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Wage Restraint and Volatility

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Abstract: This paper studies the notion that a rise in job insecurity, due to rising labor market uncertainty, leads to wage moderation - the 'wage restraint hypothesis'. It begins by finding only mixed theoretical support for this hypothesis, as an increase in uncertainty generates an ambiguous effect on wages, although it raises job insecurity. Then, using industry data, it finds evidence of wage restraint, as volatility significantly lowers the share of (production) wages in value added.

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1 Introduction

> "Atypical restraint on compensation increases has been evident for a few years now and appears to be mainly the consequence of greater work insecurity." Alan Greenspan (1997), Testimony to the US congress.

There is increasing evidence that labor demand uncertainty has risen in the last two decades. Gottschalk and Moffit (1994) have reported an increase in earnings volatility in the 1980's, which seems to have hit mainly the unskilled. There is also expanding evidence of a rise in job insecurity, in the 1990's (Farber, 1997; Aaronson and Sullivan, 1998; Schmidt, 1999).[2] Hence, while the postwar decades were characterized by a period of fairly stable employment and wage growth, things have become much more unstable since the early 1980's. Moreover, these changes in labor markets seem to be associated with rising industry-specific volatility in product markets. For example, Magnani (2001a) finds that, despite the well established decline in aggregate business cycle fluctuations, the volatility of 3-digit industry shipments in the United States has substantially grown, from the mid 1970's to the late 1980's.

This paper looks at the extent to which the rise in labor market uncertainty and job insecurity is associated with the moderation in wage growth. This notion, henceforth 'the

[2] Farber (1997) and Aaronson and Sullivan (1998) report increases in displacement rates in the 1990's, in the United States. Similar evidence has been found in other industrialized countries. In a recent study, OECD (1997) concludes that workers' perceptions of job insecurity have risen sharply in most OECD countries; although, on average, jobs last just as long now as in the 1980s. See also Nickel, Jones and Quitini (2002) and Green, Felstead and Burchell (2000), for evidence on the UK.

wage restraint hypothesis' is motivated by the statement of Fed chairman Greenspan that opens this paper. The empirical debate surrounding the role of insecurity for the slowdown in wage growth of the last two decades remains inconclusive. Aaronson and Sullivan (1998) report that job-insecurity has had an impact on wage restraint. However, Deavers (1998) rejects this view, based on the evidence that the growth of the average wage in the 1990's was consistent with measured productivity growth, and the share of US national income going to wages has remained relatively stable.

We develop a simple theoretical model where labor demand (i.e. the marginal productivity of labor) is volatile, and wages and job-insecurity are interdependent variables set through contracts. Assuming an institutional context where wages are not renegotiable, dismissals occur when the wage is lower than the value of productivity net of firing costs, generating ex-ante job-insecurity.[3] Hence, when setting wages, workers face a clear trade-off: a higher wage means higher income in the favorable state of the world, but also increased job-insecurity.

Our goal is to look at the effect of an increase in labor demand volatility (LDV) on wages, contingent on expected productivity. Surprisingly, we find that, although the a rise in LDV increases the probability of job-loss, the wage adjustment that it implies is ambiguous. The intuitive view that it will posit wage restraint, captures only the income effect: the increase in volatility will make workers worse off, by raising the prospects of job-loss, and will, in equilibrium, be accommodated by a decline in wages and job-security, which are both

[3] Hall and Lilien (1979) argue that these are common features of the most widespread forms of wage bargaining. Kahn and Huberman (1988) and Hall (1995) provide a framework where non-renegotiable and non-contingent contracts with right to fire emerge in equilibrium, if an effort is required by the worker that in unobservable by the employer. Hamermesh (1991) builds a related model to discuss the effects on wages of a downward shift in the distribution of productivity shocks that raises the likelihood of bankruptcy.

normal goods.

However, we uncover also a conflicting effect capturing the implications of an increase in LDV for the trade-off between wages and job-security (the substitution effect) : as the distribution of productivity undergoes a mean-preserving-spread, the marginal benefit of wage cut, in terms of increased job-security, falls, i.e. the 'price of job-security' increases. This makes workers less willing to accept wage sacrifices, and may produce an increase in equilibrium wages.

Then, we take the 'wage restraint hypothesis' to the data. Using the NBER Manufacturing Productivity database, we measure LDV as the volatility of productivity growth, obtained from the predicted conditional variance of an ARCH 1 regression. We show that there has been an increase in the mean industry's LDV after the mid-1970s, although there is no discernible trend within the last two decades. Meanwhile the mean industry's share of labor (production workers) in value added, which we view as a measure of the wage deflated by (i.e. contingent on) marginal productivity, has declined dramatically from the 1960's to the 1990's.

We estimate a time- and industry-fixed effects regression, looking at the effect of LDV on the share of labor. We show that the effect of changes in LDV on the share of labor is negative and statistically very significant, lending support to the 'wage restraint hypothesis'. In addition, wage restraint is magnified when the degree of unionization in the industry rises, which we impute to the less competitive nature of labor markets in such industries. Moreover, the economic significance of our estimates is high, generating changes in the share of labor that are very close to the actual changes.

In the next section, we discuss the institutional setting that motivates our model of wage determination. Section three looks at the effects of an increase in the labor demand volatility, captured as a mean-preserving spread in the distribution of productivity. Section four integrates the seemingly contradictory notions of (a) wage restraint in the face of higher job-insecurity and (b) compensating wage-premia in high job-insecurity industries. Section five looks at the empirical evidence. Section six concludes.

2 A Model of Wage Determination

2.1 Labor Market Institutions

In this paper, we look at a world where employers and workers establish implicit or explicit contracts that set a fixed wage (not contingent on productivity), but give the firm the right to dismiss the worker, at a cost. Hence job-security is endogenously determined and depends on the set wage, relative to productivity. This section introduces a stylized framework for wage setting that attempts to capture the legal and institutional arrangements behind such contracts.

First, we assume that only employers (and not workers) can observe the realization of productivity, which is stochastic. Here, we see the stochastic nature of productivity as associated with conditions of technology, product markets, and performance in other divisions of the firm, which are unobservable to the worker from his workplace and are privy to the manager. This assumption has been part of many models of labor market contracting under asymmetric information, starting with Calvo and Phelps (1977). (See Parsons 1986, for a survey). Letting W denote the real wage agreed ex-ante between the employer and the worker, this implies that the contract arrangement must be non-contingent on the realization of productivity.[4] .

Second, we assume also that the possibility remains that, upon knowing productivity (i.e. market conditions), the employer can choose to fire the worker. Job loss implies a cost to the worker, including sunk investments with the current employer (e.g. building personal relationships with employers and co-workers), future earnings losses, search costs and temporary unemployment, geographical relocation, etc... Under these conditions, as Hall (1995) points out, "suppression of renegotiation" is central to the contract. Otherwise, the worker can be held up to accept a lower wage, under the threat of dismissal, with its implicit costs. Hall (1995) argues that suppression of renegotiation emerges in a repeated game, and has become an important part of the cultural norms of the labor market, - the most common reason given by employers being that lowering wages destroys morale.

A third and final assumption is that, if she discharges the worker, the employer saves on paying the worker's wage but incurs in an exogenous firing cost c. The latter includes legal costs, related to "red-tape" and severance pay, and the cost associated with the specific investment by the firm (e.g. training).

The existing literature presents two examples of environments where a non-contingent, non-renegotiable contract with right to dismiss, such as the one outlined earlier, Pareto-dominates the full-(job)-security alternative, where the employer commits to a wage given by the worker's expected productivity: first, if the employer is subject to liquidity constraints that prevent her from providing full insurance to all its workers; second, if productivity re-

[4] Even though the actual realization of productivity is not available for inclusion in the employment contract, presumably correlated variables are available (e.g. market indicators of firm performance, government industry statistics). Hall and Lilien (1979) propose that the firm's employment level itself can be used as an indicator of product demand conditions. For simplicity, we ignore this possibility, under the assumption that the productivity of each worker is far from indicators of the performance of the firm or sector.

quires an effort from the worker that is unobserved by the employer. In the case of liquidity constraints, the worker accepts to be dismissed if the firm runs into cash-flow difficulties, as part of a union led negotiation that takes into account the increased prospects for the remaining workers (Hamermesh, 1991). In the case of an unobserved worker-effort, committing to full job security would undermine the incentive to the worker. Hence the efficient contract has the parties agreeing in advance on a wage and, upon observing the worker's productivity, the employer choosing to either pay the wage or discharge the worker; in equilibrium, the worker undertakes the necessary investment (Khan and Huberman, 1988). [5]

2.2 The Equilibrium Contract

Now, we develop a model of labor market contracts, under the general framework outlined in the previous section. Hence we assume that the firm and the employer set a non-contingent, non-renegotiable real wage (W), with the employer keeping the right to discharge the worker, upon a firing cost (c).

Take v to denote the 'real value of productivity' of a worker, given by

$$v = \bar{v}e^{\alpha\epsilon} \qquad 0 < \alpha < 1 \tag{1}$$

where ϵ is a random variable, with $E(\epsilon) = 0$ and $Var(\epsilon) = 1$, and $\alpha\epsilon$ captures the random component of productivity. Meanwhile, $\bar{v}$ includes all non-stochastic determinants of worker productivity, including industry-employment, and determines the expected productivity. In labor markets, v captures labor demand and α is a measure of the **conditional labor demand volatility** (LDV). Formally yielding a mean preserving spread of the distribution

[5] In a freely negotiated contract of the type outlined above, employer and worker could, in principle, agree on severance pay. We assume that the legal firing costs outweigh the equilibrium severance pay that would emerge from the contract. Of course, this may imply that the investment of the worker is suboptimal.

of $\ln v$, an increase in α captures the rise in LDV.[6]

Given the wage (W) and the firing cost (c), a worker is laid-off when $v - W < -c$. Note that, in this context, v denotes the productivity of the marginal worker, at the industry level. It is taken as given by each worker, who assumes he is the first to be laid-off. However, it is determined, in equilibrium, by the cross-industry allocation of workers (which is discussed in section 3). From (1), the lay-off condition can be rewritten as

$$\epsilon < \Omega(\omega) \equiv \alpha^{-1} \ln \left[\frac{W}{\bar{v}} (1 - c/W) \right] = \frac{\omega - \eta}{\alpha} \tag{2}$$

where $\omega \equiv \ln(W/\bar{v})$ is the **productivity-deflated-wage** and $\eta \equiv -\ln(1 - c/W) \approx c/W$ $(0 < \eta < 1)$ is the firing cost as a proportion of the wage.[7] The productivity-deflated-wage (ω) denotes the share of the worker's expected productivity appropriated by the worker as his real wage. The remaining productivity is captured by the employer. For simplicity, we will refer to ω as the wage (as opposed to W, the real wage).

Now, letting F and f denote, respectively, the distribution and density of ϵ, we can obtain the probability that the worker will not be laid off (ϕ), addressed henceforth as the *job security rate*, as

$$\begin{aligned} \phi \quad &\equiv \quad \Pr[\epsilon > \Omega] = 1 - F(\Omega(\omega)) \qquad (3) \\ &\Longrightarrow \quad \phi'_\omega = -\alpha^{-1} f < 0 \end{aligned}$$

[6] The 'real value of productivity' in an industry can be seen as $v \equiv pA/P$, where p is the price in the industry, A is the physical productivity and P is the general price level. An increase in α depicts, for example, the effects of increased competitiveness in product markets. Let $v \equiv pA$, where p is the price and A is physical productivity. Taking a demand curve with elasticity $1/(1-\alpha)$, i.e. $q^d = p^{-1/(1-\alpha)}$, and assuming that output is given by $q^s = A$, we obtain: $v = A^\alpha = \bar{v}e^{\alpha\epsilon}$. As is well-known, the elasticity of demand is a measure of the competition in product markets.

[7] If $\eta > 1$, i.e. the firing cost (c) is higher than the wage (w), the worker will never be fired and full job security is obtained. We assume away such degenerate equilibria.

Eq. (3) captures a crucial trade-off for workers: that they must choose between a higher wage, thus appropriating a larger share of their expected productivity, and increased job security.

For the employer, there are two ex-post outcomes: if productivity is high enough, it gets positive ex-post returns from the worker $(v - W)$; if it is too low, it takes on the losses associated with firing costs (c). Hence, we can write the expected profit of an employer, for a given contract wage, as

$$\begin{aligned} \pi &\equiv \int_{\epsilon > \Omega} (v - W) dF - c \int_{\epsilon < \Omega} dF \Longleftrightarrow \\ \frac{\pi(\omega)}{\bar{v}} &= 1 + \alpha \int_{\epsilon < \Omega(\omega)} e^{\alpha \epsilon} F(\epsilon) d\epsilon - e^{\omega} \end{aligned} \tag{4}$$

where Ω, given in (2), depends on the wage. Let $\bar{\omega}$ denote the solution to $\pi(\bar{\omega}) = 0$. From $\pi'_{\omega} = \alpha F - 1 < 0$, we obtain $\pi \geq 0 \Leftrightarrow \omega \leq \bar{\omega}$. Since a necessary condition for $\pi \geq 0$ is that the real wage must be lower than expected productivity, we obtain $\bar{v} \geq W \Leftrightarrow \bar{\omega} \leq 0$.

Now, we turn to the worker. Assuming away insurance or credit markets, a worker's expenditure equals his real wage. Let $u_*(W)$ denote his utility, which can be rewritten as $u(\omega) = u_*(e^{\omega} \bar{v})$. Then, his expected welfare is given by

$$U = U(\phi, W) = U(\phi, e^{\omega} \bar{v}) = [1 - F(\Omega(\omega))] u(\omega) + F(\Omega(\omega)) \bar{u} \tag{5}$$

where $\bar{u}$ is the worker's utility in case of a lay-off, i.e. severance pay net of displacement costs, and we assume $\bar{u} < u(\omega)$. A key feature is that the expected utility of the worker, U, may be a non-monotonic function of the wage: on one hand, a higher wage raises expected utility by allowing for increased consumption $(u(\omega))$ in good states of the world; on the other it raises the probability of layoffs (F), with the associated displacement costs.

Assuming a high enough degree of risk aversion by workers, we obtain that the expected welfare of a worker is a non-monotonic, strictly concave function of the wage. To see this, note that the second derivative of $U(\omega)$, obtained from (5), is given by

$$\partial^2 U/\partial\omega^2 = -\Delta u'$$
$$\Delta \equiv f'\left(1 - \frac{\bar{u}}{u(\omega)}\right)\alpha^{-2} + \rho(1-F) + 2f\alpha^{-1} \tag{6}$$

where $\rho \equiv -u''/u'$ a measure of risk-aversion.[8] The expression is negative (i.e. U is concave) if $\rho > 0$ is large enough (or $f' > 0$).

Hence, U reaches an unconstrained maximum at $\tilde{\omega}$, defined by the first-order condition

$$\tilde{\omega} \equiv \arg\max_{\omega} U \Longleftrightarrow$$
$$\alpha^{-1} f(\tilde{\Omega})[u(\tilde{\omega}) - \bar{u}] = u'(\tilde{\omega})[1 - F(\tilde{\Omega})] \tag{7}$$

where $\tilde{\Omega} \equiv \Omega(\tilde{\omega})$ (see eq. 2). On the left-hand side of (7), we have the marginal benefit of a wage cut, i.e. the value of the lower probability of getting fired. On the right-hand side, we have the marginal cost, i.e. the expected utility cost of the lower wage.

Finally, we can look at the equilibrium contract, establishing the wage, ω^*, through negotiations between an employer and a worker. For employers, who compete for workers under free-entry, the contract must entail non-negative expected returns ($\pi \geq 0$), which implies $\omega^* \leq \bar{\omega} \leq 0$, as discussed in (4). Workers take on the employer offering the contract with the highest expected utility. Note that, in a world of perfect insurance, this would imply a real wage given by the expected value of productivity $\bar{\nu}$, i.e. $\omega = 0$.

[8] Note that, in terms of $u_*(w) = u(\omega)$, we have $\rho \equiv -u''/u' = -u_*''w/u_*' - 1 = \rho^{AP} - 1$, where ρ^{AP} is the Arrow-Pratt measure of relative risk-aversion. Hence, our assumption that $\rho > 0$ (i.e. $\rho^{AP} > 1$) is more stringent than the traditional (Arrow-Pratt) definition of risk-aversion (i.e. $\rho^{AP} > 0$).

With imperfect insurance, due to right to fire, there are two possibilities for the equilibrium, depending on $\tilde{\omega}$, the unconstrained welfare maximizing wage (see eq. 7), and $\bar{\omega}$, the zero profit wage (see eq. 4). First, if $\tilde{\omega} > \bar{\omega}$, the expected utility is an increasing function of ω ($U'_{\omega} > 0$), in the relevant interval ($\omega < \bar{\omega}$). Hence, the zero-profit condition is binding and the equilibrium contract yields $\omega^* = \bar{\omega} < 0$, clearing the labor market. Any firm offering a lower wage is not able to attract workers, and any firm offering a higher wage makes losses. This contract entails a real wage equal to expected productivity net of expected firing costs.[9]

Second, if $\tilde{\omega} \leq \bar{\omega}$, the optimal contract entails $\omega^* = \tilde{\omega} < \bar{\omega} \leq 0$, which maximizes the expected utility of the worker. Unlike in the previous case, a firm offering a higher wage is not able to hire, due to the higher probability of displacement (and lower expected utility) it entails. Note that, in this case, there is excess demand for labor, as the expected returns to incumbent firms are positive, despite free-entry of risk-neutral employers.

For the remainder of the paper, we focus on the second case, assuming that the equilibrium contract entails the interior solution $\tilde{\omega}$, denoted in (7). As we will see, in this case, the distribution of rents between employers and workers may be affected by changes in LDV (α), giving rise to a theory of wage restraint. In the first equilibrium there are no rents, as the zero profit condition binds, and thus no potential for a theory of wage restraint.[10] Ultimately, the question here is an empirical one, which we address in section 5.

[9] In this case, changes in α may affect the equilibrium wages if they affect the rate of lay-offs.

[10] It should be noted that, also in the first equilibrium, changes in LDV will affect wages, since they affect the firms' expected firing costs, which have to be borne by workers' wages.

3 A Theory of Wage Restraint

This section looks at the effects of an increase in LDV, captured by an increase in α, when the equilibrium contract yields $\omega^* = \tilde{\omega} < \bar{\omega} \leq 0$. Taking the differential of (7) and substituting $\alpha(1-F)/f$ for $(u-\bar{u})/u'$ (from eq. 7), we obtain

$$\Delta \frac{d\omega}{d\alpha} = \overbrace{f\tilde{\Omega}}^{\text{Income effect}} + \overbrace{\left(f + f'\tilde{\Omega}\right)\frac{1-F}{f}}^{\text{Substitution effect}} \tag{8}$$

where, from (6), $\Delta > 0$ and, given (2) and $\tilde{\omega} < 0$, we have: $\tilde{\Omega} = \Omega(\tilde{\omega}) \leq 0$. Hence the sign of (8) is ambiguous, and depends on the shape of the distribution F. The first term captures the income effect, and is negative. This is the intuitive view that an increase in volatility lowers the welfare of the worker, which reacts by lowering the wage, implying that job-security is a normal good.

The second term is the substitution effect, capturing the effects of an increase in α on the trade-off between job-security and the wage level. To understand this trade-off, note from (3) that $-\phi'_\omega = \alpha^{-1} f(\tilde{\Omega}) > 0$ (which appears on the left side of eq. 7) is the price of a higher wage, in terms of job security. The effect of an increase in α on this price is given by $\partial(-\phi'_\omega)/\partial\alpha = -\alpha^{-2}(f + f'\Omega)$, which determines the substitution effect. It has an ambiguous sign that depends on f'. When a rise in α raises the price of a higher wage, in terms of job-security, $\partial(-\phi'_\omega)/\partial\alpha > 0$, workers will command a lower wage, and the substitution effect is negative (along with the income effect), strengthening the case for wage restraint. Note that this requires that f' is positive.

INSERT FIGURE 1 HERE

On the other hand, if the (job-security) price of a higher wage falls when α rises,

$\partial(-\phi'_\omega)/\partial\alpha < 0$, the substitution effect is positive, conflicting with the income effect. If sufficiently strong to outweigh the income effect, this undermines the case for wage restraint, as workers ask for higher wages when LDV rises.[11] Figure 1 provides a graphic representation of the case against wage restraint. In the job-insecurity/wage space, it displays the worker's indifference curve (U) and the cumulative distribution function ($F(\Omega)$). Recall from (3) that the latter captures the trade-off between job security and the contract wage. An increase in α implies a shift in $F(\Omega)$ (from $F(\Omega_o)$ to $F(\Omega_1)$), as the distribution of ϵ undergoes a mean-preserving spread. The optimal contract goes from $(\omega_o,\ F_o)$ to $(\omega_1,\ F_1)$, with job-security falling and the wage rising. As a result, the welfare of the worker falls from U_o to U_1. We can decompose the move into the income and substitution effect. The former moves the contract from $(\omega_o,\ F_o)$ to $(\omega_i,\ F_i)$, thus leading to wage restraint. The substitution effect arises due to the change in the slope of F, and moves the contract from $(\omega_i,\ F_i)$ to $(\omega_1,\ F_1)$, thus undermining the notion of wage restraint.

This result raises questions on the conventional wisdom that workers react to an increase in the volatility of labor demand by cutting down wages for the sake of job security. This conventional wisdom is captured in the statement from Fed Chairman Alan Greenspan that opens this paper, suggesting the increasingly uncertain job market conditions have produced wage moderation in labor markets. Equation (8) shows that the intuitive view relies on the income effect of an increase in volatility.

However, the presence of a substitution effect may affect workers' decisions by reducing

[11] If $f' \leq 0$ (e.g. ϵ follows a uniform distribution), the case against wage restraint emerges: using a Taylor expansion to obtain: $F(\tilde{\Omega}) \approx F(0) + f\tilde{\Omega}$, we get: $1 - F + f\tilde{\Omega} = 1 - F(0) > 0$, which implies that (8) is positive if $(1 - F)f'\tilde{\Omega}/f > 0$ (i.e. $f' \leq 0$).

the marginal benefit of a wage cut, in terms of increased job security. The strength of this substitution effect, which will generate increased wage demands, depends on the distribution of the shocks to labor demand.

Finally, the effect of a rise in LDV on the equilibrium job security can be obtained from (3).

$$\alpha \frac{d\phi}{d\alpha} = \underbrace{-f \frac{d\omega}{d\alpha}}_{\text{wage channel}} + \underbrace{f\Omega}_{\text{direct channel}} < 0 \tag{9}$$

From (8), we obtain $\Delta(d\omega/d\alpha - \Omega) = (1 - F) - \Omega \{f + \alpha\rho(1 - F)\} > 0$, which implies: $d\phi/d\alpha < 0$. The direct channel captures the effects of an increase in α, for a given wage, and is negative, depicting an increase in job-insecurity. There is also the wage-channel that captures the effects of the induced wage adjustment. This channel has an ambiguous sign, given the ambiguity of wage adjustments outlined above. However, the direct channel is the first-order effect.

4 Wage restraint vs. wage-premia

We conclude the theoretical analysis of the paper, with a discussion of the implications of an integrated labor market, when workers can opt among different industries, with diverse levels of LDV. In equilibrium, this implies that workers must have the same expected welfare across industries, which we denote by the reservation welfare, $\hat{U}$.

Letting j denote an industry, we obtain from (5) that the expected welfare of a worker under the equilibrium contract must satisfy

$$U(\underset{+}{\tilde{\phi}_j}, \underset{+}{\tilde{W}_j}) = \hat{U} \tag{10}$$

In such setting, compensating differentials imply that in industries where job-insecurity is larger, workers must be compensated by a larger real wage, in order to obtain $U(\tilde{\phi}_j, \tilde{W}_j) = \hat{U}$. Since, as shown above, job-insecurity is positively associated with LDV ($d\tilde{\phi}_j/d\alpha_j < 0$), this suggests a positive cross-sectional association between LDV and wages, across industries.

This must be reconciled with the previous result that an increase in LDV may lower the wage (wage-restraint). A key point is that the results in the previous section look at the effects on the productivity-deflated-wage, ω. Hence, rewrite (10) as

$$U(\tilde{\phi}_j, e^{\tilde{\omega}_j}\bar{v}_j) = \hat{U} \tag{11}$$

If an increase in volatility lowers $\tilde{\phi}_j$ and $\tilde{\omega}_j$, the only alternative to balance (11) is to raise $\bar{v}_j$, the expected marginal product of a worker, which was taken a given in the previous sections. Hence workers in highly volatile and insecure industries obtain a higher real wage than in other industries ($\tilde{W}_j$, compensating differential), even if it is still a smaller share of their marginal productivity ($\tilde{\omega}$, wage restraint), as predicted in the previous section. An implication is that the share of capital is larger in industries with higher volatility, even if employers and capitalists are risk-neutral.

Adjustments in the industry-specific marginal productivity ($\bar{v}_j$) emerge due to the changes in the cross-industry allocation of labor, with the value of the marginal product decreasing with a rise in industry-employment, either due to technology or to the effect of supply on the industry price. As a result, industries with higher LDV will have relatively less labor (as workers avoid the higher job-insecurity), yielding a higher $\bar{v}_j$ and a higher W_j, even if ω_j is smaller.

What are thus the effects of a rise in α_j on ω_j, ϕ_j and W_j, if we consider the implications for labor market equilibria through $\bar{v}_j$? As shown in the previous section, the effects on ω_j and ϕ_j do not depend on $\bar{v}_j$. However, the same is not true for the real wage, $W_j = e^{\omega_j}\bar{v}_j$. On one hand, if the rise in LDV happens in a single, infinitesimal industry (leaving the rest of the economy unaffected), wage restraint (lower ω_j, when the income effect dominates) may coincide with a higher wage, W_j, in that industry (to satisfy eq. 10), as the outflow of labor (with lower expected welfare) raises the marginal product, $\bar{v}_j$. On the other hand, if the rise in LDV is felt across all industries, there will be no reallocation of labor or changes $\bar{v}_j$, and only the wage restraint effect will be present and wages will fall across industries.

In sum, wage restraint is compatible with a wage premium in volatile industries, because productivity will be larger in these industries. In equilibrium, this arises because workers avoid industries with high volatility. When the volatility in an industry increases, workers leave the industry, raising marginal productivity; for those that stay, the wage will rise (compensating differential), but by less than the increase in productivity (wage restraint).

5 Empirical Evidence

5.1 Specification

In this section, we look at the empirical impact of changes in the **conditional volatility of labor demand** (LDV) on the **productivity deflated wage** (ω). Following the previous discussion, the productivity-deflated-wage is given by $\omega = W_j/\bar{v}_j$, where W_j is the real wage and $\bar{\nu}_j$ is the marginal product of labor, in industry j. Now, letting κ_j denote the ratio of the marginal to the average productivity, of labor, in industry j, we can rewrite $W_j/\bar{\nu}_j$ as

$$\ln\left(\frac{W_j}{\bar{\nu}_j}\right) \equiv \ln\left(\frac{W_j}{y_j/l_j}\kappa_j^{-1}\right) \equiv \ln s_j - \ln \kappa_j$$

where y_j/l_j is the average productivity and $s_j \equiv W_j l_j / y_j$ is the share of labor in value added, in industry j. Hence, motivated by (8), we estimate the following equation

$$\ln s_{jt} = \beta_0 + \beta_1 \ln s_{jt-1} + \beta_{2j}\ LDV_{jt} + \beta_{3j}\ LDV_{jt}^2 + \beta_4 X_{jt} + \beta_{5j} + \beta_6 t + \xi_j \tag{12}$$

where, ignoring time changes in κ_j ($\kappa_{jt} = \kappa_j$), β_{5j} is an industry-fixed effect that includes $(\beta_1 - 1)\ln \kappa_j$ and $\beta_6 t$ is a time fixed-effect. The autoregressive term captures the adjustment lag and should be positive ($\beta_1 > 0$). ξ_j is a white noise.

Meanwhile, β_{2j} and β_{3j} are industry-specific coefficients that capture the impact of LDV (volatility) on the share of labor, for industry j. Hence the short- and long run elasticity of the share of labor, s, with respect to the LDV, in industry j, denoted respectively by D_j and LR_D_j, are given by

$$\begin{aligned} D_j &\equiv \partial \ln s / \partial \ln LDV = \frac{\beta_{2j} + 2\ LDV_j\ \beta_{3j}}{LDV_j} \\ LR\_D_j &= D_j/(1-\beta_1) \end{aligned} \tag{13}$$

As discussed in the previous sections, wage restraint will emerge and generate $D_j < 0$ and $LR\_D_j < 0$, only if the income effect dominates or the substitution effect is negative.

Since, in competitive labor markets, employment relations are fluid and the wage equals productivity, we expect the magnitude of D_j to be stronger in industries where labor markets are less competitive. One example of lack of labor market competition is the presence of unions. Hence we expect that rises in unionization should magnify the implications of LDV for wages. In the case of wage restraint, this means that more unionized industries will suffer more intense wage declines, in the presence of a rise in volatility.

Hence, we express β_{2j} and β_{3j} in terms of the industry's rate of unionization, U_j, as follows: $\beta_{2j} = \theta_2^* + \theta_2 U_j$ and $\beta_{3j} = \theta_3^* + \theta_3 U_j$, where θ_2^*, θ_3^*, θ_2, and θ_3 are parameters. Under the assumption of wage restraint ($D_j < 0$), θ_2 and θ_3 are negative, yielding that the (second-order) effect of an increase in unionization on the marginal impact of volatility (D_u), which is given below, is negative.

$$D_u \equiv \partial D/\partial U = \theta_2/LDV_j + 2\theta_3 \tag{14}$$

Finally, in X_{jt}, two variables were included as controls: the skill intensity (HL_{jt}) and the growth of real productivity (GRP_{jt}); the latter is defined as the sum of the growth of productivity and the relative price in the industry. Both HL and GRP should lower the share of labor ($\beta_4 < 0$) by increasing (a) within industry volatility of labor demand (unless the substitution effect is positive and dominant) and (b) the anti-labor bias of technological change. In the estimation, we included also quadratic terms for these controls.

5.2 Data

Eq. (12) is estimated using the NBER productivity database (Bartelsman and Gray, 1996). This database includes data at the four-digit SIC (1972) code within manufacturing, for the 1958-96 period. We will focus on the wages of production workers, for two reasons: first, to minimize the role of variations in the skill composition of an industry's labor force on the share of labor; second, because lower skilled production workers are less mobile across industries (Fallick, 1993; Magnani, 2001b), and thus are less able to edge displacement risk.

The evolution of the value added share of labor (production workers) and skill intensity (the ratio of total employment to production workers) for the mean industry can be found in Figure 2a (by year) and Table 3 (by decade average). There is a clear decline in the share of labor: from 1960 to 1996, the share of labor declined 37%. At the same time, there was an increase in skill intensity, widely believed to capture the bias of technological change that has contributed to the declining wages of the unskilled.

INSERT FIGURE 2 and TABLE 3 HERE

Next we turn to measuring volatility, LDV_{jt}. Following the discussion in the previous sections, we take shocks to real productivity as the key driver of unexpected changes to labor demand. So, we begin by obtaining the yearly growth of real productivity (GRP_{jt}), as the sum of the growth of TFP and of the deflator for shipments (industry price) net of aggregate (producer) inflation. Then, we obtain LDV_{jt} by estimating for each industry, the following ARCH model of GRP_{jt}

$$\begin{aligned} GRP_{jt} &= \gamma_{0j} + LDV_{jt}\ u_{jt} \qquad (15) \\ LDV_{jt}^2 &= \left[\gamma_{1j} + \gamma_{2j}(LDV_{jt-1}\ u_{jt-1})\right]^2 \end{aligned}$$

where $u_{jt} \sim N(0,1)$. The use of an ARCH model for estimates of the expected volatility is dictated by the need to produce yearly observations, in order to obtain a panel of industry-year data that allows for industry-fixed effects. Note that, in this case, LDV_{jt}^2 is the conditional variance of GRP_{jt}: $Var(GRP_{jt}|GRP_{jt-1}) = LDV_{jt}^2$. In fact, we obtained LDV_{jt} as the squared-root of the predicted values for the conditional variance.

The evolution of LDV and GRP for the mean industry can be found in Figure 2b (by year) and Table 3 (by decade average). There is a clear spike in the mid-1970's, as a consequence of the dramatic years following the oil crisis. Moreover, in the aftermath of the oil crisis, LDV was clearly higher than up to the mid-1970s. In fact, even if we omit the years of 1974-76, LDV rose from an average of 5.63 in the 1961-73 period to 6.11 in 1979-96 - an increase of

8.15%. During the same time-span, the share of labor has fallen 23.4% (from 33.5 to 26.5).

5.3 Regression results

A reduced form of (12) and (14), obtained by substituting for β_{2j} and β_{3j} to obtain the interactive terms: $U_j * LDV_{jt}$ and $U_j * LDV_{jt}^2$, was estimated using the first-difference estimator (to eliminate the industry-fixed effect β_{5j}), and instrumenting the first-difference of $\ln s_{jt-1}$ with $\ln s_{jt-2}$. [12] The regression results are presented in table 4.

INSERT TABLE 4 HERE

Looking first at the effect of volatility, we obtain highly significant results with the expected signs in most equations. In column 1, when the Union interaction is absent, a rise in volatility lowers the share of labor. In column 3, when the Union interaction is introduced, it is highly significant and has the expected sign. The quadratic terms for LDV are not significant (columns 2, 4 and 5). In the last three rows, we compute the short- and long run elasticity, D and LR_D, and the (second-order) effect of unionization, D_U, as given in (13) and (14), using the mean values for unionization and LDV_{jt} (see table 3).[13] In all columns, including those with quadratic terms, the values are negative, confirming the result that volatility lowers the share of labor, and suggesting that, as we expected, this effect is stronger in unionized industries, with less competitive labor markets.

[12] In the regression there were 412 industries. Although the NBER dataset includes 446 industries, 34 were dropped due to computational problems (flat likelihood) in obtaining the ARCH estimates. The following sic codes were dropped: 2047, 2291, 2294, 2431, 2771, 2822, 2891, 2895, 2992, 3079, 3161, 3261, 3264, 3322, 3361, 3362, 3451, 3469, 3483 3497, 3532, 3534, 3537, 3542, 3549, 3552 3553 3612, 3622, 3635, 3644, 3675, 3795, 3942

[13] Data for rates of unionization was obtained from the NBER Labor Markets Database (Abowd, 1991). The rate of unionization for production workers was averaged across years, to obtain industry-specific measures. The mean and standard deviation of the cross-industry distribution, were 43.8 and 14.6, respectively.

Moreover, the estimates for the short- and long-run elasticities in D and LR_D suggest that the coefficients are economically significant. For example, the estimate for the long-run elasticity in column 3 is -3.26, which implies that the rise in LDV of 8.15% after the mid-1970s (see table 3) yields a decline in the share of labor of around 26.57%, against an actual decline of 23.64% (table 3).

Meanwhile, in both cases, the coefficient on the autoregressive term is positive and significant capturing the slow adjustment of the share of labor. The control for the growth of real productivity (GRP) is very significant, and indicates that a rise in productivity growth should lower the share of labor, as expected. The effect of skill intensity (HL) is significant and, for the mean industry (with a skill intensity of 1.38), it lowers the share of labor.

In sum, our regression results support the view of wage restraint, i.e. that rise in the conditional volatility of labor demand will lead to reduced wage demands, and thus lower the share of labor. We obtain highly significant, negative estimates for the effect of LDV on the share of production workers. Finally, and more important, our estimates yield magnitudes for the long-run elasticity that predict sizeable declines in the share of labor. Back of the envelope calculations based on our estimates of the long-run elasticity and the actual rise in LDV between the periods of 1961-73 and 1979-96 (for which we identified a break in LDV), predict changes in the share of labor (production workers) that are very close to its actual decline.

6 Conclusion

In this paper, we have addressed the notion that an increase in labor market uncertainty is associated with wage moderation: the 'wage restraint hypothesis'. We have stressed the notion that job security and wages are endogenously determined in a worker's labor contract, if the employer has the right of dismissal. We have looked into how the two variables, wages and job-security, react to an increase in the volatility of labor demand.

Our results have shown that the conventional wisdom that labor demand volatility and wages should be negatively correlated fails to capture all of its effects. In fact, the rise in volatility generates also a substitution effect which contributes to raise wages. Using industry data, we have looked at the empirical evidence. Our results display a highly significant negative impact of labor demand uncertainty on the share of workers in value added (i.e. the wage, contingent on productivity), providing statistical support to the wage restraint hypothesis. Moreover, the economic significance of the estimates is high. For the sample of production workers, predictions based on our estimates and the changes in LDV between the periods of 1961-73 and 1979-96, for which we have identified a clear break in labor demand volatility, are very close to the actual changes in their share in value added.

7 References

Abowd (1991) "The NBER Immigration, Trade, and Labor Markets Data Files" in Immigration, trade, and the labor market, A National Bureau of Economic Research Project Report, Chicago and London: University of Chicago Press, 1991

Aaronson, D. and Sullivan, D. (1998): "The Decline of Job Security in the 1990s: Displacement, Anxiety, and Their Effect on Wage Growth"; Federal Reserve Bank of Chicago Economic Perspectives, 1st Quarter 1998, v. 22, iss. 1, pp. 17-43

Bartelsman, W. and Gray, W. (1996) "The NBER Productivity Database" NBER Technical Working Paper n 205, October 1996

Calvo, G. and Phelps, E. (1977) "Indexation Issues: Appendix", Journal of Monetary Economics, Supplementary Series 1977, v. 5, iss. 0, pp. 160-68

Deavers, K. (1998) "Downsizing, Job Insecurity, and Wages: No Clear Connection", Backgrounder, Employment Policy Foundation

Fallick, B. (1993) "The Industrial Mobility of Displaced Workers", Journal of Labor Economics, 11 (2)

Farber, H. (1997) "The Changing Face of Job Loss in the United States, 1981-1995", Brookings Papers on Economic Activity, Microeconomics 1997, v. 0, iss. 0, pp. 55-128

Gottschalk, P. and Moffitt, R. (1994) "The Growth of Earnings Instability in the U.S. Labor Market", Brookings Papers on Economic Activity, 1994, v. 0, iss. 2, pp. 217-54

Green, F.; Felstead, A. and Burchell, B. (2000) "Job Insecurity and the Difficulty of Regaining Employment: An Empirical Study of Unemployment Expectations", Oxford Bulletin of Economics and Statistics, Special Issue Dec. 2000, v. 62, iss. 0, pp. 855-83

Hall, R. (1995) "Lost Jobs", Brookings Papers on Economic Activity, 1995, v. 0, iss. 1, pp. 221-56

Hall, R. and Lilien, D. (1979) "Efficient Wage Bargains under Uncertain Supply and Demand", American Economic Review, Dec. 1979, v. 69, iss. 5, pp. 868-79

Hamermesh, D. (1991) "Wage Concessions, Plant Shutdowns, and the Demand for Labor", Job displacement: Consequences and implications for policy, 1991, pp. 83-106; Labor Economics and Policy Series Detroit: Wayne State University Press

Kahn, C. and Huberman, G. (1988) "Two-sided Uncertainty and "Up-or-Out" Contracts", Journal of Labor Economics, October 1988, v. 6, iss. 4, pp. 423-44

Magnani, E. (2001a) "Market Volatility and the Structure of US Earnings", Labour, March 2001, v. 15, iss. 1, pp. 57-80

Magnani, E. (2001b) “Risk of Labor Displacement and Cross-Industry Labor Mobility” Industrial and Labor Relations Review 54 (3)

Nickell, S; Jones, P. and Quintini, G. (2002): "A Picture of Job Insecurity Facing British Men", Economic Journal, January 2002, v. 112, iss. 476, pp. 1-27

OECD (1997) "Is job insecurity on the increase in OECD countries?" OECD Employment Outlook 1997, OECD, Paris

Parsons, D. (1986) "The Employment Relationship: Job Attachment, Work Effort, and the Nature of Contracts", Handbook of labor economics. Volumes 2, 1986, pp. 789-848; Handbooks in Economics series, no. 5 Amsterdam; Oxford and Tokyo: North-Holland; distributed in North America by Elsevier Science, New York

Schmidt, S. (1999) "Long-Run Trends in Workers’ Beliefs about Their Own Job Security: Evidence from the General Social Survey", Journal of Labor Economics, Part 2 October 1999, v. 17, iss. 4, pp. S127-41

FIGURE 1

The case against 'wage restraint'

Effects of an increase in LDV on wage and job-security when the substitution effect dominates

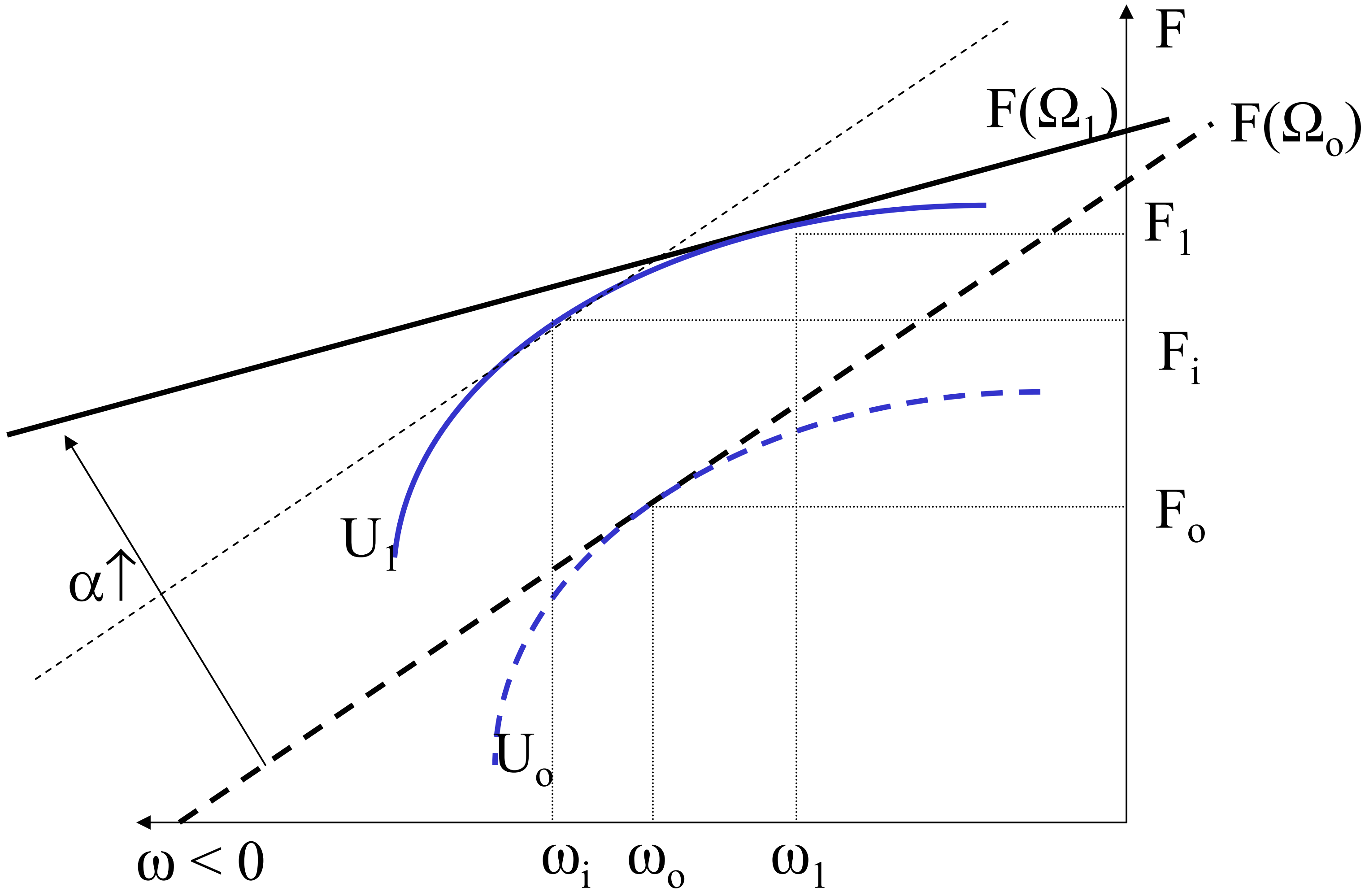
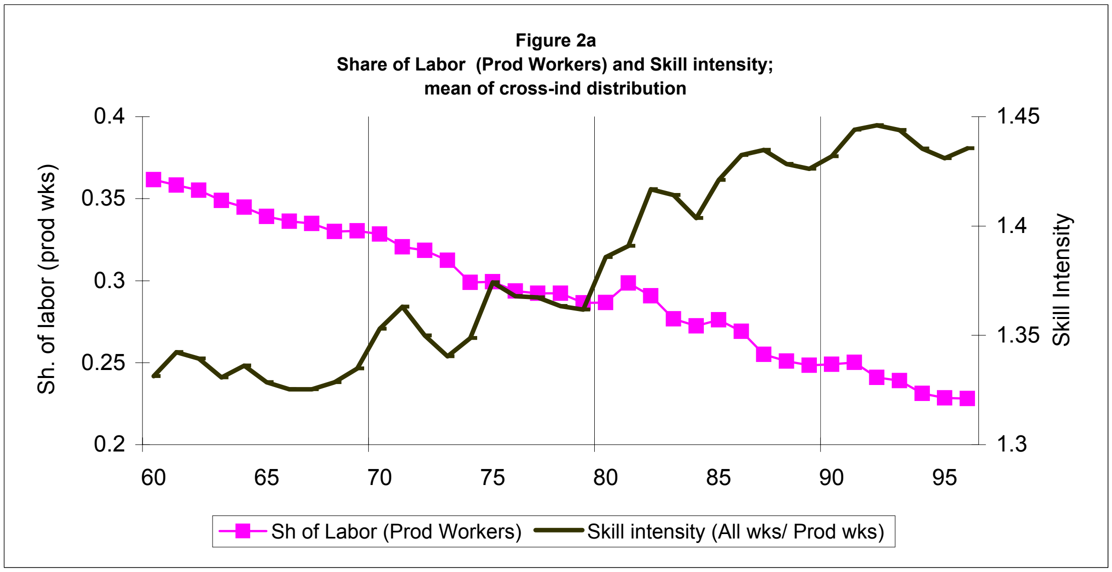


Figure 2



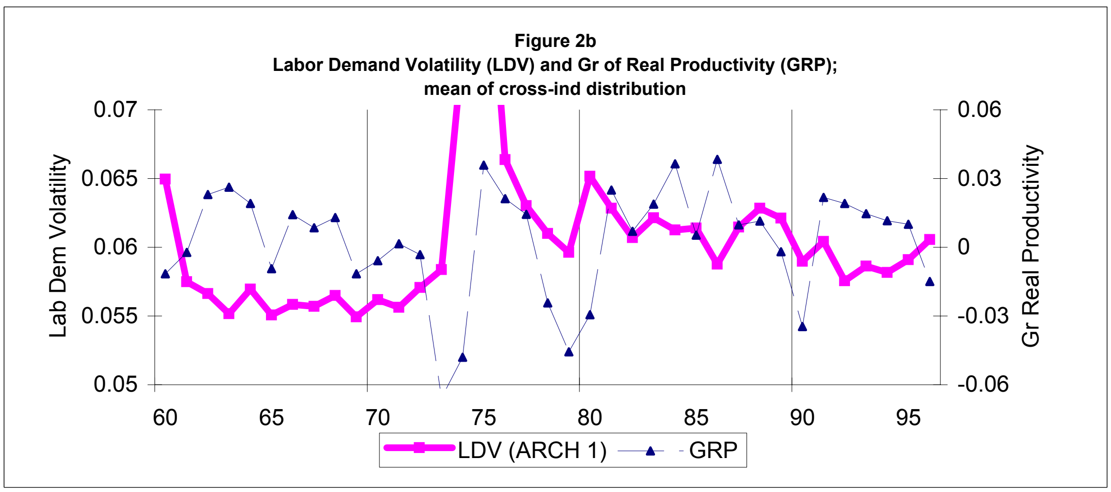


Table 3

Mean of cross-industry distribution of key variables
for different periods

Period	Sh of labor	LDV(ARCH 1)	Skill Int
1960-69	0.34	0.0569	1.33
1970-79	0.30	0.0639	1.36
1980-89	0.27	0.0619	1.42
1990-96	0.24	0.0591	1.44
1961-73	0.34	0.0563	1.34
1976-96	0.26	0.0611	1.41
%change	-23.64%	8.15%	

Table 4

Regression Results (with p-values in %)

First-difference IV estimates, with industry- and year-fixed effects

Dep Var: Ln Share of Labor (Production Workers)					
	1	2	3	4	5
Ln S* (t-1)	0.500	0.496	0.505	0.501	0.499
	0%	0%	0%	0%	0%
LDV	-0.138	-0.105	0.473	0.509	0.507
	0%	2%	0%	0%	0%
LDV2		-0.022		-0.023	
		38%		34%	
U* LDV			-0.013	-0.013	-0.013
			0%	0%	0%
U* LDV2					-0.001
					19%
HL	-0.499	-0.499	-0.499	-0.499	-0.499
	0%	0%	0%	0%	0%
HL2	0.036	0.036	0.036	0.036	0.036
	0%	0%	0%	0%	0%
GRP	-0.907	-0.905	-0.914	-0.911	-0.911
	0%	0%	0%	0%	0%
GRP2	0.256	0.252	0.261	0.256	0.255
	0%	0%	0%	0%	0%
Constant	-0.007	-0.007	-0.007	-0.007	-0.007
	0%	0%	0%	0%	0%
R-sq: within	0.743	0.742	0.743	0.742	0.741
between	0.970	0.969	0.970	0.970	0.970
overall	0.880	0.879	0.880	0.879	0.878
D	-2.287	-1.783	-1.615	-1.076	-0.859
Du			-0.216	-0.217	-0.212
LR_D	-4.571	-3.535	-3.262	-2.156	-1.716