Organization based cross-subsidization: 
Who must pay to incentivize managers?  

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Abstract 
We study a competitive model in which firms’ organization structure is determined jointly with production and contractual decisions. Firm shareholders can either delegate production to a self-interested manager, or run the business on their own. Because of labor specialization, managers are more efficient than shareholders: the bright side of delegation. But, due to moral hazard, they can divert part of the firm revenues in order to enjoy private benefits at the shareholders’ expense: the dark side of delegation. We characterize the competitive equilibrium of the model and find necessary and sufficient conditions under which this outcome does not maximize social welfare. Considering alternative informational regimes, we then characterize the welfare maximizing budget-balancing fiscal policy. If it is possible to tax and subsidize firms based on their shareholders’ monitoring ability, the first best is implemented by a policy that taxes delegated firms and subsidizes self-managed ones. This cross-subsidization scheme may however fail to implement the first-best when demand is sufficiently inelastic to price. In this case, the planner is willing to tolerate an equilibrium with a (second best) optimal number of self-managed firms. Finally, when the planner does not observe shareholders’ monitoring ability, it is impossible to design a cross-subsidization policy that screen shareholders. In this case, the (third-best) policy features pooling and yields an outcome worst than the second best one.  

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1 Introduction

The 2014 Good Jobs First report, “Subsidizing the Corporate One Percent” reports striking results from the subsidy tracker study i.e. that about three-quarters of all economic development subsidies granted by U.S. States from 1976 onwards, went to just 965 corporations, through more than 245,000 subsidy awards for an approximate value of 110 billion dollars. This anecdotal evidence seems puzzling: why are U.S. national governments willing to distribute 75% of public money to big Corporations, rather than financing teachers, health-care, or other public goods with redistribution purposes? As noticed by tax analyst David Brunori: “(...) state governments decided what is best for producers and consumers. [...] Narrow business interests manipulate government policymakers, and those interests prosper to the detriment of everyone else (Forbes, 3/14/2014)”. The key question to understand government behavior is to identify such “narrow business interest”. Besides rent-seeking explanations by public choice theories (Stigler, 1976; Schleifer and Vishny, 1998), these can be motivated by problems of moral hazard that arise when firms are run by managers that act in their rather than in shareholders’ interests (Legros and Newman, 2013).

In the present paper we analyze the cross-subsidization schemes chosen by a social planner willing to implement the optimal organization structure of an industry. We study a competitive model in which firms’ organization structure is determined jointly with production and contractual decisions. Firm shareholders can either delegate production to a self-interested manager, or run the business on their own. Delegation yields benefits to shareholders but also imposes some losses. Because of labor specialization, managers are more efficient than shareholders, which increases firms productivity. However, due to moral hazard, managers can divert part of the firm revenues in order to enjoy private benefits at the shareholders’ expenses. We characterize the competitive equilibrium of the model and find necessary and sufficient conditions under which the equilibrium does not maximize social welfare. Considering alternative informational regimes, we then characterize the welfare maximizing budget-balancing fiscal policy. Our results suggest that if it is possible to tax and subsidize firms based on their shareholders’ monitoring ability, the first best is implemented by a policy that taxes delegated firms and subsidizes self-managed ones. This cross-subsidization scheme may however fail to implement the first-best when demand is sufficiently inelastic to price. In this case, the planner is willing to tolerate an equilibrium with a (second best) optimal number of self-managed firms. Finally, when the planner does not observe shareholders’ monitoring ability, it is impossible to design a cross subsidization policy that screen shareholders. In this case, the (third-best) policy features pooling and yields an outcome worst than the second best one.

Up to our knowledge, this is the first paper that analyzes optimal taxation and subsidization in a general equilibrium framework with managerial firms. It contributes to two main strands of the economic literature. The first the one that envisages a corrective role for tax policies in the presence of various forms of market imperfections. The existing literature generally looked at imperfect competition e.g. due to symmetric Cournot-Nash oligopolies (Delipalla and Keen(6)), horizontal and vertical product differentiation (Kay and Keen(13); Cremer and Thisse (5); Keen(14)) and Bertrand price competition with differentiated products (Andersen, de Palma and Kreider(2)). In addition and in contrast with the main focus in this body of work is the welfare comparison of ad-valorem and unit taxes (see Keen(14) for a synthesis).
these studies that focus on imperfect competition, we highlight a cross-subsidization policy that serves a corrective in the presence of moral hazard problems at the firm level. The second strand of the literature is the one that looks at allocation of property rights and the choice of firm governance e.g. between integrated and non-integrated production structures with incomplete contracts (Hart and Holmstrom (10)) or in principal-agents frameworks featuring the manager as an agent characterized by moral hazard (Holmstrom and Tirole (?)) in partial equilibrium. The recent contribution by Legros and Newman (16) is the first one that points out in a general equilibrium framework the welfare maximizing industry structure in the presence of managerial firms and incomplete contracts. Relative to Legros and Newman (16) we describe the optimal organizational structure with managerial firms in a setting with moral hazard and describe the optimal policy by a government under alternative information structures regarding shareholders’ monitoring ability over managers.

The paper is structured as follows. In Section 2 we describe the economy. In Section 3 we present the market equilibrium. In Section 3 we discuss welfare with complete and incomplete information on the government’s side.

2 The Economy

Players and Environment. A perfectly competitive market has a continuum of unit mass of risk-neutral firms that produce a homogeneous good. Following Legros and Newman (2013), we assume that there is a representative consumer with smooth quasi-linear utility function

\[ u(x) - px, \]

where \( x \geq 0 \) represents the quantity consumed and \( p \) the market price, with \( u'(\cdot) > 0 \) and \( u''(\cdot) \leq 0 \).

Since the consumer takes the price \( p \) as given, the first order condition for the utility maximization, \( u'(x) = p \), yields a standard differentiable downward-sloping demand function \( D(p) = u'^{-1}(p) \).

Organizational structure and technology. Firms take the (correctly anticipated) market price \( p \) as given when making their production decisions. Each firm owner (principal) may rely on a self-interested manager (agent) to run the firm. Specifically, each principal can either manage the firm on his own (self-management) or delegate production to a self-interested agent (delegation). In the economy there is a mass \( M > 1 \) of risk-neutral managers, with reservation utility normalized to zero without loss of generality.

For simplicity, we assume that each firm either produces 1 unit of the good, or it does not produce at all — i.e., a firm’s supply is \( y_i \in \{0, 1\} \). A binary production technology provides a reasonable approximation of firms’ production decisions in a perfectly competitive market, since firms are price takers and can either produce zero or a fixed share of the total quantity demanded. A self-managed firm produces 1 unit with probability \( \theta \in [0, 1] \), and 0 otherwise. Because of labor specialization, managerial firms are more productive than self-managed firms provided that managers do not shirk. In fact, due to moral hazard, managers that misbehave can divert part of the firm revenues in order to enjoy private benefits at the shareholders’ expense. Specifically, when a principal hires an agent, the firm’s production technology depends on the agent’s unobservable effort \( a_i \in \{0, 1\} \), where 0 means no effort (shirking) and 1 stays for high effort. A non-shirking manager produces 1 unit with probability \( \theta + \Delta \in [0, 1] \), where \( \Delta \)
represents his ‘value added’ to the firm. A manager that shirks does not produce.

Following Holmstrom and Tirole (***) and the subsequent literature, we assume that when an agent is employed by principal $i$ and shirks he enjoys a private benefit $B_i$, which we will interpret as an inverse measure of principal-$i$’s monitoring ability. To save on notation, we assume that agents’ effort cost is zero regardless of whether they work or shirk. The underlying idea is that principals have specific (monitoring) skills that limit the ability of their agents to ‘steal’ resources from the firm. These skills are heterogenous across principals: $B_i$ is independently distributed across the population of principals with an atomless cdf $F(B)$ over the support $[0, 1]$, with density $f(B) > 0$ and mean $E[B]$. Production costs are standardized to zero with no loss of generality.

Contracts. Principals that delegate production must induce agents to exert effort. Since effort is unobservable, principals can only offer wages that are conditioned on the realized output $y_i$ — i.e., offers $w_i(y_i)$. Agents are protected by limited liability — i.e., they cannot accept a negatative wage.

Timing. The timing is as follows:

- Principals learn their monitoring ability.
- They choose an organizational form and offer wages to their managers.
- Production takes place, agents are rewarded and products are traded.

Payoffs, Definitions and main assumptions. For any wage offer $w_i(\cdot)$, agent-$i$’s expected utility is

$$\sum_{y_i \in \{0, 1\}} \Pr[y_i|a_i] w_i(y_i) + I_{a_i} B_i,$$

where $I_0 = 1$ and $I_1 = 0$. Similarly, for any (expected) market price $p$, principal-$i$’s expected profit is

$$\sum_{y_i \in \{0, 1\}} \Pr[y_i|a_i] \left[ p y_i - w_i(y_i) \right].$$

A (symmetric) competitive equilibrium in which agents exert high effort entails a market clearing price $p^\ast$; a mass $B^\ast$ of firms that are lead by an agent; a wage structure $w^\ast(y_i)$; an effort choice $a^\ast \in \{0, 1\}$ such that:

- The market clears — i.e.,

$$D(p^\ast) = \underbrace{\int_0^{B^\ast} \int_{\theta + \Delta} \theta dF(B) + \int_{B^\ast} \theta dF(B)}_{\text{Aggregate Supply}}.$$

- The wage $w^\ast(y_i)$ satisfies the following incentive-compatibility constraint

$$\sum_{y_i \in \{0, 1\}} \Pr[y_i|a_i = 1] w_i^\ast(y_i) \geq \sum_{y_i \in \{0, 1\}} \Pr[y_i|a_i = 0] w_i^\ast(y_i) + B_i,$$
Principal \( i \) hires a manager if and only if
\[
\sum_{y_i \in \{0, 1\}} Pr \{y_i | a_i = 1 \} [p^* - w^*_i (y_i)] \geq \theta p^*.
\]

Finally, to guarantee the existence of an equilibrium we posit that:

**Assumption 1.** \( D(0) > \theta + \Delta \) and \( D(p) < \theta \) for some \( p \) large enough.

This assumption guarantees that there always exists a price that clears the market when all firms are self-managed or when they are all lead by an agent. Finally, agents are protected by limited liability.

## 3 Market equilibrium

In this section we characterize the competitive equilibrium of the model and describe its main features. To begin with, note that because principals are risk-neutral and agents are protected by limited liability, it is optimal for a principal that hires an agent to offer a wage such that \( w_i(1) = w_i \geq 0 = w_i(0) \). In addition, since \( w_i \) must induce agents to exert high effort, the following incentive compatibility constraint must hold
\[
(\theta + \Delta) w_i \geq B_i \implies w_i \geq \frac{B_i}{\theta + \Delta},
\]
which is met as an equality in equilibrium. Hence, for any expected market price \( p \), principal \( i \)'s expected profit is
\[
\pi_i (p) = \max \{(\theta + \Delta) p - B_i, p\theta\},
\]
where \((\theta + \Delta) p - B_i\) is principal-\( i \)'s profit when he delegates and \( p\theta\) is the profit that he obtains when he runs the firm on his own.

**Lemma 1** Firm \( i \) is run by a manager if an and only if
\[
B_i \leq B^*(p) \equiv \min \{1, p\Delta\}.
\]  

Hence, only principals with relatively strong monitoring ability hire an agent in equilibrium. The incentive to do so become more pronounced when the market price \( p \) increases.

Notice that condition (1) is useful to derive the market conditions consistent with all firms chosing delegation. By definition, \( B^*(p) = 1 \) is the threshold level consistent with a fully delegated industry structure, because \( B_i \leq 1 \) by assumption.

Building on Lemma 1 we can now characterize the market equilibrium — i.e., the market clearing price \( p^* \) and the industry structure which is reflected by the threshold \( B^*(p^*) \). To this purpose, we first define the aggregate supply function. Using the law of large numbers (as in Legros and Newman, 2013), the aggregate supply function is (almost surely) equal to
\[
S(p) = \int_0^{B^*(p)} [\theta + \Delta] dF(B) + \int_1^{B^*(p)} \theta dF(B) = \theta + F(B^*(p)) \Delta,
\]
which is weakly increasing in \( p \). Essentially, the supply function is equal to the common productivity factor \( \theta \) plus the excess supply that is generated by those principals hire an agent to run the firm in their
behalf.

Let $\theta(\Delta) \equiv D(1/\Delta) - \Delta$. We can establish the following.

**Proposition 2** If Assumption 1 holds, there exists a unique competitive equilibrium such that:

- If $\theta > \theta(\Delta)$, then $B^* < 1$ and the equilibrium price solves
  \[ p^* = u'(\theta + F(p^*\Delta) \Delta). \]

- If $\theta \leq \theta(\Delta)$, then $B^* = 1$ and the equilibrium price is
  \[ p^* = u'(\theta + \Delta), \]
  with $u'(\theta + F(p^*\Delta) \Delta) > u'(\theta + \Delta)$.

This proposition shows that the equilibrium industry composition hinges both on demand and supply side characteristics. If agents are sufficiently productive — i.e., is $\theta$ is relatively large — managerial and self-managed firms coexist at equilibrium. The reason is that when principals are sufficiently efficient on their own, there cannot be an equilibrium in which all firms delegate because the excess supply that this would imply has a negative effect on the equilibrium price and therefore “backfires” the principals’ incentive to delegate because, other things being equal, it is less convenient to hire an agent.

Let $\tilde{\varepsilon}(p^*) = |D'(p^*)|p^*$ denote the quasi-elasticity of demand to the equilibrium price — i.e., the sensitivity of demand to a percentage increase in the equilibrium price, keeping other factors constant.

**Lemma 3** The equilibrium price $p^*$ is decreasing in $\Delta$ and $\theta$. Moreover, $B^*$ is decreasing in $\theta$, while the effect of $\Delta$ on $B^*$ is ambiguous. In particular, assuming $\theta > \theta(\Delta)$, then

\[ \frac{dB^*}{d\Delta} = \frac{\tilde{\varepsilon}(p^*) - F(p^*\Delta) \Delta}{f(p^*\Delta) \Delta^2 + |D'(p^*)|} \leq 0 \iff \tilde{\varepsilon}(p^*) \leq F(p^*\Delta) \Delta. \]

Obviously, the market clearing price is decreasing both in $\Delta$ and $\theta$: an increase of these parameters spurs production, and hence reduces $p^*$. This also explains why $B^*$ is decreasing in $\theta$. The impact of a higher $\Delta$ on $B^*$ is ambiguous though. First, for given price, a higher $\Delta$ induces principals to be more willing to hire an agent because (ceteris paribus) this spurs production: a direct quantity effect. However, a higher $\Delta$ also triggers the backfire effect discussed above: if there are too many principals that hire a manager, supply increases and the market price falls. Hence, other things being equal, this makes it less convenient for principals to hire an agent: an indirect price effect. When the elasticity of demand to price is sufficiently low, this effect is relatively stronger than the efficiency effect. As a result, a higher $\Delta$ reduces the number of principals that delegate — i.e., it reduces $B^*$.

The linear example. To gain additional insights on the demand characteristics that drive the industry structure consider the linear demand function $D(p) = 1 - bp$, with $\tilde{\varepsilon}(p) = bp$. The condition for an equilibrium where both organizational forms coexist is

\[ \theta > \theta(\Delta) \equiv 1 - \frac{b + \Delta^2}{\Delta}, \]
which is obviously easier to satisfy when \( b \) increases — that is, when the demand elasticity to price is high. By contrast, differentiating with respect to \( \Delta \)

\[
\frac{\partial \theta(\Delta)}{\partial \Delta} = \frac{b - \Delta^2}{\Delta^2} \geq 0 \iff b \geq \Delta^2.
\]

As discussed above, this simple comparative statics suggests that an increase in the agents’ productivity increment \( \Delta \) has ambiguous effects on the equilibrium industry configuration. Indeed, if \( F(\cdot) \) is uniform, we can even compute the equilibrium price

\[
p^* = \frac{1 - \theta}{b + \Delta^2},
\]

and the mass of principals that delegate in equilibrium, as implied by the parameter

\[
B^* = \frac{(1 - \theta) \Delta}{b + \Delta^2},
\]

which is decreasing in \( b \) and \( \theta \), while the impact of \( \Delta \) is again ambiguous — i.e.,

\[
\frac{\partial B^*}{\partial \Delta} = \frac{(1 - \theta) (b - \Delta^2)}{(b + \Delta^2)^2} \leq 0 \iff b \leq \Delta^2,
\]

which implies that when demand is not enough responsive to price, an increase in the agents’ productivity leads fewer firms to delegate.

4 Welfare maximization and cross-subsidization

Having characterized the market equilibrium, in this section we study the industry structure that maximizes social welfare and discuss how this outcome can be decentralized through cross-subsidization. Specifically, considering alternative information regime, we will study the conditions under which a planner can implement the first best outcome, and when this is not feasible we will derive the second and third best policies.

4.1 The first-best benchmark

To begin with, let us consider the industry structure that maximizes total welfare. Let \( B^{FB} \) the threshold below which firms delegate. The market clearing condition is

\[
D(p) = \int_0^{B^{FB}} (\theta + \Delta) dF(B) + \int_{B^{FB}}^1 \theta dF(B) = \theta + F(B^{FB}) \Delta = D(p)
\]

This condition defines a function \( p(B^{FB}) \), and a supply

\[
S(B^{FB}) \equiv \theta + F(B^{FB}) \Delta.
\]
which is clearly increasing in $B^{FB}$. Hence, the planner chooses $B^{FB}$ so as to maximize the following welfare function

$$TW(B^{FB}) = \int_0^{B^{FB}} \left[ p(B^{FB})(\theta + \Delta) - B \right] dF(B) + \int_0^{B^{FB}} B dF(B) + \int_{B^{FB}}^1 p(B^{FB}) \theta dF(B) + u(S(B^{FB}) - p(B^{FB}) S(B^{FB})).$$

Profits + Rents within delegated firms

Profits of self-managed firms

Consumer surplus

Differentiating with respect to $B^{FB}$ we have

$$\frac{\partial TW(B^{FB})}{\partial B^{FB}} = u'(\cdot) \frac{\partial S(B^{FB})}{\partial B^{FB}} > 0.$$  

We can thus state the following result

**Lemma 4** The first best outcome obtains when all principals delegate — i.e., $B^{FB} = 1$ and $p^{FB} = u'(\theta + \Delta)$. Hence, the competitive equilibrium is first best if and only if $\theta \leq \theta(\Delta)$.

In the following sections we study what types of instruments the planner can use to implement the first-best outcome or, at least, to improve upon the market equilibrium. The key point is that if the planner cannot dictate a specific organization form to principals, which seems a somewhat reasonable assumption, this objective must be obtained through taxation and cross-subsidization. In fact, principals that feature a $B_i$ that exceeds the threshold $B^*(p^{FB})$ will not want hire an agent due to their scarce monitoring ability. In what follows we address these issues by first considering the benchmark in which the planner is fully informed about $B_i$ and then turn to the case in which $B_i$ is private information of the principals. In so doing we will assume that the planner cannot manipulate or regulate the price, which will always be the market clearing one.

### 4.2 Cross-subsidisation under complete information

Suppose that the planner knows each principal’s monitoring ability, as reflected by the parameter $B_i$. Since total welfare is increasing in the share of firms that operate under a delegated structure, the goal of the planner is to subsidize those that at equilibrium are self-managed. To see why, consider a policy that implements the first best outcome — i.e., such that the prevailing market price is $p^{FB} = u'(\theta + \Delta)$ and all firms are ruled by an agent. As discussed before, in the region of parameters in which $\theta > \theta(\Delta)$, not all principals will hire an agent unless they are incentivized to do so. Hence, the first-best outcome can be reached if and only if types $B_i$ above the critical value $p^{FB} \Delta$ are subsidized provided that they choose to hire an agent. This is because, $p^{FB} < p^*$ in the region of parameters under consideration, and thus

$$B^*(p^{FB}) < B^*(p^*) < 1,$$

so that, in the absence of subsidies, types $B_i \in (B^*(p^{FB}), 1]$ will never delegate. However, due to budget balancing, this means that principals earning extra profits must be taxed to fund these subsidies.

For every $B_i \leq p^{FB} \Delta$, let $\tau(B_i)$ be the tax that a principal with type $B_i$ must pay if he does not hire an agent. Clearly, $\tau(B_i)$ must be such that this principal is indifferent between delegating or managing
the firm on his own after taxes — i.e.,

\[ s_{FB}^*(B_i) = p_{FB}^* \theta - [p_{FB}^*(\theta + \Delta) - B_i] = B_i - p_{FB}^* \Delta > 0, \]

Similarly, for every \( B_i > p_{FB}^* \Delta \), let

\[ s_{FB}^*(B_i) = p_{FB}^* \theta - [p_{FB}^*(\theta + \Delta) - B_i] = B_i - p_{FB}^* \Delta > 0, \]

be the subsidy received by a principal that at price \( p_{FB}^* \) would choose to be self-managed, must receive in order to be willing to hire an agent.

A budget balancing policy must then satisfy the following constraint

\[ \int_{0}^{p_{FB}^* \Delta} [p_{FB}^* \Delta - B_i] \ dF(B_i) \geq \int_{0}^{1} [B_i - p_{FB}^* \Delta] \ dF(B_i). \]  

(2)

Rearranging condition (2) it then follows that the planner can implement the first-best allocation if and only if

\[ u'(\theta + \Delta) \Delta \geq \mathbb{E}[B], \]

which leads to the following result.

**Proposition 5** Suppose that \( \theta > \theta(\Delta) \), so that the competitive equilibrium is not first-best. Then the first-best outcome can be achieved by the planner via a cross-subsidization policy only if

\[ u'(1) (1 - \theta) < \mathbb{E}[B] < \max_{\Delta \in [0,1-\theta]} u'(\theta + \Delta) \Delta \]

and if

\[ \Delta \in \{ \underline{\Delta}, \min \{ \underline{\Delta}, 1-\theta \} \}, \]

where \( \underline{\Delta} \) and \( \overline{\Delta} \) are, respectively, the lowest and the highest solutions in \( \Delta \) of

\[ u'(\theta + \Delta) \Delta = \mathbb{E}[B]. \]

Hence, a necessary condition for the first best to be decentralized by a cross-subsidization policy is that, on average, the moral hazard problem is neither too severe nor too weak — i.e., \( \mathbb{E}[B] \) that takes intermediate values. Obviously, if the moral hazard problem is too severe — i.e., \( \mathbb{E}[B] \) is excessively large — very few firms will delegate, which means that it is impossible to fund the subsides necessary to induce delegation by those principals that would run the firms on their own in the absence of a policy. For the first best to be decentralized via cross-subsidization it is also necessary that the moral hazard is not too weak — i.e., \( \mathbb{E}[B] \) not too low. The reason is that if

**The linear example condition.** To get a better sense of the conditions that guarantee the implementation of the first best outcome via cross-subsidization consider again the linear example \( D(p) = 1 - bp \). It is easy to verify that, for any \( z \)

\[ u'(z) = \frac{1 - z}{b}, \]
so that
\[ u'((\theta + \Delta)\Delta) = \frac{1 - (\theta + \Delta)\Delta}{b}, \]
which is maximized at
\[ \Delta^* = \frac{1 - \theta}{2}, \]
and thus achieves a maximum of
\[ \Phi((\theta + \Delta^*)\Delta^*) = \frac{(1 - \theta)^2}{4b}. \]
Hence, the first best can be implemented only if
\[ 0 < E[B] < \frac{(1 - \theta)^2}{4b}, \quad (3) \]
and if
\[ \frac{1 - \theta}{2} - \frac{1}{2}\sqrt{(1 - \theta)^2 - 4bE[B]} \equiv \Delta < \Delta^* \equiv \frac{1 - \theta}{2} + \frac{1}{2}\sqrt{(1 - \theta)^2 - 4bE[B]].} \quad (4) \]

Since \( b \) is a measure of the demand elasticity, we can study the impact of a higher elasticity on the planner’s ability to implement the first best allocation. Simple inspection of (***)) and (***) suggest that an increase in \( b \), which will reflect a higher demand elasticity, it becomes harder to meet both the necessary condition (***) and the sufficient condition (**). This is because the relative magnitude of the back-fire effect discussed above becomes stronger, whereby implying that the planner ability to keep price high while increasing the number of firms that operate on a delegated basis.

### 4.2.1 Second-best cross-subsidization

In the previous section we have shown that the ability of the planner to induce the welfare maximizing industry structure can be limited by the back-fire effect due to an excessive reduction of the equilibrium price as a response to an increase in the number of firms that delegate production to self-interested agents. We now study the optimal second-best cross subsidization policy — i.e., the optimal policy that ..... Essentially, we will focus on the set of parameters where Proposition 1 fails.

The key finding of this section will be that the planner will be willing to tolerate some self-managed firms to shift down supply and thus mitigate the back-fire effect of the equilibrium price.....

For any equilibrium price \( p^{SB} \), consider the following redistribution policy. Let \( B^{SB} \geq p^{SB}\Delta \) denote the second best threshold above which firms would prefer in the absence of taxes and subsidies to be self-managed. Then

\[ t^{SB}(B_i) = \begin{cases} p^{SB}\Delta - B_i & \forall B_i \leq p^{SB}\Delta, \\ 0 & \forall B_i \in [p^{SB}\Delta, B^{SB}], \\ B_i - p^{SB}\Delta & \forall B_i \in [B^{SB}, 1] \end{cases} \]

and

\[ s^{SB}(B_i) = \begin{cases} B_i - p^{SB}\Delta, & \forall B_i \in [p^{SB}\Delta, B^{SB}], \\ 0 & \text{otherwise} \end{cases} \]

A budget balancing policy must satisfy
\[ \int_0^{p^{en}\Delta} [p^{SB}\Delta - B_i] dF(B_i) + \int_{B^{en}}^{1} p^{SB}\theta dF(B) \geq \int_{p^{en}\Delta}^{B^{en}} [B_i - p^{SB}\Delta] dF(B_i). \]
Proposition 6 Suppose that $\theta > \bar{\theta} (\Delta)$ and that Proposition *** does not hold. Then the second-best policy that can be achieved by means of a cross subsidization policy improves upon the competitive equilibrium and it requires all firms such that $B_i \leq B^{SB}$, with $B^{SB}$ being the unique solution of

$$
\Phi(B^{SB}) \left[ \Delta + \theta \frac{1 - F(B^{SB})}{F(B^{SB})} \right] = \mathbb{E} \left[ B | B \leq B^{SB} \right],
$$

with $p^{SB} = \Phi(B^{SB})$ and $\Phi(\cdot) = D^{-1}$ so that $p^{SB}$ solves

$$
D(p^{SB}) = \theta + F(B^{SB}) \Delta
$$

Moreover, the impact of $\theta$ and $\Delta$ on $B^{SB}$ is ambiguous — i.e.,

$$
\frac{\partial}{\partial \Delta} B^{SB} = ?
$$

$$
\frac{\partial}{\partial \theta} B^{SB} = ?
$$

Discussion

The linear example

4.3 Cross subsidization with incomplete information

So far, we assumed that the planner can observe the monitoring ability of each firm. In reality this may not be always feasible. Hence, one relevant policy question is whether a cross-subsidization can still improve upon welfare when the planner needs to elicit the firm’s private information about their monitoring ability. In what follows we will first show that in our model it is impossible to design a cross subsidization policy that enables the social planner to screen firms. Hence, the third best cross-subsidization policy must be pooling one.

Without loss of generality let us assume that the planner uses the following policy to screen types: $\mathcal{M} \equiv \{ \alpha(m_i), t(m_i), s(m_i) \}_{m_i \in [0,1]}$, where $m_i$ is firm-$i$’s report to the planner about its (inverse) monitoring ability, $\alpha(m_i)$ is the probability of receiving the subsidy $s(m_i)$ contingent on the report $m_i$, and $t(m_i)$ is the tax paid by each firm $i$ upon reporting $m_i$.

Firm-$i$’s expected profit is therefore

$$
\pi_i(m_i, B_i) = -t(m_i) + \alpha(m_i) \max \{ p^\theta \theta, p^\theta (\theta + \Delta) \} - B_i + s(m_i) + (1 - \alpha(m_i)) \max \{ p^\theta \theta, p^\theta (\theta + \Delta) \} - B_i \}
$$

Notice that for any $p^\theta$

$$
\max \{ p^\theta \theta, p^\theta (\theta + \Delta) \} - B_i = p^\theta (\theta + \Delta) - B_i \Leftrightarrow B_i \leq p^\theta \Delta
$$
and that for any $s(m_i) > 0$

$$p^C(\theta + \Delta) - B_i < p^C(\theta + \Delta) - B_i + s(m_i),$$

implying that

$$\max \{ p^C B_i - B_i + s(m_i) \} = p^C(\theta + \Delta) - B_i + s(m_i)$$

whenever $B_i \leq p^C \Delta$. This implies that, for every $B_i \leq p^C \Delta$ it must be

$$\pi_i(m_i, B_i) = -t(m_i) + p^C(\theta + \Delta) + \alpha(m_i) s(m_i).$$

But this implies the following impossibility result

**Proposition 7** As long as there exists a $B \in [0,1]$ such that $s(B) > 0$ and $\alpha(B) \in (0,1]$, then any firm $i$ such that $B_i \leq p^C \Delta$, will find it profitable to mimic $B$ rather than telling the truth. Hence, with incomplete information the only policy available to the planner is a pooling one.

Intuition.

As a result the planner can only use a uniform cross subsidization policy $(s,t)$, such that all firms are taxed the same and pay $t$, while firms that hire an agent obtain the subsidy $s$.

Let $B^{TB}$ be the threshold below which firms prefer to hire an agent rather than being self managed. Obviously

$$B^{TB} = p^{TB} \Delta + s$$

where $p^{TB}$ is the equilibrium market clearing price such that

$$D(p^{TB}) = \theta + F(B^{TB}) \Delta.$$ (7)

A budget balancing policy must then satisfy

$$\int_0^1 t dF(B) \geq \int_0^{B^{TB}} s dF(B) \Rightarrow t \geq s F(B^{TB}),$$ (8)

which will clearly bind because the planner’s objective is to increase $B^{TB}$ as much as she can. Moreover, recall that limited liability implies that self-managed firms must not make losses — i.e.,

$$t \leq p^{TB} \theta,$$ (9)

which will be again binding at the optimal (constrained) policy.

As before, let $p^{TB} = \Phi(B^{TB})$ be the solution of the market clearing condition (**). Combining equations (**), (**), (***) taken as equality, we have:

**Proposition 8** When the social planner cannot observe the firms’ monitoring ability, $B^{TB}$ solves

$$B^{TB} = \Phi(B^{TB}) \left[ \Delta + \frac{\theta}{F(B^{TB})} \right],$$
with $B^{TB} < 1$ and

5 Conclusions

In this paper we analyzed the cross-subsidization schemes chosen by a social planner willing to implement the optimal organization structure of an industry. We presented a model where firms' organization structure is determined jointly with production and contractual decisions. Firm shareholders can either delegate production to a self-interested manager, or run the business on their own. Delegation yields benefits to shareholders but also imposes some losses. We characterized the competitive equilibrium of the model and found necessary and sufficient conditions under which the equilibrium does not maximize social welfare. We then characterized the welfare maximizing budget-balancing fiscal policy considering complete and incomplete information regarding shareholders' monitoring ability over managers on the government's side. Our results suggest that if it is possible to tax and subsidize firms based on their shareholders' monitoring ability, the first best is implemented by a policy that taxes delegated firms and subsidizes self-managed ones. This cross-subsidization scheme may however fail to implement the first-best when demand is sufficiently inelastic to price. In this case, the planner is willing to tolerate an equilibrium with a (second best) optimal number of self-managed firms. Finally, when the planner does not observe shareholders' monitoring ability, it is impossible to design a cross subsidization policy that screen shareholders. In this case, the (third-best) policy features pooling and yields an outcome worst than the second best one.
References


Appendix
Proof of Proposition ??.

Rearranging
\[
\int_0^{p^* \Delta} [p^* \Delta - B_i] dF(B_i) \geq \int_{p^* \Delta}^1 [B_i - p^* \Delta] dF(B_i),
\]
it is easy to obtain the following condition
\[
\Phi (\theta + \Delta) \Delta \geq \mathbb{E}[B],
\]
(10)
Notice that (*** does not hold at \( \Delta = 0 \), while at \( \Delta = 1 - \theta \), it is \( \Phi (1) \) which is strictly higher than \( \mathbb{E}[B] \) by Assumption 1. Moreover, notice that under Assumption 2 \( \Phi' (\cdot) < 0 \) and \( \Phi'' (\cdot) \leq 0 \). Hence, \( \Phi (\theta + \Delta) \Delta \) is strictly concave and maximized at \( \Delta^* \) that solves the following first order condition.
\[
\Phi' (\theta + \Delta) \Delta + \Phi (\theta + \Delta) = 0,
\]
\[
\Phi (\theta + \Delta^*) \Delta^* = -\Phi' (\theta + \Delta^*) |\Delta^*|^2 = |\xi \Phi (\Delta^*) |\Delta^*|
\]
identifies a unique maximum \( \Delta^* \) of the function \( \Phi (\theta + \Delta) \Delta \). This means that if \( \mathbb{E}[B] > \Phi (\theta + \Delta^*) \Delta^* \), the first best outcome cannot be implemented.

Proof of Proposition ??.

First notice that the market clearing condition requires
\[
D (p^{SB}) = \theta + F (B^{SB}) \Delta
\]
where \( p^{SB} = \Phi (B^{SB}) \). Hence, the budget balancing condition (***) can be rewritten as
\[
\int_0^{\Phi (B^{SB}) \Delta} [\Phi (B^{SB}) \Delta - B_i] dF(B_i) + \int_{B^{SB}}^1 \Phi (B^{SB}) \Phi (B^{SB}) dF(B_i) \geq \int_B^{B^{SB}} [B_i - \Phi (B^{SB}) \Delta] dF(B_i).
\]
Rearranging this equation we have
\[
\Phi (B^{SB}) \left[ \Delta + \theta \frac{1 - F (B^{SB})}{F (B^{SB})} \right] \geq \mathbb{E} [B | B \leq B^{SB}], \quad (11)
\]
Notice that the left-hand side of this condition is decreasing in \( B^{SB} \) — i.e.,
\[
\frac{\partial}{\partial B^{SB}} \Phi (B^{SB}) \left[ \Delta + \theta \frac{1 - F (B^{SB})}{F (B^{SB})} \right] = \Phi' (B^{SB}) \left[ \Delta + \theta \frac{1 - F (B^{SB})}{F (B^{SB})} \right] - \Phi (B^{SB}) \frac{\theta f (B^{SB})}{F (B^{SB})^2} < 0.
\]
While the right-hand side is increasing in \( B^{SB} \) under Assumption (***) and since (***) cannot be met at \( B^{SB} = 1 \), while it holds with a strict inequality at \( B^{SB} = B^c \) — i.e., since \( p^{SB} = p^c \) when \( B^{SB} = B^c \) then follows that \( B^c = p^c \Delta \), and
\[
\int_0^{p^c \Delta} [p^c \Delta - B_i] dF(B_i) + \int_B^{B^c} \Phi (B^{SB}) \Phi (B^{SB}) dF(B) > 0.
\]
Hence, $B^{SB} \in (B^*, 1)$. 