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Productivity Dynamics in French Woodworking Industries

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Abstract

This paper investigates productivity dynamics of firms active in French woodworking 4-digit industries. For this purpose we analyze firm-level data from the two fiscal data bases FICUS (1994 - 2008) and FARE (2008 - 2016). Based on firm-level productivity measures, recovered from the estimation of a value-added Cobb-Douglas production function, we mainly study the industries' aggregate productivity growth related to entry and exit. Also, by constructing a transition matrix we investigate firms' probability to survive, enter or exit given a specific ranking of their productivity. We find that all industries increased considerably their aggregate productivity between 1994 and 2016, where the by far largest part of this positive development is contributed by survivors productivity improvement. Entrants contribute negatively to aggregate productivity growths while the contribution of exitors varies in sign for different industries. Also, we find that firms reveal high persistence in their productivity ranking over time and that entry and exit is more probable for low productive and small firms.

Keywords: production function estimation, aggregate productivity, productivity decomposition, technological change, firm entry and exit.

JEL Classification: C13; C14; D24; D30; O47

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1 Introduction

The French woodworking industries have experienced a dramatic decrease in the number of active firms, especially during the pas decade. As our data show, in 2016 there were about 30% less firms active compared to 1994. At the same time total production has only slightly increased, by about 7%. Also, the industries' trade balance reveals a negative trend over the same period. Generally, the trade deficit of French woodworking industries accounts for about 10% of France's total trade deficit, see Levet et al. (2015). Comparing world's most important producing countries of wood products, Koebel et al. (2016) illustrate that the export market share of the French woodworking industries has decreased between 2000 and 2011 from 4.1% to 3.7 %. Koebel et al. (2016) also show that there is a positive relation between an industry's total factor productivity (TFP) and its trade balance. That is, an increase in an industry's (aggregate) total factor productivity is associated with an increase in its trade balance (exports - imports). These recent works indicate that France's woodworking industries have lost in their ability of competitiveness and that the industries' productivity plays an important role for this development.

With this study we aim to provide new information on the change in aggregate productivity of French woodworking industries, where we focus on changes in aggregate productivity related to firm dynamics, that is, firm entry and exit. For our empirical investigation we combine the firm-level data sets FICUS (1994-2007) and FARE (2008-2016), covering the universe of firms active in the considered 4-digit woodworking industries. In doing so, a first contribution of our work is the exploitation of a panel data set over 23 years, which to our knowledge, has not yet been done on the firm-level for French woodworking industries.

Furthermore, we obtain firm-level productivity through the estimation of a value-added production function (Wooldridge (2009)). Having obtained firm-level productivity we apply the Dynamic Olley-Pakes Productivity Decomposition (DOPD), presented by Melitz and Polanec (2015), to decompose the aggregate productivity growth into the contribution of surviving, entering and exiting firms.

Generally, there are many ways to calculate firm productivity. For instance, Helvoigt and Adams (2009), investigating productivity growth of U.S. sawmills, use the Malmquist index in the frame work of a stochastic frontier production function model.[1] Walden et al. (2017), in the context of productivity change in the U.S. fishery industries, apply another nonparametric approach by using the Bennet-Bowly indicator to obtain firm-level productivity.[2] We estimate firm-level productivity through the estimation of a value-added production function since, in contrast to other nonparametric methods, this also provides estimates of output elasticities allowing for further comparison among the considered industries.[3] Similar to the estimation of firm-level productivity, its decomposition into different parts and/or firm groups is an extensively discussed topic in the field of applied industrial organisation. For instance, Baily et al. (1992), analysing U.S. manufacturing industries, Olley and Pakes (1996) examining the U.S. telecommunication industries and Griliches and Regev (1995) analysing the israelian manufacturing industries between 1979-1988.[4] We use the approach presented by Melitz and Polanec (2015) which is the latest metric of productivity decomposition, correcting for some bias occurring in the measure proposed by Baily et al. (1992) and Griliches and Regev (1995).

By the application of the DOPD approach our second contribution to the existing literature is the explicit analysis of the contribution of firm dynamics to productivity change in woodworking industries. Furthermore, beside the DOPD analysis a minor objective of the paper is to provide some further insights in the dynamics of firm productivity, such as changes in the distribution of firm productivity over time as well as firms' mobility in terms of improving/decreasing in their productivity ranking within the distribution of productivity. The latter is conducted by calculating nonparametric transition probabilities, similar to Foster et al. (2006) presenting productivity transitions for the case of the U.S. retail sector.

We find that French woodworking industries have significantly increased their aggregate productivity level over time. Our measures show that the growth is mainly driven by surviving firms' productivity improvement and much less (unless negligible) by market share reallocation. We also find that the group of entering firms contributes little but negatively to aggregate productivity growth. On the other hand, the contribution of firm exit to aggregate productivity growth varies

[1] Also see Färe et al. (1994) using the Malmquist index for productivity estimation.

[2] See Chambers and Pope (1996) for more details on the Bennet-Bowly indicator.

[3] Note that firm productivity (or total factor productivity) is the difference between output and a given level of input factors. Instead, firm efficiency is the distance between the firm's level of productivity and a specific production frontier.

[4] Also see further applications Pavcnik (2002) and Polanec (2004).

among industries. That is, some industries exhibit a strong negative impact of firm exit, such as the industries for wood and wood products, while other industries as those for furniture reveal a negative contribution. In the latter case this indicates that these industries have lost over time less productive firms compared to those firms that survived. Furthermore, by the constructing of a transition matrix depicting firms' ability to improve the probability ranking we find that firms are very sticky with respect to improvements in their productivity ranking, implying high persistence in firms' relative productivity level. Also firm entry and exit is more probable to occur for low productive firms. Relating firm productivity to firm size we find a strong positive correlation between both variables.

The paper is organized as follows. Section 2 presents the data and descriptive statistics; Section 4 presents the methodical framework; Section 4.1 presents the method adopted for the estimation of the production function and firm-level productivity; Section 4.2 presents the DOPD method to measure aggregate productivity with entry and exit; Section 4.3, presents the calculus for firms transition probabilities with the productivity distribution; Section 5 presents the empirical results and Section 6 concludes.

2 Data and Variables

We use French fiscal firm-level data of firms active in woodworking industries, covering the period 1994 - 2016. See Appendix A for a description of the considered 4-digit woodworking industries. The data contains information based on firms' balance sheet and income statement, where each firm is identified by a specific identification number. Furthermore, the data is composed of the two fiscal data sets FICUS (1994 - 2007) and FARE (2008 - 2014). It is important to mention that in 2008 the French Institute of Statistics made significant modifications with respect to the 4-digit industry nomenclature firms belong to. That is, the industries firms belong to are differently classified in FICUS and FARE. In order to maintain the current industry nomenclature (used in FARE) throughout the whole period, 1994-2016, we adopt the method presented in De Monte (2020). The method consists in the construction of 4-digit industry transition probabilities of those firms observed both in FICUS and FARE. The obtained transition probabilities are then used to assign to those firms that are only observed in FICUS (in case of firm exit before 2008) by probability the current industry classification. In this manner we obtain a sample consistent in 4-digit industry classification through out the whole sample period. See De Monte (2020) for a more detailed description of the merging of the data sets FICUS and FARE, where also an exemplary transition matrix is presented.

2.1 Production function variables

Since we are mainly interested in the estimation of a value-added Cobb-Douglas production functions to recover firm-level productivity, we describe in the following the variables necessary for this purpose. Beginning with the production input factors. Firms' log capital stock, labor and intermediary products, denoted by k_{nt}, l_{nt} and m_{nt}, consists in firms' log amount of tangible assets, number of employees and intermediary products consumption. The latter is given by the sum of firms' expenditures for both raw materials and intermediary products. Firms' (deflated) value added production is denoted by $Q_{nt} = Y_{nt} - M_{nt}$, where Y_{nt} and M_{nt} represent firms' (deflated) gross output (the sum of firms' reports on annual sales, stocked production and capitalized production) and materials. Note that q_{nt} denotes the log value of firms' value-added output.[5]

2.2 Definition of firm entry and exit

The number of firms in our data set varies for three reasons: first, firm entry and exit, second temporal inactivity and third, nonresponse. The latter reason is not frequently observed since firms' participation in the survey is mandatory. Instead, temporal inactivity, i.e cases in which firms are not observed for given interval whereupon they reactivate their activity, is more frequently observed. However, the data also shows that this is more often the case for shorter intervals. In order to allow consistent analysis on firm entry and exit we adopt the following approach:[6] Let

[5] Note that we deflate the variables by a corresponding 2-digit industry price index. For each firm and industry, we know the imbrication $n \in \mathcal{N}_4 \subseteq \mathcal{N}_2$, where $\mathcal{N}_2$ and $\mathcal{N}_4$ denote the set of firms within the 2- and 4-digit industries respectively. For each active firm in a 4-digit industry we can thus relate prices that are only observed on a 2-digit level.

[6] See De Monte (2020) using the same methodology on the definition of firm entry and exit, providing some more information. Also see Blanchard et al. (2014) for a similar approach.

$a_{nt} \in \{0,1\}$ be a binary variable, taking the value 0 in case of inactivity, and 1, if the firm is active. A firm is said to be active at t, if it reports nonmissing or nonzero data for one of the following variables: total production, sold production, turnover, net profit. In all other cases the firm is supposed to be inactive. Further, survival is denotes by $s_{nt} \in \{0,1\}$ with $s_{nt} = 1$ if $a_{n,t-1} = a_{nt} = a_{n,t+1} = 1$. Entry is denoted by $e_{nt} \in \{0,1\}$ with $e_{nt} = 1$ if $a_{n,t-1} = 0$ and $a_{nt} = a_{n,t+1} = 1$. Exit is denoted by $x_{nt} \in \{0,1\}$ with $x_{nt} = 1$ if $a_{n,t-1} = a_{nt} = 1$ and $a_{n,t+1} = 0$. The status of firms that are active between two periods of inactivity is not identified since the firm could both entrant and exitor. For this case we define $u_{nt} \in \{0,1\}$ and takes the value 1 if $a_{n,t-1} = 0$, $a_{nt} = 1$ and $a_{n,t+1} = 0$.[7]

2.2.1 Definition of entry and exit between longer time-spans than one year

The above presented method to define entry and exit is based on a yearly basis, which is a very useful measure for presenting entry and exit patterns from year to year, as we will see in the following section. However, for the analysis of aggregate productivity growth as well as the analysis of firms' transition probabilities with respect to their productivity we are not able to present results for each single year of our 23-year sample period. Instead, we will provide results spanning over periods longer than one year. For this reason we need to slightly extend the above definition of entry and exit to the case of time spans longer than one year: Let t_1 and t_2 be two periods in time with $t_1 < t_2$. A firm is defined as a survivor from t_1 to t_2 if the firm is active both in t_1 and t_2. Furthermore, a firm is defined as an exitor if the firm has exited the market, i.e. $x_{nt} = 1$, for some t with $t_1 \leq t < t_2$ and if the the firm was active in t_1 but inactive in t_2. Moreover, a firm is defined as an entrant if the firm has entered the market, i.e. $e_{nt} = 1$, for some t with $t_1 < t \leq t_2$ and if the firm was inactive in t_1 but active in t_2.

2.2.2 Further information

In this context it is important to mention that we only consider firms reporting at least one employee. The motivation is that only the data Set FARE does explicitly contain self-employees, whereas the preceding data base FICUS is not supposed to consider these firms.[8] To establish consistency between both data sets we only consider firms with one employee or more. In the data we observe that firms shift between zero and one employee and vice versa. Since we do not consider firms with zero employees such cases can be identified as firm entry and exit. For more details see Appendix A, where Tables report shifts in the number of firms with one and zero employees.

3 Descriptive statistics

To illustrate heterogeneity in the data, Table 1 shows averages over time of various statistics with respect to firm size groups, across all industries and years. Note that firm size, given in the first column, is measured by number of employees. It can be seen that, the number of firms is generally decreasing in firm size, where the highest average number of firms belongs to the size group of 2-4 employees. The table shows that firms with less than 50 employees represent a massive part in the French woodworking industry, given by almost 95% of all firms. Moreover, those firms demand about 45% of total employment. The table also shows that larger firms are older on average and exhibit lower entry and exit rates and, thus, higher survival rates.[9] In particular, firms with only one employee reveal an entry (exit) rate of 14.5% (15.6%), whereas firms with more than 500 employees only enter (exit) with a rate of 2.3% (2.3%). On average, the entry (exit) rate is given by 6.6% (10.6%).

[7] Note that $u_{nt} = 1$ if and only if $s_{nt} = e_{nt} = x_{nt} = 0$, that is, the firm is not identified as survivor, entrant or exitor.

[8] It should be noted, however, that we also observe in FICUS firms reporting zero employees, which to our knowledge is either linked to a reporting error and/or linked to the economic cycle where firms temporally switch between very less and zero employees. See Appendix A for details.

[9] See in the appendix further information of the importance of these statistics with respect to the considered 4-digit industries.

Table 1: Summary Statistics Size 16/17/31

Size	# of firms	Share of firms	# of employees	Share of employees	Age	Survival Rate	Entry Rate	Exit Rate
1	2015	23.1	2015	1.4	13.2	55.4	14.5	15.6
2-4	2490	28.6	6855	4.8	13.6	75.3	7.4	8.5
5-9	1684	19.3	11382	8.0	15.6	80.2	5.6	6.2
10-19	1127	12.9	15543	10.9	19.0	82.5	4.2	5.1
20-49	917	10.5	28869	20.3	22.0	85.7	2.8	3.6
50-99	249	2.9	17401	12.2	25.3	84.9	2.9	3.6
100-199	125	1.4	17231	12.1	26.6	85.3	2.7	3.8
200-499	71	0.8	21006	14.8	24.5	85.9	2.8	3.5
>=500	27	0.3	21977	15.4	26.9	87.4	2.3	2.3
Total	8705	99.8	142279	99.9	20.0	74.3	6.6	10.6

Figure 1 shows the evolution over time of the number of active firms, as well as the entry and exit rate over all industries. It can be seen that the number of firms (represented by the dashed line, with the corresponding values on the left y-axis) keeps relatively stable until 2007/2008, whereupon a significant negative trend has taken place.[10] In fact, in 2016 the number of firms has decreased by about 30% compared to 1994, which translate into a (negative) average annual growth rate of -1.4%.[11] This trend is reflected in the entry and exit patterns, represented by the solid and dotted lines, respectively (with the corresponding y-axis on the right). Until 2007/08 both the entry and exit rate oscillate at a similar level, whereas from 2008 on the exit rate lies consistently above the entry rate.

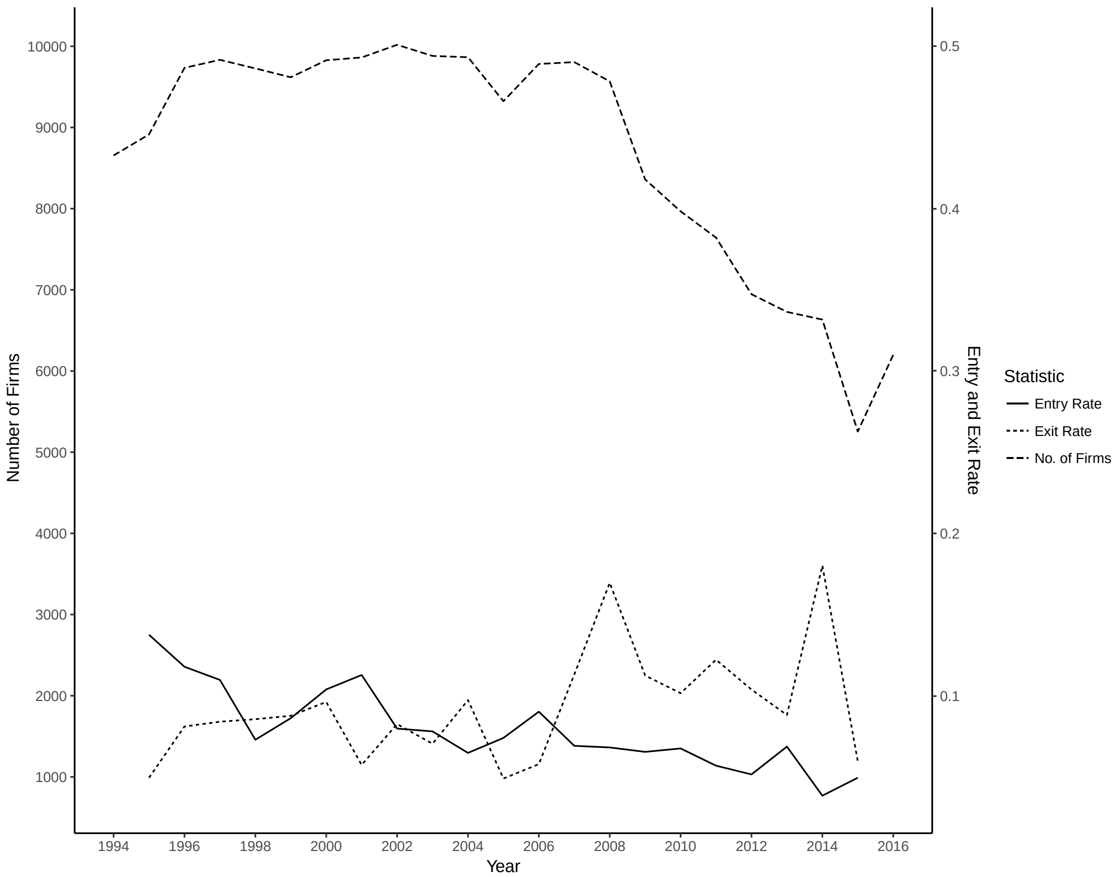

Figure 1: Dynamics in Number of Firms

Figure 2 presents the aggregate evolution of the necessary variables for the estimation of the

[10] Note that the sharp decrease in the number of firms in 2015, followed by an increase in 2016 at approximately the same level compared to 2014 is due to the fact that unreasonably many firms shifted from 2014 to 2015 from one to zero employees, which is again reversed in 2016. Since we only consider firms with at least one employee and the fact that small firms represent a large part in the total number of firms, the number of firms significantly decreases in 2015. See Appendix A for more details.

[11] See Appendix A for more details on changes according to the considered 4-digit industries.

value-added Cobb-Douglas production function, i.e. value added (VA) production as well as the input demand factors, labor and capital. The time series for each variable represent sums over all firms and industries, expressed in %, where 1994 states the base year representing 100%. As can be seen, similar to the the evolution of the number of firms presented in Figure 1, value added production, represented by the solid line, has increased until 2007 whereupon a negative trend has taken place. In 2016, however, the level of aggregate of value-added production is only at about 102% with respect to 1994. The aggregate labor demand, represented by the dotted line, shows the strongest negative trend, where in 2016 the total labor demand only accounts for about 63% relative to the initial level in 1994. Instead, the demand for capital, represented by the dashed line, has increased throughout the whole period, where the aggregate level in 2016 exceeds the level in 1994 by about 46 percentage points.

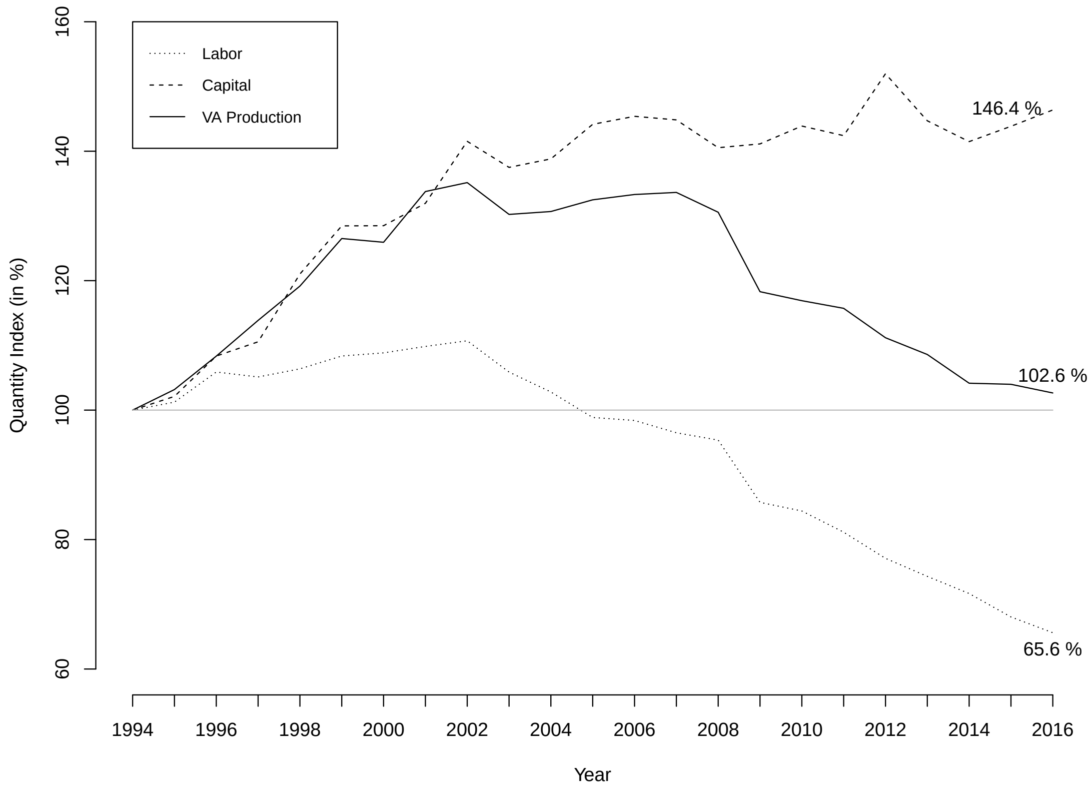

Figure 2: Evolution Production and Factors

4 Methodical approach

The main objectives of the investigation of firm-level productivity with respect to (i) aggregate productivity change by decomposing the contribution of surviving, entering and exiting firms, (ii) the analysis of productivity persistence and the relation between firms' relative productivity level and entry and exit. For this purpose, the first step is to obtain consistent estimates of the production function, from which firm-level productivity is recovered. In the following we describe the adopted methodology to estimate the production function as well as the analytical framework for the mentioned points (i) and (ii).

4.1 Production function estimation

The estimation of production functions is an intensively discussed topic in empirical industrial organization. To illustrate the difficulties to overcome for a consistent estimation of the parameters of interest we first present our production function specification and discuss further below the estimation procedure. Consider the following value-added Cobb-Douglas production function

$$Q_{nt} = AK^{\beta_k} L^{\beta_l} \exp(\epsilon_{nt}), \qquad \text{with} \qquad A = A_0 \exp(\omega_{nt} + \delta t), \tag{1}$$

where Q_{nt}, K_{nt} and L_{nt} denote firm-level value-added and capital (deflated) as well as the number of employees. The output elasticities with respect to capital and labor are given by β_K and β_L, respectively. A denotes unobserved productivity and is composed of a constant common to all firms, A_0, a stochastic individual firm's productivity, given by ω_{nt}, and an autonomous trend in productivity related to time progress, given by δt. ϵ_{nt} denotes an idiosyncratic error term. Taking the log, the production function becomes

$$q_{nt} = \alpha_0 + \beta_k k_{nt} + \beta_l l_{nt} + \omega_{nt} + \delta t + \epsilon_{nt}, \tag{2}$$

where lower case letters indicate variables in log. Generally, ω_{nt} can also be viewed as a residual containing all variation in firms output that is not explained by the variation in the input of labor and capital and/or time progress. As commonly assumed in the production function literature, ω_{nt} is supposed to be known (or anticipated) by the firm but unobserved to the econometrician. In other words, a firm's input choices are usually to correlated with its productivity. In the literature this is also known as the simultaneity bias, since firms may likely adjust their inputs with respect to the anticipated level of productivity. I.e., more productive firms will likely use more labor or capital, compared to less productive firms. To control for this unobserved heterogeneity we apply the proxy variable approach first proposed by Olley and Pakes (1996) (OP) and further improved by Levinsohn and Petrin (2003) (LP) and Ackerberg et al. (2015) (ACF). The identification strategy relies on two key assumptions. First firms' intermediary product consumption can be expressed as a function of capital use and (unobserved) productivity and is supposed to be monotone in both arguments, implying invertibility, i.e.,

$$m_{nt} = f(k_{nt}, \omega_{nt}) \Longleftrightarrow \omega_{nt} = f^{-1}(k_{nt}, m_{nt}) \tag{3}$$

Second, productivity is assumed to follow a first order Markov process, given by

$$E(\omega_{nt} | k_{n,t}, l_{n,t-1}, m_{n,t-1}, \ldots, k_{n,1}, l_{n,1}, m_{n,1}) = E(\omega_{nt} | \omega_{n,t-1}) \tag{4}$$

$$= g\Big(f^{-1}(k_{n,t-1}, m_{n,t-1})\Big) \tag{5}$$

Concerning the timing of input factor decisions, it is commonly assumed that capital is predetermined (fixed), which means that k_{nt} is uncorrelated with ω_{nt}, whereas labor and intermediary product consumption are assumed to be flexible inputs and, hence, l_{nt} and ω_{nt} are assumed to be potentially correlated. By these assumptions, we can write the following two equations:

$$q_{nt} = \alpha_1 + \beta_k k_{nt} + \beta_l l_{nt} + f^{-1}(k_{nt}, m_{nt}) + \delta t + \epsilon_{nt}, \tag{6}$$

$$q_{nt} = \alpha_2 + \beta_k k_{nt} + \beta_l l_{nt} + g\Big(f^{-1}(k_{n,t-1}, m_{n,t-1})\Big) + \delta t + u_{nt}, \tag{7}$$

where in equation (7) $u_{nt} = \epsilon_{nt} + \omega_{nt} - E(\omega_{nt}|\omega_{n,t-1})$. By both key assumptions as well as the timing assumptions on input factors, the following moment conditions can be deduced:

$$E(\epsilon_{nt} | l_{nt}, k_{nt}, m_{nt}, l_{n,t-1}, k_{n,t-1}, m_{n,t-1}, \ldots, l_{n1}, k_{n1}, m_{n1}) = 0, \quad t = 1, 2, \ldots, T, \tag{8}$$

$$E(u_{nt} | k_{nt}, l_{n,t-1}, k_{n,t-1}, m_{n,t-1}, \ldots, l_{n1}, k_{n1}, m_{n1}) = 0, \quad t = 2, \ldots, T. \tag{9}$$

The approaches presented by OP, LP and ACF treat f^{-1} in a first step nonparametrically where, in a second parametric step the parameters of interest, i.e. β_K and β_L are identified. Wooldridge (2009) proposes a one-step estimation procedure, in which both equations are estimated jointly in a fully parametric setting. There are some advantages for the parametric one-step approach: first, by estimating both equations jointly in a system-GMM fashion, we can control for between-equation correlation. Furthermore, since nonparametric regression can be computationally burdensome, the parametric estimation provides a faster estimation procedure. Wooldridge (2009) proposes to approximate f^{-1} by a polynomial of the pair (k_{nt}^p, m_{nt}^q), with $p + q \leq 3$. We specify,

$$\begin{aligned} f^{-1}(k_{nt}, m_{nt}) =& \lambda_0 + c(k_{nt}, m_{nt})\lambda \\ =& \lambda_0 + \lambda_1 k_{nt} + \lambda_2 m_{nt} + \lambda_3 \frac{1}{2}(k_{nt})^2 + \lambda_4 \frac{1}{2}(m_{nt})^2 + \lambda_5 \frac{1}{2}(k_{nt} m_{nt}) \end{aligned} \tag{10}$$

Further, g can be approximated by

$$g(c_{n,t-1}) = \rho_1(c_{n,t-1}\lambda) + \ldots + \rho_G(c_{n,t-1}\lambda)^G, \tag{11}$$

where $c_{nt} \equiv c(k_{nt}, m_{nt})$, from equation (10). By assuming $G = 1$ and $\rho_1 = 1$, Wooldridge (2009) shows that the residual functions derived from the two equations (6) and (7) can be expressed by

$$r_{nt,1}(\theta) = q_{nt} - \alpha_1 - \beta_k k_{nt} - \beta_l l_{nt} - \delta t - c_{nt}\lambda \tag{12}$$
$$r_{nt,2}(\theta) = q_{nt} - \alpha_2 - \beta_k k_{nt} - \beta_l l_{nt} - \delta t - c_{n,t-1}\lambda. \tag{13}$$

Expressed in matrix form the system can then be represented by

$$\mathbf{q}_{nt} = \mathbf{X}_{nt}\theta + \mathbf{r}_{nt}, \tag{14}$$

where $\mathbf{q}_{nt}$ is a $(2{\times}1)$ vector containing both q_{nt}'s from equations (6) and (7), and $\theta \equiv (\alpha_1, \alpha_2, \beta_K, \beta_L, \lambda_1 - \lambda_5)$. The regressor matrix is given by

$$\mathbf{X}_{nt} = \begin{bmatrix} 1 & 0 & t & l_{nt} & k_{nt} & c_{nt} \\ 0 & 1 & t & l_{nt} & k_{nt} & c_{n,t-1} \end{bmatrix} \tag{15}$$

where c_{nt} and $c_{n,t-1}$ contain all variables of the higher order approximation of the empirical control functions. Furthermore, from the moment conditions (8) and (9) a (potential) instrument matrix can be derived by

$$\mathbf{Z}_{nt} = \begin{bmatrix} l_{nt} & c_{nt} & z_{nt2} & 0 \\ & 0 & & z_{nt2} \end{bmatrix}, \tag{16}$$

with $z_{nt2} = \begin{bmatrix} 1 & k_{nt} & l_{n,t-1} & c_{n,t-1} & q_{n,t-1} \end{bmatrix}$, and $q_{n,t-1}$ a nonlinear transformation of $c_{n,t-1}$. Then, the parameter vector θ is estimated by system GMM such that the orthogonality conditions are fulfilled, given by[12,13]

$$E\left[\mathbf{Z}'_{nt}\mathbf{r}_{nt}(\theta)\right] = 0. \tag{17}$$

To construct a productivity index we follow Pavcnik (2002). For each 4-digit sector separated, a firm's productivity index is constructed by the firm's distance between its productivity level and the productivity level a (artificial) average reference firm, i.e. the average output and input from a specific year, which we chose to be 2014.[14] Formally, the productivity index is obtained by

$$\tilde{\omega}_{nt} = q_{nt} - \hat{\alpha}_1 - \hat{\beta}_k k_{nt} - \hat{\beta}_l l_{nt} - \hat{\delta} t - (y_r - \hat{y}_r)\,, \tag{18}$$

where $q_r = \bar{q}_r = N_r^{-1}\sum_{n=1}^{N_r} q_{nr}$, with the reference year $r = 2014$ and N_r the number of firms in this year. The predicted log value-added output of the reference firm is given by

$$\hat{q}_r = \hat{\alpha}_1 + \hat{\beta}_K \bar{k}_r + \hat{\beta}_L \bar{l}_r + \hat{\delta} r. \tag{19}$$

4.2 Productivity decomposition

In this section we present the adopted methodology for decomposing the aggregate productivity growth into the contributions of surviving, entering and exiting firms. For notational convenience, we drop the tilde over $\tilde{\omega}_{nt}$, denoting firms' productivity level. Olley and Pakes (1996) presented a static approach to measure aggregate productivity for a given industry, by

$$\begin{aligned}\Omega_t &= \sum_{n}^{N_t} s_{nt}\omega_{nt} = \bar{\omega}_t + \sum_{n}^{N_t} (s_{nt} - \bar{s}_t)(\omega_{nt} - \bar{\omega}_t) \\ &= \bar{\omega}_t + cov(s_{nt}, \omega_{nt}),\end{aligned} \tag{20}$$

[12] We construct our system GMM following Lee (2010, Chapter 2, Section 1.3).

[13] As Wooldridge (2009) illustrates there is a large bunch of candidate instruments for estimating the system of equations. Donald et al. (2009), however, point out that properties of the GMM estimator are very sensitive with respect to used instruments, saying that the number of instruments influences the estimators' efficiency and bias/variance. But not only the number of instruments itself influences the properties and results, the choice of the instrument variables is crucial, too. For instance, Donald et al. (2009) argue that lower order approximation functions, such as linear or quadratic, contain more information than higher order transformations and that those instruments should be preferably used to interaction terms. For this reason we do not use higher than second order transformations and also only use instruments of maximum one lag of the endogenous variable.

[14] We chose 2014 as reference year, since this is also the base year of the price indices we use to deflate the nominal values of the production variables.

where the first equality is the weighted average productivity, weighted by firms' market shares, s_{nt}. The second and third equality separates the weighted average into and unweighted productivity average, $\bar{\omega}_t = N_t^{-1} \sum_{n=1}^{N_t} \omega_{nt}$, and the covariance between firms' productivity and their market share. Note that N_t denotes the number of active firms for a given industry in t and $\bar{s}_t = 1/N_t$ the average market share. Considering the productivity growth between two periods, i.e. $\Delta\Omega_t = \Omega_t - \Omega_{t-1}$ it can be shown that the growth is transmitted by individual firms' productivity improvement, i.e. by a change in the unweighted average productivity $\Delta\bar{\omega}$, and by market share shifts among firms, i.e, by a change in the covariance of market shares and firm level productivity $\Delta cov(s_{nt}, \omega_{nt})$. Here, aggregate productivity growth induced by individual firms' productivity improvements and market share reallocation is referred to "within-change" and "between-change", respectively. In a dynamic setting, where firm entry and exit is taken into account, $\Delta\Omega_t$ can be expressed by the sum of changes in aggregate productivity with respect to the groups of surviving, entering and exiting firms. To measure the contribution of these groups we adopt the Dynamic Olley-Pakes Decomposition (DOPD, henceforth) (Melitz and Polanec (2015)).[15] As already pointed out by Griliches and Regev (1995), entering and exiting firms can have a positive or negative contribution to aggregate productivity depending on the considered reference level of productivity. For instance, if the aggregate productivity of a set of entering firm is lower than the prevailing reference level of the set of active firms the aggregate productivity level is negatively impacted by the entrants. Similarly, if the aggregate productivity level of a set of exitors is lower compared the aggregate productivity of the reference group of surviving firms, the disappearance of the exitors will increase the aggregate productivity. The DOPD approach models aggregate productivity with entry and exit in the following way: Let $S_{Gt} = \sum_{n \in G} s_{nt}$ denote the aggregate market share of a group G, where $G = (E, S, X)$ indexes the group of survivors, entrants and exitors. A group's aggregate productivity is then defined by $\Omega_{Gt} = \sum_{n \in G} (s_{nt}/S_{Gt})\, \omega_{nt}$. Considering the aggregate productivity of two periods, where the aggregate productivity of $t = 1$ and $t = 2$, Ω_1 and Ω_2, is given by

$$\Omega_1 = S_{S1}\Omega_{S1} + S_{X1}\Omega_{X1} = \Omega_{S1} + S_{X1}(\Omega_{X1} - \Omega_{S1}) \tag{21}$$

$$\Omega_2 = S_{S2}\Omega_{S2} + S_{E2}\Omega_{E2} = \Omega_{S2} + S_{E2}(\Omega_{E2} - \Omega_{S2}). \tag{22}$$

It can be seen that Ω_1 is composed of the weighted sum of aggregate productivity of the groups of firms surviving until $t = 2$, and those firms that will have exited. Instead, Ω_2 is composed of the weighted aggregate productivity of the firms having survived and the new firms that have entered the market in $t = 2$. Taking the difference between (21) and (22) we obtain

$$\begin{aligned} \Delta\Omega &= \underbrace{(\Omega_{S2} - \Omega_{S1})}_{\text{Survivors}} + \underbrace{S_{E2}(\Omega_{E2} - \Omega_{S2})}_{\text{Entrants}} + \underbrace{S_{X1}(\Omega_{S1} - \Omega_{X1})}_{\text{Exitors}} \\ &= \Delta\bar{\omega}_S + \Delta cov_S + S_{E2}(\Omega_{E2} - \Omega_{S2}) + S_{X1}(\Omega_{S1} - \Omega_{X1}). \end{aligned} \tag{23}$$

Here, the contribution of surviving firms is further decomposed into the within- and between-change, derived by Olley and Pakes (1996). Note that entrants only contribute positively to aggregate productivity change if their aggregate productivity in $t = 2$ is higher compared to the aggregate productivity of survivors in $t = 2$ $(\Omega_{E2} - \Omega_{S2})$. Similarly, the group of exitors only contribute positively to aggregate productivity change if their aggregate productivity in $t = 1$ is lower compared to the aggregate productivity of surviving firms in $t = 1$ $(\Omega_{S1} - \Omega_{X1})$.

4.3 Productivity transitions

To analyze firms' mobility with respect to their ranking within the productivity distribution we construct transition probabilities summarized in a transition matrix. Let $\phi_{\omega,t}$ be the distribution of firms' productivity for a given year t. Each active firm contributes with its own productivity, ω_{nt}, to the empirical distribution of productivity. Let d_{nt}, with $d_{nt} \in \{0, 1, 2, 3, 4\}$ denote a variable that indicates the quartile a firm belongs to within the distribution $\phi_{\omega,t}$. That is $d_{nt} > 0$ is a measure for firm n's productivity ranking in t. If a firm is ranked within the first quartile $d_{nt} = 1$, within the second quartile $d_{nt} = 2$ and so on. From t_1 to t_2 with $t_1 < t_2$ a firm may survive or exit. Furthermore, between t_1 and t_2 new firms enter into the market. In the case a firm exits in t_2, its productivity measure for this year is not available, then $d_{n,t_2} = 0$.

Likewise, for a firm that enters between t_1 and t_2 there is no productivity available for t_1. In this case $q_{n,t_1} = 0$. We distinguish between three types of transition probabilities: first, firms'

[15] See De Monte (2020) for an application of the DOPD approach on various French 2-digit manufacturing industries.

probability to transit between quartiles of the distribution of productivity of two points in time and/or to remain in the same quartile. Here, by definition we look at the transition probabilities of survivors. Second, firms' probability to exit in t_2 from a given quartile in t_1. And third, firms' probability to enter into a given quartile of the distribution of productivity in t_2. The transition probability for survivors is calculated by

$$P^s_{ij} = P(d_{n,t_2} = i | d_{n,t_1} = j) = \frac{1}{N_1} \sum_{n=1}^{N_1} \mathbf{1}_{[d_{n,t_2}=i \cap d_{n,t_1}=j]} \quad \text{with } i,j = 1,2,3,4 \tag{24}$$

where $\mathbf{1}_{[A]}$ is a dummy variable equal to one of the condition A is fulfilled and N_1 denotes the number of active firms in t_1. The transition probability of exitors is calculated by

$$P^x_{-j} = P(d_{n,t_2} = 0 | d_{n,t_1} = j) = \frac{1}{N_1} \sum_{n=1}^{N_1} \mathbf{1}_{[d_{n,t_2}=0 \cap d_{n,t_1}=j]} \quad \text{with } j = 1,2,3,4. \tag{25}$$

The transition probability of entrants is given by

$$P^e_{i-} = P(d_{n,t_2} = i | d_{n,t_1} = 0) = \frac{1}{N_2} \sum_{n=1}^{N_2} \mathbf{1}_{[d_{n,t_2}=i \cap d_{n,t_1}=0]} \quad \text{with } i = 1,2,3,4 \tag{26}$$

where N_2 denote the number of active firms in t_2.

5 Empirical results

In this section we present the empirical results. Section 5.1 shows production function estimates as well as insights in dynamics of the distribution of firm-level productivity, Section 5.2 discusses the results of the analysis of aggregate productivity growth by the application of the Dynamic Olley Pakes Decomposition (DOPD), Section 5.3, shows changes in the productivity distribution over time and discusses results with respect to productivity persistence, and Section 5.4 presents firms transition probabilities within the productivity distribution.

5.1 Production function estimates

Table 2 provides the production function estimation results, separately for each considered 4-digit woodworking industry. The estimates show that for all industries in our data set the coefficient of the autonomous time trend, $\hat{\delta}$, has a negative sign (except for industry for veneer sheets, however, statistically insignificant), implying that time progress is negatively related to firms' productivity. This finding is somewhat counter intuitive since in theory firms are supposed to increase their productivity when time goes on by learning about their economic environment. With regard to the estimates of the technological parameters, i.e. the output elasticities for labor and capital, $\hat{\beta}_l$ and $\hat{\beta}_k$. It can be seen that the coefficient associated with labor varies between 0.467 and 0.714, estimated for the industries "other builders' carpentry/joinery" and "sawmilling/wood planing". The coefficient associated with capital varies on a much lower level, between 0.069 and 0.214, estimated for the industries "veneer sheets/wood panels" and "other builders' carpentry/joinery". Note that the sum of both coefficients is always smaller than one, indicating decreasing economies of scale: an increase in both input factors by 1% does translates in an increase in (value added) production smaller than 1%. A very useful feature of the GMM estimation is the over-identification test with which we can test for over-identification restrictions, i.e. testing for the validity of the set of instruments.[16] The test shows that - except for the industries "sawmilling/wood planing" and "other furniture" - the chosen instruments are statistically valid at the 1 % significance level. Estimates for which the over-identification test does not reject the H_0 (p-value < 0.05) should be considered with caution. By having obtained these estimates, firm-level productivity is recovered.

[16] Let x be an endogenous regressor, and z a potential instrument, then the instrument is valid if $E(zx) \neq 0$ and $E(uz) = 0$, where u is the error term of the underlying regression. When the number of instruments is higher than the number of endogenous regressors, the over-identification test jointly tests for both conditions that define the validity of the instruments. That is, the null hypothesis, H_0 = "invalid instruments", should be rejected, which is the case if the p-value is larger than the 5% level of significance.

Table 2: Production function estimates

	Industry				
Coeff.	1610 Sawmilling/ wood planning	1621 Veneer sheets/ wood-based panels	1623 Other builders' carpentry/joinery	1624 Wooden containers	1629 Other wood products
$\hat{\alpha}$	0.151*	-0.656	0.832***	0.388*	0.450**
	(0.116)	(0.713)	(0.272)	(0.237)	(0.215)
$\hat{\delta}$	−0.0261***	0.0479	−0.059***	−0.0413***	−0.0481***
	(0.008)	(0.049)	(0.018)	(0.017)	(0.017)
$\hat{\beta}_L$	0.714***	0.605***	0.468***	0.620***	0.520***
	(0.018)	(0.122)	(0.033)	(0.035)	(0.033)
$\hat{\beta}_K$	0.074***	0.069	0.214***	0.159***	0.197***
	(0.010)	(0.063)	(0.028)	(0.030)	(0.024)
Obs.	57164	3366	36816	23872	19442
# of Firms	3271	189	2575	1317	1338
Over-Id. Test	0.000	0.476	0.097	0.990	0.484
Coeff.	1711/12 Pulp and paper	3101 Office/shop furniture	3102 Kitchen furniture	3109 Other furniture	
$\hat{\alpha}$	0.582*	0.589***	0.177	0.928***	
	(0.442)	(0.205)	(0.195)	(0.130)	
$\hat{\delta}$	-0.025	−0.031***	−0.020*	−0.092***	
	(0.026)	(0.013)	(0.012)	(0.011)	
$\hat{\beta}_L$	0.479***	0.612***	0.510***	0.541***	
	(0.096)	(0.037)	(0.040)	(0.016)	
$\hat{\beta}_K$	0.091**	0.161***	0.108***	0.143***	
	(0.046)	(0.027)	(0.026)	(0.010)	
Obs.	4478	20486	15526	94692	
# of Firms	238	1247	1068	7411	
Over-Id. Test	0.681	0.323	0.330	0.000	

[a] *p<0.1; **p<0.05; ***p<0.01
[b] Standard errors are given in parenthesis.

5.2 Productivity decomposition

In this section we present the empirical results from the Dynamic Olley-Pakes Productivity Decomposition. As described in Section 4.2, the primer interest lies on the assessment of the contribution to aggregate productivity growth of the three firm groups survivors, entrants and exitors. For more convenience we do not report growth rates for each year but only for chosen three-year waves. That is, we report growth rates for the waves 1998, 2001, 2004, 2007, 2010, 2013 and 2016, where all growth rates are relative to 1995. Note that for the identification of firms' status of being entrant, exitor or survivor we rely on our definitions for entry and exit of longer time spans (see Section 2.2).

The productivity growth decomposition is carried out for each 4-digit woodworking industry separately, where, as mentioned in Section 4.2, the contribution to the aggregate productivity growth of the group of survivors is further decomposed into the "within change" and a "between change" components. (see equation (23)). Results are presented in Table 3. To sustain the interpretation of these results we also present the results of the aggregate productivity decomposition corresponding to the two-period model of aggregate productivity, given by equations (21) and (22). Results are provided in Table 4 and Table 5, respectively. Note that here, the two periods of the aggregate productivity model, t_1 and t_2, correspond in our empirical case to the initial year 1995 (t_1) and a specific wave between 1998 - 2016 (t_2).

The results are summarized with respect to three aspects: (i) total change in aggregate productivity, (ii) the within and between contribution to aggregate productivity growth of surviving firms, (iii) the contribution of entrants and exitors to total aggregate productivity change;

5.2.1 Total change in aggregate productivity

Considering first the total change in aggregate productivity, reported in Table 3, column(s) "total change". Generally, except the industry "veneer sheets/wood panels", all industries reveal positive growth rates in aggregate productivity throughout the whole sample period. However, the amplitude varies substantially. Relative to 1995, the industries' growth rates in 2016 are given by 78.18% (sawmilling/wood planing), - 83.92% (veneer sheets/wood panels), 142.72% (other builders' carpentry/joinery), 114.66% (wooden containers), 120.88% (other wood products), 88.33% (pulp and paper), 86.78% (office/shop furniture), 69.26% (kitchen furniture), 207.89% (other furniture).

Among the industries with a positive productivity growth, the most industries increase consistently their aggregate productivity. However, we also see that from wave to wave productivity growth is non-linear. For the industry "sawmilling/wood planning", for instance, we observe a slow down in the growth between the years 2007 and 2010, the period where the economic crisis has hit at most the French woodworking industries. More precisely, from 2007 to 2010 the industry "sawmilling/wood planing" experienced a productivity growth slow down, where in 2007 and 2010 the growth rates are given by 44.43% and 41.07%, relative to 1995. We will see that firm exit has contributed to this development substantially. Other industries such as the industry "office/shop furniture" shows much higher productivity growth rate for the beginning of the sample period, given by 17.26% (1998) and 40.81% (2001), relative to 1995. Instead, between 2007, 2010 and 2013 the industry's aggregate productivity only grew by 79.49%, 83.06% and 86.78%, relative to 1995.

5.2.2 Within and between productivity improvement of surviving firms

The contribution to aggregate productivity growth of surviving firms', is decomposed into the within (individual firms' productivity change) and the between (productivity growth through reallocation of market shares) productivity growth is presented in column(s) "within" and "between". Generally, the figures show that the group of surviving firms contribute at most to total productivity change. The decomposition into the within- and between-growth components shows that the within-growth component plays by far the most important role. We can see that in all 4-digit industries the group of surviving firms has significantly increased over time its productivity due to proper improvements. More precisely, relative to 1995, firms that have survived until 2016 increased their within productivity by 84.32% (sawmilling/wood planing), -79.18% (veneer sheets/wood panels), 136.89% (other builders' carpentry/joinery), 113.89% (wooden containers), 108.57% (other wood products), 71.25% (pulp and paper), 89.90% (office/shop furniture), 72.48% (kitchen furniture), and 197.07% (other furniture). Instead, according to our results, survivors' between-growth contribution, seems to be negligible, since we only measure a very small growth rate. However, throughout most of the industries and years the sign of the between-growth rate is positive. Only the group of survivors belonging to the industries "pulp and paper", "office/shop furniture" and "kitchen furniture" exhibit for several years a negative sign with respect to their between contribution. Note that in the case of a positive sign of the between growth rate, market shares tend to move from lower to higher productivity firms - and vice-versa if the sign is negative. Haltiwanger (2011) evaluates a positive sign of the between-growth component as an indication for a "well-functioning" economy. This is, since firms with a higher productivity are able to generate more output with the same level of input leading in a competitive economic environment to a higher consumer surplus.

5.2.3 The contribution of entrants and exitors to aggregate productivity change

Considering first the contribution of entering firms. It can be seen that throughout nearly all industries and years entering firms have a relatively small but negative effect on the aggregate productivity growth. The only industries for which we measure for some waves a positive contribution of the group of entering firms are the industries "vener sheets/wood-based pannels", "other wood products", and "pulp and paper". For some cases, however, the contribution of entrants can have a significant effect on the total change in productivity. For the industry "sawmilling/wood planning" we measure for the year 2010 a contribution of entrants of -16.40%, relative to 1995. Similar for the industry "kitchen furniture" where entrants considerably pull down the industry's' total growth rate. The industry for "vener sheets/wood based pannels" states a counter example: here surviving firm contribute negatively and entering firm considerably positively to aggregate productivity growth. Remember that in equation (23) it is shown that entering firms only contribute positively to the aggregate productivity growth if the groups aggregate productivity level in t_2 is higher compared to the productivity level of surviving firms in t_2 (where the difference is weighted by the (aggregated) market share of the entrants). A measured negative contribution implies that entering firms have a lower productivity level compared to the group of survivors. This is illustrated in Table 5. The table shows for both the group of survivors and entrants between 1995 (column t_1) and the considered wave (column t_2), the aggregated productivity (columns Ω_S and Ω_E, for survivors and entrants, respectively) as well as the aggregated market shares (columns S_S and S_E for survivors and entrants, respectively).[17] It can be seen that the aggregate level of entrants is almost always lower than that of the group of survivors, except for those industries and years, where we observe a positive contribution of entrants. The Table also shows that for each

[17]Table 5 precisely corresponds to equation (22).

industry the market shares of survivors decreases over time, whereas the market shares of entrants increases. For instance, considering the industry "sawmilling/wood planing", the aggregated market share of firms survived and of those that have entered from 1995 to 1998 (2016) accounts for 91.06% and 8.94% (63.53% and 36.47%), respectively. This pattern is also reflected in the observed number of survivors and entrants, i.e., the farther from 1995, the lower (higher) the number of survivors (entrants). Note that these patterns are observed for all industries. The finding of a negative contribution of entering firms to aggregate productivity change firms confirms findings of other empirical works (see, for instance, Foster et al. (2001) and Fariñas and Ruano (2005)). This is often explained by the fact that entering firms have less experience and thus lag back in terms of productivity relative to firms that have survived, where more experience is associated with higher efficiency in the production process as well as a better adaption to the prevailing economic environment (see Nelson and Winter (2002)).

Considering now the contribution the group of exiting firms to aggregated productivity change. Compared to the group of entrants, the contribution of exiting firms to aggregate productivity growth seems to be less distinct. That is, for some industries, such as "sawmilling/ wood planning", "veneer sheets/wood-based panels" and "other wood products" we measure a consistent negative contribution to aggregate productivity growth of the group of exiting firms. Here exitors contribute considerably negatively especially in the industries "veener sheets/ wood based pannels" (-13.26%, 2007) and "other wood products" (-17.13%, 2010). For other industries, however, exiting firms contribute consistently positively to the aggregate productivity growth especially for the industries "pulp/paper" (11.42%), "office/shop furniture" (19.82%, 2016), "kitchen furniture" (23.18%, 2013) and "other furniture" (16.54%, 2013). According to equation (23), the contribution is measured by the difference between the aggregated productivity level in 1995 ($t = 1$) of those firms that survive and exit until the considered wave $1998, \ldots, 2016$ ($t = 2$). Hence, a positive contribution implies that firms that survived have in 1995 a higher aggregated productivity level compared to those that have exit the market and vice versa. Table 4 provide the corresponding measures for these comparisons. The table shows the aggregate productivity in 1995 of surviving firms (column(s) Ω_S) and of those firms that exit (column(s) Ω_X) between 1995 and the considered wave (column(s) t_2) as well as the corresponding aggregated market shares (column(s) S_S and S_X). Considering, for instance, industry "veneer sheets/wood-based panels", exhibiting an important negative contribution of exiting firms to aggregate productivity growth, it can be seen that the aggregate productivity of the group of exitors is higher compared the group of surviving firm. In particular, the aggregate productivity in 1995 of those firms that survived until 2016 is given by 1.53, whereas the aggregate productivity in 1995 of those firms having exited until 2016 is higher, given by 1.63. By the disappearance of exiting firms, aggregate productivity will drop and hence exiting firms contribute negatively to aggregate productivity growth. In other words, those industries that experience a negative contribution to aggregate productivity growth by the group of exitors loose "good" firms. Table 4 also illustrates the number of observed survivors and exitors between 1995 and the considered wave. Note that the number of survivors reported in Table 4 is, by definition, the same as the number reported in Table 5. However, the aggregate productivity measure between both tables changes since in Table 4 the aggregated productivity is measured for the initial year 1995, whereas in Table 5, the aggregate productivity is measured for the respective period t_2. We observe the general pattern, the bigger the time gap between 1995 and the considered wave, the smaller the observed number of survivors and, consequently, the higher the number of exitors.

Table 3: Aggregate Productivity Decomposition (DOPD): 1995 - 2016[a]

Industry	Year	Contr. Survivors		Contr. Entrants	Contr. Exitors	Total Change[b]	Industry	Year	Contr. Survivors		Contr. Entrants	Contr. Exitors	Total Change[b]
		Within	Between						Within	Between			
1610	1998	14.90	0.004	-1.62	-2.03	11.25	1700	1998	19.10	-0.149	-1.98	3.21	20.18
Sawmilling/	2001	28.12	0.006	-0.70	-1.17	26.26	Pulp and	2001	32.03	-0.103	-2.97	3.53	32.49
wood planning	2004	42.89	0.013	-2.94	-2.41	37.55	paper	2004	43.62	-0.041	-6.76	5.59	42.41
	2007	50.49	0.020	-3.48	-2.60	44.43		2007	47.15	0.163	-4.21	6.08	49.18
	2010	60.77	0.025	-16.40	-3.32	41.07		2010	58.31	0.165	-8.69	10.15	59.94
	2013	71.25	0.043	-8.70	-3.08	59.51		2013	69.27	0.107	-3.39	11.42	77.41
	2016	84.32	0.055	-3.62	-2.57	78.18		2016	71.25	-0.003	5.87	11.21	88.33
1621	1998	1.28	0.211	-1.35	-4.61	-4.47	3101	1998	18.91	0.004	-2.49	0.84	17.26
Veener sheets	2001	-11.70	0.009	2.52	-3.22	-12.39	Office/shop	2001	43.62	0.011	-7.88	5.06	40.81
wood-based	2004	-23.30	0.109	20.28	-13.18	-16.09	furniture	2004	57.92	-0.023	-8.50	6.01	55.41
pannels	2007	-36.40	0.378	14.40	-13.26	-34.88		2007	79.33	0.000	-9.42	9.58	79.49
	2010	-62.99	0.837	-2.77	-11.29	-76.21		2010	82.67	-0.050	-11.13	11.57	83.06
	2013	-94.38	1.311	0.29	-9.07	-101.85		2013	84.74	-0.043	-11.42	13.50	86.78
	2016	-79.18	1.508	2.96	-9.21	-83.92		2016	89.90	-0.123	-0.41	19.82	109.19
1623	1998	21.90	0.013	-3.37	-4.56	13.98	3102	1998	12.18	-0.050	-1.66	4.36	14.83
Other builders'	2001	50.10	0.010	-6.06	-0.51	43.54	Kitchen	2001	41.24	-0.105	-2.65	8.12	46.60
carpentry/joinery	2004	77.15	0.011	-6.16	-2.27	68.73	furniture	2004	51.10	-0.089	-8.09	7.90	50.82
	2007	97.75	0.016	-8.41	-0.77	88.59		2007	55.90	-0.055	-10.89	8.14	53.09
	2010	113.55	0.002	-10.17	-1.71	101.67		2010	61.32	0.002	-10.07	14.74	65.99
	2013	126.39	-0.005	-5.23	1.80	122.95		2013	58.00	0.366	-18.51	23.18	63.04
	2016	136.08	0.016	-2.33	8.95	142.72		2016	72.48	0.686	-19.27	15.36	69.26
1624	1998	18.99	0.008	-1.56	0.09	17.53	3109	1998	32.98	0.003	-5.87	-0.27	26.84
Wooden containers	2001	37.42	0.035	-3.10	1.65	36.01	Other	2001	70.59	0.006	-6.04	2.24	66.80
Other wood	2004	56.65	0.041	-7.23	3.24	52.70	furniture	2004	106.15	0.013	-14.09	6.14	98.21
products	2007	69.14	0.064	-7.88	4.55	65.87		2007	135.20	0.016	-13.54	9.58	131.26
	2010	87.40	0.044	-6.43	5.43	86.44		2010	152.06	0.042	-11.40	14.68	155.38
	2013	99.86	0.043	-4.29	6.08	101.69		2013	171.04	0.080	-7.72	16.54	179.94
	2016	113.89	0.042	-6.13	6.86	114.66		2016	197.07	0.124	-5.36	15.70	207.53
1629	1998	19.90	0.010	-2.80	2.61	19.72	All	1998	17.79	0.006	-2.52	-0.04	15.24
Other wood	2001	39.25	0.051	-2.32	-11.25	25.73		2001	36.74	-0.009	-3.24	0.49	33.98
products	2004	57.26	0.012	1.75	-9.27	49.75		2004	52.16	0.005	-3.53	0.19	48.83
	2007	65.75	0.062	5.80	-14.04	57.57		2007	62.70	0.074	-4.18	0.81	59.40
	2010	85.61	0.076	1.02	-17.13	69.58		2010	70.97	0.127	-8.45	2.57	65.21
	2013	97.48	0.142	-1.85	-16.22	79.55		2013	75.96	0.227	-6.76	4.91	74.34
	2016	108.57	0.215	22.03	-9.94	120.88		2016	88.26	0.280	-0.70	6.24	94.09

[a] All contributions represent growth rates in % relative to 1995.
[b] The total change in aggregate productivity is the sum of the contributions of survivors, entrants and exitors.

Table 4: Productivity Decomposition in the base year 1995 (t_1): survivors and exitors

Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_X^b	$S_X^{c,d}$	Ω_1^e	# Surv.	# Exits	Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_X^b	$S_X^{c,d}$	Ω_1^e	# Surv.	# Exits
1610	1995	1998	-0.31	87.73	-0.14	12.27	-0.29	1320	219	1700	1995	1998	0.59	97.03	-0.49	2.97	0.56	120	14
Sawmilling/	1995	2001	-0.28	80.14	-0.23	19.86	-0.27	1116	393	Pulp and	1995	2001	0.60	89.24	0.27	10.76	0.56	99	30
wood planning	1995	2004	-0.31	70.28	-0.22	29.72	-0.28	992	498	paper	1995	2004	0.66	75.37	0.43	24.63	0.60	85	43
	1995	2007	-0.30	62.65	-0.23	37.35	-0.27	845	611		1995	2007	0.64	69.83	0.44	30.17	0.58	75	53
	1995	2010	-0.32	54.88	-0.24	45.12	-0.28	693	745		1995	2010	0.66	56.99	0.42	43.01	0.56	57	63
	1995	2013	-0.31	49.26	-0.25	50.74	-0.28	576	841		1995	2013	0.69	55.50	0.44	44.50	0.58	49	71
	1995	2016	-0.30	46.00	-0.26	54.00	-0.28	521	884		1995	2016	0.63	45.98	0.43	54.02	0.52	43	74
1621	1995	1998	1.54	86.55	1.88	13.45	1.58	81	13	3101	1995	1998	-0.07	86.95	-0.13	13.05	-0.08	373	76
Veener sheets	1995	2001	1.56	81.71	1.73	18.29	1.59	70	21	Office/shop	1995	2001	-0.02	81.53	-0.29	18.47	-0.07	315	123
wood-based	1995	2004	1.44	66.43	1.83	33.57	1.57	61	30	furniture	1995	2004	-0.04	77.69	-0.31	22.31	-0.10	278	148
pannels	1995	2007	1.45	61.54	1.80	38.46	1.59	52	34		1995	2007	0.00	72.39	-0.34	27.61	-0.09	253	170
	1995	2010	1.48	54.70	1.73	45.30	1.59	46	38		1995	2010	0.02	68.20	-0.34	31.80	-0.10	213	204
	1995	2013	1.51	50.57	1.69	49.43	1.60	37	44		1995	2013	0.04	61.24	-0.31	38.76	-0.09	178	233
	1995	2016	1.53	40.66	1.68	59.34	1.62	26	49		1995	2016	0.12	55.42	-0.33	44.58	-0.08	141	260
1623	1995	1998	-0.37	84.76	-0.07	15.24	-0.33	634	144	3102	1995	1998	1.11	94.04	0.38	5.96	1.06	311	80
Other builders'	1995	2001	-0.32	76.64	-0.30	23.36	-0.32	512	242	Kitchen	1995	2001	1.14	87.15	0.51	12.85	1.06	247	128
carpentry/joinery	1995	2004	-0.39	72.48	-0.30	27.52	-0.36	478	271	furniture	1995	2004	1.15	79.87	0.75	20.13	1.07	229	138
	1995	2007	-0.36	69.11	-0.33	30.89	-0.35	443	295		1995	2007	1.16	69.23	0.89	30.77	1.08	199	166
	1995	2010	-0.37	61.72	-0.32	38.28	-0.35	365	356		1995	2010	1.22	61.14	0.84	38.86	1.07	151	203
	1995	2013	-0.33	55.87	-0.37	44.13	-0.35	276	439		1995	2013	1.31	51.16	0.84	48.84	1.08	113	232
	1995	2016	-0.28	43.79	-0.44	56.21	-0.37	223	481		1995	2016	1.26	38.62	1.01	61.38	1.10	94	249
1624	1995	1998	-0.69	89.13	-0.70	10.87	-0.69	579	95	3109	1995	1998	-0.61	84.06	-0.60	15.94	-0.61	2544	853
Wooden containers	1995	2001	-0.67	79.46	-0.75	20.54	-0.69	469	175	Other	1995	2001	-0.63	73.01	-0.71	26.99	-0.65	2030	1284
Other wood	1995	2004	-0.65	74.17	-0.78	25.83	-0.68	410	219	furniture	1995	2004	-0.54	66.09	-0.72	33.91	-0.60	1656	1581
products	1995	2007	-0.63	67.16	-0.77	32.84	-0.68	358	266		1995	2007	-0.53	58.01	-0.76	41.99	-0.62	1331	1825
	1995	2010	-0.63	60.56	-0.77	39.44	-0.69	291	321		1995	2010	-0.47	43.47	-0.72	56.53	-0.61	654	2335
	1995	2013	-0.63	57.20	-0.77	42.80	-0.69	262	344		1995	2013	-0.41	34.19	-0.66	65.81	-0.58	441	2498
	1995	2016	-0.61	53.26	-0.76	46.74	-0.68	240	359		1995	2016	-0.45	29.67	-0.67	70.33	-0.61	315	2604
1629	1995	1998	-0.13	91.97	-0.45	8.03	-0.16	583	166	All	1995	1998	0.12	89.14	-0.04	10.86	0.12	727	184
Other wood	1995	2001	-0.25	68.14	0.10	31.86	-0.14	450	263		1995	2001	0.13	79.67	0.04	20.33	0.12	589	295
products	1995	2004	-0.20	57.21	0.02	42.79	-0.11	366	325		1995	2004	0.12	71.07	0.08	28.93	0.12	506	361
	1995	2007	-0.28	46.31	-0.02	53.69	-0.14	299	375		1995	2007	0.13	64.03	0.08	35.97	0.12	428	421
	1995	2010	-0.31	35.05	-0.05	64.95	-0.14	210	459		1995	2010	0.14	55.19	0.06	44.81	0.12	297	524
	1995	2013	-0.29	26.38	-0.07	73.62	-0.13	144	511		1995	2013	0.18	49.04	0.06	50.96	0.13	230	579
	1995	2016	-0.22	23.28	-0.09	76.72	-0.12	113	530		1995	2016	0.19	41.85	0.06	58.15	0.12	190	610

[a] According to equation (21) this table reports measures of aggregate productivity and market shares for the group of surviving and exiting firms. The measures are always (and only) for the initial year 1995.

[b] The columns Ω_S and Ω_X denote the aggregate productivity of the firm groups survivors and exitors, respectively.

[c] The columns S_S and S_X denote the aggregated market shares of the firm groups survivors and exitors, respectively.

[d] S_S and S_X are given in %.

[e] Columns Ω_1 denotes the aggregate productivity for the initial year 1995.

Table 5: Productivity decomposition in t_2: survivors and entrants[a]

Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_E^b	$S_E^{c,d}$	Ω_2^e	# Surv.	# Entr.	Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_E^b	$S_E^{c,d}$	Ω_2^e	# Surv.	# no Entr.
1610	1995	1998	-0.10	91.06	-0.29	8.94	-0.12	1320	386	1700	1995	1998	0.65	89.67	0.45	10.33	0.63	120	21
Sawmilling/	1995	2001	0.07	82.31	0.03	17.69	0.06	1116	581	Pulp and	1995	2001	0.86	82.40	0.69	17.60	0.83	99	29
wood planning	1995	2004	0.27	75.18	0.16	24.82	0.24	992	700	paper	1995	2004	0.94	75.55	0.67	24.45	0.88	85	33
	1995	2007	0.42	71.01	0.30	28.99	0.38	845	780		1995	2007	1.14	75.42	0.97	24.58	1.10	75	42
	1995	2010	0.56	63.24	0.11	36.76	0.39	693	760		1995	2010	1.21	67.43	0.94	32.57	1.12	57	39
	1995	2013	0.73	63.81	0.49	36.19	0.65	576	703		1995	2013	1.22	69.56	1.11	30.44	1.19	49	34
	1995	2016	0.98	63.53	0.88	36.47	0.95	521	564		1995	2016	1.03	57.40	1.17	42.60	1.09	43	35
1621	1995	1998	1.73	93.22	1.53	6.78	1.72	81	21	3101	1995	1998	0.16	86.13	-0.02	13.87	0.14	373	177
Veener sheets	1995	2001	1.52	84.08	1.68	15.92	1.55	70	37	Office/shop	1995	2001	0.47	81.21	0.05	18.79	0.39	315	257
wood-based	1995	2004	1.39	61.43	1.92	38.57	1.59	61	39	furniture	1995	2004	0.44	73.77	0.11	26.23	0.35	278	299
pannels	1995	2007	1.47	58.09	1.82	41.91	1.62	52	37		1995	2007	0.75	68.97	0.45	31.03	0.66	253	322
	1995	2010	1.33	66.36	1.25	33.64	1.30	46	36		1995	2010	0.70	67.82	0.35	32.18	0.59	213	291
	1995	2013	1.23	65.76	1.23	34.24	1.23	37	29		1995	2013	0.75	65.24	0.42	34.76	0.63	178	276
	1995	2016	1.25	62.78	1.33	37.22	1.28	26	24		1995	2016	0.60	65.07	0.59	34.93	0.60	141	223
1623	1995	1998	-0.11	88.04	-0.39	11.96	-0.15	634	318	3102	1995	1998	1.19	85.25	1.07	14.75	1.17	311	146
Other builders'	1995	2001	0.15	81.30	-0.17	18.70	0.09	512	493	Kitchen	1995	2001	1.36	76.59	1.25	23.41	1.33	247	204
carpentry/joinery	1995	2004	0.38	77.26	0.10	22.74	0.31	478	617	furniture	1995	2004	1.41	73.62	1.10	26.38	1.33	229	252
	1995	2007	0.68	68.66	0.42	31.34	0.60	443	854		1995	2007	1.34	73.72	0.93	26.28	1.24	199	306
	1995	2010	0.78	60.24	0.53	39.76	0.68	365	900		1995	2010	1.44	74.81	1.04	25.19	1.34	151	215
	1995	2013	0.89	56.05	0.77	43.95	0.84	276	753		1995	2013	1.88	76.79	1.08	23.21	1.69	113	166
	1995	2016	1.04	51.72	0.99	48.28	1.01	223	628		1995	2016	2.05	77.74	1.18	22.26	1.85	94	140
1624	1995	1998	-0.43	87.26	-0.55	12.74	-0.44	579	149	3109	1995	1998	-0.20	88.82	-0.72	11.18	-0.26	2544	1134
Wooden containers	1995	2001	-0.10	80.42	-0.25	19.58	-0.13	469	208	Other	1995	2001	0.11	79.07	-0.18	20.93	0.05	2030	1777
Other wood	1995	2004	0.12	79.45	-0.23	20.55	0.05	410	234	furniture	1995	2004	0.56	78.51	-0.09	21.49	0.42	1656	2024
products	1995	2007	0.30	78.26	-0.06	21.74	0.22	358	259		1995	2007	0.84	68.46	0.41	31.54	0.71	1331	2250
	1995	2010	0.36	74.87	0.11	25.13	0.30	291	256		1995	2010	1.12	61.82	0.82	38.18	1.01	654	1278
	1995	2013	0.52	68.16	0.39	31.84	0.48	262	253		1995	2013	1.34	63.20	1.14	36.80	1.27	441	915
	1995	2016	0.64	67.00	0.46	33.00	0.58	240	228		1995	2016	1.58	64.33	1.43	35.67	1.53	315	671
1629	1995	1998	0.19	92.57	-0.18	7.43	0.17	583	146	All	1995	1998	0.34	89.11	0.10	10.89	0.32	727	277
Other wood	1995	2001	0.38	83.69	0.24	16.31	0.36	450	214		1995	2001	0.54	81.23	0.37	18.77	0.50	589	422
products	1995	2004	0.36	72.88	0.43	27.12	0.38	366	230		1995	2004	0.65	74.18	0.46	25.82	0.62	506	492
	1995	2007	0.50	64.72	0.67	35.28	0.56	299	231		1995	2007	0.83	69.70	0.66	30.30	0.79	428	564
	1995	2010	0.67	64.10	0.70	35.90	0.68	210	181		1995	2010	0.91	66.74	0.65	33.26	0.82	297	439
	1995	2013	0.93	63.06	0.88	36.94	0.91	144	175		1995	2013	1.05	65.74	0.83	34.26	0.99	230	367
	1995	2016	1.20	51.62	1.66	48.38	1.42	113	129		1995	2016	1.15	62.35	1.08	37.65	1.15	190	293

[a] According to equation (22) this table reports measures of aggregate productivity and market shares for the group of surviving and entering firms. The values always represent measures concerning the second time period t_2.

[b] The columns Ω_S and Ω_E denote the aggregate productivity of the firm groups survivors and entrants, respectively.

[c] The columns S_S and S_E denote the aggregated market shares of the firm groups survivors and entrants, respectively.

[d] S_S and S_E are given in %.

[e] Column Ω_2 denotes the aggregate productivity for the second time period t_2.

5.3 Productivity dispersion

To provide some insights into dynamics of the distributions of firm-level productivity, we discuss in this section productivity dispersion over time. Figure 3 shows a nonparametric 3D kernel density estimate of firm productivity (across all industries) conditional on time. Figure 4 provides the corresponding 2D plot, for the waves 1995, 2000, 2005, 2010 and 2015.[18] It can be seen that in the early years of our sample the density of low productive firms is considerably higher. Over time, this mass decays and becomes less concentrated.

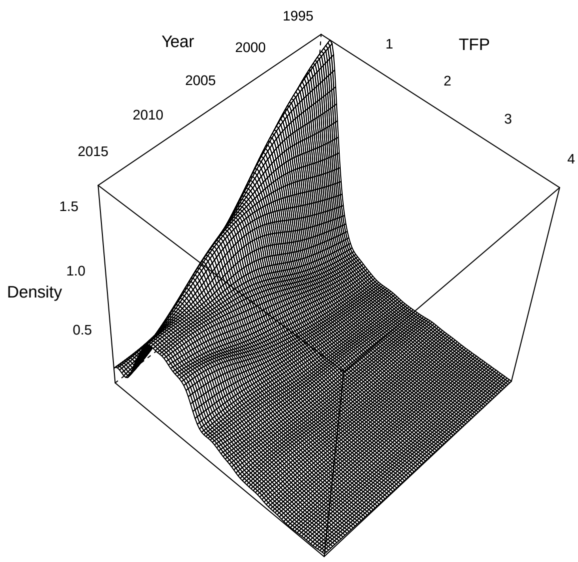

Figure 3: Productivity density conditional on time: $\hat{\phi}(\hat{\omega}_{nt}|t)$.

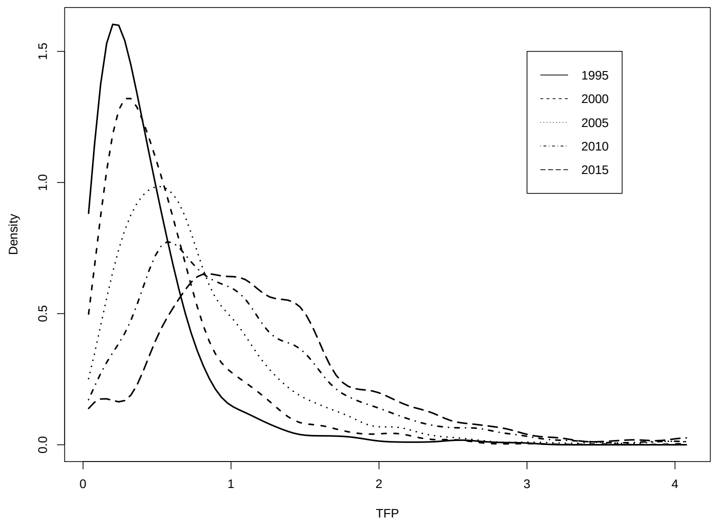

Figure 4: Unconditional productivity density for different waves: $\hat{\phi}_t(\hat{\omega}_n)$

[18] Note that Figure 3 is a nonparametric estimate of a conditional density of firm productivity on year. I.e., the plots show an estimate for $\phi(\omega_{nt}|t)$, where ϕ denotes the distribution function and ω_{nt} firm productivity. The corresponding 2D plot shows the unconditional density, however, for some chosen waves. The estimates are obtained by using of the R-package "np", where optimal bandwidths are obtained applying likelihood cross-validation.

Figure 5 provides further insight to these dynamics. The left hand side figure (a) shows the yearly evolution of the first quartile (dashed line), the median (solid line) as well as the third quartile (dotted line) of the distribution of firm-level productivity. It can be seen that the curves are slightly diverging over time, which means that productivity becomes more dispersed over time within the interquartile range. That is, firms with a productivity level at the 75% percentile of the productivity distribution improve faster their productivity compared to firms at the 25% percentile. Additionally, the right hand side figure (b) shows the 90/10-percentile ratio in productivity over time (solid line) and corresponding time-mean (dashed line). Contrarily to figure (a), figure (b) shows that the 90/10 percentile ratio first declines quite rapidly, until around 2006, whereupon the ratio seems to stabilize and finally increases. This demonstrates that depending on which statistic we are looking at, changes with respect to the productivity dispersion of firms' productivity can be differently evaluated. While the inter-quartile dispersion steadily increases over time, the dispersion between the 90th and 10th percentile decreases for a long time span before an increase takes place. We pursue our analysis with the investigation of firms mobility within the productivity distribution of firm level productivity.

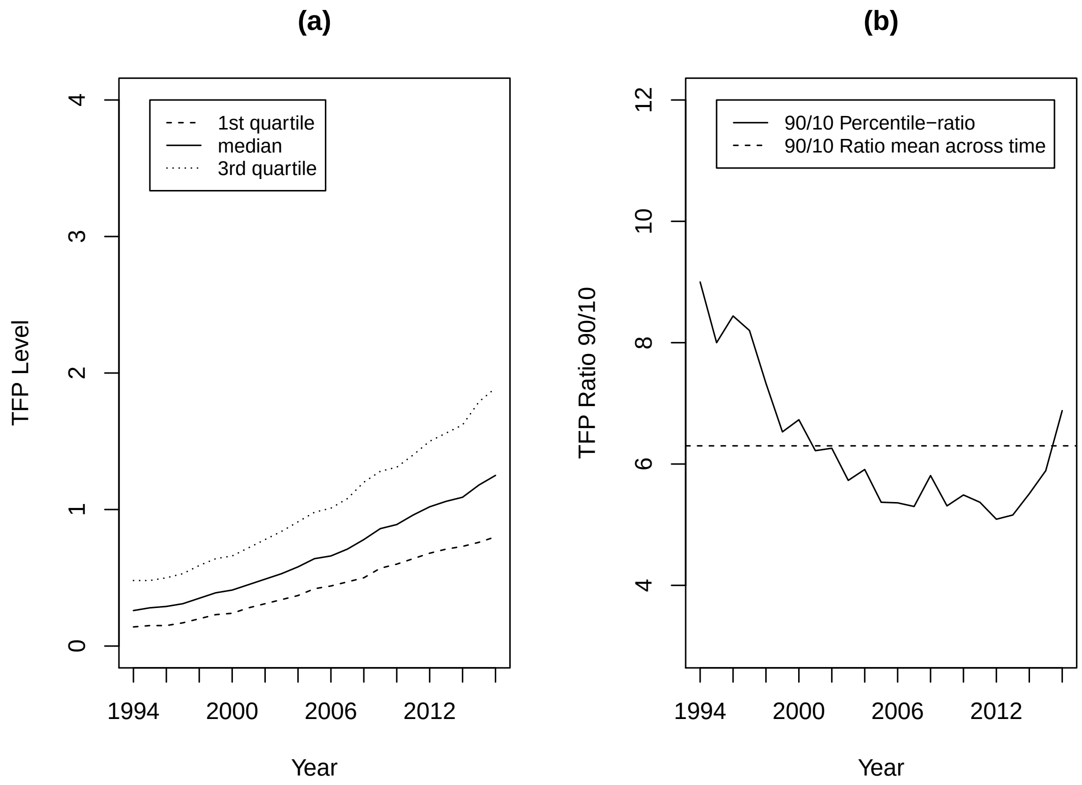

Figure 5: Productivity dispersion over time.

5.4 Productivity transitions

We now turn to the results of firms' transition probabilities within the distribution of firm level productivity. As outlined in Section 4.3, we investigate the probability of survivors to move between quartiles of the productivity distribution with respect to two points in time. Also, we report probabilities of entrants and exitors to enter or exit into or from a given quartile of the productivity distribution. For this purpose we select five waves, 1995, 2000, 2005, 2010 and 2015, where we always consider two of them, say t_1 and t_2, with $t_1 < t_2$. Note that we relay on the definitions made in Section 2.2 to identify firms' status of either survivor, entrant or exitor for longer time spans. Table 6 provides the results. Each cell of the transition matrix contains the probability for a specific pair, t_1 and t_2, of either transiting between two quartiles, remaining in the same quartile, exiting from a given quartile or entering into a given quartile - within the distribution of firm productivity. In the following we summarize the most important findings.

5.4.1 Survivors are sticky

Consider first the top left square, i.e. transitions between the two periods $t_1 = 1995$ and $t_2 = 2000$. Given firms survive between 1995 and 2000, firms' highest probability is measured to remain in the quartile they came from (t_1), which can be seen by the probabilities on the diagonal of the square. More precisely, given a firm was ranked in 1995 in the first quantile Q1 (Q2, Q3, Q4, for the quartiles two, three and four), the probability to remain in 2000 in Q1 is given by 40.4% (33.5%, 38.7%, 59.6%). Comparing five-year spans, this pattern is also observed for any other of those couples. For instance, the square in the bottom right, i.e. $t_1 = 2010$ and $t_2 = 2015$, the probability that firms are ranked in the same quartile, is given by 25.9% (Q1), 23.4% (Q2), 25.3% (Q3), 41.2% (Q4), which is, compared to the other possible transition outcomes (except exit), the highest probability. For very large time spans, such as for $t_1 = 1995$ and $t_2 = 2015$, the probabilities to survive and, thus, to move between quartiles, decreases drastically. Hence firm exit is the by fare most probable outcome.

5.4.2 Exit is very likely, but more likely for low productive firms

Firm exit in t_2 turns out to be highly probable for firms belonging to any productivity quartile in t_1. For example, for $t_1 = 1995$ and $t_2 = 2000$, the probability that a firm ranked in 1995 in Q1 (Q2, Q3, Q4) and exits in t_2 is given by 37.4% (30.5%, 23.3% and 19.8%). Comparing the other five-year spans, given by 2000-2005, 2005-2010, and 2010-2015, we measure an increase in the probability to exit over time. For the time-span 2010-2015, for instance, given a firm was ranked in Q1 (Q2, Q3, Q4) the probability to exit is given by 59.8% (46.5%, 40.0%, 28.9.9 %), which is significantly higher compared to the exit probabilities for 1995-2000. Note that this pattern goes in line with the general observation of a decrease in the number of firms, i.e., positive net exit rates, especially from 2007 on (see Figure 1. Generally, we find that the probability to exit is decreasing in firms productivity ranking. That is, exit is more likely for lower productive firms. This finding confirms important hypothesis made in well-known modes describing industry dynamics, such as Hopenhayn (1992) and Ericson and Pakes (1995). Furthermore, when the time span increases, the probability to exit increases substantially for all groups. Taking the longest time span for which we measure transition probabilities, $t_1 = 1995$ and $t_2 = 2015$, it can be seen that firms ranked in 1995 in Q1 (Q2, Q3, Q4), exit in 2015 with a probability of 89.8% (81.0%, 67.1%, 58.1%).

5.4.3 Entrants are most likely ranked among low productivity firms

For each couple t_1 and t_2, Table 6 also provides the probabilities of firms to transit from inactivity to activity, that is, firms entering into a given quartile of the distribution of firm productivity. Consider first the transition probabilities shown in the upper left square, $t_1 = 1995$ and $t_2 = 2000$. It an be seen that firms inactive in 1995 but active in 2000 enter in the market ranked in Q1 (Q2, Q3, Q4) with a probability of 33.3 % (26.7%, 22.6%, 17.4%). Given the time span $t_1 = 2010$ and $t_2 = 2015$, we observe a similar pattern: firms' probability to enter between 2010 and 2015 in Q1 (Q2, Q3, Q4), with a probability of 33.6% (17.6%, 20.1%, 28.7%).

These results confirm earlier studies such as Foster et al. (2006), analysing such dynamics in the the U.S retail market.

Table 6: Transition Matrix of Productivity: 1995 - 2015

	t_2	2000					2005					2010					2015				
t_1		Q1	Q2	Q3	Q4	Exit	Q1	Q2	Q3	Q4	Exit	Q1	Q2	Q3	Q4	Exit	Q1	Q2	Q3	Q4	Exit
	Q1	40.4	18.1	3.2	0.9	37.4	24.1	11.8	3.9	1.0	59.1	11.5	6.9	2.8	1.1	77.8	5.3	2.4	1.6	0.9	89.8
	Q2	14.4	33.5	17.8	3.8	30.5	12.7	19.7	12.1	4.4	51.1	9.6	11.1	7.3	3.6	68.4	6.6	5.9	3.5	3.0	81.0
1995	Q3	3.1	14.7	38.7	20.2	23.3	6.0	14.8	23.3	15.6	40.3	6.6	11.9	14.2	10.6	56.7	7.9	9.8	8.8	6.5	67.1
	Q4	0.9	3.1	16.5	59.6	19.8	2.0	5.8	16.9	42.6	32.8	4.2	7.4	14.8	27.3	46.3	5.2	8.0	12.6	16.1	58.1
	Entry	33.3	26.7	22.6	17.4		29.2	25.9	24.1	20.8		27.6	25.2	24.4	22.8		25.7	24.9	24.6	24.7	
	Q1						38.5	13.5	2.8	0.7	44.5	15.6	9.6	2.9	1.5	70.4	7.5	3.9	1.9	0.7	86.0
	Q2						17.8	30.8	14.0	3.6	33.8	13.8	14.3	9.0	3.7	59.2	9.0	7.7	4.8	2.6	76.0
2000	Q3						5.9	21.4	34.6	13.9	24.1	8.2	15.9	19.2	9.9	46.9	10.1	12.2	10.4	5.9	61.4
	Q4						1.3	4.5	19.3	56.7	18.2	4.0	6.6	17.4	35.7	36.2	4.3	8.4	14.9	21.8	50.6
	Entry						30.5	24.7	24.2	20.6		28.5	25.3	23.8	22.4		25.6	24.3	24.5	25.5	
	Q1											27.6	12.4	3.4	1.8	54.8	13.1	5.2	2.4	1.2	78.2
	Q2											16.4	24.8	13.1	3.2	42.4	12.1	13.6	6.6	2.6	65.1
2005	Q3											6.4	20.2	28.7	12.9	31.7	8.6	16.5	15.5	7.7	51.7
	Q4											3.1	5.8	19.4	48.3	23.4	4.3	8.0	18.2	27.8	41.7
	Entry											34.1	23.6	22.0	20.3		29.2	21.3	22.1	27.4	
	Q1																25.9	9.1	3.4	1.8	59.8
	Q2																17.9	23.4	9.5	2.6	46.5
2010	Q3																5.8	20.0	25.3	8.9	40.0
	Q4																2.9	6.9	20.1	41.2	28.9
	Entry																33.6	17.6	20.1	28.7	

5.5 Firm productivity and firm size

So far we have seen that French woodworking industries have been very dynamic in terms of firm entry and exit over the past years and that lower productivity firms are especially concerned from entry and exit. It is therefore interesting to study whether firms' productivity level is related to firm size. Firm size is often measured by firms' number of employees. We use the log input factors capital, labor and intermediary inputs (k, l, m) as possible firm size measures and consider the correlation between these variables and firms' log productivity. Also, correlations are calculated between firm productivity and the binary variables entry and exit. Table 7 provides the correlation table, where the correlation are presented across all industries as well as for each 4-digit industry separately. Generally, it can be seen that firm productivity is positively correlated with all firm size measures (input factors). Considering all industries jointly, the correlations between firm productivity and the capital stock, labor and material use is given by 0.42, 0.45 and 0.53, respectively. The correlations vary quite substantially among industries. For instance, the lowest correlations for capital, labor and materials are given by 0.30 (3109), 0.31 (1610) and 0.41 (1610). Instead, the highest correlation between productivity and the three variables (same order) are given by 0.77, 0.77 and 0.81 (all for the industry 1711/12. The latter result is not surprising since the pulp and paper industry is know to be very capital intensive with many big and less small firms. Finally, consider the correlation between firm productivity and firm status of either entrant or exitor, reported in the two last columns. The figures show that firm productivity is negatively correlated with both entry and exit. This last result is expected since we already saw in the previous section that entry and exit is more likely to occur for firms ranked in lower quartiles of the productivity distributions. By the result of a positive correlation between firm productivity and size and a negative correlation between firm productivity and firm entry/exit, we can conclude that small firms are rather less productive and that those firms are especially menaced from exit.

Table 7: Correlation between firm-level productivity and input factors (in logs).[a,b]

	$cor(\hat{\omega}_{nt}, k_{nt})$	$cor(\hat{\omega}_{nt}, l_{nt})$	$cor(\hat{\omega}_{nt}, m_{nt})$	$cor(\hat{\omega}_{nt}, e_{nt})$	$cor(\hat{\omega}_{nt}, x_{nt})$	Obs.
All	0.42	0.45	0.53	-0.13	-0.09	185,289
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
1610	0.36	0.31	0.41	-0.12	-0.10	35,891
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
1621	0.64	0.65	0.73	-0.17	-0.15	2,102
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
1623	0.40	0.47	0.58	-0.15	-0.07	25,108
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
1624	0.35	0.35	0.43	-0.12	-0.12	14,595
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
1629	0.34	0.40	0.50	-0.11	-0.09	13,062
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
1711/12	0.77	0.77	0.81	-0.08	-0.11	2,678
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
3101	0.34	0.39	0.46	-0.11	-0.11	12,977
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
3102	0.51	0.57	0.64	-0.13	-0.10	10,381
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
3109	0.30	0.36	0.46	-0.12	-0.04	68,495
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	

[a] Industry description: 1610 - Sawmilling/wood planing; 1621 - Veener sheets/wood-based panels; 1623 - Other builders' carpentry/joinery; 1624 - Wooden containers; 1629 - Other wood/products; 1711/12 pulp and paper; 3101 - Office and shop furniture; 3102 - Kitchen furniture; 3103 - Other furniture;

[b] p-values reported in parenthesis.

6 Conclusion

The French woodworking industries have experienced a significant decrease in the number of active firms, especially throughout the past ten years. One reason for this development is a very competitive trade environment, where foreign firms take more and more market shares (Koebel et al. (2016)). Since firms' degree of competivtivness is often linked to productivity (Hopenhayn (1992), Ericson and Pakes (1995)) we aim to study the French woodworking industries' evolution of aggregate productivity related to firm entry and exit. This is studied by the application of the method proposed by Melitz and Polanec (2015), where, for a given industry, the measure of aggregate productivity is decomposed into those parts contributed by surviving, entering and exiting firms. Furthermore, we study firms transition probabilities to move with respect to their productivity ranking between two points in time. In this framework we also study firms' probability to enter or exit into or from a given quartile of the probability distribution. Finally, we relate firm-level productivity to firm size measures. To empirically investigate these aspects we combine the French fiscal firm-level data sets FICUS (1994-2007) and FARE (2008-2016). We then estimate a value-added Cobb-Douglas production function (Wooldridge (2009)) for each considered 4-digit woodworking industry and recover firm-level productivity based on the production function estimates.

The DOPD productivity decomposition reveals that nearly all industries have considerably increased their aggregate productivity. Relative to 1995 the aggregate productivity has increased until 2016 in a range by about 70% (Kitchen furniture) and 207% (Other furniture), with only one industry that experienced a negative productivity growth, given by about -83% in 2016 relative to 1995. The productivity decomposition shows that for the most industries the largest part to the growth is contributed by those firms who survived until the reported waves (1998-2016, reporting each third wave). In particular, survivng firms increased the aggregate productivity by increasing their individual productivity (within-change). Instead, our results show that surviving firms' contribution through market share reallocations (between-change) is very low, indicating that among surviving firms' market shares hardly wander from low to higher productive firms. Similar results with respect to the strong contribution of within-change to aggregate productivity change were found in other studies (see Baily et al. (1992), Griliches and Regev (1995)), Melitz and Polanec (2015)). Furthermore, the group of entrants has generally contributed negatively to aggregate productivity growth. That is, the group of entrants has a lower level of aggregate compared to the group of survivors, which pulls down the aggregate productivity. The composition also shows that the group of exitors have contributed both negatively and positively, depending on the considered industry. Especially the manufacturing industries of wood and products of wood industries (those industries classified within the 2-digit industry 16*) have experienced a negative contribution by the group of exitors. For these cases this implies that the group of exitors have a higher productivity compared to the the group of survivors. I.e., the industry suffered from a loss of relatively productive firms, pulling down the aggregate productivity level. Instead, the manufacturing industries for furniture have experience a positive contribution by exitors, in these cases the industries have lost relatively unproductive firms, which in turn increases the total change in aggregate productivity.

The investigation of firms' mobility within the productivity distribution has shown that, given a firms survives, firms are sticky over time with respect to their productivity ranking. That is, high (low) productivity firms strongly tend to remain high (low) productivity firms. Beside stickiness, firm exit is very likely, where especially less productive firms are menaced by a higher probability to exit. Similarly, firms entry is most likely to occur for within lower quartiles of the productivity distribution. Generally, our results with respect to firms' transition, entry and exit probability with respect to their productivity ranking go in line findings presented in Foster et al. (2006). Lastly we also relate firm productivity to firm size and find that both variables are positively correlated. This implies that especially small and unproductive firms are exposed to a higher risk of exit.

The study can be refined and extended in various ways. First, with respect to Koebel et al. (2016), showing that an industry's aggregate productivity is positively related with its competitiveness, it would be interesting to investigate to which extend trading and nontrading woodworking industries have improved their aggregate productivity overtime, similar to Pavcnik (2002). Second, the use of value-added Cobb-Dougals production function is a restrictive representation of the production technology. It is likely that the Cobb-Douglas specification would be rejected against a more flexible production function. Furthermore, using a gross output production function might change the recovered firm-level productivity estimations considerably. See Gandhi et al. (forthcoming) for a comparison between productivity measures based on a value-added and gross output production function and De Monte (2020) for a similar empirical application using a translog gross output production function. Furthermore, beside the impact of firm entry and exit on and industry's aggregate such as productivity and or output, it is crucial to know more about reasons for firm exit. See for instance De Monte and Koebel (2020) for some theoretical foundations concerning firm dynamics in the framework of Cournot competition, where firms' efficiency in fixed and variable costs are considered with an empirical application based firm-level data of French manufacturing firms.

Appendix A Data

A1 Considered industries and number of observations

Table 8: Table A1: Description 2-Digit Manufacturing Industries

Industry	Description	# Firms	# Obs.
16	**Manufacture of wood, and products of wood and cork**		
1610	Sawmilling and planing of wood	4,501	38,831
1621	Manufacture of veener sheets and wood-based panels	258	2,265
1623	Manufacture of other builders' carpentry and joinery	3,982	27,175
1624	Manufacture of wooden containers	1,744	15,894
1629	Manufacture of other products of wood	2,012	14,235
17[a]	**Manufacture of pulp, paper, and paperboard**		
1711	Manufacture of pulp	16	130
1712	Manufacture of paper and paperboard	300	2,784
31	**Manufacture of furniture**		
3101	Manufacture of office and shop furniture	1,710	14,059
3102	Manufacture of kitchen furniture	1,539	11,192
3109	Manufacture of other furniture	11,310	73,578
Total		27,372	200,143

[a] By the reason of only less observations for industry 1711, we treat the industries 1711 and 1712 jointly.

Complementary to Table 1 from section 3, Table 10 shows the same summary statistics, however, not in terms of size groups but in terms of the considered 4-digit industries (column 1). Note that, all figures represent averages over all years. Table 10 shows that industry 3109 is the biggest in terms of number of firms, with a share of firms with respect to all industries given by 37.0%, followed by the sectors 1610 and 1623, with shares of number of firms given by 19% and 14%, respectively. The industries also vary in terms of firms' average ages, where firms belonging 1712 is shown to be the oldest industry with an average age of 22.2 years, whereas the youngest average firm age is measured for industry 1711, with 10.1 years. Average ages are also reflected in the survival, entry and exit rates of the various industries. For instance, the industries 1623 and 3109, revealing relatively low average firm ages also have lower survival rates and higher entry and exit rates compared to other (older) industries.

A2 Missing values

As already mentioned in Section 2 we drop firms with zero employees to establish consistency between the merged data bases FICUS and FARE. Additionally, if a firm reports missing values for the number employees after having already reported a non-zero value, we replace the missing-value by the most recent non-zero and non-missing value. Furthermore, for the estimation of the production function we only keep those firm observations that are non-missing and non-negative values in the dependent variable, i.e. value-added production, as well as in the explanatory variables (including those for the control function), i.e. capital and materials), which is necessary when estimating the log-linearized model of the production (see equation (2)). This implies that we only obtain for the kept firm observations productivity estimates (on which further analysis is carried out). Since we link firm productivity to entry and exit we check whether missing values are particularly linked to firms identified as entrants, survivors and exitors firms. Table 9 below shows the share of missing values for each (log) variables and with respect to each firm group. The shares are calculated over all industries and years. The first three rows in Table 9 show the share of missing values of the variables value-added production, capital, labor and intermediary product consumption within the group of entrants, exitors and survivors. It can be seen that within each group, entrants and exitors the shares of missing values are considerably higher for entrants and exitors compared to survivors. For the variable value-added production, for instance, within the firm groups of entrants and exitors the share of missing values is about 14%, whereas within the group of survivors the share is only at about 11 %. Similarly, for the variable capital within the group of entrants, exitors and survivors the share of missing values is given by about 6%, 12% and 1%. It can also be seen, that the share of missing values of the variable labor reduces to zero by first dropping firms with zero employees and second by replacing missing values by the most recent non-missing value. The forth and fifth row show the shares of observations according to each group when keeping and when dropping all rows containing missing values of the listed variables. It can be seen that keeping all observations i.e. with missing values, the share of entrants, exitors and survivors is given by about 8%, 9% and 71%. Once we drop all rows contain missing values, the corresponding shares slightly change to about 7%, 8% and 74%. The slight decrease in the share of observations of entrants and exitors comes from the fact that within these groups we find relatively more missing values compared to the group of survivors. Consequently, the share of survivors slightly increases when dropping missing values. This means, by the nature of our data entering and exiting firms are slightly underrepresented implying that effects related to these firm groups might be underestimated.[19]

Table 9: Shares of missing values

		Entrants	Exitors	Survivors
Share of missing values	y	14.78	14.58	11.54
	k	6.72	12.10	1.69
	l	0.00	0.00	0.00
	m	4.34	4.51	1.77
Share of observations	Share with NAs	8.13	9.66	71.53
	Share without NAs	7.54	8.49	74.21

Figures are expressed in %

A3 Further descriptive statistics

Table 10: Average statistics with respect to 4-digit industries

Industry	# of firms	Share of firms	# of employees	Share of employees	Age	Survival Rate	Entry Rate	Exit Rate
1610	1689	19.0	19498	14.0	18.1	78.1	6.1	6.6
1621	99	1.0	7069	5.0	21.1	81.2	5.2	5.5
1623	1182	14.0	18843	13.0	14.5	72.5	8.8	8.5
1624	692	8.0	13621	10.0	18.1	80.8	5.0	5.3
1629	619	7.0	6167	4.0	18.4	74.4	6.4	8.8
1711	6	0.0	1073	1.0	10.1	83.8	5.4	2.3
1712	122	1.0	19882	14.0	22.2	81.9	4.4	4.9
3101	612	7.0	16196	11.0	16.6	78.9	5.8	6.2
3102	487	6.0	9823	7.0	15.2	75.8	6.9	8.0
3109	3200	37.0	30108	21.0	14.5	69.7	9.2	10.8
Total	8708	100.0	142280	100.0	16.9	77.7	6.3	6.7

Table 11 illustrates for the considered 4-digit woodworking industries changes between 1994 and 2016 with respect to the number of firms and the (deflated) output level. It can be seen that except the industries 1623, 1711, and 3102, all industries have experienced a significant decrease in the number of firms. Particularly affected by this development are the industries 1629, and 3109, with a decrease in the number of firms of -55.0% and -61.6%, respectively. For the same industries we also observe a decrease in real gross output, by -22.3% and -43.2%, respectively. Many other industries, experiencing a decrease in the number of firms, however, increased in the production level over time.

[19]Note that the share of observations of entrants, exitors and survivors does not add up to 100%, since there are firms whose status can not be identified.

Table 11: Changes 1994 - 2016

Industry	# firms 1994	# firms 2016	Average growth rate	Total Change	Prod. 1994	Prod. 2019	Average growth rate	Total Change
1610	1569	1371	-0.6	-12.6	23300.5	32653.6	1.5	40.1
1621	96	67	-1.6	-30.2	14005.7	15054.1	0.3	7.5
1623	787	1280	2.1	62.6	17651.3	25021.5	1.5	41.8
1624	707	592	-0.8	-16.3	13311.0	21179.2	2.0	59.1
1629	809	364	-3.4	-55.0	7110.4	5523.1	-1.1	-22.3
1711	3	6	3.1	100.0	2764.6	6374.3	3.7	130.6
1712	133	94	-1.5	-29.3	54501.2	51688.8	-0.2	-5.2
3101	482	600	1.0	24.5	15670.0	20149.5	1.1	28.6
3102	395	416	0.2	5.3	9654.0	10931.7	0.5	13.2
3109	3674	1409	-4.1	-61.6	32411.3	18407.5	-2.4	-43.2
Total	8655	6199	-1.4	-28.4	190380.1	206983.2	0.4	8.7

In Figure 1 we have seen the overall evolution of the number of firms with the yearly entry and exit rates. The figure shows a dramatic decrease in the number of firms for the year 2015, which is recovered again in 2016. Table 12 provides some insights into this uncharacteristic decrease. The table shows the number of firms for all years by keeping also firms with zero employees (which are dropped for the analysis presented in the main text). The table furthermore reports the number of firms with zero and one employee as well the number of firms with zero employees in $t-1$ and one employee in t and vice versa (last two columns). It can be seen that in 2015 there were 604 firms with zero employees that had reported one employee in 2014. In 2016, these firms seem to report again one employee as we observe 814 firms reporting one employee in 2016 while having reported zero employees in 2015. For this reason we observe extraordinarily many exits in 2015 and a relatively high rate of entry for 2016. Table 12 reports the number of firms with zero and one employee.

Table 12: Firms dynamics of firms reporting one and zero employee.

Year (t)	# of firms	# of firms with zero employees	# of firms with one employee	# of firms with zero employee in t-1 and one in t	# of firms with one employee in t-1 and zero in t
1994	18447	7257	2886		
1995	18988	7566	2926	444	420
1996	20390	7922	3217	601	400
1997	20557	8168	3223	419	429
1998	20645	8561	2987	413	646
1999	20701	8703	2921	548	611
2000	20169	7865	3188	791	268
2001	19727	7656	3042	428	406
2002	20465	8175	3162	395	480
2003	20289	8171	3247	462	437
2004	20395	8310	3254	498	483
2005	19006	7685	2983	444	493
2006	20070	8265	3157	429	386
2007	19840	8024	3251	458	276
2008	24146	11899	3092	350	778
2009	22277	11925	2156	317	944
2010	22993	12363	1978	241	400
2011	22634	12487	1843	185	337
2012	22581	12605	1679	202	320
2013	23261	13539	1482	193	347
2014	24778	14759	1565	214	271
2015	21556	15400	1091	182	604
2016	22161	14394	2072	814	107

Appendix B Productivity dispersion

Table 13 shows for the considered 4-digit industries average productivity ratios of the 90/10, 95/5, and 99/1 percentile ratios. As the table illustrates, productivity dispersion varies substantially between the different industries. More precisely, it can be seen that the industry 1711/12 exhibits the by fare highest productivity dispersion. Here the 90/10, 95/5, and 99/1 percentile ratio is given 19, 47.7 and 277.3. This implies, that a firm at the 90th percentile (of the distribution of productivity) produces 19 times as much as a firm at the 10th percentile, with the same amount of inputs. Other industries, such as 3101 show a much lower degree of productivity dispersion, given by 5.2, 9.2, and 38.8, for the 90/10, 95/5, and 99/1 percentile ratio, respectively.

Table 13: Productivity percentile ratios

		Industry[a]								
Ratio	All	1610	1621	1623	1624	1629	1711/12	3101	3102	3109
90/10	10.0	5.3	9.8	8.0	5.4	7.4	19.0	5.2	6.2	11.3
95/5	20.3	9.7	20.5	15.6	9.6	15.8	40.7	9.2	12.8	23.1
99/1	109.4	60.8	126.3	64.0	46.3	90.8	277.3	38.8	73.7	147.7

[a] Industry description: 1610 - Sawmilling/wood planing; 1621 - Veener sheets/wood-based panels; 1623 - Other builders' carpentry/joinery; 1624 - Wooden containers; 1629 - Other wood/products; 1711/12 pulp and paper; 3101 - Office and shop furniture; 3102 - Kitchen furniture; 3103 - Other furniture;

Appendix C Productivity decomposition (DOPD)

We present here the DOPD productivity decomposition with the base year 2007 (whereas in the main text, the initial year is 1995) and the corresponding growth rates for waves 2010, 2013, 2016. Results are presented in Table 14.

Furthermore, Table 15 provides the corresponding aggregate productivity measure of the base year composed of survivors and exitors. And 16 the aggregate productivity measure of the considered waves, composed of the aggregate productivity of surviving and entering firms. Table 14 illustrates that in 2016, the aggregate productivity has increased for all industries except one. More precisely, the total change in 2016 relative to 2007 is given by 36.01% (Sawmilling), -34.32% ("veneer sheets/wood-based panels), 54.67% (Other builders carpentry/joinery), 45.75% (Wooden containers), 75.55% (Other wood products), 24.56% (pulp and paper), 17.31% (office/shop furniture), 21.57% (kitchen furniture) and 77.58% (other furniture). Considering the contribution of surviving firms we can see that the by fare largest part of the contribution is due to individual firms productivity improvement (within change) and only a negligible amount is contributed by market share shifts (between change). Generally the contribution of entering and exiting firms is smaller compared to the contribution of surviving firms. We measure for almost all years and industries a negative contribution of entering firms with respect to the aggregate productivity in 2007. That is, in these cases the aggregate productivity of entering firms is smaller compared to the aggregate productivity of surviving firms, which decreases the total change in aggregate productivity. Table 16 shows the corresponding differences in the aggregate productivity of the group of survivors and entrants, measured for the respective wave (t_2). Instead, relative to 2007, our results reveal a positive contribution of exiting firms for all years and industries. This is different to what we have measured for some industries (especially the industries for wood and wood products) when the base year was set to 1995. This means, the aggregate productivity of those firms that exit after 2007 was lower in 2007 compared to the aggregate productivity of surviving firms, leading to a positive contribution to aggregate productivity of exiting firms. This indicates that the economic distributions from 2007 on mainly affected firms with lower level of productivity, compared to those firms that survived. Also note Table 15 showing the differences between survivors and exitors, measured for the base year in 2007 (t_1). It can be seen that the difference in aggregate productivity is only favorable to the group of surviving firms.

Table 14: Aggregate Productivity Decomposition (DOPD): 2007 - 2016[a]

Industry	Year	Contr. Survivors		Contr. Entrants	Contr. Exitors	Total Change[b]	Industry	Year	Contr. Survivors		Contr. Entrants	Contr. Exitors	Total Change[b]
		Within	Between						Within	Between			
1610	2010	13.04	0.000	-3.26	0.96	10.74	1700	2010	7.23	0.216	-3.24	1.85	6.06
Sawmilling/	2013	17.15	0.012	-3.02	3.73	17.87	Pulp and	2013	25.55	-0.090	-2.88	5.07	27.65
wood planning	2016	30.96	0.019	-0.76	5.79	36.01	paper	2016	16.91	-0.235	4.38	3.51	24.56
1621	2010	-27.57	0.046	-4.67	4.21	-27.98	3101	2010	-1.18	-0.016	-0.76	2.25	0.29
Veener sheets	2013	-48.61	0.299	-2.83	9.90	-41.24	Office/shop	2013	2.37	-0.006	-2.11	3.50	3.75
wood-based	2016	-50.10	0.576	-2.87	18.07	-34.32	furniture	2016	10.41	-0.041	-0.28	7.22	17.31
1623	2010	18.84	-0.015	-2.53	3.37	19.67	3102	2010	2.08	0.040	-0.39	4.91	6.64
Other builders'	2013	29.93	-0.017	-0.39	6.50	36.02	Kitchen	2013	5.38	0.199	-4.21	11.22	12.59
carpentry/joinery	2016	39.71	-0.011	2.70	12.27	54.67	furniture	2016	12.94	0.322	-7.56	15.87	21.57
1624	2010	14.29	-0.004	-1.95	2.38	14.72	3103	2010	21.69	0.006	-1.40	9.69	29.99
Wooden	2013	25.81	-0.006	-0.78	4.35	29.37	Other	2013	42.98	0.017	3.32	8.64	54.96
containers	2016	41.69	-0.014	-2.51	6.58	45.75	furniture	2016	61.17	0.039	1.04	15.33	77.58
1629	2010	19.26	0.007	0.68	2.82	22.77	All	2010	7.52	0.031	-1.95	3.60	9.21
Other wood	2013	27.06	0.110	-3.15	8.44	32.46		2013	14.18	0.058	-1.78	6.82	19.27
products	2016	41.89	0.076	24.03	9.55	75.55		2016	22.84	0.081	2.02	10.47	35.41

[a] All contributions represent growth rates in % relative to 2007.
[b] The total change in aggregate productivity is the sum of the contributions of survivors, entrants and exitors.

Table 15: Productivity Decomposition in the base year 2007 (t_1): survivors and exitors

Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_X^b	$S_X^{c,d}$	Ω_1^e	# Surv.	# Exits	Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_X^b	$S_X^{c,d}$	Ω_1^e	# Surv.	# Exits
1610	2007	2010	0.38	86.17	0.31	13.83	0.37	1265	429	1700	2007	2010	1.01	86.51	0.87	13.49	0.99	91	24
Sawmilling/	2007	2013	0.41	78.66	0.23	21.34	0.37	1021	643	Pulp and	2007	2013	1.14	83.21	0.84	16.79	1.09	78	36
wood planning	2007	2016	0.44	74.48	0.21	25.52	0.38	873	742	paper	2007	2016	1.12	74.84	0.98	25.16	1.09	66	43
1621	2007	2010	1.63	87.41	1.30	12.59	1.59	70	19	3101	2007	2010	0.69	90.83	0.45	9.17	0.67	480	116
Veener sheets	2007	2013	1.70	79.63	1.22	20.37	1.60	58	29	Office/shop	2007	2013	0.70	80.27	0.53	19.73	0.67	395	189
wood-based	2007	2016	1.78	70.83	1.16	29.17	1.60	43	35	furniture	2007	2016	0.74	71.47	0.49	28.53	0.67	313	254
1623	2007	2010	0.64	91.34	0.25	8.66	0.60	947	348	3102	2007	2010	1.34	82.77	1.05	17.23	1.29	338	170
Other builders'	2007	2013	0.67	81.25	0.32	18.75	0.61	665	595	Kitchen	2007	2013	1.41	69.87	1.04	30.13	1.30	233	254
carpentry/joinery	2007	2016	0.72	71.44	0.29	28.56	0.60	546	703	furniture	2007	2016	1.46	59.07	1.08	40.93	1.31	190	285
1624	2007	2010	0.19	91.61	-0.09	8.39	0.17	511	119	3103	2007	2010	0.86	77.20	0.43	22.80	0.76	1553	1699
Wooden	2007	2013	0.21	85.19	-0.08	14.81	0.17	437	183	Other	2007	2013	0.85	61.83	0.62	38.17	0.76	943	2169
containers	2007	2016	0.25	81.24	-0.10	18.76	0.18	391	219	furniture	2007	2016	0.94	51.30	0.63	48.70	0.79	659	2391
1629	2007	2010	0.58	81.11	0.43	18.89	0.55	341	201	All	2007	2010	0.81	86.11	0.56	13.89	0.78	621	347
Other wood	2007	2013	0.66	65.64	0.41	34.36	0.57	237	289		2007	2013	0.86	76.17	0.57	23.83	0.79	451	487
products	2007	2016	0.65	53.39	0.44	46.61	0.55	169	328		2007	2016	0.90	67.56	0.58	32.44	0.80	361	555

[a] According to equation (21) this table reports measures of aggregate productivity and market shares for the group of surviving and exiting firms. The measures are always (and only) for the initial year 2007.

[b] The columns Ω_S and Ω_X denote the aggregate productivity of the firm groups survivors and exitors, respectively.

[c] The columns S_S and S_X denote the aggregated market shares of the firm groups survivors and exitors, respectively.

[d] S_S and S_X are given in %.

[e] Columns Ω_1 denotes the aggregate productivity for the initial year 2007.

Table 16: Productivity decomposition in t_2: survivors and entrants[a]

Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_E^b	$S_E^{c,d}$	Ω_2^e	# Surv.	# Entr.	Industry	t_1	t_2	Ω_S^b	$S_S^{c,d}$	Ω_E^b	$S_E^{c,d}$	Ω_2^e	# Surv.	# no Entr.
1610	2007	2010	0.54	87.14	0.29	12.86	0.51	1265	264	1700	2007	2010	1.14	93.33	0.65	6.67	1.10	91	11
Sawmilling/	2007	2013	0.70	83.70	0.52	16.30	0.67	1021	317	Pulp and	2007	2013	1.20	93.66	0.75	6.34	1.17	78	13
wood planning	2007	2016	0.95	80.84	0.91	19.16	0.95	873	259	paper	2007	2016	1.01	78.77	1.21	21.23	1.05	66	17
1621	2007	2010	1.32	94.22	0.51	5.78	1.28	70	18	3101	2007	2010	0.64	95.34	0.48	4.66	0.63	480	54
Veener sheets	2007	2013	1.23	97.60	0.05	2.40	1.20	58	13	Office/shop	2007	2013	0.70	91.91	0.44	8.09	0.68	395	82
wood-based	2007	2016	1.27	89.29	1.00	10.71	1.24	43	11	furniture	2007	2016	0.61	90.39	0.58	9.61	0.61	313	72
1623	2007	2010	0.71	89.17	0.47	10.83	0.68	947	345	3102	2007	2010	1.33	94.09	1.26	5.91	1.32	338	50
Other builders'	2007	2013	0.84	81.78	0.82	18.22	0.84	665	379	Kitchen	2007	2013	1.72	90.99	1.25	9.01	1.68	233	63
carpentry/joinery	2007	2016	0.99	77.69	1.12	22.31	1.02	546	316	furniture	2007	2016	1.99	87.07	1.40	12.93	1.91	190	56
1624	2007	2010	0.30	94.25	-0.03	5.75	0.28	511	64	3103	2007	2010	1.01	88.19	0.90	11.81	1.00	1553	411
Wooden	2007	2013	0.47	85.13	0.41	14.87	0.46	437	97	Other	2007	2013	1.22	80.50	1.39	19.50	1.25	943	424
containers	2007	2016	0.60	84.38	0.44	15.62	0.57	391	93	furniture	2007	2016	1.50	80.62	1.56	19.38	1.51	659	325
1629	2007	2010	0.76	90.92	0.83	9.08	0.76	341	65	All	2007	2010	0.86	91.85	0.60	8.15	0.84	621	142
Other wood	2007	2013	1.12	89.64	0.82	10.36	1.09	237	94		2007	2013	1.02	88.32	0.72	11.68	1.00	451	164
products	2007	2016	1.18	65.36	1.88	34.64	1.42	169	78		2007	2016	1.12	81.60	1.12	18.40	1.14	361	136

[a] According to equation (22) this table reports measures of aggregate productivity and market shares for the group of surviving and entering firms. The values always represent measures concerning the second time period t_2.

[b] The columns Ω_S and Ω_E denote the aggregate productivity of the firm groups survivors and entrants, respectively.

[c] The columns S_S and S_E denote the aggregated market shares of the firm groups survivors and entrants, respectively.

[d] S_S and S_E are given in %.

[e] Column Ω_2 denotes the aggregate productivity for the second time period t_2.

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