Productivity-Enhancing Reallocation and Capital Structure of Downstream Markets - Empirical Evidence from the European Sugar Market

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This article is concerned with the measurement of productivity and profitability in sugar beet farming. Following the 2006 announcement to abolish the EU sugar quota in 2017, a reallocation of beet production has been observed. We empirically test to what extent the reallocation contributed to productivity growth in the sector using German farm accountancy data. We find that the importance of productivity differences across farms in determining resource allocation is low, but the relative importance compared to profitability differences has been increased after the announcement. The results further indicate that reallocation is hampered by the capital structure of the sugar factories: the contribution of resource reallocation towards sector productivity growth is larger in catchment areas of private sugar companies compared to companies that are owned by farmers who hold secure delivery rights.

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1 Introduction

The abolishment of the sugar quota in 2017 is expected to have major effects on the sugar sector in the EU. As the industry will be allowed to produce unlimited amounts of sugar and increase exports, the demand for sugar beets will increase at least in the short-term. On the other hand, domestic sugar prices are increasingly linked to the world market prices, which have been far below the EU sugar price in past years (see figure 1). In the long term, a particular threat for the EU sugar beet industry comes from the possibility to import an unlimited amount of cane sugar and the use of High-fructose corn syrup (HFCS) as sugar substitute. HFCS is said to have manufacturing advantages over sugar (White, 2009). (Buysse et al., 2007)

The complexity of short term and long term consequences of the abolishment of the sugar quota rises the question how EU sugar beet growers respond to the new market situation. In general, market liberalization "aims at increasing competition and shifting production away from low- and towards high-productivity businesses" (Eslava et al., 2004) Frick and Sauer (2017) shows how the abolishment of the EU dairy quota in 2004 has increased productivity in the German dairy sector. To the best of our knowledge, no such evidence is yet available for the case of sugar farming. In this context, various articles have been dealing with predicting changes in sugar production, price, and trade patterns after the abolishment of the sugar quota. For example, Nolte, Buysse, and van Huylenbroeck (2011) predict an increase of 2.2 million tons by 2019/20 with ten EU member states increasing and nine reducing sugar production. Our article contributes to the literature in three ways: First, we focus on the adjustment of sugar beet production following the sugar reform in 2006 when the abolishment in 2017 has been announced. It is claimed that as a response to this announcement, beet production in the EU has already been reduced and shifted towards the most competitive regions (BMEL). As discussed in Bureau et al. (1997) and Gohin (2006), conditions and marginal costs of sugar production are very heterogeneous across farms, regions, and countries. Therefore, there is a high potential of sector productivity growth through resource reallocation. Second, we measure the relative importance of farm-level productivity and profitability on resource allocation between farms. Third, we distinguish regions with different capital structures of the sugar factories. In Germany, there are three major sugar companies which run the factories. In southern Germany, the dominating company is corporate limited by share ownership (*Aktiengesellschaft*). The main shareholder is a farmers' cooperative. In exchange for their capital contribution to the sugar company, the farmers hold delivery rights which are not freely tradable. In the other hand, the sugar company dominating in western Germany is a *GmbH & Co. KG*, a limited partnership business entity. Thus, competition among farmers is higher and a shift of resources more likely in western Germany compared to the South. The business model of the third major sugar company, running sugar factories in northern Germany, is a hybrid of the former two.

In the following section, we provide a summary of historical developments in EU sugar policies. We then proceed to describe the link between productivity and profitability and the measurement of resource reallocation. In section 4, we describe the data before the results are presented in section 5. Concluding remarks are given in sections 6.

2 Sugar Policy in the European Union

The EU's common market organization (CMO) for the sugar sector was introduced in 1968 to improve food self-sufficiency as one of the five original objectives of the CAP[1]. Along with a sugar quota system, support prices for producers were set at a level significantly higher than the world market price. Each member state was endowed with supply quotas that have been distributed across sugar factories. The

[1] Council regulations No 1009/67EEC

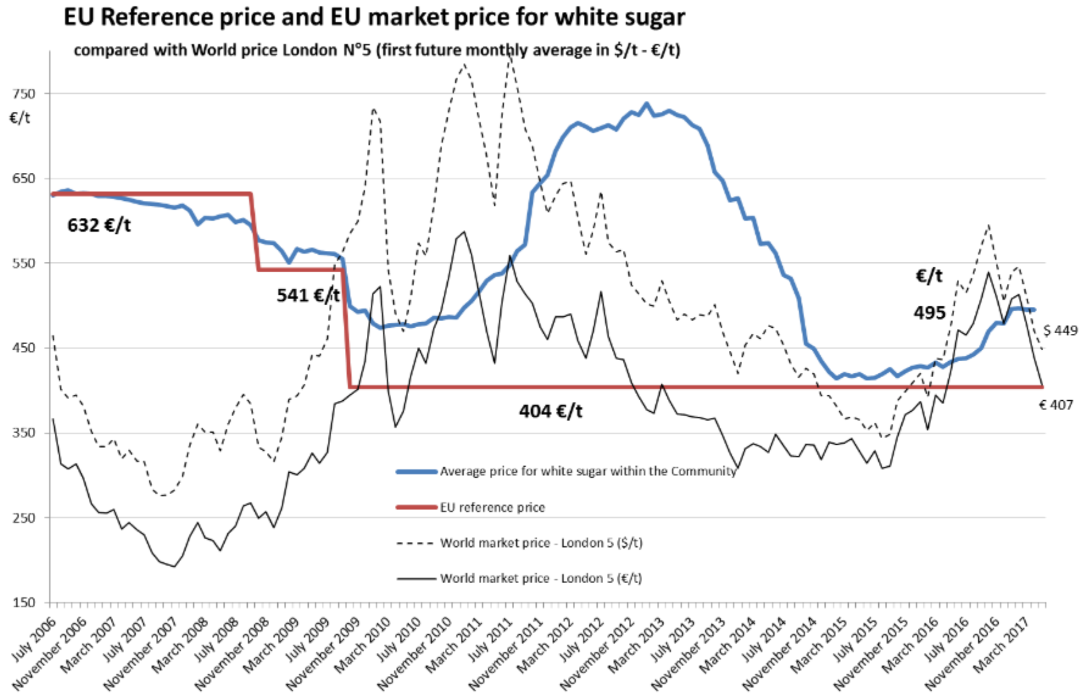

Figure 1: EU Reference price and EU market price for white sugar compared with World price London N.5; Source: Committee for the Common Organisation of Agricultural Markets, 29 June 2017

factories, in turn, issued delivery rights to beet growers, guaranteeing a minimum price for A- and B-quota beets. Out-of-quota sugar could be exported or carried over to the following year. In 1992, with the introduction of decoupled of direct payments to farmers, the support price for sugar has been significantly reduced, and as a result of the decoupling of direct payments in 2003, the payments were not longer linked to the quantity of sugar produced. With the exception of these major CAP reforms, the sugar policy remained mostly unchanged until the reform in 2006. The main changes introduced by the 2006 reform are the replacement of public intervention storage, limits on out-of-quota sugar exports, and the conflation of A- and B-quota. Furthermore, the minimum price for white sugar has been gradually reduced (see figure 1). While in 2006 the sugar price in the EU was almost twice as high as the world market price, the EU prices have dropped following the 2006 reform, but recovered after an increase of the world market price. Finally, the EU and world market sugar prices are increasingly linked to each other. Simultaneously, the minimum price for A- and B-beets of €46.72/t and €32.42/t, respectively, have been reduced by 20 %. While tariff rates were maintained in the 2006 reform, sugar exports have been limited to 1.374 million tons to meet WTO regulations. In addition to these immediate changes in the CMO for sugar, further decisions were taken for the period starting 2017. These include the abolishment of the quantitative supply restrictions, institutional and minimum prices, and export restrictions. (Burrell et al., 2014)

The described policies with the varying scale of quotas, price levels, and export restrictions, largely shaped the sugar beet production on farms in the EU. From 2000 to 2016, the area planted with sugar beets in the EU dropped by 33 % from 2818 to 1892 ha, while production decreased only by 14 % from 156000 to 134000 (see figure 2). This implies a considerable increase in productivity, which can be decomposed into farm-level productivity growth (”within growth”) and growth due to a shift of production from less to more productive farms (”between growth”). If reallocation is based on factors other than productivity differences, resource allocation is not efficient. Thus, we compute both productivity and profitability measures in the following.

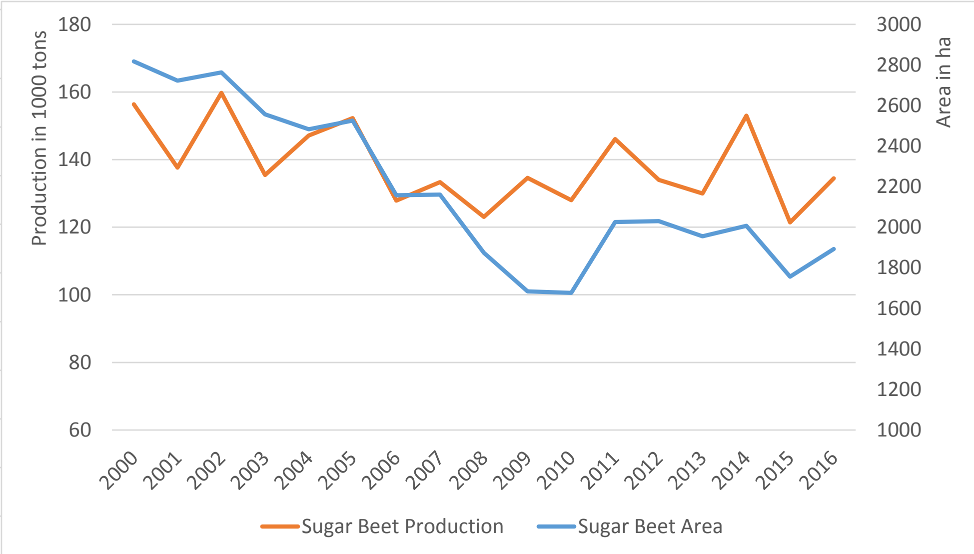

Figure 2: Sugar beet production and area, 2000 - 2016

3 Productivity and Profitability

The theoretical link between productivity and profitability is illustrated in figure 3. The slope from the origin through the production point of firm indicates productivity. Maximum profitability is given when the iso-profit line $y = \frac{\pi_{it}}{p_{it}} + \frac{w}{p}x$ is tangent to the production frontier. It can be easily seen that higher productivity does not necessarily lead to increased profit with this particular production technology. For example, decision-making unit A is more productive than unit B, but B generates more profit. On the other hand, firm C is both less productive and less profitable than firm B. Allowing firms to be inefficient and prices to be different, the profit difference for firms A and B can be algebraically expressed as

$$
\begin{aligned}
\pi_A - \pi_B &= \Big(y_A \cdot p_A - x_A \cdot w_A\Big) - \Big(y_B \cdot p_B - x_B \cdot w_B\Big) \\
&= \Big(x_A \cdot \frac{y}{x}|_A \cdot p_A - x_A \cdot w_A\Big) - \Big(x_B \cdot \frac{y}{x}|_B \cdot p_B - x_B \cdot w_B\Big) \qquad (1) \\
&= \Big(x_A \cdot \frac{f(x)}{x}|_A \cdot e^{-u}|_A \cdot p_A - x_A \cdot w_A\Big) - \Big(x_B \cdot \frac{f(x)}{x}|_B \cdot e^{-u}|_B \cdot p_B - x_B \cdot w_B\Big) \\
\frac{\pi_A - \pi_B}{p_B} &= x_A\Big(TFP^0_A \cdot e^{-u}_A \cdot \frac{p_A}{p_B} - \frac{w_A}{p_B}\Big) - x_B\Big(TFP^0_B \cdot e^{-u}_B - \frac{w_B}{p_B}\Big) \\
&= \Big(x_A - x_B\Big)\Big(TFP^0_A \cdot e^{-u}_A \cdot \frac{p_A}{p_B} - \frac{w_A}{p_B}\Big) \\
&\qquad + x_B\Big(TFP^0_A \cdot e^{-u}_A - TFP^0_B \cdot e^{-u}_B - \frac{p_A - w_A - w_B}{p_B}\Big) ,
\end{aligned}
$$

where π is profit, y and x (p and w) are vectors of output and input quantities (prices), respectively, $f(x)$ denotes the level of maximal possible output vector y given the input x, and $e^{-u} \in [0;1]$ reflects inefficiency. Further, the subscripts A and B indicate two distinct firms and TFP^0 is total factor productivity at the production frontier. For simplicity, let us first assume that the price vectors are identical for both firms. Then, the last line of equation 1 reduces to

$$
\frac{\pi_A - \pi_B}{p_B} = \Big(x_A - x_B\Big)\Big(TFP^0_A \cdot e^{-u}_A - \frac{w}{p}\Big) + x_B\Big(TFP^0_A \cdot e^{-u}_A - TFP^0_B \cdot e^{-u}_B\Big) . \quad (2)
$$

From equation 2, it becomes clear that the difference in profitability depends on both the terms of trade (the inverse of w/p) and the difference in productivity as well as the technology. For example, let us consider the case of a concave production function where both firms are fully efficient and $x_A < x_B$. From concavity, it follows that firm A is more productive than firm B. If firms are maximizing profits, i.e. $TFP_A > w/p$, then the first term of equation 2 is negative and the second one is positive. Thus, depending on the productivity differences and the terms of trade, firm B can be more or less profitable than firm A, even though we know that firm A is more productive and the two firms face identical prices. Note that this is even the

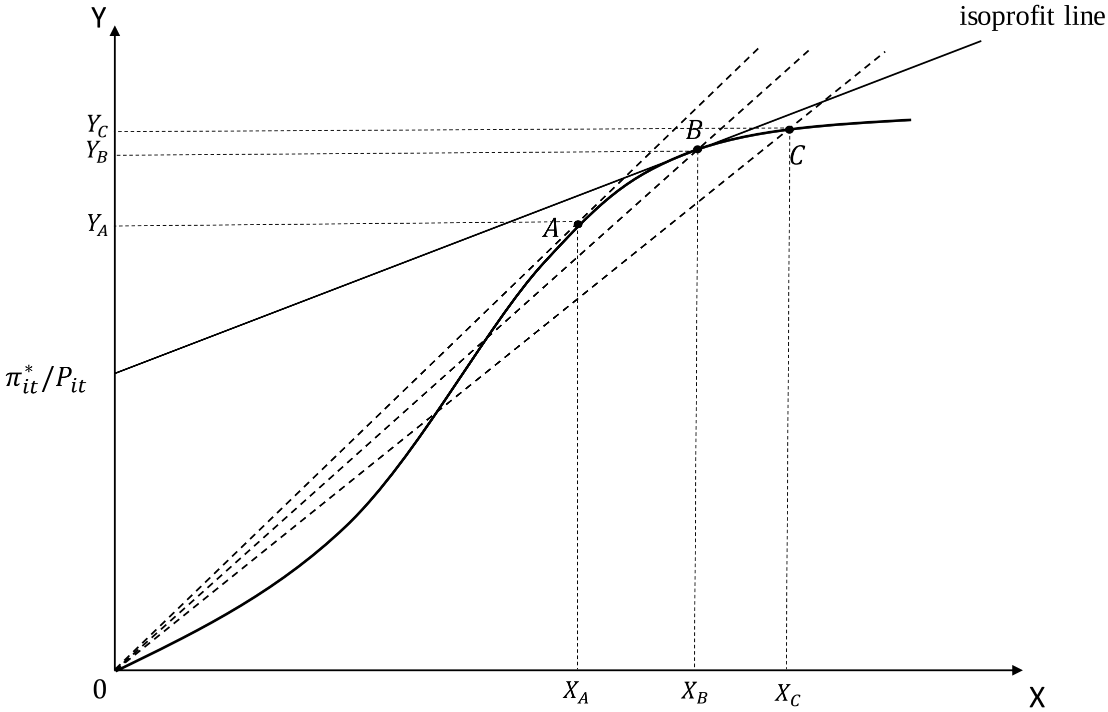

Figure 3: Productivity and profitability

case if $x_A < x_B$ and $TFP_A < TFP_B$, which is possible due to inefficiency.

3.1 Lowe Index

Total factor productivity can be measured in various ways. For example, if output of a firm is represented as a function of the firm's inputs and its productivity, the residual of this relationship is a measure of TFP (van Beveren, 2012). Alternatively, stochastic frontier analysis can be used to calculate a productivity growth index as the sum of technical change, changes in scale efficiency, and changes in technical efficiency. In this study, we use a non-parametric approach as it does not suffer from endogeneity problems and does not require specifying a functional form for the production technology. Specifically, we use the non-parametric Lowe index to aggregate total output and input quantities and to decompose profitability into total factor productivity and terms of trade. O'Donnell (2012). O'Donnell (2008) shows that in contrast to the commonly used Laspeyres, Paasche, Fisher and Törnqvist indexes and their EKS counterparts, the Lowe index satisfies all economically relevant axioms from index number theory including the transitivity and identity axioms. These two axioms guarantee that direct and indirect comparisons of two observations yield the same estimate of TFP change and that the TFP index takes the value one if outputs and inputs are unchanged between to observations, respectively. A profitability index that compares the profitability of firm A in period s with the profitability of firm B in period t is defined as

$$\begin{aligned} PROFI_{BtAs} &= \frac{PROF_{As}}{PROF_{Bt}} = \frac{P_{As}Q_{As}}{W_{As}X_{As}} \times \frac{W_{Bt}X_{Bt}}{P_{Bt}Q_{Bt}} \\ &= \frac{PI_{BtAs}}{WI_{BtAs}} \times \frac{QI_{BtAs}}{XI_{BtAs}} = TTI_{BtAs} \times TFPI_{BtAs} \ . \end{aligned} \tag{3}$$

Equation 3 shows that a profitability index can be decomposed in a productivity index and a index for terms of trade. If the index for terms of trade is identical between two observations (either one firm in two time periods or two firms in the same period or two firms in two time periods), then the entire profitability difference can be attributed to the difference in TFP, and vice versa. The Lowe index consists of the values of different baskets of goods evaluated at the same set of reference prices p_0 and w_0 (O'Donnell, 2012):

$$\begin{aligned} QI_{BtAs} &= \frac{Q(q_{As})}{Q(q_{Bt})} = \frac{p_0' q_{As}}{p_0' q_{Bt}} \\ XI_{BtAs} &= \frac{X(x_{As})}{X(x_{Bt})} = \frac{w_0' x_{As}}{w_0' x_{Bt}} \\ TFPI_{BtAs} &= \frac{QI_{BtAs}}{XI_{BtAs}} = \frac{p_0' q_{As}}{p_0' q_{Bt}} \times \frac{w_0' x_{As}}{w_0' x_{Bt}} \end{aligned} \tag{4}$$

O'Donnell (2012) emphasizes that reference price vectors p_0 and w_0 should be representative of the price vectors faced by all firms in the data set. In our empirical application, we chose the average prices over all farms and years. These Lowe quantity indexes are then used to measure the reallocation effect on productivity and profitability growth.

3.2 Resource Reallocation

To investigate the extent to which resource reallocation has contributed to changes in sector-level productivity, we use farm-level productivity measures to decompose sector-level productivity into various components (see, for example, Kimura and Sauer, 2015). Given the estimates of TFP index (TFP_{it}) and market share (s_{it}) of farm i at year t, sector level productivity TFP_t can be calculated as market share-weighted average of farm-level productivity:

$$\Phi_t = \sum_{n=1}^{N} \sigma_{it}\varphi_{it} = \overline{\varphi}_t + \sum_{n=1}^{N} \big(\sigma_{it} - \overline{\sigma}_t\big)\big(\varphi_{it} - \overline{\varphi}_t\big) \tag{5}$$

If there is no correlation between productivity and market share, the second term of equation 5 is zero and sector level productivity is equal to the unweighted average firm level productivity. If more productive farms have a higher market share than less productive farms, than the sector level productivity exceeds the unweighted average. In addition to this static measure, which does not take into account the effect of farm entry and exit, we compute a dynamic version of this Olley-Pakes productivity decomposition following (Melitz and Polanec, 2015). This is particularly interesting in our empirical case, as some farms did not only reduce sugar beet production after the reform in 2006 but entirely removed sugar beets from their portfolio. The dynamic decomposition is defined by

$$
\begin{aligned}
\frac{\Phi_t - \Phi_s}{\overline{\Phi}_{st}} &= \frac{\Phi_{cont,t} - \Phi_{cont,s}}{\overline{\Phi}_{st}} + s_{entry,t}\frac{\Phi_{entry,t} - \Phi_{cont,t}}{\overline{\Phi}_{st}} + s_{exit,s}\frac{\Phi_{cont,s} - \Phi_{exit,s}}{\overline{\Phi}_{st}} \\
&= \frac{1}{1-\overline{\widetilde{cov}}_{cont}}\frac{\overline{\Phi}_{cont}}{\overline{\Phi}_{st}}\left(\frac{\overline{\varphi}_{cont,t} - \overline{\varphi}_{cont,s}}{\overline{\Phi}_{cont,st}} + \widetilde{cov}_{cont,t} - \widetilde{cov}_{cont,s}\right) \\
&\quad + s_{entry,t}\frac{\Phi_{entry,t} - \Phi_{cont,t}}{\overline{\Phi}_{st}} + s_{exit,s}\frac{\Phi_{cont,s} - \Phi_{exit,s}}{\overline{\Phi}_{st}}\ ,
\end{aligned} \tag{6}
$$

where S denotes survival farms, E are entry farms, and X are exit farms.

4 Data Description

In our analysis, we use farm accountancy data for Germany covering the years 2004 to 2013 obtained from the EU Farm Accounting Data Network (FADN). The FADN is a harmonized survey carried out by each Member State of the European Union, which is representative of commercial agricultural holdings due to stratification according to region, type of specialization and economic size. Since the sample is organized as a rotating panel, it does not allow determining whether a farm exists the survey because it exits the business or for some other reasons. Thus, we also do not know if an exiting farm exits sugar production or not. Similarly, we do not know whether a farm that produces sugar beet in its the first sample appearance entries sugar production or not. Thus, we chose a conservative estimation and do not treat them as entrants and exits. To incorporate them in the productivity change measure, we assign the regional average sample mean productivity to them in years they do not appear in the dataset. After restricting the sample to farms that produce sugar beets at least once during the period of the study, the sample consists of 9803 observations and 2050 farms. On average, a farm remains in the sample for 6.63 years (For 3.42 % of the farms, only one observation is available. At least 5 years are available for 76,5 %, and 18.0 % remain in the sample for the entire study period of 10 years).

With regard to sugar beet production, 86.2 % of the farms produce beets in each year they appear in the sample, 11.6 % cancel beet production and 4.1 % start beet production [2].

To picture geographic patterns of sugar beet production over the years, we computed sugar beet production shares on the nuts3 level (municipalities). Figure 4 visualizes the concentration of sugar beet production in Germany over the years 2004, 2007, 2010, and 2013. It can be seen that sugar beet production slightly moved from the southwest of Germany to the northeast over this period of time. Additionally, we conducted a Moran's I test for spatial autocorrelation for each year. The Moran's I is defined as

$$I = \frac{N}{W} \frac{\sum_i \sum_j w_{ij} \left(x_i - \bar{x}\right) \left(x_j - \bar{x}\right)}{\sum_i \left(x_i - \bar{x}\right)^2} \,, \tag{7}$$

where N is the number of nuts3 regions indexed by i and j, x is the share of beet production, w is a matrix of spatial weights with zeroes in the diagonal, and W is the sum of all w_{ij}. Thus, the Moran's I value varies between -1 and 1, representing maximum negative and positive autocorrelation. If sugar beet production is randomly distributed over space, the Moran's I takes the value 0. In our case, the Moran's I varies between 0.042 and 0.058 over the years and is statistically different from zero at the 1 % significance level. Thus, the null hypothesis that there is no spatial concentration present in the share of sugar beet production is rejected. Moreover, we observe a negative trend of the Moran's I between 2004 and 2009, followed by an increasing trend between 2009 and 2014. Thus, the spatial concentration of sugar beet production has indeed been increasing few years after the announcement of the quota abolishment.

To analyze productivity and profitability for sugar beet production, we distinguish five inputs and their respective price indices: land, labor, capital, intermediate

[2] The shares add up to a little more than 100 because some farms cancel and start again or vice versa during the study period.

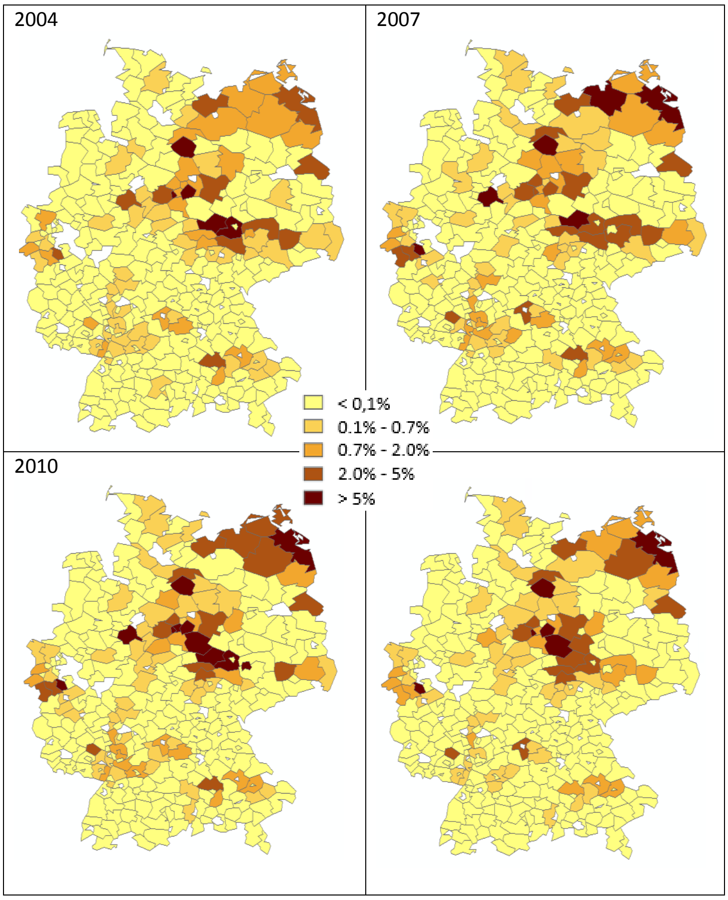

Figure 4: Share of sugar beet production on the nuts3 level

inputs, and crop-specific inputs. Land is measured in hectares and labor is measured in annual working hours, including both paid and unpaid labor. Capital is the capital stock at the end of the booking year. Intermediate inputs (fuel, electricity, contract work, insurance, and other farming overheads) and crop-specific inputs (seed, fertilizer, and pesticides) are measured in costs. To obtain implicit quantities, we divide these costs by price indices which were computed using weighted average costs shares. The price for land is calculated from regional average land rental prices. Analogously, the price for labor is computed as regional average wage for hired workers. Both the land rental price and the paid wages can be calculated from the data set. Following Henry de Frahan et al. (2011), the farm level price for capital is calculated as the sum of the rental price of acquisition, measured by dividing the financial expenses by the debt, and the rate of depreciation obtained by dividing the depreciation by the initial value of capital.

One major data issue has to be resolved before proceeding to measuring productivity and profitability of sugar beet farming. With the exception of land, input use is not reported separately for each crop but aggregated over all outputs and there are no highly specialized beet farms in the data set (naturally, the share of sugar beet production rarely exceeds 30 % at the farm level). We thus follow Just et al. (1990) to allocate inputs the individual farm outputs. This approach is based on the assumption that farmers behave as if their production functions have constant returns to scale so that their decisions consist of the variable input/land ratios and land allocations. [3] Thus, the total use of input j can be expressed by

$$X_{jit} = \sum_{k=1}^{K} [\alpha_{kj} + \beta_{ji} + \gamma_{jt}] L_{kit} + \epsilon_{jit} \ , \tag{8}$$

where α_{kj} denotes the regional average use of input j for producing the k^{th} output, β_{ji} is the i^{th} farm's deviation thereof, and γ_{jt} captures the time effect. Further, L_{kit} is the land used to produce output k by farm i in year t. The error term ϵ_{jit} is assumed to be independent and identically distributed. The estimated allocation of input j to crop k is then defined by

$$\hat{X}_{kjit} = [\hat{\alpha}_{kj} + \hat{\beta}_{ji} + \hat{\gamma}_{jt}] L_{kit} \ . \tag{9}$$

To allocate inputs, equation (8) was estimated with a simple OLS regression model as the hypothesis of a heteroscedastic error term was rejected. The coefficients for the

[3] More recently, this approach has been applied by Serra et al. (2009). Articles that have no information on output-allocation of some fixed inputs use either the total number of products (de Loecker, 2011) or revenue shares (Foster, Haltiwanger, and Syverson, 2008; Collard-Wexler and de Loecker, 2015) to allocate inputs. The latter assumes the mark-up of different outputs to be equal, which is not an appropriate assumption in sugar beet farming because of the quota.

Table 1: Input Allocation per Hectare in Germany

	Sugar beet	Cereals	Other crops	Total
Labor (hours)	64.75	46.76	57.75	63.04
Capital (const. €)	4.49	2.49	2.88	3.1
Intermediates (const. €)	6.36	4.65	4.19	5.61
Crop-specifics (const. €)	8.77	4.95	4.96	5.61
Nr. of observations	5291	8775	7908	8902

average regional use and the time dummy variables were all statistically significant at the 1% significance level. The resulting input allocation from equation (9) for Germany are presented in table 1. Consistent with input use recommendations from extension services, more inputs are allocated towards sugar beets than towards cereals and other crops.

5 Results and Discussion

Using the farm-level predictions for crop-specific input use, we calculate and decompose the Lowe profitability index using the R package *productivity* Dakpo, Desjeux, and Latruffe (2017). The unweighted average of farm profitability and its components are presented in table 2. Over this time period, profitability in sugar beet growing was maximized in 2004. In 2013, the level of profitability is 15.4 % lower than in 2004. The least profitable year was in 2008. It is also seen that profitability change is largely driven by terms of trade: while productivity remains rather stable between 2004 and 2013, we observe a decrease in terms of trade between 2004 and 2009 at an average rate of 6.8 %, followed by an increase between 2009 and 2013 at an average rate of 5.4 %. These changes in terms of trade are consistent with the sugar price levels in the EU with a valley around 2008/09 and a peak in 2011 as discussed in section 1.

Table 2: Descriptive Statistics of Profitability, Terms of Trade, and TFP

Year	PROF	TT	TFP	TFP*	TFPE
2004	1.36 (0.38)	3.02 (1.15)	0.49 (0.15)	0.76 (0.18)	0.64 (0.14)
2005	1.31 (0.37)	2.69 (1.00)	0.52 (0.16)	0.79 (0.17)	0.66 (0.14)
2006	1.10 (0.32)	2.65 (1.16)	0.46 (0.16)	0.73 (0.18)	0.63 (0.16)
2007	0.94 (0.27)	2.24 (0.90)	0.47 (0.17)	0.76 (0.21)	0.61 (0.15)
2008	0.88 (0.26)	2.37 (4.02)	0.45 (0.19)	0.76 (0.24)	0.58 (0.16)
2009	0.98 (0.27)	2.09 (1.04)	0.51 (0.16)	0.78 (0.20)	0.66 (0.15)
2010	0.91 (0.31)	2.27 (0.87)	0.43 (0.15)	0.73 (0.20)	0.59 (0.14)
2011	1.24 (0.32)	2.83 (1.01)	0.47 (0.15)	0.74 (0.18)	0.63 (0.13)
2012	1.22 (0.31)	2.56 (0.80)	0.51 (0.15)	0.76 (0.17)	0.67 (0.14)
2013	1.15 (0.34)	2.51 (0.98)	0.50 (0.16)	0.77 (0.17)	0.65 (0.16)

5.1 Productivity, Productivity, and Resource Allocation

Sugar beet profitability at the farm level does not provide insights into changes in sector level profitability and productivity. We are particularly interested in the role of productivity and profitability in the allocation of activity. Thus, we present the Olley-Pakes decomposition of both the productivity measure and profitability measure in table 3. Several patterns can be observed in this table. First, sector productivity is mainly determined by farm productivity; the contribution of allocation towards sector productivity is almost neglectable. Second, this contribution remains relatively constant over time, implying that the announcement of quota abolishment or the stepwise reduction of the beet minimum price did not contribute towards a more efficient resource allocation. Third, the role of profitability in resource allocation had diminished over time: Contributing 5% and 6% in 2004 and 2005, it declined to less than 2% in 2013. Moreover, while profitability played a larger role in allocation of activity from 2004 to 2006, productivity was more important from 2007 to 2013 with one exception. This observation points towards a small but positive effect of the market liberalization on productivity-enhancing reallocation.

Figure 5 shows the contribution of resource reallocation to productivity growth calculated with equation 6 as well as farm profitability. It is seen that the effect of

Table 3: Decomposition of Sugar Beet TFP and Profitability

Year	TFP			PROF		
	Sector	Within	Between	Sector	Within	Between
2004	0.510	0.490	0.020	1.430	1.360	0.070
		(0.961)	(0.039)		(0.951)	(0.049)
2005	0.550	0.520	0.030	1.390	1.310	0.080
		(0.945)	(0.055)		(0.942)	(0.058)
2006	0.470	0.460	0.010	1.160	1.090	0.060
		(0.979)	(0.021)		(0.940)	(0.052)
2007	0.510	0.470	0.050	1.000	0.940	0.060
		(0.922)	(0.098)		(0.940)	(0.060)
2008	0.510	0.450	0.050	0.920	0.880	0.040
		(0.882)	(0.098)		(0.957)	(0.043)
2009	0.520	0.510	0.020	1.020	0.980	0.040
		(0.981)	(0.038)		(0.961)	(0.039)
2010	0.450	0.430	0.020	0.920	0.910	0.020
		(0.956)	(0.044)		(0.989)	(0.022)
2011	0.500	0.470	0.030	1.270	1.240	0.030
		(0.940)	(0.060)		(0.976)	(0.024)
2012	0.520	0.510	0.020	1.260	1.220	0.040
		(0.981)	(0.038)		(0.968)	(0.032)
2013	0.530	0.500	0.030	1.170	1.150	0.020
		(0.943)	(0.057)		(0.983)	(0.017)

entrants into sugar beet farming and exiters is relatively small, and that the exiters consistently are responsible for a growth in productivity while the entrants contribute to a decrease in productivity. This implies that farms that stop growing sugar beets do so because of reasons other than productivity disadvantages.

5.2 Factory's Capital Structure and Reallocation Efficiency

As discussed in the introduction, there are differences in the capital structure of Germany's major sugar companies. As a consequence, one could expect that resource allocation is more prevalent in the western part of the country than it is in the South.

Figure 5: Contribution of farm-level productivity growth and resource allocation to productivity

If this is true, and market deregulation aims at increasing sector productivity, then the business models of predominating companies in a sector deserve more attention in this context. To empirically analyze the potential effect of the capital structure on resource allocation, we calculated the Olley-Pakes decomposition of productivity separately for farms within catchment areas of the different sugar factories. The results for Western and Southern Germany are presented in table 4. On average, TFP growth is relatively similar between the two regions, and - as hypothesized - the between effect is slightly higher in Western Germany than in Southern Germany. The picture becomes clearer if the relative contribution of the within effect and the between effect towards sector productivity growth are evaluated over time: Before 2007, the importance of the between effect was slightly higher in Southern Germany, but from 2007 onwards it is considerably higher in Western Germany. These numbers indicate that resource allocation played a considerable role in productivity growth in sugar beet farming after the announcement of the quota abolishment especially in the catchment area of the limited partnership business entity. In the catchment area of the sugar company which is largely controlled by a farmers' cooperation, ressource reallocation plays a minor role.

Table 4: Decomposition of Productivity Growth by Region

	Southern Germany				Western Germany			
Year	TFP Growth	Within	Betw	% betw	TFP Growth	Within	Betw	% betw
2004	0.551	0.516	0.035	6.41%	0.571	0.553	0.018	3.10%
2005	0.535	0.511	0.024	4.50%	0.606	0.579	0.027	4.45%
2006	0.553	0.525	0.028	5.03%	0.500	0.495	0.004	0.88%
2007	0.525	0.471	0.054	10.34%	0.532	0.476	0.056	10.51%
2008	0.456	0.419	0.037	8.04%	0.629	0.555	0.075	11.86%
2009	0.566	0.557	0.009	1.67%	0.572	0.548	0.024	4.26%
2010	0.500	0.490	0.010	2.06%	0.488	0.457	0.031	6.34%
2011	0.534	0.514	0.020	3.73%	0.532	0.480	0.052	9.80%
2012	0.547	0.546	0.001	0.22%	0.529	0.513	0.016	3.02%
2013	0.566	0.545	0.021	3.74%	0.527	0.503	0.024	4.58%
Avg	0.533	0.509	0.024	4.57%	0.549	0.516	0.033	5.88%

6 Concluding Remarks

In this article, we measured productivity and profitability in sugar beet farming in Germany. The sector is particularly relevant in the context of the EU sugar quota abolishment in 2017. Considerable changes in the sector are expected from 2006 onwards when the abolishment was announced, as farms prepare to the changes in market conditions and the minimum beet price was stepwise reduced in 2008 and 2009. Using a Lowe profitability index, we find that the level of productivity remained relatively stable over the period of the study (2003 - 2013), and that changes in profitability were mainly driven by terms of trade. Further, the results show that the relative importance of productivity differences across farms in resource allocation increased compared to profitability differences from 2007 onwards, leading to a more efficient resource allocation from a technological perspective. Finally, we provide evidence that resource allocation is less efficient in the catchment areas of a sugar company that is controlled by a farmers' association. If policy aims to increase sector productivity, the policy measures should not only focus on market liberalization but also on the capital structure of downstream markets. The results are also evidence for the functioning of farmers' cooperatives, whose goal it is to provide advantages in competitive markets to their individual members.

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