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Long-Term Contracts as a Strategic Device¹

by

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Abstract

This paper shows that in a two-sector labor market, union choice between short and long-term nominal-wage contracts involves a trade-off between expected levels of inflation and unemployment and their variability. On the one hand, if the union sets long-term contracts, it can affect (future) competitive-sector wage contracts through its impact on inflationary expectations, and as a result it can achieve lower expected levels of inflation and unemployment. On the other hand, because long-term contracts introduce uncertainty regarding future productivity shocks, this alternative may lead to variability in inflation and unemployment from the union's perspective. This framework also evaluates the effect of union density on union choice. The analysis indicates that lower union density may lead to long-term contracts at low degree of central bank conservatism, and to short-term contracts at high degree of central bank conservatism.

Key words: Contract length, labor market, union density, central bank conservatism.

JEL Classification: E50, E58, J50, J51.

1. Introduction

The fact that labor-contract length varies between countries and across time¹ has attracted many economists to study this issue from theoretical as well as empirical perspectives. One of the first studies that explicitly examined the contract length is the seminal paper by Gray (1978). Gray shows that for any level of wage indexation, optimal contract length is a decreasing function of uncertainty in the economy (regardless of the source) and an increasing function of contracting costs (transactions costs).² Her result derives from the different advantages associated with each type of contract. Specifically, although long-term contracts reduce the fixed costs associated with negotiating a contract

¹See for example table 11.7 in Bruno and Sachs (1985) and Groth and Johansson (2002).

²Shorter contracts usually increase the amount of time that managers and union officials spend in contract negotiations and may lead to more frequent strikes.

as the number of contracts to be negotiated declines over time, short-term contracts adjust to the changing environment more rapidly and thus produce smaller expected losses resulting from employment and output deviations from their desired levels.³

Empirical analyses provide some support for Gray's hypothesis. For instance, Christofides and Wilton (1983), who based their analysis on 1966-1975 Canadian data, find that inflation uncertainty tends to shorten labor-contract and transaction costs, as measured by the number of employees covered by the contracts, tend to lengthen it.⁴ The negative correlation between inflation uncertainty and contract length was also found in a study by Vroman (1989), who based her analysis on 1958-1984 US data.⁵

Unlike Gray who found that real and nominal uncertainties have similar effects on contract length, Danziger (1988) distinguishes between the two. He argues that risk-averse workers seek insurance against contemporaneous real shocks. In his view, in cases of high uncertainty regarding real shocks, workers tend to extend new contracts in order to protect themselves from the effects of such shocks.⁶ Danziger refers to this phenomenon as "efficient risk sharing". Murphy (2000) uses US data to estimate the differential effects of nominal and real uncertainties on contract length. His results are compatible with those of Danziger.

The externalities of long-term contracts have been also studied by Ball (1987). Using a monopolistic competition framework, Ball shows that long-term nominal contracts do not always stimulate employment fluctuations. He argues that because long-term contracts contribute to price rigidity, they have ambiguous effects on employment stability: On the one hand, price rigidity increases the variance of aggregate demand (as a result of stochastic nominal shocks) and therefore lead to employment fluctuations; on the other, price rigidity reduces the variability of real wages

³Canzoneri (1980) uses the elements of Gray's model and argues that monetary policy could affect contract length by affecting uncertainty in the economy, such that a successful stabilization policy may be expected to increase the contract length.

⁴In another paper, Christofides (1990) finds that wage indexation does not affect contract duration. The negative correlation between the two stems from the fact that inflation uncertainty increases indexation and decreases contracts' duration.

⁵Vroman (1989) uses the Livingston index of inflation expectations to calculate inflation uncertainty.

⁶Dye (1985) obtains that optimal contract length is independent of price uncertainty because he assumes risk neutrality.

because it makes it easier for the firms to forecast future prices; it thus supports employment stability. Calmfors and Johansson (forthcoming) argue that other than employment fluctuations, long-term contracts also lead to higher expected levels of both real wages and unemployment. Their result stems from the fact that wage setters demand higher risk premiums the larger the uncertainty associated with long-term contracts.

The following paper differs from the above studies in two main aspects. First, unlike previous papers that assume a homogenous labor market in which all workers are unionized under one or more labor unions, this paper focuses on a two-sector labor market, which differ in the wage determination. In one sector - the "unionized sector" - workers are unionized under one union, and hence coordinate in order to achieve their preferred real wage; in the second sector - the "competitive sector" - workers act independently, hence they lack bargaining power. In this competitive sector the real wage clears the market. Second, unlike previous papers that use contract length as a continuous parameter, in this paper the union faces a binary choice: whether to set the wage for period t in a long-term contract, i.e., prior to productivity-shock realization (in period t) and its internalization in competitive-sector wage contracts, or to set the wage for period t in a short-term contract, i.e., post shock realization.

The main result of this analysis is that the union's choice as to nominal-wage contract length involves a trade-off between inflation and unemployment variability and their expected levels. That is, if the union sets long-term contracts, it can affect (future) competitive-sector wage contracts through its impact on inflationary expectations, thereby achieving lower expected levels of inflation and unemployment. Alternatively, because long-term contracts involve some uncertainty regarding future productivity shocks, this option may, from the union's point of view, lead to some variability in both variables.

In addition, the present framework evaluates the effect of union bargaining power (as measured by union density) on its choice between short and long-term contracts. Stieber (p.140) argues that long-term contracts eliminate union ability to attend to its members' needs for long periods; hence greater bargaining power and contract length should be inversely related. In a recent study, Groth and Johansson (2002) show that union bargaining power, as measured by degree of centralization, affects

contract length in a non-monotonic manner, i.e., high and low degrees of centralization generate long-term contracts whereas intermediate degrees of centralization yields short-term contracts.⁷

As in Groth and Johansson (2002), the following framework also produces an ambiguous impact of bargaining power (as measured by union density) on contract length. The analysis shows that at high levels of central bank (CB) conservatism, where the expected loss from unemployment-uncertainty dominates the expected loss from inflation-uncertainty, higher union density (which increases the CB's reaction to productivity-shocks and thus reduces unemployment-uncertainty) increases the space in which the long-term contracts are preferable. At low levels of CB conservatism, where the expected loss from inflation-uncertainty dominates, higher union density increases the space in which the short-term contracts are preferable (because it increases inflation fluctuations).

The paper is organized as follows: Section 2 presents the general structure of the labor market and the strategic interaction between the CB, the labor union and wage setters in the competitive sector. This structure is later utilized to characterize the equilibrium features of several economic variables such as the real wage, inflation, inflationary expectations and unemployment. Section 3 analyzes union choice regarding the optimal timing of the nominal-wage contracts and examines the parameters that affect this choice. Concluding remarks follow.

2. The Model

2.1 The Basic Structure

Consider a labor market that contains two sectors: a unionized sector, in which employees coordinate in order to achieve their preferred real wage; and a competitive sector in which workers act independently and therefore lack bargaining power. In this sector, the real wage clears the market. Each sector owns a production technology that exhibits decreasing returns to scale to labor input, given as (for simplicity capital is fixed and normalized to 1) -

$$(1) \quad Y_j = UL_j^a \quad a < 1, \quad j = c, un, \quad U \sim (1, \sigma_u^2),$$

⁷In particular, Groth and Johansson (2002) obtain that an increase in centralization yields two opposite effects on contract length. On one hand it reduces the fixed cost per union member (which makes it optimal to write shorter contracts). On the other hand, it raises the co-ordination costs (since various employers and unions have to reach an agreement on a common stand), therefore it makes it optimal to increase the duration of the contracts.

where Y_j and L_j are output supply and labor input in sector j (the subscripts un and c denote the unionized sector and the competitive sector, respectively). By equating marginal productivity to the real wage, one can obtain labor demand in each sector. In logarithms, the labor demand is given by:

$$(2) \quad \log(L_j^d) \equiv l_j^d = \alpha(d - w_r + \varepsilon); \quad d = \log(a); \quad \alpha = \frac{1}{1-a}; \quad \log(U) = \varepsilon,$$

where w_r is the log of the real wage ($w_r = w - \pi$); w is the log of the nominal wage and π denotes the inflation rate during the period ($\pi = p - p_{-1}$). For simplicity and without loss of generality, the log of the price level in the previous period is normalized to zero. The parameter α reflects the elasticity of labor demand with respect to the real wage and ε represent mean-zero productivity shock [$\varepsilon \sim (0, \sigma_\varepsilon^2)$].

The economy's labor force is perfectly inelastic and is given by l_0 (in logarithms). The proportion θ denotes the share of the labor force that works in the unionized sector (henceforth, this parameter will be referred to as union density) and the complementary proportion $(1 - \theta)$ denotes the share who works in the competitive sector. Accordingly, labor supply in each sector can be written as:

$$(3) \quad l_{un}^s = \theta l_0,$$

$$(3') \quad l_c^s = (1 - \theta) l_0.$$

The unemployment rate in each sector (u_j) can be obtained by subtracting labor demand from labor supply. In the unionized sector, this yields the following expression:

$$(4) \quad u_{un} = \alpha(w_{r,un} - w_{r,un}^c) = \alpha[w - \pi - (Ew_{r,un}^c + \varepsilon)];$$

$$w_{r,un}^c = Ew_{r,un}^c + \varepsilon \equiv \left[d - \frac{\theta l_0}{\alpha} \right] + \varepsilon,$$

where $w_{r,un}^c$ expresses the equilibrium (competitive) real wage in this sector, that is the real wage in which the unemployment rate is equal to zero. Eq. (4) indicates that the unemployment rate is increasing in the gap between the actual real wage ($w_{r,un}$) and the equilibrium real wage. This gap is henceforth referred to as the real-wage premium.

In the competitive sector, the real wage clears the market such that the real wage premium is equal to zero. However, because workers prefer to avoid real wage erosion during the period, they internalize

the expected inflation within the nominal-wage contracts. Hence, in this sector, the unemployment rate increases with unexpected inflation:⁸

$$(4') \quad u_c = \alpha(\pi^e - \pi) .$$

Using Eq. (4) and Eq. (4'), total unemployment rate (u) can be described as the weighted average of the unemployment rate in each sector:⁹

$$(5) \quad u = \theta u_{un} + (1 - \theta) u_c ,$$

$$(5') \quad u = \alpha[\theta(w - Ew_{r,un}^c) + (1 - \theta)\pi^e - \pi] - \alpha\theta\varepsilon .$$

Inflation is determined by choice of monetary policy as well as by realization of the shock, ε , and is given by the following equation (as in Walsh 1995):

$$(6) \quad \pi = m - \rho\varepsilon ,$$

where m is the rate of money growth chosen by the CB and ρ is a positive parameter that determines the direct, negative effect of production shocks on inflation.

2.2 Timing of Events

In order to determine the union's choice regarding wage contract length, I divide the entire-period¹⁰ into two sub-periods: period t and prior to this period. In the beginning of period t , workers in the competitive sector internalize their inflationary expectations into nominal-wage contracts immediately upon observation of the production-shock realization. This setting captures the high flexibility of this sector with respect to real shocks.¹¹ At the end of this period, the central bank, which acts by discretion, chooses a policy instrument, m , and the inflation rate is realized.

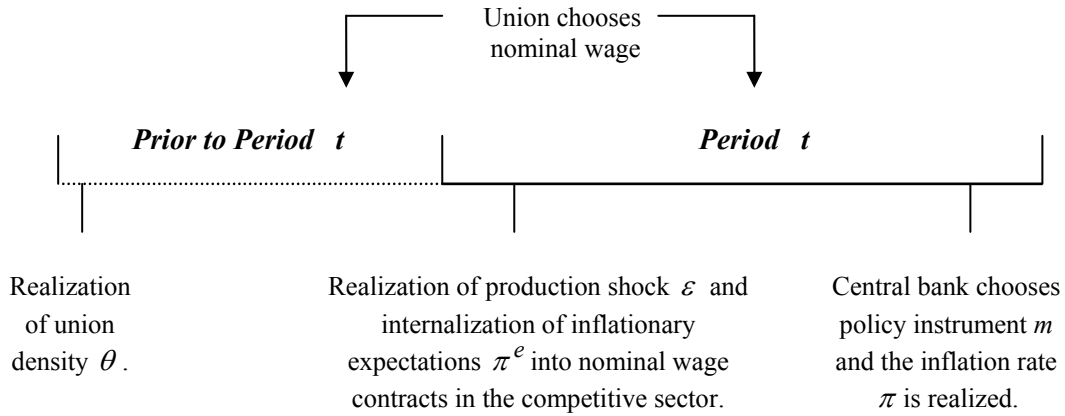
⁸The actual real wage in the competitive sector can be expressed as: $w_{r,c} = w_{r,c-1} + \pi^e - \pi$. Since I assume that the real-wage premium is equal to zero ex ante, i.e., $w_{r,c}^e = w_{r,c-1}$, the unemployment rate in this sector can be expressed in terms of unexpected inflation as in Eq. (4').

⁹A formulation of a labor market that contains two sectors also appears in Cukierman, chapter 3 (1992). The current framework differs in two main aspects. First, there is no substitution in production between the two sectors. Second, as will be shown later, the following model distinguishes between short and long-term nominal contracts.

¹⁰The entire period is defined as the period in which union density is fixed. Data on the collective bargaining coverage rate (which may be a proxy for the union density parameter) shows that in many OECD countries, this variable is stable over time. See for example chapter 3, the OECD Employment Outlook (1997).

¹¹The rigidity of the nominal wage with respect to inflation together with its flexibility with respect to the production shocks can be explained by the relatively high frequency of inflation-rate changes in comparison to real business cycles.

Figure 1 - Timing of events



As illustrated in Figure 1, the union has two alternatives in determining its nominal wage for period t . In the first alternative, the union sets the nominal wage for period t prior to this period, i.e., before supply-shock realization and its internalization in competitive sector nominal-wage contracts. This alternative represents long-term nominal wage contracts that do not correspond immediately to the changes in the labor market's environment. The second represents a more flexible nominal-wage contract, i.e., the union sets the nominal wage for period t post supply-shock realization and simultaneously with determination of the nominal wage in the competitive sector. The choice between the two alternatives is made prior to period t , according to the loss expected by the union.¹²

2.3 The Central Bank Strategy

In order to obtain the optimal strategies for each stage, the model is solved backwards, beginning with the CB's optimal behavior. As in Barro and Gordon (1983), the CB aims to minimize unemployment and inflation variability around a desired rate. For convenience, the desired rate is normalized to zero.

The CB's loss function is given by:

$$(7) \quad \tau = \frac{1}{2}u^2 + \frac{I}{2}\pi^2 \quad I > 0,$$

where the parameter I is positive and measures the relative importance that the central bank assigns to the objective of low inflation versus low unemployment. A higher I implies that the CB is more conservative, i.e., it assigns a greater weight to price stability than to unemployment stability. By

¹²As will be shown later, as long as the union is inflation-averse, even in the case where the economy is not exposed to production shocks, the two alternatives produce different levels of unemployment and inflation.

inserting Eq. (5') and Eq. (6) into the CB's loss function [Eq. (7)] and minimizing it with respect to policy instrument m , one obtains the following CB's reaction:

$$(8) \quad \frac{\partial \tau}{\partial m} = 0 \Rightarrow m = \frac{\alpha^2}{\alpha^2 + I} [\theta(w - Ew_{r,un}^c) + (1-\theta)\pi^e] + (\rho - \frac{\alpha^2 \theta}{\alpha^2 + I}) \varepsilon .$$

As the central bank acts by discretion, it generates higher rate of money growth the higher the nominal wage in both sectors in order to erode the real wage and obtain its desired employment. As one can see, the union density (θ) and the complementary proportion ($1-\theta$), reflect the weights that the central bank ascribes to each sector in its reaction function.

Inserting the rate of money growth [Eq. (8)] into Eq. (6) yields the inflation rate:

$$(9) \quad \pi = \frac{\alpha^2}{\alpha^2 + I} [\theta(w - Ew_{r,un}^c) + (1-\theta)\pi^e] - \frac{\alpha^2 \theta}{\alpha^2 + I} \varepsilon .$$

The negative relationship between the productivity shock and inflation in the above equation stems from the fact that for a given a fixed real wage, a positive shock reduces the unemployment rate in the unionized sector, thereby reducing the CB's incentive to erode real wage in this sector. This equation also demonstrates that within this framework, the inflationary bias depends solely on the existence of a unionized labor force. If the labor force is not unionized ($\theta = 0$), there will be no inflationary bias ($\pi = \pi^e = 0$).

2.4 The Union Choice of the Nominal Wage

Like the central bank, the union also aims to reduce unemployment (among unionized workers) and minimize inflation fluctuations around a zero rate.¹³ In addition, the union is also motivated to increase the real wage level among its members. Following Cukierman and Lippi (1999), the union loss function can be expressed as

$$(10) \quad \Omega_{un} = \frac{\delta}{2} u_{un}^2 + \frac{\gamma}{2} \pi^2 - w_{r,un} ,$$

where the parameters δ and γ are positive and denote the weight that the union ascribes to unemployment and inflation relative to its real wage objective.

¹³The union's inflation-aversion may be motivated by the observation that pensions of the union workers are often not indexed and that union members, like other individuals, generally dislike inflation.

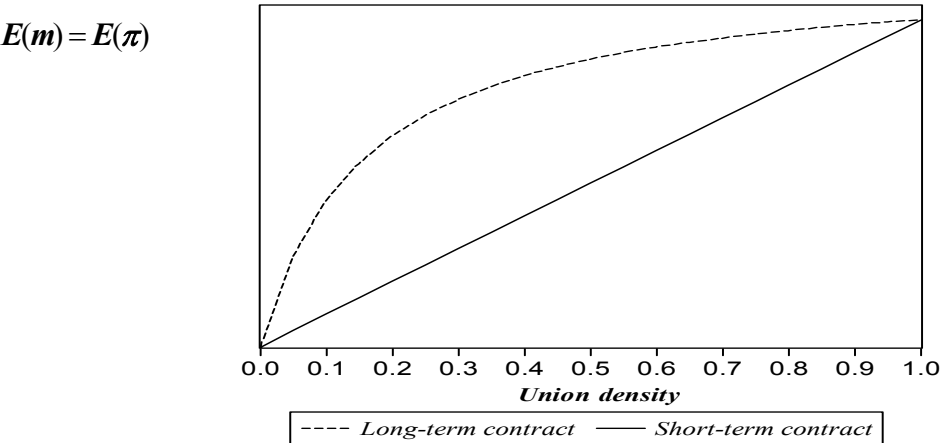
In case the union chooses to set a long-term nominal wage contract (prior to productivity-shock realization in period t), it could affect nominal-wage contracts in the competitive sector through the impact of its wage demands on inflationary expectations. From the union's perspective, the expected inflation will be

$$(11) \quad E(\pi) = E(\pi^e) = E(m) = \frac{\alpha^2 \theta}{\alpha^2 \theta + I} (w - Ew_{r,un}^c).$$

In case the union chooses to set a short-term nominal wage contract, i.e., ex-post production shock realization and simultaneously with the competitive sector, it takes the inflationary expectations and productivity-shock as given. In this case, inflation (from the union's perspective) is determined as in Eq. (9).

By comparing the expected inflation rates in the two alternatives [Eq. (9) and Eq. (11)], one can see that as long as union density is positive but lower than 1, a long-term wage contract "produces" a more aggressive CB reaction from the union's point of view (see Figure 2).

Figure 2 - The CB's expected reaction to the union's nominal wage



The difference between the two alternatives stems from the fact that by setting long-term contracts, the union directly controls nominal-wage contracts in the competitive sector through its direct impact on inflationary expectations. In this case, a given rise in w raises not only the nominal wage in the unionized sector but also the nominal wage in the competitive sector. Because the CB aims to reduce unemployment in both sectors, this rise will lead to a more aggressive CB response in terms of inflation. In the case of short-term contracts, where the union acts simultaneously with the competitive

sector (ex-post production-shock realization), the union can affect nominal-wage contracts in the competitive sector only indirectly, through the effect of w on the inflation rate, and through the inflation rate, on inflationary expectations ($w \rightarrow m \rightarrow \pi \rightarrow \pi^e$). Hence, the CB's reaction from the union's perspective is more moderate.

Let w^{LT} denote the union's nominal wage demands when it acts before the productivity-shock realization in period t (when it sets long-term contracts). By inserting Eq. (11) into the union's loss function [Eq. (10)] and minimizing with respect to w , the explicit solution for w^{LT} is

$$(12) \quad w^{LT} = Ew_{r,un}^c + \frac{I(I + \alpha^2\theta)}{\alpha^2(\delta I^2 + \alpha^2\theta^2\gamma)}.$$

Let w^{ST} denotes the union's nominal-wage demands when it acts ex-post the realization of the productivity-shock (when it sets short-term contracts). By inserting Eq. (9) into the union's loss function [Eq. (10)] and minimizing with respect to w , the explicit solution for w^{ST} is

$$(13) \quad w^{ST} = Ew_{r,un}^c + \frac{[I + \alpha^2(1-\theta)](\alpha^2 + I) + \pi^e\alpha^4(1-\theta)\{\delta[I + \alpha^2(1-\theta)] - \gamma\theta\}}{\alpha^2\{\delta[I + \alpha^2(1-\theta)]^2 + \gamma\theta^2\alpha^2\}} + \varepsilon.$$

2.5 Features of Equilibrium Outcomes

By inserting the union's nominal-wage demands [Eq. (12) and Eq. (13)] and the CB's reaction function [Eq. (8)], into the unemployment and inflation equations [(5') and (6)], one obtains the equilibrium levels of real wage, inflation rate, inflationary expectations and unemployment rate for both alternatives.

In case the union chooses long-term nominal wage contracts, i.e., signed prior to productivity-shock realization in period t , the equilibrium levels are:

$$(14) \quad w_{r,un}^{LT} = Ew_{r,un}^c + \frac{I^2}{\alpha^2(\delta I^2 + \alpha^2\theta^2\gamma)} + \frac{\alpha^2\theta}{\alpha^2\theta + I}\varepsilon = Ew_{r,un}^c + \phi^{LT} + \frac{\alpha^2\theta}{\alpha^2\theta + I}\varepsilon,$$

$$(15) \quad \pi^{LT} = \pi^e = \frac{\theta I}{(\delta I^2 + \alpha^2\theta^2\gamma)} - \frac{\alpha^2\theta}{\alpha^2\theta + I}\varepsilon = \frac{\alpha^2\theta}{I}\phi^{LT} - \frac{\alpha^2\theta}{\alpha^2\theta + I}\varepsilon,$$

$$(16) \quad u^{LT} = \theta u_{un}^{LT} = \frac{\theta I^2}{\alpha(\delta I^2 + \alpha^2\theta^2\gamma)} - \frac{\theta I}{\alpha^2\theta + I}\varepsilon = \alpha\theta\phi^{LT} - \frac{\theta I}{\alpha^2\theta + I}\varepsilon,$$

where ϕ^{LT} denotes the real wage premium resulting from long-term contracts.

In case the union chooses short-term nominal wage contracts, i.e., signed ex post productivity-shock realization in period t , the equilibrium levels are:

$$(14') \quad w_{r,un}^{ST} = Ew_{r,un}^c + \frac{I[I + \alpha^2(1-\theta)]}{\alpha^2 \{I\delta[I + \alpha^2(1-\theta)] + \gamma\theta^2\alpha^2\}} + \varepsilon = Ew_{r,un}^c + \phi^{ST} + \varepsilon,$$

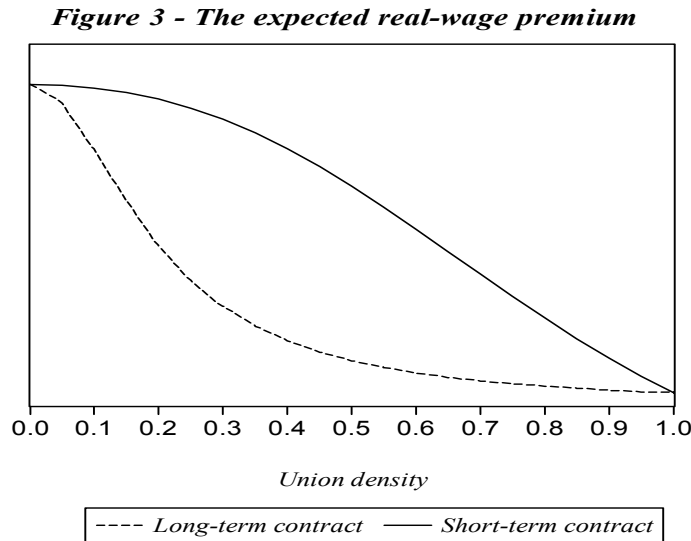
$$(15') \quad \pi^{ST} = \pi^e = \frac{\theta[I + \alpha^2(1-\theta)]}{I\delta[I + \alpha^2(1-\theta)] + \gamma\theta^2\alpha^2} = \frac{\alpha^2\theta}{I} \phi^{ST},$$

$$(16') \quad u_{un}^{ST} = \theta u_{un}^{ST} = \frac{\theta I[I + \alpha^2(1-\theta)]}{\alpha \{I\delta[I + \alpha^2(1-\theta)] + \gamma\theta^2\alpha^2\}} = \alpha\theta\phi^{ST},$$

where ϕ^{ST} denotes the real wage premium resulting from short-term contracts.

Proposition 1: *If the union is inflation-averse ($\gamma > 0$) and union density is positive but less than 1 ($0 < \theta < 1$), the expected real-wage premium (ϕ), the expected unemployment rate [$E(u)$] and the expected inflation rate [$E(\pi)$] will always be lower when the union sets long-term contracts than when it sets short-term contracts.*

(For proof, see part A in the Appendix).



This result stems from the fact that by setting a long-term contract, the union commits to a certain level of nominal wages for period t prior to that period. This commitment enables the union to affect the nominal wage in the competitive sector directly; hence, the union knows the exact consequence - in terms of expected inflation - of a given change in the nominal wage. Because the union's aim is to avoid high inflation, the "excess information" that it gains from this commitment leads to moderation

of the real-wage premium and as a result, the equilibrium levels of inflation and unemployment decline. In the second case, in which the union acts simultaneously with the competitive sector (ex post production-shock realization), not only does it relinquish the ability to affect contracts in this sector directly, it also sets the nominal wage without taking into account the indirect effect that this wage has on nominal wages in the competitive sector ($w \rightarrow m \rightarrow \pi \rightarrow \pi^e$). As a result, the union determines a higher real-wage premium (in comparison to the first alternative) that leads, in turn, to higher rates of both inflation and unemployment.

Proposition 2: *The relationship between union density (θ) and both the inflation and unemployment rates will be non-monotonic for cases of long and short-term contracts, if union inflation-aversion is above the following thresholds (γ_c)¹⁴:*

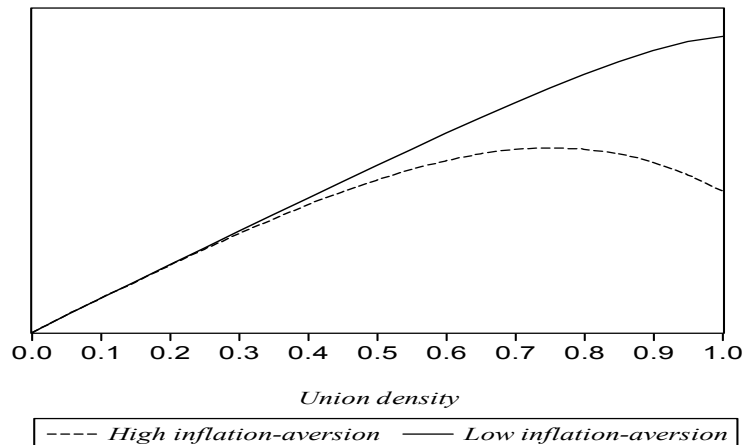
1. *If the union sets short-term contracts, the threshold is:*

$$\gamma > \frac{[I + \alpha^2(1-\theta)]^2 I \delta}{\theta^2 \alpha^2 (I + \alpha^2)} \equiv \gamma_c^{ST}$$

2. *If the union sets long-term contracts, the threshold is:*

$$\gamma > \frac{\delta I^2}{\alpha^2 \theta^2} \equiv \gamma_c^{LT}$$

Figure 4 - The expected unemployment rate



The non-monotonic relationship between union density and both inflation and unemployment (a Calmfors-Driffill hump-shaped relationship) is derived from the combination of two effects that

¹⁴ This condition is sufficient for both the inflation and the unemployment because there is a linear relationship between the variables that does not depend on θ ($u = \frac{I}{\alpha} \pi$).

operate when union density changes.¹⁵ An increase in the unionized labor force reduces competition in the labor market, which induces the central bank to choose a higher inflation rate (via higher money growth) in order to erode the real wage ("competition effect"). Simultaneously, as union density increases, the union internalizes the impact of its wage demands on the chosen inflation rate and consequently moderates its real-wage premium ("strategic effect" or "internalization effect"). The magnitude of the wage moderation depends on the inflation-aversion parameter (γ). When the union's inflation-aversion is above the thresholds presented in proposition 2, the "strategic effect" will dominate, and inflation and unemployment will be reduced.¹⁶

3 The Union's Choice between Short and Long-Term Nominal-Wage Contracts

Proposition 1 reveals that from the union's perspective, the choice between short and long-term nominal-wage contracts creates a trade-off between the expected levels of the real wage, unemployment and inflation and their variability. On the one hand, in case the union chooses to set long-term contracts, it could affect wage contracts in the competitive sector and induce lower values of both unemployment and inflation as a result. On the other hand, this choice exposes the union to variability in these variables because at this point there is some uncertainty regarding the magnitude of the productivity-shocks to be realized in period t .

The determination between the two alternatives is made according to the union's expected loss, prior to the productivity-shock realization in period t . If the union prefers long-term contracts, its expected loss is

$$(17) \quad E(\Omega_{un}^{LT}) = E \left\{ \frac{\delta}{2} \left[\alpha \phi^{LT} - \frac{I}{\alpha^2 \theta + I} \varepsilon \right]^2 + \frac{\gamma}{2} \left[\frac{\alpha^2 \theta}{I} \phi^{LT} - \frac{\alpha^2 \theta}{\alpha^2 \theta + I} \varepsilon \right]^2 - \left[Ew_{r,un}^c + \phi^{LT} + \frac{\alpha^2 \theta}{\alpha^2 \theta + I} \varepsilon \right] \right\}.$$

In the short-term contracts case, the union's expected loss is

$$(18) \quad E(\Omega_{un}^{ST}) = E \left\{ \frac{\delta}{2} \left[\alpha \phi^{ST} \right]^2 + \frac{\gamma}{2} \left[\frac{\alpha^2 \theta}{I} \phi^{ST} \right]^2 - \left[Ew_{r,un}^c + \phi^{ST} + \varepsilon \right] \right\}.$$

¹⁵¹⁵Calmfors and Driffill (1988) and Cukierman and Lippi (1999) obtain a similar non-monotonic relationship between both inflation and unemployment and centralization.

¹⁶An extensive discussion about the "competition effect" and the "strategic effect" that this framework produces appears in Klein (2004).

By comparing the union's loss in the two alternatives, one obtains the condition under which the union will prefer long to short-term contracts. This condition is summarized in the following proposition:

Proposition 3: *The union will prefer long-term nominal-wage contracts, i.e., concluded prior to the productivity-shock realization in period t , if the following inequality holds:*

$$(19) \quad E(\Omega_{un}^{LT}) < E(\Omega_{un}^{ST}) \Leftrightarrow \delta\sigma_{un}^2 + \gamma\sigma_{\pi}^2 \equiv \frac{(\delta I^2 + \alpha^4 \theta^2 \gamma)}{(\alpha^2 \theta + I)^2} \sigma_{\varepsilon}^2 < \frac{\alpha^6 \theta^4 (1-\theta)^2 \gamma^2}{A[A + \alpha^2 \delta I(1-\theta)]^2},$$

$$\text{where } A = (\delta I^2 + \alpha^2 \theta^2 \gamma), \quad \sigma_{un}^2 = \frac{I^2}{(\alpha^2 \theta + I)^2} \sigma_{\varepsilon}^2, \quad \sigma_{\pi}^2 = \frac{\alpha^4 \theta^2}{(\alpha^2 \theta + I)^2} \sigma_{\varepsilon}^2.$$

This inequality shows that as long as the expected losses from uncertainty in inflation and unemployment (left side) is below the benefits that long-term nominal-wage contracts produce (in terms of lower expected levels of inflation and unemployment – right side), the union will prefer to sign long-term nominal-wage contracts.¹⁷

This condition also indicates that:

- i. If the economy is not exposed to production shocks ($\sigma_{\varepsilon}^2 = 0$), an inflation-averse union will always prefer long-term nominal-wage contracts, i.e., sign prior to nominal-wage determination in the competitive sector.
- ii. If the economy is exposed to some productivity shocks ($\sigma_{\varepsilon}^2 > 0$), and the union is indifferent to inflation ($\gamma = 0$), the union will always prefer short-term contracts.

3.1 Comparative statics¹⁸

Figure 5 below describes the union's indifference curve between the two alternatives in the space determined by productivity-shock variance (σ_{ε}^2) and CB conservatism (I). While the curve indicates indifference between the two alternatives, the space below the curve indicates union preference for

¹⁷Note that this result holds also in the presence of partial wage indexation. This can be seen from the parameter α which reflects the labor demand elasticity with respect to real wage. As long as this parameter is positive the inequality in Eq. (19) can be obtained.

¹⁸Since the indifference condition [Eq. (19)] contains high order polynomial, some of the following results were obtained by numeric simulations.

long-term contracts whereas the space above the curve indicates union preference for short-term contracts. As one can see the indifference curve reflects the trade-off between productivity-shock variance and CB conservatism. On the one hand, lower uncertainty regarding the magnitude of the productivity shocks (lower σ_{ε}^2) reduces the union's expected loss from long-term nominal-wage contracts as it desires to avoid fluctuations in both unemployment and inflation. On the other hand, the benefits from these contracts decrease with CB conservatism, because greater conservatism drives the union to choose a higher real-wage premium. As a result, this choice induces higher rates of inflation and unemployment.¹⁹

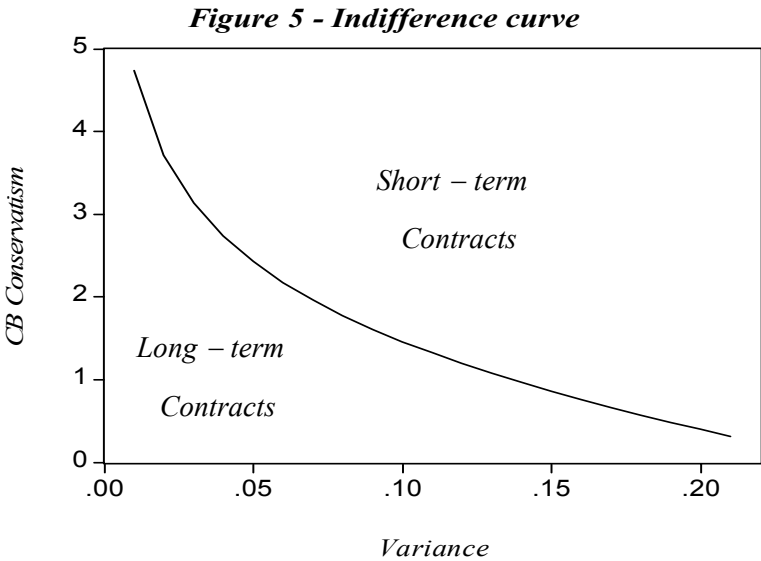


Figure 1.A in the Appendix shows the ambiguous effect of union density (θ) on the indifference curve. In general, an increase in union density increases the CB's incentive to react to productivity shocks; in response it increases the expected loss from inflation variability at the same time that it reduces the expected loss from unemployment variability [see Eq. (19)]. Therefore, the effect of union density on total expected loss from shock uncertainty depends on whether σ_{π}^2 or σ_{un}^2 dominates (see part B in Appendix). As figure 1.A shows, at higher levels of CB conservatism, where the expected loss from unemployment uncertainty dominates, higher union density, which decreases total expected

¹⁹As shown in the previous sections, moderation of the real-wage premium (and, as a result, moderation of inflation and unemployment) intensifies when the CB is more liberal, i.e., willing to tolerate higher levels of inflation in order to reduce unemployment. Hence, greater conservatism reduces the gap between the expected unemployment and inflation in both alternatives and as a result it reduces the benefit from long-term nominal contracts.

loss from productivity shocks, increases the space in which long-term contracts are preferable. At low levels of CB conservatism, where the expected loss from inflation uncertainty dominates, higher union density, which increases total expected loss from productivity shocks, reduces the space in which long-term contracts are preferable.²⁰

Figure 2.A in the Appendix shows the direct effect of union unemployment-aversion (δ) on the indifference curve. Higher δ increases the expected loss from unemployment uncertainty and simultaneously it reduces the benefit from long-term contracts (because the relative weight that the union ascribes to inflation declines). Therefore, higher δ shifts the indifference curve downwards and the space in which short-term contracts are preferable, subsequently widens.

As the effect of union density, the union inflation-aversion (γ) also has an ambiguous effect on the indifference curve because an increase in this parameter augments the loss from inflation uncertainty as well as the benefit from long-term contracts [see also Eq. (19)]. As can be observed from Figure 3.A, at low levels of productivity-shock uncertainty (σ_ε^2), an increase in γ increases the benefit from long-term contracts at a greater magnitude than it raises the loss. The indifference curve then moves upwards (i.e., the space in which long-term contracts are preferable widens). At high levels of productivity-shock uncertainty, an increase in γ has the opposite effect: the indifference curve moves downwards such that the space in which long-term contracts are preferable shrinks.

4. Concluding Remarks

This paper presents a simple interaction between a central bank and wage setters in unionized and competitive sectors in order to evaluate the costs and the benefits from short-term versus long-term contracts. The analysis shows that the union's choice regarding contract length creates a trade-off between inflation and unemployment variability and their expected levels. While long-term contracts produce lower expected levels of inflation and unemployment, they may introduce uncertainty with respect to these variables (from the union's perspective).

²⁰Union density affects also the benefit from long-term contracts. However, simulations show that the significant impact that this variable has on the union choice drives from uncertainty loss.

The benefit from long-term contracts stems from the fact that by setting them, the union commits to a certain nominal wage for period t prior to this period and as a result, it can affect future nominal-wage contracts in the competitive sector through its impact on inflationary expectations. This commitment moderates the union's real-wage premium as the union internalizes not only the CB's reaction to wage determination in the unionized sector, but also the CB's reaction to the wage contracts in the competitive sector. Eventually, this moderation lowers expected rates of inflation as well as unemployment when compared to the case of short-term contracts. Note that the assumption of union inflation-aversion is very crucial to this result: It is the union fear from inflation that promotes real-wage moderation.

The cost associated with long-term contracts derives from uncertainty regarding the magnitude of future productivity shocks. Thus, by setting long-term contracts, the union faces some uncertainty regarding central bank reaction and as a result, uncertainty regarding actual unemployment and inflation levels.

In addition, this framework evaluates the effect of union density on union choice between short and long-term nominal-wage contracts. The analysis shows that at high levels of CB conservatism, where the expected loss from unemployment uncertainty dominates expected loss from inflation uncertainty, higher union density (which increases CB reaction to productivity shocks and thus reduces unemployment uncertainty) increases the space in which the long-term contracts are preferable. At lower levels of CB conservatism, where the expected loss from inflation-uncertainty dominates, higher union density increases the space in which short-term contracts are preferable (because it increases inflation fluctuations).

Appendix

A. Proof of proposition 1:

If the following inequality holds, then the real-wage premium is always lower in the case where the union prefers long-term nominal-wage contracts than in the case where the union prefers short-term nominal-wage contracts:

$$(A.1) \quad \phi^{LT} = \frac{I^2}{\alpha^2(\delta I^2 + \alpha^2\theta^2\gamma)} < \phi^{ST} = \frac{I[I + \alpha^2(1-\theta)]}{\alpha^2\{I\delta[I + \alpha^2(1-\theta)] + \gamma\theta^2\alpha^2\}}$$

After defining $A = \delta I^2 + \alpha^2\theta^2\gamma$ and some rearrangement, the above inequality can be written as follows:

$$(A.2) \quad \frac{I}{A} < \frac{[I + \alpha^2(1-\theta)]}{[A + \delta I\alpha^2(1-\theta)]} \Rightarrow 0 < \alpha^4\theta^2(1-\theta)\gamma$$

Eq. (A.2) shows that this inequality holds for any positive inflation-averse ($\gamma > 0$) with union density between zero and one ($0 < \theta < 1$). Because unemployment and inflation are linear functions of the real-wage premium, the following inequalities - $u_{un}^{LT} < u_{un}^{ST}$, $\pi^{LT} < \pi^{ST}$ - also hold. *Q.E.D.*

B. The effect of union density on union loss from production shocks

Define V as the expected loss from production shocks:

$$(B.1) \quad V = \delta\sigma_{un}^2 + \gamma\sigma_{\pi}^2 \equiv \frac{\delta I^2}{(\alpha^2\theta + I)^2}\sigma_{\varepsilon}^2 + \frac{\alpha^4\theta^2\gamma}{(\alpha^2\theta + I)^2}\sigma_{\varepsilon}^2$$

It is easy to see from Eq. (B.1) that while an increase in union density (θ) reduces the expected loss from unemployment, it increases the expected loss from inflation. The total impact of θ on V is:

$$(B.2) \quad \frac{\partial V}{\partial \theta} = \frac{\alpha^2 I \sigma_{\varepsilon}^2}{(\alpha^2\theta + I)^3}(\alpha^2\theta\gamma - \delta I).$$

Eq. (B.2) states that at high levels of CB conservatism, when the following inequality $\alpha^2\theta\gamma < I\delta$ holds, the expected loss from unemployment uncertainty dominates; therefore, higher θ reduces the expected loss from productivity shocks. At low levels of CB conservatism, when the inequality $\alpha^2\theta\gamma > I\delta$ holds, the expected loss from inflation uncertainty dominates; therefore, higher θ increases the expected loss from productivity shocks.

Figures:

Figure 1.A - Indifference Curve

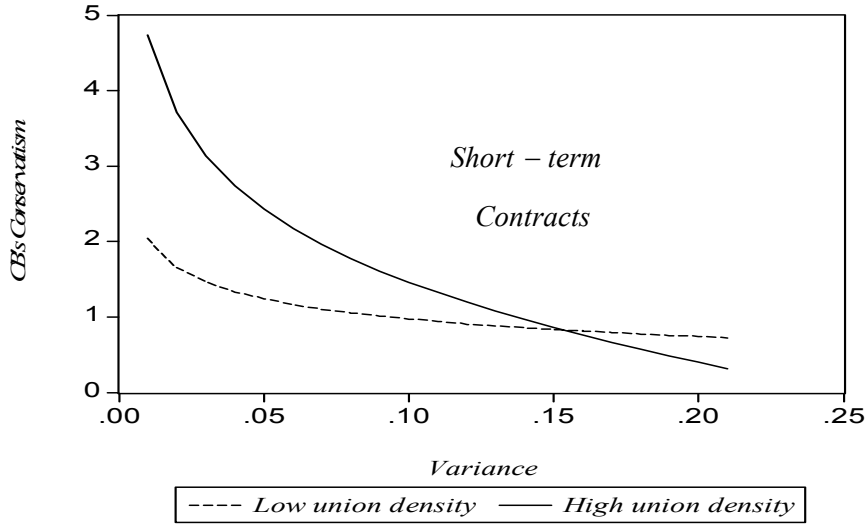


Figure 2.A - Indifference Curve

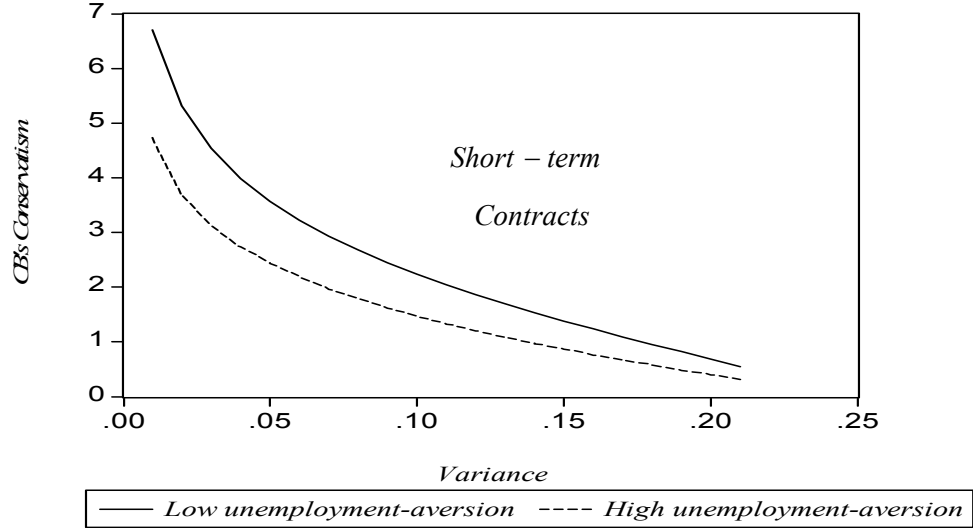
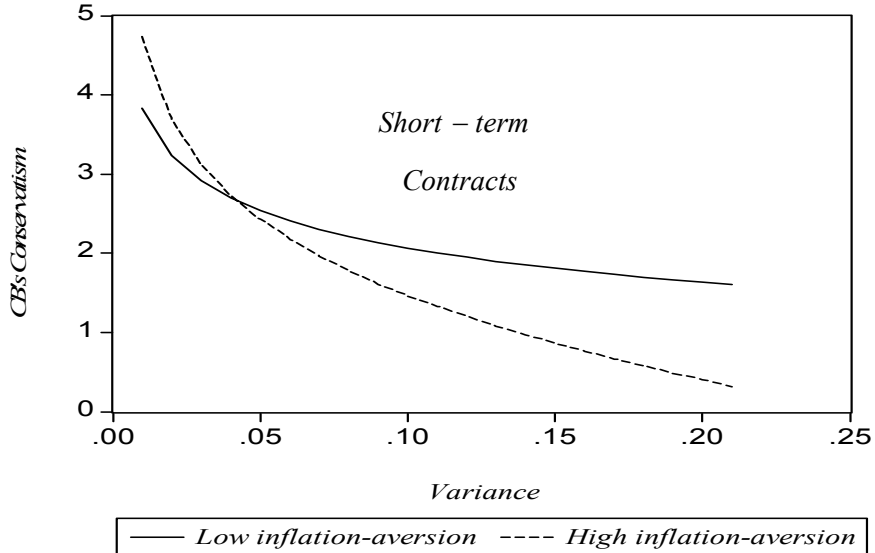


Figure 3.A - Indifference Curve



References

- Ball, L. (1987) "Externalities from Contract Length." *American Economic Review* 77: 615-629.
- Bruno, M., Sachs J.D. (1985) *Economics of Worldwide Stagflation*. Cambridge, MA: Harvard University Press.
- Calmfors, L. (1993) "Centralization of Wage Bargaining and Macroeconomic Performance – A Survey." *OECD Economic Studies*, 21: 161-191.
- Calmfors, L., Driffill, J., (1988) "Bargaining Structure, Corporatism and Macroeconomic Performance." *Economic Policy* 6: 14-61.
- Calmfors, L., Johansson, A. (Forthcoming) "Unemployment Benefit, Contract Length and Nominal Wage Flexibility." *Scandinavian Journal of Economics*.
- Canzoneri, M.B. (1980) "Labor Contracts and Monetary Policy." *Journal of Monetary Economics* 6: 241-255.
- Christofides L.N. (1990) "The Interaction between Indexation, Contract Duration and Non-Contingent Wage Adjustment." *Economica* 57: 395-409.
- , Wilton, D.A. (1983) "The Determinants of Contract length: An Empirical Analysis Based on Micro Data." *Journal of Monetary Economics* 12: 309-319.
- Monetary Integration in Europe*, MIT Press.
- Cukierman, A. (1992) "Central Bank Strategy, Credibility and Independence: Theory and Evidence, Cambridge, MA: MIT Press.
- , Lippi, F., (1999) "Central Bank Independence, Centralization of Wage Bargaining, Inflation and Unemployment: Theory and some Evidence." *European Economic Review* 43, 1395-1434.
- Danziger, L. (1988) "Real Shocks, Efficient Risk Sharing and the Duration of Labor Contracts." *Quarterly Journal of Economics*: 435-440.
- Dye, R. (1985) "Optimal Length of Labor Contracts." *International Economic Review* Vol. 26 (1): 251-270.
- Fischer, S. (1977) "Long-Term Contracts, Rational Expectations and Optimal Money Rule." *Journal of Political Economics* 85:191-205.

- Gray, J.A. (1976) "Wage Indexation, A Macroeconomic Approach." *Journal of Monetary Economics* 2: 221-35.
- (1978) "On indexation and Contract Length." *Journal of Political Economy* Vol. 86: 1-18.
- Groth, C., Johansson, A., (2002) "Bargaining Structure and Nominal Wage Flexibility." In A. Johansson, *Essays on Macroeconomic Fluctuations and Nominal Wage Rigidity*, IIES Monograph Series 43.
- Klein, N. (2004) "Collective Bargaining and Its Effect on Central Bank Conservatism: Theory and some Evidence." Discussion Paper No. 2004.07, Research Department, Bank of Israel.
- Murphy J.K. (1992) "Determinants of Contract Duration in Collective Bargaining Agreement." *Industrial and Labor Relation Review* 45 (2): 352-365.
- (2000) "What Effect Does Uncertainty have on the Length of Labor Contracts?" *Labour Economics* 7: 181-201.
- OECD 1997. "Economic Performance and the Structure of Collective Bargaining." *Employment Outlook*: 63-92.
- Stieber, J. (1959) "Evaluation of long-term contracts." In: H. Davey, H. Kaltenborn, S. Ruttenberg, (Eds.), *New Dimensions in Collective Bargaining*. New York: Harper, pp. 137-153.
- Vroman S.B., (1989) "Inflation Uncertainty and Contract Duration." *The Review of Economics and Statistics* 71 (4): 677-681.
- Wallace, H.F., Blanco, H. (1991) "The effects of Real and Nominal Shocks on Union-Firm Contract Duration." *Journal of Monetary Economics* 27: 361-380.
- Walsh, C (1995), "Optimal Contracts for Central Banker." *American Economic Review* 85, 150-67.