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INVESTING IN THE EAST:
WAITING AND LEARNING

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INVESTING IN THE EAST: WAITING AND LEARNING

Abstract

After the break-down of socialism in eastern Europe many western firms announced investment activities in these countries. However, the initial euphoria has vanished quickly and many firms are now waiting with their investment projects. The reason for this lies mainly in the greater uncertainty linked to investment in eastern Europe compared to investment in the West. Firms do not have information on the productivity of a particular country or region, and - as it is assumed - the government or local authorities cannot provide credible information on this. The only way to obtain relevant information is via the experiences of other western investors. Therefore, every investor provides an external effect he himself does not take into account. As in general sunk costs are incurred in connection with investment, the investment decision can be postponed, and over time new information becomes available, waiting for the firms may be advantageous. This is particularly harmful because the firms are the potential source of information.

The paper starts from the experience in eastern Germany, where many firms are waiting with their investment projects in order to gather better information, and extends this to eastern Europe, where the information trap is even more crucial since the uncertainty of investment is even greater. The paper presents a formal model that captures the role of information in the investment process. Based on the conclusions of this model, the existing policy instruments are discussed and policy recommendations are developed.

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1. Introduction

Investment of western firms plays a crucial role for the speed and success of economic transformation in the post-socialist economies of eastern Europe. Indeed many firms of the West are considering expanding their activities to the new markets of the East. So far, however, actual investment has taken place to a much lesser extent, when compared to the projections made two years ago after the communist regimes had collapsed and when compared to the necessary investment for a rapid and successful transformation.

Investment in the East promises high returns. However, the risks connected to it are clearly higher and have many more dimensions than the risks connected to a comparable investment in the West: In addition to the market environment there are the questions involving political and financial support by local authorities, provision of infrastructure, qualification of the labour force, and quality of the environment, to name but a few. In general this information cannot be provided by the government and official agencies because they themselves have an interest to put bias on the information and in part because they do not know how the qualities of their country fit the particular needs of a western investor. The more valuable way to gather information for potential investors is to observe the success or failure of actual investments. Hence the latter provide an informational externality the investors themselves do not take into account, making for a classic example of welfare enhancing government intervention. However, there has been a turn in western commitment in eastern Europe, which is seen most clearly in the example of eastern Germany. Here numerous initial investment announcements have been revised downwards: After information from the experiences of the first firms began to leak through, many potential investors have halted, cut down their investment projects or even cancelled them for the time being.¹ The initial policy measures were not based upon a correct perception of the investment difficulties, and when these difficulties became apparent the measures were not adjusted in an adequate way.

¹ The most prominent recent example is that of Mercedes Benz. The project to build a large truck factory in Brandenburg with 4,000 employees was cancelled in November 1992 (*Frankfurter Allgemeine Zeitung*, 3.11.92).

This paper tries to model the informational aspects of the investment process in the East explicitly to provide a basis for the discussion of apt policy measures. It starts from an outline of the development in eastern Germany (section 2). Since of all the former socialist economies eastern Germany is farthest in its economic transformation, the prevailing trends of the investment process can be best seen here. Some lessons can be learned for eastern Europe from this, both with respect to the change in the investment process and the policy reactions, because here the lack of specific information will be even more crucial for the investment and transformation process. Section 3 develops a simple waiting model which is regarded as relevant for the investment process in eastern Europe as a whole. Section 4 concludes with a discussion of the diverse policy measures that are applied in eastern Germany and eastern Europe.

2. Investment trends in eastern Germany

2.1. The actual development

In late 1989 and early 1990, shortly after the revolution in the GDR, western officials claimed that in a few years eastern Germany would be a flourishing country. In April 1990 the West German Minister of Economics stated he was convinced that soon in East Germany a "huge upswing would take place", and "new economic miracle in Germany" would come about.² In a report of the *Institut der deutschen Wirtschaft*, Cologne, in March 1990 a repetition of the economic miracle of the early 1950s was regarded as "realistic if not even highly probable"³. The underlying vision was a true investment boom foreseen in the region, installing high-tech and high-productivity equipment there. The Cologne institute reported that "enterprises from the Federal Republic - both large corporations, medium-size enterprises and free professionals - are in their starting blocks with plans for direct investment and are just

² Quotation from an interview conducted with H. Haussmann. Found in: Christ and Neubauer (1991, p.101) (translated).

³ Institut der deutschen Wirtschaft (1990, p.48) (translated).

waiting for the starting signal", which would yield "an immediate surge of productivity also in existing GDR enterprises".⁴ In the end the investment activities would place eastern Germany at the front of European economic prosperity and "soon turn it into a core of European economic growth"⁵. Already within few years economic integration was foreseen to become a clear success; the time span for by-and-large catching up with West Germany was roughly estimated at 5-10 years.⁶

Among some economists there was even a (short) debate whether investment subsidies for eastern Germany would be necessary at all.⁷ A renowned IMF survey argued that a smaller per capita capital stock than in western Germany would be necessary in the East due to the vintage effect of the newly installed capital which would be much more modern on average. So-called "efficiency advantages" of eastern Germany of 5 and 10 per cent were calculated.⁸

There ought to be several reasons for investment of western firms in eastern Germany: covering a new market, preventing entry of existing or new competitors, benefiting from a lower wage level with a potentially highly productive labour force, or getting a foot onto the east European market. Out of the 500 firms surveyed by the Ifo-Institute in February 1990 more than 60 per cent had investment preparing activities in East Germany, another 20 percent were planning such activities for the near future.⁹

In fact many firms needing proximity to the consumers and at the same time having low setup costs, e.g. retail, banking, and insurance sector, invested rapidly in new subsidiaries in the East. Also investment in the form of purchases of former GDR firms took place. (In fact 90 per cent of all privatised Treuhand firms were sold to West-German companies.) However, many of these privatised Treuhand firms were not only diminished in employment but also in capacity, some of them were even closed down entirely,¹⁰ reflecting the intention not to build up a

⁴ Institut der deutschen Wirtschaft (1990, pp.45 and 33) (translated).

⁵ Schmieding (1990, p.175) (translated).

⁶ Siebert (1990, pp.49 f.).

⁷ Cf., e.g., the study of H. Willgerodt for the German chancellor, quoted by Franz (1992, p. 5).

⁸ McDonald and Thumann (1990, p.76).

⁹ Brander (1990, pp.9 ff.) (translated). An earlier survey had shown an interest of similarly high magnitude; see *Wirtschaftswoche* 6, 2 February 1990, pp.29f.

¹⁰ Carlin and Mayer (1992, p.333).

production site but rather to prevent entry of other firms or new entry of the former GDR-firms onto the common German market.

Where production was continued or re-established, it was either as high-tech (Opel in Eisenach) or on a small scale, consequently with relatively low employment in all cases. Therefore, all in all investment in eastern Germany was sluggish and a catching-up with the West cannot be foreseen for the near future. Net capital investment amounted to roughly DM 150 billions within the three years after unification, which is somewhere between 10 and 15 percent of the necessary amount to catch up with the West German level of 1990. As early as 1990 many firms curtailed their investment plans in the new states, and some even withdrew from their initial announcement of investing in eastern Germany.¹¹ How come?

After the initial phase of investment announcements more detailed investigations revealed multi-dimensional uncertainty in the region considered. The labour force was said to lack skill and motivation to work under the regime of a market economy; many of those who were highly qualified and motivated migrated or have been commuting to the West (about one million people since late 1989). More thorough inspections of the environment revealed dangers of massive ecological damages and a partially written capital stock. Property was difficult if not impossible to acquire due to the restitution law, and the 'obstacle removal law' of March 1991 showed only little relief. The level of infrastructure was low, and attracting western executives to the East was difficult. Finally, support from local authorities was said to be remote due to massive changes in institutions, regulations and in personnel of the administration.

All these are phenomena relevant not only for eastern Germany but even much more for the other post-socialist economies of eastern Europe. By means of the unification East Germany adopted the entire legal framework of West Germany. Hence the informational difficulties of investment are removed on a macro level and refer to the regional level only. In contrast, in the other economies of eastern Europe there is uncertainty on all the issues listed

¹¹ There are very few articles in scientific journals on this tendency. However, general newspapers report numerous cases that clearly reveal this trend. Cf. *Wirtschaftswoche* 48/1992, pp.22-25 or *Der Spiegel* 46/1992, pp. 152 ff.

above and on the level of overall political and economic stability. In fact, from many of these countries early investors report large information problems that in part lead them to curtail their investment plans.¹² These hurdles are in part physical hurdles, but for the greater part they are a lack of information that hinders investment. Some of them, like the provision of physical infrastructure, are observable as such, but information on the main problems, like skill and productivity of labour, support by political authorities or environmental quality, are only becoming apparent through investment activities by early investors.

2.2. A change in paradigm

Eastern Germany may serve as an illustrative case of a trend that might become even more devastating for eastern Europe. What one can observe in the case of eastern Germany is a fundamental change in the perception of the underlying process, from a one-shot game to a multi-stage game, in game-theoretic terms: Initially, investment in the former GDR was regarded as a one-time opportunity; processes of this kind have often been called "rat races"¹³ where the rats run in order to reach the (fixed) amount of cheese first. Applications are patents where firms accelerate their research activities in order to receive a certain patent, and those who do not arrive first obtain nothing. This leads to inefficiencies from a social point of view, caused by excessive research of the firms.¹⁴ The analogue in the context discussed here would be over-investment, or a too rapid investment process in eastern Germany, which is certainly not what is being observed. In a working paper of the Kiel Institute of World Economics Irving Collier and Horst Siebert (1991, p. 2) remarked: "The May 18 treaty (*on German economic*

¹² A short selection of headlines may suffice here to give an intuition of the faltering investment process: "Investors Turn Sour on Poland: Bureaucratic Niggling and Xenophobia Hurt Prospects" (*International Herald Tribune*, 11 Feb 1992); "Some Joint Ventures in Russia Encounter Unforeseen Roadblocks - 'There Really Are No Rules'" (*The Wall Street Journal*, European Edition, 9 March 1992); "Big investors in Hungary think again - Changes in the economic climate have upset company plans" (*The Financial Times*, 14 Sept 1992); "GE Slows Investment in Hungarian Firm" (*The Wall Street Journal*, European Edition, 27/28 March 1992); "Inquiétudes pour deux grands projets d'investissement français en Tchécoslovaquie" (*Le Monde*, 22 Sept 1992); "It's a Roll of the Dice, Some Foreign Investors Find" (*International Herald Tribune on Poland*, 27 May 1992).

¹³ Akerlof (1976)

¹⁴ Rasmusen (1990, pp. 295ff.)

and monetary union) was supposed to signal the start of a great capital race into East Germany. However, with the notable exception of West German financial institutions and retailers, both West German and foreign investors have stayed pretty close to their starting blocks."

The government policy instruments that were applied under the paradigm of a one-shot game, such as tax exemptions, tax reductions, investment grants and accelerated depreciation allowances, tried to speed-up this process even further by limiting the time horizon within which these subsidies were granted. But the time limits of the diverse subsidies were not credible as an unconditional government commitment, independent of economic growth in eastern Germany: When things became worse in the new states and showed that a multi-stage game was the correct paradigm, the grants were prolonged for several times. First, the measures were prolonged in duration in 1991. Then, in mid-1992, the policy of the Federal Government was to make the measures decrease over time and thereby keep the pressure on the process. However, before these measures took effect, the government agreed on a new package of even higher investment grants in autumn 1992,¹⁵ causing a further loss in credibility of all government estimates.

This means, the initial government predictions and forecasts by all optimistic officials on the characteristics of the investment process were incorrect. In particular the initial optimism on the profitability of investment projects had been replaced by large uncertainty. Hence, potential investors halted and waited for better information. As government institutions had at least partially lost their reputation, the information could only be provided credibly through other investors in eastern Germany. This caused a fundamental change in two dimensions:

First, the shift from the initially perceived one-shot game to a repeated multi-stage game, where reliable information can only be collected through other firms, made waiting possible and gave it a positive value.

¹⁵ See Bundesminister der Finanzen (1992, p. 16).

Second, the provision of relevant information through other investors created an interdependence among the firms. Action and outcome of one firm (no investment, investment and success, investment and failure) directly affect the other firms' decision calculus.

In such a gradual process with waiting having a positive value there can be two general outcomes: None of the firms starts the process, or the process is begun but does not continue at a socially optimal speed. In the first outcome the hurdles are too high to be overcome by an individual firm; not even the firm with the lowest setup costs can expect to recuperate them by the returns on investment. Here, a first mover disadvantage¹⁶ would prevail since the first firm has to provide infrastructure, pressure on local authorities, etc., thus providing not only the usual monetary externalities (through demand of its employees) but also physical externalities to subsequent investors. If the costs for this are too high for any firm, a situation of no investment can occur.¹⁷

Eastern Germany and eastern Europe, however, rather fit the second possible case: Investment occurs, some firms have started the process, but it is continued at an insufficient speed. The following section will try to adequately model this process and to provide a basis for an analysis of apt policy measures.

¹⁶ For a general discussion of first mover (dis-)advantages see Sutton (1991, pp.19 ff.) and Waterson (1984, p.69).

¹⁷ In the literature this situation where a public good has a positive value for everyone but only the person that provides it has to bear the costs, has been labelled the "dragon slayer" problem. Examples are donating a library or jumping in to save a drowning swimmer. See Bliss and Nalebuff (1984).

3. Investing in a region of unknown productivity: the model

3.1. A simple model of waiting and learning

With the opening of eastern Europe for capitalist investors, an enormous amount of possible new projects became available for western firms. Because of the long period of central planning, however, it is not known whether a particular region is of high or low productivity. This may comprise the value of human capital, the functioning of local authorities, the stability of the political framework and the quality of the environment. Not even the government may have sufficient information on the productivity type of the region since these characteristics are not observable *ex ante* and will only become apparent through actual local investment. The first firms that invest in the former communist economy therefore act under great uncertainty with regard to the productivity of the region chosen, but in time the true quality of a region will be learned through experience. And this knowledge will not be private to the early investors, but be publicly known to all potential successors.

For a simple model, we take any region with a finite number of available investment projects, which only differ in the fixed capital necessary to start them. It is equivalent to assume that any of the western firms has in mind a single investment project with given sunk costs. (Hence the terms "investment project" and "firm" are used as synonyms.) If a project fails, the initial investment can never be recovered, hence the setup costs are sunk. We assume that these sunk costs K of all new firms are equally distributed on the interval $K \in [0; \bar{K}]$. Every project that is undertaken will pay a return per period to the investor. For simplicity we reduce the possible pay-off outcomes to two types: If the region is highly productive the project pays $R > 0$ per period, if the region is of low productivity the project pays nothing: $R = 0$.

For each firm, there may be exactly one project which is denoted by the corresponding sunk cost K . The expected gross benefit from investing in the eastern region can be written as

$$p^h \cdot \frac{R}{r} + p^l \cdot 0,$$

where p^h (p^l) denotes the subjective probability for a high (low) productivity region. Using the interest rate r as discount factor, $\frac{R}{r}$ is the current value of an investment in a productive region. We have no information *ex ante* on the quality of the region. Applying the principle of insufficient reason¹⁸ we substitute $p^h = p^l = \frac{1}{2}$, and the expected gross benefit of an investment project is given by

$$\frac{1}{2} \cdot \frac{R}{r}.$$

A risk neutral investor compares the uncertain investment to the alternative use of his capital in a riskless financial asset, which yields a return of $r \cdot K$ per period (or K in present value). From an *ex ante* point of view an investment project will be profitable if it yields a positive net benefit, i.e. if

$$\frac{1}{2} \cdot \frac{R}{r} - K \geq 0.$$

However the quality of a region will not remain a secret forever. Firms who start investing at an early stage will not only learn for themselves about the productivity of the region. The information will be passed on to other potential investors who have not yet made the step to eastern Europe. Hence, the general setting is coined by three characteristics: There are sunk costs that have to be incurred for the investment, the investment decision can be postponed (or not taken at all), and with a positive probability the information on the state of the region is provided by other investors after the first period. The probability of this is increasing in the number of initial investors.¹⁹ The traditional criterion of the Marshallian trigger (invest if the per period cash flow in current value terms exceeds $r \cdot K$) therefore cannot be applied any more.²⁰ Here, the timing of investment becomes endogenous: On the one hand, waiting for more information about the unknown productivity of the region may help to avoid

¹⁸ This is an innocuous assumption made for expositional clarity only and does not change the results.

¹⁹ This general idea, without any informational externalities of investment however, has been outlined, e.g., by Pindyck (1991) and Dixit (1992). Also Bernanke (1983) stresses the importance of waiting in the context of irreversible investment, explaining cyclical fluctuations of investment. He too, however, considers a single or representative investor and not informational interdependencies within a group of investors.

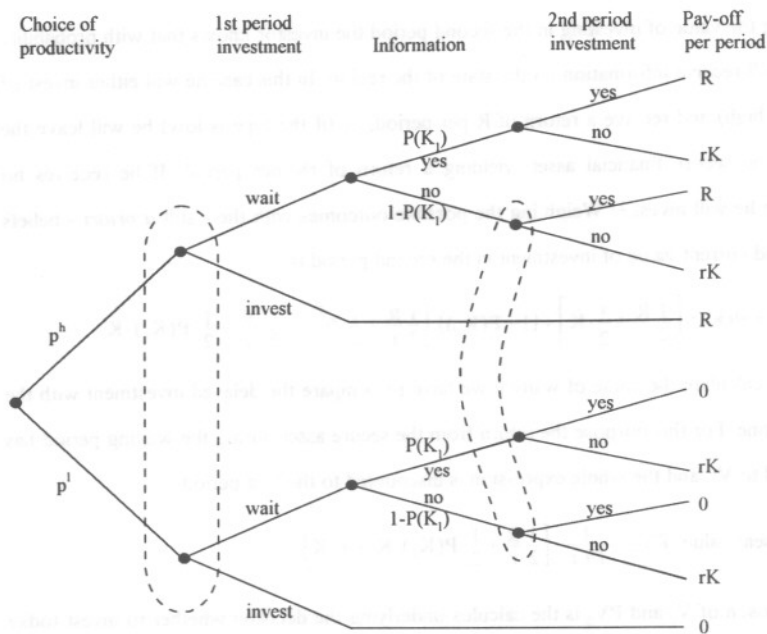
²⁰ A Marshallian trigger would imply that there are many identical investors for one project. If this project makes at least zero expected profits, every competitor will try to be the first undertaking the project. Waiting for more information becomes impossible. See Dixit (1992, pp.110 and 118).

the loss of the sunk costs K if the region proves to be of low productivity. On the other hand, waiting implies that the investor forgoes profits if the region is of high productivity.

To simplify the timing process, we reduce our model to two periods: In the first period, K_1 firms, i.e. projects with setup costs $K \in [0; K_1]$, decide to go east under the *a priori* beliefs p^h and p^l . With a certain probability P the true type of the region will be revealed and will become public knowledge at the beginning of the second period, when all firms that have waited can decide whether to invest or to leave their capital in financial assets. The probability P is an increasing function of K_1 , i.e. of the number of firms that have undertaken the investment project in the first period. The underlying rationale can be explained as follows. The variable K stands for all possible projects within a given region, across all branches of industries. However, for a firm which is considering investment in the East only the performance of an investor of the same or a related branch of industry allows it to draw conclusions on the profitability of its own project and hence to gain valuable information: Only such an investor undertakes an activity that is quantitatively (size of investment) and qualitatively (industry sector) comparable to the one considered by the waiting firm, i.e. a computer factory will hardly benefit from the information provided by the performance of the ubiquitous and proverbial *Currywurst* (hot-dog stands) in eastern Germany. With any increase of the total number of firms investing in the East, only the probability rises that a comparable firm is among the investors and hence that valuable information will be provided for the waiting firm. If the firms are independently and identically distributed the marginal probability increase caused by an additional firm investing in the East is declining, which yields a concave learning function: $P'(K_1) > 0$, $P''(K_1) < 0$, and $P(0) = 0$.²¹

The described investment process can be summarized in a simple decision tree:

²¹ The firm specific effort or the mere chance in the process could also be treated explicitly, but since such a process would not differ in substance and in results, all this is for the sake of simplicity captured in the learning function.



In the following two subsections we will compare the private investment decision with the socially optimal one.

3.2. The private investment decision

To analyze the private decision process we take a single firm which considers an investment in the East with fixed costs K .²² The expected value of this investment undertaken in the first period is the present value of all returns (discount rate r), given the *a priori* probability for the high productivity region of $\frac{1}{2}$:

$$V_1 = \frac{1}{2} \cdot \frac{R}{r}$$

If the investor calculates the corresponding current value for waiting until the second period, he will have to take the advantage of the informational gain (with probability $P(K_1)$) together with the possible disadvantage of foregone expected profits into consideration.

²² The upper bound for such investments is the maximum gross benefit R/r . Therefore, the discussion can be restricted on projects with $0 \leq K \leq R/r$.

Calculating the value of investing in the second period the investor knows that with probability $P(K_1)$ he will receive information on the state of the region. In this case he will either invest (if the type is high) and receive a return of R per period, or (if the type is low) he will leave the capital in the secure financial asset, yielding a return of rK per period. If he receives no information he will invest.²³ Weighting the possible outcomes with the - still *a priori* - beliefs the expected current value of investment in the second period is

$$V_2 = P(K_1) \cdot \left[\frac{1}{2} \frac{R}{r} + \frac{1}{2} \cdot K \right] + (1 - P(K_1)) \cdot \left[\frac{1}{2} \frac{R}{r} + \frac{1}{2} \cdot 0 \right] = \frac{1}{2} \cdot \frac{R}{r} + \frac{1}{2} \cdot P(K_1) \cdot K$$

In order to calculate the value of waiting we have to compare the delayed investment with the immediate one. For this purpose the return from the secure asset during the waiting period has to be added to V_2 , and the whole expression is discounted to the first period:

$$\text{Present value } PV_2 = \frac{1}{1+r} \cdot \left[\frac{1}{2} \frac{R}{r} + \frac{1}{2} \cdot P(K_1) \cdot K + r \cdot K \right]$$

The comparison of V_1 and PV_2 is the calculus underlying the decision whether to invest today or tomorrow. Since the projects can be ranked in K investors will undertake the projects in the first rather than in the second period if

$$\frac{1}{2} \cdot \frac{R}{r} \geq \frac{1}{1+r} \left[\frac{1}{2} \frac{R}{r} + \frac{1}{2} \cdot P(K_1) \cdot K + r \cdot K \right] \quad , \text{ i.e. if}$$

$$\frac{R}{2} - r \cdot K \geq \frac{1}{2} \cdot P(K_1) \cdot K$$

This means that investment will take place in the first period and waiting is not profitable, as long as the advantage from learning $\frac{1}{2} \cdot P \cdot K$ is lower than the foregone expected profit during the first period $\frac{R}{2} - r \cdot K$. Since $P(K)$ is a strictly increasing function in K (starting from 0) and $\frac{R}{K} - 2 \cdot r$ is decreasing in K , there always exists a privately optimal investment K_1^{priv} which satisfies the implicit equality

$$P(K_1^{\text{priv}}) = \frac{R}{K_1^{\text{priv}}} - 2 \cdot r \quad (1).$$

²³ As we will see this is always true for the relevant range of potential first period investors.

Figure 2 illustrates this condition.

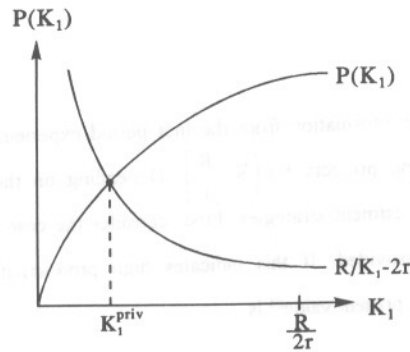


Figure 2: The private optimum

3.3. The social optimum

To calculate the pareto-optimal investment we assume a social planner who maximizes the value of the economy over both periods. This social planner has the same information set as the private investors; he too does not know the true productivity of the region. However, he is able to make full use of the informational externality which was not taken into account by the selfish entrepreneurs. Our intuitively appealing result that too little investment occurs in a laissez-faire economy relies only on the externality from learning and not on the assumption of a omniscient social planner.²⁴

In maximizing the investment value, the social planner only has one decision variable: the number of investment projects undertaken in the first period. The expected social value of these K_1 investment projects, which are necessary in order to explore the productivity of the

²⁴ The assumption that the social planner knows more about the productivity of a country could be relevant to discuss the government's influence in regional fiscal competition. This case is applied e.g. in King and Welling (1992) or in Bond and Samuelson (1986).

unknown region, is equal to the expected gross return minus the opportunity cost over all projects

$$\int_{K=0}^{K_1} \frac{1}{2} \cdot \frac{R}{r} - K \, dK .$$

Depending on the information from the first period experience, the planner will then decide over the remaining projects $K \in \left(K_1, \frac{R}{r} \right]$. Depending on the outcomes of the first period, there are two investment strategies: First, consider the case that information on the type of the region is provided. If this indicates high productivity, all projects will be undertaken. The expected present value²⁵ is

$$\int_{K=K_1}^{\frac{R}{r}} P(K_1) \cdot \frac{1}{2} \cdot \left[\left(r \cdot K + \frac{R}{r} \right) \cdot \frac{1}{1+r} - K \right] dK$$

Should the information reveal low productivity no more projects will be undertaken and all capital will remain in financial assets. The value is therefore $P(K_1) \cdot \frac{1}{2} \cdot [K - K] = 0$. Second, with probability $1 - P(K_1)$ nothing will be learned from the early investors. Given this uncertainty, the social planner should then undertake all projects with a positive expected value $K \in \left(K_1, \frac{1}{2} \cdot \frac{R}{r} \right]$ and leave all other capital in financial assets.²⁶ In this case, the value can be written as

$$\int_{K=K_1}^{\frac{R}{2 \cdot r}} [1 - P(K_1)] \cdot \left[\left(r \cdot K + \frac{R}{2 \cdot r} \right) \cdot \frac{1}{1+r} - K \right] dK$$

²⁵ With probability $P(K_1)$ the true state will be revealed and in 50 per cent of all cases the region will be highly productive.

²⁶ Implicitly, we assume that less than $\frac{R}{2 \cdot r}$ projects are undertaken during the first period. The optimality conditions will show that it can never be optimal to invest more than this.

The social value of the economy for any K_1 is just the sum of the above terms:

$$SV = \int_{K=0}^{K_1} \frac{1}{2} \cdot \frac{R}{r} - K \, dK + \int_{K=K_1}^{\frac{R}{2r}} P(K_1) \cdot \frac{1}{2} \cdot \left[\left(r \cdot K + \frac{R}{r} \right) \cdot \frac{1}{1+r} - K \right] dK + \int_{K=K_1}^{\frac{R}{2r}} [1 - P(K_1)] \cdot \left[\left(r \cdot K + \frac{R}{2 \cdot r} \right) \cdot \frac{1}{1+r} - K \right] dK$$

Integrating by parts allows us to rewrite the social value as

$$SV(K_1) = \frac{1}{1+r} \cdot \left[\frac{1}{2} \cdot K_1 \cdot R - \frac{1}{2} \cdot r \cdot K_1^2 + \frac{1}{8} \cdot \left(\frac{R}{r} \right)^2 + P(K_1) \cdot \left(\frac{1}{8} \cdot \left(\frac{R}{r} \right)^2 - \frac{1}{4} \cdot K_1^2 \right) \right]$$

To maximize this value, the social planner can decide on the number of first period projects K_1 . On the one hand, the more firms he sends to the East the higher the probability that the true state is known and the capital can be used optimally. Furthermore, returns can be gained which are far above the 'waiting'-return in the financial asset. On the other hand, every early investment increases the expected costs from failed projects in a bad region. The first order condition for an optimal investment path is obtained by setting the derivative of SV with respect to K_1 equal to zero:

$$\frac{dSV}{dK_1} = \frac{1}{1+r} \cdot \left[\frac{1}{2} \cdot R - r \cdot K_1 - \frac{1}{2} \cdot P(K_1) \cdot K_1 + \frac{dP}{dK_1} \cdot \left(\frac{1}{8} \cdot \left(\frac{R}{r} \right)^2 - \frac{1}{4} \cdot K_1^2 \right) \right] = 0 \quad (2)$$

This condition can be rewritten similar to the private solution with the socially optimal first period investment $P(K_1^{soc})$ implicitly given by

$$P(K_1^{soc}) = \frac{R}{K_1^{soc}} - 2 \cdot r + \frac{dP}{dK_1} \cdot \frac{1}{K_1^{soc}} \cdot \left[\frac{1}{4} \cdot \left(\frac{R}{r} \right)^2 - \frac{1}{2} \cdot K_1^{soc2} \right] \quad (3)$$

The first two terms on the right-hand side are identical to the market solution. The additional third term reflects the internalized learning benefit from an additional first period project. Private and social solution are depicted in figure 3. The socially optimal number of projects is always above the private one.

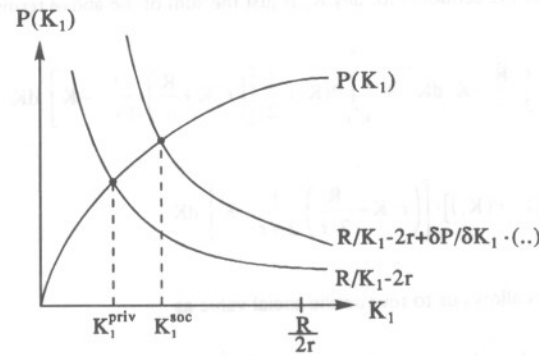


Figure 3: The social optimum

3.4. Evaluating the outcomes

What are the basic characteristics of the overall solution?

First, as outlined in the previous section the private solution always lies below the number of projects $R/(2 \cdot r)$, realized at once if no information could be obtained through waiting: This can be seen by writing the private optimum condition (1) as $K_1^{\text{priv}} = \frac{R}{2 \cdot r + P(K_1^{\text{priv}})}$. Because P is always positive, the value of the right-hand side will be lower than $R/(2 \cdot r)$.

Second, the socially optimal investment level is also below $R/(2 \cdot r)$. This means also the social planner makes use of the value of waiting. This can be seen from the following considerations. Any marginal investment beyond $K_1 = R/(2 \cdot r)$ will strictly decrease the social value $\left(\frac{dSV}{dK_1} \left(K_1 = \frac{R}{2 \cdot r} \right) < 0 \right)$: Substitute $K_1 = R/(2 \cdot r)$ in (2):

$$\frac{dSV}{dK_1} = \frac{1}{1+r} \cdot \left[-\frac{1}{2} \cdot P(K_1) \cdot \frac{R}{2 \cdot r} + \frac{dP}{dK_1} \cdot \frac{1}{16} \cdot \left(\frac{R}{r} \right)^2 \right] =$$

$$= \frac{1}{1+r} \cdot \frac{1}{2} \cdot \frac{R}{2 \cdot r} \left[-P(K_1) + \frac{dP}{dK_1} \cdot \frac{1}{2} \cdot \frac{R}{2 \cdot r} \right]$$

This expression will be negative if the term in brackets has a negative sign. This is always true because rearranging the bracket term gives

$$\frac{dP}{dK_1} \cdot \frac{K_1}{P(K_1)} < 2,$$

where the right-hand side can be interpreted as the elasticity of the learning function P with respect to the number of investment projects. For P is a concave function, the elasticity is always lower than unity, and therefore the marginal social value is negative. The marginal social value is declining in K_1 on its relevant range, which can be seen from the second derivatives. It follows from this that the socially optimal level of investment, where $\frac{dSV}{dK_1} = 0$, lies below $K_1 = R/(2 \cdot r)$, where $\frac{dSV}{dK_1} < 0$.

Finally it remains to be shown that the socially optimal investment is higher than the private one. The two conditions differ only in the last term of equation (3). This term is positive for all $K_1 \leq \frac{1}{\sqrt{2}} \cdot \frac{R}{r}$. The inequality holds because as shown above K_1 is always below the expected value $R/(2 \cdot r)$. Since $P(K_1)$ is an increasing function in K_1 , pareto-optimal investment demands higher levels of capital input than the market can bring forth under laissez-faire conditions.

Moving from the private to the social optimum the number of projects realized in the first period increases since the external informational effect is internalized. The individually optimising investors do not consider the value of the public good they provide by investing. A social planner, however, can find the right balance between learning from investing and risking losses in a potentially bad region. However, also from the socially optimizing point of view waiting still has a positive value.

4. Some policy conclusions

The model outlined above has shown that for the investment process in eastern Europe, given the relevant underlying conditions of the investment environment there, waiting has a positive value for the firms and thus becomes an intrinsic feature of the overall process. This waiting however, prevents full use being made of the positive externality which is provided by early investors.

The externality can cause severe economic consequences for the regions concerned, due to the crucial role of western investment for the speed and success of the transformation process on the whole. Therefore, policy intervention seems highly justified in order to offset the market imperfections. In fact, several policy instruments are available, for instance subsidies on the fixed costs of investments, reduced interest rates, accelerated depreciation. All of these policy measures should follow some specific criteria as suggested by the model:

1. The time horizon for the policy measure must be limited. In the two-period case described above it would be useless to subsidize both generations of investors because this would not discriminate between first and second period investment. From a social viewpoint, however, investment in the first period has a higher value. It only provides the positive externality. Thus additional investors have to be attracted from the second to the first period. This can only be achieved if the subsidy is of limited duration and ends at the time announced.

2. The announcement of the limited time horizon has to be credible. This is a problematic point since the usual policy measures are typically not time consistent. Given that the rate of investment is perceived as too little, the government will always have an incentive to renew the policy measure in the next period in order to then obtain the desired effect once again.

3. Expectations are crucial to this time inconsistency problem in two respects: Forward-looking investors who expect the government to react to an investment process which is too slow will not be influenced by the subsidy in the first period. In addition expectations may create a bandwagon effect in that the investors form expectations on other investors'

expectations, and if everybody expects everybody else to wait, all firms will wait for an increased subsidy in the following period.

4. In the context of eastern Europe investment is large and hence will always comprise sunk costs.²⁷ Since the existence of sunk costs causes the waiting problem, policy measures should focus as much as possible on the subsidy of these costs. This is also advisable from a budgetary point of view since it lowers the overall volume of support necessary. Therefore, if discrimination between sunk costs and recouperable costs is possible only the former should be considered. This would also preclude free-rider problems.²⁸

5. An essential difficulty is a possible distortion of the resulting capital-labour ratio in the long-run equilibrium. As the subsidy refers only to capital costs such a distortion can be precluded only if the subsidy ends before all the capital is installed. Since, however, the installation of the large amounts of capital necessary in eastern Europe will take several years if not decades, there exists a substantial time span for economic policy support without having this distortionary effect.²⁹

In order to better understand the relevance of these criteria and to be able to derive more detailed policy conclusions for east European countries it may be useful to have a closer look at existing measures applied in eastern Germany.

The list of policy measures in eastern Germany is very long³⁰ but there are four main elements:

1. Investment grant for equipment (12 per cent, later 8 per cent)
2. Investment subsidy (up to 23 per cent from regional development programme)
3. Accelerated depreciation (additional 50 per cent in the first year)
4. Low-interest credits

²⁷ As Dixit (1990, p.108) puts it: "...almost as a matter of definition an investment entails some sunk cost, an expenditure that cannot be recouped if the action is reversed at a later date."

²⁸ This problem has been recognized, e.g. by the Council of Economic Experts in Germany. See Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (1991, p.20).

²⁹ For a detailed discussion of possible long-run distortions caused by persistent policy measures see Sinn and Sinn (1992, p. 180-192).

³⁰ See Schneider (1991).

In the variables of our model, the investment grant and investment subsidy are subsidies on the sunk costs K . The difference of both measures is mainly institutional (e.g., different sources of funding; legal right vs. discretion of support). The accelerated depreciation affects the level of return R , and the credit subsidy lowers the interest rate r . In general the prevailing externality can be internalized through any of these four measures. The peculiarity of the accelerated depreciation is that it only becomes relevant in the case of success. If the investor makes losses accelerated depreciation does not improve his position.

All measures are of limited duration, the investment subsidy is scheduled until mid-1995, the accelerated depreciation until the end of 1994. The most important means of support by volume, the investment grant, is generally an apt measure to overcome the waiting problem.³¹ However, the effectiveness is clearly undermined by the difficulty of commitment. The investment grant was initially planned to last for only twelve months until June 1991 at 12 percent and then to decrease to 8 percent for another 12 months. However, it was prolonged twice by the end of 1992. In November 1992, the level of 8 percent was extended to investment purchased until mid-1994 and installed by the end of 1996.³² Only a few weeks later, the German government agreed upon raising the measure to a level of 20 per cent, bowing to pressure arising from the sluggish investment in the East.³³ Also the accelerated depreciation was initially planned only for investment goods purchased in 1990 but then too was prolonged until the end of 1994.³⁴ This lack of steady guidelines illustrates the commitment problem of the government. Investors who expected that the government would react to the small investment were well advised to wait in order to collect both the information from earlier investors and the (increased) government support.

The time inconsistency problem arises since true commitment has been hardly possible for the German government. There is no way it can credibly commit itself to stop the measure if in the next period it would again help to stimulate investment. Not only has it a self-interest in then prolonging its support but it also will be subject to pressure from lobbies.

³¹ Naturally the endogenous value of waiting is not the only element that hinders a rapid investment process in eastern Germany. Other important reasons are e.g. the wage level far above labour productivity and the restitution law.

³² Bundesministerium der Finanzen (1992, p.16).

³³ See *Frankfurter Allgemeine Zeitung*, 24 Nov 1992, p.1.

³⁴ See Klodt (1990, p.22) and Bundesministerium für Wirtschaft (1991, p.11).

For the case of eastern Europe, however, there may be a way to overcome this commitment problem. Since the countries rely heavily on support from supranational agencies, such as the IMF, this support could be linked to a credible ending of national investment grants mentioned above. The national government could always refer to binding agreements with these agencies, not to prolong the measure and thus free itself from national lobbying activities. The supranational agency, in turn, does not want to lose reputation just because of the pressure of a single country in eastern Europe. Therefore, this international linkage creates an opportunity of establishing an effective, long-run oriented and credible economic policy in these countries that helps to overcome their informational problems in the first place. Eastern Germany did not have this option. Its main source of support is western Germany which is the same entity politically and therefore the pressure cannot be passed on to any outside agency.

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