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Privatization, risk-taking, and the communist firm

Dominique Demougin[a], Hans-Werner Sinn[b,*]

[a]*University of Quebec, Department of Economics, P.O. Box 8888, Montreal, Canada*
[b]*NBER, CEPR and Center for Economic Studies, University of Munich, Schackstraße 4, 80539 München, Germany*

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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 sleeping 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 expected 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.

Key words: Privatization; Risk theory; Economic transformation

JEL classification: P13; D44

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

* Correspondence to: Hans-Werner Sinn, Center for Economic Studies, University of Munich, Schackstraße 4, 80539 München, Germany.

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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 that 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 widespread ownership and a diffusion of responsibilities; they are an indirect way of bringing in the new management necessary to adapt 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 could 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 giveaway 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 discussed in earlier publications (Sinn, 1991, 1992; Sinn and Sinn, 1991), found considerable political attention in Germany, and was further developed in a number of papers including those of Bös (1991) and Bolton and Roland (1992).[1] 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'

[1] The participation model has been adopted by the new Bolivian government because it does not violate the Bolivian constitution which forbids sales of national property. See Sinn and Sinn (1993).

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.[2] 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.

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 reorganization investment. The bid that promises the highest expected present value of the cash flow accruing to the government is selected.

It is possible to think of the participation contract as a dividend tax – such as the Meade Committee's (1978) S-base tax – whose rate can be offered by the investor together with the initial value of reorganization investment. 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.[3] The tax interpretation makes it clear that our analysis is related to existing papers which discuss the impact of capital income taxation on risk taking, e.g. Domar and Musgrave (1944), Tobin (1958), Mossin (1968), Stiglitz (1969) or Ahsan (1974). To some extent the participation mechanism that we analyze acts like the model tax assumed in this literature. However, the application to, and the resulting implications for, the problem of privatizing state-owned firms are novel. In addition, of course, the tax literature was not concerned with competitive bidding procedures or tax rates endogenous to the taxpayer's decision problem.

To focus on risk problems, the theoretical part of the paper abstracts from imperfections in credit markets. Incorporating credit constraints would strengthen our basic conclusions (see Sinn and Sinn, 1991). For simplicity, we model the government as a risk-neutral agent focusing on the expected

[2] A non-formal discussion of the risk-sharing properties of the participation model can also be found in Sinn and Sinn (1991).

[3] See Sinn (1987, esp. ch. 11) and the literature cited therein.

present value of its cash flow though our conclusion would remain as long as it is less risk averse than private investors. If we think of the government as a collective interest of risk-averse individuals as in Gordon (1985), then our presumption is warranted if the government is the best risk-consolidating agency available. In Section 8 we discuss why we think that this is the case in the context of privatizing former communist firms.

Although the paper applies primarily to eastern countries other than East Germany, it was motivated by controversial discussions 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? Which will induce more private reorganization 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 paper is organized as follows. Section 2 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 that he promises to finance with an equity injection. We assume that the government can monitor I and enforce the promise, but has no voting rights. 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.

Recalling the tax interpretation mentioned in the introduction, $1-q$ can be identified with the Meade Committee's S-base or dividend tax rate. However, unlike the Committee's proposal, q is a choice variable and expensing of the initial equity injection is not allowed. Future investment is assumed to be financed from retained earnings and will thus be treated as the Committee suggested.[4]

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 an arbitrarily distributed random variable with expected value $\mu(\theta)>0$ and standard deviation $\sigma(\theta)>0$.[5] For 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.

We specify the model using a (μ, σ) approach. Applying a result developed by Sinn (1983) we first show that given the above technology our approach is no more restrictive than the standard expected utility method even though we do not assume quadratic utility or normal distributions. Let $\mu(Y)$, $\sigma(Y)$, and $Z(Y)$ denote the expected valued, the standard deviation, and the standardized distribution, respectively, of the random variable Y:

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

$$\sigma(Y) = q\sigma(\theta)f(I) , \tag{2}$$

$$Z(Y) \equiv \frac{Y-\mu(Y)}{\sigma(Y)} . \tag{3}$$

[4] Cf. Section 7 below.

[5] Since we place no particular restrictions of the shape of θ's probability distribution, this formulation is equivalent to the form $g(\theta)f(I)$, where g is an arbitrary function and θ the state of the world. See, for example, Stiglitz (1974). Nevertheless, of course, the specification is not perfectly general. Analyzing more general kinds of randomness may be desirable, but will certainly imply substantial complications.

Substituting Y, $\mu(Y)$, and $\sigma(Y)$ into Eq. (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 any von Neumann–Morgenstern utility function can exactly be represented by the utility function $u[\mu(Y), \sigma(Y)]$ without loss of generality.

Let $s(\mu, \sigma)$ denote the slope of an indifference curve at the combination (μ, σ) which measures the *local marginal risk aversion*.[6] As discussed by Meyer (1987, 1989) and Sinn (1983, 1989), the slope of any indifference curve has a number of plausible properties. It is zero along the μ-axis: $s(\mu, 0) = 0$; and risk aversion implies that the indifference map is convex: $\mathrm{d}s(\mu, \sigma)/\mathrm{d}\sigma|_u > 0$. Moreover, the Pratt–Arrow measures of absolute and relative risk aversion have straightforward implications for $s(\mu, \sigma)$. For example, if the preferences of an agent exhibit decreasing absolute risk aversion, an increase in μ, holding σ constant, will decrease the local marginal risk aversion. More generally, for $\sigma > 0$:

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

and

$$\left.\frac{\mathrm{d}s(\mu, \sigma)}{\mathrm{d}\mu}\right|_{\mu/\sigma = \text{const.}} \{\gtreqless\} 0 \Leftrightarrow \begin{Bmatrix} \text{increasing} \\ \text{constant} \\ \text{decreasing} \end{Bmatrix} \text{relative risk aversion} .$$

These properties will be needed in the analysis to follow.

3. Revenue comparison with given reorganization investment

The two crucial policy questions in the privatization debate have been: Which privatization method generates most revenue? Which induces the highest volume of reorganization investment? For didactic purposes, we begin our analysis by comparing the expected revenue for the government generated by the two contract types, when investment is kept constant at a given level I. First, we consider a standard cash-sales contract: $P > 0$, $q = 0$. With this contract, the expected revenue for the government is simply the

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

cash price P. Second, 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, for either contract, $[\mu(Y), \sigma(Y)]$ is assumed to satisfy the requirement

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

When we compare the maximum expected return generated by both contracts, we expect from the standard risk-sharing result that the participation mechanism should do better, because the government absorbs some of the risks and earns a risk premium. We prove the result formally to illustrate the mechanics of the model.

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

Proof. To prove this proposition we 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 line*. The moments $\mu(Y)$ and $\sigma(Y)$ follow from Eqs. (1) and (2) by setting $P = 0$. Eliminating q yields the participation line

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

The participation line is illustrated in Fig. 1. Point A is characterized by $q = 1$, point B by $q = 0$. Point A gives the (μ, σ) combination when the government 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, $[\mu(Y), \sigma(Y)]$ moves along the line segment AB. Eq. (4) implies that the slope of the participation line 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 $q = BD/BA$. Since the total expected return on the investment is given, the expected return to the government equals the vertical distance between points A and D, i.e. the distance between A and E.

To conclude the proof, we compare AE with the maximum cash price of the firm. A positive cash price reduces the expected return on the investment but leaves the standard deviation unaffected. Again, point A

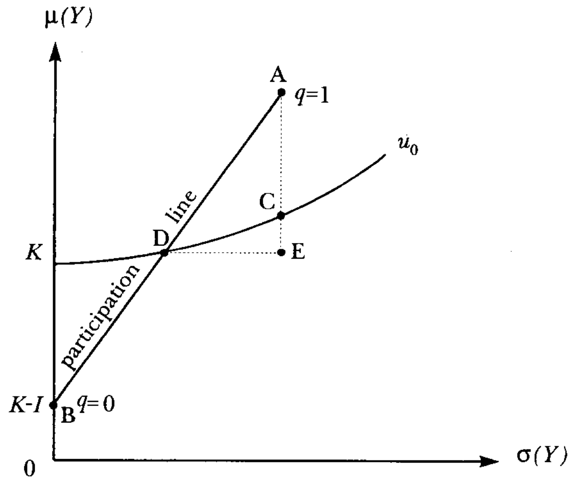

Fig. 1. Revenues with given investment.

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 $AE > AC$. Q.E.D.

4. Giving the firm away

Although maximization of the government's privatization revenue is a significant goal, many politicians have argued that the stimulation of private investment is of overriding importance. In fact, in the German debate it has frequently been recommended that the Treuhand should simply give its properties away in order to maximize the volume of private reorganization investment, and this is what the agency often does. This section discusses the validity of this recommendation. It neglects the revenue goal and compares the cash-sales, give-away, and participation schemes solely with regard to the level of reorganization investment they will induce.

The main tool needed for this analysis is the efficiency curve ε, which is depicted in Fig. 2. The efficiency curve is defined 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 A proves analytically that this is indeed the case, and even in a strict

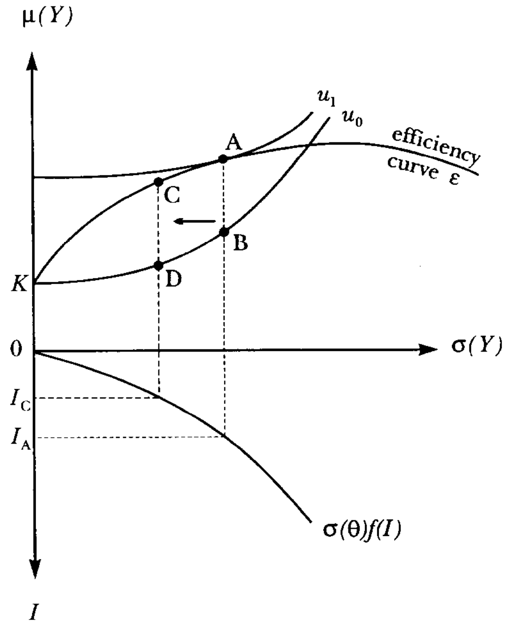

Fig. 2. Give-aways vs. competitive sales.

sense. An auxiliary tool is the curve $\sigma(\theta)f(I)$ in the lower part of Fig. 2. It illustrates the relationship between the standard deviation of the firm's cash flow and the volume of reorganization investment which follows from (2) for $q = 1$.

Compare first competitive cash biddings and give-aways. In the present model, the view that give-aways generate more investment than cash sales can be rationalized by the well-founded assumption that the preferences of investors exhibit decreasing absolute risk aversion. A positive cash 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 cash-sales contract yields less investment than giving the firm away.

Proof. Fig. 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 tangential.

We now compare I_A, the corresponding level of investment, with the optimal investment level when the government sells the firm at the maximum feasible price.[7] 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 credibly increase his cash bid. For the cash-sales contract, the optimal level of investment in Fig. 2 is I_C. To see this, notice that a competitive bidding process would guarantee that the utility of the winning bidder remains at the reservation level u_0. Therefore, the maximum and, thus, the winning bid maximizes the distance between the efficiency curve and the indifference curve for the given level of utility u_0. Q.E.D.

Let us next compare the give-away strategy with competitive bidding under the participation contract. While the cash sale reduces $\mu(Y)$ and does not directly affect $\sigma(Y)$, the participation contract reduces both of these moments and may thus bring about a Domar–Musgrave effect of increased risk-taking. The next proposition specifies the exact conditions under which this result can be expected. The proposition does not shed a favorable light on the Treuhand's policy of selling its assets for a symbolic Deutschmark only.

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 which maximizes the expected revenue of the government yields more investment than giving the firm away.

Proof. Using Fig. 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 $K - I_A > 0$; therefore, the participation line is above a ray from the origin through the point A. We define point B as the intersection

[7] 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.

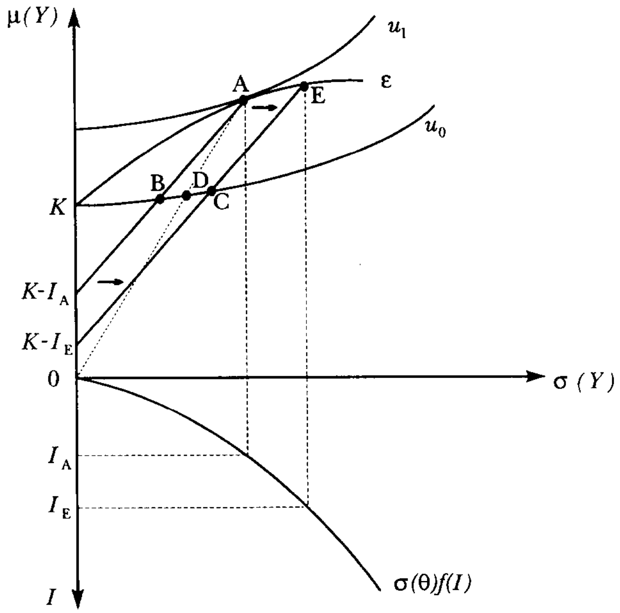

Fig. 3. Give-aways vs. participation contract.

between u_0 and the participation line 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,

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

In Appendix B we prove analytically the geometric intuition from Fig. 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 line. 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 Eq. (4) that an increase in I shifts the participation line parallel to the right. In conclusion, if the government offers the optimal participation contract, which maximizes its expected revenue, it will also induce more investment than by giving the firm away. In Fig. 3, the optimal contract is characterized by points E and C, and induces the level of investment $I_E > I_A$. Q.E.D.

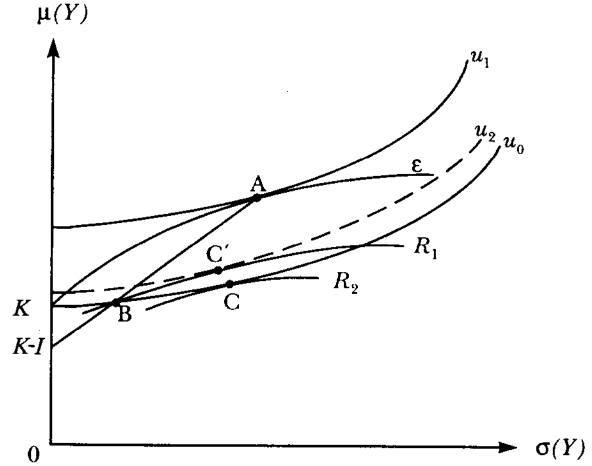

Fig. 4. Competitive bidding and iso-revenue curves.

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, Fig. 4 offers an alternative proof of the proposition which helps clarify the result. An iso-revenue curve is the locus in (μ, σ) space where alternative combinations of the level of investment I and the investor's rate of participation q generate the same expected revenue for the government. The efficiency curve ε is the iso-revenue curve for a revenue of zero because, on this curve, $q = 1$ and the investor's pre- and post-contract wealth distributions coincide. For higher levels of government revenue there are iso-revenue curves such as R_1 and R_2 in Fig. 4. Consider point B which is derived from point A by reducing q below unity and moving along the corresponding participation line in a south-west direction. Since no resources are lost, the vertical distance between points A and B measures both the investor's loss in expected wealth and the government's expected revenue from the participation contract, as characterized by the participation rate q and the level of investment I. Other combinations of q and I that generate the same revenue for the government are characterized by similar pairs of points that have the same vertical distance but are connected by other participation lines. In the figure, R_1 is the locus of (μ, σ) combinations characterizing the investor's post-contract wealth that generate the same revenue for the government as point A. Similarly R_2 is the locus of (μ, σ) combinations attainable through suitable choices of q and I that generate the same revenue as point C.

Let $i(\mu, \sigma)$ and $e(\mu, \sigma)$ denote the slopes of an iso-revenue curve and the efficiency curve ε, respectively, at a point (μ, σ). Since, from (4), the slope of the participation line is independent of q and I, $i(\mu, \sigma) = e(\mu_X, \sigma_X)$ for an arbitrary point X on the efficiency curve and all feasible combinations (μ, σ) that characterize the participation line through this point. (For a proof see Appendix C.)

Suppose that the government offers an investor the contract characterized by point B. Since A is the give-away optimum and A and B are on the same participation curves, it follows that $e(\mu_A, \sigma_A) = s(\mu_A, \sigma_A) = i(\mu_B, \sigma_B)$, and obviously (5) and (6) imply that an iso-revenue curve, R_1 in Fig. 4, intersects the indifference curve u_0 from below at point B: $i(\mu_B, \sigma_B) > s(\mu_B, \sigma_B)$. This implies that an investor can make a credible offer, for example an offer characterized by point C' in Fig. 4, where the expected revenue of the government remains constant at R_1 yet the alternative participation rate and investment yield a higher utility for the investor. 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. Since C is on a participation line that is below the original participation line, it implies a higher level of investment than A.

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 inventor 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 refers to Fig. 5 and parallels the proof of Proposition 3. Again, point A characterizes the optimal plan of the investor, when the agency gives the firm away. However, by assumption $K - I_A < 0$, and, therefore, point B is to the right of D. From the convexity of u_0, we know that $s(\mu_B, \sigma_B) > s(\mu_D, \sigma_D)$. Also, the preferences exhibit constant or decreasing relative risk aversion, thus $s(\mu_D, \sigma_D) \geqslant s(\mu_A, \sigma_A)$. Obviously, the

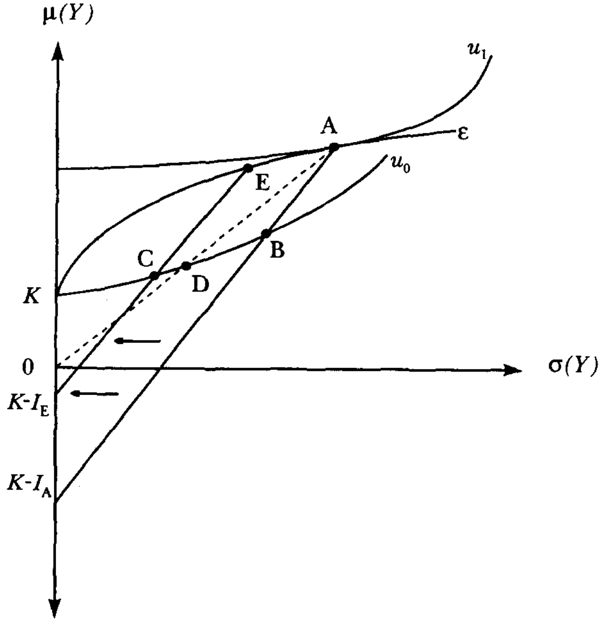

Fig. 5. Cash gifts can dominate.

efficiency curve at point A is flatter than u_0 at point B: $s(\mu_B, \sigma_B) > e(\mu_A, \sigma_A)$. The curvatures 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 vertical distance between points such as A and B, and hence the expected revenue of the agency. The optimum is characterized by the participation line through E and C. Q.E.D.

Despite Proposition 4 we conclude that there are no a priori reasons to believe that a simple give-away policy should maximize private reorganization investment. It is true that under weak assumptions the cash-sales contract will lead to less investment than giving the firm away (Proposition 2). However, it is also true that under other very reasonable constellations – e.g. constant or increasing relative risk aversion and wealth exceeding the investor's optimal investment – the participation contract yields more investment than giving the firm away (Proposition 3). In the light of this section, and, even if we abstract from all revenue considerations, both policies advocated by the Treuhand – cash sale and de facto give away – appear theoretically weak.

5. The optimal contract

Proposition 1 showed that the participation contract is a good revenue raiser when the level of investment is given, and Propositions 2 and 3 showed that this contract may generate more investment than the cash-sales contract or even a give-away scheme. This suggests that the participation contract dominates the cash-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 cash-sales contract.

Proposition 5. In the case where the investors are risk averse and the government is risk neutral, the participation contract dominates the cash-sales contract. It generates both higher expected revenue and a higher level of reorganization investment.

Proof. Consider Fig. 6. Point A characterizes the optimal cash-sales contract. Thus, the slope of the efficiency curve in A and the slope of the indifference curve in B are equal: $e(\mu_A, \sigma_A) = s(\mu_B, \sigma_B)$. From Proposition 1 we know that the revenue associated with this policy is AB. We also know that if we keep the level of investment constant at I_A the associated participation contract – characterized by the point C – yields a higher expected revenue AD. The convexity of μ_0 implies

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

From Appendix B 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 u_0 have the same slope along the participation line $e(\mu_E, \sigma_E) = s(\mu_F, \sigma_F)$. The equality of the slopes ensures that the vertical distance between the corresponding points on ε and u_0 is maximized. This distance is the associated expected government revenue, EG in the figure. Obviously, by construction $EG > AD > AB$. Q.E.D.

Proposition 5 shows that, from a pure revenue perspective, the participation contract dominates the cash-sales contract for two reasons. First, because the government provides a partial insurance and earns a risk premium (Proposition 1). Second, because competitive bidding with the

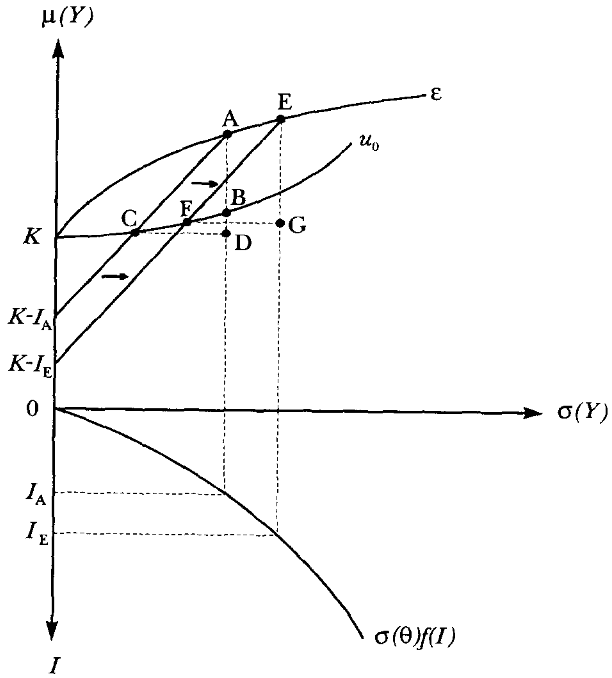

Fig. 6. Cash sales vs. participation contract.

participation contract induces a higher level of investment and a higher value of the aggregate cash flow available to both parties. This result stands the majority 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 agency. 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 replace $f(I)$ with $f(I, z)$ and 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 and higher marginal rate of return to investment.[8] Geometrically, these assumptions guarantee that an increase in z shifts the efficiency curve upward and that for every I the slope of the efficiency curve increases.[9] 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 in 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 $M = \{\tilde{I}(z), \tilde{q}(z)\}$. 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 Fig. 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 investment is kept constant at the level I_B, it will generate the point C along the efficiency curve $\varepsilon(z_1)$. Point C is on the same participation line 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

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

[9] This result follows immediately by differentiating (A.1) from Appendix A:

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

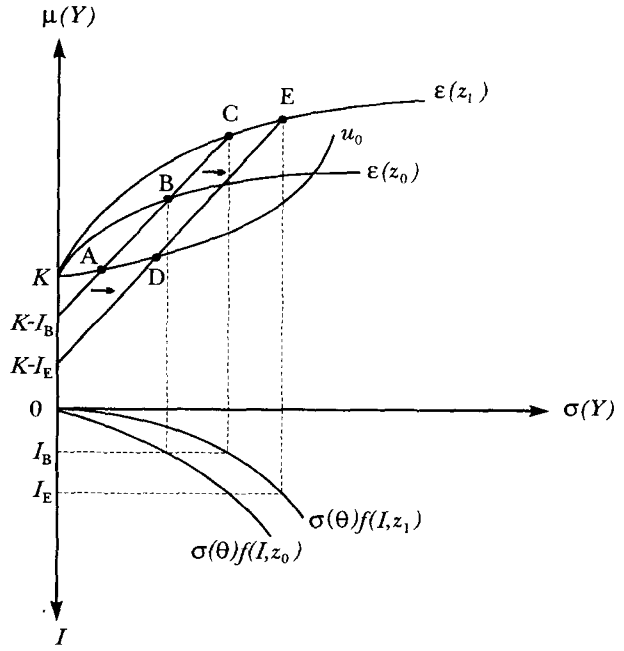

Fig. 7. Investment and profitability.

require the participation line to shift to the right towards points E and D, thereby increasing investment from I_B to I_E.

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 and 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

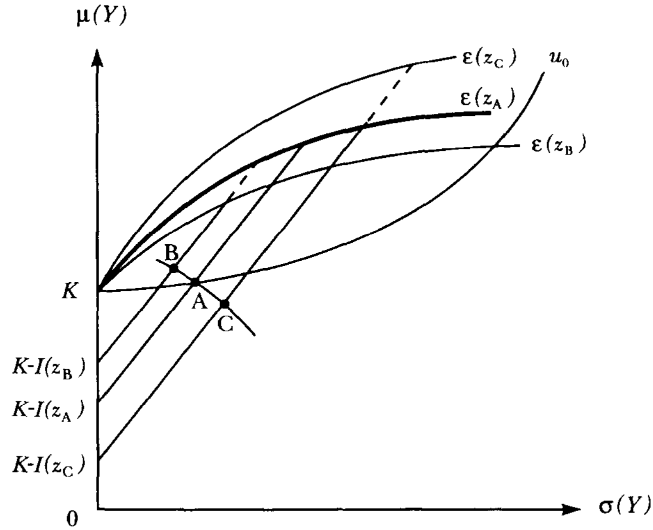

Fig. 8. Truthful revelation.

selects one investor as owner of the firm, offers the contract type M^*, and asks the investor to make an investment offer. Using Fig. 8 it is easy to show that the randomly selected investor will *not* bid optimally.

Assume the true profitability is z_A. If the investor bids $I = \tilde{I}(z_A)$, he will reach point A. Suppose the investor wants to suggest that z_B is true and bids $I = \tilde{I}(z_B)$ instead, with $z_B < z_A$. The participation rate, $q = q^*[\tilde{I}(z_B)]$, 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 Fig. 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 $I = \tilde{I}(z_A)$, and attain the level of utility u_0.

Overstating the profitability is not attractive either. Suppose the investor bids $I = \tilde{I}(z_C)$, with $z_C > z_A$, knowing that the government requires $q = q^*[\tilde{I}(z_C)]$ 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. Q.E.D.

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 $M = \{\tilde{I}(z), \tilde{q}(z)\}$ with $M^{**} = \{I^{**}(q)\}$, where

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

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 $\tilde{q}$ 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.

Proof. It is sufficient to prove that, under the assumptions made, q may be rising or falling with z. In Fig. 9, z_0 yields the participation line ABC and $\tilde{q}(z_0)$ 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 line $A'B'C'$ such that $\tilde{q}(z_2) = A'B'/A'C'$. The profitability z_2 has been chosen such that C and C', B and B', A and A' are all on rays through a point X on the ordinate. This ensures that $\tilde{q}(z_0) = \tilde{q}(z_2)$ and that 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 $\tilde{q}(z_3) = A'B'/A'C''' < \tilde{q}(z_0)$ and $\tilde{q}(z_1) = A'B'/A'C'' > \tilde{q}(z_0)$. 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 increases with z, q cannot reveal the underlying value of z, and thus cannot be used for a bidding process. Q.E.D.

Proposition 8 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.

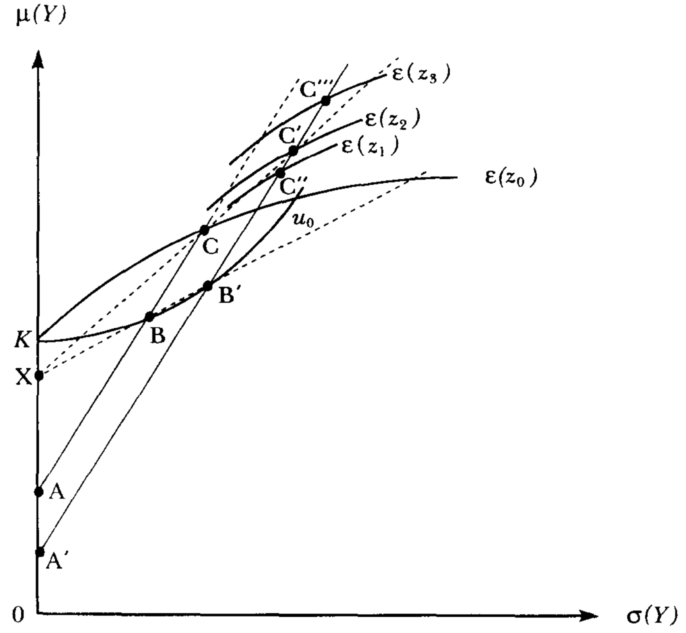

Fig. 9. Ambiguity in the value of q.

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 argument points to three 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 in terms of reduced dividends to a degree given by its own participation or tax rate $1-q$. When the rare case occurs that the investor plans additional equity injections, the government can choose 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 ways of financing future investment have not been formalized explicitly. However, investment from retained earnings and equity injections by the government are implicitly captured by defining $\theta f(I)$ as the present value of the net cash flow generated by the firm. Moreover, it is obvious that awarding private investment with an increase in the participation rate will preserve the necessary investment incentives in the future.

The second, more serious, incentive problem concerns *unobservable and non-contractable* resource transfers from the investor to the firm. 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, 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 blends between the participation and cash sales contracts 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 Fig. 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 is contractable, i.e. $f_1 = 0$. 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 optimal risk-sharing will require some participation of the government:[10] $q < 1$. 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, which may result from small reductions in q below one, will only lead to second-order changes in utility. On the other hand, the reductions in q themselves will have first-order effects, because the government is risk neutral and the investor is strictly risk averse.

In the intermediate case where both f_1 and f_2 are positive, 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.

The third incentive problem is the possibility of asset stripping. In order to make the participation contracts attractive for private investors it is necessary that the government's participation does not imply voting rights. However, the absence of voting rights makes the government vulnerable to a fraudulent erosion of the firm's equity base by selling assets to other firms controlled by the investor at below market prices. This problem is the same as with any company tax system, and its only solution is to give the government extensive rights to monitor the behavior of the firm and punish asset sales that do not satisfy the arm's length principle. Fortunately, the marginal costs of establishing such a monitoring system would be low, since it would have to be established anyway if a corporate tax system is to be introduced.

8. Conclusions: Privatization with incomplete risk markets

Privatizing the communist firm is not the same as privatizing British Telecom. It is true, 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. It is well known from the work of Mintz (1982), Bulow and Summers (1984), Gordon (1985) and others that, with well-functioning stock markets, mixed enterprises cannot improve the allocation of risk-bearing.

This statement may even be true, when information asymmetries create adverse selection problems and make the capital and risk markets incom-

[10] For a related discussion, see Shavell (1979).

plete. 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.[11]

The situation is very different, though, with the actual privatization problems faced by the former communist countries of the East. Except Germany, the cash-sales method is not a viable alternative because 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.

The conclusions of our model have been derived under the simplifying assumption that the government is risk neutral while private investors are risk averse. The heuristic generalizes for the case where the government is risk averse as long as it is less risk averse than private investors, i.e. as long as it can off-load the risk onto more shoulders than private investors can. We believe that in the context of privatizing a communist firm, this assumption is satisfied in a large variety of circumstances.

Communist dictatorship was not an adverse selection problem, and in most cases 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, with a competitive bidding process, 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.

It is true that, in principle, the asset markets of the West could be used to consolidate the risks involved in privatization by selling the state properties to foreign joint-stock companies. Certainly the world capital markets have

[11] This view is expressed by Konrad (1991) who considers risk markets with interior, partial coverage insurance solutions. Discussions of the virtue of government risk-sharing under less ideal conditions can be found in Mintz (1979) or Boardman et al. (1982).

more consolidating power than the poor states of the East. However, there are prohibitive political constraints. The public aversion to Western dominance and influence is so strong that basing the privatization programs on sales to foreigners is simply not a feasible policy option. With the exception of East Germany, all countries of the former Eastern Bloc have retained constraints that strongly discriminate against selling state property to foreigners.

In addition to the legal and political constraints there are severe informational and language problems that make a substantial foreign involvement difficult. Even the German Treuhand agency which actively tried to sell its assets to foreigners and to pave the way to East Germany was not successful. Less than 10 percent of the firms sold have been bought by foreigners, and while East Germans bought 6 percent, about 85 percent of the firms were sold to West Germany.[12]

This fact is all the more important as the West German stock market is chronically underdeveloped, unable to diversify the Treuhand risks. There are excessively high legal entry barriers, primarily in the form of quality requirements, that prevent both direct and indirect access.

A direct access would have been a privatization via share issues, but this was only a theoretical possibility. The Treuhand has sold or given away more than 12,000 firms, but in no case has it been able to sell a firm in the stock market. The establishment of a new 'junk bond' market tailored to the special needs of the East German firms was never considered as a serious political option. The German stock market's inability to support the privatization of the East German economy demonstrates a severe case of market incompleteness.

An indirect access would have involved a sale to West German stock companies which have a diversified ownership. This access was not available because there are only a few companies of this type in Germany. While there are about half a million companies in total there are only about 600 publicly traded joint-stock companies in Germany, and no more than one-tenth of these have a diversified ownership (in the sense that there is no single majority owner). The typical German company is an entrepreneurial firm or partnership with no more than a handful of owners. West Germany is not comparable with the United Kingdom, let alone the United States.

Developed risk markets that could have absorbed the Treuhand risks were 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

[12] These figures are based on the number of places of work sold rather than the plain number of legal entities counting as 'firms'.

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 billion. 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 billion, one-tenth of the original value. Given this huge discrepancy, there is every reason to think about alternative privatization procedures. This paper discussed one.

Acknowledgement

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Appendix A

In this appendix we prove analytically that the efficiency curve is concave. The efficiency curve, ε, 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:

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

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

$$\frac{\mathrm{d}\sigma_I}{\mathrm{d}I} = \sigma(\theta)f'(I) > 0 .$$

(A.2) also proves that the efficiency curve is concave. Q.E.D.

Appendix B

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

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

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

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. Q.E.D.

Appendix C

In this appendix we prove that, along the participation line (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

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

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

Eqs. (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). Q.E.D.

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