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Socialist Economies

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How Redistribution Hurts Productivity in a Socialist Economy (Yugoslavia)

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In socialist economies, profitable firms are taxed to subsidize unprofitable ones, and productive workers subsidize unproductive workers. Yugoslav firms, Vodopivec concludes, produce less because of both types of redistribution.

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This paper — a product of the Socialist Economies Division, Country Economics Department — is part of a larger effort in PRE to investigate the behavior of firms in socialist economies. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Julia Lutz, room N6-037, extension 36970 (39 pages).

Socialism as practiced in Eastern Europe is characterized by massive income redistribution. Vodopivec focuses on (1) interfirm redistribution, consisting of taxing profitable firms in order to subsidize unprofitable ones, and (2) intrafirm redistribution, consisting of the compression of personal income differentials within a firm.

Vodopivec constructs a theoretical model of redistribution of income as practiced in Yugoslav firms. Empirical results lead him to conclude that efficiency in production could be improved at no cost if such redistribution were abolished. Furthermore, economies in which much of GNP is redistributed through bargaining are bound to be inefficient also in distribution — because some groups are less able to represent their common interests than others. Contrary to a common belief, socialist countries can not be praised on the count of equity either.

Increasing wage differentials may not be too controversial or difficult a task in Yugoslavia. More difficult will be the issue of interfirm transfers, and to prevent them the government should:

- Stop subsidizing enterprises (from either government or enterprise sources).

- Make the fiscal system unselective and transparent (apply uniform tax rates, unburden enterprises of parafiscal "financial investments," and reduce the system's technical complexity by reducing the variety of taxes enterprises pay).

- Impose positive interest rates (in real terms) on any kind of loan — for example, by indexing debts.

Vodopivec claims that socialist countries lack adequate mechanisms to prevent such redistribution — that ill-defined property rights, together with a monoparty political system, generate such redistribution. Changing that means introducing new mechanisms to:

- Provide alternative services on the basis of *impersonal* (market) decisionmaking, thus supplanting bargaining between interest groups, where feasible.

- Where impersonal decisionmaking is not feasible (as in fiscal and monetary policy), supplement current institutions by providing checks and balances in political decisionmaking.

The peaceful revolutions in Eastern Europe have removed political obstacles to introducing such changes, but implementing them may be a long, painful process.

Interfirm and intrafirm redistribution should be abolished and a social safety net established — one that does not hamper efficiency (as in Sweden). Dethroning all old institutions in socialist countries in a "great leap," however, might be like throwing out the baby with the bath water. Many institutions deserve abandonment, but in a radically changed environment, worker participation in profit-sharing and decisionmaking may increase productivity, as it does in developed market economies.

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* Valuable comments of Alan Gelb, Dennis Mueller, Peter Murrell, Robert Myers, and participants of the SSRC Workshop on Soviet and East European Economics are gratefully acknowledged.

1. INTRODUCTION

Socialism as practiced in Eastern Europe is characterized by massive income redistribution. Its most evident form is subsidization of consumption (basic food items, housing), but there is also more subtle and pervasive redistribution in the form of (i) interfirm redistribution, consisting of taxing profitable firms in order to subsidize unprofitable ones, and (ii) intrafirm redistribution, consisting of the compression of personal earnings differentials within a firm. The redistribution of the latter two types is of very specific nature - it amounts to bailing out (i.e., avoiding bankruptcy) and/or increasing the earnings of the ailing or less productive firms/workers, all this at the expense of the more productive ones.

The systematic pattern of the socialist redistribution of income provides protection and security, and thus yields insurance to workers, giving rise to the moral hazard problem. Kornai, the originator of the soft-budget-constraint concept (which is closely related to the above mentioned interfirm redistribution), and the literature spurred by his work, mostly focus on allocative inefficiencies resulting from "softness" of the budget faced by socialist firms (e.g., Kornai, 1980). Much less attention has been paid to another consequence of socialist redistribution, namely the dampening effect of redistribution on work incentives[1] (indeed, Kornai (1986a) even incorrectly attributes the dampening effect to the randomness of redistribution). Yet, it has been found that low productive efficiency (which can be attributed to

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[1]To deduce that the redistribution dampens work incentives one must assume, as shown later, some sort of profit sharing; as a rule, this is the case in Eastern Europe.

inappropriate work motivation) is a very serious problem in Yugoslavia,[2] and the sa is likely to be true for Eastern Europe in general.

The claim that workers in socialist firms lack adequate motivation contrasts with the findings of the empirical literature on worker participation in Western economies. In general, the above literature finds that worker participation increases workers' motivation, and thus their productivity.[3] Since workers in socialist firms participate in profit-sharing and decision-making, one might expect higher productivity in socialist firms as compared with capitalist ones. In reality, however, the opposite seems to be true, and one can easily account for the actual lack of motivation in socialist firms once the redistributive aspect of socialist economies is also taken into account. The literature on the self-managed firm (and, as a special case, on the Yugoslav firm), preoccupied with narrow minded "Illyrian analysis",[4] has so far ignored the redistributive aspects of socialist

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[2]Bajt (1984, p. 38) blames "insufficient quality and intensity of work, together with the organization of production process" for the low labor productivity in Yugoslavia. Furthermore, Bateman et al (1988) provide a specific support for the claim that redistribution affects work motivation by finding that investment transfers (grants!) from more developed to less developed regions of Yugoslavia impaired the productive efficiency in firms in the less developed regions.

[3]For a recent review of the literature, see Blinder (1990).

[4]Following Ward (1958), there has been a huge stream of literature simply paralleling the analysis of the capitalist firm in all aspects except imposing income per worker maximization instead of profit maximization. Ward, quite aptly, named his firm an "Illyrian" one. Many of his numerous followers,

economies, and was therefore unable to explain the apparent lack of incentive in real-world socialist firms.

The model below captures the main redistributive institutions of socialist firms and possesses several desirable features. First, instead of the unrealistic assumption of identical workers commonly found in the self-management literature, the model assumes differences in productivity among workers, allowing one explicitly to address differentials in personal incomes. Second, the treatment of firms as monolithic entities is supplanted by a broader view that allows for multiple decision making in providing work effort. Third, the replacement of the traditionally used income per worker postulate with maximization of utility enables a direct exploration of the consequences of the two types of redistribution described above on firm productivity (a novelty in the self-management literature). Fourth, the model allows for testing the effects of self-management on productivity.

The theoretical model capturing the productivity effects of redistribution and worker participation is developed in Section 2, together with its empirical implications (for the sake of brevity, the institutional details of the Yugoslav firm, providing the starting point for the construction of the model, are limited to brief remarks underpinning the crucial steps of the modeling). The estimating framework and the results of the empirical analysis obtained on the basis of a sample of Slovenian enterprises are presented in Section 3. A brief discussion of policy implications concludes.

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however, take it for a Yugoslav one even though the resemblance is indeed as remote as the millennia elapsed from times of ancient Illyria suggest.

2. THE MODEL

The assumptions

The most important assumptions are the following:

(a) The model is short-term: the capital stock, the number of workers, the quality of intrafirm communication channels, and interfirm redistribution parameters are assumed to be predetermined.

(b) In focusing on distribution, the technology is kept very simple: I assume linear homogeneity and Leontief technology.

(c) Full information: each worker knows not only his own productivity and effort actually exerted, but also the productivity and effort of everybody else in the firm.[5]

(d) Workers of the firm do not collude or engage in logrolling.

(e) There is no uncertainty about the future states of the world.

(f) The model is static.

The definitions

Let a firm consist of N workers who differ in productivity but have identical preferences (utility functions). Let the production function be Leontief and linear homogeneous in labor input L: $Q = Q(L, F_1, \ldots, F_K) = L$

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[5]This rules out the problem of adverse selection and of moral hazard arising in team production. Such a treatment is simplistic, but the distortion introduced by it in the case of the self-managed firm may not be too severe because, first, the units in question are relatively small (averaging approximately 200 workers), and second, the workers of a self-managed firm have better communication channels available, and hence they know each other better.

$q(k_1, \ldots, k_K)$, where F_i is the i-th production input (one of them being capital), and $k_i = F_i/L$, $i = 1, \ldots, K$. Let the overall labor input of the firm, L, be the sum of contractual labor input, L_0, and non-contractual labor input, L_{nc}: $L = L_0 + L_{nc}$, $L_0 = \sum_{i=1}^{N} x_i e_0$ and $L_{nc} = \sum_{i=1}^{N} x_i e_i$, where x_i is the productivity of worker i, $e_i = e_i(e^{(i)})$ is his provision of effort over and above a minimum effort e_0 necessary to retain a job, and $e^{(i)} = (e_1, \ldots, e_{i-1}, e_{i+1}, \ldots, e_N)$ the provision of effort of all other workers except the i-th one. Correspondingly, let us define Y, the income generated by the firm, as

$$Y = pQ - \sum_{i=1}^{K} p_i F_i = (pq - \Sigma p_i k_i) \sum_{i=1}^{N} x_i (e_i + e_0) = v \sum_{i=1}^{K} x_i (e_i + e_0) = Y_0 + Y_{nc}$$

where $Y_0 = v \sum_{i=1}^{N} x_i e_0$, $Y_{nc} = v \sum_{i=1}^{N} x_i e_i$, correspond to income arising from the contractual and non-contractual provis · of effort, respectively; p and p_i are the prices of output and i-th production input, respectively; and $v = pq - \Sigma p_i k_i$ is value added per unit of labor.

The economy is characterized by the following distributive institutions:

(a) Worker earnings are determined using two principles: income sharing[6] and profit sharing. The former is of the "distribution according to work" type: the pre-redistribution income sharing part of the personal income of the worker with productivity x_i, y_i^r, is defined as $y_i^r = vx_i e_i$.[7] Profits Π are

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[6]The use of the income sharing scheme (as well as the median voter framework introduced later) follows Meltzer and Richard's (1983) modeling of the size of government.

[7]The income sharing scheme fully mirrors the personal earnings formation on

defined as $\Pi = Y - Y_0^n = Y_{nc} - Y^n$, where $Y^n = Y_0^n - Y_0$, and Y_0^n is an externally given parameter.[8] Assume that profits are distributed equally.[9]

The pre-redistribution personal income of the worker with productivity x_i, y_i^p, is thus equal to

$$y_i^p = vx_ie_i + \frac{1}{N}\Pi = vx_ie_i + \frac{1}{N}(Y - Y_0^n) \qquad (1)$$

(b) There is redistribution within the firm through which more productive workers subsidize less productive ones (equivalently, there is a compression of personal earnings differentials within the firm).[10] T

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the basis of the so-called live labor contribution as practiced in Yugoslav firms: x_i corresponds to the index of "complexity of work" (largely predetermined); e_i to the index of quality of work (determined discretionary), and v to the (planned) value added per unit of labor (see Schrenk, 1981).

[8]A firm's norm for profits, Y_0^n, is based on economy- or industry-wide performance, as prescribed by law (see Schrenk, 1981, or, for the discussion of a more recent regulation, Vodopivec, 1989).

[9]This is a simplification. It, nonetheless, captures some of the important stylized facts of the income distribution in the Yugoslav firm. First, equal distribution holds for the collective consumption fund, and second, the collective consumption fund tends to be more closely connected with profits than personal incomes fund.

[10]There is a well-documented tendency to compress wage differentials within the Yugoslav firm. Prasnikar and Svejnar (1988, p. 279), for instance, conclude that "[v]arious measures suggest that the distribution of personal income is relatively egalitarian in Yugoslav firms" and that "Yugoslav skilled workers

conceptualize it in the following way: the income sharing part of the income of each worker is "taxed" at the rate t ($0 < t < 1$) and used for financing an equal per capita subsidy r. Net intrafirm redistribution per worker is thus equal to $r - tvx_i e_i$. Imposing a "balanced budget", $Nr = tv\Sigma x_i e_i$ or $r = t\bar{y}$, $\bar{y} = \frac{Y_{nc}}{N}$. (One can justify such a conceptualization on the grounds that it captures two basic features of real-world intrafirm redistribution: (i) it represents a redistribution from richer to poorer and (ii) it preserves the ordering of personal earnings, thereby compressing the structure of personal earnings).

(c) There is also redistribution among firms, amounting to taxing profitable firms in order to subsidize unprofitable ones - a "soft-budget-constraint-redistribution".[11] Let net subsidy - total subsidies minus total taxes - of a firm (NSUBS) be a linear function of profits

$$NSUBS = C + s\Pi, \qquad C > 0, \; -1 < s < 0 \tag{2}$$

where C is a constant and (- s) is a subsidy rate.

Accordingly, a worker with productivity x_i receives actual income y_i equal to

$$y_i = y_i^p + r - tvx_i e_i + \frac{1}{N}(C + s\Pi) = r + c + (1 - t)vx_i e_i + \frac{1}{N}(1 + s)\Pi \tag{3}$$

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and managers earn less relative to unskilled workers than their counterparts in capitalist firms".

[11]On the state paternalism causing such a redistribution, as well as on the general channels of such redistribution, see, e.g., Kornai (1980). The discussion of Yugoslav specificities is given in Vodopivec (1989).

where $c = \frac{1}{N}C$. Subsequently, v is normalized to equal 1.

Equilibrium level of work effort

Each worker takes the parameters r, t, s, c, and Y^n as given and chooses e_i to maximize his utility. To render the model empirically testable, a specific form for the utility function (Stone-Geary) is assumed

$$u(y, \Lambda) = \ln (y + \omega) + a \ln(\Lambda + \lambda); \qquad a, \omega, \lambda > 0 \tag{4}$$

where Λ is leisure of a worker. Furthermore, a decisive worker (voter) chooses the tax rate t to maximize his utility, taking into account the responses of other workers to the changes in the tax rate as summarized in their supply of effort functions.

To solve the model, let us first obtain the supply of effort functions of individual workers. Maximizing (4), taking into account the budget constraint (3) and defining $\Lambda = 1 - e$, yields

$$\max_{\{e_i\}} u(y_i, 1 - e_i) = \max\left[\ln\left(\omega + r + c + (1 - t)x_i e_i + \frac{1}{N}(1 + s)\left(\sum_{j=1}^{N} x_j e_j - Y^n\right)\right) + a \ln(1 - e_i + \lambda)\right]$$

Differentiating the above equation and denoting $s' = \frac{1}{N}(1 + s)$, we get

$$\frac{x_i (1 - t) + s'\left(x_i + \sum_{j \neq i}^{N} x_j \frac{\delta e_j}{\delta e_i}\right)}{\omega + r + c + (1 - t)x_i e_i + s'\Pi} - \frac{a}{1 - e_i + \lambda} = 0$$

Rearranging, denoting the "conjectural variation", $\sum_{j \neq i}^{N} x_j \frac{\delta e_j}{\delta e_i}$, with h_i

$$(1 + \lambda)\left[(1 - t + s')x_i + s'h_i\right] - \left[(1 - t)x_i + s'x_i\right]ae_i -$$

$$- \left[(1 - t + s')x_i + s'h_i\right]e_i - \left[\omega + r + c + s'\left(\sum_{j \neq i}^{N} x_j e_j - Y^n\right)\right]a = 0$$

and finally, denoting $\sum_{j \neq i}^{N} x_j e_j - Y^n$ with Π_i,

$$e_i = \frac{(1 + \lambda)\left[(1 - t + s')x_i + s'h_i\right] - (\omega + r + c + s'\Pi_i)a}{(a + 1)(1 - t + s')x_i + s'h_i} \quad \text{for } x > x_0 \qquad (5)$$

$e_i = 0$ for $x \leq x_0$

$$\text{where } x_0 = \frac{(\omega + r + c + s'\Pi)a - (1 + \lambda)s'h_0}{(\lambda + 1)(1 - t + s')} \qquad (6)$$

x_0 being the productivity of the most productive worker among those who opt not to provide any effort over and above the minimum e_0, and h_0 the conjectural variation of that worker (note that for him $\Pi_i = \Pi$). Let this worker be the i_0-th one as ranked by productivity. Note that the equilibrium provision of effort of worker i, e_i, depends - through the Π_i term - on the equilibrium provision of effort of other workers (those with productivity greater than x_0). To assure a compatible solution, then, one must assume that workers have consistent expectations, i.e., that all of them correctly anticipate the true equilibrium level of profits of a firm. To assure non-negativity of x_0, let us impose

$$(\omega + r + c + s'\Pi)a > (1 + \lambda)s'h_0, \text{ for all } i \qquad (7)$$

(since $0 < t < 1$ and $s' > 0$ by assumption, the expression $1 - t + s'$ is positive).

On the basis of the supply of effort functions (5), one can obtain the following comparative statics result:[12]

Proposition 1: A higher degree of expected cooperation among workers - as reflected in the increase of the conjectural variation term h - gives rise to a higher equilibrium work effort of all workers (ceteris paribus).

The intuition is clear--a higher expected degree of cooperation increases the value marginal product of effort and thus induces a higher supply of effort.[13] In order to render the proposition to empirical testability, let us postulate that the conjectural variation, h, depends on (i) the quality of self-management and (ii) number of workers, i.e., $h = h(S,N)$.[14] Together with this relationship, Proposition 1 says that the better the quality of worker self management and (or) the smaller the number of workers in the firm, the

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[12]Proofs of this, as well as of the four propositions stated below, are given in Appendix 1.

[13]Note that this is a partial equilibrium result, general equilibrium one being analytically non-tractable. In other words, the direct effects of the change in the expected degree of cooperation on the provision of work effort are taken into account, but not the indirect ones (those resulting from the ensuing changes in firm profitability and redistribution subsidy). It is thus assumed--and empirically shown below--that the latter effects are negligible.

[14]One may justify these assumptions along the lines of Tyson's (1979) coalition formation argument. For details, see Vodopivec, 1989.

higher the equilibrium effort of each worker, and consequently, the overall output. These are empirically testable hypotheses and will be tested in the empirical analysis below (self-management being represented with suitable proxies).

As is obvious from the structure of the model, Proposition 1 rests on the assumption of profit sharing. In other words, if profit sharing is not in place, the expected reactions of co-workers to the change of effort of one of the workers does not matter. This result provides a formal theoretical underpinning of the Cable and FitzRoy (1980) claim that there exist powerful interactions between profit sharing and participation of workers in decision making in determining labor productivity.

Productivity effects of interfirm redistribution

The model also yields the following two propositions regarding the interfirm redistribution:

Proposition 2: The higher the amount of net subsidies received by the firm regardless its performance (i.e., the higher c), the lower its output.

Proposition 3: The lower the subsidy rate of the firm, the bigger, generally, the output.[15]

Proposition 2 is driven purely by the income effect. At a higher level of non-labor income brought about by the increase in the non-conditional external gift (represented in the model by the parameter c) the marginal rate of substitution between leisure and effort matches with the value marginal product of effort at a lower level of effort supplied. Note that this is a

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[15]Note that the subsidy rate is defined as the negative of s, $-1 > s > 0$, and is thus positive.

general equilibrium result. The proposition, of course, provides a nice testable implication for the empirical analysis.

Proposition 3, on the other hand, deals with productivity effects arising from changes in the subsidy rate (- s). To understand the ambiguity of predicted effects, one should note that increases (decreases) in a subsidy rate are, in fact, equivalent to decreases (increases) in the product price of the firm, and thus both substitution and income effect are present. The ambiguity comes from the fact that these two effects may work in opposite directions.

Regarding income and substitution effect, there is an interesting asymmetry between the profitable and loss-making firms. For the former, e.g., a reduction of a subsidy rate has a positive substitution effect, but a negative income effect (since less income is taken away from them). For sufficiently profitable firms, then, the combined effect is negative. On the other hand, for loss-makers both effects work in the same direction (e.g., a reduction of subsidy rate has a positive substitution and income effect; the latter because less income is transferred into the firm). Since one cannot unambiguously sign the effects of changes in a subsidy rate, it is left to the empirical analysis to determine which effect actually dominates.

A comment on the nature of redistribution flows that generate negative productivity effects, which is misinterpreted in the literature, is in order. Kornai (1986a) correctly asserts that positive effects of profit sharing are lessened when firms face soft budget constraint. However, he inappropriately attributes the dampening effect of such redistribution to its randomness. He says "(t)he frequent unforeseeable and incalculable redistribution flowing through a hundred channels makes profit incentive illusory ... " (p. 129). As follows from the last two propositions, however, it is precisely the

systematic nature of the interfirm redistribution which has (or may have) negative effects on labor effort in a profit-sharing environment.

Productivity effects of intrafirm redistribution

The modeling of intrafirm redistribution as a particular tax-subsidy scheme (defined earlier in this section) reduces typically multi-dimensional issue of redistribution to only two dimensions--per-capita subsidy (r) and intrafirm tax rate (t). By requiring that the budget be balanced, only one of them, in fact, can be independently determined (the tax rate t is the choice variable below).

In order to proceed with modeling, one has to take into account the following two characteristics of the Yugoslav firm: (i) the structure of personal earnings within the firm is largely determined by the so-called scale of complexity of work positions, and (ii) that this scale is accepted by the referendum of all workers based on a simple majority rule.[16] These two characteristics of the decision-making, together with the treatment of redistribution as a single dimensional issue, enable invoking a median voter theorem[17] which says that the preference of the median voter decides.[18]

Inserting $r = t$ and $y_d = x_d e_d$ for the income of the decisive voter

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[16]For details, see Vodopivec (1989).

[17]For a discussion of the median voter theorem, see, e.g., Mueller (1979).

[18]The subsequent analysis only make sense if the personal income of the median worker is lower than average. Only in that case, namely, he imposes redistribution "from richer to poorer"; otherwise, the optimal tax rate is evidently zero. Since normally personal income distribution is skewed to the right, this condition is likely to be fulfilled.

(subscript d standing for a decisive voter) into the utility function (3), we have

$$\max_{\{t\}} u(y_d, 1 - e_d) =$$

$$= \max_{\{t\}} \left[\ln\left(\omega + t\bar{y} + c + (1 - t)y_d + \frac{1}{N}(1 + s)(N\bar{y} - Y^n) \right) + a \ln(1 - e_d + \lambda) \right]$$

and the first order condition is

$$\bar{y} + \left(t + (1 + s) \right) \frac{d\bar{y}}{dt} - y_d = 0 \qquad (8)$$

since - by the envelope theorem - the coefficient of the $\frac{de_d}{dt}$ term, $\frac{\delta u}{\delta e_d}$, is zero ($e_d$ being the outcome of the utility maximization).

To solve equation (8) for t, the total derivative of (non-contractual) output with respect to the tax rate must be expressed in terms of coefficients and predetermined variables. As shown in Appendix 1, the following holds:

Proposition 4: An increase of the intrafirm tax rate t has a negative effect on the output of the firm.

Unfortunately, this intuitively appealing result does not render itself to empirical verifiability, since the intrafirm tax rate t is unobservable. By employing the equilibrium condition (8), however, one can derive a functional relationship between the unobservable tax rate t and an observable variable. Equation (8), namely, embodies the following fundamental trade-off faced by the median voter: by imposing a higher tax rate, he is better off through the higher subsidy r (which is proportional to t). However, there is also an indirect effect of the increase of the "tax rate" (the decrease of the size of the overall pie, as stated in Proposition 4) which makes the decisive voter worse off.

As shown in Appendix 1, the equation determining the equilibrium intrafirm tax rate is non-linear and cannot be solved analytically. It is, however, possible to show that, under economically meaningful conditions, the following holds:

Proposition 5: The higher the mean as compared to the median personal income of the firm, the higher is the intrafirm tax rate t.

The intuition behind this result is the following. The intrafirm tax-subsidy scheme adopted in the model is such that the structure of after tax-subsidy personal earnings corresponds to the structure of pre-tax-subsidy earnings, and thus also reflects the structure of productivity among workers. Therefore, the proposition can be interpreted as saying that the lower the productivity of the median worker (ranked by productivity) as compared to the productivity of the worker with the mean income, the more the median worker can gain by imposing a higher tax rate (or, loosely speaking, a higher intrafirm redistribution of income).

Combining propositions 4 and 5, one thus obtains the following testable implication:

Corollary 1: The higher the mean as compared to the median personal income of the firm, the lower the output of the firm.

Let me conclude this subsection by discussing policy instruments available to the decisive voter to implement the redistribution. As mentioned, workers determine the scale of complexity of work positions of the firm by referendum. This scale, together with overall amount of income earmarked for personal earnings, largely determines personal earnings received by the workers. Having the optimal intrafirm tax rate in mind, the median--decisive--worker sets the scale of complexity of work positions in such a fashion that it produces precisely the redistribution that is optimal from his point of

view. By shrinking the index of complexity of individual work position (I_i^{COMP})--as established through the scale of complexity of labor positions of the firm--for all the workers whose non-contractual contribution of effort is above the average, and increasing it for all the workers below the average (as compared with the distribution of personal incomes in the absence of intrafirm redistribution), the decisive worker ensures the distribution of the income sharing portion of personal incomes $\hat{D} = \{e_i x_i + (\bar{y} - x_i e_i)t \equiv e_i x_i \sigma_i,\ i = 1, \ldots, N\}$, instead of $D = \{e_i x_i,\ i = 1, \ldots, N\}$.[19] Formally, $\hat{I}_i^{COMP} = \sigma_i I_i^{COMP}$, where the hat indicates the modification of the variable by the redistribution as imposed by the decisive voter.

3. EMPIRICAL RESULTS

3.1 The estimating framework

According to the theoretical model, the provision of equilibrium effort of individual workers (and of the firm as a whole) depends on motivational factors (notably the degree of intra- and interfirm redistribution, and the conduciveness of environment for cooperation). That provision may be labelled as "effectively provided labor", as opposed to a conventional labor input measured by the physical presence of workers (e.g., by number of workers or work hours). Let us define effectively provided labor (L) of the firm consisting of N workers as $L = N\bar{e}$, where $\bar{e}$, the average effectively provided labor of the firm, is the following function:

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[19]The suppression coefficients, σ_i-s, are defined as $\sigma_i = 1 + \frac{(\bar{y} - x_i e_i)t}{e_i x_i}$, $i = 1, \ldots, N$ (note that $\sigma_i \gtreqless 1$ as $\bar{y} \gtreqless x_i e_i$).

$$\bar{e} = \bar{e}(h, c, s', m) \qquad (9)$$

The explanation and the theoretical underpinning of the arguments of the $\bar{e}$ function are given in the previous section (predictions of the expected signs of the derivatives of the $\bar{e}$ function with respect to its arguments are provided by Propositions 1-3 and Corollary 1, respectively).

In trying to estimate equation (9), one is, of course, confronted with a fundamental problem of non-observability of the dependent variable, the effectively provided labor. Fortunately, a solution for this problem is readily at hand: one can identify the effects of the structural variables of interest not on the effectively provided labor itself, but on its results. One can thus employ a production function analysis, with effectively provided labor substituting for the conventional labor input. Since the analysis focuses on the identification of structural factors determining effectively provided labor, only simple production functions of the Cobb-Douglas type are used.

The production function estimating framework, however, requires the re-introduction of some of the complexities of the real world which are, for the sake of analytical convenience, assumed away in the theoretical model. In the empirical analysis I thus distinguish different levels of skills of workers typically found across industries; this is accomplished by treating education as a separate production factor. Furthermore, by controlling for capital stock, I allow for differences in technology among firms.[20]

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[20]This implies substitutability between capital and labor, while fixed proportion technology is assumed in the theory. Since the assumption of fixed proportions is relatively unimportant in the theoretical model, the validity

Consequently, the following form of the production function is used as a basic vehicle of the empirical analysis:

$$INC = AK^{\alpha}L^{\beta}E^{\gamma}e^{u} \qquad (10)$$

where A is a constant; INC - income of the firm ; K - value of fixed assets in use; $L = N\bar{e}(h, c, s', m)$ - effectively provided labor as just defined; E - average duration of professional education of workers; α, β, and γ - the elasticities of income with respect to K, L, and E, respectively; and e^{u} - a random variable (in the exponential form).

While the theory gives a guidance on which incentive factors to include in (9) and, consequently, in (10), it is silent about its functional form. On the experimental basis, the following functional form for the effectively provided labor was selected:[21]

$$L = N(1 + a_1h + a_2c + a_3s' + a_4m) \qquad (11)$$

yielding the following estimable form of (10):

$$INC = AK^{\alpha}\left(N(1 + a_1h + a_2c + a_3s' + a_4m)\right)^{\beta}E^{\gamma}e^{u} \qquad (10')$$

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of its predictions is most likely unaffected.

[21]Note that the selected functional form assumes interaction between firm size and motivational factors (an alternative specification is also tested below), and that the form does not allow for the possible negative productivity effects of the firm size arising from reduced chances for cooperation in larger firms.

Equation (10') is a form of an augmented production function and thus resembles the ones used extensively in the literature on testing for the productivity effects of worker participation. It is, however, distinguished by two important features: (i) it is based on a tightly specified theoretical model, and (ii) as dictated by the theory, motivational (structural) factors enter into (10') in a specific, distinctly labor-interacting manner.

Equation (10') provides ammunition for the criticism of the existing empirical literature on productivity effects of worker participation. The presence of h (conduciveness of environment for cooperation) in (10') gives a theoretical underpinning for the inclusion of proxies for decision-making and possibly ownership in empirical tests in the literature. In light of (10'), however, profit-sharing is often completely misrepresented. Namely, instead of using a *level* of profit per worker,[22] one should use, as the presence of the s' term in (10') suggests, a profit sharing *rate* as the explanatory variable representing the effects of profit-sharing. Indeed, based on (10'), the level of profits per worker has no place among variables explaining productivity effects of profit sharing. In fact, being of residual nature and thus reflecting many factors which may have nothing to do with worker actions (e.g., monopoly rents, first mover advantages, etc.), one may expect the sign of the level of shared profits on the right hand side of (10') to be even negative - functioning, namely, in the same role as c in (10').

Except m, the ratio of mean to median personal earnings of the firm, all

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[22]Estrin et al (1987), for instance, use a variable BONUS, defined as average surplus distributed per worker, as one of the "structural" variables augmenting the production function.

other variables in (11) need a comment on their derivation or empirical representation. Let me start with the selection of the appropriate variable for the conjectural variation term, h, representing the conduciveness of the environment for cooperation ("team spirit", or, even broader, quality of self-management, control by voice). Based on empirical availability, the following variables are considered as possible candidates: labor turnover (TURN), the percentage of payments for sick leaves in total hours paid by the firm (SICK), and the percentage of personal earnings paid as a reward to individuals for rationalizations and innovations (CREATE).

The expected sign of the first two variables, SICK and TURN, is negative. The less conducive environment is for cooperation (the worse the discipline, as primarily reflected in the SICK variable, and the more disturbed the working relations are, as one can understand from the TURN variable), the lower the output. The turnover variable, in addition, captures also the "asset specificity" effects (which work in the same direction as the effect based on the cooperation argument). The longer the workers stay in the firm, the more firm specific knowledge they acquire, and - other things equal - the more productive they are.

Reflecting payments received by individuals for their notable contributions in improving the production process of the firm, CREATE can be interpreted as an indicator of organized efforts to stimulate individual creativity, which can, in turn, be associated with a generally conducive work environment (high team spirit). Alternatively, it may represent a very large increase of the "price of the product" (in this case, only of the worker receiving the innovation reward) which induces the increase of output (one can expect that the substitution effect dominates the income effect in this case). In either case, its expected sign is positive.

One should note that the interpretation of the motivational proxies SICK, TURN, and CREATE adopted here (representing the conduciveness of the environment for cooperation) is not the only possible one yielding the productivity effects as just described. The alternative interpretations for TURN (asset specificity argument) and CREATE (the increase of "the price of the product" argument) were already given. SICK, also, can be alternatively interpreted as representing better allocative efficiency in the sense of more intense internal policing via stricter supervising.

Fortunately, it is possible to design an empirical test to determine which interpretation of the motivational factors TURN, SICK, and CREATE included in (11) is more appropriate. Namely, if the cooperation argument holds, then the effect of these variables is related to the size of the firm and the above variables should enter (11) in an interactive fashion with the size of the firm (represented by number of workers, N). This implies that holding labor turnover, sick leave, and innovation reward rate constant, the larger the firm, the more negative the effect of TURN and SICK, and the less positive the effect of the innovation reward rate on output. If, however, the alternative interpretation is correct, there are no interactions between these motivational factors and firm size. Consequently, one can determine which specification is correct by comparing the empirical results obtained from alternative specifications (judging, above all, by the sign and significance of the estimates in question).

Another possible criticism of the interpretation of the proxies for the conduciveness of the environment for cooperation should be addressed. One may object to linking these variables to the quality of self-management, by simply arguing that TURN, SICK, and CREATE have nothing to do with it, since they could play the same role also in capitalist economies. However, if one takes

into account the tradition of self-management in Yugoslavia, as well as that there exists a well established formal network involving workers in the decision making of the Yugoslav firm, one realizes that labor turnover, sick leaves, and rewarding workers for improvements of the production process are necessarily influenced, among other things, by the extent of worker participation in firm decision making (or "quality of self-management").

Finally, c and s', the constant component of the interfirm transfers per worker and the profit sharing rate of an individual worker respectively, are computed as the parameters of the interfirm transfer function (2), estimated by industry.[23] With a few exceptions, the fit of estimated equation (OLS method is used) is very good, especially for cross-section data. The subsidy rate (-s) falls in the theoretically permissible range (0,1) in all but two cases (out of 19 industries), and is normally highly significant. Less significant, in general, is the constant term, ranging from positive to negative values

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[23]Defining profits as the difference between actual income (INC) and the exogenously determined norm for income ($\overline{INC}$, proxied by the industry average of the income per worker multiplied by the number of workers of the firm) and using this definition in the interfirm transfer function (2), the following estimable function is obtained: NSUBS = CONST + s*INC, where CONST is a constant and (-s) is a subsidy rate, from which the variables s' and c are computed as $s' = \frac{1 + s}{N}$ and $c = \frac{CONST + s*\overline{INC}}{N}$. Note that the above method of calculating s' implies that its value is the same for all firms within the industry (one can justify that by the similarity of rules and practices determining the softness of the budget constraint faced by individual firms, especially in regard to crediting (e.g., some industries are given priority by social plans and are so entitled to concessionary financing).

(detailed results are presented in Vodopivec, 1989) [24]

3.2 The results

On the basis of (10') and the discussion of proxies used for the conjectural variation term, h, the following augmented production function was estimated (in logarithmic transformation):

$$INC = AK^{\alpha}\left(N(1 + a_1 m + a_2 c + a_3 s' + a_4 TURN + a_5 SICK + a_6 CREATE)\right)^{\beta} E^{\gamma} \qquad (12)$$

The estimation results, with alternative combinations of proxies for the h term, are presented in Table 1.[25] The fit is very good and meaningful values are obtained for the usual parameters included in production functions.[26] Furthermore and of central importance, all of the estimated

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[24]The estimated negative value for c, the constant component of the interfirm transfers per worker, is theoretically acceptable, but it does weaken some of the predictions of the theoretical model; empirical results that would contradict some of the predictions of the model could, therefore, be attributed to the negativity of c.

[25]Definitions of the variables used in the analysis and the description of the data base are given in Appendix 2.

[26]The estimates of elasticities suggest that the economy operates at approximately constant returns to scale (the sum of capital and effectively provided labor elasticities ranges from .997 in model (2) to 1.034 in model (4)). A bit surprising is a high estimate for the elasticity of education, ranging from 1.75 to 2.879.

TABLE 1

ESTIMATES OF THE AUGMENTED PRODUCTION FUNCTION

	(1)	(2)	(3)	(4)
m	-.451*	-.493**	-.438*	-.304
	(-2.69)	(-2.92)	(-3.56)	(-0.92)
10^{-2}•c	-.827*	-.926*		-.907
	(-2.37)	(-2.06)	–	(-1.88)
s'	4.726	4.658	–	4.510
	(.50)	(.57)		(.48)
10^{-1}•TURN	-.135*	-.150*	-.075	-.169
	(-2.09)	(-2.11)	(-1.82)	(-1.73)
10^{-1}•SICK	-.125	–	-.240*	-.227
	(-.68)		(-2.39)	(-.86)
CREATE	.296	.287	.266	.473
	(1.57)	(1.35)	(1.85)	(1.41)
K	.293**	.300**	.305**	.317**
	(7.96)	(8.12)	(8.68)	(7.67)
L	.722**	.704**	.724**	.717**
	(7.54)	(8.12)	(16.43)	(6.84)
E	1.949**	1.978**	2.879**	1.750**
	(3.70)	(3.62)	(5.65)	(2.99)
INTERCEPT	-1.446	-1.450	-3.520*	-1.320
	(-1.11)	(-1.18)	(-2.92)	(-0.90)
R^2	.815	.801	.807	.813
Observations	403	403	403	323

Notes: Among the variables in the first column appears also L, effectively provided labor (the expression in the big parentheses of (12)), with β as the corresponding coefficient. The values in parentheses are t-statistics. Variables significant at 1% are marked with two asterisks (**), and those significant at 5% with one asterisk (*). Model (4) is based on the restricted sample (only observations with $m \geq 1$ were used).

parameters of the motivational variables (modifiers of the conventionally defined labor input) are of the expected sign and mostly significant. This provides empirical confirmation for the relevance of the three groups of motivational factors (intrafirm and interfirm redistribution, cooperation among workers) as determinants of productivity of the Yugoslav firm.

The variable representing intrafirm redistribution, m (the ratio of mean to median personal earning of the firm), is found to have a significantly negative influence on the gross income (in model (4) the estimate loses significance, but retains a negative value). To repeat, m functions as an indicator of the intrafirm redistribution (more precisely, of the intrafirm tax rate t), so the higher the m, the more redistribution is taking place (the higher the tax rate), and, consequently, the lower the output. It is interesting that m gains significance when the sample is not restricted to only the observations which have mean personal income higher than the median,[27] thus providing additional evidence that the firms with no intrafirm redistribution perform better than the ones where the "median voter" imposes redistribution (i.e., compresses the differentials in personal earnings).[28]

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[27]Note that in great majority of enterprises (80.1% of them), the mean personal income is indeed larger than the median, as the theory above assumes.

[28]To be able to run the model on the extended sample, strictly speaking, the influence of m on the gross income should be represented by a kinked function, flat for $m \leq 1$. With the mean personal income being equal or below the median, namely, the intrafirm redistribution disappears, and so does its effect on output. Since m enters into (12) via a logarithmic function and is negatively signed, the decrease of of the importance of the values of $m \leq 1$ is, to some extent, accomplished simply by the nature of the logarithmic function.

Both interfirm redistribution parameters, c and s', confirm the negative effects of interfirm redistribution on productivity. As described above, the negativity of the c term, the constant component of the interfirm transfers per worker, shows that the firms with higher non-conditional gifts (lower dues) generate systematically less output than those with lower non-conditional gifts (higher dues). The sign of the other interfirm parameter, s' (the profit sharing rate of the individual worker) is theoretically ambiguous, reflecting the presence of both substitution and income effects (the latter may, in some cases, work in the opposite direction as the former). Possibly as the result of these conflicting tendencies, the estimated coefficient of s' is not significant. Its positiveness, nonetheless, provides some support to the hypothesis that negative effects of interfirm redistribution arise because the profit sharing rate of the individual worker is lowered causing negative substitution effects that are larger than the ensuing positive income effects.

Lastly, the empirical results also provide support for our choice of proxies for motivational factors here interpreted as representing the conduciveness of the environment for cooperation ("team spirit"). Statistically the most significant among them is labor turnover (TURN); SICK and CREATE, while being correctly signed, are statistically insignificant (except SICK in model (3)). Note that they all enter (12) in a fashion that assumes the interaction with the number of workers N, the specification that produced better empirical results.[29] The empirical results thus show that the

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[29]The following equation was also estimated:

$$INC = AK^{\alpha}\left(N(1 + a_1 m + a_2 c + a_3 s') + a_4 TURN + a_5 SICK + a_6 CREATE\right)^{\beta} E^{\gamma}$$

Note that TURN, SICK and CREATE enter in a fashion that does not assume an

appropriate interpretation of the above motivational factors is the one based on the cooperation argument: the better the relations among workers (the more they feel that they can influence the working environment, as reflected in a lower turnover and sick leave rate), the higher the output (except for CREATE which reflects both cooperation and individualistic "price" incentives).

To assess the importance of the institutional inefficiencies discussed above, one would estimate the output forgone because of these inefficiencies. The empirical estimates of the parameters in (12) enable one to do precisely that. That is, one can perform a simple experiment consisting of inserting a modified value instead of the true one for a chosen exogenous variable (an instrument under consideration) in (12) and observe the ensuing difference in the income, the dependent variable. The results of such experiments with the parameters of interfirm and intrafirm redistribution are reported in Table 2.[30]

The estimated loss of income due to the presence of interfirm redistribution amounts to 3.23% (obtained on the basis of parameter c), to which one may add .86 % income loss caused by the effects of the non-zero

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interaction with N, number of workers (because the effectively provided labor is raised to a power of β, some interaction, when $\beta \neq 1$, exists, but it is of second order magnitude). In comparison with the equation where the interaction is assumed, the general fit was lower; t-statistic of TURN was impaired (but the sign remained the same), SICK reversed the sign (!) but was insignificant, while the significance and sign of CREATE remained unchanged.

[30]Simulations are performed at the "sample mean". That is, the value of the sample mean is taken for the value of the corresponding explanatory variable in (12), except for K and E, for which the sample means for log(K) and log(E) are used.

TABLE 2

INCOME FORGONE DUE TO INSTITUTIONAL INEFFICIENCIES

Instrument	Characterization of the change of the instrument	Income forgone (in %)
c	Reduction of c by 7.3% of the average income of the sample	3.23
s'	s' = 1/N assumed (i.e., zero interfirm transfer rate, s = 0)	.86
m	m = 1 assumed (no intrafirm transfers)	2.70

Notes: Estimated coefficients are taken from the model (1) of Table 1. World Bank (1989) reports a net transfer of income amounting to 7.3% of gross social product from the banking to enterprise sector in Yugoslavia in 1986, so the reduction of c corresponds to the abolishment of net inflow of resources into the enterprise sector.

transfer rate (the latter estimate could only be taken provisionally, since the coefficient of s' in (12) is not significant and hence its true value may be considerably different). The estimate of the output forgone because of the intrafirm redistribution (i.e., because of the compressed intrafirm differentials in personal earnings) is 2.70%.

The magnitude of these numbers is neither negligible nor spectacular. Compared with estimates of welfare loss from monopoly,[31] these numbers seem

[31]With few exceptions, studies on the U.S. economy, including the pioneering Harberger's (1954) one, find welfare losses attributable to monopoly of a very low magnitude (approximately .1% of GNP).

very significant and support Leibenstein's (1966) claim that X-inefficiency losses are likely to be much greater than losses arising from monopoly. The estimates of income forgone thus provide evidence that the redistribution focused on in this research has been a substantial hindrance to the development of Yugoslavia, and most likely also to the development of other socialist countries of Eastern Europe.

Similar simulation experiments were performed also with TURN, SICK, and CREATE as instruments. The results are as follows. The reduction of the average labor turnover rate from its present mean value to the value of the present first quartile (i.e., a reduction from 2.50% to .95%) yields a 2.58% increase of income, and a similar reduction of a sick leave rate (from 4.05% to 3.03%) a 1.58% increase of income. These results show that the realization of quite achievable targets in improving the conduciveness of the environment for cooperation - what these two variables, as shown above, stand for - would quite substantially increase production.

Similarly, the simulation with CREATE as an instrument shows significant unexploited productivity reserves. The result shows that if all firms rewarded their workers for their exceptional work contributions at the average rate of those firms that actually did,[32] the resulting increase of income would be 5.29%, and, furthermore, the income generated in this fashion is 51 times higher than the reward received by workers.

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[32]Since such a stimulation may not be appropriate for some industries, only industries where this method was actually used are accounted for.

4. CONCLUDING REMARKS

The results of the empirical analysis show that Yugoslav firms suffer important output losses caused by both intrafirm and interfirm redistribution (the same is likely to be true for other socialist firms). This leaves room for costless efficiency improvements if such a redistribution is abolished.

A society free of *any* redistribution is, by no means, ideal. It is only the particular types of interfirm and intrafirm redistribution that are under attack.[33] The claim that the soft-budget-constraint economy is appealing from the equity point of view (made, e.g., by Kornai, 1986b) is questionable. The economies where a huge portion of GNP is redistributed through an informal system of bargaining[34] are bound to generate not only inefficiencies in production (as demonstrated above), but also in distribution--the latter ones simply because of differences in the ability of different groups to represent their common interests as implied by the logic of collective action (Olson, 1965).[35]

The increase of wage differentials may indeed be neither too controversial nor too difficult task (an important step in this direction is,

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[33]Indeed, together with the abolition of the above discussed redistribution, a society should establish an alternative "social safety net", but one that minimizes the efficiency hampering effects (an often quoted example is Sweden).

[34]For the evidence on the size of interfirm redistribution, see Konovalov (1989) for Yugoslavia, and Saldanha (1990) and Schaffer (1990) for Poland.

[35]As argued by Olson (1982), "a society that would achieve either efficiency or equity through comprehensive bargaining is out of the question" (p. 37).

e.g., the Yugoslav 1989 legislation, which abolishes the referendum that had previously been required for establishing intrafirm earnings differentials). Incomparably more complex is the issue of interfirm transfers. To prevent them, one should (i) stop subsidizing enterprises (whether from government or enterprise sources), (ii) make the fiscal system unselective and transparent (in particular, apply uniform tax rates, unburden enterprises of parafiscal "financial investments", and reduce the technical complexity of the system by reducing the variety of taxes paid by enterprises), and (iii) impose positive interest rates (in real terms) on any kind of loans (e.g., by indexation of debts).

On the basis of the discussion of the confrontation of coalitions that underlies the soft-budget-constraint redistribution, it has been claimed elsewhere (Vodopivec, 1989) that socialist countries at present simply lack adequate mechanisms to prevent such redistribution: It is the ill-defined property rights, together with the absence of competition characterizing both political and economic institutions of these societies, which generates such a redistribution. Uprooting the redistribution, therefore, calls for the introduction of a new mechanisms that would (i) provide alternative services on the basis of *impersonal* (market) decision-making and thus supplant bargaining between interest groups, in the areas where this is feasible, and (ii) supplement current institutions by providing checks and balances in the political decision-making process, in the areas where impersonal decision making is not possible (e.g., fiscal and monetary policy etc). The Eastern Europe "peaceful revolutions" of the second half of 1989 seem to have removed political obstacles for the introduction of such changes--but their actual implementation might still be a lengthy and painful process.

To conclude, a remark on the destiny of the worker participation in

current reforms of socialist countries, particularly relevant for Yugoslavia. The empirical evidence presented above, which indicates strong productivity potential of factors determining the conduciveness to an environment of cooperation, is in line with the results of the empirical literature on worker participation in market economies, favoring worker participation on productivity grounds (recent findings are summarized in Blinder, 1990). The current trend of the dethronement of all old institutions--which takes place, as usual in socialist countries, in a "great leap" style--thus brings a danger of throwing out the baby with the bath water: while many of the existing institutions indeed deserve a complete demise, this is not the case with all aspects of worker-management. In a radically changed overall environment, these countries may well find worker participation to be productivity increasing, as it is in developed market economies.

APPENDIX 1: PROOFS OF THE PROPOSITIONS

Proof of Proposition 1

Taking a partial derivative of (5)[36] with respect to h_i, and denoting the denominator of (5) with D, one obtains

$$D^2\frac{\delta e_i}{\delta h_i} = [(\omega + r + c + s'\Pi_i) + (1 + \lambda)(1 - t + s')x_i]as'$$

The last expression is positive, since (i) a, s' and $(1 + \lambda)$ are positive by definition, (ii) the term $(1 - t + s')$ is positive because of the nature of the problem ($s' = \frac{1 + s}{N}$ is positive, and it is economically meaningful to

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[36]Equations of the main text are referred to with the same numbers as they were given in the text; the equations derived in the appendix are labelled - and later referred to - with a letter A followed by a number.

assume $t < 1$), and (iii) the term $(\omega + r + c + s'\Pi_i)$ is positive by (7).

Proof of Proposition 2

Let us first derive the expression for the equilibrium non-contractual component of the income generated by the firm, Y_{nc}, or, equivalently, $\bar{y}$ ($Y_{nc} = N\bar{y}$). From equation (5) (dropping the terms containing h_i since they represent at this stage an unnecessary complication) one obtains

$$e_i x_i = \frac{1 + \lambda}{1 + a} x_i - \frac{(\omega + r + c + s'\Pi)a}{(a + 1)(1 - t + s')} + \frac{as'}{(a + 1)(1 - t + s')} e_i x_i$$

Collecting the $e_i x_i$ terms, and remembering that $(\omega + r + c + s'\Pi)a = (\lambda + 1)(1 - t + s')x_0$ (from (6))

$$e_i x_i = \frac{(1 + \lambda)(1 - t + s')}{1 - t + s' + a(1 - t)} (x_i - x_0) \qquad \text{(A1)}$$

Using the definition of $\bar{y}$ and (A1)

$$\bar{y} = \frac{1}{N} \sum_{i=1}^{N} x_i e_i = \frac{1 + \lambda}{N\left(1 + \frac{1 - t}{1 - t - s'} a\right)} \sum_{i > i_0} (x_i - x_0) \qquad \text{(A2)}$$

where i_0, $i_0 = i_0(x_0)$, is number of workers not providing non-contractual contributions of effort.

Comparative statics performed on equation (A2), using (6), again dropping the term containing h_0, and defining $y^n = \frac{Y^n}{N}$ and $G(x_0) = \frac{i_0}{N}$, yields

$$\frac{d\bar{y}}{dc} = \frac{1}{\left(1 + \frac{1 - t}{1 - t - s'} a\right)} \frac{1 + \lambda}{N} \sum_{i > i_0} \left(-\frac{dx_0}{dc}\right) =$$

$$= - \frac{(1 - G)a}{(1 - t + s') + (1 - t)a} \left[1 + (1 + t + s)\frac{d\bar{y}}{dc}\right]$$

Solving the above equation for $\frac{d\bar{y}}{dc}$, one obtains

$$\frac{d\bar{y}}{dc} = - a(1 - G)[(1 - t + s') + (1 - t)a + (1 + t + s)(1 - G)\, a]^{-1}$$

which is unambiguously negative: a, (1 - G), and s' are positive by definition, and $0 < t < 1$, so all of the multiplicands on the right hand side

are positive.

Proof of Proposition 3

Comparative statics performed on equation (A2) with respect to s' yields

$$\frac{d\bar{y}}{ds'} = \frac{d}{ds'}\left\{\frac{1}{\left(1 + \frac{1 - t}{1 - t - s'}\,a\right)}\,\frac{1 + \lambda}{N}\sum_{i>i_0}(x_i - x_0)\right\} =$$

$$= C_1 - \frac{(1 + \lambda)(1 - t + s')(1 - G)a}{[(1 - t + s') + (1 - t)a](\lambda + 1)(1 - t + s')^2}$$

$$\left([\Pi + (1 + s + t)\frac{d\bar{y}}{ds'}](1 - t + s') - (\omega + r + c + s'\Pi)\right)$$

where $C_1 = \dfrac{(1 - t)a}{[(1 - t + s') + (1 - t)a]^2}\,\dfrac{1 + \lambda}{N}\sum_{i>i_0}(x_i - x_0)$.

Solving the above equation for $\frac{d\bar{y}}{ds'}$

$$\frac{d\bar{y}}{ds'} = \frac{C_1C_2 + a(1 - G(x_0))\left(c + \omega + r - (1 - t)\Pi\right)}{C_2 + C_3} \qquad \text{(A3)}$$

denoting $C_2 = [(1 - t + s') + (1 - t)a](1 - t + s')$, and $C_3 = (1 - G)\quad(1 + t + s)(1 - t + s')a$. Note that C_i, i = 1, ..., 3, are positive, as is the $a(1 - G(x_0)$ term. The sign of $\frac{d\bar{y}}{ds'}$ thus depends on the utmost right bracketed expression of the numerator. With $c + \omega + r$ being positive, $\frac{d\bar{y}}{ds'}$ is positive as long as $(c + \omega + r) > (1 - t)\Pi$. For sufficiently profitable firms, however, $(c + \omega + r) < (1 - t)\Pi$, and thus $\frac{d\bar{y}}{ds'}$ is negative.

Proof of Proposition 4

Let us first compute $\frac{dx_0}{dt}$ by differentiating (6):

$$\frac{dx_0}{dt} = \frac{a\left(\bar{y} + t\frac{d\bar{y}}{dt} + (1 + s)\frac{d\bar{y}}{dt}\right)(1 - t + s') + a(\omega + r + c + s'\Pi)}{(1 + \lambda)(1 - t + s')^2} \qquad \text{(A4)}$$

Differentiating (A2) and using (A4), remembering that $r = t\bar{y}$, and

dropping, for simplicity, additive s' terms (being of second order magnitude) yields

$$\frac{d\bar{y}}{dt} = \frac{1+\lambda}{N(1+a)} \sum_{i>i_0} - \left(\frac{dx_0}{dt} + (x_i - x_0)\frac{di_0}{dt}\right) =$$

$$= - \frac{a(1 - G(x_0))}{(1+a)(1-t)^2} \left((2+s)\bar{y} + \omega + c - (1+s)y^n + (1+t+s)(1-t)\frac{d\bar{y}}{dt}\right) \tag{A5}$$

Solving (A5) for $\frac{d\bar{y}}{dt}$ yields

$$\frac{d\bar{y}}{dt} = - \frac{a(1 - G(x_0))\left((2+s)\bar{y} + c + \omega - (1+s)y^n\right)}{(1-t)[(1+a) + a(1+s)(1 - G(x_0)) - t(1 + aG(x_0))]} \tag{A6}$$

All the multiplicative terms of the ratio on the right hand side are positive - also the last term of the numerator, since $\bar{y}$ and y^n are of the same order of magnitude, and c and ω are positive - so (A6) implies that $\frac{d\bar{y}}{dt} < 0$. Since the number of workers is fixed by assumption, this completes the proof of Proposition 4.

Proof of Proposition 5

Inserting (A6) into (8) (dropping the argument of the G function) gives

$$\bar{y} - y_d - \frac{(1+t+s)a(1-G)\left((2+s)\bar{y} + c + \omega - (1+s)y^n\right)}{(1-t)[(1+a) + a(1+s)(1-G) - t(1+aG)]} = 0$$

Multiplying the above equation with the denominator of the utmost right term and dividing it by $y_d(1-G)a$, denoting $m = \frac{\bar{y}}{y_d}$ and $A = \frac{c + \omega - (1+s)y^n}{y_d}$, yields

$$\left(\frac{(1-t)[(1+a) - t(1+aG)]}{a(1-G)} + (1+s)(1-t)\right)(m-1) -$$

$$- [(2+s)m + A](1+t+s) = 0$$

Rearranging (adding and subtracting $(1-t)(m-1)$ and $[(2+s)m + A]$ terms), and and defining $b = \frac{1+a}{a(1 - G(x_0))}$, yields

$$(b-1)(m-1)(1-t)^2 + \left(2(2+s)m + A - 2 - s\right)(1-t) -$$

$$- ((2 + s)m + A)(2 + s) = 0 \qquad (A7)$$

Equation (A7), determining the optimal tax rate of the decisive (median) worker, is quadratic in t - 1. However, since $G(x_0)$ and m also depend on t, the left hand side cannot be treated as a quadratic function of t. To derive the relationship between t and m which renders the model empirical verifiability, therefore, one must also specify the relation between the participation in the provision of non-contractual contributions, $G(x_0)$, and a tax rate. From (6), $\frac{\delta x_0}{\delta(1 - t)} < 0$, so it seems reasonable to assume $\frac{\delta[\ln G(x_0)]}{\delta[\ln(1 - t)]} = -1$. Total differentiation of (A7) then yields

$$\frac{d(1 - t)}{dm} = - \frac{(b - 1)(1 - t)^2 + 2(2 + s)(1 - t) - (2 + s)^2}{(m - 1)(1 - t)\left(2(b - 1) - \frac{bG(x_0)}{1 - G(x_0)}\right) + (4 + 2s)m + A - 2 - s} \qquad (A8)$$

To complete the proof of Proposition 5, one must prove that the right hand side of (A8) is negative. While this is not true in general, one can show that both the numerator and denominator of the ratio on the right-hand-side are positive for economically meaningful values of the above parameters:

(i) The denominator is positive, as long as $m > 1$, $0 < t < 1$, $G \leq .5$).

(ii) The numerator is positive for $t < .33$ (assuming $a = 1$ and $G = 0.5$).

APPENDIX 2: DATA SOURCES AND VARIABLES USED IN THE EMPIRICAL ANALYSIS

The empirical analysis is based on the sample of 403 Slovenian manufacturing units engaged directly in production, for 1986. The units are either Basic or so-called Uniform Organizations of Associated Labor. To allow for the possibility of industry level analysis, 19 industries (defined at the lowest, 5-digit level) with 10 or more firms were selected (drawn and rolled steel; cast metal products; production of bricks; manufacturing of building

materials; sawmilling; manufacturing of boards; furniture; paper and paper products; manufacture of cotton fabrics; manufacture of wool fabrics; knitwear; underwear; garment; footwear; bread and pastry; vegetable and fruit processing; slaughtering; wine production; and printing). The enterprises of the sample account for approximately 10% of total GMP of the Republic of Slovenia, the most developed among the republics and autonomous provinces of Yugoslavia.

The data were obtained from The Social Accounting Service of Slovenia (accounting data--for each firm it contains 149 variables of the income statement, 362 variables of the balance sheet, and 110 variables of special accounting data), and from The Statistical Office of Slovenia (data on labor turnover, professional education, and personal earnings distribution).

The variables used in the empirical testing of the model are defined as follows (the calculation of c and s' is given in the text):

INC - gross income of the firm (revenues minus material costs);

NSUBS - net subsidies of the firm (obtained from the income statement and the balance sheet; for details, see Vodopivec, 1989);

K - value of fixed assets in use (at the end of the year);

N - number of working hours, defined as number of hours paid corrected for the number of hours spent on sick leaves;

E - average duration of the professional education of workers, in years (available only at the industry level);

m - the ratio of the mean to median personal earnings of the firm, computed on the basis of the number of workers falling in fourteen personal earnings brackets as of March 1986;

TURN - labor turnover, defined as the percentage of the sum of separations and hirings in the total number of workers of the firm (as of March 1986);

SICK - the percentage of sick leaves in total hours paid;

CREATE - the percentage of personal earnings paid as a reward to individuals for rationalizations and innovations.

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