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PRIVATIZATION, RISK-TAKING AND THE COMMUNIST FIRM

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Abstract

This paper studies alternative methods of privatizing a formerly communist firm in the presence of imperfect risk markets. The methods include cash sales, a give-away scheme, and a participation contract where the government retains a fractional ownership in the firm. It is shown that, with competitive bidding, the participation contract dominates cash sales because it generates both more private restructuring investment and a higher present value of revenue for the government. Under weak conditions, the participation contract will induce more investment than the give-away scheme, and it may even share the cash sales' virtue of incentive compatibility.

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1. Introduction

The collapse of communism is the most important historic event since the second world war, and the privatization of the formerly communist firms is the most important and most difficult economic problem in the subsequent transition to a market economy. The enormous transition cost in terms of output losses, distributional upheavals and the resulting social unrest makes it essential for privatization to be socially balanced and to activate the market forces as quickly and strongly as possible.

The typical communist firm was internally inefficient, was adapted to a wrong price vector, and had learned to react to institutions that were unlike those which constitute a market economy. It has few survival chances, if it continues to operate in its usual fashion. It will only be possible for the former state owned companies to prosper in the strong gale of international competition, if privatization succeeds in stimulating energetic entrepreneurial activities and large scale reorganization investment, and only then can a quick recovery of the ex-communist economies be expected.

There are many ways of privatizing the communist firm. Natural restitution, voucher schemes, cash sales, and participation models are among the methods used or discussed. Natural restitution is time consuming and prohibitively complicated, if not impossible. Voucher schemes lead to a widespread ownership and a diffusion of responsibilities; they are a very indirect way of bringing in the new management necessary for adapting the firm to market conditions. Many economists therefore prefer plain cash sales to competent entrepreneurs. They argue that competitive cash sales maximize the incentive to carry out reorganization investment and are thus the best way to foster economic recovery.

However the cash sales method is not without problems. It absorbs funds that credit constrained investors otherwise would have borrowed for restructuring purposes and it raises the market rate of interest when the government uses the sales revenue for the purchase of goods and services rather than for reinvesting in the capital market. Both micro- and macroeconomic credit constraints imply serious stock-flow mismatches which impede private investment and which can only be mitigated by selling at give-away prices or by slowing down the privatization process.

An alternative to cash sales is a participation contract where the government, instead of receiving a cash payment, retains a sleeping fractional ownership in the firm which entitles it to receive a certain percentage of all future profit distributions. This model was developed in earlier publications (Sinn 1991a, 1991b; Sinn and Sinn 1991), found considerable political attention in Germany, and was studied in a number of papers including those of Bös (1991) and Bolton and Roland (1992). In effect, applying the participation contract is the same as the government using its cash sales revenue to provide the firm with an equity endowment in exchange for ownership shares. The equity endowment frees the investors' funds for the purpose of reorganization investment and loosens the micro- and macroeconomic credit constraints. The ownership shares can be distributed to the workers and the general population to compensate them for the loss of state owned assets which they had previously owned in common.

An important additional aspect of the participation model is its risk sharing property, and this is the theme of this paper.[1] Restructuring the communist firm is a very risky, but potentially lucrative enterprise. It encounters thousands of unprecedented and unknown difficulties, but it promises huge pioneer profits. Many potential investors may hesitate to become engaged in the risky cash sales program and if so, they may chance only moderate stakes. The participation model may help overcome their risk aversion, because the government shares the risk of failure by reducing or giving up its claim to receive the sales price. Private risk markets, in principle, could also do the job, but for reasons that will be discussed in section 8, they do not exist or are underdeveloped in the countries

[1]A discussion of the risk sharing properties of the participation model can also be found in Sinn and Sinn (1991). However these authors do not derive a formal risk-theoretic model as is done here.

concerned.

We develop a risk theoretic competitive auction model that makes it possible to compare cash sale and participation contracts. Instead of making cash bids, the bidders are allowed to offer participation contracts which specify the percentage sleeping ownership ceded to the government and the volume of restructuring investment. The bid that promises the highest expected present value of the cash flow accruing to the government is selected.

The paper was motivated by controversial discussions about the two privatization contracts in the Scientific Advisory Committee of the German Ministry of Economics (Wissenschaftlicher Beirat beim Bundesministerium für Wirtschaft 1991). A minority of the Committee advocated the participation contract, but the majority supported the government's choice of cash sales, arguing that participation cannot increase the government revenue but will reduce the incentive for reorganization investment and slow down economic recovery. We hope that our model makes it possible to discuss the issue in a more transparent way than has been possible thus far. Our main questions are which of the two contract types will generate more revenue and which will induce more private restructuring investment.

An additional issue addressed in the paper is the rationale of a simple give-away policy where competent investors receive the firm as a gift. The give away policy has occasionally been advocated by economic advisors, and it is in many cases carried out by the German Treuhand, the central privatization agency for East Germany, where East German firms are sold to West German investors for a single symbolic deutschmark. The paper will discuss the question of whether the Treuhand's hope of maximizing the volume of reorganization investment by using this policy is justified.

The following Section 3 sets up the formal model, and Sections 3-5 compare the alternative privatization approaches. Sections 6 and 7 consider informational asymmetries, and Section 8 concludes the paper by discussing the assumption of missing risk markets.

2. The Model

We consider the problem of a risk neutral trust agency which attempts to sell a firm to some identical risk averse investors, whose preferences satisfy the von Neumann Morgenstern axioms. There may be additional investors who are different, but we assume that there are sufficiently many clones of the investor who makes the highest bid to satisfy the assumption of competitive bidding. Under the cash sales method the investor specifies his offer price P, under the participation method he specifies his own required ownership fraction q, which we denote the "participation rate", and the amount of reorganization investment I he promises to finance with an equity injection. We assume that the government can monitor I and enforce the promise. For the time being we also assume that all parties have identical beliefs about the cash flow distribution that will result from I. One way of interpreting this assumption is that the investor has to give any information he has to the government and that the latter can verify its truth without cost. The assumption will be relaxed in section 6. Unless otherwise stated the government selects the offers so as to maximize its own expected revenue.

We like to think of the participation contract as a dividend tax of the Meade Committee's (1978) S-base type whose rate, $1-q$, can be chosen by the investor together with the initial equity endowment he contributes. The endogeneity of the tax rate makes our problem theoretically interesting while the cash flow character of the dividend tax promises the administrative and allocative advantages that have been derived in other model frameworks.[2]

The present value of the dividends resulting from the reorganization investment takes the form $\theta f(I)$ where f is a strictly increasing and concave function and θ is a random variable with expected value $\mu(\theta)$ and standard deviation $\sigma(\theta)$. For

[2]The tax interpretation also points to similarities with the traditional public finance literature on taxation and risk taking. Despite the similarities, the propositions of this paper have, to the best of our knowledge, not yet been derived.

simplicity we assume that $f(0) = 0$. Algebraically, we allow for simultaneous cash and non-cash bids. When the contract parameters q, I, and P are specified, the investor's post contract wealth is

$$Y = q\,\theta\, f(I) - I - P + K$$

where K is his initial wealth.

Let $\mu(Y)$, $\sigma(Y)$, and $Z(Y)$ denote respectively the expected value, the standard deviation, and the standardized distribution of the random variable Y:

$$\mu(Y) = q\,\mu(\theta) f(I) - I - P + K \qquad (1)$$

$$\sigma(Y) = q\,\sigma(\theta) f(I) \qquad (2)$$

$$Z(Y) = \frac{Y - \mu(Y)}{\sigma(Y)} \qquad (3)$$

Substituting Y, $\mu(Y)$, and $\sigma(Y)$ into equation (3) shows that the standardized distribution of Y is independent of the policy parameters P, q, and I:

$$Z = \frac{\theta - \mu(\theta)}{\sigma(\theta)}$$

The independence implies that all attainable probability distributions of the firm's net cash flow belong to a unique linear class for which the investor's von Neumann Morgenstern utility function can exactly be represented by the utility function $u[\mu(Y), \sigma(Y)]$ without assuming normal distributions or quadratic utility. Let $s(\mu,\sigma)$ denote the slope of the indifference curve at the combination (μ,σ) which measures the *local* *marginal risk aversion.*[3] As discussed by Mayer (1987, 1989) and Sinn (1983, 1989), the slope of any indifference curve is zero along the μ-axis: $s(\mu,0) = 0$, and risk aversion implies that the indifference map is convex:

$$ds(\mu,\sigma)/d\sigma\Big|_u > 0 .$$

Naturally, the Pratt-Arrow measures of absolute and relative risk aversion have direct implications for $s(\mu,\sigma)$. For example, if the preferences of an agent exhibit decreasing absolute risk aversion, an increase of μ holding σ constant, will decrease the local marginal risk aversion. More generally, for $\sigma > 0$:

$$\frac{\partial s(\mu,\sigma)}{\partial \mu} \quad \begin{Bmatrix} \geq \\ = \\ \leq \end{Bmatrix} 0 \Leftrightarrow \begin{Bmatrix} \text{increasing} \\ \text{constant} \\ \text{decreasing} \end{Bmatrix} \text{absolute risk aversion}$$

and

$$\frac{ds(\mu,\sigma)}{d\mu}\Bigg|_{\mu/\sigma=\text{const.}} \quad \begin{Bmatrix} \geq \\ = \\ \leq \end{Bmatrix} 0 \Leftrightarrow \begin{Bmatrix} \text{increasing} \\ \text{constant} \\ \text{decreasing} \end{Bmatrix} \text{relative risk aversion.}$$

These properties will be needed in the analysis to follow.

3. Revenue Comparison with Given Reorganization Investment

For didactic purposes, we begin our analysis by comparing the expected revenue for the government generated by the two contract types, assuming that investment is kept constant at a given level I. First, we consider a standard sales contract: $P > 0$, $q = 0$. With this contract, the expected revenue for the government is simply the sales price P. Second,

[3]It is assumed that $\mu = \mu(Y)$ and $\sigma = \sigma(Y)$ unless it is explicitly defined to which random variable the two moments refer.

we consider a "pure" participation contract: $P = 0$, $q < 1$. Now the expected revenue for the government is equal to its portion of the cash flow $(1-q)\,\mu(\theta)f(I)$. We assume that competitive bidding guarantees that the government can extract the entire rent. Specifically, we assume that, for either contract, $[\mu(Y),\sigma(Y)]$ satisfies the requirement:

$$u[\mu(Y),\sigma(Y)] = u(K,0) .$$

When we compare the maximum expected return generated by both contracts, intuition suggests that the participation mechanism should do better, because the government absorbs some of the risks and earns a risk premium. Proposition 1 proves that this intuition is, indeed, correct.

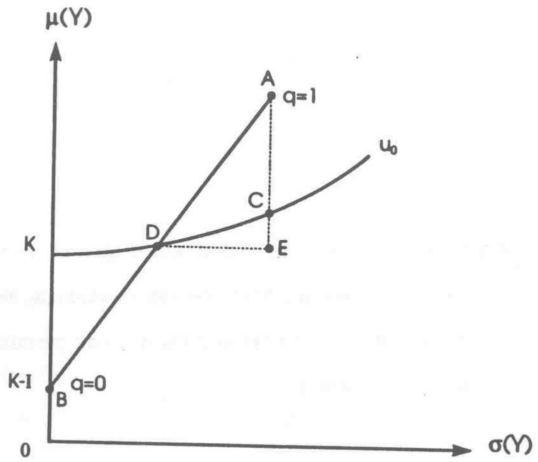
Proposition 1: *Given the volume of reorganization investment, the participation contract yields a higher expected revenue for the government than the sales contract.*

Proof: To prove this proposition, first consider the participation contract. Holding I constant and varying q yields a linear relationship between $\mu(Y)$ and $\sigma(Y)$, which we refer to as the *participation curve.* $\mu(Y)$ and $\sigma(Y)$ follow from equations (1) and (2) by setting $P = 0$. Eliminating q yields the participation curve:

$$\mu(Y) = \frac{\mu(\theta)}{\sigma(\theta)}\sigma(Y) + K - I \tag{4}$$

The participation curve is illustrated in figure 1. Point A is characterized by $q = 1$, point B by $q = 0$. Point A gives the (μ,σ) combination when the agency gives the firm away to the investor at zero price. Point B represents the other extreme case where the investor gives the reorganization investment away. As q varies between 0 and 1,

Figure 1: *Revenues with Given Investment*



$[\mu(Y),\sigma(Y)]$ moves along the line segment AB. Equation (4) implies that the slope of the participation curve is $\mu(\theta)/\sigma(\theta)$.

The indifference curve $u_0 = u(K,0)$ represents the minimum level of utility which the investor is willing to accept. Thus, D characterizes the minimum value of q which does not violate the individual rationality constraint of the investor, the value being given by $q = \mathrm{BD}/\mathrm{BA}$. Since the total expected return on the investment has not changed, the expected return to the agency equals the vertical distance between points A and E.

To conclude the proof, we compare AE to the maximum sales price of the firm. A positive sales price reduces the expected return on the investment but leaves the standard deviation unaffected. Again, point A characterizes a price of zero. As the price increases, the point $[\mu(Y),\sigma(Y)]$ moves along a vertical line down from point A. The maximum price, where the agency extracts the entire rent, is therefore characterized by the distance AC. As can be seen from the figure, the convexity of the indifference curve guarantees that AE > AC. QED

4. Giving the Firm Away

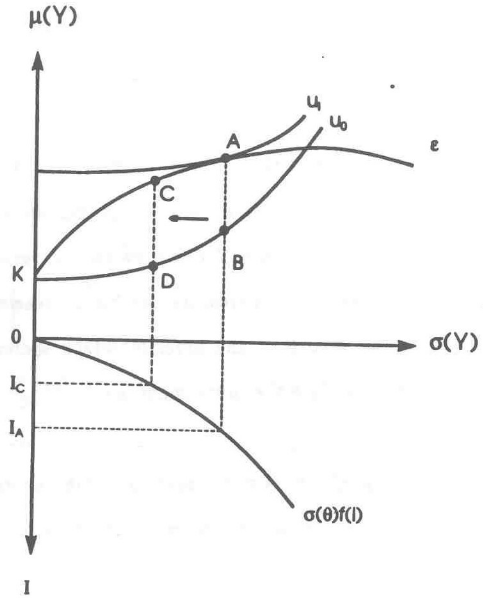
In the context of the privatization of centrally planned economies, the government will not only be interested in maximizing revenue. As explained above, an important objective of the agency is to induce a high level of investment. This objective has been considered numerous times in the context of the German discussion and has led some participants to suggest that the Treuhand should simply give its properties away in order to increase the level of investment. In the present model this view can be rationalized by the well founded assumption that the preferences of investors exhibit decreasing absolute risk aversion. A positive price reduces the wealth of the investor which increases his local risk aversion. This, in turn, leads him to reduce the investment level.

Proposition 2: *When the preferences of the investor exhibit decreasing absolute risk aversion, the sales contract yields less investment than giving the firm away.*

Proof: We define the efficiency curve ε as the relationship between expected wealth and standard deviation when the agency gives the firm away and the investor varies I. It follows from (1) and (2) that the efficiency curve starts from the coordinate at $\mu(Y) = K$ and has a maximum where $\mu(\theta)f'(I) = 1$. The two properties suggest that ε is concave. Appendix 1 proves analytically that this is indeed the case, and even in a strict sense.

Figure 2 compares the optimal investment under the two policies of giving the firm away and selling the firm at the maximum price. When the government gives the firm away, the investor searches for the best (μ,σ) combination along the efficiency curve. The optimal investment plan is then characterized by a point like A, where the efficiency curve and the indifference curve u_1 are a tangential.

Figure 2: *Give Aways vs. Competitive Sales*



We now compare I_A with the optimal investment level when the government sells the firm at the maximum feasible price.[4] For the sake of argument, consider a bidder who intends to keep the level of investment equal to I_A. The investor would be willing to pay up to AB. Notice, however, that decreasing absolute risk aversion implies:

$$s(\mu_A,\sigma_A) < s(\mu_B,\sigma_B)\,.$$

Thus, the concavity of the efficiency curve and the convexity of the indifference curve guarantee that an investor, who reduces investment below I_A, can

[4]When our notation is self-explanatory, we skip an explicit definition. For example, I_A, μ_A, and σ_A are the levels of investment, expected wealth, and standard deviation associated with point A in the diagram.

credibly increase his bid. For the selling contract, the optimal level of investment in figure 2 is I_C. It maximizes the distance between the efficiency curve and the indifference curve for the given level of utility u_0. QED

The key element in the above argument is that a change in the sales price reduces the expected return but leaves the variance of the investment constant. This argument does not generalize to the participation contract, because a change in q affects both moments $\mu(Y)$ and $\sigma(Y)$. In fact, the next proposition shows that there are realistic situations where the participation contract induces a higher level of investment than giving the firm away does.

Proposition 3: *When the preferences of the investor exhibit constant or increasing relative risk aversion and the optimal investment, under the give away policy, is less than the wealth of the investor, then the participation contract yields more investment than giving the firm away.*

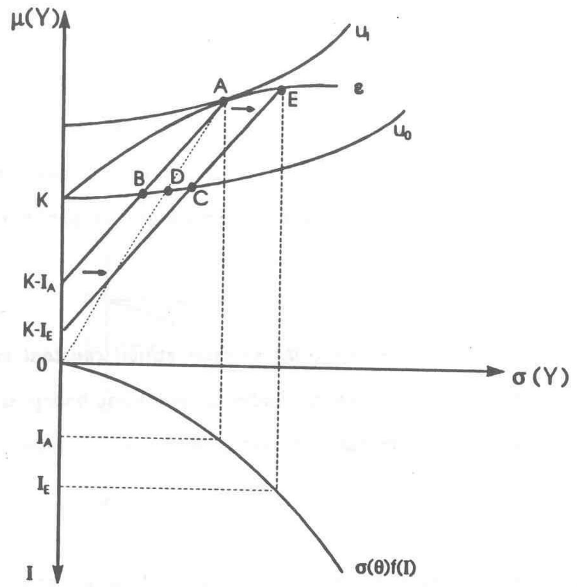
Proof: Using figure 3, we start the argument at point A, which characterizes the optimal investment plan when the agency gives the firm away. In A, the efficiency curve ε and the indifference curve u_1 are just tangent. By assumption $K\text{-}I_A > 0$, therefore, the participation curve is above a ray from the origin through the point A. We define point B as the intersection between u_0 and the participation curve for investment I_A, and D as the intersection between u_0 and the ray from the origin through A. Since the preferences exhibit constant or increasing relative risk aversion, we know that

$$s(\mu_A,\sigma_A) \geq s(\mu_D,\sigma_D)\,, \tag{5}$$

and, because of the strict convexity of the indifference curve,

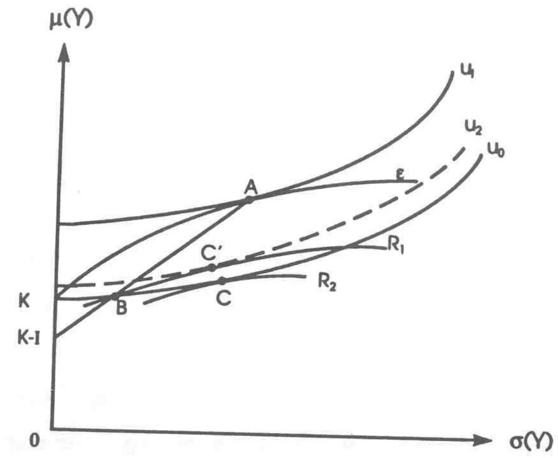
$$s(\mu_D,\sigma_D) > s(\mu_B,\sigma_B)\,. \tag{6}$$

Figure 3: *Give Away vs. Participation Contract*



In appendix 2, we prove analytically the geometric intuition from figure 3, that if the government wants to maximize its expected revenue using the participation contract, it is necessary for the slope of the indifference and the efficiency curves to be equal along the participation curve. Since (5) and (6) imply that $s(\mu_B,\sigma_B) < s(\mu_A,\sigma_A)$, this can only happen to the right of points A and B. Notice from equation (4), that an increase in I shifts the participation curve parallel to the right. In conclusion, if the government offers the optimal participation contract, it will induce more investment than by giving the firm away. In figure 3, the optimal contract is characterized by points E and C, and induces the level of investment $I_E > I_A$. QED

Figure 4: *Competitive Bidding and Iso-revenue Curves*



At first, Proposition 3 might appear counter-intuitive because it is not to be expected that reducing the profit of the investor could induce him to increase I. By introducing the government's iso-revenue curves figure 4 offers, perhaps, a more intuitive explanation of the proposition than the proof does. An iso-revenue curve is the locus in (μ,σ) space where alternative combinations of the level of investment I and the rate of participation q generate the same expected revenue for the government. We prove in appendix 3 that the iso-revenue curves have equal slopes along a participation curve. Since the efficiency curve ε is the iso-revenue curve for a revenue of zero, this means that the iso-revenue curves can be constructed by parallel shifts from the efficiency curve in a south-west direction, along the participation curves. The vertical distance covered by such a shift measures the government's revenue. Let $i(\mu,\sigma)$ be the slope of an iso-revenue curve at the combination (μ,σ).

Suppose that the government offers an investor the contract characterized by point B. Since B and A are on the same participation curves, it follows that

$s(\mu_A,\sigma_A) = i(\mu_B,\sigma_B)$ and obviously (5) and (6) imply that an iso-revenue curve, R_1 in figure 4, intersects the indifference curve u_0 from below at point B:

$$i(\mu_B,\sigma_B) > s(\mu_B,\sigma_B)\,.$$

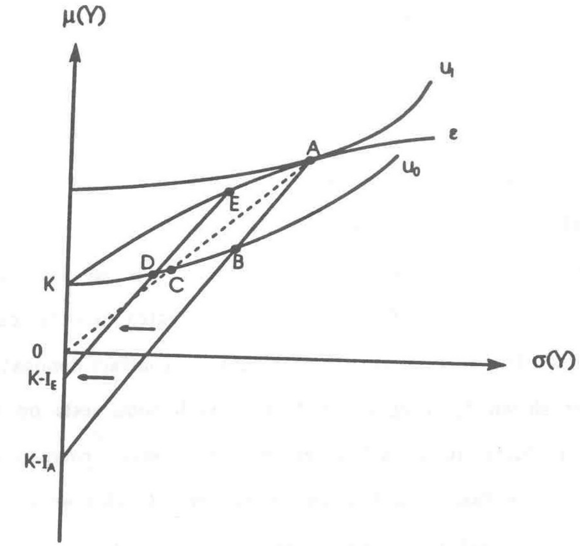
We conclude that the investor can make a credible offer, C^ in figure 4, where he receives a higher participation rate q, invests more, obtains a higher level of utility, and keeps the expected revenue of the government constant. However, C^ is not an equilibrium. Competitive bidding will guarantee that contracts with lower participation rates for the investor and higher revenues for the government are offered. At the optimal contract C, the iso-revenue curve R_2 is tangent to the indifference curve u_0. There is no other contract which would make the investor better off without reducing the revenue of the government.

As is obvious from the above discussion, the main reason for the investment stimulus is that the introduction of the participation contract reduces the investor's local marginal risk aversion. The negative wealth effect of paying dividends to the government increases the local marginal risk aversion, but the risk reduction resulting from the participation contract reduces the local marginal risk aversion even more. While we believe that the assumptions underlying this constellation are plausible, there are others that would change the sign of the net effect of the two forces. The next proposition clarifies this.

Proposition 4: *When the preferences of the investor exhibit constant or decreasing relative risk aversion and the optimal investment under the give away policy is larger than the investor's wealth then the participation contract yields less investment than giving the firm away.*

Proof: The present proof parallels the proof of Proposition 3. Again, point A characterizes the optimal plan of the investor, when the agency gives the firm away. By assumption

Figure 5: *Cash Gifts Can Dominate*



$K\text{-}I_A < 0$, and, therefore, point C is to the left of B. From the convexity of u_0, we know that:

$$s(\mu_B,\sigma_B) > s(\mu_C,\sigma_C)\,.$$

Also, the preferences exhibit constant or decreasing relative risk aversion, thus:

$$s(\mu_C,\sigma_C) \geq s(\mu_A,\sigma_A)\,.$$

Therefore, the slope of the efficiency curve at the point A is flatter than the slope along u_0, at the point B . The curvature of the efficiency curve and of u_0 guarantee that a reduction in investment, which shifts the participation curve to the left, will increase the expected return of the agency. QED

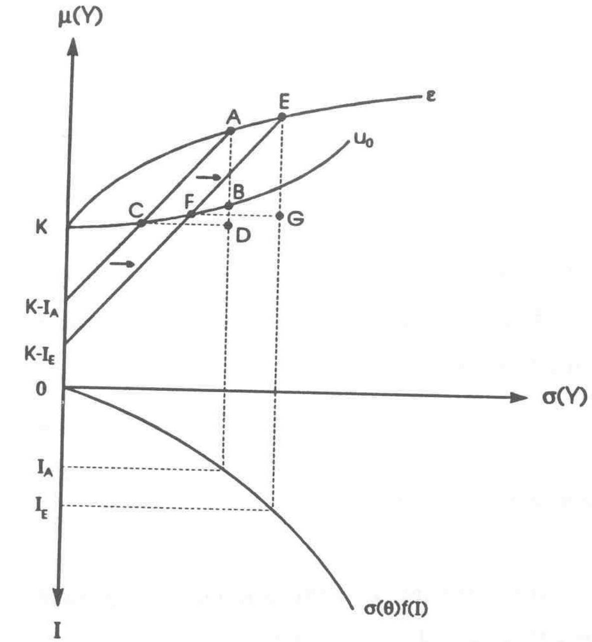
5. The Optimal Contract

In the previous section, we proved that, when the preferences of investors exhibit decreasing absolute and increasing relative risk aversion, the give away scheme dominates competitive sales in terms of the resulting level of reorganization investment (Proposition 2) and is itself likely to be dominated by the participation contract (Proposition 3). This suggests that the participation contract dominates the sales contract. However, as shown by Proposition 4, this implication rests on special assumptions. Moreover, of course, it is unclear whether the revenue comparison of Proposition 1 generalizes to the case of endogenous investment. In this section, we use a different argument to prove that, under the assumptions of our model, in all cases the participation contract dominates the sales contract.

Proposition 5: *In the case where the investors are risk averse and the selling agency is risk neutral, the participation contract dominates the sales contract, that is, generates higher expected revenue and a higher level of reorganization investment.*

Proof: Consider figure 6. Point A characterizes the optimal sales contract. Thus, the slope of the efficiency curve in A and the slope of the indifference curve in B are equal. Suppose we keep the level of investment constant at I_A. From Proposition 1, we know that the associated participation contract yields a higher expected revenue and is characterized by

Figure 6: *Sales vs. Participation Contract*



the point C. The convexity of u_0 implies:

$$s(\mu_C,\sigma_C) < s(\mu_B,\sigma_B) = e(\mu_A,\sigma_A)$$

where $e(\mu,\sigma)$ denotes the slope of the efficiency curve. Therefore, from appendix 2, we know that the government can further increase its expected revenue. The curvatures of the efficiency curve and u_0 imply that the optimal level of investment is larger than I_A. In the figure, the optimal contract is characterized by the level of investment I_E, because this level implies that the efficiency curve and the indifference curve have the same slope along a participation curve: $e(\mu_E,\sigma_E) = s(\mu_F,\sigma_F)$. The government's expected cash flow now is

EG . Obviously, EG > AD >AB, where AD is the government's revenue from the participation contract with constant investment, and AB is the government's revenue from the sales contract. QED

Proposition 5 shows that, from a pure revenue perspective, the participation contract dominates the sales contract for two reasons. First, because the government provides a partial insurance and earns a risk premium (Proposition 1). Second, because the participation mechanism induces a higher level of investment and a higher value of the aggregate cash flow available to both parties. This result stands the opinion of the Scientific Advisory Committee to the German Ministry of Economics, which was cited in the introduction, on its head, and it supports the minority's recommendation of the participation model.

6. Incentive Compatibility

In the next two sections, we discuss generalizations by introducing asymmetric information between the potential investors and the government. In this section, we model the idea that investors have more accurate information than the agency does about the state of the firm - meaning its ability to generate profit. Specifically, we assume that the functional form $f(I,z)$ is common knowledge, but that z, which parameterizes the profitability of the firm, is observable by the investor only. The investor may convey his information to the government, but the government cannot verify its truth. We impose the restrictions f_z, f_{I_z} > 0. Thus, a larger z denotes a more profitable firm.[5] Geometrically, these assumptions guarantee that an increase in z shifts the efficiency curve upward and that

[5]The second inequality is a single crossing requirement. This type of assumption is very common in asymmetric information problems.

for every I the slope of the efficiency curve increases.[6] Examples of what we have in mind are patents, land sites, know how, or teams of workers whose use requires complementary capital investment. The government does not know whether, or to what extent, such investment makes sense, and it has to rely on the estimates given by the buyers.

In the remainder of this section, we show that, irrespective of the information asymmetry, the optimal solution described sections 4 and 5 remains attainable. Initially, disregarding the information asymmetry, we denote the optimal participation bidding mechanism M, described by an investment function and a participation function $M = \{\bar{I}(z),\bar{q}(z)\}$. We will prove that M is incentive compatible. If a buyer reveals z, the government calculates and imposes the corresponding values of the participation rate q and the amount of investment I which extract the investor's rent as described in the previous section. The government then calculates the resulting cash flow distribution and assigns the property to the bidder who reveals the highest z and whose information therefore promises the highest expected revenue for the government. The bidders can lie about z and try to manipulate the conditions of the contract, but we will show that it is in their interest not to do so. Revealing a false value of z will either result in a (q,I) contract that is unattractive to the investor or brings the risk that other investors will make higher bids.

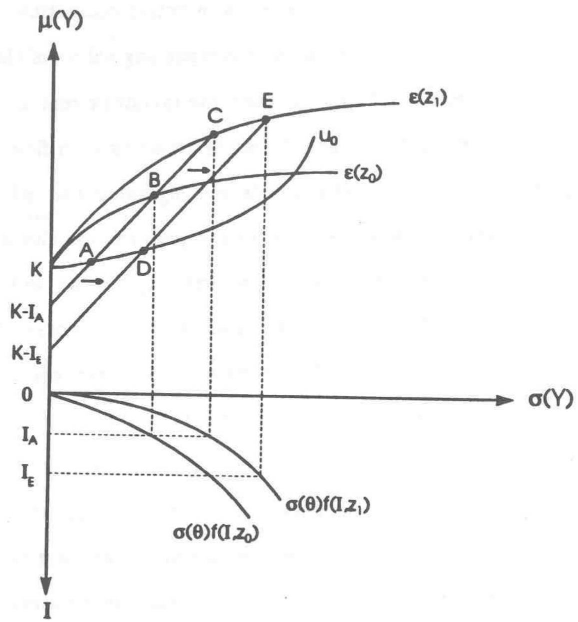
Before proving this result, we note that our complementarity assumption $f_{I_z} > 0$ implies that the optimal level of investment I, as derived in the previous section, is a strictly increasing function of z. In figure 7, $\varepsilon(z)$ denotes the efficiency curve when the level of profitability is z. We consider the case of two alternative profitability levels z_1 and z_0, where $z_1 > z_0$. Point A characterizes the optimal participation contract for $z = z_0$. Thus, the slopes at points A and B are equal. Consider now state z_1. If the investment is kept constant at the level I_A, it will generate the point C along the efficiency curve $\varepsilon(z_1)$. Point

[6]This result follows immediately by differentiating (A.1)

$$\frac{d}{dz} e(\mu_I,\sigma_I) = \frac{d}{dz}\left[\frac{\mu(\theta)f_I(I,z) - 1}{\sigma(\theta)f_I(I,z)}\right] = \frac{\sigma(\theta)f_{I_z}(I,z)}{[\sigma(\theta)f_I(I,z)]^2} > 0 \quad .$$

C is on the same participation curve as B, because, from (4), the position of this curve is independent of *f(I,z)*. By assumption, the slope of the efficiency curve is steeper at C than at B. The curvatures imply that equalizing the slopes between the indifference curve u_0 and $\varepsilon(z_1)$ will require the participation curve to shift to the right, thereby increasing investment.

Figure 7: *Investment and Profitability*



Since the level of investment, *I*, is strictly monotonic in *z*, there exists an equivalent bidding mechanism to *M*, $M^* = \{q^*(I)\}$, where

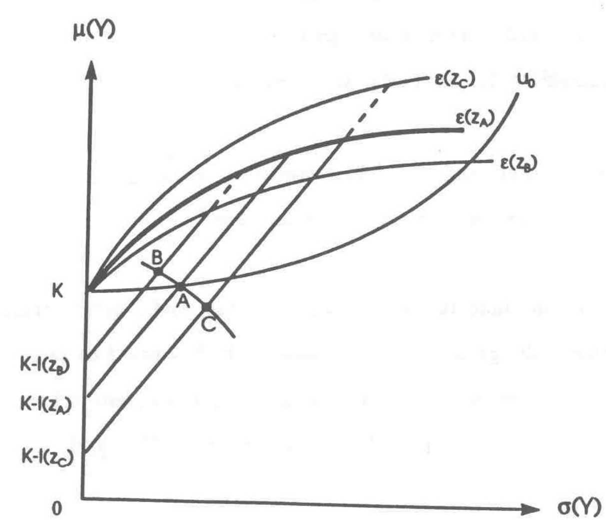
$$q^*(I) = \tilde{q}[\tilde{I}^{-1}(I)]$$

This suggests, as a solution to the information asymmetry, letting the investors bid in *I*, giving the firm to the investor who offers the highest level of investment at the participation rate $q^*(I)$. The next proposition shows that this procedure, indeed, overcomes the information asymmetry between investors and the agency.

Proposition 6: *Bidding in I according to the mechanism M* will implement the participation mechanism as in the foregoing section despite the information asymmetry.*

Proof: For the sake of argument assume that, initially, the agency randomly selects one investor as owner of the firm, offers the contract type M^*, and asks the investor to make an investment offer. Using figure 8, it is easy to show that the randnomly selected investor will *not* bid optimally.

Figure 8: *Truthful Revelation*



Assume the true profitability is z_A. If the investor bids $I = \bar{I}(z_A)$, he will reach point A. Suppose the investor wants to suggest that z_B is true and bids $I = \bar{I}(z_B)$ instead, with $z_B < z_A$. The participation rate, $q = q^*[\bar{I}(z_B)]$, has been calculated in such a way that, when the investor tells the truth, his utility is reduced to u_0. Since the investor understates the profitability of the firm, he must attain a better position, like point B. The curve AB yields the (μ,σ) combinations where the investor understates the profitability of the firm by alternative degrees and, therefore, underinvests.

Understating the profitability makes sense when the investor has no rivals, but not when he participates in a competitive bidding process. In a competitive bidding process a point like B in figure 8 is not attainable, since there are other investors who are willing to offer higher investment volumes, those that fit the true efficiency curve better. Ultimately the investors will bid the entire rent away, offer $I = \bar{I}(z_A)$, and attain the level of utility u_0.

Overstating the profitability is not attractive either. Suppose the investor bids $I = \bar{I}(z_C)$ with $z_C > z_A$, knowing that the government requires $q = q^*[\bar{I}(z_C)]$ to extract the rent that would be available if z_C were true. This reduces the investor to a point like C which is below his initial utility level u_0. QED

Obviously, there is no incentive to cheat. Since the bidding mechanisms M and M^* are equivalent, this immediately gives another result.

Proposition 7: *Investors will truthfully reveal their knowledge of the firm's profitability z when a competitive participation mechanism is applied.*

To conclude this section we note that, under our assumptions, it is not in general possible to design a bidding mechanism which is based on the participation rate q rather than the investment level I. At first glance, q and I seem to have symmetrical roles such that it is possible to replace the mechanism $M = \{\bar{I}(z), \bar{q}(z)\}$ with $M^{**} = \{I^{**}(q)\}$

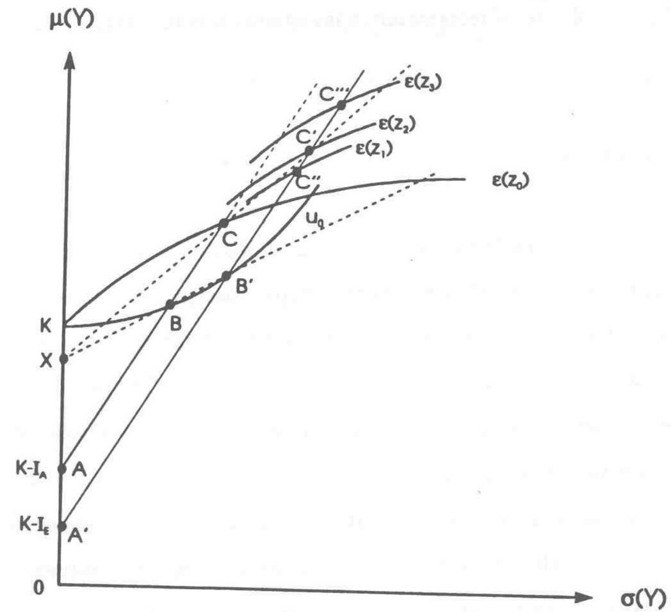
where

$$I^{**}(q) = \bar{I}[\bar{q}^{-1}(q)]$$

and then assign the firm to the bidder who accepts the lowest participation rate. It is easy to show, however, that q cannot reveal the investor's information because the inverse of the participation function $\bar{q}$ does not in general exist. This implies the following statement.

Proposition 8: *Bidding in q according to the mechanism M^{**} will not, in general, be able to implement the participation mechanism M.*

Figure 9: ***Ambiguity in the Value of q***



Proof: It is sufficient to prove that, under the assumptions made, q may be rising or falling with z. In figure 9, z_0 yields the participation curve ABC and $\bar{q}(z_0)$ is given by the ratio AB/AC. Suppose, the profitability increases to z_2 so that the efficiency curve shifts to $\varepsilon(z_2)$. The condition that there be equal slopes of the efficiency and utility curves now defines the new participation curve $A'B'C'$ such that $\bar{q}(z_2) = A'B'/A'C'$. By construction C and C', B and B', A and A' are all on rays through point X. Thus $\bar{q}(z_0) = \bar{q}(z_2)$. The efficiency curve $\varepsilon(z_2)$ is the borderline case between an increase and a decline of q as a reaction to an increase of z. Obviously $\bar{q}(z_3) = A'''B'''/A'''C''' < \bar{q}(z_0)$ and $\bar{q}(z_1) = A''B''/A''C'' > \bar{q}(z_0)$. Since $\varepsilon(z_1)$, $\varepsilon(z_2)$, and $\varepsilon(z_3)$ are all compatible with the assumption that, given I, the slope of the efficiency curve rises with z, q cannot reveal the underlying value of z, and thus cannot be used for a bidding process. QED

The last proposition may serve as a warning to those who believe that the government's participation (or tax) rate $1 - q$ can be used in an auction in a way that parallels the cash price in a standard auction. Proposition 6 makes it clear that the planned and promised level of reorganization investment is much better suited for that purpose.

7. *Moral Hazard*

A criticism frequently raised in the German debate on the participation model was that it might reduce the private investment incentive, because, it was maintained, the government participates in the investor's returns but not in his expenses. It has been shown above that the basic fear behind this argument is unwarranted. The simultaneity in the choice of revenue maximizing values of q and I creates a stronger investment incentive than revenue maximization does with the cash sales method. Nevertheless the the argument points to two possible incentive problems that are worth discussing in more detail.

The first concerns the incentives for *future* investment. Such incentives are created in the participation model in three possible ways, depending on whether retained

earnings or new capital injections are the source of equity finance. When, as is normally the case in private firms, retained earnings are the source of finance, the government fully shares the cost of investment to a degree given by its own participation or tax rate $1 - q$. When the investor plans additional equity injections, the government can chose between two options. One is contributing its fair share $1 - q$ by also injecting more funds. The other is not contributing at all and accepting an increase in the investor's participation rate q instead. In the present, atemporal, model these constellations have not been formalized explicitly. However, the first two of them are implicitly captured by defining $\theta f(I)$ as the present value of the net cash flow generated by the firm, and it is obvious that the third constellation will preserve the investment incentives in the future.

The second, more serious, incentive problem concerns *unobservable and non-contractable* resource transfers from the investor. It is true that the investor has every reason to document and prove such transfers carefully because he wants his bid to win, or to receive the government's fair equity contribution, or to increase his participation rate. However, there are some resources that cannot easily be documented. Specifically, in the context of the transfer of knowledge, which plays an essential role in restructuring centrally planned economies, it will be very difficult to measure the real cost associated with the transfer of managerial know-how. Suppose an investor reallocates one of his managers to the new firm. The real cost of this transfer depends on the manager's alternative occupation, information which, in general, will not be available to the government.

For the sake of argument, we assume that the investor's post contract wealth takes the following form:

$$Y = q\,\theta\, f(I_1, I_2) - I_1 - I_2 - P - K$$

where the variables I_1 and I_2 denote contractable and non-contractable investments respectively. That is, in I_2 we sum up all the non-contractable decision variables. We analyze optimal contract patterns defined by I_1, q, and P and start by discussing two extreme cases.

First, consider the case where all the investments are contractable; i.e., $f_2 = 0$. In this case, the participation model is fully applicable. In fact, it is easy to see from figure 1 that, in this case, the participation model is so attractive for the investors that a revenue maximizing and rent extracting government should set the investor's participation rate equal to zero, $q = 0$, and "charge" a negative cash price equal to the volume of reorganization investment: $P = - I_1$. The government would thereby effectively abandon privatization and earn a full-insurance risk premium. Of course, this solution would violate a number of incentive requirements and political constraints outside the model, but it is a theoretical extreme which highlights an important potential for welfare gains from the participation contract.

The second extreme case is where none of the investments are contractable. In this instance, $P > 0$ and the optimal participation rate of the investor will be close to one, because the moral hazard problem reduces the possibility of insuring the investor. Note, however, that even in this case there will be some participation of the government: $q < 1$. The intuition is straightforward. For $q = 1$ investments are first-best, the derivative of utility with respect to investment is zero. Thus small changes in I will only lead to second order changes in utility. On the other hand, changes in q will have first order effects.

In the intermediate case, the optimal participation rate will be in between the two extremes. A policy which sets $P = 0$ and requires potential investors to bid in q and in the level of contractable investment I_1 might be a justifiable approximation.

8. Conclusions: Privatization with Incomplete Risk Markets

Privatizing the communist firm is not the same as privatizing British Telecom. In a well

functioning market economy with developed capital and risk markets there is a good case for privatization via cash auctions. If the firm to be privatized is profitable, bidders can easily raise the cash needed to pay the government and they can also find insurance in the risk markets. For example, they can raise the funds needed and load the risks involved on many people's shoulders by reselling all or part of the privatized firm in the stock market. There is good reason to believe that revenue maximizing cash bids are the optimal privatization method.

This statement may even be true, when information asymmetries make the capital and risk markets incomplete. When the government has no superior knowledge there may be very little it can do to improve the privatization procedure by trying to replace the missing market contracts.

The situation is very different, though, with the actual privatization problems faced by the former communist countries of the east. These countries have no credit markets and no risk markets, and yet they have to privatize their firms as quickly as they can. Establishing risk and credit markets before privatization is simply not an option. Creating the legal framework for these markets takes years, and even if the laws could be put in place quickly, private market agents first had to learn how they function. But how can they learn *before* privatization takes place? Surely, privatization has to precede the creation of the markets.

Communist dictatorship was not an adverse selection problem, and the state is the only financial and risk consolidating agency available. There can be little doubt that, under these circumstances, the plain cash sales contract loses many of its virtues and that the participation contract is an attractive alternative. The participation contract mitigates the problem of missing capital markets because it allows the investor to pay later, and it mitigates the problem of missing risk markets because it allows the investor to pay only if, and to the extent that, distributable profits become available. The latter aspect has been studied in this paper. We have shown that the participation contract will generate more revenue for the government than cash sales and, what is more, that it will also induce more private investment. Under plausible conditions the participation contract can be expected to generate even more investment than giving the firms away would, and its virtues are likely to remain if there are asymmetric information problems.

Compared to the countries of the East, Germany's case is less obvious because there are capital and risk markets which, in principle, make the cash sales strategy worth considering. However, there are a number of reasons why we believe the participation contract to be superior even there.

First, the poverty of the East Germans makes it difficult for them to borrow. Banks impose credit contraints which are a certain multiple of the available equity capital, but if someone has no equity he receives no credit. The poverty is not the result of the inefficiency of communist production, but an implication of the currency exchange program. East Germans received exactly the amount of transactions cash necessary to match the West German velocity ratio, but they were not given the financial wealth which, in a market economy, would have backed the existing stock of real assets. East Germans are therefore unable to buy this stock from the Treuhand.

Second, the poverty of the East Germans creates excessive risk aversion. Even the most lucrative investment chances are unable to make them risk substantial commitments. Small wonder that, thus far, only 5 % of the Treuhand sales have involved East German buyers.

Third, the West German stock market is chronically underdeveloped, unable to diversify the Treuhand risks. There are excessively high legal entry barriers that have effectively prevented Treuhand firms from being sold via this market. The Treuhand has sold or given away thousands of firms, but only in one case has it been able to sell a firm in the stock market. Of course, it would have been possible for Germany to establish a new "junk bond" market tailored to the special needs of the East Germans firms, but this was never considered as a serious political option. The German stock market's inability to support the privatization of the East German economy is an extreme case of policy failure.

At first sight it might be tempting to believe that the difficulties of selling

the east German firms directly in the stock market could be overcome by selling them indirectly in this market via West German partner firms. The West German firms could buy the east German firms and issue new shares in the stock market to spread the financial risks over many shoulders. However, the west German firms that are supposed to buy the Treuhand properties are mostly entrepreneurial firms or partnerships with no more than a handful of owners. There are only about 600 publicly traded stock companies in Germany, and no more than one tenth of these has a diversified ownership (in the sense that there is no single majority owner). West Germany is not comparable with the UK, let alone the US. Developed risk markets that could absorb the Treuhand risks are simply not available. The peculiar German way of organizing the financial markets may have had advantages under the steady and stable conditions of the past. However, the unexpected flood of entrepreneurial risks that came with unification has overexhausted the risk bearing capacity of the existing financial system. Under these circumstances the cash and give away privatization strategies of the Treuhand are not beyond doubt.

Originally, the German Treuhand had forecast that it would be able to earn a revenue of about DM 600 b. Now, after seeing the revenue it is actually collecting, even the more optimistic forecasts do not place the total revenue at more than DM 60 b., one tenth of the original value. Given this huge discrepancy, there is every reason to think about alternative privatization procedures. This paper discussed one.

A 1

Appendix 1: In this section, we prove analytically that the efficiency curve is concave. The efficiency curve, $\mathcal{E}$, is defined as the total (μ,σ) relationship generated by different levels of investment when $P = 0$ and $q = 1$. The (μ,σ) combination follows from the level of investment, specifically:

$$\mu_I = \mu(\theta)f(I) - I + K$$

$$\sigma_I = \sigma(\theta)f(I)$$

Let $e(\mu,\sigma)$ denote the slope of the efficiency curve at the combination (μ,σ). Obviously,

$$e(\mu_I,\sigma_I) = \frac{\partial\mu_I/\partial I}{\partial\sigma_I/\partial I} = \frac{\mu(\theta)f'(I) - 1}{\sigma(\theta)f'(I)} \tag{A.1}$$

Further differentiating the above expression with respect to investment, yields:

$$\frac{d}{dI}e(\mu_I,\sigma_I) = \frac{\sigma(\theta)f''(I)}{[\sigma(\theta)f'(I)]^2} < 0 \tag{A.2}$$

that is, the slope of the efficiency curve decreases as investment goes up. Since σ_I is increasing,

$$\frac{d\sigma}{dI} = \sigma(\theta)f'(I) > 0 \ ,$$

(A.2) also proves that the efficiency curve is concave. QED

A 2

Appendix 2: In this section, we prove the geometrical claim discussed in Proposition 3, that the optimal participation contract requires that the indifference and the efficiency curve have equal slopes. The optimal government's participation contract solves the following problem:

$$\max_{q,I} \ (1-q)\,\mu(\theta)f(I)$$

$$\text{s.t.} \ u[q\,\mu(\theta)f(I) - I - P + K, \ q\,\sigma(\theta)f(I)] \geq u_0 \ .$$

Differentiating the appropriate Lagrangian with q and I respectively, yields two first-order conditions:

$$-\mu(\theta)f(I) + \lambda[u_\mu\,\mu(\theta)f(I) + u_\sigma\sigma(\theta)f(I)] = 0 \ , \tag{A.3}$$

$$(1-q)\,\mu(\theta)f'(I) + \lambda\{u_\mu[q\,\mu(\theta)f'(I) - 1] + u_\sigma q\,\sigma(\theta)f'(I)\} = 0 \ . \tag{A.4}$$

where λ is the Lagrange multiplier. From (A.3) we see that λ is non-zero, that is, the constraint is always binding and the agency extracts the entire rent from the investor. Dividing (A.3) by $f(I)$ yields the equality:

$$\mu(\theta) = \lambda[u_\mu\,\mu(\theta) + u_\sigma\sigma(\theta)] \ . \tag{A.5}$$

Substituting this expression into (A.4), further yields:

$$\mu(\theta)f'(I) = \lambda u_\mu \ .$$

Finally, using (A.5) to eliminate λ, we obtain:

$$f'(I) = \frac{u_\mu}{u_\mu\,\mu(\theta) + u_\sigma\sigma(\theta)} \ .$$

This equality can easily be transformed to the necessary condition:

$$-\frac{u_\sigma}{u_\mu} = \frac{\mu(\theta)f'(I) - 1}{\sigma(\theta)f'(I)} \ .$$

This concludes the proof: the left hand side of the above equation is the slope of the indifference curve and, from (A.1), the right hand side is the slope of the efficiency curve. QED

A 3

Appendix 3: In this appendix we prove that, along the participation curve (4), the government's iso-revenue curve has the same slope, regardless of the revenue level R. With the participation contract $(P = 0, \ q \geq 0)$ the iso-revenue condition is:

$$R \equiv (1-q)\,\mu(\theta)f(I) = \text{const.}$$

Solving for the parameter q and substituting into the definitions of the expected value and the standard deviation of Y, (1) and (2), yields:

$$\mu(Y) = \mu(\theta)f(I) - R - I + K \tag{A.6}$$

$$\sigma(Y) = \sigma(\theta)f(I) - R\frac{\sigma(\theta)}{\mu(\theta)} \tag{A.7}$$

Equations (A.6) and (A.7) define the iso-revenue curve in (μ, σ) space for alternative levels of revenue R. Differentiating the two equations for I gives the slope of an iso-revenue curve:

$$i[\mu(Y), \sigma(Y)] = \frac{\partial\mu(Y)/\partial I}{\partial\sigma(Y)/\partial I} = \frac{\mu(\theta)f'(I) - 1}{\sigma(\theta)f'(I)} \ .$$

The slope is a function of I, which is constant along a participation curve, but not a function of R, and obviously it is the same as the slope of the efficiency curve as given by (A.1). QED

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