Why wages tend to be lower in worker owned firms than in investor owned firms?

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**Why wages tend to be lower in worker owned firms than in investor owned firms?**

Luigi Bonatti* and Lorenza A. Lorenzetti**

**Abstract:** Consistently with the empirical evidence and in contrast with Shapiro & Stiglitz (1984), we demonstrate that worker owned firms exhibit not only more wage flexibility and less employment volatility than investor owned firms, but also lower expected wages than the latter. This is due to the informational advantage enjoyed by the firm’s owners relatively to the workers concerning some circumstances that affect the performance of the firm. We show this both in the case in which each investor owned firm offers labor contracts to single workers who act atomistically and in the case in which each investor owned firm negotiates labor conditions with its workers who act as a group (a “union”). Finally, we show that differences in attitudes towards risk between investor owned firms and their workers are not necessary to explain the typical combination of state-independent wages and cyclical layoffs that characterizes most industries.

**Key words:** labor demand uncertainty, wage flexibility, labor contracts, asymmetric information, employment volatility, worker co-operatives.

**JEL codes:** D21, D86, J33, J41, J54.

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1. INTRODUCTION

In a pioneering article focusing on the labor-market implications of asymmetric information between employer and employees, Shapiro & Stiglitz (1984) demonstrated that in worker owned firms (WOFs), i.e. in firms whose workers are also the owners, wages are higher than in investor owned firms (IOFs), i.e. firms whose workers and owners are distinct individuals.

However, this result is at odds with the empirical evidence relative to various countries, overwhelmingly showing that WOFs tend to exhibit not only more wage flexibility and less employment volatility than IOFs, but also lower wages than the latter.\(^1\) In the search for an explanation of this stylized fact, the hypothesis that WOFs pay lower wages because they are less efficient than IOFs does not appear supported by the evidence.\(^2\) An alternative explanation is based on the existence of asymmetric information between employer and employees on a different aspect of their relationship than that emphasized by Shapiro & Stiglitz (1984), who focus on the costs that the owners of a IOF (but not the owners of a WOF) incur for monitoring the performance of the workers. In contrast, the alternative explanation that we model in this paper hinges on the fact that, if the labor contract makes wages contingent on some event affecting the performance of the firm, the owners of a IOF (but not the owners of a WOF) have an incentive (in order to pay lower wages) to exploit their informational advantage by claiming that the state of the world is worse than what actually is. Given this hypothesis, we show that WOFs exhibit not only more wage flexibility and less employment volatility than IOFs, but also lower expected wages than the latter. These results are derived in a simple setup that accounts both for a

\(^1\) See, e.g., Bartlett et al. (1992), Craig et al. (1995), Pencavel et al. (2006), Clemente et al. (2012).

framework where each IOF offers labor contracts to single workers who act atomistically and for a framework where each IOF negotiates with its workers who act as a group (a “union”). Moreover, our results hold both under the assumption that workers are risk averse and under the assumption that they are risk neutral (as in Shapiro & Stiglitz, 1984), thus challenging—as in Albanese et. al (2015)—the traditional explanation of workers’ preference for fixed wages in IOFs based on risk aversion.

The prevalence, especially in industries whose product demand is uncertain, of contractual arrangements entailing wage stickiness and layoffs of workers in periods of low demand motivated a literature emphasizing the role that risk-neutral IOFs play in insuring their risk-averse employees against undesired labor income fluctuations (Baily, 1974; Azariadis, 1975). Hence, differences in attitudes towards risk between IOFs and their workers were invoked in this literature to explain the typical combination of state-independent wages and cyclical layoffs that characterizes these industries. Here, we show that these differences are not necessary for explaining such a mix, since workers’ lack of trust in the veracity of their employer’s representation of facts and their difficulty to ascertain them are sufficient to generate that combination.

With regard to our approach to WOFs, we follow the pioneering contribution of Miyazaki and Neary (1974), whose analysis hinges on the distinction between those workers who unite for establishing an enterprise and those of them who are actually employed, implying that a rational member of a WOF should maximize its expected utility, given the income and employment risk associated to its WOF’s membership.

The rest of the paper is organized as follows: in section 2 we present the model and we derive our main result; section 3 extends the basic model to the case in which the workers are risk neutral and receive an unemployment benefit paid by the government if laid off; in section 4 we briefly conclude.
2. **THE BASIC MODEL**

We model an industry in which a single product can be produced both by a large number (normalized to be one) of identical investor owned firms (IOFs) and by a large number (normalized to be one) of identical worker owned firms (WOFs). The assumption that IOFs coexist with WOFs adds realism to our analysis, which differs from Shapiro & Stiglitz (1984), in which the equilibrium emerging when all firms are IOFs is compared to the equilibrium emerging when all firms are WOFs.

Each firm $j$ produces the single product (whose price is normalized to be one) according to the following technology:

$$Q_j = xL_j^\gamma, \ 0 < \gamma < 1, \ j = i, w,$$

where $Q_i$ ($Q_w$) is the quantity of the single product produced by the representative IOF (WOF), $L_i$ ($L_w$) are the workers employed by the representative IOF (WOF), and $x$ is an uniformly distributed random variable with support $[0,a]$, $a>0$.

Each firm $j$ ($j=i,w$) has a group of $N_j$ workers before the realization of $x$ and cannot employ workers who do not belong to this group ($L_j \leq N_j$).\(^3\) Firms attract workers by offering to each of them a level $\overline{U}_j$ of expected utility larger than the (exogenously given) level $\overline{U}$ that a worker can expect to reach

\(^3\) This assumption is consistent with a situation in which workers need some specific training in order to be employed in the production process. Thus, in the short term, each firm $j$ cannot expand its employed workforce beyond $N_j$, that are those who have acquired these specific skills.
elsewhere in the economy, namely if and only if $U_j \geq \bar{U}$. Workers affiliated with firm $j$ receive a wage $W_j$ (paid by the firm) if employed and zero if unemployed. Therefore, their expected utility is $p_j \frac{W_j^{1-\theta}}{1-\theta}$, where $\theta$ ($0 \leq \theta < 1$) is the coefficient of (relative) risk aversion and $p_j$ is the representative worker’s probability of being employed, which is defined as $^4$

$$p_j = \begin{cases} 1 & \text{if } L_j \geq N_j \\ \frac{L_j}{N_j} & \text{otherwise.} \end{cases}$$

(2)

**2.1 Investor owned firms**

The presence of asymmetric information between investors and workers prevents the latter from verifying the true realization of $x$. Hence, IOF’s labor contracts cannot make the wage contingent on $x$: wages are state-independent and are set before the realization of $x$. These contracts typically leave to the firms the right to freely choose the level of employment after the realization of $x$ (“right to manage”). This implies that the representative IOF chooses $L_i$ knowing both $W_i$ and $x$ so as to maximize its profits $\Pi_i = Q_i - W_i L_i$ subject to (1), thus obtaining:

$$L_i = \begin{cases} \left( \frac{\gamma x}{W_i} \right)^{\frac{1}{\gamma}} & \text{if } x \leq \frac{W_i N_i^{1-\gamma}}{\gamma} \\ N_i & \text{otherwise.} \end{cases}$$

(3)

$^4$ Notice that all workers have the same probability of being employed: those to be laid off are selected at random.
Given (1)-(3), one can obtain both the expected profits of the representative IOF:

\[
\Pi_i = \begin{cases} 
\int_0^\gamma x \left( \frac{\gamma x}{W_i} \right)^{\frac{1}{\gamma}} \frac{(1-\gamma)dx}{a} + \int_0^{\frac{a}{w_iN_i^1}} \frac{(aN_i - W_iN_i)dx}{a} = \frac{W_i^2N_i^{1-\gamma}}{2a(2-\gamma)} + \frac{aN_i^\gamma}{2} - W_iN_i & \text{if } W_i \leq \frac{a\gamma}{N_i^{1-\gamma}} \\
\int_0^\gamma x \left( \frac{\gamma x}{W_i} \right)^{\frac{1}{\gamma}} \frac{(1-\gamma)dx}{a} = a^{\frac{1}{\gamma}} \left( \frac{\gamma}{W_i} \right)^{\frac{1}{\gamma}} (1-\gamma)^2 & \text{otherwise,}
\end{cases}
\]

and the expected utility of the representative worker hired by a IOF:

\[
U_i = \begin{cases} 
\int_0^\gamma x \left( \frac{\gamma x}{W_i} \right)^{\frac{1}{\gamma}} dx \frac{a}{N_i} + \int_0^{\frac{a}{w_iN_i^{1-\gamma}}} dx = \frac{W_i^{1-\theta}}{1-\theta} = \left[ 1 - \frac{W_iN_i^{1-\gamma}}{a\gamma(2-\gamma)} \right] \frac{W_i^{1-\theta}}{1-\theta} & \text{if } W_i \leq \frac{a\gamma}{N_i^{1-\gamma}} \\
\int_0^\gamma x \left( \frac{\gamma x}{W_i} \right)^{\frac{1}{\gamma}} \frac{W_i^{1-\theta}dx}{(1-\theta)aN_i^\gamma} = a^{\frac{1}{\gamma}} \left( \frac{\gamma}{W_i} \right)^{\frac{1}{\gamma}} (1-\gamma)W_i^{1-\theta} & \text{otherwise.}
\end{cases}
\]

With regard to wage setting, we take into consideration two possible setups: in the first scenario we assume that the workers hired by a IOF act atomistically vis-à-vis it, namely that each firm makes its wage offer unilaterally so as to attract a workforce of optimal size, while in the second scenario we assume that the workers hired by a IOF act as a group vis-à-vis it, namely that they are unionized and sets the wage unilaterally so as to maximize their expected utility (“right to manage” bargaining model).

2.1.1 Atomistic wage setting

In the first scenario, the order of events is the following: i) the representative IOF makes a wage offer and hires its workforce, ii) a shock occurs, iii) employment is determined.
At date i), before the realization of x, the representative IOF chooses $W_i$ and $N_i$ in order to maximize $\Pi_i$ subject to $\bar{U}_i \geq \bar{U}$. Given (4) and (5), its problem can be formulated as

$$\max_{w_i, n_i} \quad \frac{W_i^2 N_i^{2\gamma}}{2a(2-\gamma)} + \frac{aN_i}{2} - W_i N_i \quad \text{subject to} \quad \bar{U}_i = \left[1 - \frac{W_i N_i^{1-\gamma}}{a\gamma(2-\gamma)}\right] \frac{W_i^{1-\theta}}{1-\theta} \geq \bar{U} \quad ,$$

thus obtaining the equilibrium values:

$$W_i^* = a\gamma \varphi(\gamma, \theta)(N_i^*)^{\gamma-1} ,$$  \hspace{1cm} (7)

and

$$N_i^* = \psi(\gamma, \theta, a, \bar{U}) \quad (8)$$

$$\bar{U}_i^* = \left[1 - \frac{\varphi(\gamma, \theta)}{(2-\gamma)} \right] \frac{(W_i^*)^{1-\theta}}{1-\theta} = \bar{U} ,$$

where $\varphi(\gamma, \theta) < 1$ and $\psi(\gamma, \theta, a, \bar{U})$ are functions of the parameters (see the Appendix).

### 2.1.2 Union wage setting

In the second scenario, the order of events is the following: i) the representative IOF hires its workforce, ii) the representative union sets the wage, iii) a shock occurs, iv) employment is determined.

At date ii), given $N_i$ and before the realization of x, the representative union chooses $W_i$ in order to maximize $\bar{U}_i$, thus setting

\[ W_i > a\gamma N_i^{\gamma-1} \]

It is easy to check by inspecting (4) that it is never optimal for a IOF to set $W_i > a\gamma N_i^{\gamma-1}$.
\[ W_i = w(N_i) = \frac{(2-\gamma)(1-\theta)a\gamma}{(2-\theta)N_i^{\gamma-1}} < \frac{a\gamma}{N_i^{\gamma-1}}. \quad (10) \]

At the moment of hiring its workforce, the representative IOF chooses \( N_i \) in order to maximize \( \Pi_i \) subject to \( \bar{U}_i \geq \bar{U} \) and being aware of the optimizing behavior of the union. Given (4), (5) and (10), its problem can be formulated as

\[
\max_{N_i} \frac{[w(N_i)]^2 N_i^{2-\gamma}}{2a\gamma(2-\gamma)} + \frac{aN_i^\gamma}{2} - w(N_i)N_i \quad \text{subject to} \quad \bar{U}_i = \left[1 - \frac{w(N_i)N_i^{\gamma}}{a\gamma(2-\gamma)}\right] \frac{[w(N_i)]^{1-\theta}}{1-\theta} \geq \bar{U}, \quad (11)
\]

from which one obtains the equilibrium values:

\[
N_i^\# = \left\{ \left[\frac{(2-\gamma)a\gamma}{U(1-\theta)(2-\theta)^{2-\gamma}}\right]^{\frac{1}{(1-\gamma)(1-\theta)}} \right\}^{1-\gamma}, \quad (12)
\]

\[
W_i^\# = w(N_i^\#) = \left[\frac{(2-\theta)(1-\theta)U}{\left[\frac{w(N_i^\#)}{1-\theta}\right]^{1-\theta}}\right]^{\frac{1}{1-\theta}} \quad (13)
\]

and

\[
\bar{U}_i^\# = \frac{[w(N_i^\#)]^{1-\theta}}{(2-\theta)(1-\theta)} = \bar{U}. \quad (14)
\]

### 2.2 Worker owned firms

In the case of WOFs, the order of events is the following: i) a group of workers of size \( N_w \) establishes a WOF, ii) a shock occurs, iii) the wage is set and employment is determined.
At date iii), after the realization of x, the group of workers controlling the firm chooses $W_w$ and $L_w$ in
order to maximize $p_w \frac{W_w^{1-\theta}}{1-\theta}$ subject to the firm’s budget constraint $Q_w - W_w L_w \geq 0$. Given (1) and (2),
its problem can be formulated as

$$
\max_{w_w} \begin{cases} 
\left( \frac{x}{W_w} \right)^{1-\gamma} \frac{W_w^{1-\theta}}{N_w (1-\theta)} & \text{if } W_w \geq xN_w^{1-1} \\
\frac{W_w^{1-\theta}}{1-\theta} & \text{otherwise,}
\end{cases}
$$

(15)

thus obtaining $W_w = xN_w^{1-1}$, which implies $L_w = N_w$ and $p_w \frac{W_w^{1-\theta}}{1-\theta} = (xN_w^{1-1})^{1-\theta}$. Notice that for the representative member of a WOF it is always optimal to maintain full employment:
even when the firm is hit by an extremely adverse shock, the gain in expected utility due to a higher wage
does not compensate the fall of expected utility associated with the lower probability of being employed
that this wage increase brings about.

At date i), before the realization of x, the size of the group of workers controlling the representative
WOF is determined. This number $N_w$ must satisfy

$$
\bar{U}_w = \frac{a}{(1-\theta) a} \int_0^a (xN_w^{1-1})^{1-\theta} dx = \frac{[aN_w^{1-1}]^{1-\theta}}{(1-\theta)(2-\theta)} = \bar{U},
$$

(16)

thus entailing the equilibrium values

$$
N_w^* = \left\{ \frac{a^{1-\theta}}{\bar{U}(1-\theta)(2-\theta)} \right\}^{1/(1-\gamma x(1-\theta))}
$$

(17)
and

\[ W_w^* = x(N_w^*)^{\gamma-1} = \frac{x[\bar{U}(1-\theta)(2-\theta)]^{1/\gamma}}{a}. \]  \hspace{1cm} (18)

2.3 Comparing the IOFs’ expected wage to the WOFs’ expected wage

The possibility for the workers to freely choose where to work (full labor mobility) implies that in equilibrium the workers’ expected utility is equalized across the economy: \( \bar{U}_i^* = \bar{U}_i^w = \bar{U}_w^* = \bar{U} \). In this context, the following proposition holds:

**Proposition 1** The IOF’s expected wages \( \bar{W}_i^w \) and \( \bar{W}_i^\# \) are strictly larger than the WOF’s expected wage \( \bar{W}_i^* \) and

\[ \bar{W}_i^w > \bar{W}_i^\# > \bar{W}_i^* \]

where \( \bar{W}_i^* = W_i^# \), \( \bar{W}_i^w = W_i^\# \) and

\[ \bar{W}_w^* = \int_0^a \frac{x(N_w^*)^{\gamma-1} dx}{a} = \frac{a(N_w^*)^{\gamma-1}}{2} = \left[ \frac{\bar{U}(1-\theta)(2-\theta)}{2} \right]^{1/(\gamma-1)}. \]  \hspace{1cm} (19)

*Proof:* One can easily check that \( \bar{W}_i^\# > \bar{W}_w^* \) by comparing (13) to (19). To verify that \( \bar{W}_i^\# > \bar{W}_i^* \) and \( \bar{W}_i^w > \bar{W}_w^* \) see the Appendix.

Intuitively, the workers affiliated with a WOF choose to minimize employment volatility, since—differently than their colleagues affiliated with a IOF—they can ascertain the true state of the world and make their wage contingent on it. In this way, they can maximize their probability of being employed, and therefore they are willing to accept a lower expected wage than their colleagues affiliated with a IOF, who are exposed to a higher probability of being laid off. In a IOF, the wage is higher (and the probability of employment is lower) when the workers negotiate it collectively with the firm, thus
exploiting their monopoly power over the labor services needed by the firm, rather than when they negotiate the wage individually. In the latter case, indeed, it is profit-maximizing for a IOF to offer to their employees a contract which sets forth a lower wage—and consequently a higher probability of employment—than the wage set by a monopoly union.

3. **UNEMPLOYMENT BENEFIT**

In this section, we consider an extension of the basic model presented above by assuming—as in Shapiro & Stiglitz (1984)—that the workers are risk neutral (which in our setup amounts to impose $\theta = 0$) and that those who are laid off receive an unemployment benefit $b$. This unemployment benefit is paid by the government and is assumed to be $0 < b < \bar{U}$. In other words, the expected utility of a worker affiliated with firm $j$ (including $i$ and $w$) is now $\bar{U}_j = p_j W_j + (1 - p_j)b$.

3.1 **Investor owned firms**

The expected utility of the representative worker hired by a IOF becomes

---

$^7$ The assumption that $b < \bar{U}$ is consistent with the fact that elsewhere in the economy a worker is entitled to receive $b$ if unemployed and has a non-zero probability to find employment at a wage strictly higher than $b$. 

11
\[
\bar{U}_i = \begin{cases} 
\frac{\int_0^\gamma \left( \frac{\gamma x}{W_i} \right)^{1/\gamma} \, dx}{a N_i} + \frac{a}{W_i N_i^{1/\gamma}} \int_0^\gamma \left[ N_i - \left( \frac{\gamma x}{W_i} \right)^{1/\gamma} \right] b \, dx \, a N_i 
& \text{if } W_i \leq \frac{a \gamma}{N_i^{1/\gamma}} \\
\frac{\int_0^\gamma \left( \frac{\gamma x}{W_i} \right)^{1/\gamma} \, dx}{a N_i} + \frac{a}{W_i N_i^{1/\gamma}} \int_0^\gamma \left[ N_i - \left( \frac{\gamma x}{W_i} \right)^{1/\gamma} \right] b \, dx \, a N_i = b + \frac{(W_i - b)(1 - \gamma)}{(2 - \gamma) N_i} \left( \frac{\gamma a}{W_i} \right)^{1/\gamma} 
& \text{otherwise.}
\end{cases}
\]

### 3.1.1 Atomistic wage setting

Under atomistic wage setting, the problem of the representative IOF becomes:

\[
\begin{align*}
\text{Max} = & \quad \frac{W_i^2 N_i^{2/\gamma}}{2 a \gamma (2 - \gamma)} + \frac{a N_i^\gamma}{2} - W_i N_i \\
\text{subject to} & \quad \bar{U}_i = W_i - \frac{W_i N_i^{1/\gamma} (W_i - b)}{a \gamma (2 - \gamma)} \geq \bar{U},
\end{align*}
\]

from which we obtain the equilibrium values:

\[
W_i^* = \omega(\gamma, b, \bar{U}),
\]

\[
N_i^* = \eta(\gamma, a, b, \bar{U}) = \left[ \frac{a \gamma (2 - \gamma) [\omega(\gamma, b, \bar{U}) - \bar{U}]}{\omega(\gamma, b, \bar{U}) [\omega(\gamma, b, \bar{U}) - b]} \right]^{1/\gamma}
\]

and

\[
\bar{U}_i^* = \frac{W_i^* (N_i^*)^{1/\gamma} (W_i^* - b)}{a \gamma (2 - \gamma)} = \bar{U},
\]

\[\text{Again, it is easy to check by inspecting (4) that it is never optimal for a IOF to set } W_i > a \gamma N_i^{-1} .\]
where \( \omega(\gamma, b, \overline{U}) \) is a function of the parameters (see the Appendix).

### 3.1.2 Union wage setting

The wage set by the representative union is now

\[
W_i = n(N_i) = \begin{cases} 
  \frac{(2 - \gamma)a\gamma N_i^{1-\gamma}}{2} + \frac{b}{2} & \text{if } \frac{b}{\gamma} \leq \frac{a\gamma}{N_i^{1-\gamma}} \\
  \frac{b}{\gamma} & \text{otherwise.} 
\end{cases}
\]

Given (4), (20) and (25), at the moment of hiring its workforce, the representative IOF solves:

\[
\max_{N_i} \frac{n(N_i)^2 N_i^{2-\gamma}}{2\alpha(2 - \gamma)} + \frac{a N_i^{1-\gamma}}{2} - n(N_i) N_i \quad \text{s.t.} \quad \begin{align*}
  \overline{U}_i &= n(N_i) \left[ 1 - \frac{[n(N_i) - b] N_i^{1-\gamma}}{a\gamma(2 - \gamma)} \right] \geq \overline{U} \quad \text{if } \frac{b}{\gamma} \leq \frac{a\gamma}{N_i^{1-\gamma}} \\
  \overline{U}_i &= b + \frac{[n(N_i) - b](1 - \gamma)}{(2 - \gamma)N_i} \left[ \frac{\gamma a}{n(N_i)} \right]^{1/(1-\gamma)} \geq \overline{U} \quad \text{otherwise},
\end{align*}
\]

from which one obtains the equilibrium values:

\[
N_i^\# = \left\{ \left[ \frac{(2 - \gamma)a\gamma}{[2\overline{U} - b] + \sqrt{[2\overline{U} - b] - b^2}} \right]^{1/(1-\gamma)} \right\},
\]

\[
W_i^\# = n(N_i^\#) = \overline{U} + \frac{\sqrt{[2\overline{U} - b] - b^2}}{2}
\]

and

\[
\overline{U}_i^\# = \frac{(2 - \gamma)a\gamma N_i^{\#1-\gamma}}{4} + \frac{b^2(N_i^\#)^{1-\gamma}}{4(2 - \gamma)a\gamma} + \frac{b}{2} = \overline{U}.
\]
3.2 Worker owned firms

After the realization of x, the group of workers controlling the representative WOF solves

\[
\max_{W_w} \begin{cases} 
\left( \frac{x}{W_w} \right)^{1-\gamma} (W_w - b) N_w - b & \text{if } W_w \geq x N_w^{1-\gamma} \\
W_w & \text{otherwise},
\end{cases}
\]

thus obtaining

\[
W_w = \begin{cases} 
x N_w^{1-\gamma} & \text{if } x \geq b N_w^{1-\gamma} \\
b & \text{otherwise}
\end{cases}
\]

and

\[
L_w = \begin{cases} 
N_w & \text{if } x \geq b N_w^{1-\gamma} \\
\left( \frac{x}{b} \right)^{1-\gamma} & \text{otherwise}.
\end{cases}
\]

Notice that now—differently than in the absence of an unemployment benefit—it is optimal for the representative member of a WOF to set a lower bound for the wage, which generates unemployment when the shock hitting the firm is particularly adverse.

At date i), before the realization of x, the size of the group of workers controlling the representative WOF is determined. This number \( N_w \) must satisfy

\[
\bar{U}_w = \int_0^{b N_w^{1-\gamma}} \frac{b dx}{a} + \int_{b N_w^{1-\gamma}}^{a} \frac{x N_w^{1-\gamma} dx}{a} = \frac{b^2 N_w^{2-\gamma}}{2a} + \frac{a N_w^{1-\gamma}}{2} = \bar{U},
\]

thus entailing the equilibrium values
\[ N_w^* = \left\{ \frac{a}{U - \sqrt{U^2 - b^2}} \right\}^{(1-\gamma)} \]  

(35)

and

\[ W_w^* = \begin{cases}  
x(N_w^*)^{-1} = \frac{x[U - \sqrt{U^2 - b^2}]}{a} & \text{if } x \geq b(N_w^*)^{1-\gamma} \\
b & \text{otherwise.} \end{cases} \]  

(36)

3.3 Comparing the IOFs’ expected wage to the WOFs’ expected wage

One can demonstrate that Proposition 1 holds even in the presence of an unemployment benefit (see the Appendix). In particular, the fact that both \( \bar{W}_i^\# > W_w^* \) and \( \bar{W}_i^* > \bar{W}_w^* \) hold, where \( \bar{W}_i^\# = W_i^\# \), \( \bar{W}_i^* = W_i^* \) and

\[ \bar{W}_w^* = \int_0^b \frac{b(N_w^*)^{3-\gamma}}{a} dx + \int_{b(N_w^*)^{1-\gamma}}^a \frac{x(N_w^*)^{-1}}{a} dx = \frac{b^2(N_w^*)^{1-\gamma} + a(N_w^*)^{-1}}{2a}, \]  

(37)

can be deducted by observing that in equilibrium \( \bar{U}_i^\# = \bar{U}_i^* = \bar{U}_w^\# = \bar{U}_w^* = U, \) \( \bar{U}_w^\# = \bar{W}_w^* \), \( \bar{U}_i^\# < \bar{W}_i^\# \) and \( \bar{U}_i^* < \bar{W}_i^* \).  

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9 In its turn, the fact that \( \bar{U}_i^\# < \bar{W}_i^\# \) can be checked by recalling that \( \bar{U}_i^\# = p_i^\# W_i^\# + (1 - p_i^\#)b \), where \( 0 < p_i^\# < 1 \), \( W_i^\# = W_i^\# \) and \( W_i^\# > b \). Similarly for the fact that \( \bar{U}_i^* < \bar{W}_i^* \).
4. CONCLUSIONS

Consistently with the empirical evidence and in contrast with Shapiro and Stiglitz (1984), we have demonstrated that, if the firm’s owners enjoy an informational advantage relatively to the workers concerning some circumstance that affects the performance of the firm, worker owned firms exhibit not only more wage flexibility and less employment volatility than investor owned firms, but also lower expected wages than the latter. We have shown this both in the case in which each investor owned firm offers labor contracts to single workers who act atomistically and in the case in which each investor owned firm negotiates labor conditions with its workers who act as a group (a “union”). Finally, we have shown that differences in attitudes towards risk between investor owned firms and their workers are not necessary to explain the typical combination of state-independent wages and cyclical layoffs that characterizes most industries.

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REFERENCES


**APPENDIX**

**A1 Derivation of** \((W_i^*, N_i^*)\)

To solve (6), we derive the following first-order condition for a maximum with respect to the choice of \(W_i\):

\[
\frac{dN_i}{dW_i} \bigg|_{U_i = \bar{U}} = 0.
\]

(A1)

Considering that \(\frac{dN_i}{dW_i} \bigg|_{U_i = \bar{U}} = \frac{W_i^{2-\gamma} N_i^* \gamma(2 - \gamma)}{(1 - \gamma)} - \frac{W_i^{2-\gamma} N_i^* \gamma(1 - \gamma)}{(1 - \gamma)}\), one can rewrite (A1) as a cubic equation in \(M \equiv \frac{W_i N_i^{1-\gamma}}{a\gamma}, \ 0 < \frac{W_i N_i^{1-\gamma}}{a\gamma} \leq 1:\)

\[
\Omega(M, \gamma, \theta) = 0,
\]

(A2)

where \(\Omega(M, \gamma, \theta) = M^2 \left[ \frac{1}{2(1 - \gamma)} \right] - \frac{(2 - \gamma)}{2(1 - \gamma)} - M \left[ \frac{1 - (1 - \theta)(2 - \gamma)}{2(1 - \gamma)} \right] + \frac{(2 - \gamma)(1 - \gamma)}{2(1 - \gamma)} + \frac{(2 - \gamma)(1 - \theta)}{2(1 - \gamma)}\). Notice that

\[
\frac{\partial \Omega(M, \gamma, \theta)}{\partial M} < 0.
\]

Solving (A2) for \(M\), one obtains \(M = \frac{W_i N_i^{1-\gamma}}{a\gamma} = \phi(\gamma, \theta)\), entailing
Given (A3), one can use \( \bar{U}_i = \left[ \frac{1 - W_i N_i^{1-\gamma}}{a\gamma(2-\gamma)} \right] W_i^1 = \bar{U} \) to obtain

\[
N_i^* = \psi(\gamma, \theta; a, \bar{U}) = \left[ \frac{1 - \frac{a\psi(\gamma, \theta)}{(2-\gamma)}}{1 - \frac{a\psi(\gamma, \theta)}{(2-\gamma)}} \right]^{\frac{1}{(1-\gamma)(1-\theta)}}.
\]  

(A4)

**A2 Proof that \( \bar{W}_i^* > \bar{W}_i > \bar{W}_w^* \)**

To see that \( \bar{W}_i^* > \bar{W}_i^* \), consider that \( \bar{U}_i^* = \bar{U}_i^* \) implies \( N_i^* = N_i^{\gamma-1} \left[ \frac{1 - \frac{a\psi(\gamma, \theta)}{(2-\gamma)}}{1 - \frac{a\psi(\gamma, \theta)}{(2-\gamma)}} \right]^{\frac{1}{(1-\gamma)(1-\theta)}} \) if and only if

\[
\left[ \frac{1 - \frac{a\psi(\gamma, \theta)}{(2-\gamma)}}{1 - \frac{a\psi(\gamma, \theta)}{(2-\gamma)}} \right]^{\frac{1}{(1-\gamma)(1-\theta)}} > 1.
\]  

(A5)

In its turn, (A5) is satisfied if and only if

\[
\frac{(2-\gamma)(1-\theta)}{(2-\gamma)} > \psi(\gamma, \theta).
\]  

(A6)

One can verify that (A6) holds by noticing that \( \frac{\partial \Omega(M, \gamma, \theta)}{\partial M} < 0 \) and by checking that \( M = \frac{(2-\gamma)(1-\theta)}{(2-\gamma)} \) entails \( \Omega(M, \gamma, \theta) < 0 \), while \( M = \psi(\gamma, \theta) \) satisfies \( \Omega(M, \gamma, \theta) = 0 \).
To see that \( \hat{W}_i^* > W_i^* \), consider that \( U_i^* = \hat{U}_w^* \) implies \( N_i^* = N_w^* \left[ 1 - \frac{\varphi(\gamma, \theta)}{(2 - \gamma)} \right]^{(1/\gamma)(1-1/\gamma)} \), thus

\[
\frac{a(N_w^*)^{y-1}}{2} < \frac{a(N_w^*)^{y-1}}{2} \cdot \frac{1}{\left[ 1 - \frac{\varphi(\gamma, \theta)}{(2 - \gamma)} \right]^{(1/\gamma)(1-1/\gamma)}} \text{ if and only if }
\]

\[
\left[ 1 - \frac{\varphi(\gamma, \theta)}{(2 - \gamma)} \right]^{(1/\gamma)(1-1/\gamma)} < 2. \tag{A7}
\]

In its turn, (A7) is satisfied if and only if

\[
(2 - \gamma) \left[ 1 - \frac{2^{1-\gamma}}{(2 - \gamma)} \right] < \varphi(\gamma, \theta). \tag{A8}
\]

One can verify that (A8) holds by noticing that \( \frac{\partial \Omega(M, \gamma, \theta)}{\partial M} < 0 \) and by checking that \( M = (2 - \gamma) \left[ 1 - \frac{2^{1-\gamma}}{(2 - \gamma)} \right] \) entails

\( \Omega(M, \gamma, \theta) > 0 \), while \( M = \varphi(\gamma, \theta) \) satisfies \( \Omega(M, \gamma, \theta) = 0 \).

**A3 Derivation of \((W_i^*, N_i^*)\) in the presence of unemployment benefit**

To solve (21), we derive the first-order condition (A1). Considering that now \( \frac{\partial N_i}{\partial W_i} \bigg|_{U_i = U} = \frac{N^*_i a(2 - \gamma) - N_i (2 W_i - b)}{(1 - \gamma) W_i (W_i - b)} \),

one can rewrite (A1) as

\[
\frac{(1 - \gamma)(W_i - b)}{(2 - \gamma)^2} \left( \frac{W_i N_i^{1/\gamma}}{a\gamma} \right)^2 - \frac{(1 - \gamma)(W_i - b)}{(2 - \gamma)} \left( \frac{W_i N_i^{1/\gamma}}{a\gamma} \right) + \frac{a^2 N_i^{1/\gamma}}{2} - \frac{(2 W_i - b)}{2(2 - \gamma)} \left( \frac{W_i N_i^{1/\gamma}}{a\gamma} \right)^2 = 0 \tag{A9}
\]

It follows from \( \hat{U}_i = U \) that

\[
N_i = \left[ \frac{a(2 - \gamma)(W_i - U)}{W_i (W_i - b)} \right]^{\frac{1}{1-\gamma}}. \tag{A10}
\]
Using (A10) for substituting $N_i$, the condition (A9) becomes:

$$
\Psi(W_i, \gamma, b, \bar{U}) = 0,
$$

(A11)

where

$$
\Psi(W_i, \gamma, b, \bar{U}) = 2(1-\gamma)(2-\gamma)[(W_i - b)(W_i - \bar{U})^3 - (W_i - b)^2(W_i - \bar{U})^2] + (W_i - b)^3 W_i - (W_i - b)^2 (2W_i - b)(W_i - \bar{U}) + + (2 - \gamma)^2 [(W_i - b)W_i(W_i - \bar{U})^2 - (2W_i - b)(W_i - \bar{U})^3] - 2(2 - \gamma)[(W_i - b)^2 W_i(W_i - \bar{U}) - (W_i - b)(2W_i - b)(W_i - \bar{U})^2].
$$

Notice that (A11) is a biquadratic equation in $W_i > 0$ such that $\frac{\partial \Psi(W_i, \gamma, b, \bar{U})}{\partial W_i} < 0$, whose solution gives $W_i^* = \omega(\gamma, b, \bar{U})$.

**A4 Proof that $\bar{W}_i^\# > \bar{W}_i^\ast > \bar{W}_w^\ast$ in the presence of unemployment benefit**

One can verify that $\bar{W}_i^\# > \bar{W}_i^\ast$ holds by noticing that $\frac{\partial \Psi(W_i, \gamma, b, \bar{U})}{\partial W_i} < 0$ and by checking that $W_i = \bar{W}_i^\#$, where $W_i^\# = \bar{W}_i^\#$, entails $\Psi(W_i, \gamma, b, \bar{U}) < 0$, while $W_i = W_i^\ast = \bar{W}_i^\ast = \omega(\gamma, b, \bar{U})$ satisfies $\Psi(W_i, \gamma, b, \bar{U}) = 0$.

One can verify that $\bar{W}_w^\ast > \bar{W}_w^\ast$ holds by noticing that $\frac{\partial \Psi(W_i, \gamma, b, \bar{U})}{\partial W_i} < 0$ and by checking that $W_i = \bar{W}_w^\ast$, where $W_i^\ast = \bar{W}_w^\ast = \bar{U}$, entails $\Psi(W_i, \gamma, b, \bar{U}) > 0$, while $W_i = W_i^\ast = \bar{W}_w^\ast = \omega(\gamma, b, \bar{U})$ satisfies $\Psi(W_i, \gamma, b, \bar{U}) = 0$. 

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