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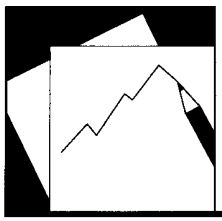

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Institutional Inertia

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Institutional Inertia

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Abstract

We study the relative efficiency of outside-owned versus employee-owned firms and analyze implications for institutional change in a context of technological innovation. When decisions are made through majority voting, the vote on technology choice is used to influence the later vote on the sharing rule. We show how this dynamic voting generates a systematic technological bias that is contingent on firm ownership. We provide conditions under which the pivotal voter's political leverage leads the firm to an institutional trap whereby majority voting and inefficient technology choice reinforce each other, leading to institutional inertia.

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Contents

I. Introduction

This paper is concerned with the persistence of inefficient institutions. At the heart of an institution is the allocation of control rights that govern technological change and drive the evolution of the institution. To understand some of the political forces leading to institutional inertia, we consider the generic case of the failure to transform a firm's legal status despite the availability of an efficiency-enhancing opportunity which the transformation would bring about. Specifically, we examine the role of technology adoption as an engine of the evolution of the firm between two possible legal forms, the cooperative (or partnership) and the corporation.[2] Our starting point is that technological and institutional change (or lack thereof) at the firm level is governed by political economy considerations. Thus, we take as an essential and distinctive feature of a cooperative its collective decision-making among heterogeneous agents, in contrast with recent explorations of this theme such as Levin and Tadelis (2005) and Morrison and Wilhelm (2008).

We cast our analysis in the context of a dynamic voting model in a world of incomplete contracts. The environment we consider has agents differing both in terms of their individual productivity within the firm and their outside option. A technology is thus defined as a distribution of individual productivities across employees. Crucially, an employee's productivity ability across technologies is unobservable. Provided technology adoption cannot be contracted ex-ante and alternative technologies generate different distributions of productivities and outside options across agents, all legal forms are susceptible to making an inefficient technology choice. We therefore ask two questions. First, what is the role of the firm's legal form (or ownership structure) on the efficiency of technology choice? Second, whenever the status quo legal form leads to inefficiency, will a change in the legal form take place as a mechanism to restore efficiency? Regarding the first question, we show that a systematic technological bias emerges contingent on the firm's ownership structure. Regarding the latter, we show that the answer is no: an inefficient legal form can persist even if institutional change bears no cost.

With heterogeneous agents, collective decisions in the firm are made through majority voting. Our model considers a two-stage voting process where employees decide in sequence over technology adoption and distribution of aggregate output. It departs from the traditional analysis of institutional or organizational design insofar as employees' preferences are not ordered and therefore the median voter theorem does not apply in our setup. Instead, the voting outcome is determined by the preferences of the winning coalition. The first main contribution of the paper is to show that, the pivotal voter for technology choice turns out to be also pivotal for redistribution and, more crucially, for institutional change. Two key implications follow. First, an inefficient technology may be the source of a large vested interest for the pivotal voter not because it yields a higher individual productivity for him but because his role as pivotal voter at the redistribution stage becomes more valuable. Second, an employee-owned firm will be unable to get around this inefficiency by selling to outside investors, as the pivotal voter will vote against institutional change. Moreover, the existence of private information on employees' multidimensional ability would render the cooperative unable to compensate the pivotal voter for his loss of political leverage. In sum, selling off the firm to efficient outside investors fails as a recourse to restore efficiency regardless of the cooperative's bargaining power vis-a-vis the investors. This leads to the second main contribution of the paper, i.e. the demonstration that a

[2] We use the terms cooperative and partnership interchangeably throughout the paper.

firm's initial ownership structure may lead to an institutional trap whenever majority voting and inefficient technology choice reinforce each other.

As our emphasis is purely on the inefficiencies arising from collective decision-making among heterogeneous agents, our model is useful not only to understand the technological implications and the determinants of a firm's governing structure but also to shed light on the issue of institutional reform under political economy constraints in a macroeconomic setting.

For ownership to affect efficiency contracts must be incomplete. Thus our paper builds on the literature on incomplete contracts developed by Grossman and Hart (1986) and Hart and Moore (1990) insofar as agents cannot commit ex-ante to a future technology or sharing rule. In particular, it contributes to a vast literature which highlights the relative distortions to efficiency under alternative ownership structures. In our model inefficiencies arise due to collective decision problems among heterogeneous agents as documented by Hansmann (1996)[3] rather than from individual underinvestment in firm-specific skills (see Kremer 1999, Bolton and Xu 2001, and Roberts and Van den Steen 2001).

A more recent literature on partnerships has focused on the link between ownership structure and employee quality efficiency. Morrison and Wilhelm (2004) show in a model combining moral hazard and adverse selection that partnerships constitute an efficient organizational form in industries where tacit human capital is essential and monitoring is noncontractible. The partnership form gives incentives to identical partners to monitor young associates in order to preserve the value of their partnership shares by ensuring a high quality of future partners. In subsequent work (Morrison and Wilhelm, 2008) they apply their model to the financial industry and predict that partnerships go public in response to technological innovations that substitute for human capital or that require a minimum operating size that is unattainable within a partnership. Their result rests on the assumption that a technological shock may render monitoring too costly by requiring a large firm size thus exacerbating free riding. In contrast, a technological shock in our model increases employees' productivity at no cost. However, by altering the distribution of skills across employees it swings the balance of power to set redistribution in a manner that turns out to be detrimental for the winning majority under the status quo technology. A key role played by redistribution in partnerships is highlighted by Levin and Tadelis (2005) who argue that per partner profit maximization ensures a higher employee quality hiring threshold in a partnership than in a corporation because partners try to avoid profit dilution. In their adverse selection framework, signaling a firm's high quality through its ownership structure has merits whenever market monitoring is weak.[4] While we abstract from endogenous membership in partnerships, another key difference between our model and those just discussed is our assumption of an endogenous sharing rule coupled with limited commitment rather than a pre-determined sharing rule. It is precisely the endogeneity of the sharing rule that generates the bias in technology choice.

Another strand of the literature on corporate ownership has focused on the incentive problems faced by employees with restricted access to a critical resource such as financing (Kremer 1997; Rey and Tirole 2007).[5] This line of research suggests that physical-capital-intensive firms should

[3] Similarly, Canton, de Groot and Nahuis (2002) explain the failure to adopt more efficient technologies through heterogeneous costs of adoption for workers of different age.

[4] Bar-Isaac (2007) also discusses the signaling role of partnerships. In a model of adverse selection, senior partners may choose to work with junior associates and build on the latter's reputational concerns for career advancement as a signal of the firm's quality in front of uninformed clients.

[5] Borrowing may be unfeasible or excessively costly due to the high interest rate required as a way to compensate

be dominated by outside investors as opposed to human-capital-intensive firms. A similar conclusion obtains in Rajan and Zingales (2001)'s theory of organizational design that highlights the access to a critical resource such as an innovative idea as the main mechanism conferred by a firm's organizational form. They argue that vertical hierarchies are more prone to expropriation of employees' human capital and thus are less likely to prevail in sectors where property rights protection is weaker, i.e. in human capital intensive industries. By contrast, we take the view that as long as employees' productivity is partly firm-specific, expropriation may arise under any organizational structure.

Structurally, our model is in the spirit of Hart and Moore (1998) who argue that investment distortions in a consumer cooperative arise whenever the preferences of the median member differ from those of the average member. Likewise inefficient investment decisions are also likely under outside ownership as investors target the marginal consumer instead of the mean consumer. Whereas they provide conditions that ensure first-best investment under alternative ownership structures, we study the relative bias away from efficiency. Also in contrast with their model, we allow for endogenous transfers that become the source of vested interests lying at the heart of inefficient collective choice.[6]

We also emphasize the influence of future decision-making on current voting decisions as in the dynamic voting literature. Besley and Coate (1998) and Roberts (1999) show how the median voter's decision, although suboptimal based on his current period's preferences, may be optimal once the constraints generated by the democratic process and the transition rule for future states are factored in. Similarly in our model, the anticipation of the swing in the balance of power following the adoption of the efficient technology deters the current winning majority from favoring innovation.

Our results on the direction of technological biases resonates with the literature on changes in wage inequality. While there is a recent consensus on the role played by skill-biased technological change (Krusell et al., 2000, Jovanovic, 2007)[7], there is not yet a well established view of the impact of technology adoption on the distribution of ex-ante unobservable productive abilities that could explain the large rise in *residual* wage dispersion since the mid 1970s (Acemoglu, 2002). A recent attempt to explain residual wage inequality is contained in Burgess, Lane, and McKinney (2004). They focus on the impact of job reallocation of equivalent employees among firms posting different wage mark-ups and find that firm-specific effects contribute to around 45 percent of the variance of log wages in their data set. They conceive a job assignment as arising from a worker-firm pair matching and, thus, do not endogenize technology adoption or firm-specific effects as we do by allowing for different ownership structures.

We have cast our analysis as a corporate governance problem at the firm level. It could easily be reinterpreted as a governance problem at the country level. Hence, our paper is related to the literature on political economy and corporate control. Perotti and von Thadden (2006) analyze how in a democracy the choice between a bank dominated corporate system and an equity

for the potential opportunistic behavior of employees with full control rights over the firm's decisions.

[6] The role of majority voting in rendering cooperatives inefficient has been put forward by Barzel and Sass (1990), Bonin, Jones and Putterman (1993), and Hansmann (1996). Similarly, Alboeck and Schultz (1997), Barzel and Sass (1990) and Aghion and Bolton (2003) deal with the optimal allocation of votes and/or the voting rule which is conducive to minimizing the costs of decision making.

[7] Krusell et al. (2000) and Jovanovic (2007) rely on the complementarity between skills and technologies to explain the increase in wage inequality in several high-income countries. Acemoglu (2002) focuses on changes in the relative supplies of skilled and unskilled workers to explain endogeneous skill-biased technological change.

dominated corporate governance is determined by the preferences of the median voter according to his financial wealth relative to his human capital. As in Perotti and von Thadden's paper, corporate governance is determined through majority voting in our setting. Unlike their paper, however, preferences are determined by employees' political leverage to influence redistribution rather than by the desire to protect their human capital. A consequence is that we show how a Pareto dominated technology may be implemented in equilibrium.

Our paper is also related to the literature on institutions and growth. Acemoglu and Johnson (2005) highlight the significance of property rights protection in supporting higher income per capita. In their work, the potential for expropriation is proxied by exogenous constraints imposed on the government and powerful elites while in ours the scope for expropriation arises from the distribution of political power between the majority and the minority. Also we allow for the possibility of power reversal to stimulate innovation even in a lawless economy. Our approach is thus closer to Rajan and Zingales (2003) who analyze the role of incumbent interests in retarding financial development so as to preserve monopoly rents. Djankov et al. (2003) highlight the trade-off between controlling disorder under democracy and restraining expropriation under dictatorship as the key issue underlying institutional design. They also ponder whether the best political system for economic reform is necessarily democracy when a radical change is required.[8] Drawing a parallel between democracy and employee ownership on the one hand, and dictatorship and outside ownership on the other hand, their predictions echo our own.

In order to address the issues at hand, Section 2 provides an example that helps clarify the mechanism through which technological biases and institutional inertia arise. Furthermore it highlights our analysis' genuine isomorphism with a macro-institutional problem. The model is presented in Section 3 where the relative efficiency of employee and outside ownership is analyzed. Section 4 allows for the possibility of institutional change. Section 5 presents a discussion of our results. Concluding remarks are presented in Section 6.

II. A Tale of Explorers, Gold, and Diamonds

Consider a group of 15 explorers that sets off to extract the mineral resources from some island. To this end, they will need access to equipment. There are two alternative ownership structures. Either they could organize themselves as an independent expedition; i.e. they could own the equipment as a cooperative, with decisions taken by majority vote. Or they could become a royal mission, whereby the king would own the equipment and take all decisions. There are two decisions to be taken. First, which kind of mineral to extract: they can either settle on an island with diamonds or on an island with gold. Second, how the spoils should be divided. Crucially these decisions are to be taken in sequence: they have to choose the island, and then they have to split the surplus. Also, neither decision can be contracted upon in advance.[9]

In the spirit of subgame perfection, suppose that the expedition has already landed on, say, the diamond island, and that the question is now how to share the profit. On this island, only 7 out

[8] Their paper argues that whereas an activity among participants with similar resources and with little technological change can achieve order with little dictatorship, an activity involving players with massive inequalities of power is vulnerable to more disorder for a given level of policy, a result in line with ours.

[9] The idea that decisions cannot be contracted upon in advance and that the owner of the equipment has the right to decide how it is used, first appeared in Grossman and Hart (1986).

of the 15 explorers are productive (let us say that the other 8 suffer from claustrophobia and cannot go underground). Each of the productive explorers has a productivity of 12. The unproductive have zero productivity. The productivity of each explorer is privately known before they set foot on the island, but becomes public information after they disembark.

If the mission is run as an independent expedition, the unproductive explorers will have a majority of the votes and so they will be able to expropriate productive explorers by denying them access to the equipment. To put a limit on expropriation, we suppose that the productive explorers have an outside option whereby they can get a payoff of 7 (that is, they have a productivity of 12 with access to the equipment, and 7 without). The winning proposal in the vote will thus be to leave 7 of the 12 in the hands of the 7 productive explorers, and divide the rest, 35, equally among the 8 unproductive.[10] That is, the unproductive will get a payoff of $4\frac{3}{8}$.

Had the king been in command of the expedition, he would simply expropriate all the explorers as much as possible, reducing their payoff down to their outside options (7 and zero for the productive and the unproductive types respectively). This would yield the king a payoff of 35.

Now let us suppose the expedition landed on a gold island. There are productive and unproductive explorers in this island too. But now the productive types are in the majority. Specifically, 8 of them have a productivity of 10, whereas the remaining 7 have a productivity of zero (we might suppose that they suffer from vertigo and cannot hike into the mountains searching for gold). In other words, there are more productive people on a gold island than on a diamond island, but their individual productivities are lower. For ease of comparison, let us continue to suppose that the productive explorers have an outside option of 7.

In an independent expedition, as the productive types are in the majority, there will be no expropriation on the gold island. The payoff accruing to each explorer will equal his own productivity, that is 10 or zero. Under royal authority, however, the king would expropriate the productive explorers, just as he did in the diamond island. Each of the 8 would have their payoff pushed down from 10 to their outside option 7. The king's payoff will be 24.

Having established the various' parties payoffs on each of the two islands, we can now move back to the first decision: which island to choose. Under royal authority, the king will obviously choose the diamond island, as the payoff, 35, exceeds the payoff of 24 from the gold island.

In the case of an independent mission, the choice of island is more intricate because there are four categories of explorers with competing interests: those who are productive on both islands, those who are productive on only one island, and those who are unproductive on both islands. Note that at this stage the question of who is in which category is private information, which precludes Coasian bargaining. Instead, the decision over which island to choose is made by a straight vote. Consider the payoff of an explorer who is productive on the gold island. His payoff, 10, is greater than the payoff he would get on the diamond island irrespective of whether he is productive there or not (7 or $4\frac{3}{8}$ respectively). Therefore, he will vote for the gold island. But there are 8 such explorers, so they will win the vote.[11]

Given that the decision over which island to choose varies across ownership structures, we might

[10] We suppose equal treatment within a group of explorers of the same productivity type. Various auxiliary assumptions could be made to rationalize this.

[11] Interestingly, the decisive factor in determining the outcome of this vote is the fraction of productive explorers on each island, not the exact numbers of explorers in each of the four categories.

ask which organization performs better. The wealth of the diamond island is $7 \cdot 12 = 84$. The wealth of the gold island is $8 \cdot 10 = 80$. So efficiency calls for diamond extraction. The fact that the independent mission votes for the gold island whereas the royal mission chooses the diamond island means that, in this example, outside ownership performs better than common ownership.

Of course, before the vote on choice of island is taken, the independent expedition should recognize that it would perform better under royal governance. This suggests that they should negotiate with the king for a transfer of ownership. Take the 'best' case where the explorers have all the bargaining power. They would demand a transfer price of 35, the king's maximum payoff. This amount would be divided equally among the 15 of them. Will they vote to sell to the king? No! The winning coalition formed by the 8 explorers who are productive on the gold island will block it. Under the status quo – independent mission –, they each get 10, as a result of the vote to extract gold. Under royal governance, the king would choose the diamond island and their overall payoff would be the sum of their outside option (either 7 or zero) plus their dividend ($\frac{35}{15}$) from the transfer – in total less than 10. Here we have an illustration of what we call *institutional inertia*: the failure of an inefficient organizational form to evolve into an efficient organization.

So, certainly, outside ownership is more efficient than common ownership in the above example. But this is by no means always the case. Consider a minor change to the example. Keep all the numbers the same except for the gold island where a productive type now has a productivity of 11 instead of 10. The gold island is then the efficient island as $8 \cdot 11 = 88$ is greater than $7 \cdot 12 = 84$. Applying the previous logic, it is straightforward to confirm that an independent expedition will still choose the gold island whereas the king will select the diamond island. In this modified example then, common ownership is more efficient than outside ownership.

Thus both forms of ownership structure can be efficient, depending on the circumstances. But can we say anything general about the biases away from efficiency? It turns out that we can. One thing to notice from the previous examples is that the independent expedition seems to have a tendency to vote for islands where there are more productive explorers albeit each has a smaller productivity. We might term such islands as 'egalitarian'. By contrast, the king seems to be inclined to choose islands where the productive explorers have higher productivity even though there are fewer of them. We might term these islands as 'polarized'. In the paper we prove the following general result about the *relative* bias of the two ownership structures.

A cooperative is more biased towards egalitarian projects than is an outside-owned firm. That is, if an outside-owned firm chooses an inefficient egalitarian project then so too does a cooperative. Correspondingly, an outside-owned firm is more biased towards polarized projects than is a cooperative. That is, if a cooperative chooses an inefficient polarized project then so too does an outside-owned firm.

It is important to note that this is a general result. It does not depend on the fact that one island has a majority of productive types and the other has a majority of unproductive types (as in the above examples). It might be the case that both islands have a majority of unproductive types – so that there is always redistribution.

III. The Model

We consider a firm with I heterogeneous employees, where I is an odd number. At date 0 the firm is defined by the assets required to implement a productive technology. Two potential projects are revealed by nature: project i and project j.

The firm decides at date 1 which project to undertake. The cost of either project is normalized to zero. Once the technology has been implemented, the firm determines at date 2 how to distribute aggregate surplus among the firm's participants.

Contracts are incomplete. In particular, firm owners cannot commit at date 0 to a date 1 technology. Also, they cannot commit at date 1 to a date 2 sharing rule. It is this dynamic interaction between production and redistribution that can lead to inefficient decisions.

We consider two ownership structures: cooperative and outside ownership. In a one-member-one-vote cooperative, each employee is assigned one control right; decisions are taken by majority voting. As employees are heterogeneous, conflicts in decision-making are likely to arise. By contrast, in an outside-owned firm, investors are assumed to be homogeneous because they take decisions to maximize profits; as a result, their interests are aligned and the allocation of control rights among them is thus irrelevant. We discuss these two structures in turn.

A. The Cooperative

Consider a one-member-one-vote cooperative where both decisions, namely the technology at date 1 and the redistribution at date 2, are decided by majority voting. The characterization of employees is as follows. Under project i, employees can either be low productivity types, with productivity normalized to zero, or high productivity types with productivity $x_i > 0$. Under project j, low types still accrue zero productivity whereas high types accrue productivity $x_j > 0$. We do not impose any ordering of employees across projects in terms of their individual productivity; that is, a low type under project i might be a high type under project j and viceversa. Thus at the voting stage at date 1, there are four types of employees, $\{ll, lh, hl, hh\}$, where (ll) denotes the group of employees whose productivity is low under both project i and project j, (lh) denotes the group of employees who are low types under project i but high types under project j, and so on. The fraction of these four types of employees is denoted by g_{ll}, g_{lh}, g_{hl} and g_{hh} respectively. We assume that there is a strictly positive fraction of all types; i.e. $g_{ll}, g_{lh}, g_{hl}, g_{hh} > 0$. The productivity of employees across projects is summarized in the following table:

Employee's type	Productivity (project i)	Productivity (project j)	Fraction
ll	0	0	g_{ll}
lh	0	x_j	g_{lh}
hl	x_i	0	g_{hl}
hh	x_i	x_j	g_{hh}

Note however that at date 2, once the technology has been undertaken, there are only two types of employees, namely low and high productivity types. Denote by f_i and f_j the fraction of high types under projects i and j respectively. The relation between the fractions of employees at date 1 and at date 2 is as follows:

$g_{hl} + g_{hh} = f_i$, and $g_{lh} + g_{hh} = f_j$.

Notice that there are many combinations of g_{ll}, g_{lh}, g_{hl} and g_{hh}, which yield the same f_i and f_j.

Different types of employees will exhibit different preferences at each voting stage. At date 1, it is unlikely that one single type of employee constitute a majority; rather, different types of employees will form coalitions in order to win the vote. At date 2 by contrast, there will always be a majority formed by either low types or high types.

We assume the existence of a spot labor market at date 2 offering a reservation wage to employees. We assume that as low types are unproductive inside the firm, their outside wage is zero. By contrast, once the technology has been implemented, high types develop skills that are only partially firm specific. We assume that their outside wage is contingent on technology choice, i.e. w_i and w_j; we also assume that for each project, the outside wage is strictly higher than zero, but strictly lower than high types' inside productivity, that is, $0 < w_i < x_i$ and $0 < w_j < x_j$. The effect of the outside market is to put a limit on expropriation at date 2. Low types cannot be expropriated. High types cannot be pushed below their outside wage.[12]

In the analysis that follows, we characterize the technology choice and the redistributive schedule which is chosen in equilibrium. Each employee votes to maximize his expected payoff. As it is a two-stage voting game, we solve backwards.

1. Redistribution (date 2 vote)

Suppose that project i was chosen at date 1. At date 2, we assume that voting is anonymous, in the sense that employees of the same type must be treated equally: coalitions cannot gang up on individual(s). Nonetheless, when low types are in the majority ($f_i < \frac{1}{2}$), they can expropriate high types. We assume, however, that their payoff remains lower than high types' payoff, even after expropriation. That is:

$$w_i > \frac{f_i (x_i - w_i)}{1 - f_i}.$$

Here, the LHS denotes high types' payoff following expropriation (i.e. their outside wage). The RHS denotes the expropriation receipts accrued by each low type; the numerator shows the individual expropriation suffered by high types, multiplied by the fraction of high types; the denominator shows the fraction of low types in the firm. The same applies when instead project j is chosen. These inequalities can be written more simply as:

(A1) $w_i > f_i x_i$ and $w_j > f_j x_j$

Also we assume that human capital is relatively important conditional on the given reference technology set. That is:

(A2) $x_i \geq w_j$ and $x_j \geq w_i$

[12] There is an alternative way to motivate the assumption of partial expropriation. Assume that high types need to exert effort in order to be productive. If effort is costly and non-verifiable, the anticipation of expropriation will lead to underinvestment in effort. In equilibrium, expropriation, if positive, will be limited so as to induce high types not to shirk.

In other words, a high type's outside wage is never greater than his inside productivity, irrespective of the project. This implies that an employee who is always a high type, weakly prefers the project which guarantees no redistribution at date 2. The same implication would hold true under a stronger form of (A2) whereby $w_i = w_j = w$.

2. Technology choice (date 1 vote)

As there is no ordering of employees, we cannot apply the median voter theorem at date 1. Notice, however, that a stable voting outcome always exists as the technology set has been restricted to two projects. To determine the equilibrium outcome, we should instead look at the formation of coalitions at this voting stage. Under majority voting, the winning coalition will be formed by at least $\frac{I+1}{2}$ employees. It turns out that coalition formation depends on which group is in a majority at date 2. We can thus distinguish three cases:

(Case H): High types' power: $f_i > \frac{1}{2}, f_j > \frac{1}{2}$

(Case L): Low types' power: $f_i < \frac{1}{2}, f_j < \frac{1}{2}$

(Case S): Split balance of power: $\begin{array}{c}\text{either} \quad \text{(a) } f_j < \frac{1}{2} < f_i, \\ \text{or} \quad \text{(b) } f_i < \frac{1}{2} < f_j\end{array}$

Notice that in case H, type (hh) is on the winning side in the date 2 vote, whichever project was chosen at date 1. That is, if project i was chosen, he would be productive and, since productive types are in a majority, they would vote against redistribution. The same applies if project j was instead chosen at date 1. Likewise, in case L, type (ll) is decisive in the date 2 vote, whichever project was chosen at date 1. Finally, look at case S. Under S(a), an employee of type (hl) is always on the winning side in the date 2 vote; if project i was chosen, he would be productive and, since productive types are in a majority ($f_i > \frac{1}{2}$), they would vote against redistribution; whereas if project j was chosen, he would be a low type and, since low types are in a majority ($f_j < \frac{1}{2}$), they would vote in favor of redistribution. Similarly, in case S(b), type (lh) is always decisive in the date 2 vote.

It turns out that an employee who is always on the winning side at date 2 will always be able to form a winning coalition at date 1 too. Let us now examine in detail the argument whereby this is true.

Look first at case H, where type (hh) always wins the date 2 vote and there is no redistribution at date 2. Because there is no redistribution, type (hl) always prefers project i and type (lh) always prefers project j. This implies that if (hh) prefers project i, he will join (hl) to form a winning coalition at date 1 since $g_{hh} + g_{hl} = f_i > \frac{1}{2}$. On the other hand, if (hh) prefers project j, he will form a coalition with (lh) employees. This coalition will also win as $g_{hh} + g_{lh} = f_j > \frac{1}{2}$. In short, (hh) wins the vote at date 1, whichever his preferences between project i and j.

Consider now case L, where type (ll) is always on the winning side at date 2 and there is always redistribution. At date 1, if (ll) prefers project i, this means that $\frac{f_i}{1-f_i}(x_i - w_i) > \frac{f_j}{1-f_j}(x_j - w_j)$. By A1, (hl) will also prefer project i since he anticipates a payoff of w_i under project i which is strictly higher than $\frac{f_j}{1-f_j}(x_j - w_j)$ under project j. If (ll) prefers project j instead, then type (lh)

will also prefer project j, using the same argument. Hence there are two potential winning coalitions at date 1. Either $\{ll, hl\}$ wins, because $g_{ll} + g_{hl} = 1 - f_j > \frac{1}{2}$, or $\{ll, lh\}$ wins since $g_{ll} + g_{lh} = 1 - f_i > \frac{1}{2}$. As a result, type (ll) wins the date 1 vote, irrespective of his preferences across projects i and j.

Finally, look at case S. As we have seen, in case S(a), type (hl) always wins the date 2 vote; moreover, there is redistribution under project j but not under project i. Look now at coalition formation at date 1. Type (ll) always votes for project j; although his individual productivity is zero under both projects, he gains through ex-post redistribution under project j. Type (hh) votes for project i as by (A2) he favors the project ensuring no redistribution. Therefore, the date 1 winning coalition will be formed by $\{hl, hh\}$. Since $g_{hl} + g_{hh} = f_i > \frac{1}{2}$, (hl) will also win the date 1 vote. A mirror argument holds for case S(b). Thus we have proved the following result:

Lemma 1 *Under A1 and A2, an employee who always wins the vote at date 2, also wins the vote at date 1.*

The above analysis has shown that, assuming A1 and A2, for a given f_i and f_j, the pivotal employee is decisive irrespective of the particular combination of g_{ll}, g_{lh}, g_{hl} and g_{hh}, i.e. regardless of the ex-ante distribution of employees across the four types. This has the interesting implication that equilibrium outcomes will only depend on the ex-post distribution of types, f_i and f_j.

Now that we know how coalitions form at date 1, we can ask whether employee ownership is an efficient institution. We shall see that the outcome of the date 1 vote can be inefficient. The reason is that employees who are better off under the efficient technology, cannot commit at date 1 to compensate employees who are worse off under the efficient project. An employee can be worse off under the efficient technology not only when his individual productivity is lower, but also when he anticipates to be in a minority at the redistribution stage. One may wonder why there is no Coasian bargaining at date 1. We have in mind a world in which an employee's type is private information at this stage. For a large I, free riding would preclude transfers at date 1 and hence inefficient outcomes might arise in equilibrium.[13] Note however that, once the technology has been implemented, an employee's productivity becomes public knowledge (witness the fact that the outside market can then distinguish between low and high types). So the date 2 vote takes place under symmetric information. One may think that the tools provided by mechanism design could help disclose the private information held at date 1; crucially however, an employee's type is two-dimensional. Therefore an incentive compatible mechanism whereby each employee would truthfully announce his type should incorporate transfers contingent on the employee's type under the technology chose off the equilibrium path. As it is only possible to screen on what employees' productivity would turn out to be under the technology chose on the equilibrium path the extent of private information would persist.

As a benchmark, consider the first-best case, where it is feasible to commit to a date 2 redistribution. In this case, it is efficient to choose the project maximizing aggregate production. Without loss of generality, we suppose that:

Technology i is **efficient**, that is: $f_i x_i > f_j x_j$

Notice that a project is characterized not only by its level of efficiency, but also by the fraction

[13] The result that, for a sufficiently high number of agents, free riding precludes efficient transfers under private information dates back to Mailath and Postlewaite (1990).

and productivity of its high type employees. These two variables pin down the nature as well as the extent of redistribution at date 2; therefore, they will also prove to be crucial to determine the voting outcome at date 1. Given project i characterized by $\{f_i, x_i\}$, project j can necessarily be classified as one of the following.

Conditional of the reference technology set $\{i, j\}$, project j is defined as a *dominated* technology, when it delivers fewer high types and they have lower productivity than under project i, that is, $f_j < f_i$ and $x_j < x_i$. Alternatively, project j might be characterized as a *polarized* technology, when it generates fewer high types but who each has greater productivity in comparison with project i, that is, $f_j < f_i$ but $x_j > x_i$. Finally, project j might be described as an *egalitarian* technology, when it delivers a bigger fraction of high types, but who each has a lower productivity in comparison with project i, namely $f_j > f_i$ and $x_j < x_i$. As the last two cases are economically more interesting than the first, we restrict project j to be either polarized or egalitarian.

(A3) Conditional on the technology set $\{i, j\}$, project j is defined as either a polarized or an egalitarian technology. That is,

$$\begin{array}{cc} \text{either} & f_j < f_i \text{ and } x_j > x_i, \\ \text{or} & f_j > f_i \text{ and } x_j < x_i. \end{array}$$

In addition, given that the paper seeks to explore the effect of redistribution on technology choice, we ignore case H under which there is never redistribution.

(A4) At least one of the projects generates a majority of low types.

That is, either case L or S holds.

Now we turn to the main question of this section. Is it possible for a cooperative to select an inefficient project in equilibrium? The answer is positive. Consider the example presented in section 2, satisfying assumptions A1-A4. An independent expedition of 15 explorers has to decide whether to settle on an island with diamonds or on an island with gold. In the diamond island 7 out of the 15 explorers are productive with individual productivity of 12 and outside option of 7. Positive redistribution yields a payoff of 7 and $4\frac{3}{8}$ for a productive and unproductive explorer respectively. In the gold island, 8 explorers are productive with individual productivity of 10. An explorer's payoff equals his individual productivity. The decisive coalition in technology choice is formed by the 8 productive explorers who are productive in the gold island. They favor gold extraction despite the efficiency of diamond extraction. Note that the inefficient project is egalitarian as it generates more productive explorers ($8 > 7$) albeit each has lower productivity ($10 < 12$). But is this a necessary condition for a cooperative to be inefficient? In other words, can a cooperative also vote for an inefficient polarized project? The following example provides the answer.

3. Example: Voting for an inefficient polarized technology

Consider a slight variation of the example presented in section 2. The diamond island is still characterized by 7 productive employees with productivity of 12 and outside option of 7. But now in the gold island 5 explorers are productive with productivity of 16. Their outside option is again 7. Crucially now, unproductive types are in the majority in the gold island. They will thus

expropriate productive types via redistribution. The winning proposal in the vote will be to give out 7 to the productive types and divide the rest $5(16-7)=45$ among the 10 unproductive, each accruing $4\frac{1}{2}$.

As the wealth of the diamond island, $7 \cdot 12 = 84$ is greater than the wealth of the gold island, $5 \cdot 16 = 80$, efficiency calls for diamond extraction. But the cooperative will turn out to be inefficient. In fact, consider the payoff of an explorer who is unproductive in the diamond island. His payoff $4\frac{1}{8}$ is lower than the payoff he would get on the gold island irrespective of whether he is productive or not (7 or $4\frac{1}{2}$). Therefore, he will vote for the gold island. As there are 8 such explorers, they will win the vote. Note that the gold island is polarized as there are fewer productive explorers ($5 < 7$) but with greater productivity ($16 > 12$).

The above example illustrates that there is not a clear direction of inefficiencies towards polarized or egalitarian technologies. Also, a cooperative might be an inefficient institution even when redistribution is anticipated under the efficient technology. More specifically we shall see that only in case L may a cooperative choose an inefficient polarized technology. In case S by contrast, a cooperative will always be efficient provided the inefficient technology is polarized.

Yet we can provide a general result concerning the relative bias of a cooperative in relation to an outside-owned firm. Before presenting the argument, let us first analyze technology choice under outside ownership.

B. Outside Ownership

Consider the behavior of an outside-owned firm. Investors are homogeneous and seek to maximize profits. In this model, profits are defined by the expropriation of employees' productivity. There are two types of participants in the firm. Outside investors, who are endowed with residual control rights and employees who receive a compensation to stay in the firm.

Notice that at date 2, outsiders can differentiate between low and high types. They will thus expropriate high types, obtaining a payoff of $If_i(x_i - w_i)$, under project i. Similarly for project j. Both low and high types will receive their outside options, namely 0 for low types and w_i, w_j for high types under project i and j respectively.

Will an outside-owned firm always choose the efficient project i? Notice that, project i will be chosen if and only if $f_i(x_i - w_i) > f_j(x_j - w_j)$. The fact that investors' payoff increases with project's efficiency may induce outsiders to choose project i as $f_i x_i > f_j x_j$. However, provided $f_i w_i > f_j w_j$, the expropriation effect under project j may dominate the efficiency effect under project i, leading to inefficient technology choice. As an extreme example, consider the case in which high types' inside productivity is almost equal to their outside option under the efficient project (i.e. $w_i \backsimeq x_i$). Outsiders will hence weakly prefer project j, no matter how inefficient this may be. Moreover, the inefficient project j can be selected, irrespective of whether it is polarized or egalitarian relative to project i. However, an egalitarian project can only be selected as long as the high types' outside option under the inefficient project is strictly lower than under the efficient project. To see why, suppose that outside ownership is inefficient, that is, $f_i x_i - f_j x_j < f_i w_i - f_j w_j$. As the LHS of the inequality is positive, this means that $f_i w_i$ must still exceed $f_j w_j$. If project j is egalitarian ($f_j > f_i$), it must be the case that w_j is strictly less than w_i. Yet this constraint does not apply when project j is polarized. This observation may suggest a

stronger bias towards polarized projects than towards egalitarian projects. But is the direction of distortion related to the firm's ownership structure? We turn to this question next.

C. Cooperatives versus Outside Ownership

The above analysis shows that institutional efficiency depends on the set of technologies revealed at date 1. A firm can be inefficient irrespective of its ownership structure; however, the factors leading to inefficiency differ across ownership structures. Whereas in a cooperative, the relative power between low and high types ex-post is crucial to determine efficiency, under outside-ownership the key variable is the firm-specificity of skills. Before providing the general result on technological bias, let us compare the behavior of employee and outside ownership controlling for efficiency. Suppose that i and j are equally efficient, that is, $f_i x_i = f_j x_j$ and that project i is a polarized technology relative to project j, i.e. $f_i < f_j$ and $x_i > x_j$. It is straightforward to show that an outside-owned firm will always choose the polarized technology i. The choice of the employee-owned organization is however more intricate. It will depend on the parameter space. The higher the value of the outside option the more likely it will choose the polarized project. The higher the dispersion of employees' productivity across projects, the more likely it will favor an egalitarian project. Despite the absence of a cooperative's systematic behavior in technology choice we are able to show a systematic technology bias relative to an outside-owned firm. The answer is contained in the following proposition.

Proposition 1 *Assume A1-A4. A cooperative is more biased towards egalitarian technologies than is an outside-owned firm; that is, if an outside-owned firm chooses an inefficient egalitarian technology then so too does a cooperative.*

Correspondingly, an outside-owned firm is more biased towards polarized technologies than is a cooperative; that is, if a cooperative chooses an inefficient polarized technology then so too does an outside-owned firm.

Proof.

Consider the first claim of the proposition. In case S, the characterization of project j as egalitarian implies that $f_i < \frac{1}{2} < f_j$. Assume that an outside-owned firm is inefficient: $f_i(x_i - w_i) < f_j(x_j - w_j)$. But notice that $f_j(x_j - w_j) < f_j(1 - f_j)x_j$, since, by A1, $w_j > f_j x_j$. Also, $f_j(1 - f_j) < (1 - f_j) < (1 - f_i)$. Therefore $f_i(x_i - w_i) < (1 - f_i)x_j$, so that $x_j > \dfrac{f_i(x_i - w_i)}{(1 - f_i)}$. This means that in a cooperative, type (lh) will vote in favor of project j. Remember that, given $f_i < \frac{1}{2} < f_j$, by Lemma 1 type (lh) is pivotal in technology choice. As a result, project j will also be selected by the cooperative.

In case L, project j is egalitarian if $f_i < f_j < \frac{1}{2}$. Note that in case L, by Lemma 1, the pivotal type at date 1 is (ll). Therefore our claim is that, if an outside owner chooses project j, i.e. if $f_i(x_i - w_i) < f_j(x_j - w_j)$, then it follows that $\frac{f_i}{1-f_i}(x_i - w_i) < \frac{f_j}{1-f_j}(x_j - w_j)$. But this claim follows immediately from the fact that $f_i < f_j$.

Let us now turn to the second claim of the proposition. In case S, project j is polarized if $f_j < \frac{1}{2} < f_i$. By Lemma 1, a cooperative will choose project j if the pivotal type (hl) favors it. His

expected payoff is x_i and $\frac{f_j}{1-f_j}(x_j - w_j)$ under projects i and j respectively. But notice that, using A1, $\frac{f_j}{1-f_j}(x_j - w_j) < f_j x_j$. And, since j is inefficient, $f_j x_j < f_i x_i$, which in turn is strictly less than x_i. This means that (hl) will always vote for project i. In other words, a cooperative will never choose a polarized project. By contrast, this is not always true under outside ownership. In particular, an outside owner will choose a polarized project as long as the value of w_i is large enough: $f_j(x_j - w_j) > f_i(x_i - w_i)$ if and only if $w_i > \frac{f_j w_j + (f_i x_i - f_j x_j)}{f_i}$. (Notice that this last inequality may hold even if $w_i < w_j$, given that $f_j < f_i$).

In case L, project j is polarized if $f_j < f_i < \frac{1}{2}$. By Lemma 1, a cooperative will choose project j if the pivotal type (ll) prefers it. That is, if $\frac{f_i}{1-f_i}(x_i - w_i) < \frac{f_j}{1-f_j}(x_j - w_j)$. But given $f_j < f_i$, this inequality implies that $f_i(x_i - w_i) < f_j(x_j - w_j)$. Hence the outside owner will also choose the polarized project j.

QED

In proving this proposition, we have also shown that, provided employees' power changes across projects (so that we are in case S), and as long as the inefficient project j is polarized, a cooperative is always efficient. This is because an employee always prefers to be a high type under the efficient project rather than a low type under the inefficient project; hence type (hl) favors project i. As (hl) is pivotal, he will always form a winning majority in favor of project i. By contrast, an outside owner will instead be inefficient, whenever his expected expropriation receipts are higher under the inefficient project.[14]

The intuition that underlies Proposition 1 is the following. Suppose that an outside-owned firm chooses an inefficient egalitarian technology. Then it must be the case that the inefficient technology allows higher expropriation than does the efficient technology. Now consider a cooperative. In case L, type (ll) is pivotal at date 1. He shares similar preferences with outsiders as, by Lemma 1, he is in power under both technologies and will thus expropriate high types through redistribution. The only difference in preferences being that, for a given level of expropriation, type (ll) favors technologies generating fewer low types as these would allow higher per-capita expropriation. But this is precisely the characterization of an inefficient egalitarian technology. The inefficient behavior exhibited by outside owners is thus emphasized in a cooperative. In case S, the fact that the inefficient technology is egalitarian means that (lh) is pivotal in technology choice. The inefficient technology now looks more attractive to the pivotal type than it did in case L, because it allows him to become a high type, while still being in the majority at date 2. As we know from A1 that, for a given technology, an employee prefers to be a high type rather than a low type, (lh)'s preferences for the inefficient technology will be stronger vis-a-vis type (ll).

Concerning the strong bias towards polarized technologies under outside ownership, note that in case L, if type (ll) favors a polarized technology, –generating more low types– it follows that total expropriation is necessarily higher under the inefficient technology. Therefore, an outside-owned firm would also be inefficient. Finally, the fact that a cooperative is never biased towards

[14] This logic might suggest that an employee may also prefer to be a high type under project j, rather than a low type under project i. If this were the case, whenever the inefficient project j was egalitarian, a cooperative would always be inefficient since the pivotal type is then (lh). Yet, this is not always true. If project i is efficient enough –specifically, if $x_i > w_i + \frac{1-f_i}{f_i} x_j$– then the redistribution effect will dominate the individual productivity effect and a cooperative will be efficient.

polarized technologies in case S completes our result.[15]

IV. Institutional Inertia

So far we have assumed that the firm's ownership structure is in place from date 0, before the choice of technology at date 1. As we have seen in Proposition 1, the initial ownership structure may be inefficient. Moreover, the fact that $\{f_i, x_i\}$ and $\{f_j, x_j\}$ are public knowledge means that everyone can anticipate an inefficient technology choice. In this section, we allow the firm to change its initial constitution as a commitment device to increase efficiency. The question is, will the firm's current owners hand over control rights to prospective efficient owners?

As a case in point, consider a cooperative. We know from Proposition 1 that a cooperative may select an inefficient egalitarian project j, even though an outside owner may not. If this is the case, will employees prefer instead to sell off the firm to efficient outsiders?

The context that we have in mind is one of competition among potential outside owners. Therefore the cooperative will extract all the surplus from a sale. A one-member-one-vote cooperative will divide returns equally among its members. One may wonder why dividends treat employees symmetrically. In principle, we could envisage a contingent rule whereby dividends were tied to employees's type. But this information is private at the date of the constitutional vote. Following constitutional change, employees relinquish their control rights and hence are unable to renegotiate the dividend rule. On the other hand, outsiders cannot credibly commit to compensate employees beyond their outside wage ex-post. Under the veil of uncertainty at date 0 a symmetric dividend rule is the most robust specification to changes in the economic environment including the introduction of risk aversion.

The decision on constitutional change will be driven by a simple majority vote at date 0.[16] It turns out that, with a mild strengthening of A2, we can show that an employee who is pivotal at dates 1 and 2, will also win the vote at date 0. Replace A2 with the following assumption.

(A2') $x_j > (1 - f_i)\, w_i + f_i x_i$.

–and viceversa, interchanging the subscripts i and j.

A2' resembles A2 except for the RHS of the final inequality, which is now a convex combination of w_i and x_i rather than simply w_i.

[15] At this point, it is important to emphasize that Lemma 1 underpins Proposition 1. To illustrate why, let us look back at the example presented in footnote 5, where A2 did not hold. In particular, type (hl), although decisive at date 2, failed to win the date 1 vote.

Given that $f_i x_i = 4.2 > 4 = f_j x_j$, project i is efficient. Also, as $x_j > x_i$ and $f_j < \frac{1}{2} < f_i$, project j is polarized. Recall that the date 1 winning coalition was formed by $\{ll, lh, hh\}$, in favor of project j.

On the other hand, notice that an outside-owned firm will choose the efficient project since $f_i\,(x_i - w_i) = 1.4 > 0.8 = f_j\,(x_j - w_j)$. Although the extent of expropriation is the same across technologies, project i delivers a higher number of high types. Thus, here is an example where Lemma 1 fails and the cooperative is more biased towards polarized projects than an outside owner.

[16] We might think of a more stringent voting rule, i.e. qualified majority. A more inclusive rule would be more conducive to constitutional inertia (as private information rules renders bargaining unfeasible). Our results would then be reinforced.

Surprisingly, an inefficient cooperative will never vote to sell off the firm to outsiders. That is, there is institutional inertia.

Proposition 2 *Assume A1, A2', A3 and A4. A cooperative that is currently voting for an inefficient technology will never sell to an outside owner in order to restore efficiency.*

Proof

We know from Proposition 1 that if the cooperative is voting for an inefficient technology and the outside owner is not, then the inefficient technology must be egalitarian, i.e., $f_i < f_j$. When casting his vote at date 0, each employee computes his expected payoff under both employee and outside ownership. Remember that an outside owner is efficient but cannot commit not to expropriate high types ex-post. This implies that the profit of investors under outside ownership is determined by $If_i(x_i - w_i)$. As the cooperative extracts all surplus from outside owners and divides the returns uniformly among its members, each employee receives $f_i(x_i - w_i)$ as a lump sum at date 0, in addition to his salary, under outside ownership. The equilibrium outcome at date 0 depends on the preferences exhibited by the winning coalition.

Under S, project j is egalitarian when $f_i < \frac{1}{2} < f_j$. Provided type (lh) can always form a winning coalition at date 0, the outcome on constitutional change will be robust to any ex-ante distribution of types $\{g_{ll}, g_{lh}, g_{hl}, g_{hh}\}$. The fact that the cooperative is inefficient and that (lh) is decisive in technology choice implies that $x_j \geq \frac{f_i}{1-f_i}(x_i - w_i) > f_i(x_i - w_i)$, where the last term captures the payoff accruing to (lh) upon sale. Thus, type (lh) favors employee ownership. Type (ll) by contrast will vote in favor of constitutional change. Whereas his individual productivity is always zero, the anticipates no redistribution under employee ownership but yet he receives a dividend under outside ownership. Finally, type (hh)'s anticipated payoff following constitutional change is $w_i + f_i(x_i - w_i)$. By A2' this payoff is weakly lower than his expected payoff under employee ownership, namely x_j. The winning coalition will thus be formed by $\{lh, hh\}$ in favor of the initial constitution.

Under L, project j is egalitarian when $f_i < f_j < \frac{1}{2}$. Note that if type (ll) prefers employee ownership so too does type (lh). Whereas under outside ownership the payoff of both types is the same – in particular they are both unproductive when the efficient technology is implemented–, under employee ownership the payoff of (lh) is strictly greater than (ll)'s payoff – as the cooperative implements the inefficient project and by A1 $w_j > f_j x_j$ –. Likewise if type (ll) prefers instead outside ownership, so too does type (hl). The argument mirrors the previous logic. In effect, under outside ownership the payoff of both types is the same, but under employee ownership the payoff of (hl) is greater. Therefore, type (ll) can always form a winning majority in favor of his preferred constitution; that is, (ll) is decisive at the date 0 vote. Crucially, as he is also decisive in technology choice, the cooperative can only be inefficient if and only if $\frac{f_j}{1-f_j}(x_j - w_j) > \frac{f_i}{1-f_i}(x_i - w_i)$. But $\frac{f_i}{1-f_i}(x_i - w_i) > f_i(x_i - w_i)$, where the RHS captures (ll)'s payoff under outside ownership. Therefore, the winning coalition will vote in favor of employee ownership.

QED

One may wonder how the results would change if A2' did not hold. Given technology set $\{i, j\}$, A2' is only binding under split balance of power. In such case, it can be shown that the coalition

formed by $\{ll, hl, hh\}$ would favor constitutional change whereas (lh) would vote in favor of employee ownership. Still, under split balance of power, it is possible for (lh) to form a majority Therefore the voting outcome will depend on the parameter space $\{g_{ll}, g_{lh}, g_{hl}, g_{hh}\}$. Provided $g_{lh} > \frac{1}{2}$ the result on institutional inertia would persist.

The above result shows that an inefficient cooperative fails to sell off to outsiders even when it holds all bargaining power at the selling stage and hence a take-it-or-leave-it offer would allow all employees to internalize aggregate surplus. The reason why this compensation is not sufficient to guarantee constitutional change draws on the vested interests enjoyed by the pivotal type at the selling stage. Crucially, these vested interests arise from his political clout in all collective decisions implemented under employee ownership, namely technology choice and redistribution. Showing that all future political power lies in the hands of the voter who is pivotal for constitutional change, simplifies the intuition underlying the result on institutional inertia. The argument is as follows. A cooperative can only become an inefficient institution when the type who is decisive at date 1 favors the inefficient technology. But he is also decisive at date 2. Therefore he neglects the efficient technology despite his power to set redistribution ex-post. Yet if the firm is sold off to outsiders, not only will the efficient technology be implemented but also he will lose power to expropriate the minority. On the other hand, he will be compensated through the selling price in the form of a lump sum dividend ex-ante. This dividend however treats all employees symmetrically as outsiders are unable to discriminate between low and high types at this stage. Making a promise to increase low types' compensation once the technology is implemented is not credible. Hence the payoff accruing to the pivotal type from the inefficient technology is strictly greater than his payoff from the efficient technology. As the inefficient technology is implemented only under employee ownership, institutional inertia follows. In short, the initial constitution is favored by the decisive type as a shield to perpetuate his political power within the firm.

V. Discussion

A. Supporting Evidence

An extensive empirical literature has studied the performance of cooperatives relative to outside-owned firms. Most of the results are ambiguous or fail to generate robust evidence in favor of the tested hypotheses. Yet one persistent empirical regularity holds in most of the case studies analyzed in the literature as summarized by Bonin, Jones and Putterman (1993) and Hansmann (1996): cooperatives present lower wage dispersion than outside-owned firms. For instance, in plywood cooperatives, nearly all employees adhere to a scheme under which all members receive the same rate of pay regardless of their task and seniority. Most law firms share the partnership's earnings equally among partners regardless of their individual productivity even if this is easily measurable. In the world's largest worker cooperative, Mondragon Cooperative Corporation (MCC)[17], 30 per cent of an employee's salary is transferred to a collective account. The traditional view to explain this compression of individual payoffs hinges on social preferences whereby redistribution between high and low productivity types is favored. By contrast, our model accounts for this stylized fact endogenously by allowing cooperative members to vote on a

[17]The Mondragon Cooperative Corporation based in Spain consists of over 150 companies in sectors such as manufacturing and engineering, as well as retail, finance and education.

sharing rule that may yield a redistributive scheme in equilibrium, thus narrowing the payoff gap across employees even in the absence of any social preferences.

More interestingly, anecdotal evidence reported in Bonin, Jones and Putterman (1993) indicates that a cooperative's employee-owners tend to do similar work in the firm at the expense of diversification of technology and productive activities as well as the division of labor. This is in line with our Proposition 1. Also, rarely do employee-owners have substantially different types of skills. This allows them to commonly rotate over time across projects as observed in the semi-skilled US plywood cooperatives as well as in the partnerships arrangements of professional services. Within MCC, if a subsidiary is hit by declining profits thus putting at risk the survival of the cooperative, employees are automatically redeployed to another subsidiary within the cooperative. This indicates that not only payoffs but also productivity is more evenly distributed across employees in worker cooperatives. Again, this is in line with Proposition 1 which shows that cooperatives are relatively more biased towards technologies generating a greater number of high types albeit with lower individual productivity than investor-owned firms, or in other words, that the productivity across employees is likely to be less dispersed in employee-owned firms.

A prominent example of persistence of the cooperative form is the credit union industry. Credit unions are cooperative financial institutions found in the retail financial sector of many countries.[18] Davis (2001) argues that conditions conducive to survival as a cooperative include a large competitive advantage, a long membership tenure, and a low growth rate so that intergenerational conflicts between members of a credit union are minimized. Our paper highlights the political economy constraints that may explain the continuance of the cooperative form even following a decline in competitive advantage.

B. Implications for Institutional Design

Our model points at various mechanisms that could circumvent the persistence of productive inefficiency in a cooperative. The first mechanism that comes to mind is an insurance scheme devised after a new, more efficient technology has become available but before the vote on technology choice takes place. Employees whose final payoff would shrink following the adoption of the new technology would be willing to pay an up-front premium that would guarantee a payment ex-post following a bad realization of productivity. However, this scheme boils down to a system of compensating transfers by which high types compensate low types. Limitations imposed by asymmetric information render this scheme unfeasible. To ensure efficient technology choice, compensation must be contingent on the loss of individual productivity relative to the inefficient technology. Yet it is feasible to screen on realized individual productivity only under the technology chosen on the equilibrium path but not off the equilibrium path.

A second possibility is to carefully design some governance provisions to minimize the likelihood of inefficient technology choice. First, one could remove from majority voting the set of projects that generate heterogeneity across employees so as to mitigate conflict. Second, the scope for redistribution could be restricted in the initial constitution of the cooperative. Anecdotal evidence offers some support to both options. Barzel and Sass (1990) show that projects whose

[18] For a recent overview of the credit union industry in Europe and the U.S., see Fonteyne (2007) and Goddard and Wilson (2005), respectively. While credit unions are owned by their customers (not their workers), it is easy to imagine how to translate our results to the case of customer cooperatives.

total net value is positive but on which members' opinions are likely to be divided, are excluded from the domain of voting in cooperatives of condominium developers. Likewise, Benham and Keefer (1991) explain that the constitution of the MCC cooperative limits direct voting on controversial issues such as maximum wage dispersion.

A third possibility is to change the allocation of control rights across employees. Since a superior technology is forgone whenever low productivity employees fear a low redistribution policy following investment, the allocation of more voting rights to high types would mitigate this problem. If one identifies high types with more senior employees who have accumulated more firm-specific skills over time, the model then provides a rationale for partnerships (i.e. the allocation of control rights according to seniority).

VI. Concluding Remarks

This paper has developed a simple framework to explore the relative efficiency of two alternative institutions, employee and outside ownership, and has drawn implications for institutional dynamics in the face of technology shocks.

Taking as given the firm's ownership structure, the paper has derived two main results on how firm ownership affects technology choice and wage dispersion. First, a systematic bias in technology choice emerges contingent on firm ownership. Whereas outside-owned firms are relatively more biased towards positively skewed technologies, i.e. polarized technologies, employee-owned firms are relatively more biased towards negatively skewed technologies, i.e. egalitarian technologies. Second, the model points at an amplification effect from firm ownership to wage dispersion by endogenizing the sharing rule. This latter result obtains because of the complementarity between the organization-specific distribution of employees' productivity and the technology-specific wage spread. A testable implication of the model is that industries witnessing an increasing presence of corporations at the expense of employee-owned firms also witness a rise in residual wage dispersion, as productivity derives from unobservable multidimensional ability.[19]

The model proposed here also sheds some light on the dynamics of institutional change. In principle one may expect that selling off the firm to an outside investor may serve to restore efficiency. Yet we demonstrate that the technological inefficiency does not vanish even if the firm can change the ownership structure at no cost. The intuition behind this negative result lies in the endogeneity of the sharing rule. The pivotal voter under employee ownership anticipates that he will lose it political clout to set redistribution under outside ownership. Even if the up-front compensation received at the selling stage together with the efficiency gains from the superior technology could in principle suffice to compensate him for the loss of vested interests this does not happen in equilibrium. Crucially, as the pivotal voter for institutional change turns out to be also pivotal for technology choice, the firm enters into an institutional trap whereby majority voting and inefficient technology reinforce each other. This result obtains regardless of employees' bargaining power vis-à-vis outside investors, thus giving rise to institutional inertia.

The analysis developed in this paper can be extended in several important dimensions, of which

[19] Empirical evidence on the growing prevalence of outside-owned firms in industries traditionally dominated by cooperatives (Morrison and Wilhelm, 2008) together with the sharp increase in residual wage dispersion over the last 25 years (Acemoglu, 2002) seem to lend some support to this prediction.

we briefly highlight two. We have emphasized here the key role played by redistribution in sustaining inefficient technology choice. This contrasts with the more traditional efficiency-equality trade-off generated by redistribution whereby individual underinvestment arises from the prospect of future redistribution. In Valderrama (2009a) we consider this trade-off in a set-up where employees can make a firm-specific investment at an interim stage –i.e. once the technology has been implemented but before the vote on redistribution takes place. We prove that the anticipation of redistribution may help the firm improve its technology choice even in the presence of distortions in individual investment. More importantly, the efficiency gains derived from a better technology may outweigh the losses due to individual underinvestment leading to higher overall productivity. Our result suggests the potential for an indirect efficiency-enhancing role of redistribution in addition to its direct social welfare effect. In another companion paper (Valderrama, 2009b), we explore the effect of technological uncertainty on institutional change. We show that the individual uncertainty generated by innovation may not be all bad news, as greater uncertainty reduces the scope for institutional inertia thus favoring the adoption of innovation under the new institutional form. Other questions that could be explored in future research building on our model include the birth and death of institutional forms in a competitive industry equilibrium when the same technology set is available to all firms irrespective of their type, and the conversion of outside-owned firms into cooperatives when investors are heterogeneous.

References

Acemoglu, Daron, 2002, "Technical Change, Inequality, and the Labor Market," *Journal of Economic Literature,* Vol. 40, pp. 7-72.

Acemoglu, Daron, 2003, "The Form of Property Rights: Oligarchic vs. Democratic Societies," NBER Working Papers No. 10037. (Cambridge, Massachussetts: National Bureau of Economic Research).

Acemoglu, Daron, and Simon Johnson, 2005, "Unbundling Institutions," *Journal of Political Economy,* Vol. 113, pp. 949-995.

Aghion, Philippe, and Patrick Bolton, 2003, "Incomplete Social Contracts," *Journal of the European Economic Association,* Vol. 1, pp. 38-67.

Alboek, Svend, and Christian Schultz, 1997, "One Cow, One Vote?," *Scandinavian Journal of Economics*, Vol. 99, pp. 597-615.

Bar-Isaac, Heski, 2007. "Something to prove: reputation in teams," *RAND Journal of Economics,* Vol 38, pp. 495-511.

Barzel, Yoram, and Tim R. Sass, 1990, "The Allocation of Resources by Voting," *The Quarterly Journal of Economics*, Vol. 105, pp. 745-771.

Benham, Lee, and Philip Keefer, 1991, "Voting in Firms: The Role of Agenda Control, Size and Voter Homogeneity," *Economic Inquiry*, Vol. 29, pp. 706-719.

Besley, Timothy,.and Stephen Coate, 1998, "Sources of Inefficiency in a Representative Democracy: A Dynamic Analysis," *American Economic Review*, Vol. 88, pp. 346-75.

Bolton, Patrick, and Chenggang Xu, 2001, "Ownership and Managerial Competition: Employee, Customer or Outside Ownership," Sticerd Discussion Paper TE/01/412 (London: London School of Economics).

Bonin, John, Derek C. Jones, and Louis Putterman, 1993, "Theoretical and Empirical Studies of Producer Cooperatives: Will Ever the Twain Meet?," *Journal of Economic Literature,* Vol. 31, pp. 1290-1320.

Burgess, Simon, Julia Lane, and Kevin McKinney, 2004, "Matching, Reallocation and Changes in Earnings Dispersion," (unpublished; Bristol: Bristol University).

Canton, Erik, Henri de Groot, and Richard Nahuis, 2002, "Vested interests, population ageing and technology adoption," *European Journal of Political Economy,* Vol. 18, pp. 631-652.

Davis, Kevin, 2001, "Credit Union Governance and Survival of the Cooperative Form," *Journal of Financial Services Research,* Vol. 19, pp. 197-210.

Djankov, Simeon, Edward L. Glaeser, Florencio Lopez de Silanes, Rafael La Porta, and Andrei Shleifer, 2003, "The New Comparative Economics," *Journal of Comparative Economics,* Vol. 31, pp. 595–619.

Fonteyne, Wim, 2007, "Cooperative Banks in Europe–Policy Issues," IMF Working Paper No. 07/159, (Washington: International Monetary Fund).

Goddard, John, and John O. S, Wilson, 2005, "US Credit Unions: An Empirical Investigation of Size, Age and Growth," *Annals of Public and Cooperative Economics*, Vol. 76, pp. 375-406.

Grossman, Ssanford J., and Oliver Hart, 1986, "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, Vol. 94, pp. 691-719.

Hansmann, Henry, 1996, *The Ownership of Enterprise* (Cambridge and London: Harvard University Press).

Hart, Oliver, and John Moore, 1990, "Property Rights and the Nature of the Firm," *Journal of Political Economy,* Vol. 98, pp. 1119-1158.

——, 1998, "Cooperatives versus outside ownership," NBER Working Papers No. 6421. (Cambridge, Massachussetts: National Bureau of Economic Research).

Jovanovic, Boyan, 2009, "The Technology Cycle and Inequality," Review of Economic Studies (Forthcoming).

Juhn, Chinhui, Kevin M. Murphy, and Brooks Pierce, 1993, "Wage Inequality and the Rise in the Returns to Skill," *Journal of Political Economy,* Vol. 101, pp. 410-42.

Katz, Lawrence, and David Autor, 2000, "Changes in the Wage Structure and Earnings Inequality," *Handbook of Labor Economics* vol. III, Orley Ashenfelter and David Card, eds. (Amsterdam: Elsevier).

Kremer, Michael, 1997, "Why are Worker Cooperatives So Rare?," NBER Working Papers No. 6118. (Cambridge, Massachussetts: National Bureau of Economic Research).

——, 1999, "Worker Cooperatives as Economic Democracies," (unpublished; Cambridge: Massachusetts Institute of Technology).

Krusell, Per, Lee Ohanian, Victor Rios-Rull, and Giovanni Violante, 2000, "Capital Skill Complementary and Inequality," *Econometrica,* Vol. 68, pp. 1029-1053.

Levin, Jonathan, and Steven Tadelis, 2005, "Profit Sharing and the Role of Professional Partnerships," *Quarterly Journal of Economics,* Vol. 120, pp. 131-171.

Levy, Frank, and Richard J. Murnane, 1992, "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations," *Journal of Economic Literature*, Vol. 30, pp. 1333-81.

Mailath George W., and Andrew Postlewaite, 1990, "Asymmetric Information Bargaining Problems with Many Agents," *Review of Economic Studies,* Vol. 57, pp. 351-67.

Morrison, Alan, and William J. Wilhelm, 2004, "Partnership Firms, Reputation and Human Capital," *American Economic Review*, Vol. 94, pp. 1682-1692.

——, 2008. "The Demise of Investment Banking Partnerships: Theory and Evidence," *Journal*

of Finance, Vol. 43, pp. 311-350.

Perotti, Enrico, and Ernst-Ludwig von Thadden E, 2006, "The Political Economy of Corporate Control and Labor Rents," *Journal of Political Economy*, Vol. 114, pp. 145-176.

Rajan, Raghuram, and Luigi Zingales, 2001, "The Firm as a Dedicated Hierarchy: A Theory of the Origins and Growth of Firms," *The Quarterly Journal of Economics*, Vol. 116, pp. 805-851.

——, 2003, "The Great Reversals: The Politics of Financial Development in the Twentieth Century," *Journal of Financial Economics*, Vol. 69, pp. 5-50.

Rey, Patrick, and Jean Tirole, 2007, "Financing and access in cooperatives," *International Journal of Industrial Organization*, Vol. 25, pp. 1061-1088.

Roberts, John, and Eric Van den Steen, 2001, "Human Capital and Corporate Governance," in *Corporate Governance: Essays in honor of Horst Albach,* Joachim Schwalbach, and Horst Albach, ed. (Heidelberg: Physica-Verlag).

Roberts, Kevin, 1999, "Dynamic Voting in Clubs," Sticerd Discussion Paper No. 99/367. (London: London School of Economics).

Valderrama, Laura, 2009a, "Dynamic Voting under Moral Hazard" IMF Working Paper (Forthcoming) (Washington: International Monetary Fund).

——, 2009b, "Political Risk Aversion," IMF Working Paper (Forthcoming) (Washington: International Monetary Fund).