

# Discussion Papers

# 945

Bernd Görzig • Martin Gornig • Ramona Voshage •  
Axel Werwatz

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Productivity Gap: Evidence from  
German Manufacturing Firms**

Berlin, November 2009

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## IMPRESSUM

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DIW Berlin  
German Institute for Economic Research  
Mohrenstr. 58  
10117 Berlin  
Tel. +49 (30) 897 89-0  
Fax +49 (30) 897 89-200  
<http://www.diw.de>

ISSN print edition 1433-0210  
ISSN electronic edition 1619-4535

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# **Product policy and the East-West productivity gap<sup>1</sup>**

## **Evidence from German manufacturing firms**

Bernd Görzig\*, Martin Gornig\*, Ramona Voshage\*\*\*, Axel Werwatz\*\*

Berlin, November 2009

\* DIW Berlin, Department Innovation, Manufacturing, Service, bgoerzig@diw.de,  
mgornig@diw.de.

\*\* Technische Universität Berlin, axel.werwatz@tu-berlin.de.

\*\*\* Research Data Center Berlin-Brandenburg, ramona.voshage@statistik-bbb.de

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<sup>1</sup> This research was supported by the Deutsche Forschungsgemeinschaft through the Collaborative Research Center 649 “Economic Risk”.

## **Abstract**

After 20 years of transition from an economy integrated in an exchange scheme of planned economies towards an open market economy based on the ideas of competition, we ask whether East German firms succeeded in finding their place in the international division of labour. We concentrate on the question, to what extent they have caught up with the productivity level of their Western counterparts of similar size and sector and how this productivity difference is related to changes in their product policy. We analyse these questions with a unique data set provided by Statistics Germany that contains both product policy and productivity information for individual manufacturers from both parts of the country.

Using a decomposition approach suggested by Nopo (2008) as a nonparametric extension of the widely-used Oaxaca-Blinder methodology (Blinder 1973; Oaxaca 1973) we find that the time span from 1995 – 2004 has two component periods: a *period of adaptation* from 1995 to 2001 and a *period of branding* from 2002 to 2004. The initial period is characterized by a smaller share of Eastern firms that modify their product range and by a large productivity gap of Eastern Non-Modifiers if compared to Western Non-Modifiers of comparable size and sector. The evidence for the second period, however, points to a more active and established role of East German manufacturers: more of them alter their product range and step up their productivity performance.

*Keywords:* Productivity, product policy, decomposition, transition economies

*JEL-Codes:* L25, D24, P23, C14

# 1 Introduction

In the aftermath of Germany's reunification, redesigning their product range was a major challenge for East German enterprises<sup>2</sup>. Well-versed in a culture of "providing for all contingencies" many were used to follow a rather diffuse product policy. Reunification, however, fully exposed them to the pressures of competitive markets which promote specialization and market exchange. Indeed, ever since Adam Smith's pioneering analysis, the productivity gains arising from highly differentiated division of labor has been viewed as a fundamental source of the success of Western market economies. Twenty years after reunification, however, East Germany is still considerably lagging behind West Germany's level of productivity. Is East Germany's productivity gap related to the product policies of its firms?

The dynamics of product specialization and its effect on the productivity of East German enterprises are the topics of this paper. We study these issues at the firm-level using a unique data set containing information both on firms' product-market behavior as well as their productivity performance over the period from 1995 to 2004. Throughout, the behavior and outcomes of West-German firms will serve as a reference point. We are thus able to shed light on the question whether East German firms were able to mimic the success of their West-German counterparts in finding their place in the international division of labour.

Our research strategy is built on a unique data set created by Statistics Germany by merging information from two of its surveys of manufacturers. In its "Production Census", it asks firms to classify their output according to the European PRODCOM-list, which includes about 6.000 products. This yields a quite detailed picture of their product range and – since firms are repeatedly surveyed – changes thereof. The output information from the "Production Census" is matched (via a common firm identifier) to information on manufacturers' performance drawn from the "Cost Structure Census". We focus on productivity per employee as the measure of firm-performance which has a clear interpretation at both the micro- and macro level.

We analyze East-West differences in this key variable, using the decomposition approach suggested by Nopo (2008), a nonparametric extension of the widely-used Oaxaca-Blinder method. The decomposition allows to isolate the "pure" regional component of the average East-West productivity difference from "structural" differences, such as the different size and sector compositions of the Eastern and Western firm populations. We run this decomposition

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<sup>2</sup> We use *enterprises* and *firms* as synonyms throughout this paper.

separately for firms who did (“Modifiers”) or did not (“Non-Modifiers”) alter their product range over a specific period. This yields estimates of the genuine East-West productivity gap conditional on changes in product policy, thus quantifying the influence of the latter on the former.

We consider two specific periods within our entire 10-year window: 1995 to 2001 and 2002 to 2004. The first period is already somewhat removed from the immediate turmoil created by the reunification process but may still be considered a *period of adaptation* for East German firms. During the second subperiod, however, they can be expected to have identified and to sharpen their specific profile. We thus label the time window from 2002 to 2004 a *period of branding*. These labels are suggested by our empirical findings. The share of East-German firms that increase or alter their product range (“Modifiers”) increases from 33.5% during the period 1995 – 2001 to 45.6% during the second period. But East-German firms not only got more daring in redesigning their product range. Those that kept or decreased their product range (“Non-Modifiers”) were able to narrow the gap to the level of productivity of their Western counterparts. This can be interpreted as evidence of a process of identifying and successfully branding one’s best products.

The remainder of this paper is organized as follows. In the following section, we supply the theoretical and institutional background for the empirical analysis. We then turn to the data in section 3, followed by a discussion of the decomposition methodology in section 4. The empirical results are outlined in section 5. We summarize our main findings and conclusions in the final section.

## 2 Theoretical and institutional background

### 2.1 *Specialization, diversification and productivity*

Choosing and modifying its line of products is a complex decision for any manufacturer. This was particularly true for East Germany's manufacturing firms after reunification. What are the issues involved and how do they relate to productivity? These are the topics of this subsection.

Ever since Adam Smith used the example of a pin factory to demonstrate the advantages of specialisation, it has been part of standard economic thought that labour specialisation increases efficiency and productivity, and thus increases overall wealth. However, empirical reality is often shaped by business behaviour that seems to strive for the opposite of specialisation, i.e. increased diversification. In this paper, diversification is understood in a „manufacturing sense', i.e. expanding the range of products that is being developed, manufactured and sold on the market (rather than diversification via the acquisition of other businesses). As the advantages of specialisation in an economy characterised by the division of labour are seen as an important foundation of economic thought, theoretical explanation of the phenomenon of diversification requires additional assumptions.

Research in the field of industrial organisation has developed a large number of explanations why, despite the fundamental disadvantages, diversification can be advantageous for firms. For example, theorists emphasise economies of scale (Kim 1985) in multi-product firms. Other studies make reference to „economies of scope' in the sense that synergy effects are created when producing goods, either during the process through the use of common resources, or in marketing them (Markides/Williamson 1996). Matsusaka (2001) presents a similar argument, pointing to firm-specific skills that can make it profitable to take up additional activities if the existing ones are not creating sufficient levels of profit. This, he suggests, is more profitable than abandoning unprofitable activities altogether.

Hall (1995) reports on a range of empirical studies that identify a positive relationship between the extent of diversification and the success of a firm. However, the author notes, the number of studies concluding that there is a negative relationship tends to be higher.

In this context, it is suggested that diversification is not the reason for but the result of business success or lack of success. This can explain both how high levels of profit lead to increased diversification and the reverse. Hall (1995) shows that diversification has increased in particular in firms that are less successful than the average.

Jovanovic/Gilbert (1993) give reasons in favor of diversification that focus mainly on the output side: gaining additional power in the market, risk avoidance and increasing product compatibility

Stigler (1951) suggested that the advantages of diversification for firms resulted mainly from the limited nature of markets. Increased growth in markets – whether through higher productivity or through easier trade – would thus be linked to increased specialisation by firms. Removal of trade barriers and breakthroughs in ICT and logistics may thus accentuate the benefits of, ‘focusing on core competencies’ relative to diversification.

Summing up, the case for specialization is well-established. Arguments why firms should increase or modify their product range are more complex. However, given that we do not use *physical* productivity as our measure of firm success but rather *value* productivity (gross value added per employee) it is clear that diversification may be a viable strategy for firms even those that have come under attack on their output markets.

## **2.2 *East Germany's economy in the international division of labour***

Before turning to the firm-level analysis, it is useful to provide the proper macro-level perspective of the transition process.

The economy of the former GDR had been centrally organized as a planned economy. This resulted in a number of comparatively few huge conglomerates. Although the GDR has been integrated into the COMECON framework, there has been a high tendency to autarky. In particular, GDR firms tried to make themselves as much independent from other firms as possible. This kind of strategy resulted in a high number of very different, not necessarily related products per firm.

After unification the GDR became exposed to global competition. Restricted markets have been opened suddenly in 1991. The big conglomerates were separated into individual firms by their new owner, the “Treuhandsellschaft”. Many of the new firms could not survive from the beginning. In this period of disturbance and reorganisation of the industrial structure, survival was not alone a question of competitiveness of the specific products of a firm. The ability of the management personnel played as well an important role as the monopolistic strategies of competing firms. Former GDR economic experts estimated at this time that at the end of this process about only one third of the manufacturing employment could be kept. Many of the initially existing firms vanished. From the bigger firms who survived, only a few remained independent. A considerable number of former GDR firms have been overtaken by



West German and foreign enterprises. Therefore, the resulting product strategy was much determined by the existing product range in the owning companies.

Shortly after unifications East German firms have been subsidised heavily. In the majority of cases, direct subsidies to individual firms ceased at the midst of the nineties. Furthermore, wages in East Germany converged very rapidly towards the West German levels. Already in 1995 the average wage level in manufacturing reached 80% of the one in West Germany (Görzig/Gornig/Werwatz 2005). For the firms, the pressure of applying successful economic strategies increased. East German firms now had to adapt to the same rules as their West German counterparts. In particular at the beginning, East German firms just have been copying West German productivity schemes. Although this resulted in a remarkably increase in labour productivity, it was not possible for East German firms to achieve West German productivity levels.

One explanation for this might be that East German firms in this period did not apply enough product strategies of their own, even though it can be shown that already in the Nineties, the overall degree of specialization have been even higher in the average than in West Germany. Prima facie these findings seem to be in line with the theoretical expectations of Stigler (1951), that opening the markets will increase specialization. However, Görzig/Gornig/Werwatz (2007) have shown that this has only been caused by a diverting structural composition of the East German economy and cannot be seen as the result of the strategic behaviour of individual firms. The question therefore remains whether East German firms now, 10 years later, achieved a degree of specialization that gives them an advantage over their international competitors.

### 3 Data

The establishment of the Research Data Centres (FDZ) in Germany has made it possible to evaluate official statistics microdata (Zühlke et al, 2003; Wagner 2005). For this study, data from the statistics of the producing sector was evaluated for the first time, with two different statistics being linked together at firm level. A longitudinal dataset for firms in the manufacturing sector in the period 1995 to 2004 is used. As the industrial classification scheme was comprehensively revised in 1995, the official statistics available for this period include microdata for firms in the manufacturing sector collected according to a standardised scheme.

The statistical census system for the manufacturing sector in Germany is relatively well developed. In general, the firms in question are fully covered. Units required by law to provide reports for these statistics include all firms with, generally, 20 employees or more. The data collection system consists of several consistently linked separate data sets on different topics. Two of these data sets, the production census and the cost structure census are used here in order to link product policy and firm success.

The *production census*<sup>3</sup> includes questions about the quantity and value of the products manufactured. This study focuses on production for sale. Intermediate products and allocated labour are not included. The census is directed at the respective production plants (establishments) of the firm, meaning the local units of the firms (enterprises). These plants can completely be assigned to the relevant firms. Details on the quantity and value of all 6.400 products<sup>4</sup> listed are taken from the quarterly census, which has for the purpose of this paper been aggregated to annual figures. The present study is based on GP 95, i.e. the 1995 edition. For each firm, the details from the production census have been combined with the information from the cost structure census. This makes it possible to include the number of employees for each firm as well as their production range (Görzig et al. 2007).

The *cost structure census* is conducted annually. It records data on approximately 18.000 reporting firms. It is a full census of all firms with over 499 employees. For all other reporting units, it consists of a representative rotating sample with panel properties. The

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<sup>3</sup> Here production plants, the local sites of firms in the manufacturing sector with at least 20 employees are obliged to report. If the main focus of the owning firm's activity is not in the manufacturing sector, the corresponding plant in manufacturing must have at least 20 employees. There are different cut-off points for small-scale sectors (German Federal Statistical Office 2005).

<sup>4</sup> Corresponding to the Product Classification for Production Statistics (GP).

random sample quota is 38 percent for firms with 20 to 249 employees and 73 percent for firms with 250 to 499 employees. The present study is based solely on the census values. No projection has been made. For our purpose, the key information contained in the cost structure survey is gross value added which we take as our measure of firm-level output. After dividing by the number of employees, we obtain our productivity measure: gross value added per employee.

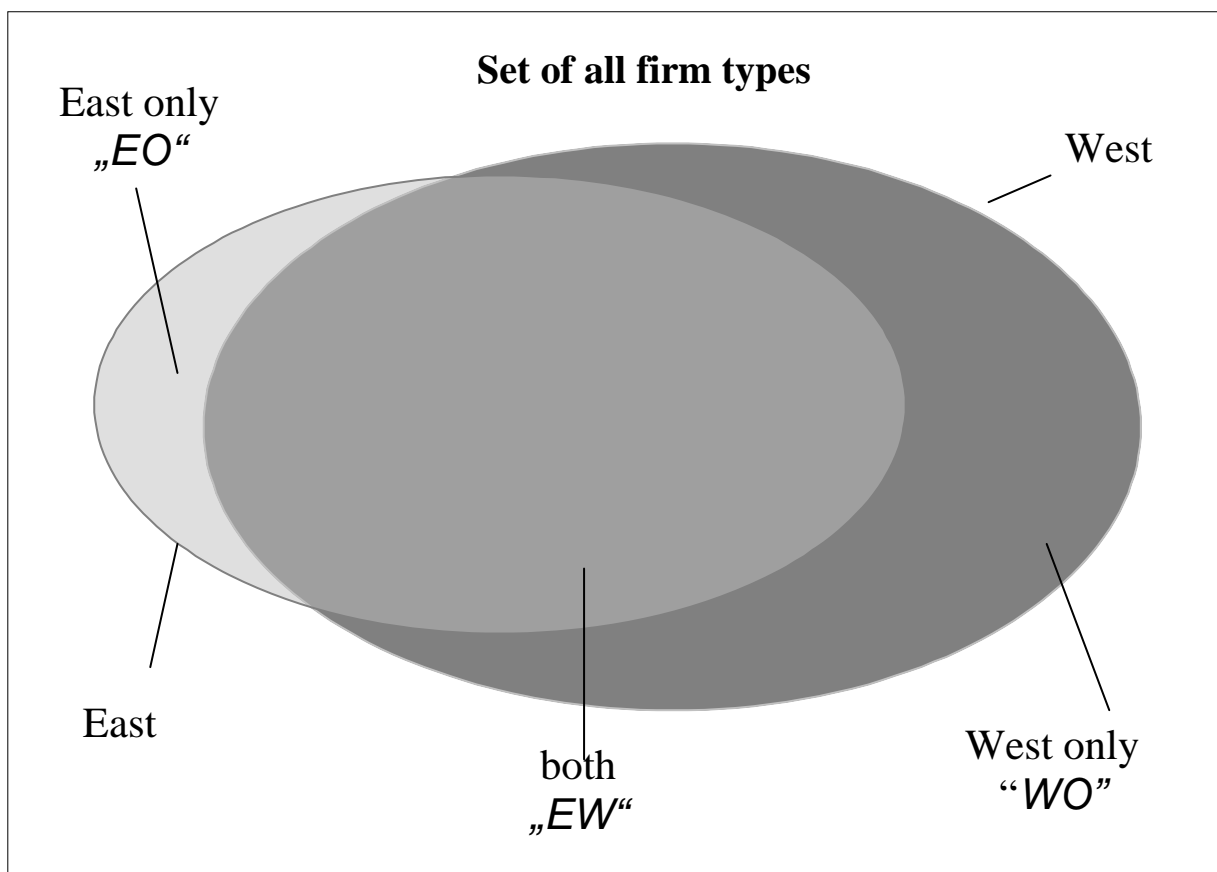
Regarding our efforts to empirically capture changes in a firm's product policy it should be pointed out that the use of the production census involves a narrower definition of the concept of diversification. The analysis is based on the smallest legal unit, the firm, as the decision-maker. It is therefore orientated more towards the diversification strategies relevant to the product market. Consequently, activities towards specialisation and/or diversification by large corporate groups, through purchases and sales of individual firms, are not observed here. The restriction of this study to production by firms means that diversification applies to products connected to the existing product range (*related products*).

In order to understand what kind of diversification is measured here, the way in which products are classified is important. When statistical product classifications are used, as is the case here, physical classification criteria are normally employed to differentiate the products. These do not reflect demand-oriented adaptation of the products through slight changes of details of fittings or cognitive product properties, for example, those conveyed through advertising. Thus, not all economically relevant product diversification can be recorded by means of statistical product classifications. Nevertheless, the degree of detail of the physical product differences observed tends to be very high in official statistics. The production census conducted in Germany in accordance with the PRODCOM Regulation differentiates between more than 6.400 products.

## 4 The decomposition methodology

Starting point of our empirical analysis is the simple „raw“ difference between the average productivity level of firms in the East,  $E[Y|East]$ , and the average productivity level of firms in the West,  $E[Y|West]$ .<sup>5</sup> This simple average productivity difference  $E[Y|East]-E[Y|West]$  is the focus of this analysis. It is, however, only a very crude measure of the productivity difference between firms from both parts of the country. In particular, it is not the same as the average East-West productivity difference between *comparable* enterprises. This is visualized in the Venn diagram of Figure 1.

Figure 1: Venn diagram of the sets of all possible and all existing types of firms



This diagram shows the set of all conceivable types of enterprises as a rectangular box. In the empirical work, a firm-type will be defined as a particular combination of a size and sector category. Some of the theoretically conceivable firm types are neither found among Eastern

<sup>5</sup> Here  $E[\cdot]$  denotes expectation in the sense of the population average.

nor among Western enterprises (unshaded area). Certain kinds of enterprises, however, are only observed in the East (“EO”) and, therefore, their productivity levels are included in the average  $E[Y|East]$  only. Similarly, certain types of enterprises (and the associated productivity levels) are found in the West only (“WO”). Both “exclusive” groups of enterprises have an influence on the average productivity in their particular region and contribute in this way to the difference  $E[Y|East]-E[Y|West]$ .

Conversely, the intersection “EW” contains all firm types found both in the East and the West. These constitute, according to the particular classification of enterprises chosen, the set of comparable enterprises. The East-West productivity difference between the members of this subset is therefore but one component of the “raw” difference  $E[Y|East]-E[Y|West]$ . Types of enterprises belonging to the intersection influence the raw difference  $E[Y|East]-E[Y|West]$  in two ways. First of all, since they are found in both parts of the country we can compute East-West productivity differences for *comparable* enterprises from this group and therefore isolate the “pure” East-West difference. Secondly, the distribution of characteristics among the members of this set is potentially different in the East and the West. That is, while, say, medium-sized industrial engineering enterprises may be found in both parts of the country, their *share* among Western enterprises may be much higher than their share among Eastern firms. This difference in the distribution of intersection firm types also contributes to the raw difference  $E[Y|East]-E[Y|West]$ .

The informal discussion of the previous paragraph is made precise by the following decomposition proposed by Nopo (2008), who – building on the seminal work of Blinder (1973) and Oxaca (1973) – has shown that the difference  $E[Y|East]-E[Y|West]$  can be broken down into four additive components:

$$E[Y|East] - E[Y|West] = \Delta_{EO} + \Delta_{WO} + \Delta_{type} + \Delta_{firm}$$

Each of these components is closely connected to one of the shaded areas in Figure 1. Nopo (2002) discusses how this decomposition and the estimation of its components are tied to the literature on estimating (causal) treatment effects from non-experimental data, in particular by using statistical matching. See also the related decomposition of the selection bias in Heckman, Ichimura, Smith and Todd (1998).

Now let  $g^E(x)$  and  $g^W(x)$  denote the average productivity for Eastern and Western firms, respectively, conditional on firm type  $x$  and let  $f^E(x)$  and  $f^W(x)$  denote the corresponding fractions of enterprises of type  $x$  in the East and West, respectively. Using this notation, the unconditional average productivity for each group of firms can be written as a weighted sum of the type specific averages:

$$E[Y|East] = \sum_{x \in EO \cup EW} g^E(x) f^E(x)$$

and

$$E[Y|West] = \sum_{x \in WO \cup EW} g^W(x) f^W(x)$$

The four components comprising the difference between  $E[Y|East]$  and  $E[Y|West]$  can now be shown to have the following precise form and interpretation:

The first component,  $\Delta_{EO}$ , is the component specific to the East and corresponds to firms of the types represented by the subset  $EO$  of Figure 1. It is the part of the East-West raw difference in average productivity that can be attributed to those types of enterprises that can be found exclusively in the East.  $\Delta_{EO}$  is formally defined as the difference between the average productivity of the kinds of enterprises found in the East only, and the average productivity of those Eastern enterprises, whose type is also observed in the West, weighted by the fraction of Eastern enterprises with no match in the West,  $P^E(EO)$ :

$$\Delta_{EO} = \left\{ \sum_{x \in EO} g^E(x) \frac{f^E(x)}{P^E(EO)} - \sum_{x \in EW} g^E(x) \frac{f^E(x)}{P^E(EW)} \right\} P^E(EO)$$

The second component,  $\Delta_{WG}$ , is the Western mirror image of  $\Delta_{EO}$ , is analogously defined and corresponds to the subset  $WO$  of Figure 1.

The third component,  $\Delta_{type}$ , corresponds to the subset  $EW$  of Figure 1 and represents the part of the simple East-West productivity differential, that can be attributed to unequal distributions in the East and the West of firm types found in both parts of the country. That is, it arises from the fact that some firm types are found both in the East and the West – albeit with unequal relative frequencies. Formally,  $\Delta_{type}$  is the sum of the type specific average

productivity levels for Eastern firms, weighted by the difference of the distributions with which these firm types are observed in the East and West, respectively:

$$\Delta_{type} = \sum_{x \in EW} g^E(x) \left\{ \frac{f^E(x)}{P^E(EW)} - \frac{f^W(x)}{P^W(EW)} \right\}$$

The fourth component,  $\Delta_{firm}$ , also corresponds to subset  $EW$  of Figure 1 and represents the part of the simple productivity gap  $E[Y|East]-E[Y|West]$ , that can be attributed to the East-West productivity differences among types of enterprises found in both parts of the country – i.e., it is the “true” East-West productivity differential between observationally identical firms.  $\Delta_{firm}$  is formally defined as the sum of the type specific East-West productivity differentials, weighted by the fraction with which each type is found in the West:

$$\Delta_{firm} = \sum_{x \in EW} \{g^E(x) - g^W(x)\} \frac{f^W(x)}{P^W(EW)}$$

Each of the formal definitions of the four components of  $E[Y|East]-E[Y|West]$  involves the conditional expectation functions  $g^E(x)$  and  $g^W(x)$ . These functions spell out how average productivity levels among Eastern and Western firms, respectively, vary with firm type  $x$ . Note that no particular functional form has been assumed for either  $g^E(x)$  or  $g^W(x)$ . Instead, both regression functions are nonparametrically defined and estimated – the latter by computing average productivity levels for each type of firm (and each region) separately.

Alternatively, the regression functions  $g^E(x)$  and  $g^W(x)$  could be defined and estimated parametrically, for instance, by assuming that average productivity levels vary linearly with firm characteristics. That is, a more standard approach would impose that  $g^E(x) = \beta_E^T x$  and  $g^W(x) = \beta_W^T x$  estimate the parameter vectors  $\beta_E^T$  and  $\beta_W^T$  by Least Squares. While estimating and interpreting this specification is straightforward, its desirable statistical properties hinge on the validity of the linearity assumption. The approach followed in this paper, to specify  $g^E(x)$  and  $g^W(x)$  nonparametrically, does not require to impose strong *a priori* restrictions on the way average productivity levels are allowed to vary with enterprise characteristics.

The flexibility of the nonparametric approach, however, comes at a certain price. Firstly, it is well known that nonparametric regression methods become very imprecise if the number of regressors is large – the so called „curse of dimensionality’. In our case, the regressors are the variables used to define firm-types. We only employ two variables, size and sector, and even use rather crudely categorized versions (four size groups, six sectors). In this way, we ensure that for any specific combination of size group and sector we have a sufficient number of observations to calculate average productivity, even if we work with subsamples stratified by region and product policy. The downside is a potential bias, particularly in the components  $\Delta_{type}$  and  $\Delta_{firm}$ , from failing to properly account for other influences of productivity besides region and product policy. Secondly, no complete asymptotic distribution theory has been worked out for the components of the decomposition. We therefore rely on the bootstrap for statistical inference.



## 5 Empirical Results

To set the stage for the results of the decomposition analysis, Table 1 contains the “raw”, unadjusted summary statistics of the productivity distributions among Eastern and Western firms. In particular, we report average, standard deviation and the coefficient of variation of the productivity distribution of a particular group of enterprises where enterprise groups are defined by region (East and West), time period (1995 – 2001 and 2002 – 2004) and product policy (Modifier and Non-Modifier). We compare the product range in the first year with that of the last year to classify a firm as a Modifier or Non-Modifier for a particular time period. Productivity figures, however, always refer to the last year of a particular time period (i.e., average productivity in the 1995 – 2001 section of the table refers to 2001).

Regarding the average level of productivity, Table 1 shows that East German firms trail their Western counterparts in all cases considered. In 2001, East German firms on the average attained 85% of the productivity per employee achieved by their Western counterparts. While Eastern firms have gained some ground from 2001 to 2004 they still considerably fell short of the Western level, reaching 88% of the West German average. This is remarkable in view of the large Western direct investments that took place in the East and the associated transfer of know-how. However, particularly the earlier period considered here may be characterized by widespread Eastern reliance on business models, production processes and products designed in the West, a phenomenon that has been labeled the “extended workbench concept” (*‘verlängerte Werkbänke’*) in the German literature. Since we are looking at value productivity (rather than physical productivity) an important part of catching up is upgrading, developing and branding one’s own line of products and attaining a strong market position. Indeed, the gap appears to be smaller among those who have previously modified their product range, though Non-Modifier seen to greater strides in have narrowing the gap from 2001 to 2004.

The variability of productivity appears to be smaller among Eastern firms, in particular for Non-Modifiers. However, this impression is reversed if their lower average level is taken into account by forming the coefficient of variation. At any rate, the variability in the East is sufficiently high to produce considerable overlap with the West German distribution in both periods. This means that at the upper end of the East German spectrum a considerable number of enterprises already achieve the high levels of productivity managed in the West.

**Table 1:**  
**Firm-level productivity in East and West Germany**

	Number of firms %		Gross value added per employee		
			Average in 1000 €	Standard- deviation	Coefficient of variation
All enterprises 1995-2001 <sup>1</sup>	15455	100.0	196.6	169.2	86.1
West Germany	13040	84.4	196.1	170.2	86.8
East Germany	2415	15.6	167.5	161.7	96.5
Non-Modifier 1995-2001	9274	60.0	189.3	169.1	89.3
West Germany	7669	49.6	194.9	171.6	88.0
East Germany	1605	10.4	162.4	154.2	95.0
Product-Modifier 1995-2001	6181	40.0	195.1	169.4	86.8
West Germany	5371	34.8	197.7	168.3	85.1
East Germany	810	5.2	177.7	175.3	98.6
All enterprises 2002-2004 <sup>1</sup>	15688	100.0	206.8	181.0	87.5
West Germany	13216	84.2	210.7	180.1	85.5
East Germany	2472	15.8	185.8	184.2	99.1
Non-Modifier 2002-2004	7824	49.9	206.0	182.7	88.7
West Germany	6479	41.3	210.5	182.6	86.7
East Germany	1345	8.6	184.5	182.0	98.6
Product-Modifier 2002-2004	7864	50.1	207.6	179.2	86.3
West Germany	6737	42.9	211.0	177.7	84.2
East Germany	1127	7.2	187.4	186.8	99.7

<sup>1</sup> German manufacturing enterprises

Sources: German Statistical Office, own calculations

The evidence presented in Table 1 suggests the labels attached to the two subperiods in the introduction: while 1995 – 2001 is still a period of adaptation, 2002 – 2004 may better be described by a *period of branding*, where East German firms developed their own, unique

profiles. However, these conclusions are yet based on raw East-West comparisons, unadjusted for the different compositions of their respective firm populations. To isolate the genuine East-West „behavioral’ productivity difference, we have decomposed the raw differences using the decomposition methodology outlined in the previous section. The results of the decomposition analysis are summarized in Table 2.

**Table 2:**

**Non parametric analysis of firm-level productivity differences between East and West Germany**

	East - West		caused by differences in			
	Difference in Average productivity		Composition $\Delta_{type}$		Behavior $\Delta_{firm}$	
	in 1000 €					
All enterprises 1995-2001 <sup>1</sup>	-28.5	**	-7.7	**	-20.9	**
Non-Modifier	-32.6	**	-6.5	**	-26.1	**
Product-Modifier	-20.0	**	-9.8		-10.1	
All enterprises 2002-2004 <sup>1</sup>	24.9	**	-7.7	**	-17.3	**
Non-Modifier	-26.0	**	-9.0	**	-17.0	**
Product-Modifier	-23.6	**	-10.4	**	-13.3	*

<sup>1</sup> German manufacturing enterprises

\* Significant at the 95% level; \*\* Significant at the 99% level

Sources: German Statistical Office, own calculations

Bootstrap inference based on 100 replications

Results from a specific decomposition are presented row-wise. To illustrate, the raw difference in the average level of labor productivity of all Eastern firms and all Western firms in 2001 is -28.500 € Decomposing this raw difference reveals two significant components,  $\Delta_{type}$  and  $\Delta_{firm}$ . The different compositions of the firm distributions in the East and the West with respect to size and sector account for 7.700€ of the raw difference. This part of the raw difference is not due to Eastern firms having lower productivity than comparable Western firms. Rather, it reflects that there are relatively more firms of a high productivity type (i.e., a

combination of size and sector that is associated with a high level of productivity) in the West. In particular, these are large firms in the pharmaceutical sector and in industrial engineering that are largely absent in the East but drive up the Western average.

The “pure”, “behavioral” part of the East-West raw difference is  $\Delta_{firm}$ . Since it is obtained by averaging over type-specific productivity comparisons, it reflects the East-West difference from “comparing the comparable”. With a value of -20.900 € it is the dominating part of the raw difference. Hence, 73% of the raw difference in productivity per employee in 2001 is due to Eastern firms achieving lower productivity than their Western counterparts of the same size group and of the same sector.

The components  $\Delta_{EO}$  and  $\Delta_{WO}$  are very small and insignificant and are therefore not reported. Hence, at least at the rather crude level at which we differentiate firm-types there seem to be no exclusively East-specific or West-specific types of enterprises.

What may account for the large, dominating "behavioral" component? We attribute this finding at least in some part to the role of Eastern manufacturers as “extended workbenches” of the West during that period. Given that we measure productivity by gross value added, it may well be that a lack of high-end activities like R&D, product development and product design characterized the activities of East German firms during this *period of adaptation*. This interpretation is underscored by the lower share of Modifiers among Eastern firms and the particularly high productivity gap among Non-Modifiers with a dominating behavioral component ( $\Delta_{firm}$  accounts for 80% of the raw difference of -32.600 € in this group).

Turning to the 2002 to 2004 period, we have already noticed in the discussion of Table 1 that the 2004 East-West productivity gap is narrower than the discrepancy in 2001. This is mainly due to the strong reduction of the behavioral component  $\Delta_{firm}$ . The compositional effect, captured by  $\Delta_{type}$ , largely remained unchanged. The reduction in  $\Delta_{firm}$  is due to Non-Modifiers. For this group, the behavioral component of the productivity gap declined from -26.100 € in 2001 to -17.000 € in 2004. Apparently, Non-Modifiers in the East successfully focused on the „right“ products. The precise mechanisms that are responsible for the measured productivity improvements among Non-Modifiers may range from improved processes, a stronger market position (branding) but possibly also more competences and more lucrative pieces of the value chain within a Western-led conglomerate.

At the same time, the share of Modifiers among Eastern firms rose considerably during the second time period and stronger than in the West. East German firms, in short, got more active on product markets. Success from this increased activity, however, has been limited. Indeed,  $\Delta_{firm}$  is larger in 2004 (in absolute value) than in 2001 for Modifiers. Put differently,

the East-West productivity difference among Modifiers has a significant „behavioral’ component in 2004. For a given type of firm, therefore, Western Modifiers significantly outperform their Eastern counterparts. Western firms seem to still enjoy an advantage in developing, and implementing new entries into their line of products.

## **6 Summary and conclusions**

In this paper, we contribute to research on East-Germany’s transition process from a firm-level perspective. Productivity is a key determinant of a country’s standard of living but it happens „on the shop floor“. We document the development of the productivity gap of East German manufacturers relative to the performance of their Western counterparts between 1995 and 2004. Using a unique data set that combines product policy and performance information of German manufacturing firms we can relate the East-West productivity difference to changes in product policy. We employ a decomposition approach proposed by Nopo (2008) to isolate the pure „behavioral’ East-West productivity difference, adjusting for the differences in terms of the size and sector compositions among Eastern and Western firms, respectively.

Our results suggest attaching the labels *period of adaptation* and *period of branding* to the subperiods 1995 – 2001 and 2002 – 2004. The initial period is characterized by a smaller share of Eastern firms that modify their product range and by a large productivity gap of Eastern Non-Modifiers if compared to Western Non-Modifiers of comparable size and sector. The evidence for the second period, however, points to a more active and established role of East German manufacturers: more of them alter their product range and step up their productivity performance.

These results indicate that the transformation process in East Germany is still in full swing. Even a mature manufacturing sector will exhibit industry dynamics but the East German manufacturing sector has yet to reach maturity. There are signs of a transition from a more passive, adapting role to a more active and independent role in our data. As of 2004, however, the well established, highly productive „top-dogs“ are still predominantly found in the Western part of the country.

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