of this approach is that it allows for the separation of the dynamics coming from contract rigidities and those from the formation of expectations (in other words, it deals with the well known Lucas critique; Lucas (1976)). For this same reason, this approach offers a promising formula to resolve the instabilities shown by the empirical Phillips curves.

This paper estimates and tests econometrically a model for Chilean aggregate wages that considers explicitly the aggregate implications of alternative type of wage contracts. Methodologically, the main contribution of the analysis is to show that it is theoretically and empirically possible to gauge the importance of different types of wage contracts using the same data regularly used in the estimation of Phillips curves. Furthermore, the paper shows that the same data contains information on several other parameters that are important in characterizing aggregate wage behavior. These include the elasticity of the contracts' target real wage with respect to the rate of unemployment, the direct effect of minimum wages on the aggregate wage, the distribution of wage negotiations during the year, and other seasonal effects.

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[1]To illustrate the pervasiveness of the traditional approach, it should suffice to note that most of the applied macroeconomic models considered in a recent project, which included "a majority of the world's leading specialists in empirical macroeconomics," have a wage equation which is "very much a Phillips–curve relationship" (see Bryant and others, 1988, pp. 5, and the comments by Blanchard in that same reference, pp. 218).

Empirically, the main finding of this paper is that the behavior of the Chilean private aggregate wage during the 1980s is well described by two–year contracts that are revised every six months according to 100 percent of past inflation, as suggested by the data on collective wage bargaining. The estimates also show that the unemployment rate was a strong determinant of the contract's target real wage, that the minimum wage had a small effect on the aggregate wage, that most wage negotiations were carried through during the first half of every year, and that there was a transitory increase in private wages during the last quarter of every year. The results prove robust to a variety of tests and fit the data better than standard Phillips curves.

The essence of the methodology used here to obtain these estimates is simple. First, the paper specifies a set of plausible type of contracts, including both indexed and nonindexed contracts, and allows for different lengths and indexation periods. Then, the paper applies standard econometric techniques on aggregate data on wages, prices, unemployment, and other variables to estimate the relative importance of the different contracts. The inference is possible because different types of contracts have different implications on the dynamics of the aggregate wage and its relationship with other variables.

A formal econometric estimation of a wage contracting model on the basis of aggregate data was attempted previously by Benabou and Bismut (1988), for the United States economy. However, their approach differs from the one followed in this paper in some important aspects. Instead of studying a small set of plausible contract types as done here, they consider an infinite number of contract types characterized by contract lengths which are distributed according to a rational distributed lag function. This may seem to be an attractive approach at first sight, but in order to make it operational they need to assume uniform staggering, and to constrain the empirical analysis to lag polynomials of low order. The former is too restrictive in practice, while the latter implies that they end up imposing, rather than estimating, a smooth decay for the length of the contracts lasting more than three quarters. The approach followed in this paper does not need these assumptions. Another difference is that Benabou and Bismut (1988) do not allow for indexed contracts.[2]

The remainder of this paper is organized as follows. Section II presents data on Chilean collective wage bargaining contracts that provides some useful background for the analysis. Section III presents a model that shows the consequences of different type of contracts on aggregate wage dynamics, allowing for different lengths and indexation periods. Section IV proposes a basic set of contracts for the Chilean case, and derives, accordingly, a model for empirical estimation that allows for a nonuniform distribution of wage negotiations.

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[2]Furthermore, their analysis assumes that the average inflation, unemployment and productivity implicitly expected in a given contract is independent of the contract's length. That assumption, which eliminates one of the sources of identification of the different types of underlying contracts, is not necessary in this paper.

Section V estimates the model and discusses the results. Section VI examines the consequences of relaxing the maintained hypotheses, and compares the fit of to the model to that of the standard Phillips curve approach. Section VII summarizes the conclusions.

II. Data on Collective Wage Contracts

One way to gain understanding on how aggregate wages are determined is to look at the form of wage contracts in those sector for which this information is available. This section presents some data on collective wage bargaining provided by Chile's Ministry of Labor. It also presents a series of initial wage increases for the period 1979–89 provided by the consulting firm Deloitte, Haskins & Sells, based on their private sample of collective wage bargaining.

Before examining this information, it is important to note that collective wage contracts in Chile last almost universally for two–years.[3] This phenomenon is probably explained by the existence of a law that constrains the contracts to be planned for at least two years. It should be noted, however, that there is a legal way to anticipate negotiations after contracts have been signed—if both parties want to do so—that is rarely used.

Table 1 summarizes the other main characteristics of the collective contracts signed during the first quarter of 1990, revealing the importance of CPI–indexation clauses. It appears that during that period, up to 88 percent of the new contracts contemplated future wage increases tied to the evolution of that index, while only 5 percent of the contracts included fixed percentage increases or no increases at all.[4] Furthermore, the average indexation degree stipulated by the indexed contracts was equal to 100 percent of accumulated inflation, and only 5 percent of them included a small wage increase above this rule.

Also, Table 1 shows that the indexation period—the period between two successive wage increases—averaged six months. This number reflects the widespread prevalence of six–month indexation rules. The distribution of indexation periods across the contracts was

[3]Although there are no formal statistics at this respect, officers at the Ministry of Labor who work with the basic data found it hard to think of exceptions to this rule when I asked for information on contract lengths.

[4]It is not clear how to classify the remaining 7 percent of contracts, as they contemplate lump sum increases, indexation to the exchange rate, indexation to the CPI but in complicated ways, and other special formulas.

Table 1. Chile: Characteristics of New Collective Wage Contracts, 1990:1

Type of Contract	Number of Contracts	Number of Workers	Indexation 1/ Degree (Percent)	Indexation 1/ Period (Months)	Fixed Increase 1/ Degree (Percent)	Fixed Increase 1/ Period (Months)
Indexed to CPI only	314	31,781	100	6	0	0
Indexed to CPI plus a fixed percentage increase	17	3,170	100	6	3	11
Fixed percentage increase	5	226	0	...	12	8
Other type of increase	28	737	0	...	0	...
No increase at all	14	557	0	...	0	...
TOTAL	378	36,471	95.6	...	0.3	...

Source: Ministry of Labor.

1/ Weighted averages using the number of workers as weights.

the following: 8 percent for one– to three–month indexation, 67 percent for four– to six–month indexation, 3 percent for seven– to nine–month indexation, 11 percent for ten– or more months indexation, 7 percent for other kind of increases, and 4 percent for no increases[5].

An important variable not shown in Table 1 is the initial increase in the renegotiated wages. In Chile, this is customarily measured in real terms, as the difference between the increase in the nominal wage at the time of signing the contract and the inflation accumulated since the previous wage increase. The average initial increase granted during the first quarter of 1990 was 5.1 percent. This was the result of aggregating a relatively spread distribution of initial wage increases across sectors: 7.7 percent in Agriculture, 0.5 percent in Mining, 4.1 percent in Industry, 3.5 percent in Public Utility Services, 0 percent in Construction, 3.8 percent in Commerce, 2.5 percent in Transport, 7.3 percent in Financial Services, and 7.1 percent in Other Services.

The evolution of the average new contracts signed between 1979 and 1989 is summarized in Table 2. The data show three main facts. First, the degree of indexation was very high during the period. The contracts always stipulated more than 80 percent compensation for cost of living increases an average, even during the years of most severe unemployment. Second, the initial wage increases and the degree of indexation were procyclical. The figures in the table can be compared with the jump in the open unemployment rate from 10.6 percent in 1980–81 to 19.6 percent in 1982, and the gradual fall in the following years to a 6.3 percent in 1989.[6] Third, although there was a slight trend towards faster cost of living revisions, the indexation period was always around 6 and 7 months, at least during the period for which data are available.

These data suggest that Chilean wages were highly indexed during the 1980s, but it is important to note that the number of workers involved in collective wage bargaining was only about 7 percent of the total labor force between 1979 and 1989. Therefore, one must be careful not to extrapolate directly from this data to the aggregate. For example, it may be that in reality a large fraction of total wages behave as determined by nonindexed contracts that last for a shorter period. The following sections address this issue.

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[5]The same distribution weighted by the number of workers instead of the number of contracts is 10 percent, 76 percent, 3 percent, 7 percent, 2 percent, and 2 percent, respectively.

[6]These figures underestimate the severity of the unemployment problem during those years, since they exclude the Special Employment Programs that where created for the unemployed during the recession. The source is the National Institute of Statistics

Table 2. Chile: Average New Collective Wage Contracts, 1979–89 1/

Year	Initial Increase (percent) (1)	Degree of Indexation Source A (percent) (2)	Degree of Indexation Source B (percent) (3)	Period of Indexation (months) (4)	Number of Contracts (5)	Number of Workers (6)
1979	11.3	103	...	...	1405	113108
1980	5.9	101	...	...	1824	152525
1981	3.5	102	...	...	1760	182884
1982	0.0	90	...	...	932	81596
1983	0.0	82	86	7.0	1407	142839
1984	0.0	84	90	7.3	1681	146324
1985	0.0	87	93	7.3	1681	146324
1986	1.6	94	98	7.0	1179	115820
1987	2.2	99	100	6.3	1684	153743
1988	3.4	100	100	6.5	1405	128513
1989	5.4	101	...	6.0	2334	221639

Sources: Deloitte, Haskins & Sells, Ministry of Labor.

Note: (1) Deloitte, Haskins & Sells, sample of 80 large and mid–size firms with a total of 57,600 workers; (2), (3) and (4) Ministry of Labor. Source A refers to their yearly figures and source B corresponds to the aggregation of their quarterly figures. The indexation period corresponds to the quarterly data set for 1983-88 and to the yearly data set for 1989.

1/ Weighted averages using the number of workers as weights.

III. Aggregate Wage Dynamics and Contracts

Different wage contract structures imply different wage dynamics. Thus, a way to discriminate between different types of contracts that may underlie the aggregate data is to examine the time series behavior of aggregate wages and the series that determine its evolution. This section presents a model of staggered wage contracts in the Fischer–Taylor tradition which is useful to make this idea operational. The analysis extends the indexed contracts model presented in Jadresic (1991), to allow for different indexation periodicity.

Consider a group of wage contracts type [N,n] that last for N periods and that contemplate cost of living adjustments according to 100 percent of past inflation every n periods. Although this is a very simple setup, it is more flexible than what it may seem at first. Nonindexed contracts can be defined as contracts in where the indexation period is equal to the contract's length (n=N). Furthermore, wages under contracts with partial degrees of indexation can be written as linear combinations of wages under indexed and nonindexed contracts with the same length.

Suppose that these contracts are renegotiated in a uniformly staggered fashion (this assumption is dropped in the empirical analysis). Suppose also that N/n is an integer, in accordance to what is seen in actual contracts. Then, brief reasoning implies that in every period 1/N of the wages are renegotiated, 1/n-1/N are adjusted according to the indexation clause, and 1-1/n are kept unchanged. If the indexation clauses are defined in terms of the inflation accumulated since the last wage increase, as it is typically the case, then the average wage increase for contracts type [N,n] in period t is given by

$$\mathbf{w}_t[N,n] = (1/n-1/N) \sum_{s=1}^{n-1} \pi_{t-s} + (1/N)x_t[N,n], \tag{1}$$

where π_t is the inflation rate in period t, and $x_t[N,n]$ the initial nominal increase of the wages type [N,n] renegotiated at time t (hereafter all variables are measured in log terms; capital letters represent levels and small case letters represent first differences).

To derive aggregate wage behavior, x_t is modeled here as the outcome of a maximization over the expected value of a quadratic function of the contract's average real wage and some other variables, exogenous to the negotiators. This may be, for example, the result of a bargaining problem in which firms preserve their right to manage, or where wages are set according to efficiency wage considerations. The precise definition of the exogenous variables that enter in the objective function is of no interest for the analysis in this section. The assumption that the maximand is quadratic in the real wage is helpful in introducing expectations linearly; it can be seen as a second order approximation to the true objective function. Assuming that it is the average real wage that matters permits avoidance of the complications of discounting.

This setup implies that the initial wage increase is set to equalize the contract's expected average real wage to a target average real wage. The latter depends on the agent's expectations on the exogenous variables that enter their objective function. If the new contracts are negotiated given the information on events occurred until time t-1, this can be written as

$$\mathbf{x}_t[N,n] \text{ is such that } E_{t-1}\Omega_t[N,n] = E_{t-1}\Omega_t^*[N,n], \tag{2}$$

where $E_{t-1}\,\Omega_t\,[N,n]$ is the expected average real wage for a contract type [N,n], and $E_{t-1}\,\Omega_t^*\,[N,n]$ is the target real wage for the same contract.[7]

Given [N,n], equation (2) implies an expression for x_t that can be replaced in equation (1). Using some simple but tedious algebra (see Jadresic (1991) for the case in which n=1), the following aggregate wage equation is obtained

$$w_t[N,n] = (1/n)\sum_{s=1}^{n} \pi_{t-s} + (1/N)(1-L^N)E_{t-1}\left(\Omega_t^*[N,n] + \sum_{s=0}^{N-1} \phi_n(s)\pi_{t+s}/N\right). \tag{3}$$

where $\{\phi_n(s)\}_{s=0}^{\infty} = \{n-1 \ldots 1 \;\; n \;\; n-1 \ldots 1 \;\; \ldots\}$

The intuition behind this equation should be clear. The first term comes partly from the increase in the wages which are adjusted according to the indexation rule, and partly from a catch–up increase in the wages that are renegotiated. The second term comes only from the initial increase of the renegotiated wages below or above the catch–up term. This tends to be positive if the real wage targeted for [t,t+N-1] is higher than the one targeted for [t-N,t-1], or if the sum of future inflations weighted by $\phi_n(s)$ is expected to be higher than what it was expected N periods before. The weighted sum measures the effect of future inflation on the average real wage during the contract's life, and depends both on N and n.

The crucial point to be noticed is that, if firms' and workers' expectations about inflation and the target real wage are specified, this equation can show how contracts with different lengths and indexation periods imply different aggregate wage dynamics. Provided

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[7] Note that this expression distinguishes between two kind of uncertainties at the time of signing the contract. One is that the negotiators are not sure about the actual average real wage that will result from setting an initial nominal wage (the left hand side). The other one is that they do not know what will happen in their relevant markets, and within the firm, during the contract's lifetime (the right hand side).

the data contains information in the right direction, this result implies that it is possible to recover the contract structure underlying the aggregate data.

To illustrate, consider first a case where inflation is a random walk and Ω_t^* is white noise. Assuming expectations are rational, it follows that expected future inflation will be given by the recently observed inflation rate, and that the target real wage will be constant across periods. Using this assumptions in equation (3) gives

$$w_t[N,n] = (1/n) \sum_{s=1}^{n} \pi_{t-s} + \{(n+1)/2N\}(\pi_{t-1} - \pi_{t-N-1}). \tag{4}$$

Therefore, if there is only one type of contract with parameters N and n, the distribution of coefficients for lagged inflation in an econometric wage equation should be characterized by a large positive coefficient at t-1, a flat region for the coefficients between t-2 and t-n, and a negative coefficient at t-N-1. Furthermore, it should be possible to write this equation as a function of only two terms: the inflation accumulated during the last n periods, and the change in inflation between t-N-1 and t-1. The coefficients for these terms should be 1 and (n+1)/2N, respectively.

Of course, if there is more than one type of contract, the coefficients on lagged inflation appearing in the aggregate wage equation will follow an average of the patterns implied by the different contracts. But if the data contains enough variability, one would still be able to judge the relative importance of the different contracts. All what is needed is the contracts to imply different lag patterns. Equation (4) indicates that in the random–walk example this indeed is the case. In order to see this, take first the contract length as given. As a longer indexation period implies a longer and flatter distribution for the coefficients on lagged inflation through the first term, with larger positive and negative spikes for the coefficients corresponding to inflation at t-1 and t-N-1 through the second term, it is clear that two contracts with similar contract lengths but different indexation periods can be distinguished. Alternatively, take the indexation period as given. As longer contracts imply smaller spikes arising from the second term, and because the negative spike in this distribution will be farther away in the past, it is clear that two contracts with similar indexation periods and different contract lengths can also be distinguished. Of course, in the more general case in which there is a large set of different types of contracts the analysis would be more complicated, but still possible.

As an alternative example, consider a case where inflation is a trend plus white noise, but the targeted red wage Ω_t^* is determined by a random walk. Equation (3) reduces to

$$w_t[N,n] = (1/n) \sum_{s=1}^{n} \pi_{t-s} + (1/N)(\Omega_{t-1}^* - \Omega_{t-N-1}^*). \tag{5}$$

The coefficients for the lags on inflation define now a rectangular box of length n and area equal to one. The length of this box permits to distinguish among contracts that have different indexation periods, but not among those which have different contract lengths. The additional information that is needed, however, is provided by the coefficients of the variables that determine the target real wage. A contract with length N must imply a positive spike for the coefficients corresponding to t-1 and a negative spike for the coefficients corresponding to t-N-1.

These examples show the implications of only two special assumptions about the stochastic processes driving the inflation rate and the target real wage. But it should be clear that the analysis carries over more complicated setups. The crucial point is that the lag structure of the aggregate wage equation provides information about the underlying length and indexation periodicity of the wage contracts. In developing a model to examine wage determination in Chile, the next Section shows that another source of identification of the contracts underlying aggregate wage dynamics is provided by the seasonal properties of the data.

IV. A Contracting Model for Chilean Wages

It would be hopeless to try to estimate with aggregate data the precise importance of a large set of underlying kind of contracts. One approach to reduce the dimensionality of the problem is to approximate the distribution of contract types by a mathematical function of a small number of parameters, as in Benabou and Bismut (1988). A more intuitive approach is to examine the relative importance of a small number of typical contracts, representative of different stylized views on how the labor market may work. This has the advantage of allowing for comparisons among sharply different contracts—and it always exist the possibility of exploring, ex post, the importance of contracts that have not been considered initially. Furthermore, the analysis in this section shows that it is easy to relax the assumption of uniform staggering when this approach is followed. This is important for realism, and also because it provides an additional source of information on the contracts underlying aggregate data.

Following this strategy, this section proposes a tentative model for Chilean wages that considers four basic types of contracts. These are chosen to represent the views (1) that wages are determined by long term–indexed contracts, (2) that wages are flexible, (3) that wages are determined by the legal minimum wage, and that (4) wages come from medium–term nonindexed contracts. After estimating this model in the next section, the consequences of allowing for a variety of other types of contracts are explored in Section VI.

The first contract type, representative of the view that wages come from long–term indexed contracts, is suggested by the data presented in Section II. That information indicates that a natural contract to look at is one that lasts for two years and considers 100 percent cost of living adjustments every six months. If for practical purposes the basic period is defined as one quarter, this can be approximated as a contract type [8,2].[8] What is the form of the implied wage equation?

In the unlikely case that staggering were uniform, it would be enough to replace N=8 and n=2 in equation (3). In practice, however, it is important to allow for an asymmetric distribution of wage negotiations during each year. Denoting by θ_i the fraction of yearly negotiations carried through in quarters i=1...4, it is easy to show that, if N=8 and n=2, equation (3) is modified to

$$\mathbf{w}_t[8,2] = (\theta_i + \theta_{i+2}) \sum_{s=1}^{2} \pi_{t-s} + (\theta_i/2)(1-L^8)E_{t-1}\left(\Omega_t^*[8,2] + \sum_{s=0}^{7} \phi_2(s)\pi_{t+s}/8 \right) \qquad (6)$$

where i corresponds to the quarter of the year associated to t, $\Sigma\theta_i=1$, and$\theta_{i+2}=\theta_{i-2}$ if i is larger than two (by an assumption of symmetry across years). $\phi_2(s)$ corresponds to the sequence {2 1 2 1...}.

This equation is the same as the one implied by equation (3), except that the lagged–inflation and initial–increase terms are weighted by coefficients that vary across the different quarters of the year. These new weights stem from the fact that, with N=8 and n=2, the fraction of wages renegotiated in a given quarter is $\theta_i/2$, and the fraction of wages that are increased according to the indexation rule is $\theta_i/2+\theta_{i+2}$. Thus, the lagged inflation term is weighted by the $\theta_i+\theta_{i+2}$ wages that are either increased according to the indexation rule or renegotiated. Similarly, the initial increase term is weighted by the $\theta_i/2$ wages that are renegotiated. Of course, these weights are equivalent to the ones implied by equation (3) when $\theta_i=1/4$.

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[8]This is an approximation, since the actual aggregate wage at the end of quarter may include, in part, adjustments according to inflation occurred during the same quarter. For example, if the monthly inflation rate and the distribution of wage negotiations are constants within every quarter, then the end–of–quarter increase in the aggregate wage due to the six month lagged indexation rule turns to be equal to $(2\pi_{t-2}+3\pi_{t-1}+\pi_t)/6$. This approximation seems reasonable because only a small part of the relevant inflation rate is affected, and because inflation rates are serially correlated. Moreover, in the Chilean case, a large devaluation of the peso implemented in May 1982 provides a natural experiment that illustrates that this can be a good approximation even when large inflationary shocks occur. Indeed, while price inflation reacted immediately after that devaluation, jumping from 0.1 percent to 9.8 percent and 9.5 percent between the second and fourth quarter, wage increases lagged behind, going from -2.0 percent to 0.1 percent and 7.4 percent during the same quarters.

The second type of contracts is representative of the view that wages are flexible, which can be approximated by the assumption that contracts are type [1,1]. As in this case the fraction of wages renegotiated in every period is equal to 1, it follows that

$$\mathbf{w}_t[1,1] = \pi_{t-1} + (1-L)E_{t-1}\left(\Omega_t^*[1,1] + \pi_t\right) \tag{7}$$

The third type of contracts are minimum wage contracts and are characterized by the rule

$$w_t[mw] = mw_t, \tag{8}$$

where mw_t is the legal minimum wage.

Finally, the fourth type of contract is inspired by the fact that until the 1960s, a large fraction of Chilean wages seem to have been nonindexed and negotiated once a year (see Cortázar, 1983). While it seems implausible that during the 1970s this type of contracts had any relevance, both because of the government intervention in the labor market and the 200 percent annual average inflation observed during that decade, it might be that the return to an annual average inflation about 20 percent during the 1980s lead to their revival. To allow for this possibility, I also consider contracts type [4,4]. Assuming that the distribution of wage negotiation during the year for this contracts is similar to the one for contracts type [8,2][9], then

$$w_t[4,4] = \theta_i \sum_{s=0}^{3} \pi_{t-s-1} + \theta_i(1-L^4)E_{t-1}\left(\Omega_t^*[4,4] + \sum_{s=0}^{3} \phi_4(s)\pi_{t+s}/4\right). \tag{9}$$

The basic model estimated below states that the aggregate wage (w_t) is determined by a weighted average of equations (6) to (9), augmented by a set of additive seasonal dummies and an error term. Denoting by $\alpha[N,n]$ the weights associated to each type of contract, and the additive dummies by D_i, the precise form of the estimated aggregate wage equation is

$$w_t = \Sigma\alpha[N,n]w_t[N,n] + \alpha[mw]mw_t + D_i + \varepsilon_t \tag{10}$$

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[9]When this assumption was relaxed in the empirical estimation, the coefficients estimated below for the basic model (Table 3) changed very little. The F–test for equality on the distribution of wage negotiations during the year for contracts [8,2] and [4,4] implied an F–value equal to 0.004. For an F(3,28), this implies that the null hypothesis is accepted at p-values up to 99.96 percent.

Table 3. Chile: Estimates of the Wage Contracts Model

Parameter	The Basic Model Estimate	The Basic Model Standard Error	A Parsimonious Model Estimate	A Parsimonious Model Standard Error
$\alpha[1,1]$	0.08	0.07	...	...
$\alpha[4,4]$	0.05	0.14	...	...
$\alpha[8,2]$	0.85	0.16	1	...
$\alpha[mw]$	0.02	0.03	...	...
η_U	-0.21	0.06	-0.22	0.05
θ_1	0.50	0.16	0.50	0.03
θ_2	0.35	0.11	0.37	0.09
θ_3	0.01	0.15	...	...
θ_4	0.14	0.13	0.13	0.10
D_1	-0.021	0.010	-0.019	0.004
D_2	0.003	0.008	...	...
D_3	-0.000	0.007	...	...
D_4	0.018	0.009	0.019	0.004
dummy	0.26	0.09	0.29	0.07
S.S.R.	0.00672		0.00710	
S.E.R.	0.0147		0.0139	
R^2(adj.)	0.703		0.736	
D.W.	1.76		1.70	

Note: $\alpha[N,n]$ is the weight for contracts that last N quarters and that have an indexation period of n quarters; $\alpha[mw]$ measures the weight of minimum wage contracts ($\Sigma\alpha[N,n]+\alpha[mw]=1$). η_U measures the elasticity of the contracts' target real wage with respect to the expected unemployment rate. θ_i measures the fraction of yearly wage negotiations carried through in quarters i=1..4 for contracts that last one or two years ($\theta_{i+2}=\theta_{i-2}$ and $\Sigma\theta_i=1$). D_i is an additive dummy for quarters i=1...4 ($\Sigma D_i=0$). The dummy measures the elasticity of the aggregate wage with respect to the official wage adjustments announced by the government during the period 1980:1-1982:2 (it must subtracted proportionally to the contract' weights reported in the first three rows for that period).

where the sum is defined over $[N,n] = \{[1,1], [4,4], [8,2]\}$ and ε_t is i.i.d.. By definition, the sum of the α's is one. For nominal homogeneity, it is also required that $\Sigma D_i = 0$.

The additive seasonal dummies are included because, in practice, only part of the seasonal variations of the aggregate wage is associated to a nonuniform distribution of wage negotiations during the year. In particular, as the aggregate wage is calculated as the wage bill divided by total employment, there are reasons to believe that Christmas bonuses tend to rise wage increases during the fourth–quarter of the year, and reduce them during the first–quarter of the year. Not allowing for these kind of effect can significantly bias some of the estimates.[10]

Finally, in the basic model, the target real wage is specified as

$$E_{t-1}\Omega_t^*[N,n] = E_{t-1}\sum_{s=0}^{N-1}(G_{t+s} + \eta_U U_{t+s})/N, \tag{11}$$

which postulates that the negotiators take into account the average unemployment rate (U_t) and full employment productivity (G_t) expected during the life of the contract. The elasticity of the target real wage with respect to the unemployment rate is measured by η_U; its elasticity with respect to the full employment productivity is assumed equal to one. Other specifications are considered below.

V. Estimation and Results

The dependent variable used to estimate equation (10) corresponds to end–of–quarter increases of an aggregate index of Chilean private wages. The series was calculated excluding from the aggregate wage index (provided by the National Institute of Statistics) its public sector component. This correction is important since public sector wages represent 21.6 percent of the current aggregate index, and about 48 percent of the aggregate index calculated until December 1982. The corrected series is more appropriate than the aggregate series for our purposes, and provides a broader measure than the industrial wage index that has been often used in the estimation of Phillips curves in Chile. Farm sector and small firm wages, however, are still not represented in the aggregate data.[11]

The sample period considered in the estimates goes from 1980:1 to 1990:2. This includes all the recent information available at the time of writing this paper, but excludes data available for the second half of the seventies for two reasons. First, Cortázar (1983) has

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[10] I owe this observation, which turned to be important for the estimation of the distribution of wage negotiations during the year, to Jeffrey Sachs.

[11] The appendix precise the definitions and sources of the other variables used in this paper. The data is available from the author upon request.

shown that government wage policies were the main short–run determinant of nominal wages between 1974 and mid–1979 (it is also likely that a similar situation occurred between 1971 and 1973) and it is not the intention of this paper to revisit this issue. Second, even the wages not affected by those policies must have behaved very differently during that period because the macroeconomic environment was substantially different. It should suffice to note that the average inflation rate was 199 percent a year during the 1970s, against 21 percent during the 1980s. It was only in 1978 that quarterly inflation rates fell below the one digit level.[12]

A special multiplicative dummy is included to measure the effect of the official wage adjustments announced by the government during the period 1980:1 to 1982:2. Although in mid–1979 collective wage bargaining was permitted to start again. until mid–1982 an important fraction of wages was still being affected by those announcements. One alternative was to eliminate part of the sample, but knowing the size of this effect is of interest in itself. Moreover, it did not seem sensible to eliminate the information provided by a period where wages, inflation and unemployment fluctuated dramatically.

Finally, the expected variables that appear in the model are proxied with the forecasts of univariate time series regressions of the actual variables. The forecasting equations were estimated using data for 1978:1 to 1990:2, but to compute the forecasts only the variables known at the forecasting date were used. Since most of the expectations appearing in the model refer to variables realized several periods later, it was necessary to perform a large number of dynamic simulations. The forecasting equations that were used in this procedure included eight lags of the dependent variable, three seasonal dummies, and a constant.

It should be noted that the use of proxies for the expected variables gives consistent estimates for the parameters of the model, but implies biased estimates for their standard errors. In the more likely case that the sign of the bias is negative, as in the examples provided by Murphy and Topel (1985), the consequence is that the standard errors tend to be underestimated. For the present analysis, this has mixed implications. On one hand, it suggests that the significance of the estimates reported below may be exaggerated. On the other hand, it also suggests that the mispecification tests conducted in the next section may be more strict than what is intended. In what follows, it is assumed that the size of the bias does not affect the results significantly.

The estimates of the basic model are reported in the left hand columns of Table 3. Nonlinear least squares were used to obtain these and all the other estimates of this paper. The fit of the model and the correlation of the residuals are quite satisfactory. All the estimated parameters have the right sign, and several of them are very significant.

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[12]The reader interested on the determination of nominal wages in Chile during the 1960s and 1970s can consult Cortázar's (1983) M.I.T. doctoral dissertation. He forcefully argues that one must distinguish several periods in the study of the determination of nominal wages, given the important institutional changes that occurred in those two decades.

The main result is that Chilean aggregate wages behave as coming mostly from the long term–indexed contracts, of the kind suggested by the collective bargaining data. While the weight estimated for those contracts is 0.85, with an estimated standard error of 0.16, the weights that are obtained for the other type of contracts are all small, both in an economic and statistical sense. Moreover, an exhaustive search showed that, to maximize adjusted R^2, the best parsimonious model is one that only considers the long term–indexed contract. The results for that particular model are presented in the right hand columns of Table 3.

It should be noted that the weights for contracts [1,1] and [4,4] are statistically insignificant not because their standard errors are estimated to be particularly large, but because their weights in the estimated equation are small. Thus this result simply indicates that these type of contracts explain a small proportion of the aggregate wage.

The weight obtained for minimum wage contracts may seem small at first, but it should be noted that it measures the importance of the minimum wage in the aggregate wage bill. Thus, the estimated weight is consistent with a larger fraction of workers being affected by the minimum wage legislation. For example, if that fraction is about 10 percent of the workers, and the minimum wage is about 1/3 of the average wage, then one would expect to find a weight for the minimum wage of about 0.03 in the aggregate wage equation. This order of magnitude is consistent with the estimate indicated by the model.

As unemployment in Chile fluctuated dramatically during this period, the estimate for η_U is of particular interest. Not only does it have a negative sign, as expected, but is also significant in statistical and economic terms. According to the estimate, a 10 percent increase in the expected unemployment rate reduces the target real wage by 2 percent, or equivalently, doubling the expected unemployment rate reduces the target real wage by 14 percent. To compare, it can be noted that after the unemployment rate jumped in Chile from 11 percent to 20 percent between 1981 and 1982, the aggregate real wage fell 15 percent in the following three years. (These unemployment figures refer to open unemployment; i.e., workers in special government programs for the unemployed are counted as employed).

The estimates also indicate that about half of the wage negotiations occur during the first quarter of the year, and about 35 percent during the second quarter. This distribution is skewed, but quite plausible. March in Chile is like September in many countries of the northern hemisphere: business, schools, and many other activities usually start in those months, following the January and February summer months. To be sure, a distribution of wage negotiations of this kind has been suspected by previous observers. In his analysis of wage formation in Chile during the 1960s, Cortázar (1983, p. 90) argued that "we cannot prove beyond all doubt that the percentage of remunerations which are renegotiated in the first half of the year is higher than in the second half", but "in <u>all</u> the years considered the industrial component of the INE's Wages and Salaries Index goes up more in the first six months of the year than in the second six months" (underlined in the original). This observation plays a main role in his criticism of previous studies of wage formation in Chile.

The seasonal dummies imply that, ceteris paribus, aggregate wages increase during the fourth quarter of the year by 2 percent, and fall during the next quarter by the same amount. This is consistent with the above observation that Christmas bonuses affect the measured aggregate wage.

Finally, the multiplicative dummy variable is also significant and correctly signed. By the way it was constructed, it can be directly interpreted as the elasticity of the aggregate private wage with respect to the official wage adjustments announced by the government during the period 1980:1 to 1982:2. Therefore, it says that about 26 percent of the aggregate private wage index moved during that period according to those adjustments; this effect adds up to 28 percent if one takes into account that the minimum wage was also revised according to those adjustment.

VI. Tests of the Basic Model

The results obtained in the estimation of the basic model seem quite satisfactory. Nonetheless, besides checking the sign and significance of the parameters, no formal tests have been performed so far. This section analyzes the consequences of including other type of contracts, of modifying the specification of the determinants of the target real wage, and of relaxing the nominal homogeneity restrictions postulated by the model. It also presents the estimates of two standard Phillips curves for wages. They provide a natural yardstick to evaluate the fit of the basic model.

The following discussion concentrates on a selected set of indicators, since it would be too long to report all of the results. It should suffice it to note that the change in the parameters that are not reported was never larger than the size of their estimated standard errors in the basic model, or in the modified model, or in both.

Table 4 examines the effects of including other contract types.[13] When the basic model is expanded to consider short term contracts type [2,2] or [2,1], or a medium–term contract type [4,2], the estimates for their weights appear to be negative and not significantly different from zero. The only type of contract with a length shorter than two years that shows a positive weight when included in the model is of the type [4,1]. But its weight is not statistically significant, and, a priori, the practical importance of this type of contract is

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[13]The wage equations associated to the contracts discussed in this section can be derived straightforwardly by following the reasoning of the previous section. In the case of semiannual contracts these estimates assume that the fraction of contracts negotiated in a given quarter is equal to $\theta_1+\theta_3$ if the quarter is odd and $\theta_2+\theta_4$ if it is even.

Table 4. Chile: Consequences of Including Other Type of Contracts

Type of Contract	Including the additional contract imply the following estimates 1/ Weight for the contract	α [1,1]	α [8,2]	$\Sigma\alpha$ [8,n]
[2,1]	-0.33	0.26	0.98	...
	(0.18)	(0.13)	(0.16)	...
[2,2]	-0.27	0.18	0.99	...
	(0.14)	(0.09)	(0.18)	...
[4,1]	0.21	0.03	0.79	...
	(0.28)	(0.10)	(0.18)	...
[4,2]	-0.03	0.08	0.86	...
	(0.29)	(0.08)	(0.20)	...
[8,1]	0.20	0.04	0.68	0.88
	(0.40)	(0.11)	(0.38)	(0.19)
[8,4]	0.21	0.09	0.69	0.90
	(0.22)	(0.08)	(0.25)	(0.17)
[8,8]	0.09	0.08	0.78	0.87
	(0.15)	(0.08)	(0.21)	(0.16)
If all these contracts are included jointly, the results are:				
1. If any α's are permitted:		0.16	-19.8	0.63
$F=2.26 \sim F[7,24]$		(0.17)	(16.5)	(0.32)
2. If only $0 \leq \alpha\text{'s} \leq 1$ are permitted:		0.05	0.52	0.93
$F=0.66 \sim F[2,29]$		(0.12)	(0.49)	(0.13)

1/ Standard errors appear in brackets.

questionable. The data on collective wage bargaining discussed above shows that, among two–year contracts, half–year indexation clauses largely dominate quarterly indexation clauses. It seems unlikely that shorter contracts would also have shorter indexation periods.

When two–year contracts are included, the weights estimated for contracts [8,2] fall somewhat, but the sum of the weights for two year contracts changes little. Since the standard errors for the weights for contracts [8,2] rise, while the standard errors for the sum of the two–year contracts almost do not change, this is a sign that the data is not sufficient to discriminate precisely among different types of two–year contracts. Note, however, that the coefficients for the [8,2] contracts are still very high, both in absolute terms, and in relation to the other two–year contracts. The above is consistent with the data on collective wage contracts that was presented in section II. The main implication is that the weight estimated for contracts type [8,2] in the basic model might include, to some extent, the weights of other two–year contracts that were omitted in that specification.

To be sure that nothing important is lost by not considering combinations of these additional contract types, two other models were estimated. First, the basic model was expanded to include all the additional contracts simultaneously. Some of the implied estimates violated by large the requirement that the contract weights be between zero and one, preventing any useful interpretation for the results. Their standard errors, however, were extremely large, and the hypothesis that the model of the previous section imposes valid constraints was not rejected at less than 0.07 p–values. Second, the basic model was expanded to include additional contracts only up to the point were the constraints on the weights were satisfied. A search that tried to minimize the sum of squared residuals suggested that such model would incorporate contracts [8,1] and [8,4] in addition to the basic ones. The results, summarized in the bottom row of Table 4, imply that the exclusion of those additional contracts cannot be rejected at less than 0.50 p–values.

Table 5 examines the consequences of alternative specifications for the target real wage. Several possibilities are taken into account: (1) that its elasticity with respect to the expected full employment productivity is different from one; (2) that it is affected by the expected average real wage, through a Keynes', or Taylor's relative wage effect; (3) that it depends on the expected real exchange rate, measured as the real cost of imports; and, (4) that its elasticity with respect to the expected unemployment rate is different in the case of the short term contracts [1,1] than in the case of the medium and long term contracts [4,4] and [8,2].

The results using these modified specifications support the simple assumptions of the basic model, even when using relatively high levels of significance. Note, however, that the size of the standard errors does not permit to discard other alternatives either. Therefore, the most interesting result is that the estimates for the remaining parameters of the model change very little. In particular, it is reassuring that the estimate for the elasticity of the target real wage with respect to the expected unemployment rate remains large and very significant in all the alternative models.

Table 5. Chile: Consequences of Different Specifications for the Target Real Wage

	The modified specification implies the following estimates 1/			
Specification	Elasticity of the target real wage with respect to the additional variable	η_u	α[1,1]	α[8,2]
Allowing η_G to be different from one	0.18 (1.21)	-0.20 (0.06)	0.08 (0.08)	0.87 (0.15)
Including the expected average real wage	-0.15 (0.40)	-0.22 (0.08)	0.07 (0.08)	0.89 (0.14)
Including the expected real exchange rate	0.11 (0.12)	-0.21 (0.06)	0.09 (0.09)	0.92 (0.14)
Allowing for η_U to be different for contracts [1,1]	-0.75 (2.29)	-0.18 (0.08)	0.04 (0.17)	0.91 (0.17)
All the previous 2/	F=0.18 ~F[3,28]	-0.19 (0.08)	0.11 (0.10)	0.89 (0.15)

1/ Standard errors appear in brackets.
2/ Except for the latter, which prevented convergence.

Table 6 summarizes the consequences of relaxing the nominal homogeneity restrictions of the model. Unlike in the previous analysis, the alternative specifications here have no clear interpretation. The first three rows examine the restrictions that the sum of the weights of the different contract types is equal to one, that the sum of the distribution of yearly wage negotiations during the year is equal to one, and, that the sum of the additive seasonal dummies is equal to zero. These restrictions are accepted by the data at high levels of significance, and their right hand sides are all very close to their theoretical values in the unrestricted estimates. The fourth row examines the hypothesis that changes in expected inflation enter in the model with unitary elasticity. Although the unrestricted equation estimates this elasticity to be negative, the large standard error associated to this estimate implies that the null hypothesis is accepted at levels of significance up to 5 percent.

The last test compares the quality of the fit of the contract model to the one of a standard Phillips curve. Table 7 presents estimates for two specifications that where judged to be fair alternatives. The comparison to the results obtained in Table 3 shows that the contracting model performs better on this respect.

VII. Conclusions

The analysis in this paper shows that it is possible to estimate the importance of different types of wage contracts using aggregate data on wages and other variables. There are several sources of identification, all related to the dynamic behavior of the data. They include the lags through which actual and expected inflation rates affect wage increases, the lags through which the changes in the expected unemployment rate affect the same variable, and the seasonal pattern of those impacts.

In applying this principle, this paper found that Chilean aggregate wages during the 1980s were basically determined by long term–indexed contracts. Specifically, it was found that the behavior of the private aggregate wage during this period can be adequately characterized by contracts that last two years and are revised every six months according to 100 percent of past inflation, as the data on collective wage bargaining suggests. The hypotheses that flexible wages, minimum wage constraints, or shorter–term nonindexed contracts underlie the aggregate data, all received little weight on the estimates.

The empirical analysis provided estimates of a number of other parameters that are important to characterize wage formation. The results show that unemployment was a strong determinant of the contract's target real wage during the sample period. A 10 percent increase in the expected unemployment rate reduced the target real wage by 2 percent, according to the estimates. Other results indicate that most wage negotiations were conducted during the first two quarters of the year, and that there is a seasonal effect that tends to increase aggregate wages transitorily during the fourth quarter of the year.

Table 6. Chile: Consequences of Relaxing the Nominal Homogeneity Restrictions

Restriction	Relaxing the restriction implies the following estimates 1/		
	RHS of the restriction unless otherwise indicated	$\alpha[1,1]$	$\alpha[8,2]$
$\Sigma\alpha[N,n]+\alpha[mw] = 1$	0.97 (0.05)	0.08 (0.07)	0.80 (0.17)
$\Sigma\theta_i = 1$	0.95 (0.06)	0.07 (0.07)	0.83 (0.16)
$\Sigma D_i = 0$	-0.005 (0.010)	0.08 (0.07)	0.84 (0.16)
Changes in expected inflation enter with unitary elasticity	The estimate for the elasticity is -1.15 (1.05)	0.16 (0.12)	0.66 (0.16)
All the previous	F=1,87 ~F[4,27]	0.15 (0.10)	0.75 (0.32)

1/ Standard errors appear in brackets.

Table 7. Chile: Two Phillips Wage Equations, 1980:1–1990:2

(Dependent variable: changes in private nominal wages)

Explanatory Variable	Eight Lags Equation		Four Lags Equation	
	Coefficient	Standard error	Coefficient	Standard Error
Constant	0.036	0.040	0.049	0.021
π_{t-1}	0.75	0.14	0.71	0.13
π_{t-2}	0.10	0.15	0.12	0.14
π_{t-3}	0.23	0.15	0.22	0.14
π_{t-4}	-0.08	0.15	0.09	0.12
π_{t-5}	0.26	0.15	...	...
π_{t-6}	-0.05	0.14	...	...
π_{t-7}	-0.02	0.15	...	...
π_{t-8}	-0.07	0.13	...	...
mw_t	0.01	0.04	0.01	0.04
$\sum_{s=1}^{4} U_{t-s}/4$	-0.027	0.017	-0.022	0.009
$\sum_{s=5}^{8} U_{t-s}/4$	0.010	0.033	...	...
$(G_{t-1}-G_{t-5})/4$	0.21	0.85	0.03	0.34
$(G_{t-5}-G_{t-9})/4$	-0.02	0.52	...	...
Dummy Q1	-0.021	0.005	-0.016	0.005
Dummy Q2	0.007	0.005	0.007	0.005
Dummy Q3	-0.003	0.005	-0.007	0.005
Dummy Q4	0.017	0.005	0.016	0.005
Dummy 80:1-82:2	0.19	0.14	0.28	0.11
S.S.R.	0.00629		0.00752	
S.E.R.	0.0162		0.0158	
R^2(adj.)	0.638		0.654	
D.W.	1.73		1.74	

Note: The dummies Q1 to Q4 are additive and sum zero. The dummy for the period 1980:1 to 1982:2 measures the elasticity of the aggregate wage with respect to the official adjustments announced periodically by the government (it must be subtracted proportionally to the remaining variables for that period). The other variables are defined in the text.

The basic model also proved to be a good approximation to the data. First, to search for mispecification, a variety of additional types of contracts were included. The weights for those contracts were not significant, and the main results were not altered. Second, more general specifications for the contract's target real wage were tried. The simplifying assumptions of the basic model were easily accepted by the data, and the estimate for the elasticity of the target real wage with respect to the unemployment rate proved quite robust. Third, the nominal–homogeneity restrictions of the model were relaxed and tested: the null hypotheses were accepted at conventional levels of significance. Finally, two alternative Phillips curves for wages were estimated to obtain a yardstick to evaluate the fitting capabilities of the model. The findings were favorable to the contracting model again.

Further research on the topic could pursue several interesting lines of inquiry. One would be to estimate and study the implications of wage equations such as the ones analyzed here in the context of complete macroeconomic models. Such an approach would not only help to improve the efficiency of the type of estimates obtained in this paper, but most importantly, it would permit to study the macroeconomic consequences of alternative shocks under data–consistent and analytically well–understood characteristics of the labor market. This should prove useful for a variety of important purposes, for instance, for obtaining better estimates of the output–costs of disinflation, for an improved understanding of the relative role of labor contracts and credibility in those experiments, for a more precise assessment of the macroeconomic merits of alternative rules for monetary policy, and so on. Another line of research would be to examine aggregate and sectorial data for other countries and periods. This could provide useful results for individual and cross country studies, as well as to examine the effects of alternative macroeconomic, institutional, and structural environments on wage formation. For instance, it could provide interesting evidence of the effects that different levels of average inflation, or degrees of exposure to aggregate shocks, have on the type of wage contracts prevailing in the economy. Furthermore, the specific empirical methods used here could certainly be improved, for instance, further research could attempt to obtain better proxies for measuring the expected variables used in the estimation, allow for the weights of the alternative type of contracts to be time–varying, and so on. Finally, perhaps the hardest challenge that lies ahead is to explain theoretically why labor contracts are as they are, a persistent question that remains unanswered.

While much remains to be investigated, the results obtained here are encouraging. During the last three decades, most of the applied macroeconomic research that acknowledges the existence of nominal rigidities has relied on the estimation of Phillips curves. Rather than the result of a theoretical strength or an empirical success, this seems to be a consequence of the lack of readily–available alternatives. Although the extent to which the approach used here proves useful in future research is yet to be discovered, this paper has shown that it is indeed possible to estimate empirically a better grounded model of aggregate wage dynamics.

Data

The wage data is described in the text. The definition and sources for the remaining variables used in the paper are as follows (INE is an abbreviation for the National Institute of Statistics). Inflation is measured by the rate of change in the CPI (INE). Unemployment corresponds to the open unemployment rate (INE). Full employment productivity is measured as the ratio between an estimate of potential GDP (Marfan Manuel & Patricio Artiagoitia, "Estimación del PGB Potencial: Chile 1960–88," *Colección Estudios CIEPLAN*, Vol. 27, December 1989) and the labor force (INE). The real costs of imports corresponds to the observed nominal exchange rate, multiplied by an index of import prices and one plus the general import tariff (all data from the Central Bank of Chile), and divided by the CPI (INE). The annual figures on potential GDP and the index of import prices were transformed to a quarterly base, using the criteria of minimizing the sum of the squares of the first differences of the new series (to obtain smooth series that respected their annual values). The figures on unemployment and the labor force for the period prior to 1986 were extrapolated by using the series estimated in Jadresic, Esteban, "Evolución del Empleo y Desempleo en Chile, 1970–85. Series Anuales y Trimestrales", *Colección Estudios CIEPLAN*, Vol. 20, December 1986).

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