

Institut für *Halle Institute for Economic Research*
Wirtschaftsforschung Halle



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**Technological capability of foreign
and West German investors
in East Germany**

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März 2004

Nr. 189

Diskussionspapiere
Discussion Papers

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1 Introduction

Foreign direct investment (FDI) plays an important role for countries or regions in the process of economic catching-up. It is normally regarded as an important source of private capital and a contribution to growth and employment. Especially in “classical” developing countries, the attraction of FDI has often been part of their developing strategy – with different results of course (OECD, 2002; Moran, 1998). Since the beginning of transition, hopes are also based on foreign capital in the former socialist countries of Central and Eastern Europe where FDI from the West was almost completely absent before. Similarly to Central and East European countries, East Germany also became a host to foreign (and West German) private investments with the beginning of transition. Today, nearly all big industrial investments in East Germany stem from West Germany or abroad. Well known examples for foreign investments in East Germany are Dow Chemical in Schkopau, Elf Aquitaine in Leuna, or AMD in Dresden. Major West German investments are e.g. BMW in Leipzig, Bayer in Bitterfeld, or Volkswagen in Dresden.

From the perspective of the host economies, it is not only the capital transfer as such that makes foreign (and in East Germany also West German) investments so attractive but also and especially the transfer of modern technology and know how. Like in Central East European countries and other catching-up economies, it is expected in East Germany that modern equipped foreign (West German) investors increase productivity, which in East Germany still lags clearly behind the Western part of the country and constitutes an ongoing developing problem.¹ Thereby it is not only the transfer of technology from the parent company to the subsidiary but also the hope that subsidiaries build a source of technology spillovers in favor of local firms. These expectations raise the question of technological capability of foreign (West German) investors. Are external investors in East Germany really characterized by technological superiority compared to pure East German firms? Do they innovate more? Are they stronger involved in R&D (if at all)? Do they finally perform better in terms of productivity? These and further aspects will be dealt with in this paper.²

¹ Since the mid 1990s, the process of productivity catching-up between East and West Germany has nearly come to a hold. In 2002, East Germany reached 72% of West Germany’s productivity in manufacturing industry (DIW Berlin/IAB/IfW/IWH/ZEW, 2003, 15).

² There exist two empirical studies that deal with the performance of external investors in East Germany (Bellmann/Ellguth/Jungnickel, 2002; Belitz/Brenke/Fleischer, 2000). Bellmann/Ellguth/Jungnickel (2002) concentrate on differences between foreign (West German) establishments and East German establishments with respect to productivity. Direct indicators of technological capability are not subject to their paper. The study of Belitz/Brenke/Fleischer (2000) is about the impact of foreign investors on competitive market structures in East Germany. Aspects of technological capability play a minor role and West German investors are not subject of their investigation.

In the following, there will be an overview about the development of FDI in East Germany based on official data provided by the Federal Bank of Germany. The investigation will also include a comparison to Central East European countries. But the focus of the paper will be the analysis of a representative enterprise survey, the IAB-establishment panel, which provides a number of variables on the technological capability of (majority) foreign, West German, and East German owned firms.

2 Technological capability of foreign subsidiaries – theoretical considerations

There is no lack of theories explaining the existence of FDI or rather the existence of multinational companies. A whole spectrum of theoretical explanations has been developed since the 1960s when foreign subsidiaries became more and more important in practice.³ The different theoretical explanations that developed over time have been integrated by Dunning (1993, 75ff) in the so called OLI-paradigm. It has become the standard theoretical framework for studies on foreign subsidiaries.⁴ The OLI-paradigm shows under which circumstances a parent company establishes a foreign subsidiary instead of entering the foreign market via export or via licensing to a local producer. According to Dunning, three conditions (O, L, I) must be fulfilled before FDI takes place. First, the potential foreign investor – compared to the firms in the foreign market – must have *ownership-advantages* (e.g. firm specific product or production technology, marketing strategies). In order to regard production within the foreign market more efficient than export, a second condition must be given. That is, the aspired foreign country must offer *locational-advantages* (e.g. lower taxes, lower wages, cheap access to raw material). However, as it could still be more efficient to have a local company within the foreign market produce via license-agreement, a third condition must be fulfilled before a subsidiary will be established abroad. That is, the potential foreign investor must face *internalization-advantages*, which means that it must be more efficient for the foreign investor to make use of the firm specific technology within the multinational concern through a subsidiary because asymmetric information

³ Major contributions came from Hymer (1960) who stressed “monopolistic” advantages as a driving force behind foreign subsidiaries, Vernon (1966) who emphasized the product cycle as a significant reason for the relocation of production from industrialized to less developed economies, and finally exponents of the internalization theory stressed the imperfections of technology markets (e. g. Buckley/Casson, 1976 and 1985; Rugman, 1980 and 1985). For an overview about the theoretical approaches explaining multinational firms (not FDI as a macro variable) see e. g. Caves (1996) or Dunning (1993, 68ff).

⁴ Barz (1998), Autschbach (1997), Klagge (1997) and many others base their empirical research on the OLI paradigm.

makes license-agreements impossible (failure of technology markets).⁵ Only if all three conditions, i. e. ownership-, locational-, and internalization-advantages, are given a firm will establish a foreign subsidiary instead of engaging in export or license agreements.

Dunning's theoretical framework has of course primarily been developed in order to explain the existence of multinational firms, but by doing so it lies the very foundation for the assumption that foreign subsidiaries are technologically superior compared to domestic firms. The firm specific technology (ownership advantages) "packed" (internalized) in a foreign subsidiary makes foreign investors a source of new technology and knowledge within the host economy. More generally speaking, foreign subsidiaries benefit from the competitive strength (ownership advantages) of their parent company worldwide.

3 FDI in East Germany: overview based on official statistics

3.1 Methodical remarks

In Germany, the Federal Bank (*Deutsche Bundesbank*) is responsible for the collection of FDI data. There are two methods of FDI data collection in Germany (flow and stock). Flow data is collected by the Federal Bank for the purpose of national accounts (balance of payments), but these figures do not allow for a breakdown between East and West Germany. Thus, they are not suitable for this paper. The collection of stock data, however, is based on the foreign subsidiary's balance sheets and therefore allows for a regional breakdown between East and West Germany (East and West German *Länder*). The legal basis for stock data collection is the German foreign trade regulation (*Außenwirtschaftsverordnung*). Since the beginning of 1999, foreign ownerships of more than 10% are subject to registration (Deutsche Bundesbank, 2003, 71).⁶ With the 10% rule, German FDI statistics finally meets the international recommendations for FDI data collection given by the International Monetary Fund (IMF, 1993). The compulsory registration of FDI according to the *Außenwirtschaftsverordnung* applies to enterprises with a balance sheet total of at least 500 000 Euro.

⁵ Thus, internalization has nothing to do with external effects here. It simply means that certain technologies or know how is being transferred internally (within the multinational concern).

⁶ In September 1989, the threshold had been changed from 25% to 20%. It is reasonable to assume that these changes (from 25% to 20% and from 20% to 10%) cause problems when comparing German FDI stock data over time. But according to calculations of the Federal Bank of Germany, the changes have not caused much falsification first of all because most FDI has been invested in 100% foreign owned subsidiaries anyway (Jost, 1999, 131 and 147).

Since balance sheets are used for stock data collection it is possible to determine the location of FDI. However, the Federal Bank records FDI only at the principal office (*rechtlicher Sitz*) of the foreign investor. It is not possible to separately account for establishments (local business units) that in turn are founded somewhere else in Germany. This may cause distortions when looking at regional FDI data. For example, an establishment in East Germany deriving from a foreign investor's principal office in West Germany is not being identified as FDI in East Germany. In other words, only investments that are coming immediately from abroad can be counted as FDI in East Germany. Since it is probable that a number of foreign investments in East Germany have been carried out by foreign firms that have traditionally been located in West Germany the method of data collection causes an underestimation of FDI in East Germany.⁷

Box 1: FDI in East Germany's privatization process

In the early years of transition, a large part of FDI came to East Germany within the privatization process. In East Germany, the *Treuhandanstalt* (trust agency) was responsible for the privatization of state owned enterprises which was completed by the end of 1994. However, reliable figures on the total sum of investment carried out by foreign firms within the privatization process is hard to come by and if so figures would be difficult to interpretate. Purchase prices did often not reflect the value of the firms and after all purchase prices were often only a symbolic price when the buyer made investment and employment promises. Thus, privatization effects can rather be expressed in terms of number of privatization projects and investment promises: In October 1994, foreign investors accounted for 855 out of 14 576 (6%) privatization projects but their investment promises were as high as 11% of all investment promises which indicates that foreign investors were mostly present in the privatization of big firms (Haas, 1996, 166f). *Treuhand* data will, however, not be used in this paper.

3.2 The development of FDI in East Germany (1991-2001)⁸

In East Germany, FDI of course started from a very low level in 1991 and increased substantially in the following years (from 665 Mio. Euro in 1991 to 9 429 Mio. Euro in

⁷ The underestimation problem can of course also happen the other way around. That means, foreign firms investing immediately in East Germany and founding establishments (local business units) in West Germany in the course of time. However, it is more likely that FDI is underestimated in East Germany since West Germany has a longer tradition in the attraction of foreign firms. About the difficulties of regional FDI data for East and West Germany see also Votteler (2001,142ff).

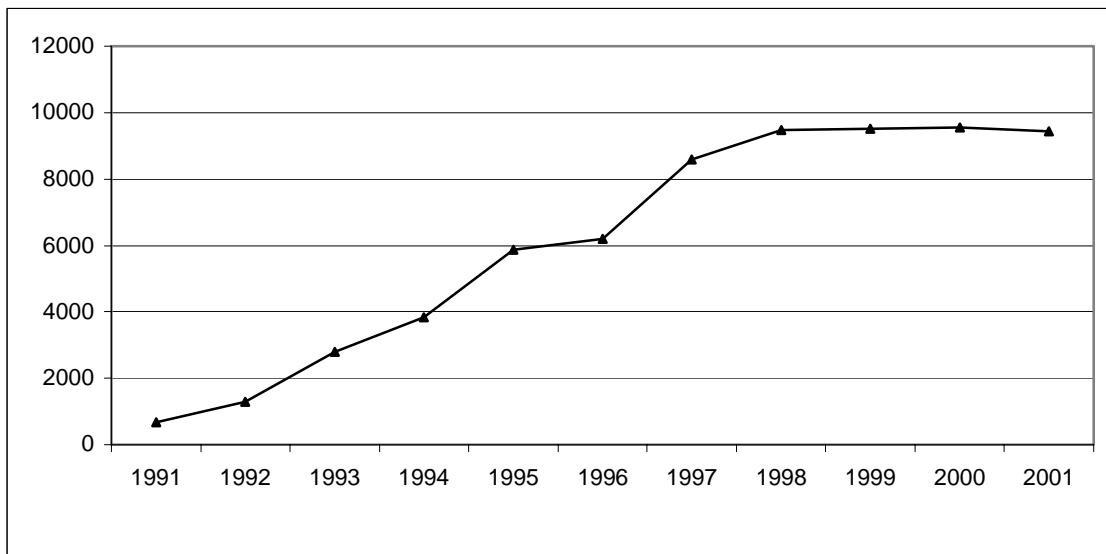
⁸ Data presented in this chapter derive from the Federal Bank of Germany. They are consolidated figures, that means data corrected for FDI that only goes into holdings in Germany and is afterwards invested somewhere else in the world.

2001), but since 1998 the FDI stock more or less stagnates as shown in chart 1 the FDI stock even declined slightly in the year 2001.

Chart 1:

FDI stock in East Germany^a 1991-2001 (end of year)

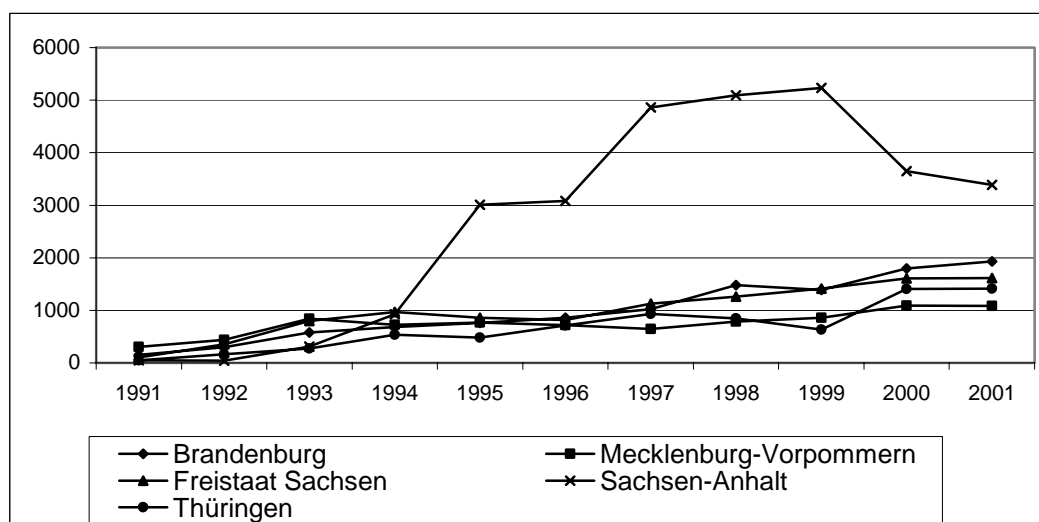
- Million Euro -



a excluding Berlin.

Source: Federal Bank of Germany (*Deutsche Bundesbank*).

The shape of the curve in chart 1 has strongly been affected by the development of FDI in Sachsen-Anhalt. Different from other federal states (*Länder*), Sachsen-Anhalt experienced a strong increase of FDI in 1995 and 1997 while it has been decreasing since 1999 (see chart 2).

Chart 2:**FDI stock in East Germany^a 1991-2001 (end of year)****- Million Euro -**

^a excluding Berlin.

Source: Federal Bank of Germany (*Deutsche Bundesbank*).

Overall, Sachsen-Anhalt has attracted by far the highest amount of FDI until the end of 2001 (3 387 Mio. Euro), followed by Brandenburg (1 932 Mio. Euro), Sachsen (1 612 Mio. Euro), and Thüringen (1 412 Mio. Euro). Least has been invested in Mecklenburg-Vorpommern (1 086 Mio. Euro). When taking into account the size of the *Länder* (in terms of number of inhabitants), Sachsen-Anhalt remains the leading region with 1 312 Euro per head (see table 1). It follows Brandenburg (745 Euro) and Mecklenburg-Vorpommern (617 Euro) – whereby the latter received substantial foreign investments in the shipbuilding industry (e. g. Aker from Norway).

Table 1:**FDI stock in the East German *Länder* in Mio. Euro and per head, 2001**

	FDI stock in Mio. Euro 2001	FDI per head in Euro 2001
Brandenburg	1 932	745
Mecklenburg-Vorpommern	1 086	617
Sachsen	1 612	368
Sachsen-Anhalt	3 387	1 312
Thüringen	1 412	586
East Germany (excl. Berlin)	9 429	687

Source: Federal Bank of Germany (*Deutsche Bundesbank*).

The comparably high FDI stock in Sachsen-Anhalt certainly reflects the big foreign investments in chemical industry and petroleum industry that have been undertaken here (e.g. Dow Chemical, Elf Aquitaine). Privatization ended by the end of 1994, and afterwards substantial investments have been carried out especially in the chemical industry. The strong shrinking of FDI stock in Sachsen-Anhalt in 2000 (from 5 231 to 3 651 Mio. Euro) is more difficult to explain. Looking at the FDI figures by branches for Sachsen-Anhalt (see appendix 1) it shows that the decrease of about 1.6 billion Euro between 1999 and 2000 took place in manufacturing industry, but within manufacturing industry it was not chemical industry that experienced a shrinking of FDI stock. In chemical industry the FDI stock even increased from 1999 to 2000. From those branches for which FDI figures are documented the following three experienced a decreasing FDI stock: “Non-metallic mineral products”, “Fabricated metal products”, and “Real estate, renting and business activities not elsewhere classified”.⁹ In general, a decreasing FDI stock may either mean the relocation of investors or it reflects repayments of loans to the parent company, profit transfer to the parent company or other financial transfers that statistically count as an FDI outflow. Official statistics do, however, not allow to identify the “form” of FDI outflow.

The relatively low FDI stock in Sachsen as shown in table 1 is certainly misleading since a number of very important industrial investments have been carried out in Sachsen. It is reasonable to assume that there are foreign investment projects that are not counted since the investing foreign firm has its main office in another federal state. And of course, West German investments as such are not included in official FDI statistics, but in Sachsen there are significant investments from West German investors, e.g. Infineon, Porsche, Volkswagen and numerous components suppliers like Bosch, Brose etc.

⁹ In order to avoid the disclosure of single investment projects the Federal Bank of Germany is not allowed to display the FDI stock for every single branch.

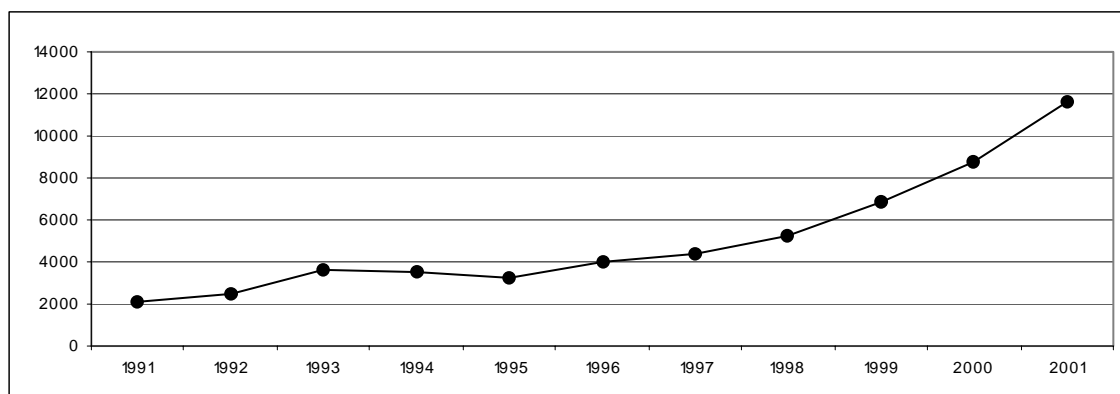
Box 2: Development of FDI in Berlin

One problem that arises when looking at FDI (and other) data for East Germany is the question how to treat Berlin since official statistics do usually not allow to differentiate between East and West Berlin. Because of its special situation, Berlin has been excluded from the FDI statistics in this chapter. It will, however, be treated separately at this point since it took a rather special and interesting development (chart 3). First, FDI took a development comparable to the five East German *Länder* although it started from a higher level. But in 1997/98, when FDI began to stagnate in East Germany, Berlin in turn experienced a strong increase of FDI. As a result, FDI in Berlin clearly exceeds the total amount of FDI in East Germany by the end of 2001, namely 11 573 Mio. Euro in Berlin versus 9 429 Mio. Euro in East Germany (see also appendix 2).

Chart 3:

FDI stock in East Germany including/excluding Berlin 1991-2002

- Million Euro -



Source: Federal Bank of Germany (*Deutsche Bundesbank*).

The strong increase of FDI in Berlin since 1997 took place because of the relocation of the capital city from Bonn to Berlin. According to the Federal Bank of Germany and the International Investment Council (IIC) Berlin¹⁰ a number of foreign firms decided to relocate their main office to Berlin, and as mentioned before FDI counts at the place (federal state) where the main office is located even if production takes place in local business units somewhere else.

¹⁰ The IIC is an investment promotion agency for East Germany founded in 1997. The stakeholders of the IIC are the German Federal Government and the five East German states plus Berlin. For further information see also: www.iic.de.

By the end of 2001, 7 385 Million Euro of the 9 429 Million Euro that have been invested in East Germany by foreign firms have gone into manufacturing industry, i. e. 78.3% (see table 2). Unfortunately, a further breakdown by branches is rather incomplete for reasons of data protection. What is striking, however, is the fact that a large part of FDI in manufacturing industry has been invested in chemical industry (35.2% of all foreign direct investments in manufacturing industry).

Table 2:
FDI stock in East Germany^a according to branches 2001 (end of year)

Branches	Million Euro	%
Manufacturing industry	7 385	78.3
Food, beverages, tobacco	X	X
Paper, publishing, printing	X	X
Manufacture of coke, refined petroleum products	-	-
Chemical industry	2 599	35.2
Rubber, plastic products	X	X
Non-metallic mineral products	X	X
Basic metals	704	9.5
Fabricated metal products	X	X
Machinery, equipment	131	1.8
Manufacture of devices for electricity production and distribution	X	X
Optical equipment	X	X
Motor vehicle production	739	10.0
Wholesale and retail trade; repair of motor vehicles etc.	214	2.3
Transport, communication	267	2.8
Financial intermediation	16	0.2
Credit institutions	-	-
Other financial institutions	X	X
Insurance industry	X	X
Real estate, renting and business activities n.e.c.	553	5.9
Real estate activities	X	X
Services mainly for enterprises	178	32.2
Management activities of holding companies (<i>Beteiligungsgesellschaften</i>)	223	40.3
Others	994	10.5
Total	9 429	100

X = not declared in order to avoid the disclosure of single investment projects

a excluding Berlin

Source: Federal Bank of Germany (*Deutsche Bundesbank*)

3.3 FDI in East Germany compared to CEEC

Not very surprisingly, FDI stock in East Germany remains low compared to West Germany. In West Germany, FDI per head has been much higher than in East Germany, namely 3 651 Euro per head in West Germany versus 690 Euro per head in East Germany. But thereby one has to take into account that West Germany has been accumulating FDI over decades while in East Germany it started only with the beginning of transition.

In order to compare East Germany's FDI stock to other regions or countries, it is more reasonable to make a comparison to Central European countries which also have been attracting foreign investors since the beginning of transition in 1990. Such a comparison is of course not free of problems related to the data collection procedures.

First of all, there are the generally known difficulties with respect to the international comparability of FDI statistics (Döhrn, 1996; Sachverständigenrat, 1997, 64ff). Nevertheless, the harmonization of FDI data collection has improved substantially in recent years, also and especially in Central European countries (Borrmann, 2003). Most important, today all Central European countries listed in table 3 (as well as Germany) apply the 10% threshold for the definition of FDI as recommended by the IMF and OECD (IMF, 1993; OECD, 1996).¹¹

Furthermore, East German FDI statistics do not include investments from West Germany as mentioned earlier in this paper. In order to achieve a better data comparability, German FDI has been excluded from FDI figures for Central East European Countries.

Finally, table 3 presents FDI stock data for eight Central European countries and East Germany. Looking at the FDI stock in absolute figures (table 3), Czech Republic, Hungary, and Poland by far exceed East Germany. When taking into account the size of the country (region) by looking at FDI stock per head, it shows that all Central European countries still exceed East Germany.

¹¹ Some Central European countries used higher thresholds before, e.g. Estonia applied the 20% threshold until the end of 1999, Slovenia used a 50% threshold between 1997 and 1999. Consequently, FDI has been underestimated compared to countries applying the 10% threshold.

Table 3:
FDI stock in East Germany and Central European countries 2001

	FDI stock Mio. US \$	FDI stock per head US \$
East Germany (without Berlin)	8 414	690
Czech Republic ^a	26 764	2 012
Estonia ^a	3 160	2 263
Hungary ^a	23 562	1 517
Slovenia ^a	3 209	1 432
Poland ^a	41 031	862
Slovak Republic ^a	5 582	803
Latvia ^a	2 332	880
Lithuania ^a	2 666	696

^a excluding German FDI.

Source: Federal Bank of Germany (*Deutsche Bundesbank*); WIIW (2003)

One has of course to take into account that the relatively low FDI rate in East Germany has to do with the underestimation problem as explained above (see chapter 3.1). Furthermore, East Berlin has not been taken into account since official statistics do not allow for a breakdown between East and West Berlin. But even if whole Berlin would be included, which in turn would be an overestimation, East Germany (with 1 095 US \$ per head) would still lag clearly behind the Czech Republic, Estonia, Hungary, and Slovenia.

Whether the relatively high amounts of FDI in Central East European Countries, especially in the Czech Republic, Hungary, and Estonia, have been carried out at the expense of East Germany cannot be answered at this point, and it is not the focus of this paper. This aspect does, however, call for further research.

4 Foreign and West German investors in East Germany – an analysis based on the IAB establishment panel

According to the theoretical considerations expressed in chapter 2, it is assumed that foreign investors are characterized by a higher technological capability and thus a better economic performance than East German establishments, and basically the same is expected with respect to West German establishments. This chapter will investigate whether the theoretical assumption holds true for East Germany's manufacturing industry. Official

statistics on FDI do not allow for any analysis of technological capability. Here the IAB establishment panel acts as a valuable data source.

The IAB establishment panel will be briefly introduced in the following. Then, some general features of foreign, West German, and East German establishments will be presented. Afterwards, the technological capability of external and East German establishments will be analyzed using various indicators.

4.1 The data source: IAB establishment panel

The IAB establishment panel is carried out annually by the Institute for Employment Research of the Federal Labour Services in Germany (*Institut für Arbeitsmarkt- und Berufsforschung der Bundesagentur für Arbeit, IAB*). It serves as the basis for empirical investigation on the technological potential of foreign and West German investors in East Germany in this paper. The panel is representative for the East German economy. All data presented in this chapter are projected figures. The basic population from which the sample is drawn is the employment statistics register of the Federal Employment Services (*Bundesagentur für Arbeit*). The register includes all establishments in Germany with at least one employee who is obliged to social insurance contribution. That means, survey unit is the establishment (local business unit) and not the enterprise as a whole. This is a particular strength of the survey especially when making investigations in the East German economy, because a number of West German based enterprises have established subsidiaries in East Germany. The response rate usually reaches as much as 70% since field interviewers are sent out. In 2001, the number of properly filled in questionnaires for the manufacturing industry amounted to 1 800 establishments for East Germany. For each case the IAB provides a weighting factor.¹²

The IAB is a data base that allows to distinguish between majority foreign, majority West German and majority East German owned establishments.¹³ It provides general business indicators (e.g. sales, employment, investments) as well as indicators of the technological capacity (e.g. innovations, research & development, organizational changes). Research & development and innovation questions have been subject to the IAB establishment panel every third year (so far in 1998 and 2001). Latest figures will be used in this paper.

¹² For further methodical information about the IAB establishment panel see Kölling (2000).

¹³ Accordingly, the terms „foreign establishment (firm)“, „West German establishment (firm)“, and “East German establishment (firm)” will be used in the following. Foreign and West German establishments will also be referred to as “external establishments (firms)”.

Different from official statistics, the IAB establishment panel for East Germany includes the Eastern part of Berlin which contributes to data accuracy.

All figures calculated from the IAB establishment panel and presented below apply to manufacturing industry in East Germany.

4.2 General features of external and East German establishments

According to the IAB establishment panel 2001, majority foreign owned establishments in East Germany account for only 1.6% of all establishments in the East German manufacturing industry while West German investors amounted to 15%. Nevertheless, foreign (West German) establishments represent relatively high proportions of employment, sales, and investments compared to East German establishments as shown in table 4.

Table 4:
Proportion of foreign, West German, and East German establishments according to number of firms, employment, sales, and investments in East Germany 2001
- in % -

	Number of firms (2001)	Employment (2001)	Sales (2000)	Investments (2000)
Foreign establishments	1.6	9.7	18.9	15.2
West German establishments	15.0	37.8	46.2	47.4
East German establishments	80.4	47.5	30.0	34.4
Other establishments ^a	3.0	5.0	4.9	3.0

^a Other establishments are majority public owned establishments, establishments without a majority owner, or establishments where the majority owner is unknown..

Source: IAB establishment panel 2001, calculation of the IWH.

These figures already indicate that external investors, especially foreign establishments, are much bigger in terms of number of employees than East German establishments. Together they account for 16.6% of all establishments but represent nearly 50% of the total employment, 65% of sales, and 63% of investments. And indeed, as shown in table 5 the average size of foreign establishments is about ten times higher than the size of East German firms.

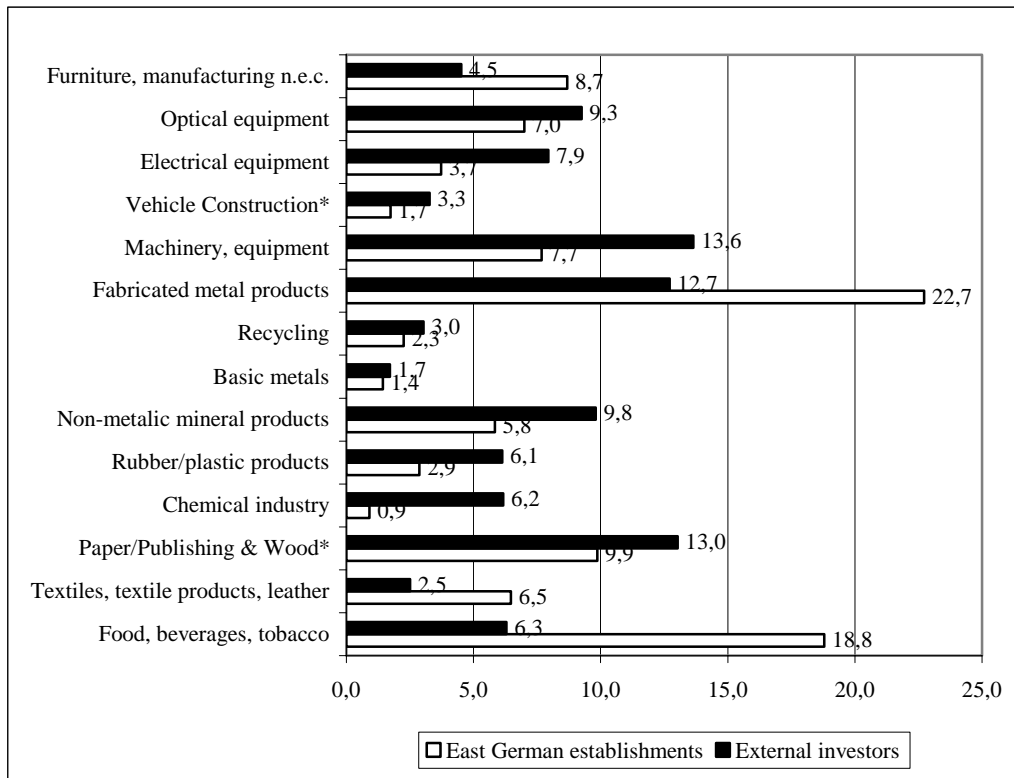
Table 5:
Average size of foreign, West German, and East German establishments (in terms of employees) 2001

	Average size (number of employees)
Foreign establishments	123
West German establishments	52
East German establishments	12
All establishments in East Germany	20

Source: IAB establishment panel 2001, calculation of the IWH.

Looking at the branch structure of external investors and East German establishments (see chart 4) it becomes visible that “fabricated metal products” and “food, beverages and tobacco” are by far the most important branches for East German establishments (22.7% and 18.8% respectively).¹⁴ The most important branches for external investors are “machinery, equipment” (13.6%), “paper, publishing & wood” (13.0%), and “fabricated metal products” (12.7%). If employees build the base for the breakdown by branches the picture does not change much (see appendix 3).

¹⁴ For the analysis by branches, foreign and West German investors had to be put together into one category (external investors) because of the otherwise insufficient number of cases (projection normally requires at least 30 cases). For the same reason, the otherwise single categories “motor vehicles/trailer/semi trailers” and “other transport equipment” had to be merged to “vehicle construction”. The same applies to “paper/publishing/printing” and “wood/wood products” which form a single category here. Except for these two jointed branches the categories in chart 4 correspond to the WZ 93 two-digit classification (comparable to NACE or ISIC).

Chart 4:**External (foreign and West German) investors and East German establishments according to branches in manufacturing industry, 2001****- establishments in % -**

* Merged categories (see footnote 14).

Source: IAB establishment panel 2001, calculation of the IWH.

The breakdown of external and East German establishments by branches implies that external investors are more present in branches with a higher technology intensity. External investors, for example, have a clearly higher weight in branches like “chemical industry” or “electrical equipment” than East German establishments. East German establishments on the other hand are more present in “food, beverages, tobacco” or “textiles, textile products, leather”. The proportion of foreign, West German, and East German establishments in the high-, medium-, and low-tech sector will be subject to the investigations on technological capacity presented in the following chapter.

Overall, the size and branch structure of external investors as well as their contribution to employment, sales, and investments is typical for transition economies (Hunya, 2002). It is first of all an outcome of the privatization process in which big industrial plants were taken

over by foreign or West German investors since East Germans did not have the financial means to buy and modernize the existing industrial firms.

4.3 Technological capability of external and East German establishments

The IAB establishment panel provides a number of variables that are suitable to express the technological capability of firms. In the following, there will first be an analysis of external and East German establishments according to low-, medium- and high-tech branches as well as an analysis of the technical condition of equipment. Afterwards, innovation and R&D activities as well as the human capital potential of external and East German establishments will be looked at. Finally, differences in economic performance (productivity) will be taken into consideration.

4.3.1 Low-, Medium- and High-Tech branches and technical condition of equipment

The very concept of how to classify low-, medium-, and high-tech is subject to an ongoing debate (Carroli/Pol/Robertson, 2000; Krockow, 2002; OECD, 1999). A frequently used classification relies on the OECD concept which distinguishes between high-tech, medium-high-tech, medium-low-tech, and low-tech (Hatzichronoglou, 1997).¹⁵ However, the OECD approach requires data with a breakdown up to 4-digit ISIC (NACE) branches, which is very often not available. In such cases, the statistical office of the EU (Eurostat) uses a modified version of the OECD classification (e.g. Foyn, 2001). High-tech and medium-high-tech are put together to high-tech, and medium-low-tech is renamed to medium-tech. Low-tech remains unchanged (see appendix 4). Since the IAB establishment panel only provides 2-digit WZ-93 classes (comparable to 2-digit ISIC or NACE classes), this paper uses the modified OECD classification as suggested by Foyn (2001). Apart from this, another problematic aspect of the classification is that foreign (West German) investors often source out the labor intensive parts of their production which do not necessarily represent the technology intensity of that branch. Overall, the classification used here is a compromise but it is the only possible solution with the available data.

¹⁵ The debate about a reasonable definition of high-tech first of all brings up the question whether high-tech industries are industries that extensively produce or extensively use technology. The OECD classification takes into account both “the level of technology specific to the sector (measured by the ratio of R&D expenditure to value added) and the technology embodied in purchases of intermediate and capital goods” (Hatzichronoglou, 1997, 3).

Table 6:
Foreign, West German and, East German establishments according to low-, medium-, and high-tech 2001
- establishments in % -

	Low-tech ^a	Medium-tech ^b	High-tech ^c
External investors	34.6	25.0	40.4
East German establishments	43.3	35.7	21.0

^aLow-tech: Food, beverages, tobacco; textiles, textile products, leather; paper, publishing, printing; wood, wood products; non-metallic mineral products; recycling. – ^bMedium-tech: Rubber, plastic products; basic metals; fabricated metal products; furniture, manufacturing n.e.c. – ^cHigh-tech: chemicals, chemical products (incl. petroleum processing which actually belongs to medium-tech); machinery, equipment; motor vehicles; other vehicles (including ship building which actually belongs to medium-tech); electrical equipment; optical equipment.

Source: IAB establishment panel 2001, calculation of the IWH.

As presented in table 6, the majority of external investors fall into the high-tech category (40.4%) while among the East German establishments only 21.0% fall into high-tech branches. East German establishments are mainly present in low-tech branches with 43.3%.

In this context, another aspect of technological capability will be looked at, namely the technical condition of equipment. It relies on a self assessment of the firms.¹⁶ In the questionnaire, the technical condition could be evaluated on a scale of 1 to 5 whereby 1 = “state-of-the-art” and 5 = “completely outdated”.

As shown in table 7, none of the establishments stated that their equipment was “completely outdated” (5). With respect to the other categories no big differences arise between West German and East German establishments, only foreign establishments evaluate the technical state of their equipment slightly better.

¹⁶ The question is „Generally speaking, how do you evaluate the technical condition of equipment compared to other firms in the branch?”

Table 7:
Technical condition of equipment (according to the self assessment of establishments)
2001
-establishments in % -

	State-of-the-art 1	2	3	4	Completely outdated 5
Foreign establishments	15.8	59.4	22.3	2.5	0
West German establishments	15.7	43.4	32.7	8.0	0
East German establishments	13.8	44.6	36.7	4.5	0
All establishments	14.0	44.4	35.9	5.4	0

Source: IAB establishment panel 2001, calculation of the IWH.

4.3.2 Product innovations and R&D

With respect to product innovations, the IAB establishment panel distinguishes between three different types:

- a) substantial improvement or further development of an already existing product,
- b) introduction of products which are new to the firm, but already existent on the market (enhancement of the range of products via imitation) and
- c) introduction of completely new products (market innovation).

Answers given to questions on innovation in the 2001 survey refer to the preceding two years, i.e. 1999 and 2000. Process innovations are not subject to the survey.

This classification of product innovations largely corresponds to the international guideline for innovation surveys, the Oslo-Manual (OECD/Eurostat, 1997). The three types of innovation can be seen as a qualitative rank order of product innovations. The improvement and further development of still existing products is less challenging in terms of technological and organizational complexity than the introduction of completely new products.

With respect to R&D, the IAB establishment panel refers to an existence of R&D activities in the relevant establishment. Further information (e.g. spending on R&D, R&D personnel) is not available.

Table 8:
Product innovations (1999-2000) and R&D (2001) of foreign, West German, and East German establishments
- establishments in % -

	Product innovations			At least one type of product innovation	All three types of product innovation	Research & Development
	Product improved or further developed	Enhancement of the range of products	Market innovation			
Foreign establishments	66.4	39.8	30.2	79.2	9.6	46.7
West German establishments	47.8	29.1	12.3	54.4	4.5	22.9
East German establishments	38.8	25.1	10.8	44.7	5.6	10.7
All establishments	40.5	25.7	11.4	46.4	5.5	13.3

Source: IAB establishment panel 2001, calculation of the IWH.

No matter what type of product innovation one looks at, West German and especially foreign establishments perform better than East German establishments. The differences are particularly striking when looking at market innovations – the most demanding form of product innovations. Among foreign establishments 30.2% exhibit a market innovation while there are only 10.8% of the East German firms that carried out a market innovation in 1999-2000. Not very surprisingly, foreign establishments also perform better when looking at the features “at least one type of product innovation” and “all three types of product innovation” (see table 8).

Looking at R&D, external investors – especially foreign firms – show a much higher proportion of establishments with R&D activities in the year 2001. Nearly half of the foreign establishments were involved in R&D (46.7%), while only 22.9% of the West German and only 10.7% of the East German establishments dealt with R&D in 2001.

4.3.3 Organizational changes

According to the Oslo Manual (OECD/Eurostat, 1997, 54f), organizational changes build another form of innovations besides pure product (or process) innovations. Generally speaking, organizational innovations in the firm include “the introduction of significantly changed organizational structures, the implementation of advanced management techniques, and the implementation of new or substantially changed corporate strategic orientations”

(OECD/Eurostat, 1997, 54). The questionnaire of the IAB establishment panel (2001) differentiates between nine types of organizational changes:

- More in-house production
- More purchasing of products or services
- Reorganization of purchasing or distribution channels
- Reorganization of departments or operational functions
- Relocation of responsibilities or decision making downwards
- Introduction of teamwork or self dependent work groups
- Introduction of units with own cost-benefit calculation
- Environment related organizational changes (e.g. eco audit)
- Improvement of quality control

Table 9 shows the proportion of external and East German establishments with the relevant organizational change. Like in the case of product innovations and R&D, external investors are more active with respect to each of the organizational changes except “more in-house production”. It may of course be questionable whether the organizational changes listed in table 9 do necessarily contribute to a better performance of the firm. Apart from this, “more in-house production” and “more purchasing of products or services” are two sides of the medal. But still, the introduction of new or the change of existing processes or techniques indicates flexibility and innovativeness. Finally, 61.2% of the external but only 46.7% of the East German establishments exhibit at least one organizational change in 1999-2000.¹⁷ When looking at these figures one should, however, bear in mind that East German establishments are much smaller than foreign and West German firms. They employ 12 persons on average (see table 5). In such small establishments it does not really make much sense to ask about certain organizational changes, such as “reorganization of departments or operational units” or “introduction of units with own cost-benefit calculation”.

¹⁷ Foreign and West German establishments could not be looked at separately because of the otherwise insufficient number of cases (projection requires at least 30 cases).

Table 9:
Organizational changes of external and East German establishments^a 1999-2000
- establishments in % -

	External investors	East German establishments	All establishments
More in-house production	15.2	19.6	18.8
More purchasing of products or services	11.5	10.9	10.8
Reorganization of purchasing or distribution channels	24.0	14.5	16.0
Reorganization of departments or operational functions	20.9	7.3	9.8
Relocation of responsibility	14.2	8.7	9.5
Introduction of team work	9.1	7.5	7.6
Introd. of units with own cost-benefit calculation	8.2	3.8	4.5
Environment related organizational changes	13.9	5.5	7.1
Improvement of quality control	47.7	30.8	33.6
At least one organizational change	61.2	46.7	48.6

a Multiple answers were possible

Source: IAB establishment panel 2001, calculation of the IWH.

4.3.4 Human capital

The IAB establishment panel allows to differentiate between several types of qualification: low skilled white collar employees (*Angestellte für einfache Tätigkeiten*), qualified white collar employees (*Angestellte für qualifizierte Tätigkeiten*), unskilled blue collar workers (*ungelernte Arbeiter*) and skilled blue collar workers (*Facharbeiter*). According to the questionnaire, low skilled employees are defined as employees without apprenticeship (*ohne Berufsausbildung*) and qualified employees are those with apprenticeship (*mit Berufsausbildung*).¹⁸

Considering the results on technological capability presented so far, one should expect that foreign and West German establishments are equipped with higher qualified human capital than East German establishments. However, the findings presented in table 10 do not

¹⁸ There are two further types of employees covered in the relevant question of the IAB panel, i.e. apprentice and active occupants/CEOs. These two groups, however, have been left aside since they are difficult to categorize with respect to human capital potential.

provide clear cut evidence for this. Actually, the expected trend only appears when looking at qualified employees.

With respect to low skilled employees, foreign establishments have a lower proportion (1.2%) than others, but West German and East German establishments show no difference (3.2% or 3.3%). Looking at qualified employees, foreign and West German investors indeed show the expected trend, i.e. a higher proportion of qualified employees (29.8% or 24.9%) than East German establishments with 21%. Considering unskilled workers, West German investors have a higher proportion (14.8%) than foreign (8.6%) and East German firms (12.8%), which suggests that West German establishments are more often “extended workbenches” of their headquarters. Looking at skilled workers, East German establishments exhibit the highest proportion (62.9%) compared to West German or foreign firms.

Table 10:
Foreign, West German and East German establishments according to their composition of work force 2001

- employees in % -

	Low skilled employees (white collar)	Qualified employees (white collar)	Unskilled workers (blue collar)	Skilled workers (blue collar)
Foreign establishments	1.2	29.8	8.6	60.4
West German establishments	3.2	24.9	14.8	57.2
East German establishments	3.3	21	12.8	62.9
All establishments	3.1	23.7	13.3	59.8

Source: IAB establishment panel 2001, calculation of the IWH.

Despite their relatively strong presence in low-tech branches, East German establishments show a composition of human capital not substantially different from foreign and West German investors. Probably this has to do with the high unemployment in East Germany which causes that qualified people work in positions that are actually below their qualification.¹⁹

While the equipment with human capital does not differ substantially between East German and foreign as well as West German investors clear differences appear when looking at

¹⁹ The unemployment rate in East Germany amounted to 17.4% compared to 7.8% in West Germany in the year 2001 (registered unemployed based on total civilian labor force) (BMWA, 2003, 2).

advanced training offered by the establishment for their employees. Here foreign investors stick out with 72%. Among West German investors, 54.4% offered advanced training but in case of East German establishments only 33.1% offered advanced training for their employees in 2001.

4.3.5 Market orientation (sales and procurement)

Market orientation is not an immediate indicator for technological capability. However, it can be assumed that firms with an international trade structure face higher competition and are thus forced to be more active with respect to innovations. As shown in table 11, foreign establishments show the highest sales in foreign markets (29.5%). West German firms make 20.4% of their sales abroad while East German establishments sell only 9.3% of their sales in foreign markets. East German establishments have a clear preference for the East German market where they make as many as 61.3% of their sales.

Table 11:
Market orientation (sales) of foreign, West German, and East German establishments 2000

- sales in % -

	East German market	West German market	Foreign markets
Foreign establishments	40.9	29.6	29.5
West German establishments	37.3	42.3	20.4
East German establishments	61.3	29.3	9.3
All establishments	45.5	36.2	18.3

Source: IAB establishment panel 2001, calculation of the IWH.

Table 12 provides information about regional preferences of foreign, West German, and East German firms with respect to procurement markets (West Germany, East Germany or abroad). In the questionnaire no percentage figure about the purchasing structure is requested but establishments are asked to state whether the relevant market is “mainly”, “partly” or “not” relevant for their procurement. Appendix 5 provides the answers (mainly/partly/none) given by the establishments for each procurement market. In order to present the results more concise, an index has been designed with 1 for “mainly”, 0.5 for “partly” and 0 for “none”. The index is shown in table 12 and can assume values between 0 and 100 with the higher the index the more weight is attached to the relevant procurement market.

For West German establishments, East and West Germany are equally important procurement markets. In comparison to this, foreign firms show less propensity for West German markets but a clearly higher preference to foreign procurement markets. Like in the case of sales market orientation, East German establishments again have a priority for local (East German) markets. Foreign procurement markets are least important for them.

Table 12:
Index of market orientation of foreign, West German, and East German establishments with respect to procurement 2001

	West Germany	East Germany	Abroad
Foreign establishments	49.5	60.5	30.0
West German establishments	62.0	62.0	15.0
East German establishments	50.0	74.0	7.0
All establishments	51.5	71.5	8.5

^a Index from 0 – 100 with the higher the index the more weight is attached to the relevant procurement market.

Source: IAB establishment panel 2001, calculation of the IWH.

4.3.6 Productivity

Finally, productivity will be looked at as an indicator of the result (outcome) of technological potential at firm level. Higher technological capability is usually related to both higher value added activities and higher technical efficiency. Consequently, the better the technological capability the higher the productivity.

The results show that external investors, especially the foreign firms, have a clearly higher productivity than East German establishments. Looking at sales per employee, foreign establishments exhibit a productivity that is 3.5 times that of East German establishments while sales productivity of West German investors is twice that of East German establishments. The same tendency can be observed with respect to value added productivity (gross value added per employee) although the gap with respect to foreign investors is less distinct which means a higher share of intermediate consumption. Foreign investors show a value added productivity that is 2.4 times higher than that of East German establishments. Labor productivity of West German establishments is twice that of East German establishments (see table 13).

Table 13 :
Sales productivity and value added productivity 2000
- in 1 000 Euro -

	Sales productivity (sales per employee)	Value added productivity (GVA ^a per employee)
External establishments	169.7	66.9
Foreign establishments	251.4	78.3
West German establishments	149.7	64.2
East German establishments	71.6	32.6
All establishments	119.1	48.6

^a GVA = gross value added.

Source: IAB establishment panel 2001, calculation of the IWH.

It is reasonable to assume that some of the higher productivity of foreign and West German establishments is a result of both their composition of branches and firm size. Therefore, the “corrected” productivity of East German establishments has been calculated supposed East German establishments had a branch structure and establishment size structure like external investors, i. e. productivity corrected for branch structure and firm size structure.

Table 14:
Sales productivity and labor productivity of East German establishments corrected for branches and enterprise size structure 2000
- in 1 000 Euro -

	East German establishments		
	Actual value	Corrected for branches ^b	Corrected for firm size ^c
Sales productivity (sales per employee)	71.6	86.7	91.7
Value added productivity (GVA ^a per employee)	32.6	37.1	38.3

Source: IAB establishment panel 2001, calculation of the IWH.

^aGVA = gross value added; ^b14 branches according to chart 4; ^cFive size classes (number of employees): 1-19, 20-49, 50-99, 100-499, >500.

As shown in table 14, East German establishments would indeed have a higher sales productivity and a higher value added productivity if they would have a branch structure and firm size structure like external investors. But still, differences in branches and firm size do not fully explain the productivity gap since the corrected figures do by far not reach the productivity of external investors. Looking at sales (value added) productivity, differences in branch structure account for 15.4% (13.1%) of the productivity while

differences in firm size structure explain 20.5% (16.6%) of the productivity gap between external investors and East German establishments.²⁰

The analysis shows that other factors not considered here may also be responsible for the lower productivity of East German establishments, like differences in capital intensity, management, internal organizational structures, access to international distribution networks etc.

5 Summary and conclusions

Official statistics on FDI show that there was a strong increase of foreign investments in East Germany with the beginning of transition, but since 1997 FDI stock has more or less come to a halt. Sachsen-Anhalt has even been characterized by a decreasing FDI stock since 1999. Comparing FDI in East Germany to FDI in Central East European countries, East Germany lags clearly behind. A major reason for that is the method of data collection which probably underestimates FDI in East Germany and the fact that West German investments do not count as FDI in East Germany. At this point, the IAB establishment panel appears as a valuable data source since it offers the possibility to distinguish between majority foreign, West German, and East German owned establishments in East Germany. The survey covers general information on the firms as well as a number of indicators for the technological capability. The results show that East German establishments dominate in terms of number of firms (80%) but foreign and West German investors account for the majority of sales (together 65%) and investments (together 63%). Foreign and West German establishments are much bigger in terms of number of employees, and they are more present in high-tech branches. With respect to the technical condition of equipment (self assessment) and human capital potential, differences between the three groups are rather marginal. However, looking at product innovation, R&D, and organizational changes – the key features of technological capability – foreign and West German establishments perform much better than East German firms. Last but not least and not very surprisingly, foreign and West German investors also perform better with respect to productivity (sales and labor productivity). Even if one “corrects” the productivity of East German establishments for the branch and enterprise size structure of external investors, a clear productivity gap between the two sides remains.

²⁰ It would have been of interest to control for branch structure and firm size structure simultaneously. Unfortunately, this has not been possible because of an insufficient number of cases. The simultaneous control for branches and firm size structure would require at least 30 cases in each branch/firm size combination, which is not given especially with respect to the firm size class >500 and branches that are less occupied. An addition of the above percentage figures is not acceptable since the two variables (branches and firm size) are not fully independent of each other.

Because of their technological superiority and higher productivity, external investors can be regarded as a means to increase the technological capability and thus productivity in East Germany. Furthermore, they serve as a potential source of technology spillovers in favor of East German firms. The latter aspect calls for further research, especially in the face of the fact that technology spillovers from FDI have not been investigated for East Germany so far.

Appendix

Appendix 1:

FDI stock in Sachsen-Anhalt by branches 1999 and 2000 (end of year)

- Million Euro -

Branches	1999	2000
Manufacturing industry	4 726	3 177
Food, beverages, tobacco	X	X
Paper, publishing, printing	-	-
Manufacture of coke, refined petroleum products	X	-
Chemical industry	2 463	2 684
Rubber, plastic products	25	54
Non-metallic mineral products	179	128
Basic metals	X	X
Fabricated metal products	206	175
Machinery, equipment	9	17
Manufacture of devices for electricity production and distribution	X	X
Optical equipment	X	X
Motor vehicle production	9	X
Wholesale and retail trade; repair of motor vehicles etc.	18	18
Transport, communication	-	-
Financial intermediation	-	-
Credit institutions	-	-
Other financial institutions	-	-
Insurance industry	-	-
Real estate, renting and business activities n.e.c.	85	28
Real estate activities	27	9
Services mainly for enterprises	44	19
Management activities of holding companies (<i>Beteiligungsgesellschaften</i>)	X	X
Other	402	428
Total	5 231	3 651

Source: Federal Bank of Germany (*Deutsche Bundesbank*)

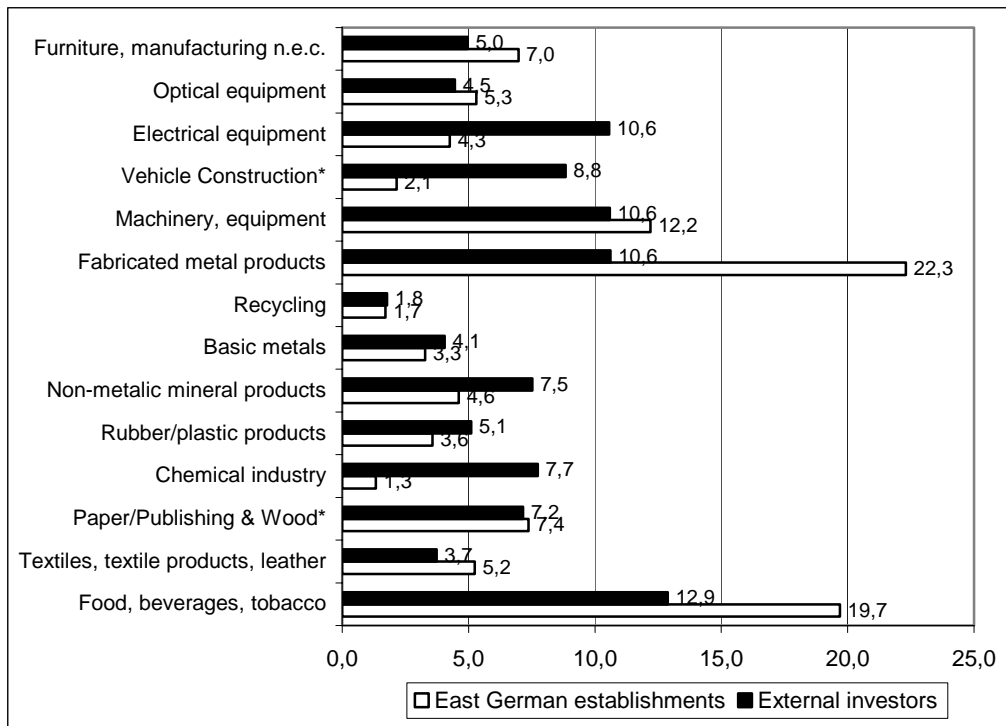
X = not declared in order to avoid the disclosure of single investment projects

Appendix 2:
FDI stock in the East German Länder 1991-2002 (Million Euro)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Brandenburg	153	297	580	685	764	860	1021	1482	1389	1794	1932
Mecklenburg-Vorpommern	307	436	838	727	768	719	648	788	856	1092	1086
Sachsen	102	355	801	969	857	819	1127	1263	1413	1606	1612
Sachsen-Anhalt	51	41	308	923	3010	3084	4862	5093	5231	3651	3387
Thüringen	51	163	272	534	481	711	931	844	634	1407	1412
East Germany total	665	1292	2799	3837	5880	6193	8589	9470	9523	9550	9429
Berlin	2096	2500	3662	3494	3278	3953	4347	5259	6894	8779	11573

Source: Federal Bank of Germany (*Deutsche Bundesbank*)

Appendix 3:
External (foreign and West German) investors and East German establishments according to branches in manufacturing industry 2001



Source: IAB establishment panel 2001, calculation of the IWH.

*Merged categories (see footnote 14)

Appendix 4:**High-, medium-, and low-tech according to the modified OECD classification**

High-Tech ^a	<i>Aerospace industry; manufacture of office machinery and computers; manufacture of radio, TV, and communication equipment; pharmaceutical products; scientific equipment; automobiles; electrical equipment; Chemicals (except for pharmaceutical products); other vehicles (except for aerospace and shipbuilding); machinery</i>
Medium-Tech	Rubber and plastic products; ship building; non-metallic mineral products; basic metals; manufacture of refined petroleum products
Low-Tech	Paper, publishing and printing; textile and leather products; food, beverages and tobacco; wood and wood products; furniture and manufacturing n.e.c.

^a Branches put in italic are those which fall into the high-tech category in the original OECD classification, the others originally build medium-high-tech.

Source: Foyn (2001)

Appendix 5:

Market orientation of foreign, West German, and East German establishments with respect to purchasing 2001
- establishments in % -

	West Germany			East Germany			Abroad		
	mainly	partly	none	mainly	partly	none	mainly	partly	none
Foreign establishments	20	59	21	32	57	10	3	54	43
West German establishments	38	48	15	34	56	10	2	26	72
East German establishments	22	56	22	53	42	5	1	12	87
All establishments	24	55	21	49	45	6	1	15	84

Source: IAB-establishment panel 2001, calculation of the IWH.

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