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Productivity Dispersion: A Case Study in the Finnish Retail Trade*

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Abstract

This paper studies productivity dispersion in a Finnish retail outlet chain. The data cover thirty-three branches of the chain over a period of forty-eight months from January 2002 to December 2005. The data are based on branch-specific observations collected in the same manner in every branch by the parent company. The emphasis is on the following questions: i) How large is the productivity dispersion; ii) Are productivity rankings persistent; iii) How does the dispersion develop over time; and iv) What are the reasons behind the productivity dispersion. Productivity is calculated for each branch as both labor and total factor productivity. We find both productivity measures highly dispersed between the branches over the observation period. Furthermore, productivity rankings are persistent in the sense that the weakest branches tend to remain in the lower quintiles while the best performing branches tend to maintain their position in the top performing quintile. In addition the labor productivity dispersion between the quintiles narrows over time, as the poorest quintile improves its productivity relative to others. This does not hold as clearly for total factor productivity, however. Accounting for employee skills and human resource management decreases the productivity dispersion only slightly.

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1 Introduction

In the past decades there have been numerous studies reporting wide and persistent productivity dispersion both between countries and within industries (see e.g. Baily et al. 1992; Oulton 1998; Dunne et al. 2004; Gordon & Dew-Becker 2005). The variation in productivity between countries can be explained for example by different circumstances in the skills base or in the regulatory environment, whereas at the industry level the observed productivity gap may be due to technological differences. What still remains somewhat of a puzzle to productivity researchers is what causes productivity to be persistently dispersed across establishments even within narrowly defined industries where there are no such evident sources of heterogeneity. Competition should equalize productivity across firms, and finding substantial and persistent productivity dispersion raises the question if the observed dispersion is “real”. Two leading views stand out from the existing literature. First, productivity dispersion is argued to be largely illusory and follow from measurement error in both inputs and outputs, for example, or differences in the production technologies of firms. Second, the measured productivity differences are suggested to be caused by (unobserved) differences in e.g. management, quality of labor, and competitive environment.

Previous literature on productivity suffers, however, substantially from “manucentrism” (Hamermesh 2000). A wide range of earlier studies concentrate on manufacturing industries despite their gradually decreasing importance in post-industrial countries. Retail and wholesale trade, on the other hand, has in several studies been proven to be the locomotive of the U.S. productivity growth for the past twelve years (see e.g. Gordon 2004). This has been acknowledged to be caused by the sector’s ability to utilize more efficiently information and communication technology (ICT). However, despite the increased interest on productivity in the retail and wholesale trade sector, there are, to the best of our knowledge, no studies of productivity dispersion in the retail trade.

This study aims to fill the gap by focusing on the establishments of a single retail company. Our intention is to compare the productivity of thirty-three branches of a retail outlet chain operating in the Finnish retail trade over a period of forty-eight months. Comparing branches within the same firm allows us to control for heterogeneity and many other forms of measurement error as the units of comparison sell similar products, pricing and purchasing is centralized, and the data are collected in the same manner in every branch by the parent company. The productivity of each branch is

calculated as both labor and total factor productivity. All the productivity measures are regression-based enabling us to control for seasonality, location, competition, human resource management, and labor quality among others. The data are entirely based on branch-specific observations covering forty-eight months from January 2002 to December 2005.

The emphasis of the study is on the following questions: i) How large is the productivity dispersion; ii) Are productivity rankings persistent; iii) How does the dispersion develop over time; and iv) What are the reasons behind the productivity dispersion.

The key results are as follows. First, productivity is highly dispersed between the branches. At the end of our reference period the best performing quarter's productivity is roughly 20% higher in both labor productivity and total factor productivity (later on TFP) than the productivity of the weakest performing quarter.

Second, productivity rankings are persistent. In order to observe the development of productivity of different branches relative to each other, the branches were divided into quintiles based on their performance in January 2002 after which the relative positioning of each branch was observed again in January 2005. This comparison reveals that for both labor productivity and TFP a considerable share of those branches classified as the most poorly performing units in 2002 were still in the weakest performing quintile in 2005 while the majority of those in the top quintile in 2002 were still in the best performing quintile in 2005. The same pattern holds also for the middle quintiles, implying that the most of the branches stayed at the same level relative to other branches, and thus did not shift their relative positioning.

Third, productivity dispersion decreases over time. This is studied by comparing the quintiles formed in January 2002 to each other over the studied forty-eight months. In other words, those branches belonging to a certain quintile in January 2002 were observed as a group over time against the other quintiles. The comparison for labor productivity reveals that although the poorest quintile tends to remain the poorest and correspondingly the best quintile tends to maintain its highest rank during the whole reference period, the poorest quintile improved its productivity remarkably relative to others. This narrowed the productivity differences between the groups although the relative order of the quintiles stayed unchanged over time. Same comparison for TFP does not depict such a distinct narrowing of the dispersion as the comparison for labor productivity, although the development of the quintiles is otherwise rather similar for both productivity measures.

Fourth, productivity differs greatly between months. This holds for both produc-

tivity measures, and is valid also after controlling for seasonality.

Fifth, accounting for human resource management (hereafter HRM) and quality of labor decreases productivity dispersion only slightly. This is surprising given that both have been offered as a reason for productivity dispersion.

2 Prior literature

During the past decades easier access to and increased availability of micro-level data have evoked a new wave of productivity studies utilizing these novel and previously inaccessible data (see e.g. Bartelsman & Doms 2000). Key stylized facts arising from these studies as noted by Bartelsman and Doms (2000), are as follows. First, productivity dispersion is found to be extremely large between firms. Although it remains unclear how large a portion of this dispersion is due to measurement error, Bartelsman and Doms list several reasons why at least a good portion of productivity dispersion should be considered real. These are i) numerous carefully implemented case studies have observed similar productivity dispersion, ii) equal dispersion has been found both in developed and developing countries, iii) productivity is found to be correlated with other variables such as wages, and technology usage, and iv) plants with higher productivity also enjoy faster output growth.

Second, higher productivity firms tend to maintain their top productivity rank over time. Productivity differences have, in addition, a high degree of persistence. Again it is of interest to examine whether these results hold for branches as well as firms. It must be remembered, however, that all the productivity variation can hardly be captured in any industry due to data and model limitations.

Productivity dispersion between firms can be explained by differences in ownership, quality of the workforce, technology, international exposure, and regulatory environment among others (see e.g. Bartelsman and Doms 2000). Griffith et al. (2006) emphasize that even in narrowly defined industries firms may be different for example with respect to production technology, and one is thus not comparing ‘like with like’ (citation from Griffith et al. 2006). In addition they argue that poorly measured intangible assets including e.g. organizational and managerial capital can be seen as other possible sources of productivity dispersion. The importance of managerial issues and particularly different human resource management practices, like employee training, teamwork, job design, and employee hierarchies, on successful performance is also

emphasized by Ichniowski and Shaw (2003). Differences in labor quality is yet another possible source of persistent productivity dispersion (see e.g. Baily et al. 1992).

Additional explanation for productivity differences between establishments is given by local competitive environment and other competition aspects. Numerous empirical studies confirm the importance of competition to productive efficiency, although in theory the relationship is not so clearly captured (Vickers 1995). Apart from the well known "Schumpeterian view" of creative destruction, competition is also suggested to affect productivity by either increasing incentives to avoid slackness, or causing more productive firms to prosper at the expense of the less productive ones. Syverson (2004a and 2004b) has extended the existing literature by emphasizing the role of demand-side features on productivity variation. He argues that higher substitutability between competing suppliers leads to smaller productivity dispersion. Thus in a homogeneous market the degree of competition might affect productivity for example through differences in output prices. However, due to data limitations on prices, area indicators are often used to capture the characteristics of local competitive environment. Regional productivity growth in Finland has previously been studied by e.g. Böckerman and Maliranta (2007). By using plant-level data of the manufacturing industry, they find the level of productivity to vary largely between the regions, and thus location having an impact on plant-level productivity.

Regardless of the evidence found on the correlation between productivity and the factors of heterogeneity, Bartelsman and Doms remind us that the direction of causality is yet to date undetermined. Management, local operating environment, and labor quality still stand out as a natural starting point in explaining the differences in productivity between branches in the service sector. Using micro-level data might, however, raise other technical difficulties as productivity estimations based on theoretical production functions face several conceptual problems (Griliches & Mairesse 1995).

Despite the methodological advantages of using more disaggregated or even firm-level data, only a handful of studies have to date focused on analyzing productivity in the service sector within the firm or between branch offices (see e.g. Bartel et al. 2004). The most similar prior work done using branch-level data is by Griffith et al. In their paper they compare the productivity of branches of a British wholesale outlet chain over a five year period from 2000–2004. The comparison is implemented separately for both individual brands of the firm, i.e. for wholesaling of building, and plumbing equipment. The results for separate brands are very much alike. First, the productivity distribution is widely spread. However, the 90/10 ratios of both the individual brands

and the overall company are all considerably lower than of the corresponding four-digit industry ratios. Second, productivity dispersion decreases over time for both brands. In addition, the relative performance of the branches stays quite stable over time. The latter means that higher productivity firms were still among higher productivity firms some years later, while poorer productivity firms continued to underperform. Third, the average performance of a branch valued by certain management measures is positively correlated with performance.

Although Griffith et al.'s paper is very similar to ours, few crucial differences can be found. Among others, i) Griffith et al. study only labor productivity, calculated as sales divided by labor costs, whereas we evaluate several total factor productivities in addition to labor productivity, ii) where Griffith et al. calculate labor productivity in a basic manner as output over labor input, our productivity measures are all regression-based, and iii) unlike the method used by Griffith et al., regression-based productivity estimation allows us to take into account location, competition, HRM environment, the number of customers, and labor quality among others. Next we describe our case in more detail.

3 The case firm and data

RETAIL is a Finnish firm operated and run by the parent company in the non-food retailing sector. The firm has 35 retail outlets around Finland, making it a large retail firm by Finnish standards. Each outlet sells similar items, although there is variation in the number of items sold, since the outlets are of different size ranging from floor space of 2106 m² to 9390 m². Among the 35 stores, 8 are specialized on home decorating and renovation. The 27 basic stores have three departments: clothing, home, and leisure. The remaining 8 stores are heavily focused on the home department; while they also have a leisure department, they do not sell clothing. The retailer is neither a discount retailer nor can it be considered as a specialized or upscale retailer. Rather its strategy is to sell standard products to a wide range of customers with all items in stock on display. Every branch is also equipped with similar cash register application, and shares a common business software application developed for the chain's specific needs. The parent company largely holds the authority of decision over the branches; the amount of labor is decided independently by the branch management, but the branches have, for example, very limited ability to affect pricing, purchasing is centralised, and yearly

budget is set and monitored by the parent company. Moreover, the budget for the forthcoming year is largely set on the basis of sales in the preceding year, and possible cyclical fluctuations on the budget concern each of the branches in a similar manner.

The data cover 34 establishments of RETAIL that were in operation during 2002-2005. All except one establishment had begun operations before the sample period, and none closed down during this period. We have to exclude the entering establishment from the analysis, since it began operations in September 2005, and not all data are available for the unit. The data include 48 (1:2002 to 12:2005) observations for each store. Summary statistics are given in Table 1.

[TABLE 1 HERE]

Output is measured by value added, which in our case is essentially the value of sales net of taxes and purchases, and is calculated and provided to us by the retail chain management. Although in retailing also materials and other intermediate products should be taken into account in measuring output, we are unable to do so due to data limitations. In order to obtain the prices in real terms, the value added has been deflated by the monthly consumer price index of Statistics Finland. The labor input is measured by the realized hours worked, and thus takes into account e.g. sickness leave absences, whereas capital input is measured according to sales space in square meters. These measures are generally viewed as both preferred and standard in the previous literature on retailing (see e.g. Reardon et al. 1996).

Earlier it was mentioned that employees' skills, human resource management, and local competitive environment may affect productivity (measures). Our measure of skills comes from the annual sales clerk competition. The chain annually organises a sales clerk competition where participation is mandatory. However, participation rates are not 100% in each establishment. For various reasons, not all employees participate each year, but the participation rates are sufficiently high, average being 76%. The competition consists of a written exam and simulation of real service situations. The participants are tested for both product knowledge and customer service. Each participant is graded on a scale from 0-4 (failure, satisfactory, good, excellent). Our measure is the average of the scores for each establishment. In our view this measure is quite good, since it focuses on the skills that are needed to perform well in the job. It should compare favourably with wages which are often used as a measure of labor quality (e.g. Baily et al. 1992, p. 202 use wage differences in order to adjust "the shift in the composition of the workforce toward higher skilled non-production workers" out of the analysis).

The human resource management measure is taken from Jones et al. (2006)¹. They measure several aspects of the HRM environment such as ability to participate in decision making concerning one's own job, sufficient information to carry out one's job, information sharing concerning the department's performance, and supervisors' fairness and efficiency. These are measured annually by employee survey. From these measures Jones et al. (2006) form an index by using principal component analysis. This practice is used in the literature since the HRM measures tend to be highly correlated.

Local competitive environment is captured by area dummies. We also experimented with community level measures of retail activity (such as number of retail outlets, and their turnover) but these turned out to be insignificant once we included the area dummies. The area dummies are based on Employment and Economic Development Centres which divide Finland into 15 regions. Next we move to describe the empirical strategy.

4 Empirical strategy

We use several productivity measures in the spirit of prior literature in which both labor productivity and various TFP measures has been studied. The first measure we use is logarithmic labor productivity, that is log of value added divided by hours worked. Since sales are highly seasonal, all the measures we use are deseasonalised. Labor productivity is calculated from the regression

$$\ln y_{it} - \ln h_{it} = \alpha + \sum_{j=2}^{12} \beta_j m_j + \sum_{k=2003}^{2005} \delta_k y_k + \eta \cdot type_i + \zeta \cdot ren_{it} + \varepsilon_{it}$$

where y_{it} is value added in establishment i at date t , m_j 's are month dummies, y_k 's are year dummies, $type_i$ is a dummy variable for the eight stores concentrating on the home department, ren_{it} is a dummy variable on whether the establishment has been under renovation during the observation period, and ε_{it} is the residual. Total factor productivity estimates are based on index theory which takes input as an index of all factors of production in use. Thus, as in our case the index includes i) labor as realized hours worked, and ii) capital as sales space in square meters, the total input is a geometric average of labor and capital weighted by their income shares. Notice that under the assumption of constant returns to scale (CRS), the sum of the respective

¹See Jones et al. (2006), section III (v). for more details.

shares of factor payments in total output must equal one. Labor's income share is calculated as a ratio of labor compensation to value added. The assumption of CRS allows us to evaluate capital's income share as one minus labor's income share. The adopted TFP measure can thus be evaluated as $\ln TFP_{it} = \ln y_{it} - \alpha_h \ln h_{it} - (1 - \alpha_h) \ln s_{it}$, where α_h is labor's income share, yielding the regression

$$\begin{aligned} \ln TFP_{it} = & \alpha + \sum_{j=2}^{12} \beta_j m_j + \sum_{k=2003}^{2005} \delta_k y_k + \sum_{l=2}^{13} \gamma_l r_{il} + \eta \cdot type_i + \zeta \cdot ren_{it} \\ & + \lambda_{skill} \cdot skill_{it} + \lambda_{HRM} \cdot HRM_{it} + \lambda_{cust} \cdot cust_{it} + \varepsilon_{it} \end{aligned}$$

where s_{it} is sales space, r_{il} 's are regional dummies, $type_i$ is a dummy variable for the eight stores focused on the home department, $skill_{it}$ is a measure of employee skills, HRM_{it} is a measure of the HRM environment, and $cust_{it}$ is the number of customers.

Monthly dummies are used to capture seasonal variation. Number of customers is another variable capturing seasonal (demand) effects. The number of customers potentially affects the efficiency of labor. During months when the number of customers is high, the labor input may be used more efficiently than if the firm is not able to adjust its use of labor input perfectly. If for example it has to offer certain number of hours per month for its permanent staff, the hours worked may vary less than demand. Furthermore, this may hold even if seasonal variation is controlled by monthly dummies, since the number of customers may vary between stores, i.e. seasonal variation may be stronger in some stores than in others. Monthly dummies, whose coefficients are restricted to be the same for all establishments, capture the average effect and the number of customers captures the part of seasonal variation not captured by monthly dummies.

Year indicators capture the development of production technology, i.e. the component of productivity common to all establishments. Regional indicators are used to measure regional effects, such as competition. The intensity of competition may affect our estimates since prices for example may vary somewhat between regions, and we are not able to measure regional price variation.

The productivity measures (both labor and total factor productivities) are finally calculated as

$$prod_{it} = \exp \left(\sum_{k=2003}^{2005} \delta_k y_k + \varepsilon_{it} \right)$$

We calculate several measures of TFP. In the baseline model $\lambda_i = 0$ for all i . Then we introduce *skill*, *HRM*, and *cust* one at a time and finally we include all of the variables in the model. We use this approach so that we can see which factors affect productivity dispersion most. The models are estimated by OLS using heteroscedasticity and autocorrelation robust standard errors of Newey-West type for the reason that the time dimension of the data is quite long. We also study fixed effect approach with all the variables but the estimation results do not largely differ from the corresponding OLS estimation. Next section presents the estimation results.

4.1 Estimation results

Table 2 gives the estimation results. The results in Table 2 show that there is considerable monthly variation and that the extent of this variation is roughly the same in all specifications. The annual dummies are significant and show average increase in productivity over time. The sign on the type of the store depends on the inclusion of the number of customers. The renovation dummy is significant for all productivity measures but differs somewhat in size. In addition, the sign of the renovation dummy is negative as expected. The number of customers is positive and significant for all of those specifications where included, although its impact remains minimal. Employee skills affect productivity quite differently depending on the productivity specification, while the HRM measure stays marginally insignificant.

[TABLE 2 HERE]

4.2 Productivity Dispersion

In this section we focus on the extent of productivity dispersion. Table 3 gives summary statistics. Since the measures come from regression residuals, they are on the same scale. The 6th column gives the ratio of 90th and 10th percentile. It shows that the best decile are up to 75% more productive than the worst decile. This is a substantial figure, given that we are comparing very similar units. Adding all explanatory variables decreases the dispersion to 44%, however. On the other hand, Griffith et al. (2006) found the 90/10 ratio to be much higher varying yearly from 2.1 to roughly 1.6 within

both observed wholesale chains indicating the top performers as being over 100% more productive than the poorest units. In this light our result is only modest.

[TABLE 3 HERE]

The last column gives the share of within variation in each productivity measure. Variance can be divided into within and between components. The former describes how much of the variance is due to units fluctuating over time around their own mean, whereas the latter indicates how much is due to units deviating permanently from each other over the whole observation period (see e.g. Griffith et al. 2006). We see the share of the within component deviating largely depending on the productivity measure studied ². The lowest shares of within variation is in baseline TFP and in those TFP measures with either skills or HRM. This, together with the result of roughly equal-sized shares of within variance in TFP specifications where either customers or all explanatory variables are included, indicates labor quality to shift the bulk of the variation towards branches to fluctuate around their own mean. The fact that the between variance is at most more than two times the within variance indicates some branches to be permanently more productive than others. Griffith et al. reported similar finding in their paper.

To get a more complete picture of the productivity dispersion, we look at some graphics. Figures 1 to 4 and again 7 to 8 depict the TFP specification in the last column of Table 2, i.e. with all explanatory variables included. Figure 1 shows the productivity distribution for the set of all observations. The distribution seems to be pretty much normal.

[FIGURE 1 HERE]

Figure 2 shows the average productivity of each of the 33 branches for the whole reference period of 2002–2005. Productivity by branch varies greatly and clearly shows a wide dispersion of productivity between the branches. In addition, both the best and the poorest performers are spread equally across Finland and between the so called basic stores and those concentrating on home furnishing. This suggests performance to be dependent on some other factors than location in a growth region, like the metropolitan area, or operational focus. In addition, the low productivity average of branch number 28 is due to a long-term renovation in the surrounding business centre.

[FIGURE 2 HERE]

Monthly average productivity for the observed 48 months is pictured in Figure

²This does not change even if we aggregate the data to annual level.

3. Average productivity increases over time, and exhibits substantial seasonal variation. The high peaks depict the high volume of sales in December of each year.

[FIGURE 3 HERE]

As can be seen from Figure 4 presenting the standard deviation of total factor productivity, there is a wide spread in efficiency across the branches. In addition, this spread holds despite the deseasonalization over the observed months implying that the breakdown of branches into successfully and poorly performing units remains valid for the whole observation period.

[FIGURE 4 HERE]

4.3 How does the productivity distribution evolve over time?

In order to observe whether the branches shift their relative positioning in the distribution over the years, the branches were divided into quintiles based on their productivity ranking in January 2002 and again in January 2005. The quintiles were then organized into a transition matrix which shows the share of branches belonging to each quintile in January 2005 versus their original positioning in January 2002. The transition matrices are depicted in Tables 4 and 5 for labor productivity and TFP, respectively. Table 4 on labor productivity indicates that 57% of the branches belonging in the lowest quintile in January 2002 were still in the lowest quintile three years later (upper left corner). Correspondingly, nearly 67% of those belonging in the highest quintile in January 2002 were still among top performers in January 2005 (lower right corner). Also for the middle quintiles the biggest shares lie close the diagonal of the matrix indicating that the relative ranking of branches stays quite persistent. These figures are relatively similar to those reported by Baily et al. (1992).

The results for TFP are somewhat different from those of labor productivity as can be seen from Table 5. The biggest shares lie also close to diagonal with, albeit, a few exceptions. For example one third of those branches belonging to the lowest quintile in January 2002 were in the middle quintile in January 2005, and thus improved their productivity. On the other hand, half of those branches belonging to the second lowest quintile in January 2002 had dropped into the lowest quintile by January 2005. In addition, every third branch in total had dropped into a lower quintile by January 2005. Yet again, eleven branches, i.e. again one third of all branches studied, performed relatively better over time, and thus improved their positioning in the distribution.

[TABLES 4 AND 5 HERE]

Another way to observe the persistency of relative positioning is to compare the development of quintiles formed in January 2002 over time. In other words, those branches belonging in a certain quintile in January 2002 were observed as a group over time and compared to the other groups or quintiles. Figures 5 and 6 illustrate this comparison for labor productivity per month and per annum, respectively, whereas Figures 7 and 8 depict the same development for TFP.

Figure 5 shows the monthly development of quintiles for labor productivity. All five groups improve their efficiency over time, although the order of the quintiles changes somewhat. This is better depicted in Figure 6 which presents the same development of quintiles at the annual level. The faster development of quintile three can be easily observed from the figure. Interestingly the order of the quintiles changes only just before our observation period ends. Thus it remains an issue of a later interest to determine how the development continues in the subsequent years. It also remains a question why quintile three, in particular, enjoys faster development.

[FIGURES 5 AND 6 HERE]

Griffith et al. also studied how the productivity distribution evolved over time by comparing the development of ten equal sized groups. Similarly they found the dispersion to narrow over time, although the narrowing was not solely caused by faster development of the lower deciles but also by decelerating development of the higher deciles. All the same they concluded that the productivity rankings stay quite persistent despite the change in both the highest and the lowest productivity level.

The following findings stand out from Figure 7. First, the dispersion narrows visibly over the observed years. However, whether this is something aspired by the parent company is not known at this point. Second, the order of the quintiles remains mostly unchanged over time indicating the same result as Table 5 that the relative rankings are quite persistent for TFP.

[FIGURE 7 HERE]

Figure 8 presents the same comparison of quintiles at annual level. All groups improve their performance in terms of TFP at a fairly similar speed. The narrowing of the dispersion here is not so obvious as in the previous figure. However, it remains a question whether the narrowing accelerates in the following years.

[FIGURE 8 HERE]

5 Conclusion

Productivity dispersion and the question of its persistence have long intrigued productivity researchers. However, despite the increased interest on productivity in the retail and wholesale industry on one hand and micro-level studies on the other hand, there are no published studies yet combining these two research topics. This study aims to fill the gap by focusing on the productivity dispersion between branches of a Finnish retail outlet chain.

The data used in this study cover 33 branches for 48 months from January 2002 to December 2005. All branches under study were in operation during the reference period. In addition, the branches can be divided into two groups by their operational focus; 26 branches sell both clothing, and home and leisure utensils, while 7 branches focus on home furnishing. However, the strategy is set and monitored by the parent company, and is the same for all branches despite their ultimate specialization.

The main results are as follows. First, we find productivity to be highly dispersed between the branches. This holds for both labor productivity and TFP. Second, the branches tend to maintain their relative positioning in the productivity distribution. This is more robust for labor productivity although the pattern is valid also for TFP. Third, labor productivity dispersion narrows considerable over time as the poorest performing branches improve their productivity relative to better performing units. The narrowing is not as easily verified for TFP, however.

Our results of labor productivity are similar in the main quite to earlier results by Bartelsman and Doms (2000), and Griffith et al. (2006). While the former reported wide productivity dispersion between firms in different industries, the latter found similar results for branches of two separate wholesale outlet chains. In addition, our results of persistent labor productivity rankings are also similar to those reported by both Bartelsman and Doms, and Griffith et al. Furthermore, Griffith et al. also found the productivity dispersion to narrow over time, as we did.

Controlling for labor quality and human resource management does not dramatically decrease the observed dispersion. Overall, the results suggest that dispersion found in many studies using micro data is “real” and not just a result of differences in technology and measurement problems.

6 Tables and figures

TABLE 1
Descriptive statistics

Variable	Obs	Mean	Standard deviation	Min	Max
Inputs and Outputs					
Log Value added	1584	12.65	0.48	11.05	14.21
Log Hours	1584	8.72	0.34	7.88	9.56
Log Space (m ²)	1584	8.40	0.37	7.65	9.15
Other					
Skills	1584	2.65	0.48	1.44	3.54
Customers ¹	1584	52.61	25.56	20.25	216.67
HRM Scale	1560	0.00	0.81	-2.31	1.63

Notes. 1) In thousands. All monetary values are in real terms and measured in euros. The deflator is monthly consumer price index, where Jan. 2000=1.

TABLE 2
Productivity estimates

	Labor productivity	Baseline TFP	TFP w/ Customers	TFP w/ Skills	TFP w/ HRM	TFP w/ All
February	0.153*** [9.73]	0.062*** [3.38]	0.127*** [9.51]	0.062*** [3.57]	0.064*** [3.61]	0.129*** [9.56]
March	0.205*** [10.74]	0.184*** [7.57]	0.190*** [12.59]	0.184*** [8.11]	0.184*** [8.03]	0.191*** [12.49]
April	0.241*** [12.84]	0.199*** [7.29]	0.246*** [15.36]	0.199*** [7.92]	0.200*** [7.84]	0.246*** [15.26]
May	0.336*** [15.58]	0.315*** [10.04]	0.332*** [18.75]	0.315*** [10.89]	0.316*** [10.81]	0.333*** [18.69]
June	0.263*** [13.54]	0.257*** [8.67]	0.248*** [14.42]	0.257*** [9.41]	0.259*** [9.40]	0.249*** [14.41]
July	0.213*** [10.27]	0.220*** [7.20]	0.155*** [8.25]	0.220*** [7.70]	0.224*** [7.82]	0.158*** [8.37]
August	0.351*** [17.50]	0.346*** [11.45]	0.331*** [19.02]	0.346*** [12.40]	0.350*** [12.42]	0.334*** [19.01]
September	0.332*** [16.96]	0.305*** [9.91]	0.332*** [19.25]	0.305*** [10.74]	0.307*** [10.68]	0.334*** [19.13]
October	0.342*** [18.15]	0.382*** [13.51]	0.341*** [20.29]	0.382*** [14.57]	0.383*** [14.43]	0.341*** [20.16]
November	0.467*** [25.25]	0.532*** [21.15]	0.482*** [29.78]	0.532*** [22.57]	0.536*** [22.46]	0.484*** [29.65]
December	0.849*** [39.84]	1.013*** [40.84]	0.671*** [22.12]	1.013*** [42.33]	1.019*** [42.06]	0.674*** [22.28]
2003	0.085*** [5.36]	0.080*** [2.62]	0.079*** [5.03]	0.084*** [3.03]	0.089*** [3.18]	0.082*** [5.21]
2004	0.153*** [10.27]	0.180*** [6.21]	0.158*** [10.48]	0.198*** [5.81]	0.188*** [6.48]	0.137*** [6.41]
2005	0.152*** [9.31]	0.201*** [6.73]	0.189*** [11.78]	0.220*** [6.55]	0.206*** [7.17]	0.167*** [8.14]
Type	0.006 [0.33]	-0.100*** [4.26]	0.056*** [2.82]	-0.131*** [4.72]	-0.135*** [5.08]	0.058*** [2.94]
Renovation	-0.042* [1.92]	-0.104*** [4.05]	-0.044** [2.44]	-0.079*** [2.74]	-0.052* [1.88]	-0.030* [1.84]
Customers			0.009*** [15.38]			0.009*** [15.31]
Skills				-0.026 [0.72]		0.046** [2.43]
HRM scale					0 [0.01]	-0.01 [1.25]
Region dummies	No	No	Yes	Yes	Yes	Yes
Observations	1584	1584	1584	1584	1560	1560
R-squared	0.693	0.584	0.855	0.646	0.651	0.858

Robust t-statistics in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Notes: Lower number of observations in the last two columns is due to missing HRM scale for one establishment for two years. The t-statistics are robust to heteroscedasticity and autocorrelation within each establishment (Newey-West errors with bandwidth=4).

TABLE 3

Variable	Descriptive statistics for productivity measures						
	Obs	Mean	Min	Max	Sd	90th/10th	Within %
Labor Productivity	1584	1.115	0.390	1.701	0.163	1.429	0.643
Baseline TFP	1584	1.157	0.429	3.189	0.319	1.748	0.208
TFP w/ Customers	1584	1.125	0.561	1.812	0.171	1.448	0.593
TFP w/ Skills	1584	1.165	0.422	3.124	0.299	1.646	0.262
TFP w/ HRM	1560	1.159	0.415	3.090	0.295	1.626	0.245
TFP w/ All	1560	1.113	0.550	1.823	0.163	1.435	0.580

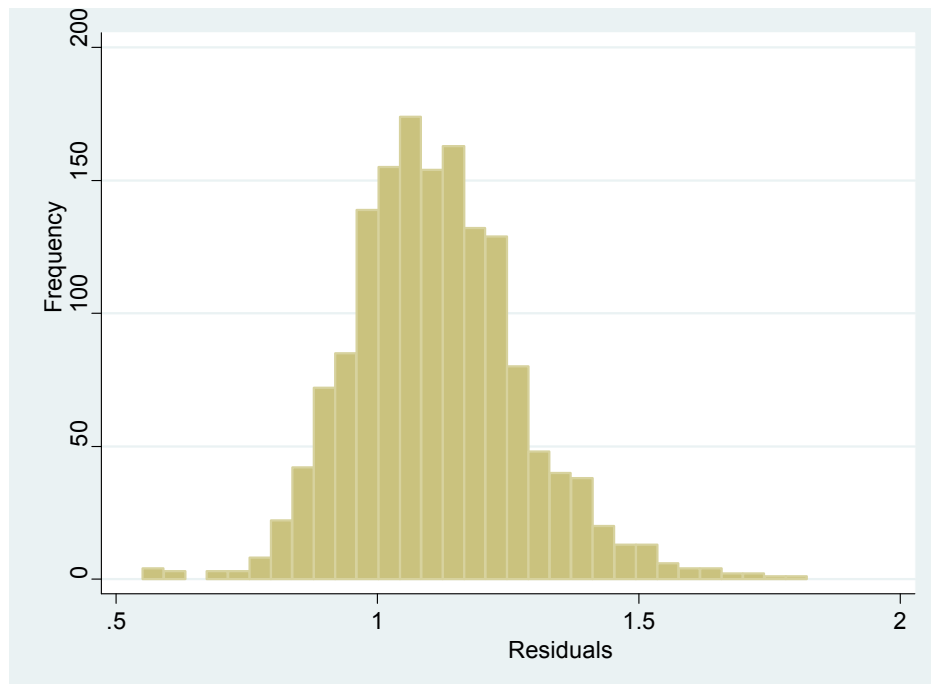


Figure 1. TFP histogram

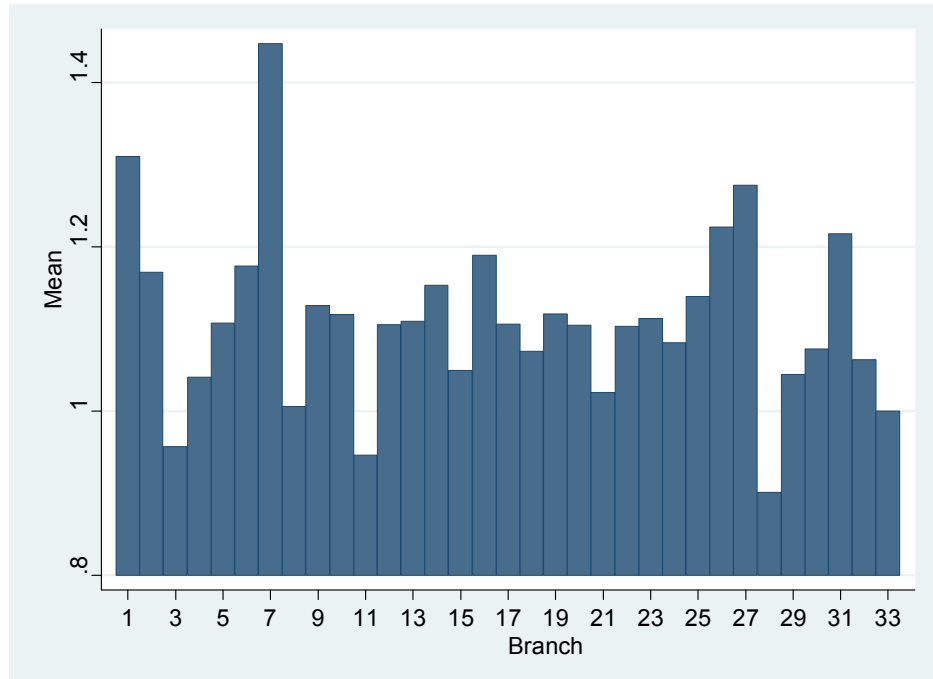


Figure 2. Average TFP by branch

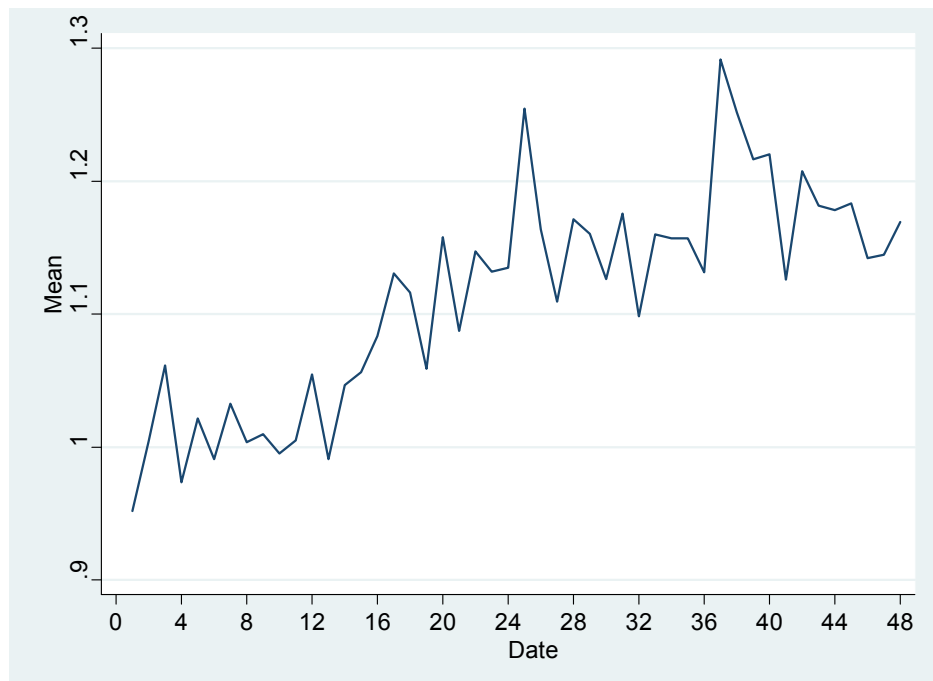


Figure 3. Average TFP by date

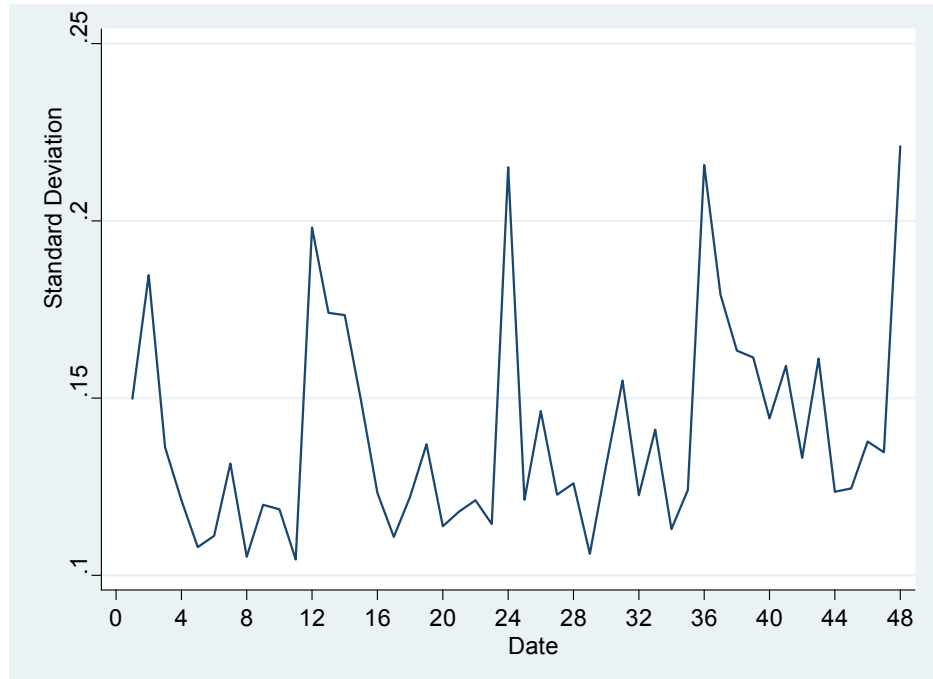


Figure 4. Standard deviation of TFP

Jan2002\Jan2005	1	2	3	4	5	Total
1	4 57.14	1 14.29	1 14.29	1 14.29	. .	7 21.21 %
2	. .	3 42.86	2 28.57	2 28.57	. .	7 21.21 %
3	. .	1 16.67	2 33.33	1 16.67	2 33.33	6 18.18 %
4	2 28.57	2 28.57	. .	3 42.86	. .	7 21.21 %
5	1 16.67	. .	1 16.67	. .	4 66.67	6 18.18 %
Total	7 21.21 %	7 21.21 %	6 18.18 %	7 21.21 %	6 18.18 %	33 100.00 %

Table 4. Transition matrix for labor productivity

Jan2002\Jan2005	1	2	3	4	5	Total
1	2 28.57	1 14.29	2 28.57	1 14.29	1 14.29	7 21.21 %
2	3 50	2 28.57	1 16.67	1 16.67	. .	7 21.21 %
3	. .	2 33.33	2 33.33	2 33.33	. .	6 18.18 %
4	1 14.29	1 14.29	1 14.29	2 28.57	2 28.57	7 21.21 %
5	1 16.67	1 16.67	. .	1 16.67	3 50	6 18.18 %
Total	7 21.21 %	7 21.21 %	6 18.18 %	7 21.21 %	6 18.18 %	33 100.00 %

Table 5. Transition matrix for TFP

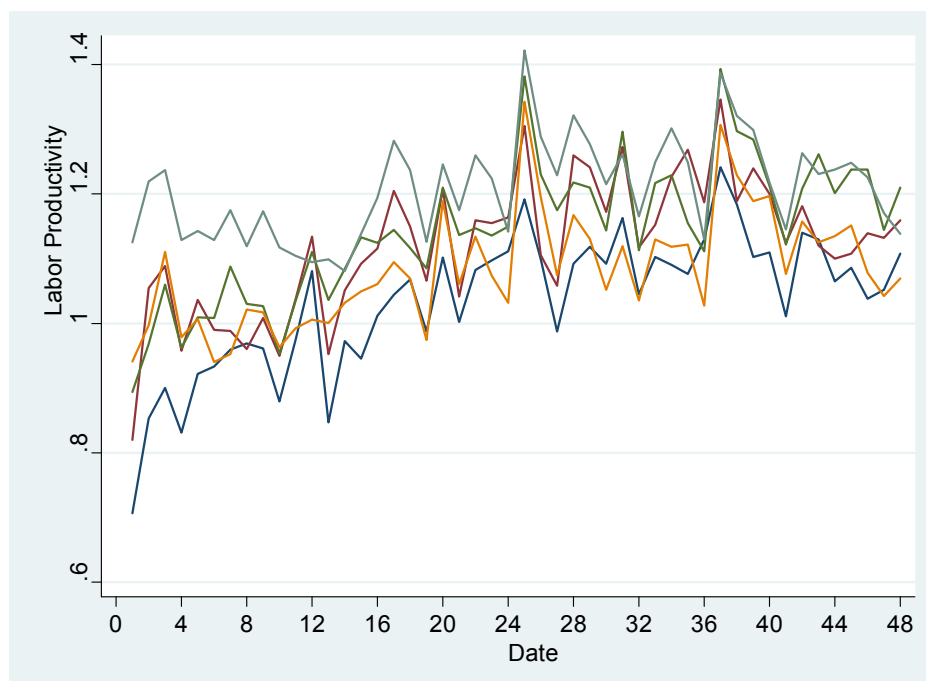


Figure 5. Monthly development of labor productivity for the quintiles

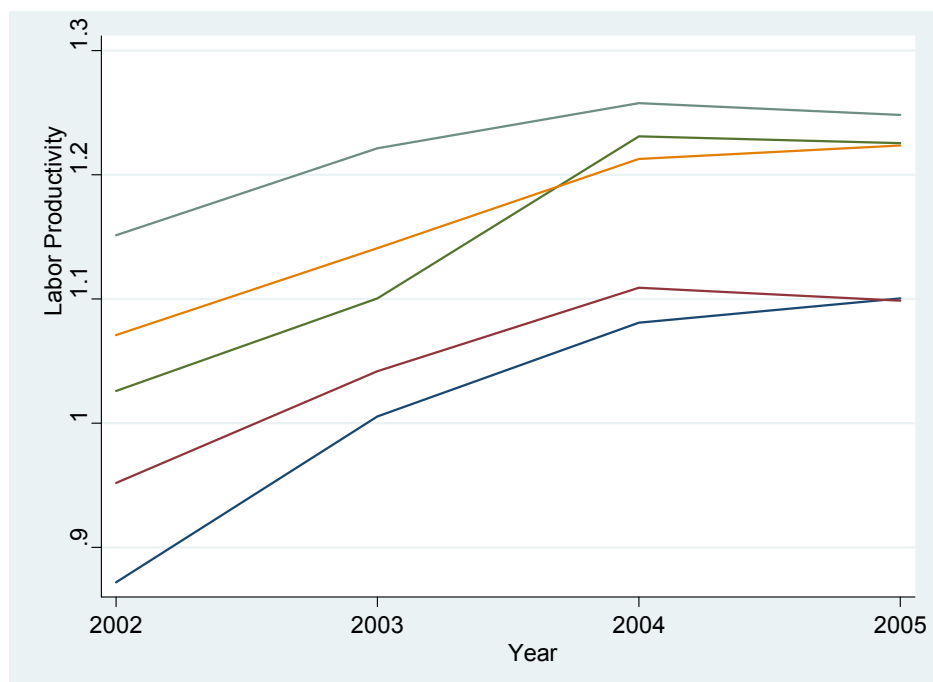


Figure 6. Annual development of labor productivity for the quintiles

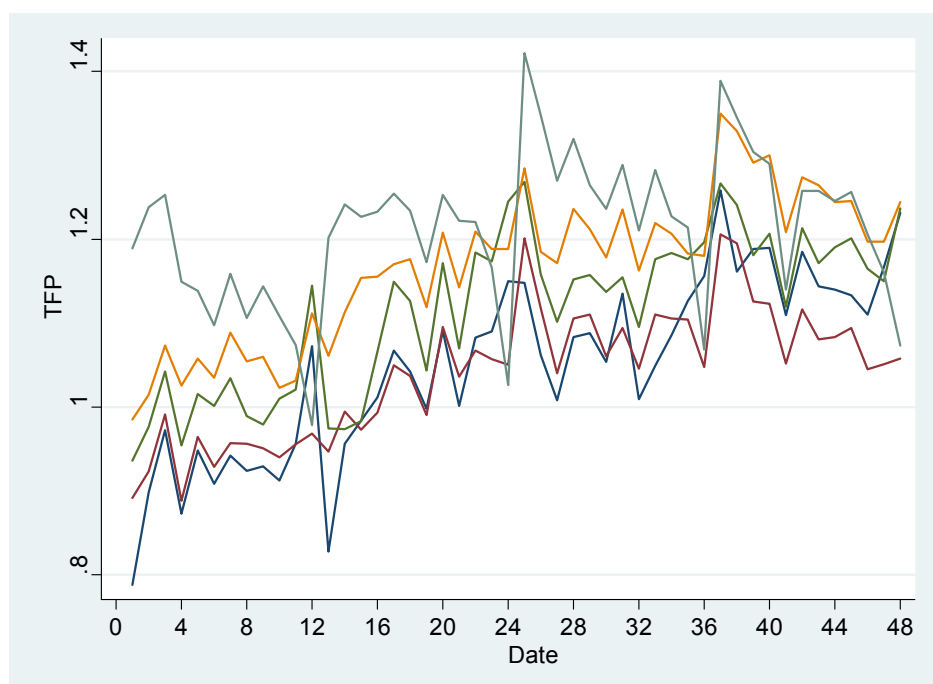


Figure 7. Monthly development of TFP for the quintiles

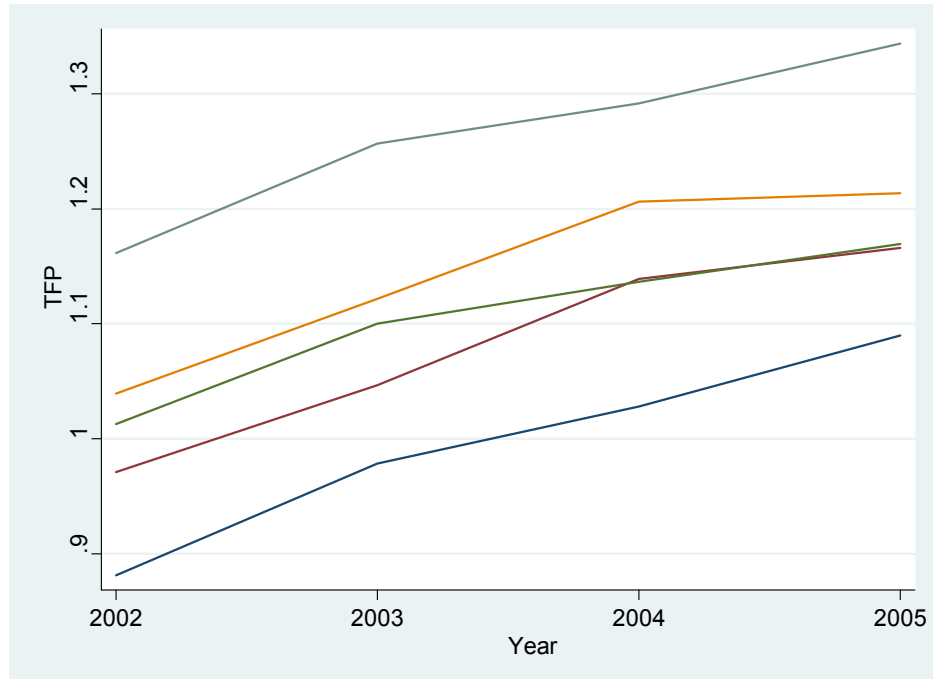


Figure 8. Annual development of TFP for the quintiles

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