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The Determination of Wages in Socialist Economies

Some Microfoundations

Simon Commander
and
Karsten Staehr

Wages are commonly assumed to be exogenously determined in socialist economies. But wages in socialist economies have been determined by a combination of institutional and economic factors.

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This paper — a product of the National Economic Management Division, Economic Development Institute — is part of a larger effort in PRE to analyze the sources and dynamics of inflation in transitional socialist economies. Copies are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Olga Del Cid, room M7-047, extension 39050 (62 pages, with figures and tables).

Commander and Staehr address the issue of how wages are determined in socialist economies.

They distinguish between different types of economic regime, in terms of how much decentralization is permitted and how extensive are market-based features or rules.

Wages are commonly assumed to be exogenously given in socialist systems, regardless of regime. Commander and Staehr show that this assumption is not warranted, given the use of incentive-based systems in these economies.

Both the classical planned economy and the partially reformed regime face the problem of motivating workers in the absence of monitoring and of such conventional penalties as unemployment. How do these regimes try to resolve the incentive problem?

In a centrally planned economy, the piece-rate mechanism is an attempt to stimulate more effort among workers. But Commander and Staehr show, using game-theoretic models, that in cooperative settings the outcome can be lower productivity than desired and that in noncooperative settings the outcome can be higher wages than warranted.

They interpret the partially reformed socialist economy as an attempt to refine the motivational structure by introducing a manager between the planner and the workers. One objective is to provide a framework in which workers and managers engage in a cooperative game to determine wages and output with the incentive structure given in effect by the planner. They show how this can yield undesired results, when managers and workers cooperate, playing a noncooperative game with the planner.

They present a preliminary treatment of an economic regime such as the one that existed in Poland after January 1990, where market-based rules almost fully predominate. Their objective is to provide coherent foundations for wage equations that can be tested empirically.

They prepare estimates for the partially reformed economies of Hungary and Poland.

Data and other limitations limit the conclusions that can be drawn. But Commander and Staehr show wages to be strongly associated with prices and rather less strongly associated with productivity. Hence, wages should not be considered fully exogenous, even if institutional and other factors indicate more exogeneity than would exist in a standard market economy.

The Determination of Wages in Socialist Economies:
Some Microfoundations

by
Simon Commander and Karsten Staehr

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Section 1: Introduction

The inefficiencies particular to socialist economies have generally been traced to the absence of market based discipline and most especially, the weights given to full employment, price stability and low income dispersion. The resulting trade-off was historically presented in terms of systemic or macroeconomic rationality alongside microeconomic inefficiency [1]. Yet increasingly this distinction has appeared irrelevant. In some instances, the extent of underlying macroeconomic imbalance was masked by recourse to heavy external borrowing and/or accompanied by attempts at piecemeal economic reform aimed at eliminating or reducing those imbalances. In general, the symptom of tension was the presence of acute goods market shortages associated with an excess demand regime. Less well perceived was the link between goods markets disequilibria and the demand for factors of production. Guaranteed full employment imposed excess demand for labour regimes generating some labour hoarding by enterprises [2]. Such hoarding could readily coexist with labour shortages and indeed could exacerbate such shortages.

Clearly, persistent excess demand for labour and capital would appear to rule out any of the behavioural relations, even correlation, between standard macroeconomic variables. Thus, even the tendency toward wage expansion that might be presumed to exist when labour reserves are exhausted might be absent in the institutional setting of the classical socialist economy. Inflation could in principle be eliminated by an ex ante balancing of incomes and expenditures. An inability to balance revenues and expenditures could be expressed as open inflation but equally as repressed inflation or simply be denied -- hidden inflation [3]. The restrictions on the functioning of a labour market then dissociate the maintenance of full employment through changes in the real wage, imply further that labour allocation and sorting occurs independently of standard signals and that with low wage dispersion a conventional intertemporal accumulation of skills does not occur.

It is now evident with the benefit of hindsight that the coordination of economic policies in a centrally planned system proved consistently more difficult than anticipated. Incomes policies proved only partially effective as a balancing mechanism with relatively rapid growth in open inflation in a number of economies, particularly those undertaking partial market-oriented reforms. On the real side of the economy performance was very mixed with apparently adverse dynamic outcomes. Table 1.1 demonstrates negative growth rates of capital productivity for the entire sample from the mid-1970s onwards. In addition, growth rates for labour productivity decelerated very significantly and universally from the early 1970s onwards.

These adverse dynamics have commonly been attributed to the inappropriate

[1] Nuti (1988)

[2] Bauer (1990); Kornai (1985)

[3] Portes (1977)

incentive structure operating in the system with emphasis on the lack of private returns to effort. The incentive problem was widely recognized by planners and

Table 1.1

Labour and Capital Productivity (average annual growth rates), 1966-85

	1966-70		1971-75		1976-80		1981-85	
	Lab	Cap	Lab	Cap	Lab	Cap	Lab	Cap
Bulgaria	8.1	n.a	6.2	-0.6	4.4	-3.6	3.5	-3.1
Czechoslovakia	5.5	n.a	5.9	1.1	3.7	-1.5	1.3	-3.4
GDR	5.0	n.a	6.2	0.1	4.4	-1.0	4.3	-0.4
Hungary	5.1	n.a	6.1	-1.5	4.5	-4.3	2.3	-3.1
Poland	4.0	n.a	7.3	1.0	4.3	-4.2	-0.1	-3.4
Romania	7.3	n.a	6.2	-0.3	5.8	-0.8	4.0	-4.2
USSR	6.3	n.a	5.8	-1.1	2.8	-2.9	3.1	-2.7

Source: ECE-UN; cited in Nuti (1988), p367

academics in socialist economies. While high material intensity, low quality capital goods and inflexible allocative mechanisms can explain part of this poor performance, the institutional framework, motivational structure and remuneration system are clearly central to explaining low productivity in the state sector. At the same time, the attentuation of private ownership and the reward structure would exacerbate problems -- familiar also to a capitalist economy -- in monitoring performance and information asymmetry. Among other results, the absence of a conventional disciplinary mechanism -- such as involuntary unemployment -- might be expected to facilitate shirking.

Despite widespread recognition that the lack of a conventional macroeconomic equilibrating mechanism in the system and the commitment to low wage dispersion has tended to dilute productivity growth, exacerbate wage pressures and been a component in the determination of the level of excess demand in the system, limited attention has been directed to the particular processes by which wages are determined in such economies. One assumption has been to view wages as largely exogenous. Yet -- as this paper attempts to show -- this is not appropriate once consideration of the incentive parameters is taken into account. We also aim explicitly to introduce incentive features particular to a variety of socialist regimes where account is taken of the degree of market-oriented reforms introduced into the system [4].

This paper focusses on the issue of wage determination starting from the case of a classical centrally planned economy and then progressively introducing

[4] It should, of course, be mentioned that there is an extensive literature on the Yugoslav experience with worker management/councils and more exotic ownership forms; see, inter alia, Ward (1958); Tyson (1979); Horvat (1986); Jones and Svejnar (1988). This paper explicitly does not concern itself with the Yugoslav case.

market directed reforms. While such regime shifts have obviously to be attributed to range of factors, we attempt to show that such reforms generally represent attempts at changing the incentive and monitoring structure and hence involve significant changes to the process by which wages are generated. We approach the problem in a simple game theoretic framework and hence with regard to the compatibility of interests among agents in these regimes. We relate the wage outcome to games involving, variously, workers, managers and the planner. The players in these games differ by regime, as do the outcomes of the games. An underlying concern of the paper is basically macroeconomic as we wish to extract a set of structural wage equations that could be cast in a macroeconomic model. We further attempt to derive observable specifications. However, the paper attempts to ground these equations by providing some simple micro-foundations appropriate to the institutional and other arrangements characterizing the socialist economy.

The organization of the paper is as follows. Section 2 presents a brief discussion of the institutional context in which wages and employment have been determined in socialist economies. A simple typology of regimes is presented that attempts to accomodate the features of the various reform measures undertaken in a range of socialist economies over the past twenty years. Sections 3 through 5 set up simple bargaining models for the various regimes. In Section 6, drawing on Hungarian and Polish experience and data, we present some preliminary estimations of our wage equations and Section 7 concludes.

Section 2: Wage Determination in the Socialist Economy

2.1 Regime Typology

The discussion that follows aims to provide summary treatment of the key features of a range of socialist economy regimes with particular regard to the wage determination. Clearly many particularities are glossed over or ignored; the objective is to encapsulate the basic regularities of the stylized regimes with which we intend to work. The characteristics of the regimes are crudely classified in Table 2.1. We distinguish four discrete regimes -- the classical centrally-planned economy (CPE), the partially reformed socialist economy in a first phase (R1E), a reformed socialist economy in its second phase (R2E) and a standard capitalist economy (CE). No strict linearity is implied by the classification which is more normative than theoretical. Rather, the typology broadly captures a series of historical experiences among European socialist economies. In general, however, the transformation has followed a linear process. Movement away from the CPE has involved a transition to an economy with R1E features. Hungary after 1968 and Poland from the early 1970s might be considered as R1E economies. Advanced reform regimes (R2E) with features increasingly akin to those of a standard capitalist economy have been a more recent feature (for example Poland and GDR in 1990). The majority of countries remain effectively located in R1E regimes.

For the purposes at hand, the distinction between the latter and the CPE relates to the change in the rules determining wage fixing; the introduction of new actors -- namely managers -- into the wage bargaining framework and the

Table 2.1

	CPE	...	R1E	R2E	...	CE
1. Ownership of enterprises	state owned		state owned	primarily state owned		largely private
2. Allocation of production inputs	plan		plan/free	free		free
3. Setting of factor prices	plan		plan/free	market		market
4. Allocation of labor input	plan		plan/free	free		free
5. Setting of wages	plan		free/rules	market / wage taxation		market
6. Allocation of consumer goods	plan		plan/free	free		free
7. Setting of consumer prices	plan		plan/free	market		market
8. Firms' budget constraint	soft		soft	soft/hard		hard
9. Unemployment goal	no unemployment		no unemployment	accepts unemployment		accepts unemployment
10. Tax policy	turn-over tax		turn-over tax profit taxed	income tax, VAT		income tax, VAT
11. Subsidies	often significant		often significant	remove		few
12. Government's budget constraint	soft/hard		soft/hard	soft/hard		soft/hard
13. Monetary policy	passive		passive	contingent		contingent
14. Separate central bank and retail banks	no		no/yes	to some extent		yes
15. Ownership of retail banks	state		state	state		private
16. Retail banks' budget constraint	soft		soft	soft/hard		hard
17. Securities markets	no		no	no		yes
18. Foreign trade	state monopoly		state + enterprises	free		free
19. Exchange rate policy	fixed, rationed		fixed, rationed	fixed/flexible		fixed/flexible
20. Convertibility	no		no	yes (current account)		yes

general shift in planner's preference toward goals not strictly denominated in quantity terms. However, no parametric shift occurs with regard to employment; nor with regard to the budget constraint facing enterprises. In short, the R1E stage represents selective market-oriented reforms with prices still largely administratively determined and resource allocation driven by the planner or central authority. To that extent, both reform economies (R1E and R2E) represent degrees of decentralization with respect to the base CPE structure. While the R2E economy bears most of the characteristics of a capitalist regime, the thinness of financial institutions and the ownership structure continue to create an effective distinction. Retention of the soft budget constraint has potentially powerful implications for the wage bargain.

2.2 The Centrally Planned Economy (CPE)

The CPE that was the characteristic organizational form for most socialist regimes until the 1970s (and in some cases -- such as Bulgaria, Romania and Soviet Union -- until almost the present day) was based on vertical controls, with the planner coordinating economic decisions. Enterprise autonomy was severely circumscribed and management was largely a transmission belt for orders emanating from the planner. Trade unions lacked autonomy and full employment was a given. Commands issued to agents and monitored essentially in quantities proceeded on the basis of a theoretical balancing of input and output flows. Similarly, revenues and expenditures were balanced with financial flows accomodating planned physical flows. Wages were commonly set at low levels and were compressed in their dispersion. A significant wedge between direct labour costs to enterprises and household income emerged given the weight of transfers and subsidies in total income. This generally implied low absolute wages but relatively high aggregate household income. Wages were consistently subject to centralized controls. These were critical for achieving balance between aggregate revenues and expenditures as also for restraining the tendency for labour market rents to be extracted out of a system where conventional ownership and market disciplines were absent.

Several well-recognised tensions emerged from this system. In dynamic terms, once labour reserves have been exhausted, the mechanism for output growth was necessarily greater capital infusions. Growth depended on new investment with higher capital-labour ratios and/or changing the product-mix toward more capital-intensive goods. Depending on the income elasticity of consumer demand for capital and labour-intensive goods, satisfying consumer demand could have adverse consequences for growth. By the same token, this could yield exaggerated mismatch between consumer demand and the structure of aggregate output [5]. This dynamic inefficiency reached down into the wage process. When labour shortages emerged and the penalty that could be exacted by the planner from the worker for inadequate effort was absent or difficult to enforce, the only feasible mechanism for inducing greater worker effort remained piece-rate wage adjustment. The use of piece-rates attempted to get round the monitoring problem. The issue turned not only on the costs of monitoring individual effort but also, given the absence

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[5] One implication of this being that any shift in preference on the part of the planner toward satisfying consumer demand would have a correspondingly negative effect on output; see Weitzmann (1970).

of a true management agency, in monitoring enterprise performance. To the extent that an information constraint emerged, the planner would tend to select a control instrument that, in principle, harmonized with the overall emphasis on physical -- hence monitorable -- targets. This meant that regulation of the wage-bill of enterprises became the other key control mechanism in the hands of the planner [6]. The enterprise wage-bill was in effect constructed as a base wage with a piece-rate adjustment [7].

The use of above-norm payments as motivational devices became a widespread feature of CPEs. By 1960 90-95% of Soviet industrial workers were paid some sort of incentive wage and over 60% were on piece-rates [8]. However, to the extent that piece-rates resulted in aggregate demand effects, the likely consequence was a further divergence of the planned supply of consumption goods from notional demand, given limitations on factor substitutions and the higher capital/labour ratios in production required to sustain growth. Shortage moreover induces observable spillover effects in consumer markets [9]. To the extent that the leisure choices of workers are constrained [10], rising excess demand (assuming that wage payments were not matched by availability of consumer goods), mirrored in higher than desired money balances, would exert influence on the relative effort applied by workers.

In short, the full employment regime imposed a weak incentive base. Attempts to raise X-efficiency by piece-rate payments further tended to have implications for balance in goods markets. Combined with the tendency for exhaustion of labour reserves to promote a structure of output that worsened consumer goods market disequilibria, this restrained the viability of sustained use of piece-rates to motivate workers.

2.3 The Partially Reformed Economy (R1E)

Characteristically, reforms to the CPE emphasized some measure of decentralization of decision-making; the underlying objective being to simulate some of the motivational features of a market economy while retaining the basic ownership structure and redistributive traits of socialism. Generally, greater autonomy for enterprises was accompanied by measures to associate domestic with

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[6] CPEs generally started out by regulating the average wage but fairly rapidly moved to regulation of the wage-bill.

[7] A wide variety of systems were tried at various stages; most aimed at improving the incentive structure and/or providing enterprises with stimuli to reduce labour absorption. In general, the wage-bill was defined as paid-out wages and bonuses. In the late 1960s, separate bonus funds were established; see Adam (1979) ppxviii/xix.

[8] Kirsch (1972), pp41/42

[9] See, for example, Podkaminer (1988)

[10] Simply 'exiting' from work has generally not been feasible, as legislation against 'parasitism' suggests.

international prices, to allow, in some cases, enterprises to have direct access to technology and other imports [11] and by greater tolerance for unofficial or parallel markets in both goods and currency. Such measures were very tentatively initiated (but then reversed) in Poland and Czechoslovakia in the late 1950s and more systematically in Hungary after 1968 and Poland after 1973/75.

Decentralization involved the central authorities relinquishing the right to set physical output targets and centrally allocate inputs and materials. Given concentration and market power, supervisory agencies were generally retained with a view to containing price expansion by monopolists. This also cohered with the discretionary reallocation of resources by means of the tax system, subsidies and refinancing credits issued through the Central Bank.

Despite specific country features, certain regularities can be isolated. In general, devolution of controls implied some measure of worker self-management, normally through enterprise councils or partially accountable entities. In Poland by the early 1980s workers' councils had been established in over 6000 enterprises while in Hungary later measures resulted in around 73% of state enterprises being transformed to management by councils [12]. From the perspective of this paper, this transition implies, first, the possible creation of a new player in the game linking plant to planner. Under the partially reformed system a diluted managerial role emerged, given the weakening of planned outputs and allocations. This generated a more complex set of games between enterprise and planner covering subsidy, tax eligibility and other negotiable arrangements; it also generated the potential for firm-specific bargaining.

Decentralization also raised the issue of the manager's function and motivation. Clearly, in a market economy, with a division between owner and manager, motivation depends variously on labour market rewards, earnings based incentives, share or stock options and any discipline exerted by external valuation on the viability or independence of the enterprise. These incentives are largely absent in the RIE. In fact, the only consistent motivational mechanism has been wage and performance-related bonus payments; themselves in part constrained by the political acceptability of wider income dispersion [13]. Further, precisely because of the horizons generated by the system of social ownership, the need to regulate the size of the incentive payments was recognized. In general, the wage premia paid to enterprise managers was explicitly associated with performance or synthetic indicators with penalties levied if wage expansion was in excess of the growth in the performance

[11] With commonly disastrous consequences involving later socialization of the debts incurred by unsatisfactorily regulated enterprise borrowing, particularly in Poland.

[12] However, central and party interference in the composition of management committees remained widespread. For a summary of the institutional changes, see IMF (1989a and 1989b).

[13] Political opposition to wage differentiation was one main reason for the failure of the 1969 reforms in Hungary; see Soos (1987).

indicator [14]. The same basic tension existed for managers as for workers with respect to the possible appropriation of labour rents. Hence, the external imposition of wage and bonus norms on both managers and workers. To that extent, as we make explicit in Section 4, the manager and workers' interests might coincide, allowing them to act cooperatively against the planner.

Decentralization in R1E systems has normally been linked to some form of tax-based incomes policy or method of wage regulation imposed on the enterprise. The exact design of such systems has varied widely, acting on either the wage bill -- the sum of enterprise wages and bonuses -- or the rate of wage growth with wages related to some measure of performance. The frequency of changes to the system suggests the difficulty in isolating the appropriate synthetic measures [15]. Tax-based incomes policies (TIP) were in principle designed to achieve several objectives. First, to restrain appropriation of labour rents; second, to regulate effective demand and goods market imbalances and, third, to regulate enterprise demand for labour and to achieve a more efficient allocation of labour within the full employment constraint. The actual design of the TIP would then in part depend on the relative weights attached to these objectives. Giving priority to regulating enterprise labour demand, for example, generally implied control of the wage bill.

The complexities in the design of wage controls are explored in detail elsewhere [16]. Several consistent, underlying tensions in the approach characteristic of R1E regimes can be isolated from a range of country experiences.

- Associating the wage path to that given by productivity proved problematic given the set of price distortions and offsetting taxes and subsidies that remained in the system. Sound indicators of financial performance were not transparent, necessitating frequent adjustments to wage control parameters.

- To the extent that wage formation was solidaristic and wage increases converged to the upper limits, the outcome would be an acceleration in inflation given the diluted discipline exerted on tradables prices by international prices. Equally, inflation could be repressed via price controls.

- Reliance on plant-level productivity adjustment had the obvious disadvantage that it could pull apart the wage distribution across industries on the basis of no sound indicator; given the structure of distorted prices. A preferable approach in any event would have been to link labour cost increases to economy-wide productivity expansion.

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[14] Such premia could amount -- as in Hungary -- to as much as 50% of the total wage; IMF (1989a).

[15] Between 1968 and 1989, there were seven major changes in the wage regulatory system in Hungary while in Poland there were six substantive changes in wage regulation betwen 1981 and 1989.

[16] See, for example, Adam (1979) and (1982); Granick (1987); Marrese (1981); IMF (1989a and 1989b)

• Using the wage bill to regulate labour demand would only tend to change the intra-firm skill composition -- with a resulting bias toward unskilled, lower wage categories -- and hence have an impact on replacement policy. Little efficiency gain might then be expected.

• Without basic political acceptance of expanded wage differentials, policies aimed at using wage diffentials as a motivational device have tended to fail. Solidaristic wage outcomes likewise counter any presumed incentive outcome. If decentralization proceeds alongside greater tolerance of the private or parallel sector, effort will be redirected to uncontrolled activities with adverse productivity implications for the socialist sector.

• Soft budget constraints for enterprise managers and short-run wage maximization objectives on the part of workers would tend to cluster wage demands at the upper limits of the permissible payment irrespective of performance.

• Any incentive effects intended to be associated with productivity and skill related adjustments would tend to be diluted by a falling or low we[illegible] of wages to total earnings [17].

• The effectiveness of any tax-based incomes approach depends on the ability to enforce the penalties [18]. To the extent that such 'control-by-consent' is absent, more complex bargaining will emerge. This appears to fit the Polish RIE experience since the late 1970s. The outcome is accelerated wage drift and the inefficacy of wage controls as a tool for demand management.

• There is an inevitable tension between using wage controls for macroeconomic objectives -- particularly excess demand in goods markets -- and for incentive purposes if ex ante excess demand is significant (and monetary overhang high) and supply elasticities low.

In summary, shifts to RIE regimes were attempts to address underlying incentive problems in the CPE and thereby raise productivity. The outcomes were inevitably ambiguous. Wage regulation could contain wage drift under certain conditions, including passive unions. The Hungarian system appears successful on this score over most of the 1980s. By contrast, where bargaining reflects a basic argument over the wage level and political power -- as in Poland -- incomes policies tend to be ineffectual in managing demand as also on motivational grounds.

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[17] It is instructive to note that for Hungary between 1984 and 1988 wages averaged 38% of total cash receipts; social benefits in cash, 22% and other receipts including private economic activity, 24%. See; C.S.O Monthly Bulletin of Statistics.

[18] Particularly problematic in a R1E where bargaining over exemptions and special treatment remains endemic. See Gomulka and Rostowski (1984).

2.4 The Reform Economy - Second Stage (R2E)

Little experience is now available, given the recent nature of the changes in Poland and former GDR. Broadly, the objective of the regime shift is to induce more completely market-based features in these economies through trade liberalization, convertibility and the direct importation of international prices. Fiscal discipline, autonomy of the monetary agency and elimination of the conditions supporting a soft budget constraint for enterprises are other components. Unemployment, wage dispersion and enterprise failures are tolerated. In principle, the R2E regime is supposed to behave like a capitalist one; the main obstacle being ownership rights and budgetary transfers. In principle, the latter can be addressed by pre-announcing a fiscal correction and pursuing a restrictive monetary policy [19]. The ownership issue is less tractable. Not only is there high concentration but also a large weight of socialized enterprises in total industrial activity. In Poland roughly 8000 state enterprises account for about 90% of industrial output. Rapid divestiture raises major questions regarding valuation, distributional and wealth effects. To the extent that divestiture cannot be rapid, the question remains whether hard enterprise budget constraints can be consistently enforced.

From the angle of wage regulation, this weight of the socialist sector requires retention of certain wage controls, particularly in the context of a stabilization. As usual, the design of the TIP is critical. For example, maintaining controls on the wage bill -- as occurred in Poland in 1990 -- would only tend to aggravate unemployment in this new context. Wage controls are also likely to have undesired effects for an emerging private sector. For this reason, private sector wages have been fully liberalized in Poland. The main tension remains permitting wages to allocate labour and serve as a standard incentive mechanism while maintaining macroeconomic balance in an environment where the rules are not fully perceived as having changed. To the extent that profit maximization and the associated penalties genuinely obtain, bargaining models developed in the context of market economies are likely to be relevant.

Section 3. Wage Determination in the Centrally Planned Economy

3.1 Introduction

We now set up wage games appropriate for a CPE, incorporating an incentive payment applied through a piece-rate, and establish the outcomes of these games in both cooperative and non-cooperative settings [20]. We are able to show that the workers' reaction to an incentive payment can either result in reduced productivity/effort or a higher than desired wage level and excess demand in good markets.

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[19] Because of the ex ante structure of borrowing and inter-firm credits, such an approach may be costly and a poor discriminator of underlying viability, see Calvo and Coricelli (1990).

[20] Throughout the paper wages refer to total remuneration including piece rate, bonus and other fringe payments.

3.2 Framework and Some Assumptions

We assume that there are two important players in the CPE: the Planner and the firms.[21] The latter are comprised of identical Workers; there is no distinct management. There is a representative Worker's utility function. With no unemployment in the CPE, this function includes effort and the expected real wage. An increased expected real wage (W/P^e) increases consumption possibilities either now or in the future and utility is hence a positive function of the real wage. The relevant price index is the consumer price index [22]. We assume that the Workers form their expectation of this period's price level in terms of the previous period so that P^e can be considered an exogenous variable.

Utility is a negative function of the effort (Z) delivered.[23] The underlying argument is that the Workers face a trade off between work and leisure and prefer less hard work. For convenience we choose an additive formulation of the utility function.

$$U_W = u(Z) + v(W/P^e)$$

We assume that $u'(Z) < 0$, $u''(Z) < 0$, $v'(W) > 0$, and $v''(W) < 0$. That $u''(Z) < 0$ follows from the fact that the disutility associated with a high effort increases with more effort. The indifference curves will be upward sloping in the 'effort - wage' space.

The Planner's role is to set economic targets and achieve them. In doing so, the Planer might be concerned about a number of objectives, including the volume of investment, private consumption, growth, income equality, price stability, and the degree of excess demand on the goods markets. This can be treated in the following way. The Planner has multiple objectives, the reconciliation of which consistently imposes a tension on the system. To achieve the objectives, the Planner allocates the whole labor force, n, to production. The output price level from the last period, P, is maintained. Finally, the Planner sets a certain minimum wage calculated per time unit. We call this basis wage, W_{base}.

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[21] In section 3-5 a closed economy is assumed.

[22] It can be argued that in an economy with chronic excess demand for goods the real wage is not a good measure for the consumption possibilities of a certain nominal wage. However we have chosen not to include any measure of the rationing at the goods market. The reason is that there is no a priori knowledge of the way excess demand on the goods market influences the workers' desired wage. One argument is that a rationed goods market will lead to less wage pressure, cf. Ellis and Fender (1985), while another view is that the workers will compensate for the present goods rationing by demanding higher wages (for later effective consumption or for purchase of goods at the black markets). Charemza and Gronicki (1983) call this last argument "wage illusion".

[23] A formulation of the worker's utility function close to the one chosen here can be found in Sokolovskii (1987), p5.

The Planner also seeks high production, hence growth. To yield these targets a plan which sets the quantity of the governments' investments and other expenditures (I) along with the private consumption (C) is developed. Since the economy is closed we have that the Planner will have a planned production target (Y_{plan}) equal to:

$$Y_{plan} = I + C \qquad [3.1]$$

The Planner gives priority to fulfilment of Y_{plan} and deviations from the target leaves the Planner with the utility $-\infty$.

This model is a fixed price model and hence we can have that the Workers' notional demand for goods can exceed the effective supply. If this is the case, then we assume that the private consumption is rationed.[24] We assume that the Workers have no voluntary savings. This means that the Workers' notional demand is equal to their income Wn. Excess demand can hence be written as:

$$X = Wn - PI - PY, \qquad [3.2]$$

where Y is the real production. We assume that the Planner prefers zero excess demand and every deviation from this target decreases the Planner's utility. We also assume that the economy is initially in a situation of excess demand which implies that once Y_{plan} is attained the Planner's utility increases as the wage decreases.

The CPE has one firm managed by the Planner. The firm's production function can be written as:

$$Y = Zf(n)$$

The production is a function of the labour input and its technical productivity, f(n), multiplied with the measure for the effort/productivity delivered by the Workers, Z. It is assumed that $f(n) > 0$, $f'(n) > 0$, $f''(n) < 0$.

We have chosen a particular utility function for the Planner. Once the production target is reached, utility decreases quadratically as the excess demand deviates from its "optimal" value, zero. If we use the above formulation of the utility function we can write the Planner's utility function as:

$$U_p = \begin{cases} -\infty & \text{if } Y \neq Y_{plan} \\ -\beta_1[PZf(n)-Wn-PI]^2 & \text{if } Y = Y_{plan} \end{cases} \qquad [3.3]$$

We have assumed that n is exogenous, so the Planner will need an average productivity equal to $Z_{plan} = Y_{plan}/f(n)$ to fulfill the plan. Therefore, if the productivity is Z_{plan} and the wage is $W = (P/n)(Z_{plan}f(n)-I)$ the Planner attains maximum utility (equal to zero).

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[24] In similar vein to Ellis and Fender (1985) and other fixed price literature.

Due to the very centralized management of the firm the Planner has limited possibilities for monitoring the work more and hence cannot rely on flexible or nuanced payment schemes. Hence, to motivate Workers the Planner has recourse to piece-rate payments [25]. We have chosen the following formulation for the piece-rate payment:

$$W = W_{base} + \sigma Z \qquad [3.4]$$

W_{base} is the core wage determined by the Planner according to social and distributional preferences, σ denotes the piece-rate payment with $W_{base} \geq 0$, $\sigma \geq 0$.

3.3 Cooperative Wage Bargaining: A Dictatorial Solution

In this section we look at the wage determination as a cooperative game with the wage (and the effort) being the result of bargaining between the Planner and the Workers. For the time being, we assume that the Planner and the Workers do not take into account systems for monitoring that the result of the bargain is actually adhered to.

The Planner and the Workers have the utility functions U_P and U_W. Let $\overline{U}_P$ denote the Planner's threat point and $\overline{U}_W$ the Workers' threat point.[26] Let Θ ($0 \leq \Theta \leq 1$) be the Planner's bargaining power. Hence $1-\Theta$ is the Workers' bargaining power.

The Nash-Zeuthen-Harsanyi (NZH) solution to the cooperative game with two players is found like this:[27]

$$\max_{W,Z} \left\{ [U_P - \overline{U}_P]^{\Theta}[U_W - \overline{U}_W]^{1-\Theta} \right\}$$

We assume for the Workers' threat point; $\overline{U}_W = u(0)+v(W_{base}/P^e)$, a situation where the Workers choose not to deliver any effort at all and hence just receive W_{base}. We assume that the Planner has an arbitrarily given threat point $\overline{U}_P$ ($< U_P$). We get:

$$\max_{W,Z} \left\{ [U_P - \overline{U}_P]^{\Theta}[U_W - (u(0)+v(W_{base}/P^e))]^{1-\Theta} \right\} \qquad [3.5]$$

Equation [3.5] denotes the NZH solution to the bargaining between the Planner and the Workers as a function of the bargaining power Θ. The set of bargaining

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[25] Extra-ordinary payments for above-norm effort have also been commonly employed; see Adam (1979).

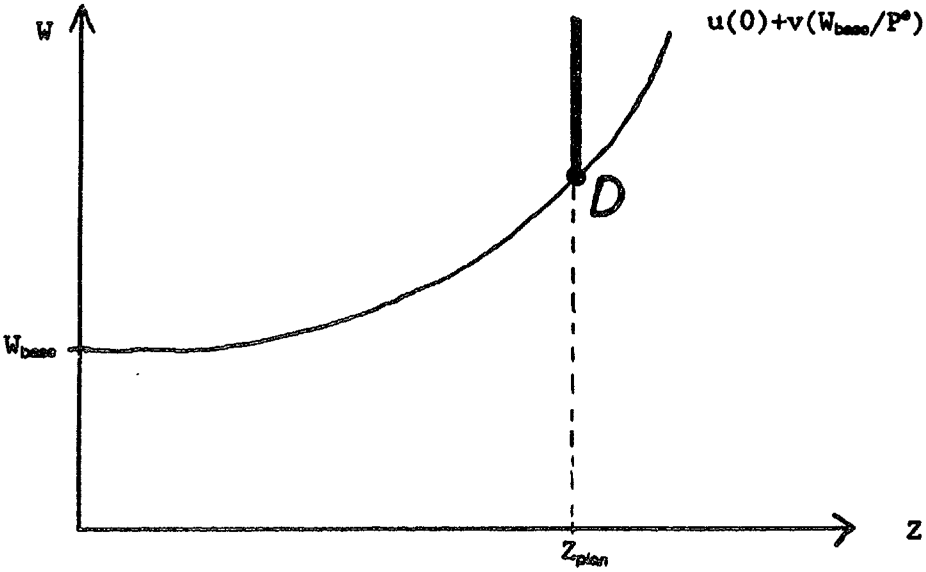
[26] The threat point denotes the lowest utility the player will accept as result of the bargaining.

[27] See Friedman (1986) chp. 5 for a standard treatment of the cooperative game. Svejnar (1986) contains a very good presentation of the Nash-Zeuthen-Harsanyi solution for an asymmetric bargaining game.

solutions (as Θ varies between 0 and 1) is the efficiency locus.

Let us discuss the shape of the efficiency locus. If the bargaining result implies that the Workers' productivity is different from Z_{plan}, the Planner's utility U_P will be $-\infty$. The Planner will then stick to the threat point $\bar{U}_P$ and hence the product in [3.4] will be zero. To avoid this, the average productivity must be Z_{plan}. The Workers' utility can never get below $u(Z)+v(W_{base}/P^e)$ since the Workers' gain from the bargain in that case would be negative. From this we have that the efficiency locus will be the points on the Z_{plan} line lying above the point where the Workers' indifference curve $u(0)+v(W_{base}/P^e)$ intersects the Z_{plan} line. If Θ is big (the Planner has large bargaining power) we will get a solution near the intersection. As Θ becomes smaller the whole line of solutions will be traced. The efficiency locus (the NZH solutions) is drawn in figure 3.1 as a bold line. The point, D, is where the indifference curve $u(0)+v(W_{base}/P^e)$ intersects the Z_{plan} line.

Figure 3.1



We now look at a special bargaining solution, namely the one where the Workers' indifference curve $u(0)+v(W_{base}/P^e)$ intersects the Z_{plan} line. This is the NZH solution to the problem in equation [3.5] in the limit case where $\Theta \to 1$.[28] We will call this particular solution the 'Dictatorial solution' since it is the outcome of a bargaining where the Workers have no bargaining power and the Planner dictates the result of the bargaining. It can be written as the vector (W^*, Z^*), such that:

$$Z^* = Z_{plan} \qquad [3.6]$$

$$u(Z^*)+v(W^*/P^e) = u(0)+v(W_{base}/P^e) \qquad [3.7]$$

[28] $\Theta \to 1$, but $\Theta \neq 1$ (since if Θ was equal to 1 then the Workers would stick to their threat point).

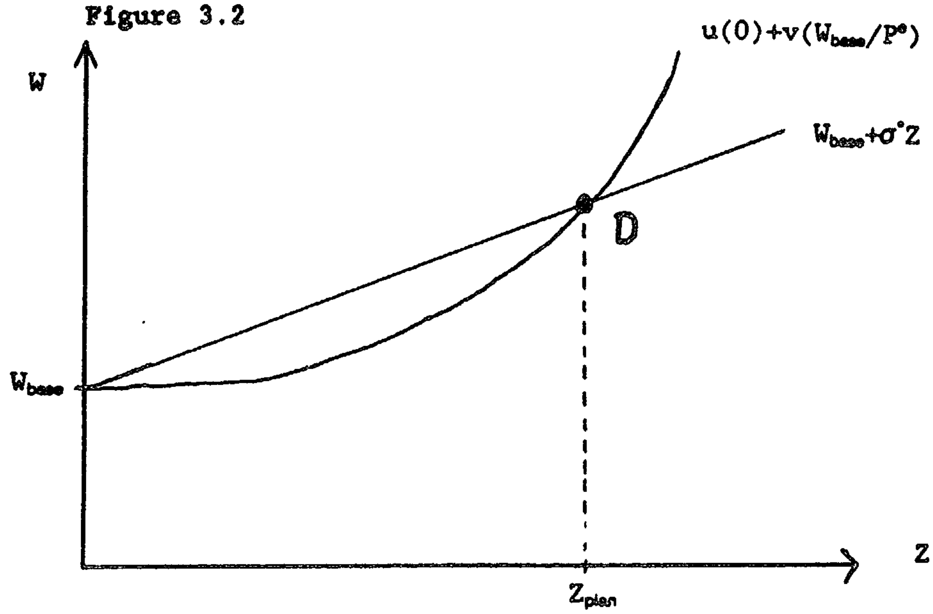
The Planner will choose to produce the planned output and pay a wage just exactly sufficient to keep the Workers from delivering zero effort. The Dictatorial solution can hence be interpreted as a solution where the Planner maximizes the utility U_p given that the Workers' utility is squeezed as much as possible.

We now return to the monitoring problem. How can the Planner be sure that the Workers will actually deliver the agreed upon effort, Z_{plan}, for the Dictatorial solution? The only thing the Planner can monitor is the actual production. To avoid the Workers receiving the payment W^* but delivering, for example, no effort, the Planner pays the Workers according to the piece-rate system described above. The Planner chooses a piece-rate σ° such that the sum of the base wage and the piece-rate payment equals the agreed wage W^*;

$$W_{base}+\sigma^\circ Z_{plan} = W^* \qquad [3.8]$$

This implementation[29] of the Dictatorial solution is illustrated in figure 3.2. The Planner will choose a piece-rate σ° such that the line $W = W_{base}+\sigma^\circ Z$ passes through the point D.

Figure 3.2



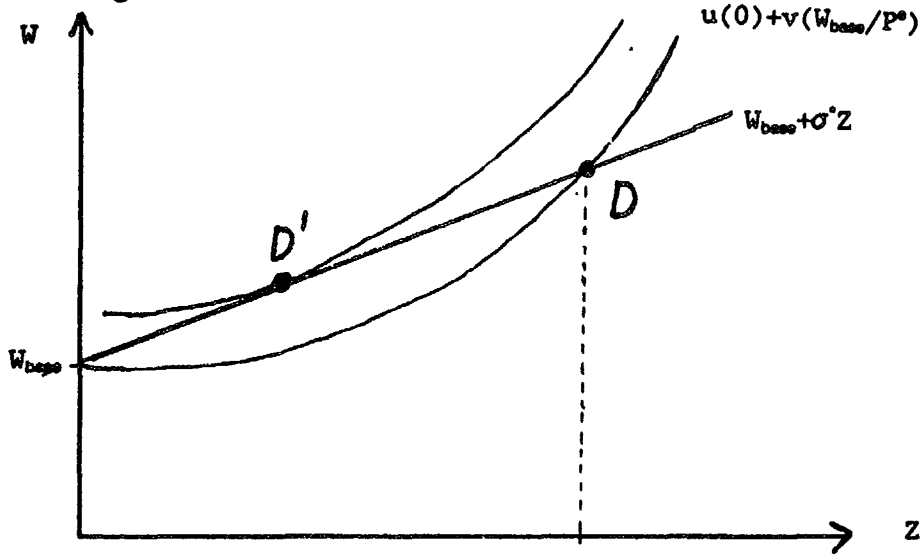
The Dictatorial solution implemented via a piece-rate system (given by the equations [3.5], [3.6], and [3.7]) is, however, unstable. In this set-up the Workers derive nothing from the bargain yet have the possibility of reneging on the outcome [30]. Once the Workers realize that (σ°, Z_{plan}) from equations [3.6]-[3.8] is the outcome of the bargain they can react by playing the game in a non-cooperative manner. This means that, given the piece-rate σ° the Workers will

[29] The piece-rate is $\sigma^\circ = (W^*-W_{base})/Z_{plan}$.

[30] Note that w_{base} is exogenous and predetermined. If this was not the case the Planner could always adjust the base wage so as to make whatever combination of wage and productivity level a stable solution.

decrease their productivity (and their total wage) to increase their utility. This behavior is illustrated in figure 3.3.

Figure 3.3



The point, D, again denotes the Dictatorial solution. The point D' will be the Workers' optimal combination of wage and effort given that the Planner has chosen the piece-rate σ^*.

From the above discussion, it can be seen that the Dictatorial solution tends to be unstable, since the Planner has not taken into account the Workers' reaction on disclosure of the piece-rate σ^*. This relates to the uneven nature of the bargaining [31]. To the extent that the solution sticks, planned production will always be attained, the wage will be relatively low and the likelihood and/or the amount of excess demand will hence be relatively small.

We now examine the Dictatorial solution more closely. We know that the productivity Z^* will be Z_{plan} and that the wage can be found from equation [3.7]. By inserting $Z^* = Z_{plan}$ in equation [3.7] we find W^* from:

$$u(Z_{plan})+v(W^*/P^e) = u(0)+v(W_{base}/P^e) \qquad [3.9]$$

From this we write the Workers' wage as a function of the base wage, the planned productivity, the price expectations, and (formally) the Planner's threat point:

$$W^* = fn(\overset{(+)}{W_{base}}, \overset{(+)}{Z_{plan}}, \overset{(?)}{P^e}, \overset{(0)}{\bar{U}_p}) \qquad [3.10]$$

The sign pattern is derived in Appendix 1 and indicated by the signs above the

[31] Note, however, that certain features of the CPE, make achieving a dictatorial solution not wholly improbable. These features have included; an absence of trade unions and a powerful repressive apparatus.

variables in equation [3.10]. An increased base wage will lead to a higher total wage since it is now more attractive for the Workers to stick to their threat point, i.e. not to work. When the planned productivity is increased, the total wage rises; this follows from the curvature of the Workers' indifference curves. Finally, an increase in the Workers' price expectations do not necessarily lead to higher wages. A higher expected price means lower real wages which is not desired. However, the real value of the threat point's W_{base} also falls. The resulting effect is uncertain. The Planner's threat point does not affect the optimal wage.

3.4 The Stackelberg Solution in a Non-Cooperative Game

We continue by examining what the Planner can do to prevent the instability shown above. The wage determination game is non-cooperative and we examine what happens if the Workers' reaction is taken into account by the Planner. We work with the same Planner and the same Workers as described in section 3.1. The Planner is assumed to be a Stackelberg leader.

We assume the following "sequencing" of the non-cooperative game. Basically the Workers produce the output and hence determine the effort while the Planner pays wage to the Workers. The Workers decide on their productivity given the offered wage. We assume they take into account that the Planner uses a piece-rate remuneration system.

Workers' Reaction Curve

For every value of the piece-rate σ which the Planner chooses, the Workers will choose an effort maximizing their utility. The set of effort-wage combinations derived in this way is the Workers' reaction curve. We find it by maximizing the Workers' utility function subject to a given piece-rate. The Workers' problem is:

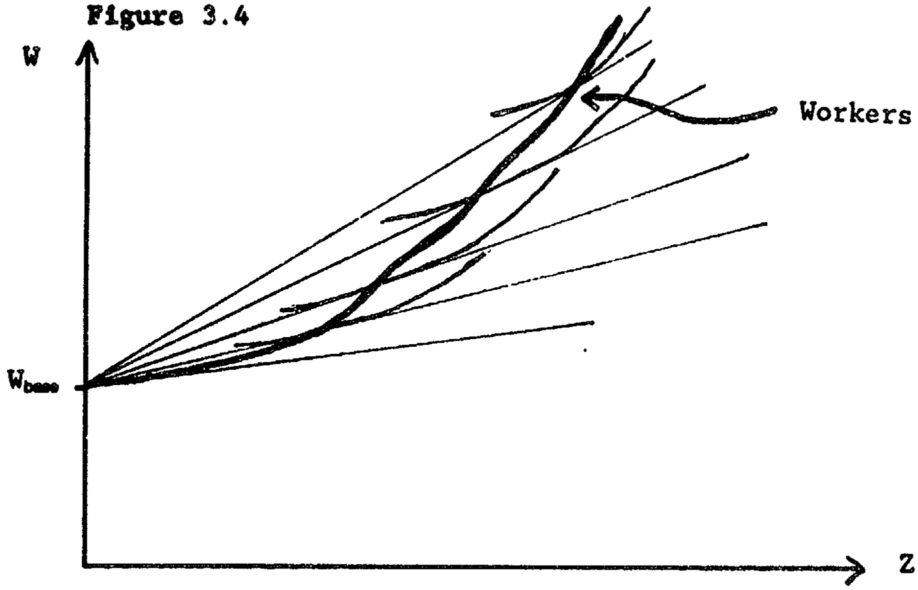
$$\max_{Z} \{ u(Z) + v((W_{base}+\sigma Z)/P^e) \}$$

The first order condition leads to the reaction curve given implicitly by equation [3.11]:

$$u'(Z) + v'((W_{base}+\sigma Z)/P^e)(\sigma/P^e) = 0 \qquad [3.11]$$

Figure 3.4 gives a graphical illustration for the construction of the Workers reaction curve. As regards the shape of the Workers' reaction curve, it will always originate in the point $(Z, W) = (0, W_{base})$. The reaction curve will tend to move upwards being led by the increasing piece-rate. However, segments of

Figure 3.4



the curve can easily be backward bending, this being a consequence of the income effect dominating the substitution effect.[32]

The Planner as Stackelberg Leader

The Planner playing the non-cooperative game as a Stackelberg leader regards the Workers' reaction curve as the possible combinations of effort and wage. The Planner's problem is hence to maximize profit given the possibilities depicted by the Workers' reaction curve and given that the Planner only can change the piece-rate parameter σ. The Planner's problem can be written as:

$$\max_{\sigma} U_P \quad \text{s.t.} \quad u'(Z) + v'((W_{base}+\sigma Z)/P^e)(\sigma/P^e) = 0 \qquad [3.12]$$

As a Stackelberg leader the Planner maximizes U_P by paying a total salary given by the lowest point where the Workers' reaction curve crosses the Z_{plan} line. That is, the Planner chooses the piece-rate σ° where the line $W_{base}+\sigma^{\circ}Z$ passes through the lowest intersection point between the Workers' reaction curve and the Z_{plan} line. This point is called S in figure 3.5 and is the Stackelberg solution.

From figure 3.5 we can derive two important results:
1) The Stackelberg solution is stable in the sense that none of the players have any incentive to deviate from the solution. The Workers cannot get higher

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[32] See Appendix 2 for a detailled discussion of the shape of the reaction curve. There is nothing preventing the reaction curve from looking for example like this:

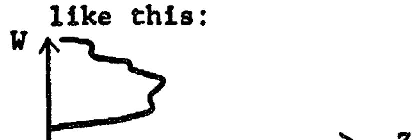
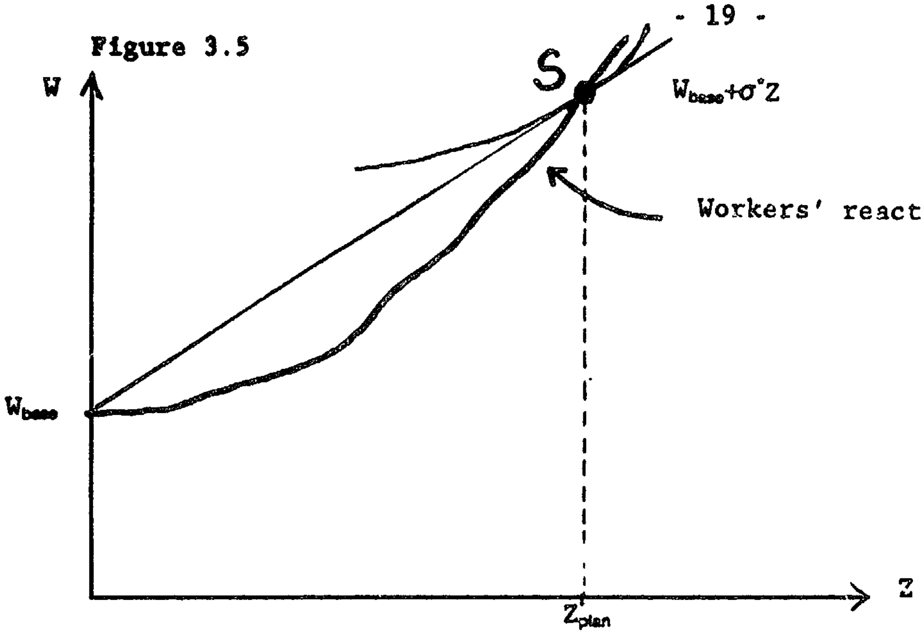


Figure 3.5



utility given the piece-rate σ^*. (Their indifference curve just tangents the point S). The Planner can not get higher utility by lowering the piece-rate, because then the production will fall short of the production target.
2) The wage will normally be higher for this solution than for the Dictatorial solution found above. This makes sense given that in the case with the Dictatorial solution the Planner squeezed the Workers as much as possible, i.e. to their threat point, while in the case of the Stackelberg solution the Planner took the Workers' reaction into account.

However, as a consequence of the relative high wage payment implied by the Stackelberg solution it is very likely that there will be significant excess demand on the goods market. This is a frequently observed phenomenon in CPEs, which (at least partially) can be explained by a high wage pressure stemming from the non-cooperative functioning of the labour market [33]. In conclusion, the Stackelberg solution proved stable but had the drawback that the wage would tend to be relatively high with a large excess demand on the goods market as the result.

Because the Workers' reaction curve can contain backward bending segments the multipliers cannot be calculated just by using the Implicit Function Theorem. However, by adding one extra assumption (namely that $v^{(3)}(W) > 0$) we can still sign the multipliers.

The solution to the Planner's problem (expression [3.12]) is to choose the productivity $Z^* = Z_{plan}$ and then the lowest piece-rate σ satisfying the equation for the Worker's reaction curve. That is, the Planner chooses σ^* as the lowest σ satisfying

---

[33] A special case can occur when the reaction curve is backward bending. If the reaction curve bends backwards before it reaches the productivity target (the Z_{plan} line) the Planner will never be able to obtain the planned production.

$$u'(Z_{plan}) + v'((W_{base}+\sigma Z_{plan})/P^e)(\sigma/P^e) = 0$$

If we assume existence of a Stackelberg Equilibrium, the Planner will choose the wage (and hence the piece-rate) occuring at the lowest point where the Workers' reaction curve intersects the Z_{plan} line. By using this reasoning the multipliers for the Dictatorial solution can be calculated (See Appendix 2).

$$W^{\circ} = fn(\overset{(+)}{W_{base}}, \overset{(+)}{Z_{plan}}, \overset{(?)}{P^e})$$

It should be noted that the wage initially will be higher in this situation than in the earlier case. Furthermore, while the multipliers have the same signs as for the cooperative game they will generally not have the same size.

3.5 Summary

In our treatment of the CPE we find that the combination of centrally determined production targets and piece-rate remuneration lead to either, (a) unstable solutions with a tendency for under-attainment of production targets, or (b), stable solutions with a likely high level of wages and significant excess demand in the goods market.

Section 4: Wage Determination in the Reform 1 Economy

4.1 Introduction

The main features of the R1E have been discussed in Section 2. The regime might be considered a partial response to the incentive problems associated with the CPE involving greater decentralization. In particular, the R1E has implied greater autonomy for the workers and the managers in the setting of production, investment and remuneration at their firms with explicit association of remuneration to a performance indicator. One underlying argument for the reforms that installed an R1E regime was that by imposing the 'right' incentive structure on the managers the latter would balance the workers' demand for higher wages and/or ensure that the workers deliver a high effort. To phrase it slightly more technically, the reforms aimed to engage the workers and the managers in a cooperative game determining production and remuneration. The government could then choose the outcome of this game by imposing the 'right' incentive structure on the workers and the managers.

Our hypothesis is that the actual outcomes of the reforms deviated significantly from intended outcomes. Especially in Poland, the government became engaged in a game with the workers and managers concerning the allocation of resources in the economy. This game can be stylized as one where the workers and managers played (more or less) together against the government or planner.

This section will model two games.[34] Section 4.2 deals with a cooperative game between the managers and the workers with an exogenous incentive structure imposed by the planner. This game is in reality a two person game with the planner as nature. Section 4.3 sets up a three player game which is cooperative between the managers and the workers and non-cooperative between these two and the government or planner.

4.2 A cooperative game

There are two players, the Manager and the Workers. The Planner's preferences do not appear directly but the Planner's policy and the institutional arrangement influence the outcome of the cooperative game. Hence, the Planner's behaviour represents nature and is exogenous to the Manager and the Workers. We impose the same assumptions on the Workers in the R1E as for the CPE. To simplify the calculations we have chosen to set the price expectation variable $P^e = 1$. The Workers' utility function now reads;

$$U_W = u(Z) + v(W)$$

We use the same production function as in section 3 and assume employment at the firm to be exogenously given by the Planner as n. The Manager's utility is assumed to be a function of the remuneration received. The Manager's total remuneration (R) is a fraction (α_2) of the firm's profit ($PZf(n)-Wn$) and a fraction (α_3) of the value of the firm's production ($PZf(n)$).

$$R = \alpha_2(PZf(n)-Wn) + \alpha_3 PZf(n)$$

We assume $0 \leq \alpha_2 \leq 1$, $0 \leq \alpha_3 \leq 1$. This arrangement for R broadly reflects the incentive structure established in the R1E [35]. We simplify and obtain:

$$R = \alpha_1 PZf(n) - \alpha_2 Wn, \quad \text{where } \alpha_1 = \alpha_2+\alpha_3.$$

The Manager's remuneration is expressed as a positive linear function of the production value and a negative linear function of the total wage-bill, Wn, with a linear band between them. We assume that the Planner can impose some penalty on the Manager's remuneration if the Manager pays wages to the Workers above a certain target. To ease the computations we choose a very simple formulation of this tax. We assume that the Planner can change α_2 independently of α_1. In other words, the Planner can increase the deductions based on the wage-bill <u>without</u> increasing the Manager's payment based on the value of the production. Henceforth, we will interpret the 'incentive coefficients' in the following way ($\alpha_1 > 0$, $\alpha_2 > 0$): $\alpha_1 < \alpha_2$ implies a profit tax and an extra tax on the wage-bill;

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[34] As explained in section 2 the reforms also allowed the strengthening of the private sector and often gave rise to dual pricing systems. These topics will not be considered in this paper. See Commander and Coricelli (1990) for a theoretical discussion of a dual pricing system in a R1E.

[35] The workers normally face economic incentives similar to the managers, but the bonus payment constitutes a much smaller part of the workers' overall salary than it does of the managers' salary.

$\alpha_1 = \alpha_2$ implies that only profit is taxed and $\alpha_1 > \alpha_2$ implies that profit and production value are taxed.

For convenience, the expectation to the price level is taken as constant and hence does not enter explicitly in the Manager's utility function. Finally, we assume that the Manager's utility is directly proportional to the remuneration received. The Manager is risk neutral. We can now write the Manager's utility function, U_M, as:

$$U_M = \alpha_1 PZf(n) - \alpha_2 Wn.$$

For simplicity, $0 \leq \alpha_1 \leq 1$ and $0 \leq \alpha_2 \leq 1$. The Manager's indifference curves are straight lines with the slope $(\alpha_1/\alpha_2)(Pf(n)/n)$.

The Planner's utility function is somewhat modified in relation to the CPE case. We assume that the Planner does not exclusively emphasize a production target and instead concentrates equally on excess demand and the deviation from the production target. The Planner prefers zero excess demand and every deviation from this target decreases the Planner's utility. However, the formula for excess demand (X) is now somewhat different, since the remuneration of the Manager has to be taken into account. Below, the expression in the curled bracket is the Manager's remuneration.

$$X = Wn + \{\alpha_1 PZf(n) - \alpha_2 Wn\} + PI - PY$$

$$\Rightarrow$$

$$X = PI - (1-\alpha_1)PZf(n) + (1-\alpha_2)Wn$$

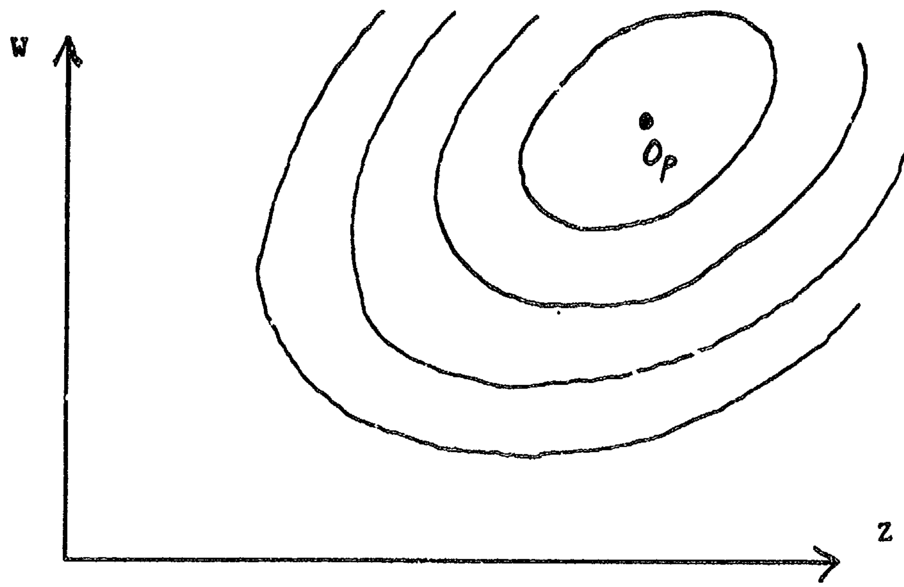
We use an additive quadratic utility function where the utility decreases quadratically as excess demand or production deviates from 'optimal' values. The Planner's utility function is given by:

$$U_p = -\beta_1[PI-(1-\alpha_1)PZf(n)+(1-\alpha_2)Wn]^2 - \beta_2[Y-Y_{plan}]^2$$

The Planner needs an average effort/productivity equal to $Z_{plan} = Y_{plan}/f(n)$ to fulfil the plan. Therefore, if the productivity is Z_{plan} and the wage is $W = (P/n)(Z_{plan}f(n)-I)$ the Planner attains the maximum utility (equal to zero). This point is called O_p. The Planner's indifference curves are elliptical curves around this optimal value and examples are given in figure 4.1.

The Planner still sets the employment n and the price level P. There is no piece-rate system in this economy and hence no W_{base} to set. Instead the Planner sets the incentive parameters α_1 and α_2.

Figure 4.1



The wage and effort are determined by bargaining between the Workers and the Manager. We call the Manager's threat point $\bar{U}_M$ and the Workers' threat point $\bar{U}_W$. Θ ($0 \leq \Theta \leq 1$) denotes the Manager's bargaining power and $1\text{-}\Theta$ is the Workers' bargaining power. The NZH solution to the bargaining between the Manager and the Workers is:

$$\max_{W,Z} \left\{ [U_M - \bar{U}_M]^{\Theta}[U_W - \bar{U}_W]^{1-\Theta} \right\} \qquad [4.1]$$

If we insert $U_M = \alpha_1 PZf(n) - \alpha_2 Wn$ and $U_W = u(Z)+v(W)$ in expression [4.1], we have:

$$\max_{W,Z} \left\{ [\alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M]^{\Theta}[u(Z)+v(W) - \bar{U}_W]^{1-\Theta} \right\} \qquad [4.2]$$

Expression [4.2] denotes the NZH solution to the bargaining between the Manager and the Workers as a function of the bargaining power Θ.

From the first order conditions for the problem in [4.2] we get the efficiency locus.[38] It can be written as:

$$\frac{\alpha_1}{\alpha_2} \frac{Pf(n)}{n} = - \frac{u'(Z)}{v'(W)} \qquad [4.3]$$

The interpretation of expression [4.3] is that of a traditional efficiency condition, namely that the marginal rate of substitution (between effort and wage) for the Manager shall equal (minus) the marginal rate of substitution for the Workers. The efficiency locus represents the set of the Nash-Zeuthen-

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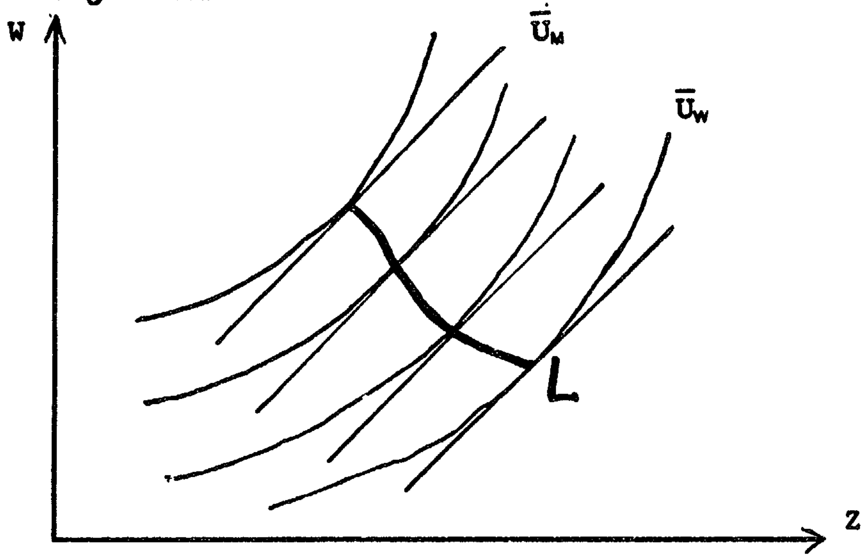
[38] See appendix 3 for the formal derivation of the efficiency locus.

Harsanyi solutions as Θ varies between 0 and 1. The slope of the efficiency locus proves to be negative (Appendix 3). The intuition is that if the Manager has a lot of bargaining power the solution will be close to the Manager's optimal choice, viz, high effort and low wage (and hence the solutions will be in the lower, right hand part of the efficiency locus). If the Workers have large bargaining power we will have solutions with low effort and a high wage. The indifference curves for the Manager and the Workers and the efficiency locus, L, are drawn in Figure 4.2.

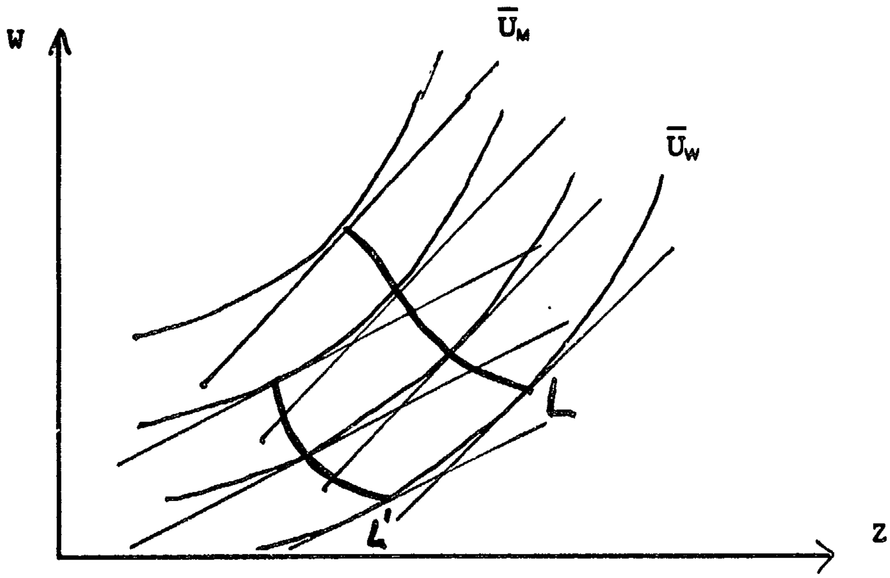
Figure 4.2



The actual outcome of the bargaining depends on the bargaining power Θ of the two players. Later we will assume that the Managers and the Workers have the same bargaining power. In this section we will briefly consider what happens to the efficiency locus as the Planner changes some of the exogenous variables. We will examine what happens to the efficiency locus if the Planner changes the incentive structure given to the Managers. Assume that the Manager's penalty on the wage-bill, Wn, is raised; i.e. α_2 is increased. The Workers' indifference curves are untouched, while the Manager's indifference lines will be flatter. This means that the efficiency locus will move downwards and to the left. In Figure 4.3 the original efficiency locus is called L and the one resulting from an increase in α_2 is called L'. That the efficiency locus will move downward can be verified directly from the expression for the efficiency locus, eq. [4.3]. $dW/d\alpha_2$ (given Z) is found in Appendix 3.[37] The sign is, as also argued above, negative.

[37] This exercise is inspired by McDonald and Solow (1981), p901.

Figure 4.3



We now derive the multipliers for the change of the wage as a function of changes in the exogenous variables. We assume that the two players have the same bargaining power, $\theta = ½$. If we insert this in [4.2] and square the expression in the curled bracket, the solution to the bargaining problem can be written as:[38]

$$\underset{W,Z}{\text{Max}} \ \{ \ [\alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M][u(Z)+v(W) - \bar{U}_W] \ \} \qquad [4.4]$$

This is the symmetric Nash bargaining solution. Appendix 3 shows how the first order conditions yield two equations having to be satisfied at the same time. By using the Implicit Function Theorem on the first order conditions we obtain a set of two equations for each exogenous variable. This set can be solved using Cramer's rule providing the multipliers showing how each endogenous variable influences W and Z. We write the Nash bargaining wage (W^*) as a function of all the exogenous variables. Eq. [4.5] provides the basis for the estimations in Section 6 of the paper.

$$W^* = fn(\overset{(+)}{\alpha_1}, \overset{(-)}{\alpha_2}, \overset{(+)}{P}, \overset{(?)}{n}, \overset{(-)}{\bar{U}_M}, \overset{(+)}{\bar{U}_W}) \qquad [4.5]$$

An increase in the incentive parameter for production (α_1) increases the wage. The reason for this is that to make the Workers produce more the Manager has to pay higher wages. An increase in the wage-bill tax (α_2) decreases the wage. If the price increases, the Manager's remuneration increases, this leading to higher wages in this cooperative game. The sign for employment (n) is undetermined.

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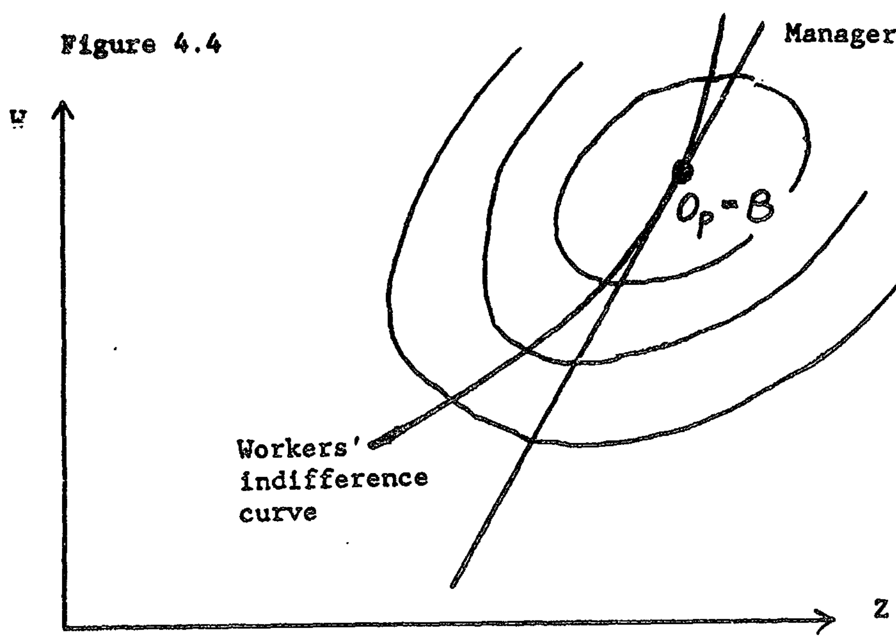
[38] To square the expression does not change the solutions to this maximization problem, since x^2 is a monotone transformation when $x \geq 0$.

If the Manager's threat point, $\bar{\bar{U}}_M$, increases the wage will fall[39], while an increase in the Worker's threat point, $\bar{U}_W$, will lead to an increased wage.

We continue this section with some remarks about the Planner. As mentioned above there is a combination of productivity and wage yielding the Planner maximum utility. This can be attained by setting up an appropriate incentive structure for the Manager, i.e. by regulating α_1, α_2. Appendix 3 contains the calculations for $dZ/d\alpha_1$ and $dZ/d\alpha_2$. One of the multipliers has undetermined sign, but generally the multipliers $dZ/d\alpha_1$ and $dZ/d\alpha_2$ will be linearly independent of $dW/d\alpha_1$ and $dW/d\alpha_2$. This means that we have two goals and two linearly independent instruments and hence the Planner can always obtain the desired productivity and wage just by adjusting α_1 and α_2. Graphically the changes in α_1 and α_2 correspond to changes in the slope and the intercept (on the W-axis) of the Manager's isoprofit lines. By changing the slope and the intercept of the isoprofit lines the Planner can ensure that the Workers' and the Manager's Nash bargaining solution is just at the Planner's utility maximizing point, O_p (see Figure 4.4). Point B denotes the Nash bargaining solution which coincides with O_p.

Figure 4.4



4.3 A cooperative game nested in a non-cooperative game

We now establish a three person game for the wage determination. Because three person games are normally difficult to apply since the possibility of coalitions has to be taken into account, we impose some restrictive assumptions. The managers and the workers play a cooperative game, while these two players

[39] Note that if soft budget constraints hold and/or the Manager's remuneration is ultimately weakly linked to performance, it might be expected that the Manager's threat point would be very low.

play a non-cooperative game against the government or planner. We will show how nesting the cooperative game in a non-cooperative setting changes the bargaining and leads to some unexpected results.

There are three players in the game, the Manager, the Workers and the Planner. The Manager's and the Workers' utility functions are the same as in Section 4.2. When the Manager and the Workers cooperate we call these two players, the Firm. We use the same quadratic utility function for the Planner as the one described in section 4.2.

The following sequencing of the game is assumed. The Planner calls out a certain wage target and the Manager and the Workers react to this by deciding on a certain effort. The Planner reacts to this announcement of the Firm's effort/productivity by offering another wage. However, this reaction will be taken into account by the Manager and the Workers. The Firms' reaction will again be taken into account by the Planner, and so on. This leads to a non-cooperative Nash equilibrium. We assume that the Manager and the Workers maximize the product of their utility gain subject to (the Planner's choice of) W. We assume again that the two players have even bargaining power, $\Theta = ½$. The problem for the Firm can be written as:

$$\max_{Z} \left([\alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M][u(Z)+v(W) - \bar{U}_W] \right) \qquad [4.6]$$

Note that the above problem closely resembles the problem in expression [4.4]. However, in this case we maximize only with respect to Z, assuming that W is given. This means that our solution will be a function relating the Firm's optimal choice of Z to W.[40] The solution to the problem in [4.6] is found in Appendix 4. The reaction curve is given (implicitly) by equation [4.7].

$$-\frac{\alpha_1 Pf(n)}{u'(Z)} = \frac{\alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M}{u(Z)+v(W) - \bar{U}_W} \qquad [4.7]$$

The interpretation of [4.7] is straightforward. The ratio of the Manager's utility gain to that of the Workers' is equal to (minus) the ratio of the marginal utilities resulting from an increase in productivity.

The reaction curve given by [4.7] is <u>not</u> the same as the efficiency locus found as equation [4.3]. The reason is that the optimization problem required to find the reaction curve is more restricted than the one required to find the efficiency locus. This means on the other hand that the reaction curve will <u>not</u> (generally) pass through the tangency point between the Manager's and the Workers' indifference curves. In figure 4.5 the reaction curve is drawn in bold (R) for the same indifference curves as used in figure 4.2. The slope of the Firm's reaction curve is positive (Appendix 4).

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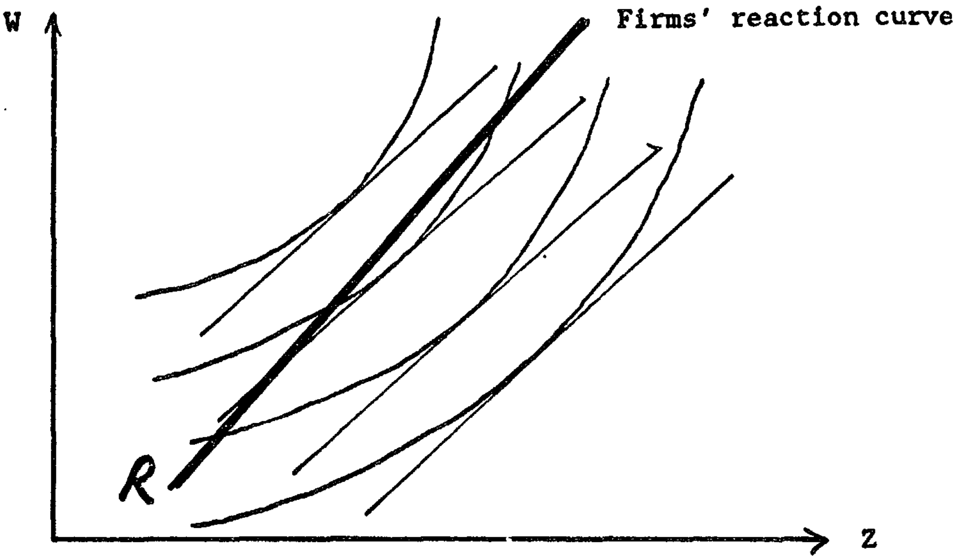
[40] In all the calculations in section 6 we have assumed that the threat points are exogenous. This can be justified by pointing to the fact that the "rules of the game" have determined the formation of coalitions a priori. Hence, the players do not consider other coalitions than the one actually formed.

Figure 4.5



The Planner reacts to the Firm's effort/productivity by choosing the utility maximizing wage. To obtain the Planner's reaction curve we must maximize the utility function U_P with respect to W. We have:

$$\max_{W} \left(-\beta_1[PI-(1-\alpha_1)PZf(n)+(1-\alpha_2)Wn]^2 - \beta_2[Y-Y_{plan}]^2 \right) \qquad [4.8]$$

The first order condition for the maximization problem leads after a little simplifycation to eq. [4.9] which also can be written as in eq. [4.10].

$$PI-(1-\alpha_1)PZf(n)+(1-\alpha_2)Wn = 0 \qquad [4.9]$$

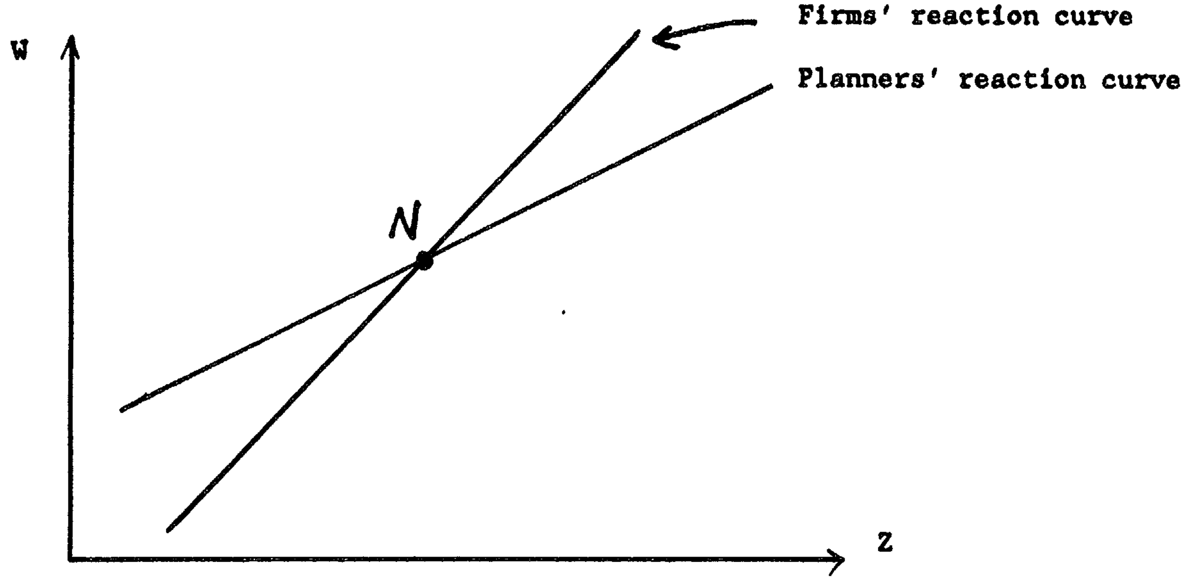
=>

$$W = \frac{(1-\alpha_1)}{(1-\alpha_2)} \frac{Pf(n)}{n} Z - \frac{PI}{(1-\alpha_2)} \qquad [4.10]$$

We see from eq. [4.9] that the Planner's reaction curve simply is a relation between wage and productivity such that excess demand is zero. The reason for this is that given the Firm's choice of effort/productivity, the only thing the Planner can do is to try to get as low excess demand as possible, viz; zero excess demand. Further, the Planner's reaction curve can be expressed explicitly and is linear (eq. [4.10]); a consequence of our choice of utility function for the Planner. Finally, the slope of the reaction curve is positive.

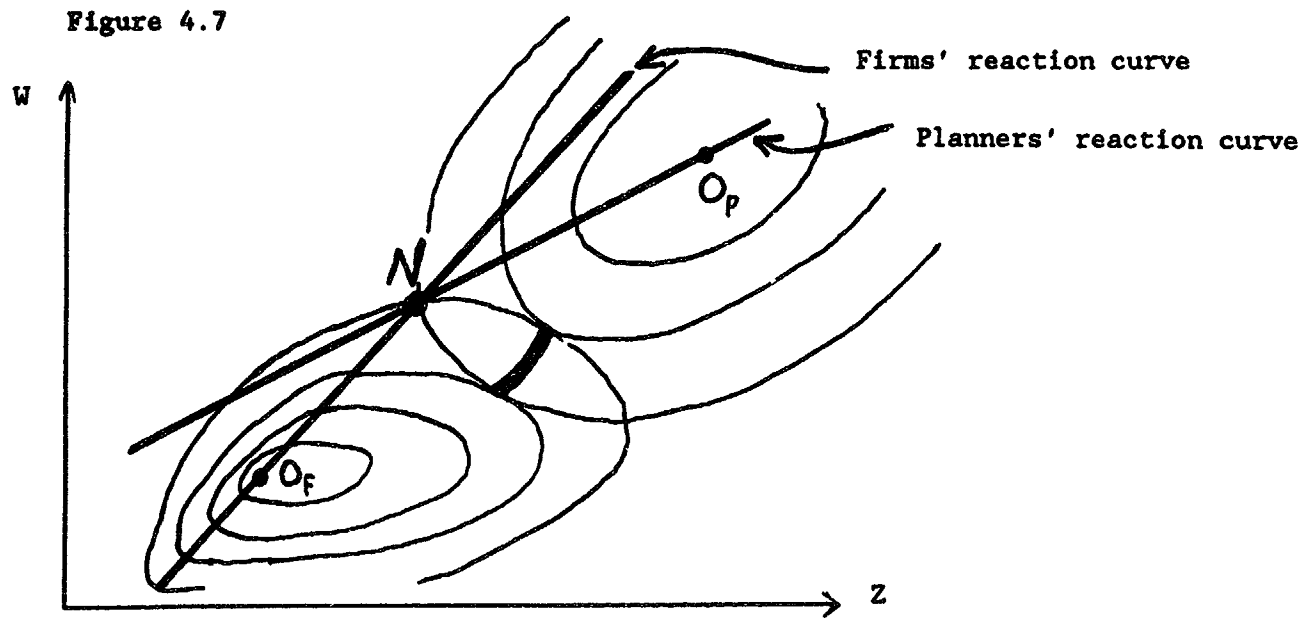
The number of players is reduced to two, the Firm and the Planner. We find the Nash equilibrium (N) as the intersection of the two players' reaction curves. This is illustrated in figure 4.6. The Firm's reaction curve is steeper than that of the Planner. This is a necessary condition for the stability of the Nash equilibrium.

Figure 4.6



In figure 4.7 are the same reaction curves as figure 4.6 but we have also included indifference curves for the Planner and the Firm. The Firm's indifference curves are constructed from the common utility function which is maximized, i.e. the Firm's indifference curves are constructed by setting the content of the curled bracket in expression [4.6] equal to a constant. Further, the Firm has an utility maximizing combination of productivity and the wage; this optimal point is O_F. The Planner's optimal point is O_P. As figure 4.7 is drawn the Nash equilibrium implies higher wage and productivity than the Firm would prefer and lower wages and productivity than the Planner would prefer. We see that the Nash equilibrium implies solutions providing zero excess demand but a

Figure 4.7



very low productivity, i.e. solutions far away from the planned production target. We also notice the non-Pareto optimality resulting from playing the game in a non-cooperative way. The bold curve in figure 4.7 shows the part of the efficiency locus Pareto dominating the Nash equilibrium.

We now derive the multipliers (see Appendix 4). The signs given below are derived without further restrictions on the parameters of the model with the exception of dW/dF where it is assumed that I is not too large.[41]

$$W^* = fn(\overset{(?)}{\alpha_1}, \overset{(+)}{\alpha_2}, \overset{(0)}{\beta_1}, \overset{(0)}{\beta_2}, \overset{(+)}{P}, \overset{(?)}{n}, \overset{(+)}{\bar{U}_M}, \overset{(-)}{\bar{U}_W}, \overset{(-)}{I}, \overset{(0)}{Z_{plan}}) \qquad [4.11]$$

The multipliers derived from the non-cooperative model are rather surprising and counterintuitive. Comparing with eq. [4.5] we see that, among the common multipliers, only dW/dP has the same sign. The results from the nested game can be interpreted as follows. Let us start with the multiplier $dW/d\bar{U}_W$ having a negative sign, so that when the Workers' threat point increases the wage will fall. When the Workers threat point increases the bargaining between the Workers and the Manager will lead to lower effort given the wage.[42] The lower effort/productivity will lead to a lower wage offered by the Planner, this again leads to lower productivity and so on until a new stable Nash equilibrium is reached. Graphically, this process can be described as a movement of the Firm's reaction curve to the left.

Another surprising result is that an increase in the wage-bill tax results in a wage increase, so that $dW/d\alpha_2$ is positive. Several effects occur at the same time. The Manager is penalized for wage expenses. Since the latter cannot determine the wage in the bargaining with the Workers the only way the Manager can compensate for this penalty is by increasing the productivity (at the given wage). This corresponds to a shift of the Firm's reaction curve to the right (see figure 4.8). However a change in α_2 also influences the Planner, since (ceteris paribus) the revenue from the wage-bill tax will increase and hence an excess supply on the goods market is created. The Planner will respond by paying higher wages (at a given productivity level). This corresponds to an upward shift in the Planner's reaction curve. The combined total effect of the movements of the reaction curves implies a new Nash equilibrium with higher wage and higher productivity, N', in figure 4.8. The remaining multipliers can be interpreted in a similar vein.

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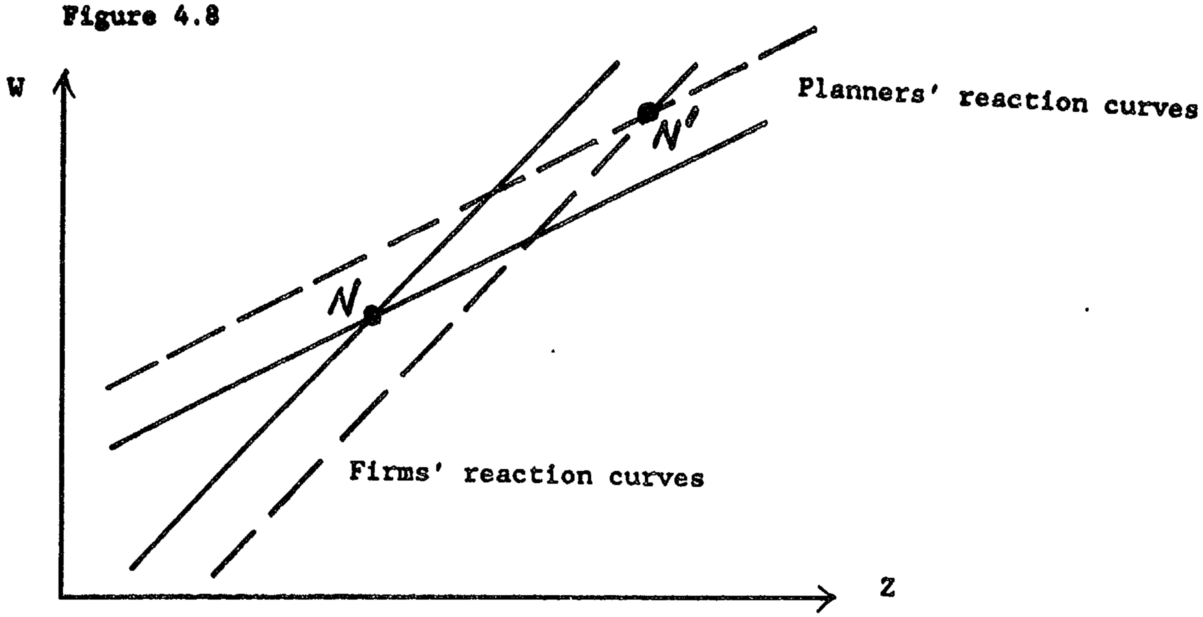
[41] $(1+\alpha_1)Zf(n) > 2I$ is a sufficient condition for dW/dP to be positive.

[42] Remember that in this nested bargain the Workers and the Manager can only settle on an effort/productivity given a certain wage. When the Workers' threat point increases they will require an increase in their utility and this is obtained by decreasing their productivity. In effect, the Workers "vote with their feet".

Figure 4.8



4.4 Summary

The above analysis has allowed us to trace out some of the implications of wage bargaining in the R1E in both cooperative and non-cooperative settings. The cooperative game inhibits a high degree of autonomy for the Planner and gave usual signs for the multipliers. The nesting of the cooperative bargaining in a non-cooperative game is an attempt to capture some of the stylized features of an economy marked by particular ownership, monitoring and information constraints. This leads to a non-Pareto optimal outcome of the game and many of the multipliers have unusual signs. Clearly a number of other crucial characteristics -- such as the presence of a soft budget constraint and its implications, in particular, for the Manager's threat point -- cannot be adequately captured in this type of approach. It should also be noted that for the non-cooperative setting the signs on the exogenous variables are obviously sensitive to the sequence of the game and would be different if, say, the Planner responded with a wage to a productivity given by the Manager and Workers. Finally, it is expression [4.5] taken from the cooperative game that will provide the basis for the later empirical work that we report in Section 6.

Section 5: Wage determination in the Reform 2 Economy

5.1 Introduction

We now present a very preliminary outline of a cooperative game between the Manager and Workers in a context where unemployment is tolerated, where an emerging private sector exists but where most of the enterprises are still state owned. In principle, soft budget constraints are no longer present and the state firm is instructed to act as a profit maximizer. However, it seems reasonable to assume that R2E regimes are characterized by uncertainty over the rule changes and by features -- including the limited size of the private sector -- that continue to distinguish them from a more conventional market economy. The model elaborated below necessarily simplifies and is based on the standard efficiency bargaining model developed in the context of a capitalist economy [43].

5.2 A cooperative game between Manager and Workers

There are two players, the Manager and the Workers. There is one firm directed by the Manager and a given number of Workers (m) seeking employment in the state owned sector. The individual Worker has the utility function defined in section 3.2. Of the m Workers seeking employment in the state sector only n ($n \leq m$) are employed. The effort delivered by Workers in the state sector is assumed to be exogenous and equal to Z. [44] The utility for a Worker employed in the state industry is:

$$U_W = u(Z) + v(W).$$

Unemployment amounts to m-n. The utility for an unemployed Worker is:

$$U_W = u(B) + v(0),$$

where B denotes exogenous unemployment benefits. Involuntary unemployment requires that $u(Z) + v(W) > u(B) + v(0)$.

Using a utilitarian formulation of the utility function [45] for the group of Workers seeking employment in the state industry we have:

$$U_S = nv(W) + (m-n)v(B) + nu(Z) + (m-n)u(0)$$

The remuneration of the Manager is formulated as in section 4.2. That means that if $\alpha_1 = \alpha_2$ the state firm actually acts as a profit maximizer, but other choices of α_1 and α_2 will induce other incentives for the Manager.

The efficiency locus is found as the first order conditions to the following problem:

$$\max_{W,n} \{ [U_M - \overline{U}_M]^{\theta} [U_S - \overline{U}_S]^{1-\theta} \} \qquad [5.1]$$

In the R2E the threat point $\overline{U}_S$ is the remuneration the Worker can obtain by being employed outside the state industry. [5.1] can be rewritten using the specific

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[43] McDonald and Solow (1981), Nickell (1982), Ellis and Fender (1985). For an excellent survey, see Oswald (1985).

[44] Notice, n is now endogenous while the effort Z is exogenous. The explanation for the latter assumption is that the Workers delivering a low effort are laid off in the R2E.

[45] This way of aggregating utility functions is also used in Oswald (1985) and McDonald and Solow (1981).

utility functions:

$$\max_{W,n}\{\ [\alpha_1 PZf(n)-\alpha_2 Wn\ -\ \overline{U}_M]^{\theta}[nv(W)+(m-n)v(B)+nu(Z)+(m-n)u(0)\ -\ \overline{U}_S]^{1-\theta}\ \}$$

The efficiency locus is found in Appendix 5. We have:

$$\frac{\alpha_1 PZf'(n)-\alpha_2 W}{\alpha_2} = -\frac{v(W)-v(B)+u(Z)-u(0)}{v'(W)}$$

The interpretation of the efficiency locus is as usual: the Manager's marginal rate of substitution between employment and wage shall equal (minus) the Workers' marginal rate of substitution between employment and wage. Since $v(W)-v(B)+u(Z)-u(0) > 0$ we have that $\alpha_1 PZf'(n)-\alpha_2 W < 0$. This indicates that the Manager employs more labour than would be the case if the Manager was operating in a competitive labour market. As shown in Appendix 5 the slope of the efficiency locus is positive.

Static comparative analysis leads to many undetermined signs. The following sign pattern is derived in Appendix 5.

$$W^* = fn(\overset{(?)}{\alpha_1},\ \overset{(?)}{\alpha_2},\ \overset{(?)}{P},\ \overset{(-)}{m},\ \overset{(?)}{B},\ \overset{(?)}{Z},\ \overset{(-)}{\overline{U}_M},\ \overset{(+)}{\overline{U}_S})$$

The three determined signs are intuitively sensible. An increase in the labour force and hence in unemployment lowers the wage. An increase in the Manager's threat point also lowers the wage, while an increase in the Workers' threat point has the opposite effect. The remaining multipliers have undetermined signs. With respect to α_1 an increase might be expected to motivate the Manager to hire more workers and this would increase the wage. Offsetting this would be the fact that the Manager's marginal remuneration as n increases would be negative, motivating a lowering of the wage. It seems feasible to suppose that the former effect will dominate [46] and this assumption would need to obtain if $dW^*/d\alpha_1$ and dW^*/dP are to be positive. It is also a sufficient condition for dW^*/dZ to be positive. As regards $dW^*/d\alpha_2$, an increase in the wage-bill tax α_2 would lead the Manager to reduce the wage-bill by lowering the wage. An indirect effect occurs if the Manager reduces employment -- a likely outcome if a tax on total wages is applied -- as this raises the Manager's utility at the margin and hence could increase the wage. The overall effect is indeterminate. For dW^*/dB, an increase in unemployment benefits raises the utility pf Workers seeking employment in the state sector. The direct effect is a fall in the wage; the indirect effect is a fall in employment which could lead to a higher wage.

5.3 Concluding remarks

The model for an R2E outlined above illustrates the feature that since the ownership of most of the enterprises still belongs to the state it can be expected that the management of these will be carried out following rules from

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[46] This means that $2(\alpha_1 PZf'(n)-\alpha_2 W)f'(n) > \alpha_1 PZf''(n)f(n)$. See Appendix 5.

the R1E. If these rules stress a high production (α_1 is large) it is likely that a high wage will be the outcome. Unemployment is in this model correlated with the size of the labor force, m, and will tend to lower the wage in the R2E. Finally, if the Workers have good income possibilities in the private sector their threat point will be large leading to upward wage pressure in the state sector.

However, the R2E regime raises a host of other interesting questions which we are unable to address adequately using the above model. Among other issues that need to be tackled will be the differences between the preferences of the union/worker group as bargainer with private employers and as an employer in its own right. The outcomes of that bargaining with respect to the wage and employment are not however obvious, particularly given the overlay of structural change imposed on the system by the transition to an R2E regime.

Section 6: Some Preliminary Empirical Results

6.1 Introduction

We now present in very preliminary form results from estimations of the equation derived from the cooperative game setting for the R1E regime (see Section 4.2). To that end we use quarterly data from both Hungary and Poland covering the periods 1982(1)-1989(2) and 1982(1)-1989(4) respectively [47]. Over that time both systems could be stylized as R1E economies. The expression with which we work is repeated below;

$$W^* = fn(\overset{(+)}{\alpha_1}, \overset{(-)}{\alpha_2}, \overset{(+)}{P}, \overset{(?)}{n}, \overset{(-)}{\bar{U}_M}, \overset{(+)}{\bar{U}_W})$$

The parameter, α_1, relates to the incentive for enhanced production. A rough approximation for this incentive could be planned or realized productivity. α_2 covers the wage bill tax. P is producer prices. In section 4 the Workers' and the Manager's expectations to the consumer prices were ignored -- we choose now to include consumer prices in our empirical analysis; n is employment. The manager's threat point U_M depends on the manager's alternative income sources (see also section 4.2), and the workers' threat point U_W relates to the workers income possibilities for example in the private sector. For the set-up presented below, however, current data limitations have forced us to drop a number of terms and concentrate in effect on the association between wages, prices and productivity. We also incorporate simple error correction terms in the estimated equations. The following notation is used throughout;

[47] Data are taken from the IMF International Financial Statistics and are more fully described in Appendix 6.

WAGE = index for average earnings.
CPI = consumer price index.
PPI = producer prices for the industry.
INEMP = index for industrial employment.
INPDN = index for industrial production.
PRO = index for industrial productivity (INEMP/INPDN).

L (as prefix) = natural logarithm of variable.
D (as prefix) = first difference of variable.
D4 (as prefix) = fourth difference of variable.

ECMH = correction term for Hungary (LWAGE-LCPI).
ECMP = correction term for Poland (LWAGE-LPPI-LPRO).
DUM<i> = dummy for period i.

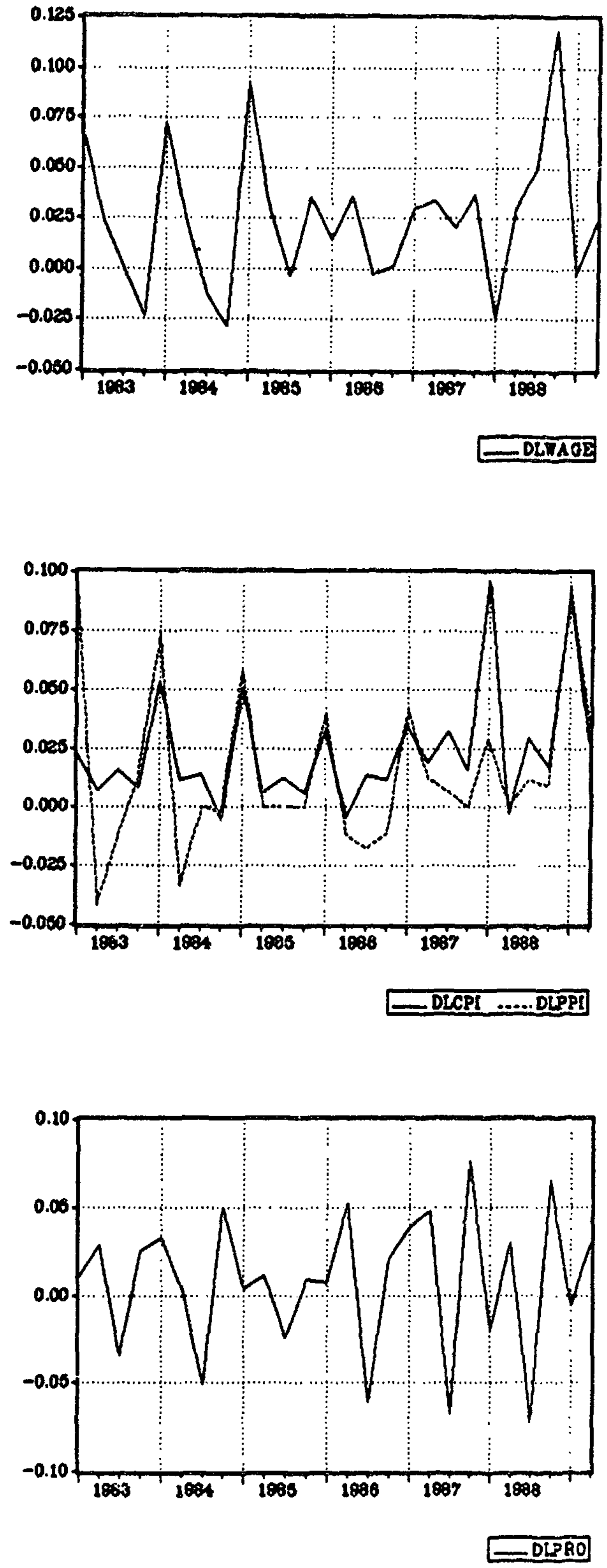
6.2 Hungary

First difference changes in wages, prices and productivity presented in Figure 6.1 pick out some particular features of the wage and price setting. Wage changes appear clustered in the first quarter up to and including 1985, therafter an annual wage round appears absent with changes more randomly distributed over the year. Intra-annual wage adjustments appear to have been adopted as an institutional routine associated with the acceleration in consumer prices over the later period. Consumer and producer price changes mostly track each other closely, with some discrepancy at the start of the period. Again, there is a consistent first quarter clustering of price changes. For productivity (measured over the socialist material sector) changes are generally concentrated in the second and fourth quarters. The spike in the fourth quarter can in part be explained by the structure of the wage round and the use of the wage tax to associate the wage and productivity paths. Reported productivity increases in the fourth quarter likely reflect the incentive structure with a tax-based wage policy. In short, there are clear institutional features that yield particular regularities in the movement of the basic variables.

Table 6.1 reports the descriptive statistics. Several features stand out. First, there is effective real wage stability over the period, as indicated by the similarity in the mean of DLWAGE and DLCPI.

Figure 6.1

Hungary



There appears to be an indexation of wages to prices [48]. The correction term ECMH -- a real wage target -- is subsequently adopted in the estimation [49]. Consumer and producer prices have an expected coefficient. However, wage and price changes are apparently very weakly correlated. The negative correlation between consumer prices and productivity can be explained by the seasonal features alluded to above. The productivity term is also marked by negative serial correlation, as indicated by the high DW statistic.

Table 6.1

Sample range: 1983(1) - 1989(2); number of observations: 26

Series	Mean	S.D.	Maximum	Minimum	DW
DLWAGE	0.0245742	0.0351654	0.1183435	-0.0284606	2.192672
DLCPI	0.0235934	0.0251316	0.0966929	-0.0053410	2.513085
DLPPI	0.0148701	0.0344912	0.0945788	-0.0419526	2.132274
DLPRO	0.0078998	0.0403732	0.0765547	-0.0723430	3.172487

	Covariance	Correlation
DLWAGE,DLCPI	0.0000035	0.0041205
DLWAGE,DLPPI	0.0003322	0.2848057
DLWAGE,DLPRO	0.0004286	0.3139611
DLCPI,DLPPI	0.0005617	0.6739663
DLCPI,DLPRO	-0.0002263	-0.2319340
DLPPI,DLPRO	0.0000690	0.0515244

The estimation presented in Table 6.2 relates wage changes to consumer prices, productivity, a one lag correction term and dummies for 1984(4) and 1988(1). The constant is suppressed; its inclusion exerted little effect on the coefficients and their standard errors [50]. The size of price and productivity coefficients enter with roughly the same magnitudes as for market economies while the correction term suggests a rapid adjustment speed. There is a clear underlying relationship linking price, productivity and wage changes. However, the equation is clearly under-identified and lacks adequate stability. This can be attributed in part to the institutional features of the economy and the many changes over this period in those arrangements. Nevertheless, a reasonably robust conclusion would be that wage formation has marked endogenous attributes and that the wage does not enter as a purely exogenous variable.

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[48] More fully explored in Commander and Coricelli (1990).

[49] The correction term is an observed relation between wage and price variables during the 1980s and is not to be interpreted as a long run equilibrium relationship.

[50] See Appendix 6 for actual and fitted values as well as residuals.

Table 6.2

Dependent Variable is DLWAGE
Sample range: 1983(1) - 1989(2); number of observations: 26

VARIABLE	COEFFICIENT	STD. ERROP	T-STAT.	2-TAIL SIG.
DLCPI	0.7908919	0.1673248	4.7266867	0.000
DLPRC	0.3075491	0.1237486	2.4852732	0.021
ECMH(-1)	-0.6369975	0.1410623	-4.5157170	0.000
DUM844	-0.0635518	0.0252779	-2.5141279	0.020
DUM881	-0.0733555	0.0295827	-2.4796703	0.022

R-squared	0.603610	Mean of dependent var	0.024574
Adjusted R-squared	0.528107	S.D. of dependent var	0.035165
S.E. of regression	0.024157	Sum of squared resid	0.012254
Durbin-Watson stat	1.811326	F-statistic	7.994525
Log likelihood	62.68714		

6.3 Poland

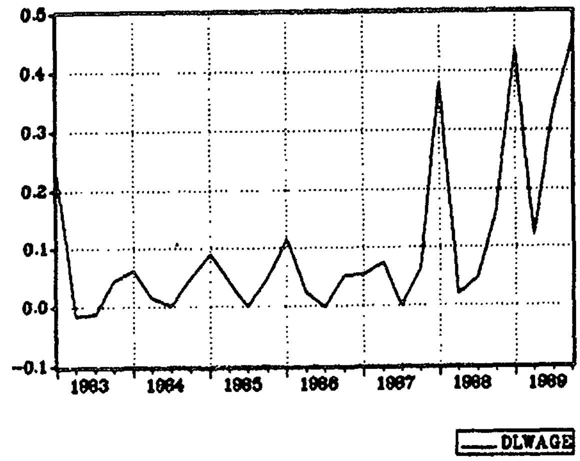
First difference changes for wage, prices and productivity are reported in Figure 6.2. The pattern of wage change is clear; adjustment is in the first quarter with the exception of 1987(1) [51]. Producer price changes exhibit a similar first quarter pattern with consumer price changes clustered generally in the second quarter. Productivity also exhibits first quarter spikes with a deceleration over the last eight quarters of the sample. For both wages and prices, there are sharp accelerations toward the end of the period, particularly from 1989(2) onward as a set of upward adjustments to administered prices occurs and the economy enters into a short high inflation period.

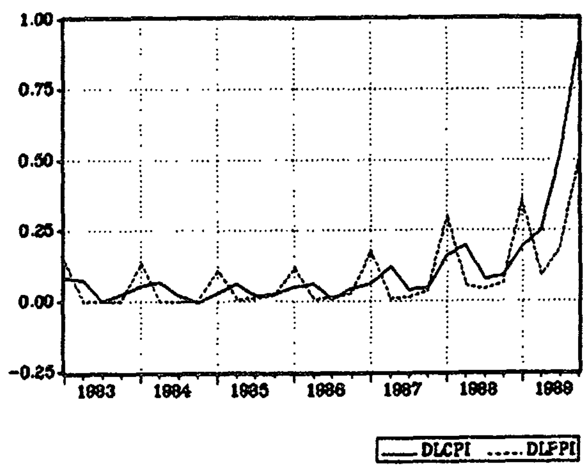
The descriptive statistics presented in Table 6.3 indicate a high and predictable correlation between wage and price changes, particularly for producer prices. The mean of wages is somewhat lower than of the consumer prices while the sum of the producer price and productivity variable almost equals the mean for the wage. This motivates the insertion of a correction term relating wages to production values (LWAGE-LPPI-LPRO). It should also be noted that the low DW point to non-stationarity in some variables, particularly consumer prices.

[51] There was a significant real wage fall as a result of a price surprise in 1987.

Figure 6.2

Poland





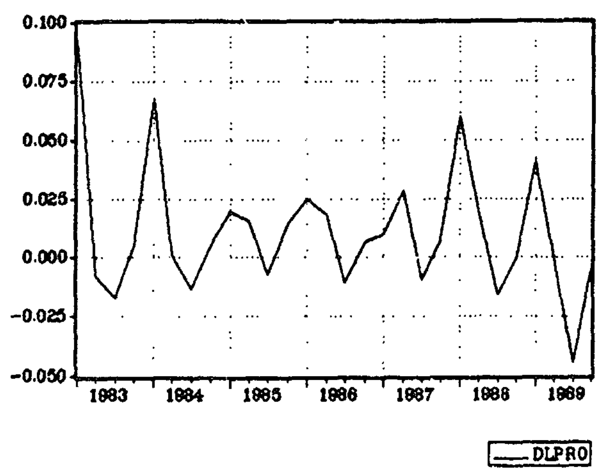


Table 6.3

Sample range: 1983(1) - 1989(4); number of observations: 28

Series	Mean	S.D.	Maximum	Minimum	DW
DLWAGE	0.1031135	0.1352018	0.4486949	-0.0153958	1.164384
DLCPI	0.1165299	0.1880734	0.9145840	-0.0054556	0.316326
DLPPI	0.0870261	0.1242070	0.4987389	0.0000000	1.358728
DLPRO	0.0108672	0.0280915	0.0927196	-0.0444890	1.724336

	Covariance	Correlation
DLWAGE,DLCPI	0.0177138	0.7224306
DLWAGE,DLPPI	0.0148153	0.9149054
DLWAGE,DLPRO	0.0009634	0.2630659
DLCPI,DLPPI	0.0169464	0.7523111
DLCPI,DLPRO	-0.0008803	-0.1727925
DLPPI,DLPRO	0.0009282	0.2758756

The estimation reported in Table 6.4 relates wage changes to consumer and producer prices, productivity, a dummy being 1 for all quarters of 1987, and the correction term [52]. The constant is suppressed. The first quarter adjustment structure for the key variables prompts fourth differencing of the data. Unlike for Hungary, both consumer and producer prices enter jointly and significantly and their coefficients sum to near unity. Producer price increases that translate into consumer price increase appear to have direct and full transmission through to the wage. The productivity term has a rather high

Table 6.4

Dependent Variable is D4LWAGE
Sample range: 1983(1) - 1989(4); number of observations: 28

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
D4LCPI	0.3745738	0.1421613	2.6348511	0.015
D4LPPI	0.6178990	0.2258889	2.7354108	0.012
D4LPRO	0.6408179	0.2495559	2.5678332	0.017
ECMP(-4)	-0.8597551	0.2577528	-3.3355802	0.003
DUM87	-0.0976912	0.0286817	-3.4060427	0.002

R-squared	0.975054	Mean of dependent var	0.342996
Adjusted R-squared	0.970716	S.D. of dependent var	0.303656
S.E. of regression	0.051964	Sum of squared resid	0.062105
Durbin-Watson stat	1.461380	F-statistic	224.7482
log likelihood	45.82553		

[52] See Appendix 6 for actual and fitted values.

coefficient. While the fit is reasonable for the period 1984-1987, the residuals for 1988/89 suggest inclusion of dummies. Their insertion did not however materially improve the performance of the estimation.

6.4 Concluding Comments

Both the Hungary and Poland estimations presented above represent very preliminary attempts at modelling wages in R1E regimes. Data and other limitations mean that the equations are evidently under-identified. The wage variable itself may not capture components of wage income committed to workers under other titles. These factors naturally limit the conclusions that can be derived. Nevertheless, it is clear that in both economies wage changes have been strongly associated with prices and somewhat less with productivity suggesting that wages should not be taken as strictly exogenous. More satisfactory empirical investigation presupposes the construction of new series allowing inclusion of the full set of variables denoted in expression 4.5 above.

Section 7: Conclusion

This paper has addressed the issue of how wages are formed in socialist economies. It has done so on the basis of a number of stylized regimes characterized by their degree of decentralization and introduction of market-based features or rules. The paper shows that one traditional treatment involving a strong assumption of exogeneity for the wage is not warranted. Both the classical planned economy and the partially reformed regime (R1E) are faced with the joint problem of motivating workers in the absence of conventional penalties -- particularly unemployment -- and of monitoring effort. The paper indicates the manner in which these regimes attempt to resolve the incentive problem. For the CPE the piece-rate mechanism is applied. We show how under cooperative and non-cooperative settings the outcome can be either lower than desired productivity or higher than warranted wages. The R1E regime can be interpreted as an attempt to refine the motivational structure by introducing another player, the manager. One underlying objective is to provide a framework where workers and managers engage in a cooperative game to determine wages and output with the incentive structure in effect given by the Planner. We attempt to show how this can yield other-than-intended results if workers and managers cooperate, playing a non-cooperative game with the Planner. This type of outcome might broadly typify recent Polish experience over the 1980s. From the bargaining model that we set up in Section 5.2 we derive an equation that can be estimated for the R1E regime and some preliminary results are reported. The assumption of exogeneity is shown to be untenable, even if institutional and other factors indicate a greater degree of exogeneity than would be the case for a standard market economy.

<u>**References**</u>

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Appendix 1: The Dictatorial solution in the CPE

Multipliers

To simplify the expression the following notational simplifications are made for Appendix 1 and 2; the stars indicating the optimal value are dropped; $W_b = W_{base}$, and $Z_p = Z_{plan}$.

The wage as a function of the base wage

To find dW/dW_b we use the Implicit Function Theorem (IFT). Define F as:

$$F = u(Z_p)+v(W/P^e)-u(0)-v(W_b/P^e)$$

From equation [3.9] in section 3.3 we have that the wage for the Dictatorial solution is W implying F = 0. From IFT, the multiplier dW/dW_b is given as:

$$\frac{dW}{dW_b} = -\frac{dF/dW_b}{dF/dW} = -\frac{-v'(W_b/P^e)(1/P^e)}{v'(W/P^e)(1/P^e)}$$

=>

$$\frac{dW}{dW_b} = \frac{v'(W_b/P^e)}{v'(W/P^e)} > 0$$

If we use $v'' < 0$, then $v'(W_b/P^e) > v'(W/P^e)$ and hence $dW/dW_b > 1$.

The wage as a function of the planned productivity

$$\frac{dW}{dZ_p} = -\frac{dF/dZ_p}{dF/dW} = -\frac{u'(Z_p)}{v'(W/P^e)(1/P^e)}$$

=>

$$\frac{dW}{dZ_p} = -P^e\frac{u'(Z_p)}{v'(W/P^e)} > 0$$

The wage as a function of price expectations

$$\frac{dW}{dP^e} = -\frac{dF/dP^e}{dF/dW} = -\frac{v'(W/P^e)(-W/P^{e2}) - v'(W_b/P^e)(W_b/P^{e2})}{v'(W/P^e)(1/P^e)}$$

We get after simplification:

$$\frac{dW}{dP^e} = \frac{v'(W/P^e)(W/P^e) - v'(W_b/P^e)(W_b/P^e)}{v'(W/P^e)}$$

dW/dP^e cannot be signed because of two opposite effects as the result of an increase in P^e. The real value of the whole salary (W) decreases which tends to increase the wage. On the other hand, the real value of the base wage W_b decreases such that the alternative (to deliver zero effort and receive W_b) becomes less attractive. The combined effect is uncertain.

The wage as a function of the Planner's threat point

$\bar{U}_p$ does not appear in F and hence $dW/d\bar{U}_p = 0$.

Appendix 2: The non-cooperative game

Slope of the Workers' reaction curve

As argued in section 3.4 the reaction curve can be backward sloping, i.e. the reaction curve constitutes a correspondance and we can not use IFT straight away. However, as a first step we can find the slope of the inverted reaction function. This means we are now going to find dZ/dW (instead of dW/dZ); using the Chain Rule we have:

$$\frac{dZ}{dW} = \frac{dZ}{d\sigma}\frac{d\sigma}{dW}$$

$dZ/d\sigma$ can be found from the implicit form of the reaction curve (eq. [3.11] in section 3.4): [53]

$$F = u'(Z) + v'((W_{base}+\sigma Z)/P^e)(\sigma/P^e) = 0$$

Using IFT gives us:

$$\frac{dZ}{d\sigma} = -\frac{dF/d\sigma}{dF/dZ} = -\frac{v''(W/P^e)(Z/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)}{u''(Z) + v''(W/P^e)(\sigma/P^e)^2}$$

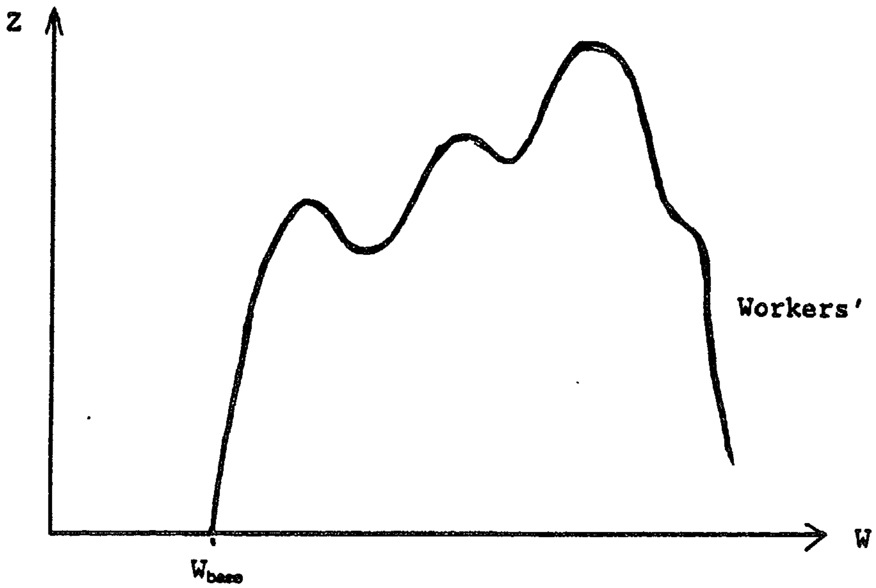
The denominator is always negative, while the numerator can be positive or negative.

[53] We generally use the notation F for the function used to derive multipliers via the Implicit Function Theorem. The F used in this appendix has no relationship to the F used in appendix 1.

The piece-rate is $\sigma = (W-W_b)/Z$. This gives the derivative $d\sigma/dW = 1/Z$. We can find the slope of the inverted reaction curve for the Workers.

$$\frac{dZ}{dW} = -\frac{v''(W/P^e)(Z/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)}{u''(Z) + v''(W/P^e)(\sigma/P^e)^2}\frac{1}{Z}$$

Again the denominator is negative, while the numerator can be positive or negative. If the term $v''(W/P^e)(Z/P^e)(\sigma/P^e)$ is smaller than $v'(W/P^e)(1/P^e)$ the numerator is positive and dZ/dW is hence positive. If $v''(W/P^e)(Z/P^e)(\sigma/P^e) > v'(W/P^e)(1/P^e)$ the inverted reaction curve is downward sloping. Since we have no a priori knowledge about v" we cannot sign the numerator and hence we cannot determine the slope of the inverted reaction curve. In the figure below an example of a possible reaction curve in an inverted 'effort - wage' space is drawn.



Multipliers for the Stackelberg equilibrium

We know that the Planner chooses the smallest piece-rate which satisfies equation [3.13] in section 3.4. This means that the Planner will always choose a wage (and effort) on the <u>upward sloping parts</u> of the reaction curve. However, the upward sloping parts on the original reaction curve will also be upward sloping on the inverted reaction curve. This means that only the upward sloping parts of the inverted reaction curve are of interest. As argued above, the inverted reaction curve slopes upward when $v''(W/P^e)(Z/P^e)(\sigma/P^e) < v'(W/P^e)(1/P^e)$. Therefore, when we calculate the Stackelberg equilibrium we know that it is going to be found where $v''(W/P^e)(Z/P^e)(\sigma/P^e) < v'(W/P^e)(1/P^e)$.

However, as illustrated above, we can say very little about the behavior of the reaction curve, and by just considering the upward sloping parts of the reaction curve we very easily risk working with overlapping "pieces" of continuous functions. To avoid this we assume that the second order derivative of v is upward sloping, that is $v^{(3)} > 0$. This condition secures that the inverted reaction curve will be bell-shaped, i.e. the original reaction curve will contain only one bend. This again means that the part where $v''(W/P^e)(Z/P^e)(\sigma/P^e) < v'(W/P^e)(1/P^e)$ will be a continuous, differentiable, and upward sloping function. The intersection between the Worker's reaction curve and the Planner's Z_{plan} line will then be unique and we can find it just by using IFT (on equation [3.13]).

The wage as a function of the base wage

The (total) wage is given as:

$$W = W_b + \sigma Z_p$$

We have:

$$\frac{dW}{dW_b} = 1 + \frac{d\sigma}{dW_b} Z_p$$

To find $d\sigma/dW_b$ we use IFT on equation [3.13]. From equation [3.13] we have that the function F_P defined below is equal zero.

$$F_P = u'(Z_{plan}) + v'((W_{base}+\sigma Z_{plan})/P^e)(\sigma/P^e) = 0$$

Using IFT we find the multiplier $d\sigma/dW_b$ as:

$$\frac{d\sigma}{dW_b} = -\frac{dF_P/dW_b}{dF_P/d\sigma} = -\frac{v''(W/P^e)(1/P^e)(\sigma/P^e)}{v''(W/P^e)(Z_p/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)}$$

We insert the expression for $d\sigma/dW_b$ into the formula for dW/dWb and obtain:

$$\frac{dW}{dW_b} = \frac{v'(W/P^e)(1/P^e)}{v''(W/P^e)(Z_p/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)}$$

Since $v'' < 0$ we have that $dW/dW_b > 1$.

The wage as a function of the planned productivity

Again using the Chain Rule:

$$\frac{dW}{dZ_p} = \frac{d\sigma}{dZ_p} Z_p + \sigma$$

To find $d\sigma/dZ_p$ we use IFT:

$$\frac{d\sigma}{dZ_p} = -\frac{dF_P/dZ_p}{dF_P/d\sigma} = -\frac{u''(Z_p) + v''(W/P^e)(\sigma/P^e)(\sigma/P^e)}{v''(W/P^e)(Z_p/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)}$$

We insert $d\sigma/dZ_p$ into the expression for dW/dZ_p:

$$\frac{dW}{dZ_p} = -\frac{u''(Z_p) + v''(W/P^e)(\sigma/P^e)(\sigma/P^e)}{v''(W/P^e)(Z_p/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)} Z_p + \sigma$$

=>

$$\frac{dW}{dZ_p} = \frac{v'(W/P^e)(\sigma/P^e) - u''(Z_p)Z_p}{v''(W/P^e)(Z_p/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)} > 0$$

The wage as a function of the price expectations

$$\frac{dW}{dP^e} = \frac{d\sigma}{dP^e} Z_p$$

$$\frac{d\sigma}{dP^e} = -\frac{dF_P/dP^e}{dF_P/d\sigma} = -\frac{v''(W/P^e)(-W/P^{e2})(\sigma/P^e) + v'(W/P^e)(-\sigma/P^{e2})}{v''(W/P^e)(Z_p/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)}$$

We insert in formula for dW/dP^e and get after simplification:

$$\frac{dW}{dP^e} = -\frac{dF_P/dP^e}{dF_P/d\sigma} = -\frac{v''(W/P^e)(-W/P^{e2})(\sigma/P^e)Z_p + v'(W/P^e)(-\sigma/P^{e2})Z_p}{v''(W/P^e)(Z_p/P^e)(\sigma/P^e) + v'(W/P^e)(1/P^e)}$$

We cannot sign the multiplier dW/dP^e.

Appendix 3: The cooperative game in the R1E

The efficiency locus

The NZH solution to the cooperative game is given by:

$$\underset{W,Z}{Max} \; \{ \; [\alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M]^{\theta}[u(Z)+v(W) - \bar{U}_W]^{1-\theta} \; \}$$

For computational ease we take the logarithm of the expression in the curled brackets. We differentiate with respect to W and Z and obtain the following first order conditions:

$$\Theta \frac{-\alpha_2 n}{\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M} + (1-\Theta) \frac{v'(W)}{u(Z)+v(W) - \bar{U}_W} = 0$$

$$\Theta \frac{\alpha_1 Pf(n)}{\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M} + (1-\Theta) \frac{u'(Z)}{u(Z)+v(W) - \bar{U}_W} = 0$$

By isolating the denominator for the first fraction in the first equation and inserting it into the second equation we get that the efficiency locus can be written as:

$$\frac{\alpha_1}{\alpha_2} \frac{Pf(n)}{n} = - \frac{u'(Z)}{v'(W)}$$

Slope of efficiency locus

Let us write the equation for the efficiency locus in a somewhat different way and call the expression on the left hand side F.

$$F = \alpha_1 Pf(n)v'(W) + \alpha_2 nu'(Z) = 0$$

Using IFT we have the following expression:

$$\frac{dW}{dZ} = - \frac{dF/dZ}{dF/dW} = - \frac{\alpha_2 nu''(Z)}{\alpha_1 Pf(n)v''(W)}$$

Since both the second order derivatives are less than zero (cf. section 4.2) we have that $dW/dZ < 0$.

Change of wage-bill tax

$$\left.\frac{dW}{d\alpha_2}\right|_Z = - \frac{dF/d\alpha_2}{dF/dW} = - \frac{nu'(Z)}{\alpha_1 Pf(n)v''(W)}$$

The denominator is, as before, negative; the numerator is negative and the whole expression is negative.

Multipliers

The first order conditions for the Nash bargaining solution can also be found without taking logs of the utility gain function first. By differentiating the expression in the curled bracket in [4.4] with respect to W and Z we get the following first order conditions:

$$F_W = [\alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M]v'(W) - \alpha_2 n[u(Z)+v(W) - \bar{U}_W] = 0$$

$$F_Z = [\alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M]u'(Z) + \alpha_1 Pf(n)[u(Z)+v(W) - \bar{U}_W] = 0$$

Subscript W respective Z denotes that the objective function is differentiated with respect to W respective Z. Let us call the Manager's gain from the bargaining δ_M, $\delta_M = \alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}M$, and the Workers' gain δ_W, $\delta_W = u(Z)+v(W) - \bar{U}_W$. Using this notation the above system can be written as:

$$F_W = \delta_M v'(W) - \alpha_2 n\delta_W = 0$$

$$F_Z = \delta_M u'(Z) + \alpha_1 Pf(n)\delta_W = 0$$

We can find the multipliers via IFT for a set of simultaneous equations. The multipliers $dW/d\alpha_1$ and $dZ/d\alpha_1$ can be found from the following system:

$$[dF_W/dW][dW/d\alpha_1] + [dF_W/dZ][dZ/d\alpha_1] = -[dF_W/d\alpha_1]$$

$$[dF_Z/dW][dW/d\alpha_1] + [dF_Z/dZ][dZ/d\alpha_1] = -[dF_Z/d\alpha_1]$$

The solutions to this system can be found using Cramers Rule:

$$\frac{dW}{d\alpha_1} = \frac{[dF_W/dZ][dF_Z/d\alpha_1] - [dF_Z/dZ][dF_W/d\alpha_1]}{[dF_W/dW][dF_Z/dZ] - [dF_W/dZ][dF_Z/dW]}$$

$$\frac{dZ}{d\alpha_1} = \frac{[dF_Z/dW][dF_W/d\alpha_1] - [dF_W/dW][dF_Z/d\alpha_1]}{[dF_W/dW][dF_Z/dZ] - [dF_W/dZ][dF_Z/dW]}$$

Call the common denominator D_3. From the second order conditions for the maximization problem we know that $D_3 = [dF_W/dW][dF_Z/dZ] - [dF_W/dZ]^2 > 0$ (as well as $dF_W/dW < 0$ and $dF_Z/dZ < 0$).

For convenience we calculate the partial derivatives for later use:

$$dF_W/dW = -2\alpha_2 nv'(W) + \delta_W v''(W) < 0$$

$$dF_W/dZ = \alpha_1 Pf(n)v'(W) - \alpha_2 nu'(Z) = 2\alpha_1 Pf(n)v'(W) = -\alpha_2 nu'(Z)$$

($dF_W/dZ = dF_Z/dW > 0$. The last two equality signs are derived using the condition for the effeciency locus).

$$dF_Z/dZ = 2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z) < 0$$

Let us first look at the impact of the exogenous variables on the <u>wage</u>.

$$dW/d\alpha_1 = (1/D_3)\{ [dF_Z/dW][dF_W/d\alpha_1] - [dF_Z/dZ][dF_Z/d\alpha_1] \}$$

$$= (1/D_3)\{ [2\alpha_1 Pf(n)v'(W)][PZf(n)u'(Z) + Pf(n)\delta_W]$$

$$- [2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z)][PZf(n)v'(W)] \}$$

$$= (1/D_3)\{ 2\alpha_1 Pf(n)v'(W)u'(Z) - \delta_M u''(Z)PZf(n)v'(W) \} > 0$$

$$dW/d\alpha_2 = (1/D_3)\{ [dF_Z/dW][dF_W/d\alpha_2] - [dF_Z/dZ][dF_Z/d\alpha_2] \}$$

$$= (1/D_3)\{ [2\alpha_1 Pf(n)v'(W)][-Wnu'(Z)]$$

$$- [2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z)][-Wnv'(W) - n\delta_W] \}$$

$$= (1/D_3)\{ 2\alpha_1 Pf(n)u'(Z)n\delta_W + \delta_M u''(Z)[Wnv'(W) + n\delta_W] \} < 0$$

$$dW/dP = (1/D_3)\{ [dF_Z/dW][dF_W/dP] - [dF_Z/dZ][dF_Z/dP] \}$$

$$= (1/D_3)\{ [2\alpha_1 Pf(n)v'(W)][\alpha_1 Zf(n)u'(Z) + \alpha_1 f(n)\delta_W]$$

$$- [2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z)][\alpha_1 Zf(n)v'(W)] \}$$

$$= (1/D_3)\{ 2\alpha_1 Pf(n)v'(W)\alpha_1 f(n)\delta_W - \delta_M u''(Z)\alpha 1Zf(n)v'(W) \} > 0$$

$$dW/dn = (1/D_3)\{ [dF_Z/dW][dF_W/dn] - [dF_Z/dZ][dF_Z/dn] \}$$

$$= (1/D_3)\{ [2\alpha_1 Pf(n)v'(W)][\alpha_1 PZf'(n)u'(Z) + \alpha_1 Pf'(n)\delta_W]$$

$$- [2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z)][(\alpha_1 PZf'(n)-\alpha_2 W)v'(W) - \alpha_2\delta_W] \}$$

$$= (1/D_3)\{ 2\alpha_1 Pf(n)v'(W)\alpha_1 Pf'(n)\delta_W + 2\alpha_1 Pf(n)u'(Z)\alpha_2[Wv'(W)+\delta_W]$$

$$- \delta_M u''(Z)[(\alpha_1 PZf'(n)-\alpha_2 W)v'(W) - \alpha_2\delta_W] \}$$

dW/dn has undetermined sign.

$$dW/d\bar{U}_M = (1/D_3)\{ [dF_Z/dW][dF_W/d\bar{U}_M] - [dF_Z/dZ][dF_Z/d\bar{U}_M] \}$$

$$= (1/D_3)\{ [2\alpha_1 Pf(n)v'(W)][-u'(Z)]$$

$$- [2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z)][-v'(W)] \}$$

$$= (1/D_3)\{ 2\alpha_1 Pf(n)u'(Z)v'(W) \} < 0.$$

$$dW/d\bar{U}_W = (1/D_3)\{ [dF_Z/dW][dF_W/d\bar{U}_W] - [dF_Z/dZ][dF_Z/d\bar{U}_W] \}$$

$$= (1/D_3)\{ [-\alpha_2 nu'(Z)][-\alpha_1 Pf(n)]$$

$$- [2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z)][\alpha_2 n] \}$$

$$= (1/D_3)\{ - \alpha_2 n\delta_M u''(Z) \} > 0.$$

We calculate how the effort/productivity Z depends on the incentive parameters α_1 and α_2:

$$dZ/d\alpha_1 = (1/D_3)\{ [dF_Z/dW][dF_W/d\alpha_1] - [dF_W/dW][dF_Z/d\alpha_1] \}$$

$$= (1/D_3)\{ [-\alpha_2 nu'(Z)][PZf(n)v'(W)]$$

$$- [-2\alpha_2 nv'(W) + \delta_W v''(W)][PZf(n)u'(Z) + Pf(n)\delta_W] \}$$

$$= (1/D_3)\{ 2\alpha_2 nv'(W)Pf(n)\delta_W - \delta_W v''(W)[PZf(n)u'(Z)+Pf(n)\delta_W] \}$$

$dZ/d\alpha_1$ has undetermined sign.

$$dZ/d\alpha_2 = (1/D_3)\{ [dF_Z/dW][dF_W/d\alpha_2] - [dF_W/dW][dF_Z/d\alpha_2] \}$$

$$= (1/D_3)\{ [-\alpha_2 nu'(Z)][-Wnv'(W) - n\delta_W]$$

$$- [-2\alpha_2 nv'(W) + \delta_W v''(W)][-Wnu'(Z)] \}$$

$$= (1/D_3)\{ \alpha_2 nu'(Z)n\delta_W + \delta_W v''(W)Wnu'(Z) \} < 0.$$

Appendix 4: A cooperative game nested in a non-cooperative game

The Firm's reaction curve

If we take logs to the content of the curled bracket in [4.6] and differentiate with respect to Z we get:

$$\frac{-\alpha_1 Pf(n)}{\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M} + \frac{u'(Z)}{u(Z)+v(W) - \bar{U}_W} = 0$$

This can only be simplified a little; we obtain the reaction curve:

$$-\frac{\alpha_1 Pf(n)}{u'(Z)} = \frac{\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M}{u(Z)+v(W) - \bar{U}_W}$$

The first order condition for the Firm can also be written as:

$$F_F = [\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M]u'(Z) + \alpha_1 Pf(n)[u(Z)+v(W) - \bar{U}_W] = 0$$

The second order condition for a maximum requires that $dF_F/dZ < 0$, which is satisfied. To simplify the notation we call the Manager's utility gain δ_M, $\delta_M = \alpha_1 PZf(n) - \alpha_2 Wn - \bar{U}_M$, and the Workers' utility gain δ_W, $\delta_W = u(Z) + v(W) - \bar{U}_W$. F_F can then be written as:

$$F_F = \delta_M u'(Z) + \alpha_1 Pf(n)\delta_W = 0$$

To find the slope of the Firm's reaction curve we use IFT:

$$\frac{dW}{dZ} = -\frac{dF_F/dZ}{dF_F/dW} = -\frac{\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z) + \alpha_1 Pf(n)u'(Z)}{-\alpha_2 nu'(Z) + \alpha_1 Pf(n)v'(W)}$$

=>

$$\frac{dW}{dZ} = \frac{2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z)}{\alpha_2 nu'(Z) - \alpha_1 Pf(n)v'(W)}$$

Both numerator and denominator are negative, so dW/dZ is positive. The Firm's reaction curve is upward sloping.

The Planner's reaction curve

We differentiate the content of the curled bracket in expression [4.8] in section 4.3. We obtain:

$$F_P = -2(1-\alpha_2)\beta_1 n[PI-(1-\alpha_1)PZf(n)+(1-\alpha_2)Wn] = 0$$

This can, provided $(1-\alpha_2)\beta_1 n \neq 0$, be simplified to equation [4.9] in section 4.3.

Multipliers

At the Nash equilibrium both the Firm's and the Planner's reaction curves are satisfied at the same time. (The intersection between the two reaction curves is the NE).

The Firm's and the Planner's reaction curves:

$$F_F = \delta_M u'(Z) + \alpha_1 Pf(n)\delta_W = 0$$

$$F_P = -2(1-\alpha_2)\beta_1 n[PI-(1-\alpha_1)PZf(n)+(1-\alpha_2)Wn] = 0$$

We have two simultanous equations. As in Appendix 3 we use IFT and Cramer's rule to obtain the following formula for the multiplier showing the change in W as α_1 changes.

$$\frac{dW}{d\alpha_1} = \frac{[dF_F/dZ][dFP_2/d\alpha_1] - [dF_P/dZ][dF_F/d\alpha_1]}{[dF_F/dW][dF_P/dZ] - [dF_F/dZ][dF_P/dW]}$$

Call the denominator D_4, that is, $D_4 = [dF_F/dW][dF_P/dZ] - [dF_F/dZ][dF_P/dW]$. Let us sign this expression. For the NE to be stable (and unique) we require that the slope of the Firm's reaction curve is bigger than the slope of the Planner's reaction curve. The slope of the reaction curves can be found using IFT on the equation for F_F and F_P.

Slope (Firm's reaction curve) > Slope (Planner's reaction curve)

=>

$$-\frac{[dF_F/dZ]}{[dF_F/dW]} > -\frac{[dF_P/dZ]}{[dF_P/dW]}$$

=>

$[dF_F/dW][dF_P/dZ] - [dF_F/dZ][dF_P/dW] < 0.$

The denominator D_4 must be negative for the NE to be stable.

For convenience we calculate the partial derivatives for later use:

$dF_F/dZ = 2\alpha_1 Pf(n)u'(Z) + \delta_M u''(Z) < 0$ (Firm)

$dF_P/dZ = 2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n) > 0$ (Planner)

Let us look at the impact of the exogenous variables on the <u>wage</u>.

$$\begin{aligned} dW/d\alpha_1 &= (1/D_4)\{ [dF_F/dZ][dF_P/d\alpha_1] - [dF_P/dZ][dF_F/d\alpha_1] \} \\ &= (1/D_4)\{ [2\alpha_1 Pf(n)u'(Z)+\delta_M u''(Z)][-2(1-\alpha_2)\beta_1 nPZf(n)] \\ &\qquad - [2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)][PZf(n)u'(Z)+Pf(n)\delta_W] \} \\ &= (1/D_4)\{2(1-\alpha_2)\beta_1 nPf(n)\} \\ &\qquad \{ -(1+\alpha_1)PZf(n)u'(Z) - Z\delta_M u''(Z) - (1-\alpha_1)Pf(n)\delta_W \} \end{aligned}$$

$dW/d\alpha_1$ cannot be signed.

$$dW/d\alpha_2 = (1/D_4)\{ [dF_F/dZ][dF_P/d\alpha_2] - [dF_P/dZ][dF_F/d\alpha_2]$$

$$= (1/D_4)\{ [2\alpha_1 Pf(n)u'(Z)+\delta_M u''(Z)][2\beta_1 nX + 2(1-\alpha_2)\beta_1 nWn]$$

$$- [2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)][-Wnu'(Z)] \}$$

$$= (1/D_4)\{ 2(1-\alpha_2)\beta_1 n^2 W\}\{(1+\alpha_1)Pf(n)u'(Z)+\delta_M u''(Z) \} > 0.$$

$$dW/d\beta_1 = (1/D_4)\{ [dF_F/dZ][dF_P/d\beta_1] - [dF_P/dZ][dF_F/d\beta_1] \}$$

$$= (1/D_4)\{ [2\alpha_1 Pf(n)u'(Z)+\delta_M u''(Z)][-2(1-\alpha_2)nX] \} = 0.$$

Excess demand is always zero.

$dW/d\beta_2$ is zero since β_2 does not occur in neither F_P nor F_F.

$$dW/dP = (1/D_4)\{ [dF_F/dZ][dF_P/dP] - [dF_P/dZ][dF_F/dP] \}$$

$$= (1/D_4)\{ [2\alpha_1 Pf(n)u'(Z)+\delta_M u''(Z)][2(1-\alpha_2)\beta_1 n(Zf(n)-I)]$$

$$- [2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)][\alpha_1 Zf(n)u'(Z)+\alpha_1 f(n)\delta_W] \}$$

$$= (1/D_4)\{ 2(1-\alpha_2)\beta_1 n\}\{2\alpha_1 Pf(n)u'(Z)(Zf(n)-I)+\delta_M u''(Z)(Zf(n)-I)$$

$$- (1-\alpha_1)Pf(n)\alpha_1 Zf(n)u'(Z)-(1-\alpha_1)Pf(n)\alpha_1 f(n)\delta_W \}$$

$$= (1/D_4)\{ 2(1-\alpha_2)\beta_1 n\}\{ \alpha_1 Pf(n)u'(Z)[(1+\alpha_1)Zf(n)-2I]$$

$$+ \delta_M u''(Z)(Zf(n)-I) - (1-\alpha_1)Pf(n)\alpha_1 f(n)\delta W] \}$$

A sufficient condition for dW/dP being positive is that $(1+\alpha_1)Zf(n)-2I > 0$.

$$dW/dn = (1/D_4)\{ [dF_F/dZ][dF_P/dn] - [dF_P/dZ][dF_F/dn] \}$$

$$= (1/D_4)\{ [2\alpha_1 Pf(n)u'(Z)+\delta_M u''(Z)][-2(1-\alpha_2)\beta_1 n(PZf'(n)-(1-\alpha_1)W]$$

$$- [2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)][(\alpha_1 PZf'(n)-\alpha_2 W)u'(Z)+\alpha_1 Pf(n)\delta_W] \}$$

dW/dn has undetermined sign.

$$dW/d\bar{U}_M = (1/D_4)\{ [dF_F/dZ][dF_P/d\bar{U}_M] - [dF_P/dZ][dF_F/d\bar{U}_M] \}$$

$$= (1/D_4)\{- [2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)](-u'(Z)) \}$$

$$= (1/D_4)\{ 2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)u'(Z) \} > 0.$$

$$dW/d\bar{U}_W = (1/D_4)\{ [dF_F/dZ][dF_P/d\bar{U}_W] - [dF_P/dZ][dF_F/d\bar{U}_W] \}$$

$$= (1/D_4)\{ - [2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)][-\alpha 1Pf(n)] \}$$

$$= (1/D_4)\{ 2(1-\alpha_1)(1-\alpha_2)\beta_1 nPf(n)\alpha 1Pf(n) \} < 0.$$

$$dW/dI = (1/D_4)\{ [dF_F/dZ][dF_P/dI] - [dF_P/dZ][dF_F/dI] \}$$

$$= (1/D_4)\{ [2\alpha_1 Pf(n)u'(Z)+\delta_M u''(Z)][-2(1-\alpha_2)\beta_1 n(-P)] \} < 0.$$

Appendix 5: A cooperative game in the R2E

The efficiency locus

The NZH solution is the solution to the following problem:

$$\max_{W,n}\{[\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M]^{\theta}[nv(W)+(m-n)v(B)+nu(Z)+(m-n)u(0) - \bar{U}_S]^{1-\theta}\}$$

We take logs of the expressions in the curled brackets, differentiate with respect to W and n, and obtain:

$$\theta \frac{-\alpha_2 n}{\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M} + (1-\theta)\frac{nv'(W)}{nv(W)+(m-n)v(B)+nu(Z)+(m-n)u(0) - \bar{U}_S} = 0$$

$$\theta \frac{\alpha_1 PZf'(n) - \alpha_2 W}{\alpha_1 PZf(n)-\alpha_2 Wn - \bar{U}_M} + (1-\theta)\frac{v(W)-v(B)+u(Z)-u(0)}{nv(W)+(m-n)v(B)+nu(Z)+(m-n)u(0) - \bar{U}_S} = 0$$

=>

$$\frac{\alpha_1 PZf'(n)-\alpha_2 W}{\alpha_2} = -\frac{v(W)-v(B)+u(Z)-u(0)}{v'(W)}$$

The slope of the efficiency locus can be found using IFT if we write the condition for the efficiency locus this way:

$$F = (\alpha_1 PZf'(n)-\alpha_2 W)v'(W) + \alpha_2(v(W)-v(B)+u(Z)-u(0))$$

$$\frac{dW}{dn} = -\frac{dF/dn}{dF/dW} = -\frac{\alpha_1 PZf''(n)v'(W)}{\alpha_2 v'(W) + (\alpha_1 PZf'(n)-\alpha_2 W)v''(W) + \alpha_2 v'(W)}$$

=>

$$\frac{dW}{dn} = - \frac{\alpha_1 PZf''(n)v'(W)}{(\alpha_1 PZf'(n) - \alpha_2 W)v''(W)} > 0$$

The efficiency locus is upward sloping.

Multipliers

The first order conditions for the Nash bargaining solution leave two simultaneous equations.

$$F_W = - \alpha_2 n\delta_S + \delta_M nv'(W) = 0$$

$$F_n = (\alpha_1 PZf'(n) - \alpha_2 W)\delta_S + \delta_M(v(W) - v(B) + u(Z) - u(0)) = 0$$

The Manager's gain from the bargaining is $\delta_M = \alpha_1 PZf(n) - \alpha_2 Wn - \overline{U}_M$ and the Workers' gain is $\delta_S = nv(W)+(m-n)v(B)+nu(Z)+(m-n)u(0) - \overline{U}_S$.

IFT for two simultaneous equations gives the multiplier:

$$\frac{dW}{d\alpha_1} = \frac{[dF_W/dn][dF_n/d\alpha_1] - [dF_n/dn][dF_W/d\alpha_1]}{[dF_W/dW][dF_n/dn] - [dF_W/dn][dF_n/dW]}$$

The denominator is called D_5 and is positive according to the second order conditions.

We calculate the partial derivative needed in all the multipliers.

$$dF_W/dn = - \alpha_2\delta_S - \alpha_2 n(v(W) - v(B) + u(Z) - u(0)) + (\alpha_1 PZf'(n) - \alpha_2 W)nv'(W) + \delta_M v'(W)$$

$$= 2n(\alpha_1 PZf'(n) - \alpha_2 W)v'(W) = - 2\alpha_2 n(v(W) - v(B) + u(Z) - u(0))$$

$$dF_n/dn = \alpha_1 PZf''(n)\delta_S + 2(\alpha_1 PZf'(n) - \alpha_2 W)(v(W) - v(B) + u(Z) - u(0))$$

$$= \alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n) - \alpha_2 W)^2 v'(W)$$

$$= \alpha_1 PZf''(n)\delta_S - 2\alpha_2(v(W) - v(B) + u(Z) - u(0))^2(1/v'(W))$$

These derivatives have been simplified using the first order condition for the Nash bargaining solution and the condition for the efficiency locus.

$$dW/d\alpha_1 = (1/D_5)\{ [dF_W/dn][dF_n/d\alpha_1] - [dF_n/dn][dF_W/d\alpha_1] \}$$

$$= (1/D_5)\{ [2n(\alpha_1 PZf'(n) - \alpha_2 W)v'(W)][PZf'(n)\delta_S + PZf(n)(v(W) - v(B) + u(Z) - u(0))]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n) - \alpha_2 W)^2 v'(W)][PZf(n)nv'(W)]$$

$$= (1/D_5)\{ 2n(\alpha_1 PZf'(n) - \alpha_2 W)v'(W)]PZf'(n)\delta_S - \alpha_1 PZf''(n)\delta_S PZf(n)nv'(W) \}$$

$= (1/D_5)\{\ nv'(W)PZ\delta_{S}\}\{2(\alpha_1 PZf'(n)-\alpha_2 W)f'(n) - \alpha_1 f''(n)PZf(n)\ \}$

$dW/d\alpha_1 > 0$ if $2(\alpha_1 PZf'(n)-\alpha_2 W)f'(n) > \alpha_1 f''(n)PZf(n)$.

$$dW/d\alpha_2 = (1/D_5)\{\ [dF_W/dn][dF_n/d\alpha_2] - [dF_n/dn][dF_W/d\alpha_2]\ \}$$

$$= (1/D_5)\{\ [2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)][-W\delta_S - Wn(v(W)-v(B)+u(Z)-u(0))]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)][-n\delta_S - Wnnv'(W)]$$

$$= (1/D_5)\{\ -2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)W\delta S + \alpha_1 PZf''(n)\delta_S[n\delta_S + Wnnv'(W)]$$

$$- 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)n\delta_S\ \}$$

$\alpha_1 PZf'(n)-\alpha_2 W > \alpha_2 W$ is a sufficient condition for $dW/d\alpha_2 < 0$.

$$dW/d\bar{U}_M = (1/D_5)\{\ [dF_W/dn][dF_n/d\bar{U}_M] - [dF_n/dn][dF_W/d\bar{U}_M]\ \}$$

$$= (1/D_5)\{\ [2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)][-(v(W)-v(B)+u(Z)-u(0))]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)][-nv'(W)]$$

$$= (1/D_5)\{\ \alpha_1 PZf''(n)\delta_S nv'(W)\ \} < 0$$

$$dW/d\bar{U}_S = (1/D_5)\{\ [dF_W/dn][dF_n/d\bar{U}_S] - [dF_n/dn][dF_W/d\bar{U}_S]\ \}$$

$$= (1/D_5)\{\ [2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)][-(\alpha_1 PZf'(n)-\alpha_2 W)]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)][-\alpha_2 n(-1)]$$

$$= (1/D_5)\{\ -\alpha_1\alpha_2 PZf''(n)n\delta S\ \} > 0$$

$$dW/dP = (1/D_5)\{\ [dF_W/dn][dF_n/dP] - [dF_n/dn][dF_W/dP]\ \}$$

$$= (1/D_5)\{\ [2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)]\ [\alpha_1 Zf'(n)\delta_S + \alpha_1 Zf(n)(v(W)-v(B)+u(Z)-u(0))]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)][\alpha_1 Zf(n)nv'(W)]$$

$$= (1/D_5)\{\ 2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)]\alpha_1 Zf'(n)\delta_S - \alpha_1 PZf''(n)\delta_S\alpha_1 Zf(n)nv'(W)\}$$

$dW/dP > 0$ if $2(\alpha_1 PZf'(n)-\alpha_2 W)f'(n) > \alpha_1 f''(n)PZf(n)$.

$$dW/dm = (1/D_5)\{ [dF_W/dn][dF_n/dm] - [dF_n/dn][dF_W/dm] \}$$

$$= (1/D_5)\{ [2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)][(\alpha_1 PZf'(n) + \alpha 2W)(v(B)-u(0))]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)][-\alpha_2 n(v(B)-u(0)]$$

$$= (1/D_5)\{ \alpha_1\alpha_2 PZf''(n)n\delta S(v(B)-u(0) \} < 0.$$

$$dW/dB = (1/D_5)\{ [dF_W/dn][dF_n/dB] - [dF_n/dn][dF_W/dB] \}$$

$$= (1/D_5)\{ [2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)]$$

$$[(\alpha_1 PZf'(n)-\alpha_2 W)(m-n)v'(B) + \delta_M(-v'(B))]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)][-\alpha 2n(m-n)v'(B)]$$

$$= (1/D_5)\{ -2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)\delta_M v'(B) + \alpha_1 PZf''(n)\delta S\alpha 2n(m-n)v'(B) \}$$

$dW/dB > 0$ if $2(\alpha_1 PZf'(n)-\alpha_2 W) > (m-n)\alpha_{1PZ}f''(n)$.

$$dW/dZ = (1/D_5)\{ [dF_W/dn][dF_n/dZ] - [dF_n/dn][dF_W/dZ] \}$$

$$= (1/D_5)\{ [2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)] [\alpha_1 PZf'(n)\delta_S + (\alpha_1 PZf'(n)-\alpha_2 W)nu'(Z) + \alpha_1 PZf(n)(v(W)-v(B)+u(Z)-u(0)) + \delta_M u'(Z)]$$

$$- [\alpha_1 PZf''(n)\delta_S - 2(1/\alpha_2)(\alpha_1 PZf'(n)-\alpha_2 W)^2 v'(W)] [-\alpha 2nnu'(Z) + \alpha_1 Pf(n)nv'(W)] \}$$

$$= (1/D_5)\{ 2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)\alpha_1 Pf'(n)\delta_S - \alpha_1 PZf''(n)\delta_S\alpha_1 PZf(n)nv'(W)$$

$$+ 2n(\alpha_1 PZf'(n)-\alpha_2 W)v'(W)\delta_M u'(Z) - \alpha_1 PZf''(n)\delta_S\alpha_2 nnu'(Z)\}$$

$2(\alpha_1 PZf'(n)-\alpha_2 W)f'(n) > \alpha_1 f''(n)PZf(n)$ is a sufficient condition for dW/dZ being positive. If there was no disutility associated by delivering a higher effort $u'(Z)$ would be zero and the stated condition would be a necessary condition.

Appendix 6: Preliminary empirical results

Data

The data printed below are from the IMF, International Financial Statistics. The Hungarian data is extracted from the database IMFGES in BESD up to Sept. 1990. The Polish data is from IMFGES and the GUS Bulletin (Statistical Office, Warsaw). The employment index for Poland before 1985 is based on a yearly series from IMF IFS adjusted for seasonal variation using estimates for the period, 1986(1) - 1989(4).

Legend (for both countries)

WAGE = index for average earnings.
CPI = consumer price index.
PPI = producer prices for the industry.
INEMP = index for industrial employment.
INPDN = index for industrial production.

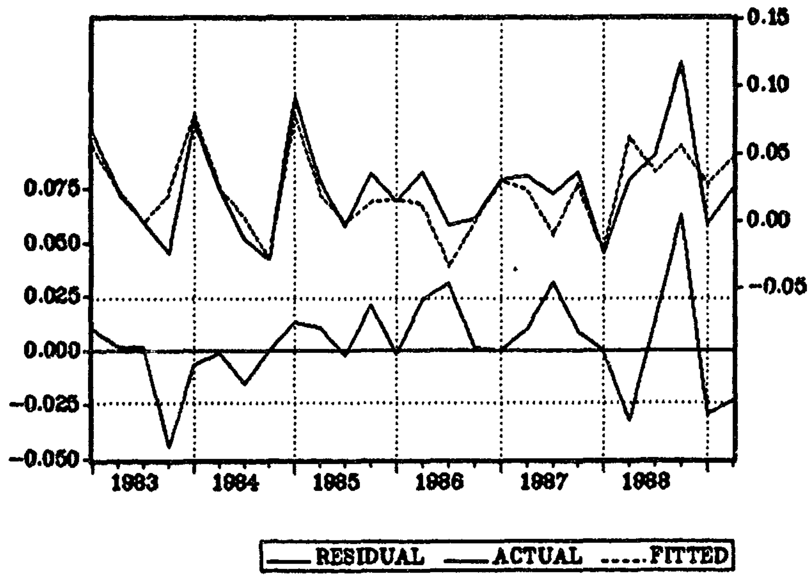
Hungary

obs	WAGE	CPI	PPI	INEMP	INPDN
1982.1	0.817021	0.781467	0.892857	1.036720	0.950820
1982.2	0.818440	0.799846	0.854037	1.038880	0.973588
1982.3	0.812766	0.823429	0.847826	1.037800	0.930783
1982.4	0.784397	0.828660	0.864130	1.032400	0.962659
1983.1	0.837589	0.847112	0.944876	1.008640	0.950820
1983.2	0.857447	0.853103	0.906056	1.012960	0.982696
1983.3	0.857447	0.866523	0.895186	1.014040	0.950820
1983.4	0.837589	0.873712	0.907609	1.018360	0.979053
1984.1	0.900709	0.921399	0.977484	1.001080	0.994535
1984.2	0.921986	0.931943	0.944876	1.007560	1.004550
1984.3	0.909929	0.944884	0.944876	1.011160	0.958106
1984.4	0.884397	0.939851	0.943064	1.015120	1.010930
1985.1	0.969503	0.987778	1.000000	0.997840	0.997268
1985.2	0.999291	0.993769	1.000000	1.002160	1.012750
1985.3	0.995745	1.006230	1.000000	1.003240	0.989071
1985.4	1.031210	1.012460	1.000000	1.006480	1.000910
1986.1	1.046100	1.045770	1.041000	0.993521	0.995446
1986.2	1.084400	1.041460	1.029000	0.995680	1.051000
1986.3	1.081560	1.055600	1.011000	0.995680	0.989071
1986.4	1.082980	1.068060	1.000000	0.998920	1.012750
1987.1	1.116310	1.105440	1.043000	0.975162	1.027320
1987.2	1.154610	1.126770	1.056000	0.973002	1.075590
1987.3	1.178720	1.163670	1.063000	0.967603	1.000000
1987.4	1.222700	1.182600	1.063000	0.969762	1.081970
1988.1	1.193620	1.302660	1.095000	0.947084	1.036430
1988.2	1.230500	1.299540	1.096000	0.943844	1.063750
1988.3	1.292200	1.338370	1.109000	0.941685	0.987249
1988.4	1.454540	1.361370	1.119000	0.944924	1.057380
1989.1	1.451000	1.489190	1.230000	0.918000	1.021000
1989.2	1.486000	1.530330	1.272000	0.910000	1.042000

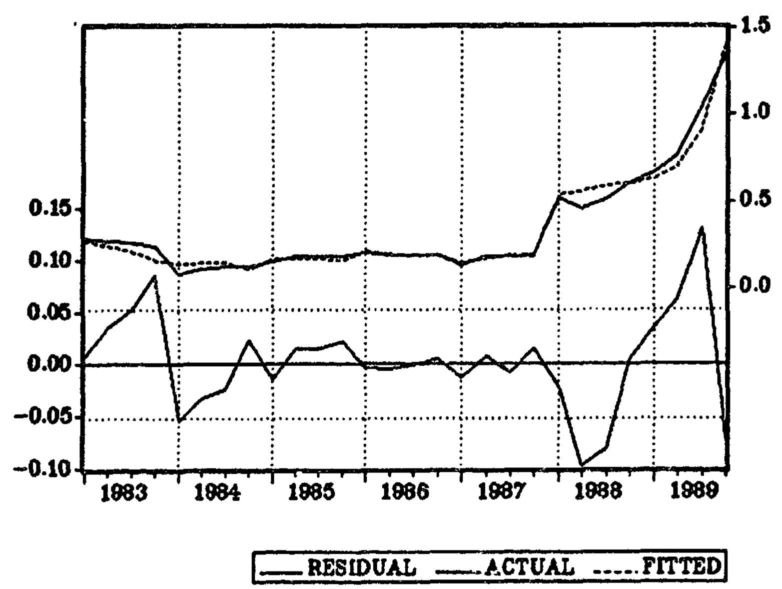
Poland

obs	WAGE	CPI	PPI	INEMP	INPDN
1982.1	0.543000	0.524000	0.652000	1.021840	0.843000
1982.2	0.539000	0.626000	0.652000	1.018810	0.849000
1982.3	0.538000	0.650000	0.652000	1.021780	0.838000
1982.4	0.575000	0.672000	0.652000	1.022000	0.858000
1983.1	0.720000	0.729000	0.752000	1.011840	0.932000
1983.2	0.709000	0.785000	0.752000	1.008810	0.922000
1983.3	0.701000	0.785000	0.752000	1.011780	0.909000
1983.4	0.734000	0.803000	0.752000	1.012000	0.914000
1984.1	0.781000	0.845000	0.861000	1.004840	0.971000
1984.2	0.793000	0.902000	0.861000	1.001810	0.969000
1984.3	0.795000	0.919000	0.861000	1.004780	0.959000
1984.4	0.834000	0.914000	0.861000	1.005000	0.964000
1985.1	0.913000	0.938000	0.963000	0.999840	0.978000
1985.2	0.953000	0.996000	0.969000	0.996810	0.990000
1985.3	0.953000	1.017000	0.979000	0.999780	0.986000
1985.4	1.000000	1.042000	1.000000	1.000000	1.000000
1986.1	1.124000	1.096000	1.126000	1.004000	1.029000
1986.2	1.151000	1.164000	1.130000	1.000000	1.044000
1986.3	1.150000	1.169000	1.144000	1.000000	1.033000
1986.4	1.211000	1.225000	1.178000	1.002000	1.042000
1987.1	1.279000	1.301000	1.409000	1.004000	1.054000
1987.2	1.378000	1.467000	1.418000	0.999000	1.079000
1987.3	1.378000	1.523000	1.439000	0.998000	1.068000
1987.4	1.470000	1.591000	1.492000	0.997000	1.075000
1988.1	2.147000	1.866000	2.028000	0.990000	1.133000
1988.2	2.188000	2.273000	2.142000	0.984000	1.149000
1988.3	2.297000	2.458000	2.233000	0.983000	1.130000
1988.4	2.704000	2.700000	2.384000	0.981000	1.127000
1989.1	4.182000	3.274000	3.432000	0.977000	1.169000
1989.2	4.722000	4.204000	3.751000	0.969000	1.159000
1989.3	6.587000	7.034000	4.528000	0.972000	1.112000
1989.4	10.31700	17.55500	7.456000	0.963000	1.096000

Hungary; estimation of DLWAGE



Poland; estimation of D4LWAGE



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