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Labour partecipation in different firm organizations

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Abstract

The main issue is the organisation of firms when different degrees of labour partecipation are taken into account. We start reviewing the literature on the LM firm. We then consider a less radical labour partecipation, i.e. the Aoki firm. We survey extensions of the Aoki's firm to the case of market uncertainty, where also the question of the optimal allocation of the shut down decision is tackeld, when shareholders are not able to maximize the total payoff accruing to both workers and owners. By and large, it appears that the degree of labour participation to decisions and rent sharing in a firm is not a settled question, even though is seems to depend on the respective degree of firm specificities of production factors.
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1 Introduction

During the last fifty years or more the theory of the firm behaviour has been quite enlarged by multiple research programs aiming at understanding how the market behaviour and the performances of a firm are influenced by: 1) the particular objective function of the firm; 2) the ownership structure of the firm; 3) the degree of labour partecipation to firm decisions; 4) the structure of internal incentives. The first three issues have given rise to a rich literature that concerns all kinds of firm organizations departing from the pure profit seeker-value maximizing firm (PM). The fourth concerns the internal organization of any kind of firm, even though it is by and large cast in a PM type of firm. The PM firm represents actually one of the two polar cases in the spectrum of firm organization. The other polar case being represented by the Labour Managed firm or cooperative firm (LM), where employees own the firm and take all relevant decisions using a democratic voting mechanism. Between these two polar cases there exists an abundant typology of firms sharing some features of either one pole or of the other.

One of the main questions that should be raised as to the firm organization is why one type has prevailed over the other, since causal and statistical observation seem to point to a clear prevalence of the PM firm over its counterpart LM or even over the rich typology of firms in between, with the consequence that we face the absence of the so called "economic democracy" within the firms. Therefore the question is: why don't we observe much economic democracy in the market economies? To this question we are going to devote some part of this work, basing our reply on the existing literature. A second question we would like to address concerns the efficiency of various firms' organizations according to the degree of employees' partecipation to the decisions of the firm. Our point of departure does not take for granted that all decisions associated with the property right of shareholders are taken efficiently. In this issue we do not include the question about "who should control the firm"[1] in terms of the financial assets. On this aspect mainly linked to the core of corporate governance we do not dwell[2].

This work will start with a section on the LM enterprises considering also extensions of the traditional model of Value Added maximization and tradable memberships. Some empirical results on LM firms will also be

[1] Zingales (1997) p.11.

[2] For a survey on this topic, see Shleifer and Vishny (1997).

mentioned as a matter of comparison with PM firms. In the third section we shall dwell on the Aoki model as a prototype of a firm in which employees take part in some decisions, as an intermediate form of partecipation between the LM and the PM firm. In the fourth section we shall consider some particular cases of firms in which employeees share the economic rent of the firm facing uncertain market conditions and having an option to shut down. This last part will be based on some contributions of ours. Some of the questions studied touch the topic of corporate governance, i.e. the way to distribute a rent among factors being able to receive in the firm more than what they would reap outside just because they become firm specific.

2 The LM firm

The LM firm appears in the nineteenth century in market economies. Alfred Marshall (Marshall, 1920, p.110, 191, 545) refers to LM firms as associations of workers based on the principles of mutuality and solidarity, dedicated mainly to agricultural production and to commercial activities (Ireland and Law, 1982; Bonin and Putterman, 1987; Bonin et al., 1993). Despite its democratic and socialist bias the LM firm consolidates its presence only in market economies, i.e. in western countries, like Spain, in the Basque provinces, Germany, England, Italy. The former semisocialist Jugoslavia is the only instance of a noncapitalist country where the LM firm was prospering. In western countries LM firms remain a marginal part of the industrial landscape. In Europe LM firms grow particularly during the 1970's reaching a share of employment of some 2.5% (Ben Ner, 1988). After that the LM firms start to contract slightly even though there is still a notable presence of LM firms in the USA in the plywood industry and in some services (Craig and Pencavel, 1992, 1995). In former socialist countries LM firms were not relevant or even completely absent because of the incompatibility between selfmanagement and central planning. The LM firm has then grown as an economic institution generated by socialist aims in economic systems which were not, by and large, socialist. Despite of that, in many cases, formerly socialist collective firms were run on behalf of workers. As a matter of fact, the scanty attention paid by the students of socialism is, therefore, explained by a general neglect for the theory of the firm. The vacuum has been partially replenished, starting with the contributions of Ward (1958), Domar (1966), Vanek (1970), Meade (1972), to mention just the most outstanding ones. All

these contributions were devoted to the LM firm, where the question of the optimal ownership structure and/or of the optimal allocation of decisions is solved in an extreme way, i.e. exogeneously. Nonetheless, the LM firm is relevant because it represents a benchmark case for all forms of labour partecipation in the decisions of the firm, even though its scarce diffusion is a signal of some intrinsic difficulties. This may be the reason why the LM firm did not become the form of enterprise organisation preferred by the fans of economic democracy.

2.1 The basic model of the LM firm

An LM firm differs from its PM counterpart since it is owned and managed by employees. This has an immediate feedback on the objective function of the LM firm which is the individual value added, i.e.:

$$\max y = \frac{[(p(f(K,L)f(K,L) - rK)]}{L} \geq w\,, \tag{1}$$

where $f(K,L)$ is the concave production function with arguments the capital services and number of employees; p is the market price of output, r the cost of capital and w the market labour wage. We usually assume that $K, L \geq 0$, $f_K, f_L \geq 0$, $f_{KK}, f_{LL} \leq 0$ and linear homogeneity of the technology. The corresponding PM objective function is:

$$\max \pi = p(f(K,L)f(K,L) - rK - wL. \tag{2}$$

First order conditions (FOCs) for the two firms operating in an equal environment are:

$$\frac{\partial y}{\partial K} = p(1 + \frac{dp}{df}\frac{f}{p})f_K - r = 0, \tag{3}$$

$$\frac{\partial y}{\partial L} = p(1 + \frac{dp}{df}\frac{f}{p})f_L - \frac{pf - rK}{L} = 0, \tag{4}$$

and:

$$\frac{\partial \pi}{\partial K} = p(1 + \frac{dp}{df}\frac{f}{p})f_K - r = 0, \tag{5}$$

$$\frac{\partial \pi}{\partial L} = p(1 + \frac{dp}{df}\frac{f}{p})f_L - w = 0. \tag{6}$$

The first two FOCs concern the LM firm, while the second two relate to the PM firm. As it can be seen (4) and (6) differ, while the other two remaining look like the same. The difference depends on the appearance of the individual value added instead of the market wage. Only if the two firms operate in a perfect competition market, i.e. with zero price elasticity and we consider long term equilibrium with free entry and zero profits, conditions (4) and (6) become the same. Individual value added will equal the market wage and all the rent derived by the LM firm membership is swept away by competition. From this result we have a first affinity between a PM and an LM firm, when considered in their long run equilibrium. It is in this circumstance that it becomes irrelevant to establish who hires whom, i.e. whether it is capital who hires labour or the other way round (Samuelson, 1957). Nonetheless, when we consider either the short run or imperfect competition, equilibrium configurations change a lot and we observe either profits or a positive difference between individual value added and market wage. Then the behaviour of the LM firm shows some peculiarities or even some "perversion". Let us consider first how the LM firm responds to market changes in the short run. The LM firm reacts to a price increase in the opposite way with respect to a PM firm. While the PM firm sells more, the LM firm restricts its supply making it downward sloping. The proof of this comes from the application of the implicit function theorem to (4). Then we obtain:

$$\frac{dL}{dp} \propto -(f_L - \frac{f}{L}), \tag{7}$$

where $\propto$ indicates proportionality. Since, with concave technology, the average productivity is always larger than the marginal productivity, we see that, as the market price increases, L decreases and, consequently, the short run supply curve of the LM has a negative slope. If we refer to imperfect competition or to positive profits the LM firm employs a smaller number of members-employees as compared to the PM firm and therefore does not give rise to an efficient allocation of resources. Moreover the LM firm reacts to the variation of fixed costs, unlike what the PM does. By substituting fixed costs to rK, using a term F, in (4) and resorting again to the implicit function theorem we can calculate $\frac{dL}{dF}$. When fixed costs increase, the LM firm adds new members in order to let them share the larger fixed cost.

There are also other "perversities". With imperfect competition and non-increasing returns to scale, in the long run, the level of optimal production tends to zero (Meade, 1974; Pestieau and Thisse, 1979; Landsberger and

Subotnik, 1981). This tendency becomes stronger when the LM firm strategically interacts in a static framework with PM firms (Delbono and Rossini, 1992; Rossini and Scarpa, 1992). It becomes even stronger when the LM firm competes dynamically using capacity as a control variable (Lambertini and Rossini, 1998).

This set of anomalies raises some questions. The first concerns the effective theoretical plausibility of the downward sloping supply curve. The second concerns the empirical validity of theoretical conclusions as to the short run reactions of the LM firm vis à vis its PM counterpart. The third question relates to the marginality and small dimension of most LM firms, since their PM competitors are usually bigger. May this be the consequence of the perverse reactions of the LM firm to market changes? These issues are dealt with in the next sections.

2.2 The short run downward sloping supply curve: other explanations

The adjustment to a change of the market price could take a different route, as compared to the variation of the number of members. For instance, if the number of hours worked per member is considered, the perversity of the LM firm response to market disappears (Ireland and Law, 1982). Yet, when it is no longer possible to resort to the change of the length of the shift the perversity comes back with its entire plausibility. Let us provide an intuitive explanation. The increase in the market price, if followed by a larger quantity supplied, leads to a value of marginal productivity and profit per employee growing less, by concavity, than when profit per employee goes up due to a decrease of the quantity supplied.

However, in all that there is a lot of ambiguity, or, in American, it is a Comma 22. In the literature L is treated the same way as the labour input in a PM firm. But L, in this case, is the decision maker of the firm. Therefore we cannot consider it as an input on which decisions are taken regardless of the opinion of the input itself. Labour is simultaneously the decision maker and the input. This double coincidence lets the LM decision scheme fall apart. To be clearer, it would be as if, in the comparative statics exercises on the PM firm, we were to associate to any variation of the input K a change in the executive board appointed by shareholders. The presumed perversion of the LM firm lies in the ambiguous definition of the labour input, which

cannot be treated the same way as in the PM firm. If we considered labour as the decision maker we should clearly look for other forms of reactions of the LM firm. The variable factor should become capital, even though this is not the case in the short run because of the well known fixity property of capital in the short run. If capital can be leased and therefore become a variable factor with no firm specificity we should be able to find some less perverse response of the LM firm. Consider equation (3). Applying the implicit function theorem, by concavity, we can get:

$$\frac{dK}{dp} = -\frac{f_K}{pf_{KK}} \geq 0. \tag{8}$$

This means that, if we consider that in the short run the membership is fixed and capital can be leased and made quantitatively flexible any sort of perversion disappears and the short run supply curve becomes positively sloped.

Following again the received literature, we find that, if the LM firm operates in a market, where there are random shocks the reaction could be a random reduction of the number of members. Otherwise the LM firm could operate without any random variation of the number of members. Then it will display a rigid supply curve, even though it does not appear quite clear how is that consistent with the existence of a competitive market (Steinherr and Thisse, 1979). An alternative route is the introduction of compensations for those who decide voluntarily (why?) to leave the firm. An extreme extension of this is the introduction of the market for membership, as we shall see later. Another route followed by some literature on LM firms is to assume that the labour force of a LM firm is made partly by members and partly by non-members hired workers. In that case the burden of short run flexibility of the variable input is on the shoulders of hired workers. This allows the LM firm to have a non perverse behaviour and to be more similar to a PM firm, with the difference that the shareholders work in the firm, reducing the principal-agent inefficiency because of easier and cheaper monitoring of the production activity.

2.3 The market for membership: the new theory of workers enterprise

During the first half of the eighties the theory of the LM firm receives a further boost. The innovation comes from the consideration of the market for

memberships which are assumed to be exchangeable and no longer personally characterised. This intuition marks the beginning of the new theory of the LM firm. Nonetheless, most think that it is fairly unrealistic and therefore, they reject the extension. In some contributions (Dow, 1986; Sertel, 1982, 1987, 1991) there emerges that the behaviour of a LM firm may become identical to its PM counterpart if a market for membership is established (workers partnership market). The new definition "workers enterprise" (WE) has been coined by Sertel (1982, 1987) and Fehr and Sertel (1993). As soon as we devise a market for membership and/or partnerships Paretian efficiency is restored and the WE firm behaves as a PM firm also in the case of impefect competition (Sertel, 1991, 1993). Every individual worker can enter (and exit) a WE enterprise simply by buying (selling) an individual right to take part to the production activity and share the rents deriving from it. This right will have a price equal to the discounted sum of individual profits that the firm is expected to get along its future life. This approach can be applied also to the problem of reduction or expansion of the number of members. However, in a LM firm, any variation of the number of members has to be approved by incumbent members. The voluntary quit of a member is possible only if the firm pays the quitter an amount equal to the income flow he would be getting if he stayed in the firm. This deed price corresponds to an indifference point, where an employee is at the same welfare level either if he stays or if he quits with the compensation. A potential entrant would be at the same indifference point. If he decides to enter he will have to pay the same amount the quitter receives. Let us briefly review the Sertel (1982, 1987) model. We consider entry and exit in a static environment. The reservation price of the entering member is given by:

$$P_D(L) = y(L+1) - w, \tag{9}$$

where $y(L+1)$ is the individual value added with $L+1$ members. On the other hand, the loss of any incumbent member because of the new entry is given by:

$$y(L) - y(L+1). \tag{10}$$

The council of incumbents is willing to let a new member join the party if the entrant pays at least:

$$P_S(L) = [y(L) - y(L+1)]L. \tag{11}$$

The LM firm does not expand (*condition of non expansion*) if:

$$P_D < P_S. \tag{12}$$

If we assume that the firm has capital $\widehat{K}$, which is fixed in the short run, then, substituting in (12), we get:

$$\frac{pf(L+1,\widehat{K})-r\widehat{K}}{L+1}+L\frac{pf(L+1,\widehat{K})-r\widehat{K}}{L+1}-L\frac{pf(L,\widehat{K})-r\widehat{K}}{L}<w, \tag{13}$$

or,

$$f(L+1,\widehat{K})-f(L,\widehat{K})<\frac{w}{p}. \tag{14}$$

In a similar manner we consider the *condition of non contraction*, which appears as:

$$P_D(L-1) > P_S(L-1). \tag{15}$$

From which, by using the same procedure, owing to the non-expansion condition we get:

$$f(K,L)-f(K,L-1)>\frac{w}{p}. \tag{16}$$

The left side of (14) may be considered a sort of marginal productivity of labour. The left side of (16) has the same meaning.

These two conditions of *non expansion* and *non contraction* provide an answer as to the non-perversion of the LM firm when new members have to pay to obtain the rent that the LM firm distributes to its members. We actually see that, if the price p increases the constraint in (14) gets more severe, while in (16) gets looser. In (14) marginal productivity, on the left, may decrease, in (16) it may decrease. This can be reached by increasing the level of activity via a higher L. This implies that the two conditions ensure that the LM firm behaves non perversely, i.e. in a way analogous to the PM firm. A more sophisticated version of this model is due to Dow (1986, 1993a). In a subsequent paper Fehr and Sertel (1993) consider the behaviour of two workers' enterprises (WE) with a different internal structure: the discriminatory workers' enterprise (DWE) and the non-discriminatory workers' enterprise (NDWE), to find out the optimal number of members.

In the DWE founding members let new members enter sequentially by price discriminating the membership right. In the NDWE, on the contrary, founding members admit fresh members in one single shot and let them pay the same entry price. Fehr and Sertel (1993) show that, with imperfect labour markets, the two different WE display distinct behaviours. The DWE, like its PM counterpart, employs an efficient amount of labour. On the contrary, the NDWE, not only behaves inefficiently, but hires an amount of labour larger than the one used by its PM counterpart. However, since this quantity does not correspond to any equilibrium situation, there arises an entry process that considers groups of potential members and discriminates over the membership price. This process comes to an end only in the long run when an efficient dimension is reached.[3]

2.4 The market for memberships: some objections

Markets for memberships exist and are not just a theoretical product. In Italy and France it is possible to enter and exit LM firms by trading memberships. The problem is that these markets are not actually well developed and are scarcely competitive. They are mostly managed by the firms themselves with a moderate participation of financial intermediaries. Craig and Pencavel (1992) report that in the American LM firms memberships prices vary between some 40,000 and 90,000 US dollars. The level of these prices points to a non competitive market for memberships letting LM firms appear as a sort of closed shop. However, despite of the existence of markets for memberships, the prevailing tendency appears as one of transforming the LM ownership structure into a PM one. The reason is that it is quite burdensome for a worker to finance its joining a LM firm. Therefore both the LM firm and the entrant workers prefer to expand production by resorting to employees who are not eligible to become members. The LM firm tends to become less cooperative and more similar to a joint stock company organized around a core of initial members who tend to become the next shareholders while working in the firm. This tendency can be observed also in LM firms which are not particularly successful, simply because it is almost impossible for a worker to obtain from a financial intermediary the necessary funds to

[3] In the behaviour of the NDWE, as described by Fehr and Sertel, time does not play any role. It just has a logical meaning, since all decisions collapse in a unique instant of time. Therefore, the entry process is istantaneous even though it considers many blocks of potential entrants.

buy a membership, while it seems much easier for an entrepreneur to get credit to acquire shares of a firm either to let it grow faster or simply to give rise to an aggressive buyout.

We list at least seven reasons why we think that the market for membership is quite imperfect and most of the times simply does not work, provided it exists.

- First. It is quite akward for a worker to provide a collateral to the lender of the funds needed for the membership acquisition. For an entrepreneur sometimes the collateral is provided by what he buys. This is not possible for the LM firm, since what a worker buys is the right to work in a firm and this is an asset contingent on his effectively working.

- Second. Workers investing most of their assets, buying a membership of the firm where they work, end up with a portfolio which is not diversified and this is not consistent with an apparent risk aversion of workers. The ownership structure of the LM which does not allow any efficient diversification has been considered sometimes (Dreze, 1976) one of the major obstacles towards a physiological growth of the firm. Perhaps the LM requires a more efficient ownership structure to avoid the deadends of the non diversification problem.

- Third. Usually the reasoning of a LM member is the following: "If a borrow money to become a member the collateral asset is my membership. However if I decide to quit I give my membership to an investment bank who will sell it to somebody willing to takeover my job". In this case the entire operation for the firm implies loosing a worker and replacing him with somebody else. However the entrant is not chosen by the firm but he is the result of a buying choice by an individual acquiring the right to work in a particular firm. This situation corresponds to a labour market quite far apart from the usual ones. The competitive market works only for the buying and selling of memberships, but absolutely not for the labour to be hired by the firm. Once you have acquired the membership you have your right to work, regardless of any ability or willingness to work you may have. In other words, it is not possible to write down standardised contracts, as in any asset traded in a financial market. Memberships are, after all, personal, unlike shares, which are never so.

- Fourth. Financing a membership acquisition in a LM firm is essentially an investment in human capital, mainly if that happens in LM firms with a low capital intensity or in LM firms which have just begun their activity. Financial intermediaries are often unable to finance human capital because it is not entirely appropriable and, therefore, not exchangeable. Moreover, human capital is often highly firm specific. The degree of irreversibility of human capital investment may, in some circumstances, be fairly high. As a matter of fact the same argument can be used for shareholders and firms since most of the physical capital installed in a firm and most of the intangible capital (brand, design, advertisement stock etc.) is specific and, therefore, sunk.

- Fifth. Workers who want to become members of a LM firm have to gather information as to the future individual value added the firm is able to secure. Clearly this is not easy and, therefore, a lot of asymmetric information may prevent an efficient result in the market for memberships, as devised by Sertel (1982). The insiders or the sellers of the memberships have a better knowledge of future earnings than the entrants. A worker who is hired by a PM firm does not face a similar problem, even though the PM firm does not solve the asymmetry problem. As a consequence the worker accepts a fixed wage that does not require him, most of the times, to know anything about the firm.

- Sixth. If entrants pay the membership at its market price only the founders of the firm will be able to reap a rent or an extra over the market wage, provided they have not invested to obtain the rent (Meade, 1972; Dow, 1986). This again raises the question of why an entrant should risk an asset in the same firm in which he works if he just gets the market wage. This is also one of the main reasons why memberships are sold at a discount.

- Seventh. Severe hurdles are faced by the firm when it tries to grow by increasing the number of members. In that case, the effect on the incumbents may be a downward shift of the market price of memberships, the same way as it happens for a PM firm when it tries to raise capital on the stock exchange. As a consequence there is a neat preference for credit markets.

As a partial conclusion it seems that the market for memberships, when-

ever it works, is far from being an efficient and perfectly competitive market. Just as a matter of record: in some countries legislation limits the degree of exchangeability of membership shares (Zan S., 1982; Zan L., 1990).

A good deal of empirical observation shows that LM firms tend to resort more to the credit market than their PM counterparts (Zan S., 1982). The LM firm is the outcome of an agreement between workers who are not supposed to own capital and, therefore, it needs, from the beginning of its life quite a lot of borrowed funds. The LM firm then results almost always overleveraged. Undercapitalization and excessive borrowed funds make the LM firm more exposed to the risk of bankruptcy, in which a further role is played by a higher moral hazard that the LM firm allows its members to take as compared to shareholders of a PM firm. An additional explanation of that may be that, in many cases, it seems that the consequences of a bankrupt are less burdensome for LM members than for shareholders (Eswaran and Kotwal, 1989).

Despite these considerations we have to emphasize the large difference between the condition of a worker in a LM firm as compared to a PM firm. In the latter firm he cannot influence the management decisions and he has no stake in the property of the firm. In the LM firm there is no hierarchy and the rule, one member-one vote, ensures a democratic management of the firm. However, as we know, every democratic voting system incurs in some inefficiency, as the literature on voting has emphasized. We have then to establish whether the more confortable conditions for workers in the LM firm have a positive effect on internal efficiency or, else, if LM firms have similar problems of control and individual incentives of the PM firm. In that case inefficiency would be the likely result since, in the LM firm, we have to add a more lenghty and complicated decision process.

Even though the management of the LM firm is mostly in the hands of workers through a voting system whereby one member has one vote, there are exceptions to this rule since sometimes the management is delegated to an outsider non member.

2.5 Static and dynamic efficiency of the LM firm: theory and empirical evidence

Leaving aside the institutional considerations we have to see whether the LM firm derives a higher efficiency from the participation of workers to the

decision and property of the firm.

To this aim, we compare statically a LM firm and a PM firm, following Dow (1993a). Take a firm using two inputs K and L in fixed proportions obtaining an output $f(K, L) \geq 0$, for every unit of capital ($L = K$). Assume that production is decided after the realisation of a technological shock h and that there is no risk aversion.

For an employee producing output f generates a disutility $c_L(f, h)$ which is increasing and convex in the first argument. The unitary cost of capital is $r(f, h)$ increasing and convex in f. The price of output is, for simplicity, equal to 1. The surplus function appears as:

$$s(f, h) \equiv f - r(f, h) - c_L(f, h). \tag{17}$$

In the case of a PM firm the owner is the *residual claimant*, i.e. he gets all what remains after having paid the workers at a fixed market wage w that does not vary from state to state, since it is not contingent on the realisation of any shock h. Once the shock has been realised f is chosen by the owner according to the rule:

$$\max_{f \geq 0} f - r(f, h) - w, \tag{18}$$

with the partecipation constraint for the worker:

$$w - c_L(f, h) \geq 0. \tag{19}$$

We can then define different levels of production for any pair of state/wage $f(w, h)$. The owner will chose ex-ante the optimal wage as a result of the maximization of the *expected profit*:

$$\pi_K \equiv \max_{w \geq 0} E\{f(w, h) - r[f(w, h), h] - w\} \tag{20}$$

In the states in which the participation constraint is binding, the wage level determines the output, otherwise it determines the surplus going to labour.

Let us see the payoff that can be obtained by maximizing, ex-post, the *social surplus* (W^*) over all states:

$$W^* \equiv \max_{f \geq 0} E_h\{f^*(h) - r[f^*(h), h] - c_L[f^*(h), h] \tag{21}$$

Dow (1993b, p.181) shows that $\pi_K < W^*$ if the disutility c_L varies from state to state. Since w does not depend on the state and therefore on the

output, the owner does not internalize the disutility of the employee when he chooses the level of production. Therefore the PM firm does not produce the socially optimal output that maximizes (21). Once the fixed wage constrains labour participation it ends up also by limiting total firm profits. This does not happens in the LM firm as workers share the residual in any state of the world, since they are not paid a fixed wage independent of the state. The participation constraint never bites and the surplus can be maximized. As a consequence, there is no choice of the wage ex-ante, yet only of the output which is chosen in each state according to the rule:

$$\max_{f>0} f - r(f,h) - c_L(f,h). \tag{22}$$

The LM firm is therefore statically efficient, while the PM firm is not, because of the inflexibility of the wage over the states that does not allow a proper consideration of work effort and this constrains the social surplus.

Things change in a dynamic framework. If we consider the investment of a LM firm we find an insufficient incentive due to the reason seen when considering the market for memberships. The tendency of memberships to be sold with a discount, in a sort of "*backwardation*" is one of the main reasons of underinvestment and of the marginalization of the LM firm in the long run. The long run race between the PM firm and the LM firm is definitely won by the PM firm.

2.6 Some conclusions on the LM firm

We are now equipped to draw some conclusions as to the marginality of the LM firm in our economies. The LM firm surely satisfies the needs for economic democracy as to the decision making process, despite complications arising in the implementation of a voting system and because of the heterogeneity of employees (white collars versus blue collars) that may pollute the one member-one vote system (Hansmann, 1990). However, the LM firm is at a disadvantage in growth, since two sets of factors hinder it. On one side its tendency to hire non-member workers establishes a tendency of the LM firm to become a PM firm organised around the core of founding members. On the other hand the quasi-impossibility to set up an efficient and competitive market for memberships makes it impossible for members to have a temporal horizon similar to the one of a PM firm shareholder.Taking part in the property and in decision making within the LM upsets the individual in-

centive structure. Consequently, the monitoring of individual effort becomes less akward than in a PM firm. However, free riding problems remain quite crucial and they make hierarchical control sometimes necessary. In that case it may be more difficult to set up than in a PM firm (Guesnerie and Laffont, 1984) because the controllers are the controlled. As a matter of fact, opportunism does not seem to play the same role it plays in a PM firm (Alchian and Demsetz, 1972). The ricurrent confrontation, that emerges within the PM firm, as to the distribution of the rent produced by factor specificties does not seem to be possible within a LM firm. Therefore, the social conflict appears as completely absent within the LM firm making it quite a stable social organization of productive activity.

The empirical evidence on LM firm performances is not very rich. Nonetheless, some answers have been given recently as to the presumed perversions of the LM firm and its market performances (Craig and Pencavel, 1992, 1995; Pencavel and Craig, 1994). Some results are worth noting. First of all, there is no evidence of the supposed downward sloping supply curve, in the short run. It actually appears that the LM firm has a supply curve which is more rigid than its counterpart PM firm because the LM firm tends to increase wages when the price of the output goes up. The effect of this is definitely an allocative inefficiency but also a greater stability of employment over the cycle, since, when prices go down, adjustment is born by workers incomes. We may therefore maintain that the LM firm has the objective of both maximizing the individual value added and to keep a stable level of employment. This is the result of the decision process in which take part also those who are the candidates to be fired. Their participation makes their dismissal less likely. This has a consequence also on the mortality and ability to survive of LM firms vis à vis the PM firms. The few empirical analyses show that LM firms tend to live longer (Ben Ner, 1988) regardless of market structure.

As far as the effect of the LM internal organization on productivity is concerned, other empirical investigations (Craig and Pencavel, 1995; Estrin *et al.*, 1987; Lee, 1988) provide a differentiated answer. Most of the analyses estimate production functions with a disembodied effect of labour participation. As a matter of fact there seems to be a gap, even though not so large, between the productivity of LM firms and their PM counterparts, with some advantage for the LM firms. An analysis confined to Italian LM firms (Estrin, 1991) appears quite inconclusive. A similar result is reported in Lee (1988), who studied Swedish LM firms. Berman and Berman (1989) examined marginal productivity in PM and LM firms in the plywood industry

in the USA, without finding any significant difference. An inconclusive, yet interesting result can be found in Conte and Svejnar (1988) on the effects of different participation schemes of employees in USA. They find positive allocative effects when labour participation is less radical than in the LM firms, which, then do not appear as the most efficient organisation of employees participation. Recently, two contributions (Piesse *et al.*, 1996; Smith *et al.*, 1997) have cast a pessimistic shadow on the desirability of LM enterprises mostly when compared with firms privatized and sold to foreigners in Eastern European countries. Sometimes it appears that LM firms in the agriculture sector are more efficient just because they are bigger and enjoy economies of scale which cannot be reached by small private farms which are the result of reforms.

By and large the empirical literature finds a tiny advantage for the LM firm in terms of internal incentives and, therefore, productivity. This advantage is not able to compensate the disadvantage the LM firms have in the long run because of their inability to grow as LM, i.e. without becoming a PM firm. The chronic undercapitalisation of the LM firm is not adequately underlined in empirical studies. The productivity advantage explains why in some cases the LM organisation is seen as the *extrema ratio* of firms near to shut-down. Unfortunately, most of these "experiments" end up with the demise of the firm, since the higher labour productivity is never a guaranty for better market performance of a firm.

The crucial problem for a LM firm appears in the long run, when the financial aspects of growth, the existence and/or the efficiency of the market for memberships seems to press the LM firm towards another organizational form, i.e. the PM (Vanek, 1977).

A great bundle of literature has analysed, since the early 1980's the performance of collective and state Chinese firms. Collective firms can be partially assimilated to the LM firms even though memberships are not tradable. Despite of that they seem to have contributed quite a lot to the rocketing growth rates of China in the last twenty years. These firms do not seem to be quite constrained in their capital and liquidity needs since they get loans and priviledged credit facilities from state enterprises and state banks (Chow and Fung, 1998) and appear therefore quite apart from the LM firms we are concerned with.

3 Profit and decision sharing: the Aoki firm

One of the firm organizations that is located between the two polar cases represented by the PM and the LM firm is the so called J firm, or Japanese firm, or Aoki firm. In this firm workers participate to many decisions of the management and share profits, but they do not have any stake in the property of the firm, which belongs to shareholders. Despite the ownership structure of the Aoki firm, there are many similarities with ESOPs (employee stock ownership plan) in which workers possess some or the entire capital of the firm but not in the uniform proportion as in the LM firm. A similar firm organization has been proposed by Komiya (1987) and is a first step towards Aoki's model, despite its later birth. The firm behaves almost like a LM firm. It decides the labour input, the investment policy to maximize the value added per employee, after having paid a fixed share of profits to shareholders. This firm faces some of the problems of the LM firms seen above. However, it keeps most of the opportunities of the PM firm since it has shareholders who receive a profit which is fixed in terms of share but is state contingent. There remains to be seen how the share of profits going to shareholders is set. This is the question on which the Aoki model seems more interesting. Here the share of profits going respectively to shareholders and workers is bargained upon simultaneously with growth and other strategic variables.

Aoki's firm is a joint organisation of employees and shareholders who are capable of giving rise, with their reciprocal collaboration, to surplus or rent with respect to what they would be able to command by operating in a disjoint manner on the market or in other firms or different organisations. This surplus is denominated by Aoki *organisational rent* and is generated by an association between workers and firms that links workers to the firm because of their specialization acquired within the firm. This implies that the human capital accumulated by workers and financed by the firm makes them firm specific. As a consequence, within the firm there arises a market for specific factors. This market is highly imperfect and prices are set by a bargaining process through which an equilibrium can be reached when neither of the contenders can expect to be able to increase her utility without incurring any risk of breakdown. In the PM firm the distribution of the rent generated within the firm takes place by referring to what the market dictates in terms of collective (nationwide, countrywide, areawide and so on) contracts. In this case the external market sets only the reference level

of the wage which does not include any rent. Whenever we consider also the supplementary contracts signed at firm level we may introduce some form of rent sharing only if the extra wage included is contingent upon the performance of the firm. In the Aoki's model the bargaining process involves also strategic decisions, i.e., market and growth policies. In this sense the labour participation is far broader than the one considered in Weitzman's contributions (Weitzman, 1984).

Let us now consider the main features of the Aoki's model (Aoki, 1980, 1984, 1994). Assume we have a firm whose specific market demand is given by:

$$x = \alpha p^{-(1/\eta)} \quad \text{with } 0 < \eta < 1 \text{ e } \alpha > 0, \tag{23}$$

where α represents the state of the economy and x the quantity sold. A higher α indicates a larger demand for the firm product. η indicates the inverse price elasticity of demand or the degree of monopoly and/or the specificity of the firm vis à vis the competitors. Assume that the firm has a growth expenditure function defined as:

$$G = \varphi(g), \tag{24}$$

where G represents the average unitary expenditure for unit of good sold necessary to support the growth rate g. This function is monotone, convex and increasing. In other words, if we wish to grow faster we have to augment growth expenditure more than proportionally.[4]

Employees are homogeneous and receive a benefit:

$$w = \overline{w} + \Delta w, \tag{25}$$

where $\overline{w}$ is the market wage and Δw represents the *premium earning* linked to the labour participation to the firm's profits. This residual, due to the partecipation in the *organisational rent*, is an endogenous variable in the model. Taking into account all these features, the profit, or *organisational rent* after the payment of growth expenditure, is given by:

$$\pi = (p - c - G)x, \tag{26}$$

[4] Aoki also assume that growth expenditure is completely financed by current sales revenue without issuing new equity.

where the unitary labour cost is $c = \overline{w}$ and there are not other operating costs. Defining θ the share of profits going to shareholders, the average premium earning for employee is:

$$\Delta w = \frac{(1-\theta)\pi}{Lx}, \quad \text{for } 0 \leq \theta \leq 1, \tag{27}$$

where L indicates the number of labour units needed for a unit of product. We confine ourselves to the case in which we have a fixed number of employees which is higher than the number of workers necessary to produce the quantity of output demanded, i.e $N \geq L$, and we assume that, in the short run, there are *no-layoffs.* Then the price set by the firm will be:

$$(x_{\max}^{\alpha})^{-\eta} \leq p \leq (\frac{N}{\alpha L})^{-\eta}, \tag{28}$$

or, in terms of the produced quantity:

$$(\frac{N}{L}) \leq x \leq x_{\max}. \tag{29}$$

It is assumed that the emplyees are interested in the amount of their *lifetime earning at the employing firm.* Therefore, assumimg stationarity for the firm and indicating with H the expected duration of the time spent by an employee at the firm, the extra-wage or the lifetime earning an employee can get is given by:

$$\Delta w \left\{ 1 - (\frac{1}{1+\rho})^{H} \right\} / \rho \ , \tag{30}$$

where ρ is the discount rate or the cost of capital. From (30), the levels of lifetime well-being of emplyoees may be odered according to current premium earning Δw. In particular, the total premium earning for the exisiting employees can be indicated as:

$$W = \Delta w N. \tag{31}$$

On the other hand the objective of shareholders is to maximise the value of the firm. Assuming absence of market uncertainty, the arbitrage condition on the financial market requires that the competitive value of the firm S satisfies the following condition:

$$gS + \theta\pi = \rho S \, , \tag{32}$$

where $\theta\pi$ are the dividends at the end of current period, and gS indicates the expected share-value appreciation.[5] Rearranging we obtain:

$$S = \frac{\theta\pi}{\rho - g}. \tag{33}$$

The shareholders are interested in having the larger value of S in the current share market.

The firm has to decide the market price p implicit in the employment level, the growth rate g and the share parameter for the profit distribution θ. For given values of p and g there will be associated a level of organisational rent π which can be allocated between the shareholders and the employees. Using (27), (31) and (33), this allocation can be represented by straight line trade-off relation between S and W. Moreover, by considering all possible pairs of g and p satisfying previous constraints on output (28), we shall get several trade-off relations in the space (S, W). The envelope of these straight lines represents the *bargaining possibility frontier:*

$$S = \psi(W). \tag{34}$$

In the figure we have many frontiers in the space (S, W), each relative to a particular pair (p, g). The envelope curve says that for each pair (p, g) we have only one efficient combination of (S, W), i.e. only one θ. Referring to the definition of average premium (27), the two intercepts in figure 1 provide the two extreme situations: the LM firm on the horizontal axis and the PM on the vertical axis.

The shape of the frontier depends on an asymmetry which exists between shareholders and workers as to regards the growth of the firm. Shareholders gain from the growth of the firm financed by the cash flow, because this implies an increase of the value of the firm and therefore a net benefit. Employees associate with the growth of the firm new workers hired by the firm and therefore a reduction or at least no increase in their profit share. In other words we again face the familiar question about the durability of the property by shareholders vis à vis the one of workers. Shareholders property can be extended to an infinite horizon, while workers have a right to get a

[5] Aoki assumes that investors replace their uncertainty about future evolutions of dividens by a simple rule of stationarity. That is, they believe that, on average, the current firm's performances will continue indefinitely. With this assumption, the expected rate of share-value appreciation will be equal to the current rate of growth g.

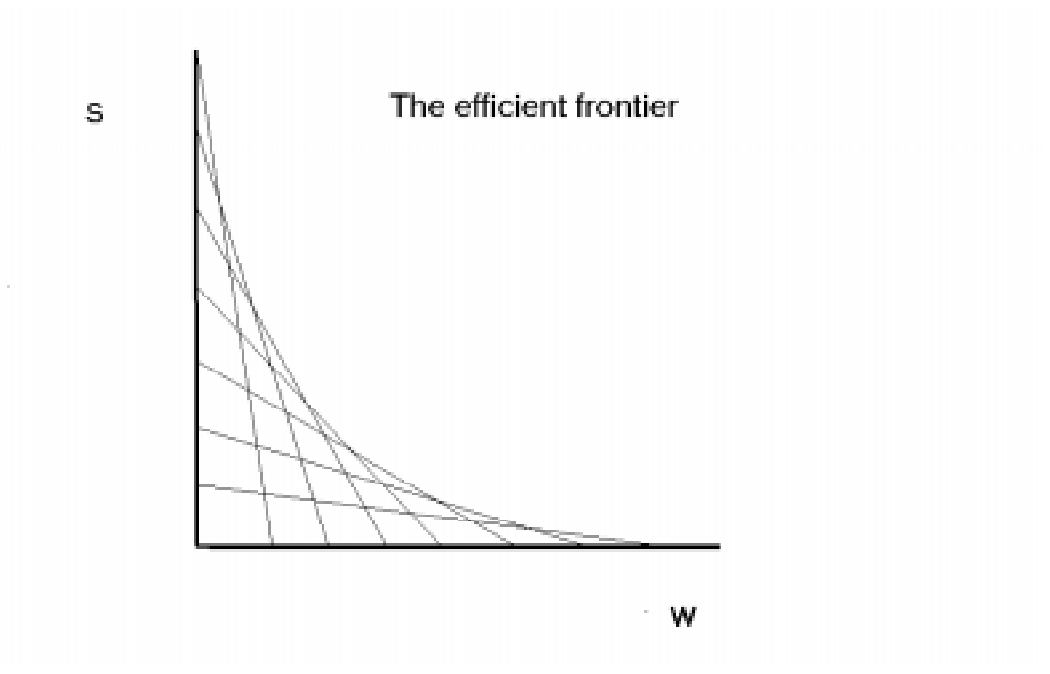

Figure 1:

share of profits which has to be referred to the number of workers and to the the time each worker will spend at the firm. The share of profits going to an individual worker appears then physically limited by his staying at the firm while for a shareholder there is no limit of this kind. Workers would like to support a suboptimal investment as a result of a market failure internal to the firm. This failure does not allow the employees to reap the entire benefits that are brought up by the investment over future periods (Hart and Moore, 1990). As we know, the remedy for this failure is the pure PM firm, which, on the other hand, does not represent a first best, due to the static inefficiency seen above.

3.1 The bargaining process in Aoki

Workers and shareholders have a reciprocal interest to write down a contract. Otherwise they both loose any benefit deriving from the rent they get by joining their efforts. As a matter of fact, the Aoki's model finds its justification in the specificity of both factors of production. Both contenders can enact threats. Workers may let the value of the firm decrease in case no agreement is reached. Shareholders may let workers miss the opportunity of sharing a rent they are not able to reap on the external labour market. In the Aoki firm the neoclassic sequence is reversed. At the beginning the strategies of the firm are chosen (price and growth rate). Then the distributive parameter that regulates the profit distribution is bargained upon and decided. In the PM firm the sequence changes, since distribution rules are given by the market through a fixed wage. Strategic decisions are taken once the distribution of value added coming from the market is known.

Using the *Nash Bargaining Solution* (NBS) concept as formulated by Harsanyi (1956, 1977) and extended by Rubinstein (1987), a joint objective function of workers and shareholders is maximized with respect to the distributive parameter θ, instead of renegotiating every time market conditions change. The organizational equilibrium of the firm is characterized by a stationary condition of the weighted sum of W and S, where the weights are the respective *boldness* of the two contenders (Aumann and Kurz, 1977, p.1147), defined as follows:[6]

[6] In words, $B_u(W)$ is the reciprocal of the marginal risk premium needed to compensate the employees for risking an infinitesimallly small probability of internal conflict when the the total earnings are W. The same interpretation holds for $B_v(S)$ (Harsanyi, 1956).

$$\frac{u'(W)}{u(W)-\widehat{u}} \equiv B_u(W) \quad \text{and} \quad \frac{v'(S)}{v(S)-\widehat{v}} \equiv B_v(S), \tag{35}$$

where u and v are the utility functions respectively of workers and shareholders and $\widehat{u} = u(\hat{W})$ and $\widehat{v} = v(\hat{S})$ are the levels of utility the two contenders would get in case of no agreement. The total premium earning as well as the value of the firm in a situation of conflict could be zero at worst. Aoki does not restrict possibilities to this extreme case and allows $\hat{W} > 0$ and $\hat{S} > 0$.

Then the simplest way to proceed is to use the weighting method where "*the manager of the firm mediates internal distributional claims and formulates managerial policies in the direction of increasing:*

$$B_u(W)W + B_v(S)S \tag{36}$$

i.e., *increasing the weighted sum of total earning of the exisiting employees and the share value of the firm, with the respective measures of parties' boldness $B_u(W)$ and $B_v(S)$ as parametric weights"* (Aoki, 1984, pp. 72-73). Using the definitions of $\Delta w, W, S$ and differentiating with respect to θ, we get:

$$\frac{B_u(W^*)W^*}{1-\theta^*} - \frac{B_v(S^*)S^*}{\theta^*} \left\{ \begin{array}{c} > \\ = \\ < \end{array} \right\} 0 \quad \text{for} \left\{ \begin{array}{c} \theta^* = 0 \\ 0 < \theta^* < 1 \\ \theta^* = 1 \end{array} \right. \tag{37}$$

or, for $0 < \theta^* < 1$:

$$\frac{1-\theta^*}{\theta^*} = \frac{B_u(W^*)W^*}{B_v(S^*)S^*}, \tag{38}$$

where the asterisks indicate the equilibrium values. The implication is that the share of profits going to each contender is directly proportional to her respective boldness.

We have to investigate now two aspects of the Aoki firm to better understand: 1) when the solution (38) can be adopted; 2) the market behaviour of the firm.

Consider the first question. Relation (38) determines the equilibrium value of profit distribution between shareholders and employees, without determining before equilibrium values of p and g. These can be set after having chosen the optimal θ. This operation is justified only in a particular case, i.e., if the *pure boldness of contenders* is costant (CPB). The *pure boldness*

is a transformation of the *boldness.* It can be obtained by dividing it by the absolute risk aversion index of Arrow-Pratt, $-u''/u'$, i.e.:

$$\xi_u = \max\left\{\frac{-(u')^2}{u''(u-\hat{u})}, 0\right\}, \tag{39}$$

and by sequentially integrating:[7]

$$\log u(W) = \frac{\xi_u}{1+\xi_u}\log(W-\hat{W}) + C_u, \tag{40}$$

with C_u as the integration constant. Simmetrically, for the shareholders we get:

$$\log v(S) = \frac{\xi_v}{1+\xi_v}\log(S-\hat{S}) + C_v. \tag{41}$$

The two utility functions of (40) and of (41) are functions with constant *pure boldness.* By substituting them in (38) we can write the optimal distribution as:

$$\frac{(1-\theta^*)\pi^* - (1-\hat{\theta})\hat{\pi}}{\theta^*\pi^* - \hat{\theta}\hat{\pi}} = \frac{1+\xi_v^{-1}}{1+\xi_u^{-1}} \equiv \xi, \tag{42}$$

where $(1-\hat{\theta})\hat{\pi} = (Lx^*/N)\hat{W}$ and $\hat{\theta}\hat{\pi} = (r-g^*)\hat{S}$ are, respectively, the employees's and shareholders's share of the organizational rent in case of no agreement. From (42) we see that the distribution of profits depends on the contenders's boldness. Solving for Δw we get:

$$\Delta w = (\frac{\hat{W}}{N}) + \frac{\xi}{1+\xi}(\frac{\pi^*}{Lx^*} - \frac{\hat{\pi}}{Lx^*}). \tag{43}$$

The extra wage employees get is equal to the gain workers get without the agreement, plus $\frac{\xi}{1+\xi}$ times the productivity gain that is brought about by cooperation. If $\hat{W}$ and $\hat{S}$ are equal to zero it means that the lack of agreement leads to zero gain for the two contenders. Then we have the solution:

$$\frac{1-\theta^*}{\theta^*} = \frac{1+\xi_v^{-1}}{1+\xi_u^{-1}} \equiv \xi. \tag{44}$$

[7] See Aoki (1984) p.76.

The shares going to workers and to shareholders do not change as decisions of the firm on market price and growth vary, if we have CPB and outside options equal to zero. CPB functions are a subset of constant relative risk aversion functions (CRRA) for which the index of relative risk aversion of Arrow-Pratt is constant. In particular, assuming $u(W) = W^{1-R}$ as the workers's utility function and $v(S) = S^q$,as the shareholders's one, with $0 \leq R < 1$ and $0 \leq q < 1$, the *pure boldnesses* become respectively $\frac{1-R}{R}$ and $\frac{q}{1-q}$, and the solution (44) reduces to:

$$\frac{1-\theta^*}{\theta^*} = \frac{1-R}{q}. \tag{45}$$

Moreover, it is interesting to see what happens if shareholders are neutral to the risk of internal conflict. In this case ξ_v tends to ∞ and (44) becomes:

$$\frac{1-\theta^*}{\theta^*} = \frac{1}{(1+\xi_u^{-1})}. \tag{46}$$

Workers can enjoy a surplus on the market wage. However, if workers are very much risk averse ($\xi_v < 0$) the entire gain of cooperation goes to shareholders (*neoclassic firm*).

Finally, let us consider the *second* question concerning the market behaviour of the Aoki firm, i.e. the choice of strategic variables p and g. From the behaviours of these variables there emerges some question about the efficiency of labour participation in firms decisions. It can be shown (Aoki, 1984; p.78-81) that an increase in the boldness of workers tends to increase the market price set by a monopolist. At the dynamic level the Aoki firm responds to an exogeneous price increase by growing faster than the corresponding PM firm, only if growth does not require an increase in the number of workers. If the growth of the firm requires more workers growth has a perverse effect since it makes the Aoki's firm growing slower than the PM firm. This reminds us of the dynamic inefficiency of the LM firm.

Another inefficiency arises when the cost of capital increases. When there are fixed costs the Aoki's firm tends to transfer to consumers the higher cost. The price shows a sort of downward rigidity each time either the workers's boldness or the cost of capital increase.

3.2 Profit sharing: empirical results

The set of empirical analyses undertaken on profit sharing is quite large. There are many studies which try to assess the crucial question about profit sharing, i.e., whether it improves productivity or not (OECD, 1995). Biagioli (1995) investigates the productivity issue in Italy and finds a positive effect enhancing firm performances. An akward question concerns the causality link, i.e. whether it is good firm performances causing profit sharing or the other way round. FitzRoy and Kraft (1987) try to establish the direction of causality, but no conclusive answer seems to come out. On the contrary, Kruse (1992) is even able to measure the productivity gains of profit sharing. He finds that, in the USA, for manufacturing firms, the advantage is about 7-9% in productivity terms, while in non manufacturing sectors is about 10-11%, when the profit sharing is extended to 100% of the employees. Partial profit sharing, i.e. non extended to the entire labour force of the firm, is not considered, even though it is quite common. Brunello (1991) does not find any evidence of the positive effect of profit sharing on firm performances, when he focuses on a group of Japanese firms. These are just some analyses of the effect of profit sharing on firm performances. By and large it must be recognised that the empirical literature attributes a positive role to profit sharing. However, we still lack any systematic analysis of profit sharing to know the typologies of firms and industries where profit sharing is more common and where it is conducive to the best results. For instance, we wonder whether it is most suitable for profit sharing a firm with capital intensive production processes or with more labour intensive ones; with more or less competitive product markets, with higher or large dimension etc.. The lack of answers on these themes is also on the theoretical ground. We shall see in the next section some attempts to clarify theoretical aspects of profit sharing when we consider firms with different degrees of factor specificities. Before closing this section we have to mention some results of participation of workers to the firm property. This is the case of ESOP schemes (Employees Stock Ownership Plan). Recent studies show that these schemes may enhance productivity, as the profit sharing schemes, with productivity gains between 2% and 5%. In a cross sectional analysis of Japanese firms Jones and Kato (1995) find that the effects on productivity of ESOP schemes is not immediate, but it takes some 3-4 years to show up. The implication is that these schemes may be useful when the labour mobility is limited and the association of workers to the firm has a quasi permanent character as in Japan until mid

1990's.

A comparative analysis of the effects of different kinds of participation has been conducted by Conte and Svejnar (1988) with some surprising results. By comparing firms where participation takes place at different levels, i.e. management, profits, stocks, there results that the best outcome, in terms of firm performances, come when participation does take radical shapes. In other words, *there seems to be an optimal level of participation of workers, beyond which the firm loses efficiency.* We then distinguish between direct and indirect participation to the firm decisions. Best results come with the indirect participation. This appears quite crucial since we may be able to enucleate among the many forms of participation those who are preferable, according either to the objective that the firm pursues or to a principle of allocative efficiency.

4 Participation and different degrees of specificity under uncertainty

The Aoki model represents, from a theoretical standpoint, the most complete interpretation of profit sharing schemes. The importance of profit sharing grows as factors become more specific. In these cases the market value of a firm is higher than the value of physical and intangible assets, since the factor specificity is an asset that may not be adequately accounted for (Mailath and Postlewaite, 1990). In some cases workers give rise to networks or teams which cannot be substituted by labour force to be hired on the market. We know that the market wage equals the marginal productivity labour can command in alternative jobs. If the firm pays workers the market wage workers do not get any reward for their portion of human capital which is firm specific. In these cases it is difficult to figure out firm organisations differing from the profit sharing of the Aoki type. The main problem of the Aoki's firm is its rigid behaviour when facing market changes.

In a series of papers (Moretto and Rossini, 1995, 1996, 1997a, 1997b; Moretto and Pastorello, 1998) this question is dealt with in a new environment where market uncertainty is introduced and the firm is defined as a continuous series of options to produce.

Market uncertainty modifies many aspects of the organisation of the partecipated firm. Three distinct aspects are considered: a) Market uncer-

tainty affects the distribution of the rent when the firm has some flexibility since it can shut down if market conditions are very adverse. b) There are imperfections in the internal market for labour, in case of firm specific factors. In that case a factor may assume a dominant position. In addition, if it owns a set of "non-contractible" decisions, this dominance looms larger. These imperfections can be reduced by introducing some form of regulation of the bargaining timing. c) The traditional allocation of some decisions linked to the shareholders property rights is not optimal in all circumstances. This makes necessary some form of decision redistribution to restore efficiency. This issue partially belongs to the bunch of questions relating corporate governance, i.e., the mechanisms to allocate the internal rent of the firm among owners of specific factors.

We consider in more detail these three topics.

4.1 Market uncertainty, inertia and profit sharing

Recent literature, sarveyed by Pindyck (1991), Dixit (1992), Dixit and Pindyck (1994, 1998), has emphasized the role of uncertainty in two fundamental aspects of investment and firm decisions: 1) The irreversibility of many decisions, especiallly those concerning the size of the firm and, 2) The possibility of postponing decisions keeping the opportunity of adopting them in later more favorable circumstances. The association of sunk costs, i.e., specificity, with uncertainty explains many hysteresis phenomena, i.e., the persistence of a phenomenon when its cause has disappeared or even reversed. Firms, for instance, do not exit at the Marshallian points, but only when the price goes much below the average variable cost, at a "trigger" price which is endogeneously set. In this context a firm akin to the Aoki one is being introduced. The question faced in Moretto and Rossini (1995) is about the effect of the external uncertainty on the profit sharing parameter. The existence of profit sharing modifies the trigger price at which the firm decides to exit with respect to a normal PM firm. The problem is to find an optimal level of the sharing parameter which is jointly optimal for employees and shareholders, i.e., a Nash bargaining solution. Shareholders enter the bargaining over the share parameter with an advantage since they possess a decision set which contains the one of workers as a subset. In particular they can decide to close the firm. This has a major implication since it means that shareholders can use this decision as a weapon to give rise to a threat, whose credibility is effective, since it is the result of an optimal program. Both contenders have

access to the same set of information as to market uncertainty. They have the same degree of risk aversion towards the risk of open conflict. Workers are represented by an expected utility function defined over the domain of all expected values of dicounted flow of the extra wage they get over their time period spent at the firm. Shareholders maximise the expected present value of the firm. The value of the firm is defined taking into account the option value of the opportunity to shut down, which is controlled by the shareholders. The results implicit in the Nash solution of the bargaining are quite interesting. For instance, the optimal exit price, or trigger price depends inversely on the parameter defining the willingness by workers to share, not only profits, but also losses. The higher this parameter the longer the firm lives. This parameter contributes also to enhancing the value of the firm. For workers things are different. An increase in the loss sharing parameter may, in certain circumstances, increase their lifetime earnings. As a result it appears that there is an optimal value for the parameter of loss sharing. But this does not coincide for the two contenders, even though low levels of the loss sharing parameter may be beneficial for both contenders.

When the option to close can be exercised by the shareholders it works as a credible threat, with the result of shifting the parameter indicating the share of profit going to the owners in their favor. This happens independently of the magnitude of the parameter of loss sharing. If this parameter is reduced, the power of shareholders increases since the shut down threat becomes stronger with an effect on profit distribution. The main conclusion of this approach is that market uncertainty modifies the distributive result of Aoki. Profit shares are, therefore, no longer proportional to the boldness of contenders. An asymmetry emerges due to the decision advantage shareholders have, since they decide the shut-down.

Let us now consider the main features of the model. We consider an incumbent firm which exhibits a constant-returns-to-scale technology and is endowed with a capital stock of infinite life. Each period the firm produces one unit of output. Marginal and average costs are equal to c. The labor force is, for the sake of simplicity, normalized to one. The internal organization of the firm is shaped by profit sharing between workers and shareholders according to Aoki's scheme. Then the extent of profit sharing is the result of bargaining between a shareholders's representative and a workers's representative.

The firm faces two kinds of uncertainty. One is concerned with its internal organization and relates to the risk of *internal conflict*, whilst the other

is exogenous and concerns the *market price,* which we assume driven by a geometric Brownian motion (random walk in continuous time):

$$dp_t = \alpha p_t dt + \sigma p_t dz_t, \qquad \text{with } \; p_0 = p \text{ and } \sigma > 0, \tag{47}$$

where dz_t is the increment of a standard Wiener process, uncorrelated over time and satisfying the conditions that $E(dz_t) = 0$ and $E(dz_t^2) = dt$ (Harrison, 1985; Dixit and Pindyck, 1994).

The organizational rent, or operating profit, at time t is:

$$\pi(p_t) = p_t - c \ , \tag{48}$$

when the firm is working and zero if it decides not to produce. The price assumption is the first departure from the original Aoki's model, where the firm is assumed to face no market uncertainty but only an internal organizational uncertainty.

The second departure implies that the firm can shut down in the future, if market conditions require it, by paying laid off workers a bonus equal to K. This represents the entire *sunk cost.*[8] As there is an opportunity cost of abandoning now rather than waiting for new information, the firm does not exit if today's price is just below the average variable cost. It is optimal to exit only if the price falls below a trigger level $p_L < c$, which has to be endogenously determined by considering future expected opportunities *vis à vis* the sunk exit cost (Dixit, 1989). This flexibility has no counterpart on the workers's side, since they are associated with the firm and are not supposed to quit because outside opportunities are rationally less appealing.

Many different types of profit sharing schemes can be figured out, cash-based or share-based. We simply assume that payments are conditional on current profits and workers share profits and losses symmetrically.[9] Therefore as in (25) we set:

$$w_t = \overline{w} + \Delta w_t \quad , \tag{49}$$

[8] In many industrialized countries severance payment for laid off workers is determined (and enforced) by law. For this reason we consider it as an institutional parameter that cannot be negotiated upon. We could also think of different bonus schemes, for instance by linking the amount of K to the time spent by workers at the firm or assuming that only a part of the entire exit cost K is paid as a bonus to the laid-off workers.

[9] Employees may receive negative extra-wages when the firm makes losses. This is the case of "solidarity contracts". A variable degree of loss sharing between shareholders and workers, is discussed in Moretto and Rossini (1995).

where $\overline{w}$ is the market wage and Δw_t is a premium earning which represents the employees' share of profits accruing to the firm. Let $0 \leq \theta \leq 1$ be the share parameter indicating the proportion of profits and losses going to shareholders, then:

$$\Delta w_t(p_t;\theta) = (1-\theta)\pi(p_t) \quad , \tag{50}$$

with $\pi(p_t) \geq p_L - c$.

4.1.1 Workers and shareholders objective functions

Assuming, as in Aoki, that the firm is a value maximizer operating in perfectly competitive markets for its product and assets, the expected present value of the stream of profits is given by:

$$S(p;\theta) = E_0\left\{\int_0^T \theta(p_t - c)e^{-\rho t}dt \mid p_0 = p\right\} \qquad \text{for } p \in [p_L, \infty\ ). \tag{51}$$

The firm's value S is a function of the parameter θ representing the share of profits going to shareholders; ρ is the discount rate ($> \alpha$) and $T = \inf(t > 0 \mid p_t = p_L)$ is the stochastic stopping time at which the firm decides to exit.

As long as workers completely share the firm's losses and $\bar{w} = c$ is constant, the level of their well-being, up to the shut down, may be ordered according to the expected discounted sum of the premium earnings at the firm. That is:

$$W(p;\theta) = E_0\left\{\int_0^T \Delta w_t(p_t;\theta)e^{-\rho t}dt \mid p_t = p\right\} \qquad \text{for } p \in [p_L, \infty\ ). \tag{52}$$

The firm's organizational equilibrium is characterized by the result of a bargaining process that takes place at the beginning of the planning period. As the solution concept we adopt the *Nash Bargaining Solution* (NBS). Then, the joint objective function of workers and shareholders, to be maximized with respect to the distributive parameter θ, is:

$$\nabla = \lg[u(W) - \hat{u}] + \lg[v(S) - \hat{v}], \tag{53}$$

subject to (51) and (52). To make things easy, we assume specificity by both parties. In words, workers are not able to find a proper job if the contract is

not signed, while shareholders lose the opportunity of producing with high skilled workers who cannot be found in the labor market at a reasonable wage. Therefore, if negotiations do not lead to any agreement, we may set the reservation levels of utility (the *threat points* of the bargaining) equal to zero, i.e. $\hat{u} = \hat{v} = 0$. This does not impose any loss of generality,

4.1.2 The efficient bargaining set

To identify the efficient bargaining set we assume that the shareholders independently decide the exit policy. For any given value of θ, when the firm is in operation, $S(p;\theta)$ must satisfy the no-arbitrage condition (32). This requires that the sum of the return on the investment, given by the dividend flow plus the capital gain $E(dS/dt)$, equals the market cost of capital ρS. Since p_t is driven by (47), applying Itô's lemma to S, the expected capital gain is given by $E(dS) = [S'\alpha p_t + \frac{1}{2}S''\sigma^2 p_t^2]dt$; then the asset market equilibrium condition leads to the following differential equation (Dixit and Pindyck, 1994, pp.114-117):

$$\frac{1}{2}\sigma^2 p_t^2 S'' + \alpha p_t S' - \rho S = -\theta(p_t - c) \quad \text{for } p_t \in [p_L, \infty), \tag{54}$$

with boundary conditions:

$$\begin{aligned} S(\infty;\theta) &= 0, && (55)\\ S(p_L;\theta) &= -K, && (56)\\ S'(p_L;\theta) &= 0. && (57) \end{aligned}$$

Equation (55) states that the value of the firm must be bounded when the market price goes to infinity. The *value matching condition* (56) holds that, when the firm exits, its value must be equal to its liabilities represented by the bonus paid to laid-off workers. The *smooth pasting condition* (57) rules out arbitrary exercise of the option to exit. By linearity with respect to S and making use of (55), the general solution of (54), evaluated at p, takes the form:

$$S(p;\theta) = Ap\beta + \theta(\frac{p}{\rho - \alpha} - \frac{c}{\rho}) \quad \text{for } p \in [p_L, \infty), \tag{58}$$

where β is the negative root of the quadratic equation: $\Psi(\beta) \equiv \frac{1}{2}\sigma^2\beta^2 + (\alpha - \frac{1}{2}\sigma^2)\beta - \rho = 0$. The last term on the r.h.s. of (58) represents the discounted

value of expected profits when the firm is active for ever, while $Ap\beta$ indicates the option value of shutting down, in terms of avoidance of expected losses.[10] The constant A and the optimal trigger price p_L are jointly determined by using (56) and (57):[11]

$$\begin{aligned} p_L &= \frac{\beta}{\beta-1}\frac{\rho-\alpha}{\rho}(c-\frac{\rho}{\theta}K), \\ A &= -\theta\frac{1}{\beta}\frac{1}{\rho-\alpha}p_L^{1-\beta} > 0. \end{aligned} \tag{59}$$

Substituting (59) into (58) we can rewrite the firm's value in the simplified form:

$$S(p;\theta) = \theta V(p;\theta), \tag{60}$$

where $V(p;\theta) = \frac{A}{\theta}p\beta + (\frac{p}{\rho-\alpha} - \frac{c}{\rho})$ is the value of the stream of profits before distribution.

By using a similar procedure for workers it can be shown that:

$$W(p;\theta) = Bp\beta + (1-\theta)(\frac{p}{\rho-\alpha} - \frac{c}{\rho}) \quad \text{for } p \in [p_L, \infty), \tag{61}$$

with a *matching value condition* saying that at the exit trigger price the value for a worker of being employed at the firm is equal to the bonus. That is:

$$W(p_L;\theta) = K. \tag{62}$$

No *smooth pasting condition* is introduced in this case since the exit decision is controlled by shareholders and workers have no influence on it.[12]

[10] The last term on the r.h.s. of (58) is given by (Harrison 1985, p.44):

$$E\left\{\int_0^\infty \theta(p_t - c)e^{-\rho t}dt \mid p_t = p\right\} = \theta(\frac{p}{\rho-\alpha} - \frac{c}{\rho})$$

[11] We assume $c\theta > \rho K$ to guarantee that $p_L > 0$.

[12] Applying (62), the constant B is equal to:

$$B = -(1-\theta)(\frac{1}{\beta}\frac{1}{\rho-\alpha}p_L^{1-\beta})(\frac{c\theta-\beta\rho K}{c\theta-\rho K}) + Kp_L^{-\beta} > 0.$$

The workers's well-being, attributable to the firm's option to stop producing, $Bp\beta$ depends, *coeteris paribus,* on the size of the bonus K. Considering the firm's market value before distribution V and taking account of (61) and (62), we get:[13]

$$W(p;\theta) = (1-\theta)V(p;\theta) + G(p;\theta,K), \tag{63}$$

where $G(p;\theta,K) = \frac{1}{\theta}K(\frac{p}{p_L})^{\beta} > 0$ indicates the increase of the lifetime well-being accruing to the workers, induced by the asymmetry between shareholders and employees, due to the bonus K (Moretto and Rossini, 1997a).[14]

4.1.3 The bargaining

For a solution of the bargaining we maximize (53) with respect to θ. We specify the workers' utility function as $u(W) = W^{1-R}$ and that of the shareholders as $v(S) = S^q$, where $0 \leq R < 1$ and $0 \leq q < 1$ are the respective degrees of relative risk aversion. It is shown in Moretto and Rossini, (1995, 1997a) that the joint maximization of ∇ leads to the following results:

- (a) If $K > 0$ and $\pi(p_t) \geq p_L - c$ the optimal relative share of shareholders and employees in firm's profits is state-dependent and given by the necessary condition:

$$\frac{W^{**}(p;\theta^{**})}{S^{**}(p;\theta^{**})}(1-\Phi^{**}(p;\theta^{**},K))^{-1} = \frac{B_u(W^{**})W^{**}}{B_v(S^{**})S^{**}} \equiv \frac{1-R}{q}, \tag{64}$$

  where:

$$\Phi^{**}(p;\theta^{**},K) = \frac{\frac{dV^{**}}{d\theta} + \frac{dG^{**}}{d\theta}}{\frac{dS^{**}}{d\theta}} > 0.$$

- (b) When the option to shut down is viable (i.e. $p_L > 0$), the shareholders' bargained share of profit is greater than Aoki's share θ^*. That is:

[13] We omit to show the dependence of S and W on K only for notational convenience.

[14] As the bonus K introduces an asymmetry between the two contenders, the workers would like to exit earlier. Indeed, if they could set the exit trigger price, p_L^w, independently, it would be:

$$p_L^w = \frac{\beta}{\beta-1}\frac{\rho-\alpha}{\rho}(c + \frac{\rho}{1-\theta}K) > p_L$$

$$\frac{1-\theta^{**}}{\theta^{**}} < \frac{1-\theta^{*}}{\theta^{*}} = \frac{1-R}{q}.$$

Part (a) indicates how the condition (38), for the share of profits going to each contender, changes when an option to shut down is introduced. Part (b) means that the bargaining over θ leads to a profit distribution which is more favorable to shareholders than Aoki's original result, θ^*, represented by the ratio of the respective degrees of risk aversion (i.e. equation (45)).

As the threat point is zero for both actors, the only asymmetry between workers and shareholders is due to the exit cost. Then, if K tends to zero, this asymmetry disappears and the profit share parameter is no longer state-dependent. That is, if $K = 0$ (or $\sigma = 0$) and $\alpha > 0$, the profit share parameter reduces to the Aoki's one (Moretto and Rossini, 1997b):

$$\frac{1-\theta^{**}}{\theta^{**}} = \frac{1-\theta^{*}}{\theta^{*}} = \frac{1-R}{q}.$$

This result has two implications. First: As long as exit is costless, shareholders and workers would chose the same exit policy, and therefore the same distribution policy as in Aoki. Second: Uncertainty affects profit distribution only if there are irreversibilities. On the other hand, if $\alpha > 0$ and $\sigma = 0$, the value of the option of shutting down goes to zero and the result above is straightforward. A different outcome follows if $\alpha \leq 0$ and $\sigma = 0$. Under certainty the firm knows exactly when it will quit: i.e., $p_L = c - \frac{\rho}{\theta}K$ and the option is still alive.

To end this section, we summarize the comparative static property of the optimal sharing parameter θ^{**} with respect to the market price. Indeed, it can be proved (Moretto and Rossini, 1997a) that, when the option to shut down is viable, (i.e. $p_L > 0$), the profit share going to shareholders decreases as p increases:

$$\frac{d\theta^{**}}{dp} < 0.$$

The effectiveness of the shut down threat weakens as market profitability grows since exit becomes less likely. As p tends to ∞ we are back with the Aoki's solution.

4.2 Profit sharing and the regulation of the recontracting time

Profit sharing seems to be able to redistribute the risk among factors in a manner that may improve firm performances. However, efficiency would require that contracts over the profit share parameter must frequently be renegotiated, mainly when market conditions change substantially. This is simply impossible to obtain just through cooperation since there is no state of the world and no time that can be agreed upon by both parties to give rise to renegotiation, just because the profit is state dependent. In that case the solution is to introduce an external arbitrator or regulator who decides when and whether to renegotiate. The alternative is to subside to open conflict. The different degrees of factor specificities are at the origin of dominant positions in the internal market for labour. For this reason the regulator may impose a recontracting of the distribution parameter when market conditions are buoyant. If, instead, the regulator objective is a lower variability of employment in the firm, to minimize losses of specific human capital, she will summon parties for recontracting when market conditions are depressed. In this sense, the regulator may appear too favorable to the labour factor. As a matter of fact, he is quite neutral if he is considered on a long run horizon, since in that circumstance it may be also in the interest of the firm not to destroy the specific human capital the firm has contributed to create by bearing a sunk cost. Therefore, the arbitrator-regulator has the role of an agency that tries to optimally distribute the risks deriving from market uncertainty when there are sunk costs born by both contenders. In Moretto and Rossini (1997a) two negotiations are considered. An initial one and one that takes place if the realisation of the uncertain market price reaches a predetermined level. This may be established in two different ways: 1) It can be announced by the regulator at the beginning of the activity period of the firm and made known to both contenders; 2) It can be established by the regulator when the state variable touches a particular level. The result of both arrangements is the setting of two distribution parameters, one for each period.

When the regulator adopts a preannounced rule, recontracting with a price higher than the initial one shifts the distribution of profits in favour of employees. This depends on the fact that, in these conditions, the shutdown threat is less effective. If contracting takes place at prices lower than the initial ones the opposite happens. Less trivial is the case of a regulator

operating in a discretional way. Then the distribution of profits becomes more stable.

As we can see, there are many arguments in favour of recontracting. When profits, i.e. market prices, become very volatile the firm would prefer a much more flexible wage setting. Profit sharing and recontracting allow this. With downward contracting employees are more keen on renegotiating. However, both prefer the regulator intervene discretionally because this leads to a lower variability of the distribution parameter. Then, a discretional regulator appears socially superior.

4.3 The efficient allocation of the shut down decision

It is quite clear that owning the opportunity to close the firm gives the shareholders an advantage. However, we cannot take for granted that assigning the shut down decision to shareholders is Pareto optimal. This raises a series of questions. Some of them touch the field of law, some remain within the borders of economics. The legal question relates to the association between the property of the firm and the complete disposition of its activity by the owners, even though this implies the governance of shareholders on firm specific human capital. We do not wish to dwell on this question since it does not belong to the scope of this paper. As a matter of fact, there are many actors, besides shareholders, influencing the decision to close a firm, like banks, local authorities, trade unions and so on. Moreover, any decision taken within an economic entity has to be taken according to efficiency criteria. If it is taken in an inefficient way we have to see why it is so and if there is some reason why the Coase (Coase, 1960) theorem does not apply. This theorem maintains that it is irrelevant, within a firm or any other economic institution, who has the responsability of a decision, whenever there is perfect information and the decision can be traded without bearing any transaction cost. In this case legal entitelments are perfectly exchangeable and they will be allocated in an efficient way. However, uncertainty and sunk costs let us depart from the Coasian picture. There is therefore a need for a sort of generalisation. In other words, we have to find an optimal allocation for the shut down decision of a firm in which there is profit sharing, market uncertainty and firm specificities. Then the question is: to whom to assign the shut down decision in order to achieve optimality? And which mechanism may be adopted to allocate it efficiently?

Let us see primarily why and when taking for granted that shareholders

decide to close may be suboptimal.

Closing inflicts a loss to dismissed workers since they will loose the entire firm specific human capital accumulated while working at the firm. If they are immediately employed elsewhere they are not able to obtain the same income because of their firm specificity. However, there is efficiency if the loss born by employees is lower than the benefit shareholders receive when they close. Otherwise, if the loss of workers is larger than the benefit of shareholders, a social loss emerges as a result of inefficiency. How to get out of this stalemate? Moretto and Rossini (1997b) generalise the Coase theorem to this case. The victim of the decision taker (workers) may be willing to pay an amount lower than the loss suffered to "buyout" the right to close or to condition the decision, that is now attributed to another agent. However, if the employers are able to put their hands on the closure decision, will they do it efficiently or not? Or, in other words, what is the opportunity cost of closure for shareholders and employees when there are specificities? To this purpose individual gain functions are devised. They capture the gain of a contender in having the decision to close as compared to the case in which she does not own it. When we compare the two gain functions we discover that they are simply given by the difference between the values of the option to close in the hands of shareholders and the option to close in the hands of workers. Three case are considered.

1. Capital and labour have the same degree of specificity. In this case there is an interval of the parameters in which the total payoff accruing to both contenders would be larger if the shut down decision were attributed to workers. They seem to possess a time horizon longer than the one of shareholders. In this case the traditional firm organisation leads to inefficiency.

2. Non specific capital, specific labour. In this case the traditional conduct is not efficient if workers receive a small portion of profits and get a small bonus when dismissed.

3. Specific capital, non specific labour. Here the traditional conduct of shareholders deciding is efficient.

As we can see there are many circumstances in which received governance is not efficient. Moretto and Rossini (1997b) suggest an arrangement, whereby the loosers "subsidise" the gainers. To this purpose there need to be

a binding committment by the subsidiser. The alternative, i.e., a lump sum subsidy is neither feasible nor efficient. If workers resorted to a lump sum subsidy, shareholders would have the incentive to close immediately after they have received it. Only with a continuos bindingly committed subsidy closure by shareholders can be avoided. The subsidy must go on until either the sum paid by workers hits their extra-wage or the workers optimal exit price is touched.

What is the nature of this subsidy? It is actually a further form of profit sharing whereby workers bear some more risk to elongate the life of the firm. But it is a partecipation form which is contingent upon the realisation of a particular value of the state variable and therefore it is different as compared to the simple establishment of a share parameter. In other words it is not a new share parameter. It is a sort of additional internal market, not for labour, but for the closure decision which can then be efficiently allocated in a Coasian style.

5 Conclusions

We have seen that the PM firm suffers of a static inefficiency since it is not able to provide the proper incentives to workers. The LM firm is affected by many inefficiencies and some perversion, even though not proved empirically. It appears that in the LM workers - members do not adopt an optimal growth path. A membership market may provide an escape way, as suggested in the literature on WE. However it is very difficult to set up workable and efficient markets for memberships, for many reasons. The crucial one is that a membership is simultaneously a right to work and an asset. If we consider factor specificities the LM arrangement appears superior with specific labour and non specific capital. While with specific capital and non specific labour the PM appears preferable.

Proft sharing and the Aoki firm stand in between the two polar cases represented by the LM firm and the PM firm. They provide useful hindsights into the optimal internal organization. Virtues and shortcomings are associated with the Aoki's firm. The main trouble is that the Aoki's firm is hindered by some rigidities once it has to react to market shocks. On the contrary, when there are factor specificities profit sharing seems quite a good shock absorber for shareholders and for the life expectancy of a firm. However, on its turn, profit sharing coupled with market uncertainty and factors

specificities requires a fresh definition of the optimal allocation of some strategic decisions within the firm. In such circumstances the traditional conduct, assigning to shareholders all choices, is no longer optimal in all contingencies. The decision to close is a credible threat which shifts distribution in favour of shareholders. This asimmetry makes contracting about the profit share parameter quite an asymmetric arrangement. To avoid dominant and/or asymmetric positions an arbitrator-regulator may call for recontracting in some particular circumstances. Nonetheless this may not allow an efficient solution. When the benefit shareholders get from closing is smaller than the damage they inflict on workers an additional internal market for the closing decision should be established to avoid the deadweight loss. If that market works in a Coasian way the decision entitelment becomes immaterial.

Specificities and uncertainty reopen many question about the optimal internal organisation of a firm between the two polar cases of the pure PM and LM settings, i.e. on the organisation of most firms. This points to a lot of space for future research.

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