REGIONAL ASYMMETRIES IN FARM SIZE[†]

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Abstract

This paper explores how the initial farm size structure affects the exit decision of farms inducing free land capacities, and the allocation of the newly available land resources to the remaining farms in a particular region. We model an agricultural market where large and small firms first decide whether to leave the market or not; in case of continuing in production the farms compete for getting access to additional land resources in a Vickrey auction. We find that larger farms allocate more additional quantity than small farms; the latter are more likely to leave the market. An empirical illustration gives further support and reveals the relation between farm size structure, farm exits and growth of the large.

Keywords: asymmetries, land market, capacity allocation, Vickrey auction

JEL codes: L11, L12, Q12

1 INTRODUCTION

Structural change in the agricultural sector has been a subject of ongoing interest (cf. among others Boehlje, 1999 or Goodard et al., 1993). Since basic food production being replaced by complex (bio-)technological production systems it is not surprising that the structure of primary production has altered: the number of farms has declined, whereas their average size has increased. This evolution results from farms' individual adaptation processes like growth and exit to changing prices, policy changes or technical progress (cf. among others Kimhi and Bollman, 1999 or Pietola et al., 2003). However, empirical evidence points to substantial differences in the regional farm size structure. In some regions farms are equally sized in terms of land endowment, while in other regions land is rather unequally distributed among the farms.[1] A frequently observed phenomenon thereby is the persistence of farms in a size category (Balmann, 1997; Boehlje, 1992). Consequently, regionally differing structures remain and allow for regionally different patterns of structural change (Harrington and Reinsel, 1995; Goetz and Debertin, 2001). For instance, Breustedt and Glauben (2007) identify higher exit rates for regions in Western Europe that are characterized by a high share of small and part-time farms. However, the regional specifity of structural change remains a puzzle for agricultural economists (Schmitt, 1992). The crucial question thereby is how do such regional asymmetries in the farm size structure measured in terms of land endowment arise and how can these be used to explain regionally differing patterns of structural change.

Most of the literature on structural change analyses either farm growth or exit.[2] However, it is common wisdom that a farm cannot grow unless other farms shrink or exit resulting in newly available land resources (e.g. Balmann et al., 2006). The immobility and shortage of this production factor causes a strong interdependence of farms within a region and affects farms' individual decision making like growth, decline or exit (Chavas, 2001). The interdependence of growth and exits is considered in Weiss (1999) as well as in Markov chain approaches (e.g. Zepeda, 1995 or Tonini and Jongeneel, 2007). Leathers (1992) directly considers the interaction in the land market. With his model he attempts to assess impacts of different farm programmes on the number of farms leaving the market, the land prices and the output prices. Land supply is assumed to be fixed and the free land from the exiting farms is traded among

[1] For instance, in the Western part of Germany there exist regions with a stable share of medium farms on the one hand, while on the other hand the phenomenon of a disappearing middle class has been detected (see also Weiss (1999) for empirical evidence of the disappearing middle class in Austria.). It has been further found that this phenomenon especially occurs in regions where land is initially distributed rather unequal among the farms (Margarian, 2007).

[2] Empirical studies about farm growth are often motivated by Gibrat's law (the size of a firm and its growth rate are independent) ignoring economic theory (e.g. Shapiro et al., 1987; Clark et al., 1992; Kostov et al., 2006; Bakusc and Fertö, 2007).

farmers. The farms differ in their initial endowment and their managerial ability determining the land market behaviour. He finds a direct effect of some farm programmes on the number of farms. For instance may price support or demand enhancement programmes cause an increase in land prices. Even though these may also lead to an increase in commodity prices the net effect may reduce the number of farms. In turn, Vranken and Swinnen (2006) focus on the development of land markets during the transition period. Analysing the competition of household owned farms with large-scaled corporate farms in Hungary, they find that the dominance of large corporate farms in some regions leads to a constraint access to land for (smaller) household farms. Huettel and Margarian (2009) show that strategic interaction – measured by market power of large farms, the potential of high competition for land within a region and possibly high rents of the status quo – is a crucial determinant of regionally differing patterns of structural change. Their findings give further evidence that initial (historic) conditions, such as the number and size of farms, lead to differing local equilibria in the land market characterized by differences in market power relations. As further emphasised by Kellermann et al. (2008), strategic interaction in the land market plays a crucial role for structural change in agriculture.

Combining theoretical and empirical approaches, we aim at determining how the initial farm structure affects both the exit decision of farms inducing free land capacities as well as the allocation of the newly available land resources to the remaining farms in a particular region. We consider an agricultural market with a finite number of firms that produce a homogenous good that they sell at a given price in final or intermediate goods markets. Firms can be either large or small, whereas the small firms are supposed to have lower returns to scale than large firms. This mirrors the higher ability of large firms to undertake investments in more efficient production techniques. We develop a simple three-stage game where first the firms decide whether to exit or to continue agricultural production. Given the exit decision of some firms, land resources become available that are distributed among the remaining firms in the market. The land market is modelled as a Vickrey auction, where a single auctioneer sells the available land resources on behalf of the exiting farmers. The auctioneer acts as an intermediary without any strategic incentives. The Vickrey mechanism ensures an efficient allocation implying that the bidder with the highest valuation wins. In turn, the auctioneer pays the selling firms an average price weighted by their capacity sold. It turns out that larger firms have an higher incentive to grow than smaller firms. Furthermore, small firms are more likely to leave the market than large firms.

In a further step, we empirically illustrate our findings. This part of the paper is closely related to Huettel and Margarian (2009); however, we reinterpret their findings in the light of the theoretical results. Additionally, to further explore exit and farm growth in more detail, we estimate two general linear models. We find that regional asymmetries in firm size measured by the concentration of land endowment is positively related to exit rates (mainly small farms) and negatively to the growth rate of the medium farms. It can further be shown that, depending on the farm size structure, a large pool of available resources or a strong competition with a low pool of free land further deepen the differentiation of farms in their size.

The paper is organized as follows. In Section 2 we present an extended literature review to provide the theoretical background of the analysis of structural change in different regions. A simple model of farm exit, land allocation and downstream competition is shown in Section 3. In Section 4 we empirically illustrate the findings to underline our results. Finally, we conclude in Section 5.

2 LITERATURE REVIEW

The theory of industry dynamics takes a prominent place in the economics of industrial organisation. For a long time, research in industrial organisation has been based on the structure-conduct-performance-paradigm. This approach assumes a one-dimensional causality between the market structure, the behaviour of firms in the market and the efficiency of the firms. That is, a more concentrated market structure facilitates coordinated behaviour of firms and, thus, increases the firms' performance in terms of profits. Taking the respective market structure as given, this approach is not satisfactory as markets are generally open and, therefore, allow for entry and exit. We further observe profound differences in the firms' market shares and in the firm size (cf. Sutton, 1991). That is, the size distribution of firms is highly skewed in most industries (Sutton, 2007). Accordingly, Dunne et al. (2009) state "*…While the effect of market structure, the number and relative size of producers, on firm and industry pricing, mark-ups, and profits is generally the focus of interest, it has long been recognized that market structure cannot be viewed as exogenous to the competitive process. Market structure is determined by the entry and exit decision of individual producers and theses are affected by expectations of future profits which, in turn, depend on the nature of competition within the market*". Thus, what are the driving forces of the industry dynamics?

Industry dynamics are mainly characterized by the simultaneous[3] entry and exit of firms as well as growth and shrinkage. While entry[4] plays a minor role in agricultural markets, there is a strong debate about the firms' incentives to leave the market.[5] Exit decisions are characterized by their (partial) irreversibility, the uncertainty of future expectations about the profitability and the investment's flexible timing. Thus, it is not surprising, that exit decisions have been analysed using real options' theory as for instance in Dixit (1989), Alvarez (1998, 1999) and Murto (2004). The main idea is that the exit decisions have to be taken under uncertain price expectations and the possibility to delay the irreversible disinvestment decision gives it the character of a put option. Dixit (1989) shows that trigger prices for exit are less than variable cost minus the interest on the exit cost.[6] Murto (2004) explores this idea further and considers exit in a duopoly model (perfect Nash equilibrium framework) with uncertain revenues where the firms negatively affect each other's profitability. He finds that there exists only a unique equilibrium if the uncertainty is sufficiently low or the asymmetry between the two firms is sufficiently high. This allows one firm to commit successfully to stay longer in the market in case the other firm leaves. As a consequence, one firm is forced to leave the market first. Under high uncertainty and if the firms are nearly about the same size, the reverse order may happen but no unique equilibrium will result.

Other studies consider the impact of uncertainty in strategic games with the aim to explore industry dynamics based on competitive equilibrium theory (e.g., Jovanovic, 1982, Ericson and Pakes, 1989, Hopenhayn, 1992, or Hanazono and Yang, 2009). Ericson and Pakes (1989) take into account that the firms' production is affected by investments with uncertain outcomes. Hopenhayn (1992) models a stationary equilibrium with idiosyncratic uncertainty to investigate high turnover rates within industries. The dynamic stochastic model for a competitive industry allows for endogenous entry and exit induced by exogenous shocks. This enables the reallocation of resources between the firms. Thus, the entry and exit rules imply the evolution of the state of the industry. He also finds that the size distribution is

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[3] Dunne et al. (1988) analyse the U.S. manufacturing industry over the period 1962-1982 and find notable and persistent differences in the entry and exit rates across industries. They also find a high correlation between entry and exit rates and conclude that there must be industry specific factors that determine these patterns of entry and exit.

[4] Note that there is large literature on market entry. For a comprehensive overview see Tirole (1988).

[5] Besides the literature that uses entry and exit as the main driver of industry dynamics there is also a large literature that focuses on technology innovation or improvement as the driving force behind industry dynamics. To this strand of literature belong Klepper and Graddy (1990), Jovanovic and MacDonald (1994), Klepper (1996) as well as Klepper and Simons (2000).

[6] Isik et al. (2003) take up this approach and directly analyse the exit and capacity choice for agricultural enterprises in remote sensing technologies. They find a greater distance between the entry and exit trigger than under disregard of uncertainty and irreversibility of the choice. However, the market structure is not directly considered.

stochastically increasing with age, meaning that larger firms have a higher survival probability. Furthermore, based on firms' learning about their relative uncertain cost positions, Hanazono and Yang (2009) explain that during shakeouts firms that entered just before the shakeout are more likely to exit than earlier entrants. They consider a dynamic game with an infinite time horizon where the firms decide in each period whether to enter or not. Their equilibrium findings confirm the empirical observations: the firms leaving the market first are those that entered the market later.

Besides the models considering uncertainty or shocks, there is also a large literature where industry dynamics are analyzed deterministically by means of competition in declining industries (mainly earlier studies), e.g. Ghemawat and Nalebuff (1985, 1990), Londreagan (1990), Reynolds (1988) and Whinston (1988). These studies explore firms' exit or their reduction in capacity in declining markets. As Liebermann (1990) notes, all their models differ slightly in their respective assumptions and results but emphasize the strategic liability of the large firm size.

Ghemawat and Nalebuff (1985) show that larger firms tend to exit first from a declining industry. This is due to the fact that big firms lose their viability more quickly compared to smaller firms. However, the order of exit may be reversed in the presence of economies of scale from which the larger firms benefit. In a later analysis, Ghemawat and Nalebuff (1990) allow for greater strategic flexibility and capacity adjustment. That is, they relax the assumption of discrete production, i.e. production to be all or nothing. If capacity adjustment is possible, they show that large firms reduce capacity first until they have reached the size of the small. Thus, survivability is inversely related to size. Whinston (1988) extends the work of Ghemawat and Nalebuff (1985). Considering lumpy exits and allowing for partial reduction of capacity in a multi-plant setting, he shows that if the firms have the same number of plants, those with higher cost leave the market first. A lager firm with more operating plants closes its plants earlier than the smaller firms as long as the cost difference is not large. Further, Londregan (1990) shows by means of a duopoly that during growth periods high reentry costs can act like high exit costs and improve the strategic position of the larger firm. During the decline phase, the smaller firm has the better position.[7]

[7] Frank (1988) as well as Fudenberg and Tirole (1986) model exit decisions in a more general context. The latter relate exit in a duopoly with incomplete about the rivals' costs. They show that in case of symmetric expectations and if exit occurs, the less efficient firm leaves the market first.

Asymmetric industry structures may also be induced or strengthened by initial differences in economic fundamentals or strategic positions. That is, asymmetries in firm size may result from a capacity accumulation game played by ex-ante identical firms that differ for instance in the cost structure, in their strategic positions or managerial ability (cf. Saloner, 1987, Leathers, 1992, Maggi, 1996, or Reynolds and Wilson, 2000). For instance, in a capacity constrained price game with sequential moves, temporal asymmetry allows the first mover (Stackelberg leader) to limit the follower's capacity level (cf. Tirole, 1988: 228). As a consequence, the asymmetric structure remains and the profitability of the Stackelberg follower is reduced. Considering a duopoly with two initially differently sized firms that compete in prices under capacity constraints, Ghemawat (1990) shows that the initially larger firms take up all investment opportunities over time. This is due to the fact that the overall duopoly profits are maximised at the most asymmetric allocation of capacities for certain capacity levels. In turn, Krishna (1999) shows that the snowball effect proposed by Ghemawat (1990) does not necessarily hold. She considers a game where multiple units of capacity are sold sequentially to two ex-ante symmetric buyers and takes the buyers' endogenous valuation of additional capacities into account. That is, the value of capacity is determined by the outcome of the subsequent market stage. It turns out that the convexity of payoffs in the market stage ensures a monopolization of capacity, while increasing returns to scale are not sufficient. In the case of concave payoffs, a monopolization cannot be an equilibrium. Note, that this does not necessarily induce that land capacities are equally shared (Krishna, 1999).

However, as emphasized by Besanko and Doraszelski (2004) most of the literature does not show *"…whether substantial and persistent size differences can arise endogenously in equilibrium in a market in which ex ante identical firms interact repeatedly and are subject to firm-specific shocks that continuously alter their positions.*" They use a dynamic model of capacity accumulation with product market competition where the firms are ex-ante identical in their size, in their cost structure and strategic position and show how asymmetries may arise endogenously. They further find that the mode of competition and the reversibility of investments are major determinants of the firm size distribution. The stronger the competition (e.g., price competition) and the higher the depreciation rate (investments are more reversible) is, the more tends the firm size structure towards stronger asymmetries (e.g., one large and one small firm).

A very appealing approach to analyse endogenous market structures has been taken by Esö et al. (2007). They consider a framework with ex-ante identical firms that compete for scarce resources in an upstream market and subsequently for sales in the downstream market. Firms are assumed to have symmetric production technologies and cost structures. The game involves two stages, in the first stage the capacities are allocated among the firms. The allocation is presumed to be efficient such that the each unit of capacity ends up with the firm that values it most. Given the respective capacity allocation resulting from the first stage, these firms compete in a second stage à la Cournot in the downstream market. The major finding is that an asymmetric industry structure becomes more likely the larger the pool of resources. However, a direct application of these models to the agricultural land market is not possible. As it is common wisdom, land is not a freely traded source that can be bought in an upstream market; in Western countries free land is only available if at least one farm leaves the market. Thus, firms can only grow if free capacities are available and so the exit-stage is crucial for any further industry development.

3 Exit and Allocation of Capacity: A Theoretical Approach

As already mentioned, structural change in the agricultural sector depends on the availability of land resources. However, land capacities become only available if farms exit agricultural production or reduce their farming activity. A farmer quits production if the respective opportunity costs are not covered anymore. That is, the exit decision depends on the previous production, on expectations about future prices and the market environment. In turn, a farm decides to opt for additional land if the respective costs are compensated by future revenues. The value of additional land resources thereby depends on the regional market environment. Hence, structural change in agriculture is determined by the farms' decision either to exit the market or to extend their land endowment.

3.1 Theoretical Framework

We consider an agricultural market with *n* firms $i = 1,...,n$. Each firm *i* produces a quantity q_i of a homogenous good to be sold in a final or intermediate goods markets of perfect competition. As commonly observed in agricultural production, firms are price takers that sell their production at a given price p. We distinguish two types of firms indicated by $k = l,s$ where $l = 1,...,m$ denotes the 'large' firms and $s = m+1,...,n$ denotes the 'small' firms. Both types differ in their initial capacity k_i, whereas the initial capacity of the large firms is assumed to be higher than the initial capacity of the small firms, i.e. $k_l > k_s$. Correspondingly, the total land capacity in the considered market refers to $K = \sum_{l=1}^{m} k_l + \sum_{s=m+1}^{n} k_s$. Firms' production costs are based on scale effects and capacity constraints. Taking into account the firms' ex-ante choice of production technique, larger firms benefit from higher returns to scale than smaller firms. Thus, we consider the following cost functions

$$c_i(q_i) = \left(1 - \alpha_k \cdot q_i + q_i^2\right)/2 \quad \forall i = 1,...,n,$$

where α_k denotes a differentiation parameter with $\alpha_l > \alpha_s$ and $\alpha_l, \alpha_s \in [0,1]$ such that we get $c_l(q_l) > c_s(q_s)$ $\forall l = 1,...,m$ and $\forall s = m+1,...,n$.

Firms decide whether to leave the market or to continue production. We denote the respective number of firms leaving the market by e_k where $1 \le e_l \le m$ and $1 \le e_s \le n-m$, respectively. If firms decide to quit they sell their initially given capacity k_i to the remaining firms in the market. We thereby neglect potential entrants as they only play a minor role in western agricultural markets. When deciding about exit, the firms balance the expected profits they earn in case of continuing production – possibly under extended capacity – and their profits in case of selling their initial capacity to the other firms in the market and likewise benefiting from the value of an outside option ψ.

Thus, if firms quit production and decide to sell their initial capacity, a land market emerges. We model the land market as a Vickery auction. For simplicity, we assume that the firms leaving the market sell their initial capacity to an auctioneer who brings the sellers and buyers together at zero costs. We neglect any strategic incentives of the auctioneer and presume zero-profits for the auctioneer. In other words, the auctioneer acts as a single seller of the newly available land resources. The bidding behaviour of the potential buyers is analyzed assuming independent private values. Thereby, we presume that the total amount of newly available land resources is a perfectly divisible good. Thus, the $n - e_l - e_s$ potential buyers bid for a share of the overall available land capacity, i.e. $\tilde{k}_i$. The total production capacity of each remaining firm refers then to $k_i + \tilde{k}_i$ with $\tilde{k}_i \ge 0$.

In a Vickery auction, a bidder winning k units pays the k highest losing bids of the competing bidders. That is, each bidder has to pay an amount equal to the externality exerted on the competing bidders. Thus, a bidder cannot influence his own payment by bidding strategically. This implies that the bidders never intend to bid below or above their true valuation such that each bidder has the weakly dominant strategy to bid truthfully. In this case, each buyer bids exactly the revenue resulting from additional resources. We further assume that the auctioneer pays the leaving firms an average price for their capacities based on the total payments made in the auction. Each firm pays ω_i for the additional capacity $\tilde{k}_i$. Accordingly, the firms' profits are given by

$$\pi_i\left(q_i, k_i + \tilde{k}_i, \cdot\right) = \left(p - c_i(q_i)\right) \cdot q_i - \omega_i \quad \text{with}\, q_i \leq k_i + \tilde{k}_i \tag{1}$$

if they continue production, while they earn

$$\varphi_i = \varpi \cdot k_i + \psi \; \text{ with } \; \varpi \equiv \frac{\sum_{i=1}^{n-e_l-e_s} \omega_i}{e_l \cdot k_l + e_s \cdot k_s}, \tag{2}$$

if they leave the market. Note that the average price ϖ the auctioneer pays to the exiting firms refers to the sum of overall payments made by the successful bidders divided by the sum of capacities that become available from firms' exit.

To summarise, we consider the following three-stage game: First, firms decide whether to leave the market or to stay. Then, the capacity of the leaving firms is distributed by an auctioneer to the remaining firms in the market. Finally, the firms decide about the quantities they produce and profits realize.

3.2 Solving the Game

To analyse the equilibrium strategies of the firms, we solve the game by backward induction.

Downstream Competition. In the last stage of the game, each firm i decides about the quantity of production q_i. Firms sell their production at a price *p*. This assumption reflects that farmers often act as price takers in intermediate or final goods markets. Maximising (1) with respect to q_i, we get the profit maximising quantities with

$$\begin{aligned} q_i^* &= \arg\max_{q_i} \pi_i(q_i, k_i + \tilde{k}_i, \cdot) \\ \text{s.t. } & 0 \leq q_i \leq k_i + \tilde{k}_i . \end{aligned} \tag{3}$$

If the capacity constraint is binding the firms' production is restricted to the total capacity of a firm. Correspondingly, the reduced profit functions are given by

$$\pi_i^*(q_i^*, k_i + \tilde{k}_i, \cdot) = \left(p - c_i(q_i^*)\right) \cdot q_i^* . \tag{4}$$

Land Market Auction. Given the exits of $e_l + e_s$ firms in the first stage of the game, an auctioneer sells the available land resources to the remaining $n - e_l - e_s$ firms in the market in the second stage of the game. The remaining firms submit their separate sealed bids for a share of the total available land capacity sold by the auctioneer. Each bidder has an individual valuation for an additional unit of land resource being equal to the payoff of the additional capacity, i.e.

$$v_i(\tilde{k}_i,\cdot) = \pi_i(q_i, k_i + \tilde{k}_i,\cdot) - \pi_i(q_i, k_i,\cdot). \tag{5}$$

Taking the first order condition of (5), we obtain the firms' bid function with

$$b_i(\tilde{k}_i) = \frac{\partial v(\tilde{k}_i)}{\partial \tilde{k}_i}. \tag{6}$$

A bid function can be thought of as an "inverse demand function" that can be inverted to obtain each bidder i's demand function for additional land capacity, i.e. $\tilde{k}_i(\rho,\cdot) \equiv b_i^{-1}(\rho)$, where ρ indicates the price the bidder is willing to pay for additional capacity, i.e. his marginal willingness to pay. Note that the considered allocation rule refers to conventional supply and demand terms. Aggregating the demand functions of all bidders – the large and the small bidders, we obtain the overall demand function for additional land capacity, i.e.

$$\tilde{K}(\rho,\cdot) = \sum_{l=1}^{m-e_l} \tilde{k}_l(\rho,\cdot) + \sum_{s=m+1}^{n-e_s} \tilde{k}_s(\rho,\cdot). \tag{7}$$

The supply function is given by the sum of the newly available capacities, i.e. $\hat{K} = e_l k_l + e_s k_s$. Equating the aggregated demand and supply functions, we immediately obtain the market clearing price ρ^c that is implicitly given by

$$\tilde{K}(\rho^c,\cdot) \equiv \hat{K}. \tag{8}$$

That is, the winning bids are those that are higher than the market clearing price ρ^c. Plugging ρ^c into $\tilde{k}_i(\rho,\cdot)$, we obtain the additional capacity that each bidder gets in the auction, i.e.

$$\tilde{k}_i^* \equiv \tilde{k}_i(\rho^c,\cdot). \tag{9}$$

By numerical solution, we obtain the following results:

Proposition 1: *Larger firms allocate more additional quantity than small firms. Note, the larger the firms are, the lower is their newly accommodated capacity.*

Proof: In Appendix A we compare by means of the numerical findings the amount of additional land resources of the small and large firms, i.e. $\tilde{k}_l^*$ and $\tilde{k}_s^*$, and get $\tilde{k}_l^* > \tilde{k}_s^*$. We further compare $\tilde{k}_l^*$ for different initial capacities k_l and find $\tilde{k}_l^* \big| k_l^1 \geq \tilde{k}_l^* \big| k_l^2$ if $k_l^1 < k_l^2$.

Larger firms tend to have a higher valuation for additional land resources than smaller firms as they benefit from higher returns to scale. That is, small firms normally have not undertaken the necessary investments to incur the same returns to scale. Accordingly, larger firms tend to bit more for additional land than small firms. Due to the efficient allocation mechanism applied here, they get a larger share from the newly available land resources than smaller firms. If the pool of newly available land is sufficiently small, as only few firms have left the market before, it can even be that the smaller firms do not get any additional resources, while the large firms share the whole pool among each other. Furthermore, our results indicate that a larger initial capacity reduces the valuation of additional land resources. This is due to the fact that the gains from increasing returns to scale are decreasing in the initial capacity.

We turn now to the bidders' payment for the additional land resources they get. In a Vickrey auction, each bidder's payment refers to the highest losing bids of the competitors., i.e. without including his own bids. Each bidder's payments equals the externality it exerts on the competing bidders. We denote the demand for land of all competing firms by $\tilde{K}_{-i}(\rho,\cdot)$ with $-i \neq i$. Based on this, we can derive the residual supply function facing bidder i which is given by

$$s_{-i}(\rho,\cdot) = \max\left\{\hat{K} - \tilde{K}_{-i}(\rho,\cdot), 0\right\}. \tag{10}$$

The residual supply function allows us to derive the payment ω_i bidder i makes for the additional land $\tilde{k}_i^*$ obtained in the auction, i.e.

$$\omega_i = \int_0^{\tilde{k}_i^*} \left(s_{-i}(\rho,\cdot)\right)^{-1} d\tilde{k}_i \, . \tag{11}$$

Note that the payment equals the externality the bidder exerts on the competing bidders.

Exit. In the first stage of the game, firms decide whether to leave the market or to continue production. When deciding, the firms balance the profit of continuing and the earnings in the case of leaving the market. The optimal number of *small* firms leaving the agricultural sector is implicitly given by

$$\pi_s(q_s^*, k_s + \tilde{k}_s^*, e_s, \omega_s, \cdot) \equiv \varpi(e_s, \cdot)k_s + \psi \, . \tag{12}$$

Analogously, the number of larger firms leaving the market is implicitly given by

$$\pi_l(q_l^*, k_l + \tilde{k}_l^*, e_l, \omega_l, \cdot) \equiv \varpi(e_l, \cdot)k_l + \psi \tag{13}$$

It turns out that that the large firms never have an incentive to leave the market. We already know from Proposition 1 that large firms value additional land capacities higher than small firms. In other words, they benefit more from continuing production with additional resources than from selling their own initial capacities to other firms in the market. Accordingly, we can state:

Corollary 1: *Small firms are more likely to exit the market.*

As large firms have a higher valuation for additional capacity than small firms, a higher number of initially large firms induces a higher exit rate of small firms. Accordingly, numerical simulations allow us to state:

Proposition 2: *The more asymmetric the initial size distribution in a market is, the higher is the exit rate and the higher is the share of small firms leaving the market.*

Proof: In Appendix A we numerically compare the number of firms leaving the market, i.e. e_s, if the initial size distribution differs. We find that a higher m indicating a more asymmetric size distribution results in a higher number for e_s.

4 Empirical Illustration

To provide some empirical support to the fundamental rationales obtained by the theoretical analysis, we empirically illustrate the relationship between farm structure, exit and growth of farms. We use farm-level data from the agricultural census provided by the RDC[8] for West Germany. These contain single farm observations and allow to measure entry/exit, shrinkage and growth of farms measured by changes in the land endowment. The farm-individual observations may be representatively aggregated at the district level (321 Landkreise). Two periods are available, 1999-2003 and 2003-2007, implying two observations over time. In order to account for the regional farm size structure, we refer to the Gini coefficient[9]. It measures the degree of asymmetries in firm size (land endowment) and indicates whether the used acreage is concentrated in one size category. If the land use is equally distributed among the size classes, the Gini coefficient is rather low and we expect a tendency to symmetric farms in their size. Contrarily, a high Gini coefficient indicates a concentration of the acreage

[8] Research Data Centres of the Federal Statistical Office and the statistical offices of the Länder.

[9] To derive the Gini coefficient we take the observations of 1999 and 2003, respectively. The Gini coefficient is then derived as: $Gini_r = 1 - \sum_{j=1}^{J} (v_{rj-1} + v_{rj})(u_{rj} - u_{rj-1})$, where *j* denotes the respective size class, *r* denotes the respective region and v_{rj} denotes the cumulative share of class *j* on the total number of farms for region *r*, thereby indicates '-1' the respective lower size class. u_{rj} denotes the cumulative share of land of class *j* on the total amount of acreage used in region *r*.

in the small or the large size category with only relatively few farms in the respective other category.

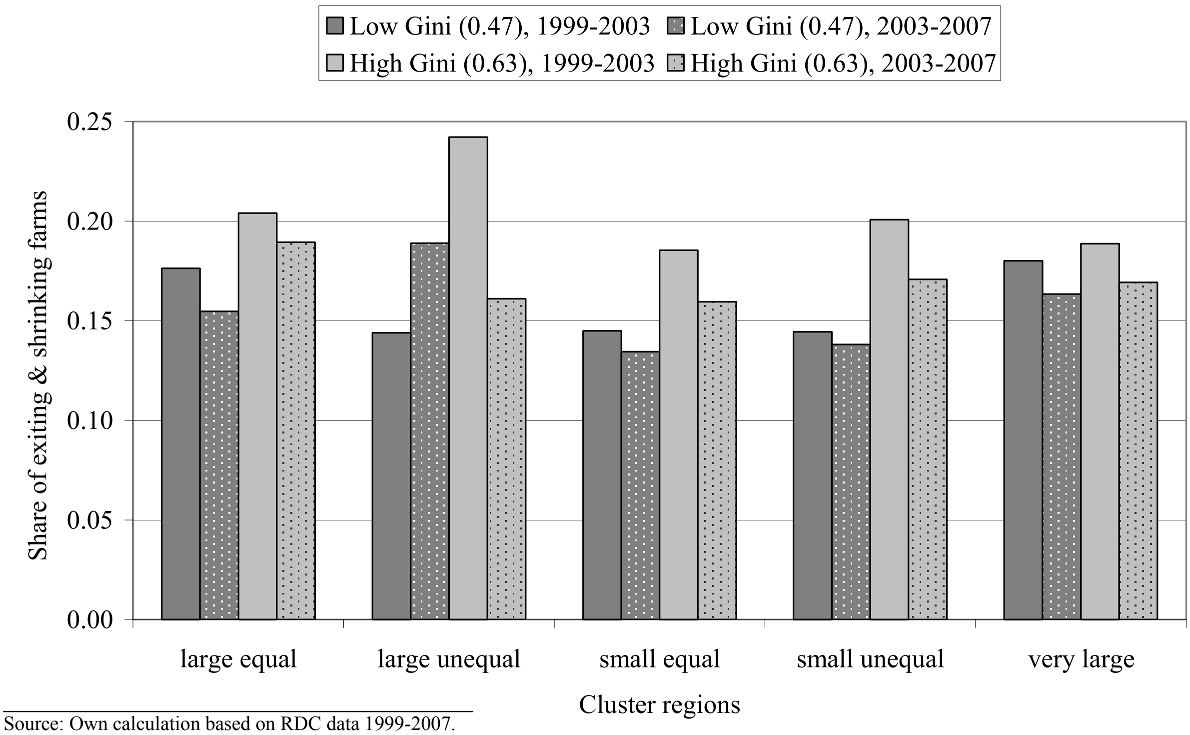
Relation of Exit and the Gini. In order to explore the relation between the farm size structure and exit, a general linear model has been estimated using the least squares approach.[10] The share of shrinking and exiting farms is regressed on several explanatory variables. However, the main variable of interest is the Gini coefficient in 1999 and 2003, respectively, indicating the initial size distribution that is relevant for the farms' respective decisions in the subsequent periods. We classify the regions according to three dimensions by means of a cluster analysis: (1) characteristic production types, (2) the socio-economic environment and (3) the farm size structure.[11] The following illustration (Figure 1) relies on the regions clustered according to the farm structure with the aim to explore how the impact of the Gini coefficient differs between the cluster regions. These have been constructed using the Gini coefficient, the share of small, large and part-time farms as well as the average regional farm size. This leads to five clusters, thereby means 'equal' that land is rather symmetrically distributed over the firms and 'unequal' denotes that the firm size is asymmetric in that region. 'large' and 'small' indicate the average firm size, respectively. In Figure 1 we illustrate the estimated partial relationship between the rate of shrinking/exiting farms and the Gini coefficient in the respective cluster regions.[12]

The findings indicate a complex relation between the farm structure and the shrinking activities of farms. With a low Gini coefficient in 1999 (dark grey bars), the expected exit rate is highest in regions with many large farms ('large equal' and 'very large'). With a high Gini coefficient in 1999 (light grey bars), the exit/shrinking activity is highest in the 'large unequal' regions, however, in the in the second period (2003-2007; bars with dots) with more favourable economic conditions, the exit rate is lower than in all other regions. The sensitivity of farms towards changing conditions seems to be highest in these regions. It should be noted, that only regions with a 'large unequal' farm size distribution and a low Gini coefficient in 2003 (dark grey with dots) show an increase in the share of exiting/shrinking farms in the second period. This coincides with the theoretical findings. That is, the more large firms are in the market the higher the aggregate demand for additional land resources. This, in turn, causes

[10] Summary statistics of the used explanatory variables accounting for the regional structure are given in Table B1 in Appendix B.
[11] Note, such clusters have also been used in Huettel and Margarian (2009); further details can also be found in Appendix B in Table B2. Note, in Table B3 the statistics of the variables of Table B1 differentiated by the cluster regions are given.
[12] Note, the estimated coefficients and their standard errors can be found in Table B4 in Appendix B, Model 1.

a higher exit rate among smaller farms. Note, that the willingness-to-pay for additional land is increasing under favourable conditions.

Figure 1: Estimated partial relationship between the rate of exiting/shrinking farms and the Gini coefficient in the cluster regions

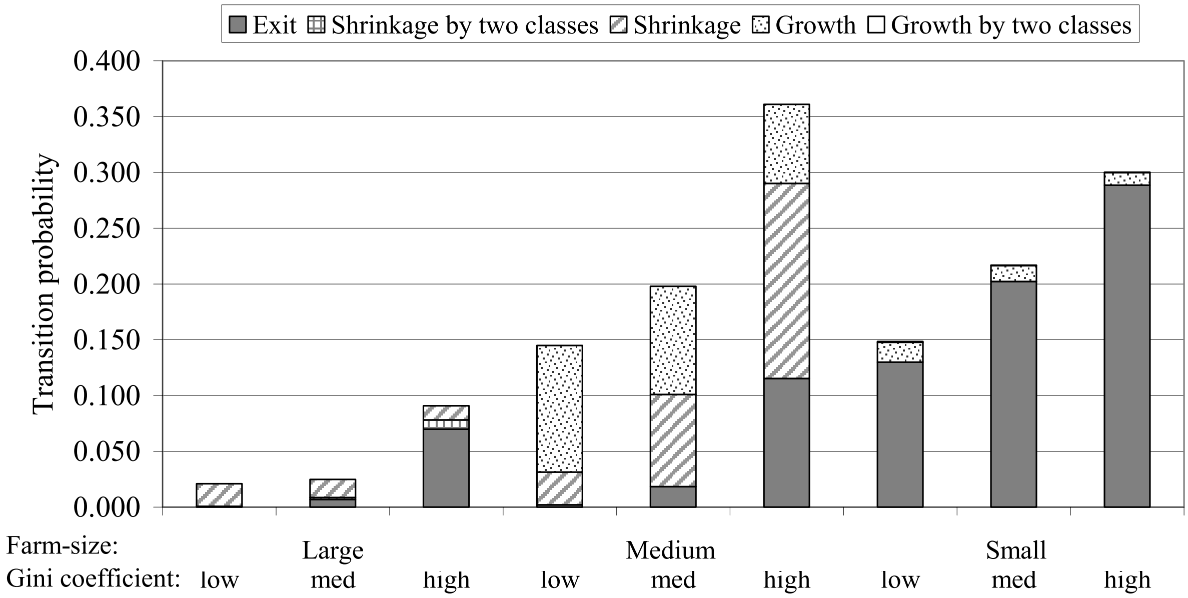


Source: Own calculation based on RDC data 1999-2007.

Joint Analysis of Exit, Growth and Decline. In order to illustrate the relation between exit and growth to find out which farms grow, we refer to the findings of Huettel and Margarian (2009) and reinterpret these in the light of the theoretical results. Their analysis is based on a Markov chain model. The respective transition probabilities are derived from the farm-individual moves between pre-defined size classes (small, medium, large) and the additional exit category. These reflect the probability of a farm to move from one size class to another or to stay within a class in a given period. Such moves reflect farm growth, decline, exit or persistence in the respective size category. The transition probabilities have been aggregated for each region and vary over the two periods. By means of a multinomial formulation, it is possible to express the series of the log of a ratio of probabilities as a linear function of the explanatory variables (for further details see Huettel and Margarian, 2009 and Gourieroux, 2000).

In Figure 2, the estimated impact the Gini coefficient on the transition probabilities is illustrated. For each size category the probability to grow by one/two classes, to exit or to shrink by one/two classes for a low, medium and a high Gini coefficient (the classification of low, medium and high has been derived using quantiles) is shown.

Figure 2: Partial Effect of the Gini coefficient on the transition probabilities



Source: Own calculation based on RDC data 1999-2007.

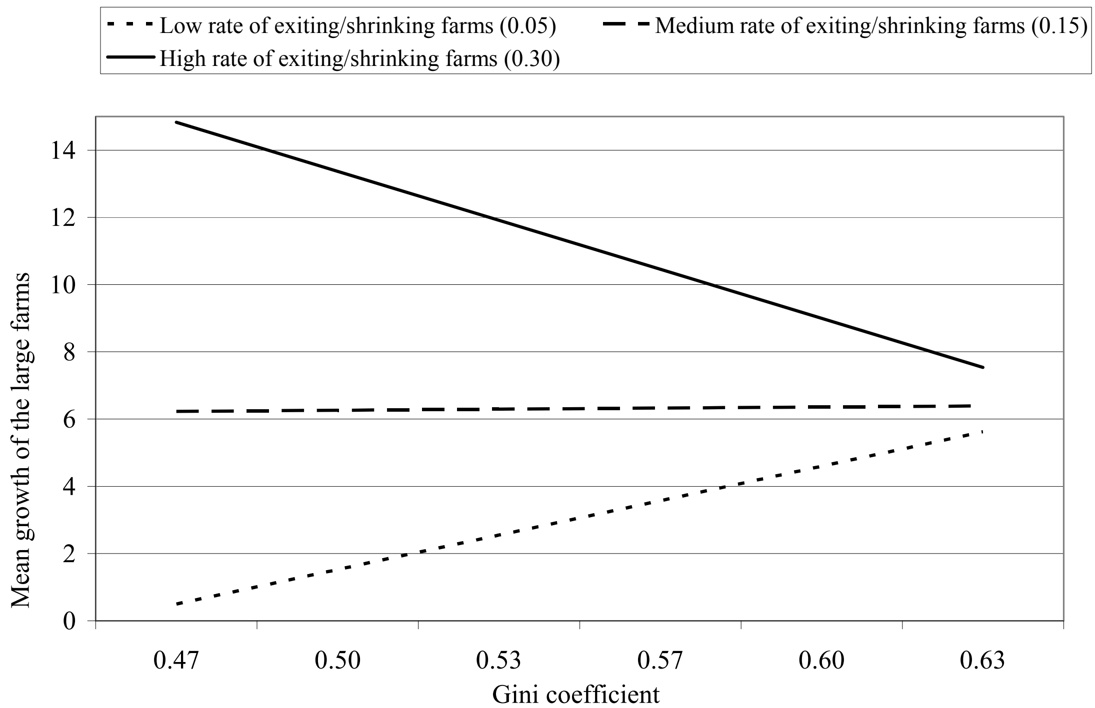
The smallest farms have the highest *exit* probability irrespective of the level of the Gini coefficient. Note, that the exit probability of all size categories is the higher, the higher the Gini coefficient is, thus the stronger the asymmetries in a region are. This coincides with the theoretical findings. Figure 2 further shows that medium farms *grow* stronger than small farms.[13] Theoretically, this refers to the higher valuation of initially larger firms for additional land resources. However, growth of the medium farms declines with a higher Gini coefficient. The highest *shrinking* probability of the medium-sized farms is observed with a high Gini coefficient. In the presence of dominant large farms, the medium farms' have an higher incentive to shrink rather than to grow. This again relies on the higher valuation of large firms for additional land resources which makes it more attractive for medium farms to shrink than to grow. The results show also that contrary to common beliefs shrinkage is a notable phenomenon. It might represent a rational strategic reaction if future growth potential is assumed to be low.

Growth of the Large Firms. We further explore the relation of asymmetries in firm size and growth of the large farms. As discussed above, the higher the availability of land is, the stronger the expected differentiation of farms with respect to their size. That is, starting from heterogeneous farms it should be the large farms that grow most under these conditions. In the Markov chain model growth of the large farms could not be measured. Here, we use the mean

[13] Note that growth of the large farms cannot be measured here because when they grow they remain in that category. This will be further explored in the third part.

growth rates of the large farms (measured in terms of land) that remained in the large farm size class from 1999 until 2003 or from 2003 until 2007 for every district and regress them on the same explanatory variables as used to explain the exit/shrinking rates (see Table B1) using a general linear model. Additionally, the share of shrinking and exiting farms has been added as a further explanatory variable. The estimated coefficients and their standard errors are presented in Appendix B in Table B4 (Model 2). As expected, the growth of large farms is increasing in the rate of exiting and shrinking farms. However, the impact of the exit rate on large farms' growth depends on the initial distribution of land between farms. This relationship is illustrated in Figure 3.

Figure 3: Estimated partial relationship between the growth of large farms, the Gini coefficient and the rate of exiting/ shrinking farms

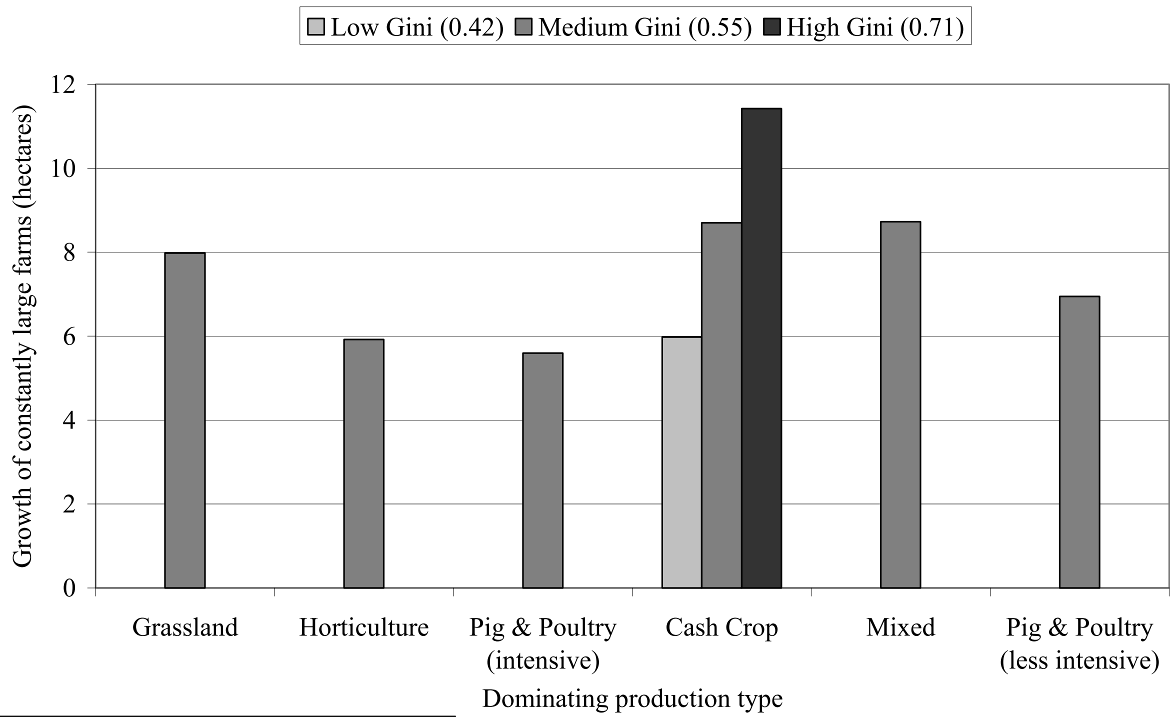


Source: Own calculation based on RDC data 1999-2007.

Interestingly, with a very unequal land distribution (Gini coefficient 0.63), the rate of exiting/shrinking farms does not severely influence the growth of large farms. In case of low exit rates (dotted line) we expect a higher competition on the land market as the pool of overall available land resources is small. This is expected to induce or to strengthen a further differentiation of firms with respect to their size. This is shown by the increasing growth rate with low exits rates in the Gini coefficient (positive slope of the dotted line). With a high rate of exiting farms (black line), large farms grow more in regions with an equal distribution (Gini 0.47) than with an unequal distribution (Gini 0.63). This is shown by the decreasing growth rate of large farms with high exit rates in the Gini coefficient. A low Gini coefficient together with a higher availability of capacity (high exit rate) causes also a stronger differentiation in farm size.

The results further show a significant impact of the Gini coefficient on the growth of the large farms in rather urban regions, in regions with a ‘large equal’ farm size structure and in regions that are characterised by mainly cash crop farms. In Figure 4, the predicted growth of the large is illustrated for regions classified according to the pre-dominating regional production type. It can be shown that the expected growth of the large farms in cash crop regions is especially low as long as the initial distribution of land is rather equal. This might indicate a low endogenous differentiation with respect to farm size as would have been expected in these regions with a pre-dominating production type that reveals a low capital intensity. Furthermore, in cash crop regions is the growth of the large farms especially high if the initial farm size distribution is very unequal. Note, an initially existing heterogeneity might be strengthened in the course of structural change irrespective of the capital intensity.

Figure 4: Estimated partial relationship between regional characteristic production type, the Gini coefficient and the growth of large farms



Source: Own calculation based on RDC data 1999-2007.

Summarising, we find that regional asymmetries in firm size are positively related to exit rates and negatively to the growth rate of the medium farms. Shrinking is a common strategy of medium-sized farms in the presence of (possibly dominant) large farms. While the exit rate of the small farms is highest, medium farms grow stronger than small farms. Depending on the farm size structure, a large pool of available land resources further deepens the differentiation of farms in their size. These findings are in line with many of the hypotheses found in the literature as well as with our own theoretically derived expectations. Therefore, the empirical results reinforce the papers' central point that farms' exit and growth behaviour is partly determined by the specific situation in the land market.

5 Concluding Remarks

The scarcity of newly available land and the close relation of farm exits and growth induce the farmers' valuation of additional land to become endogenous. A simple model has been set up in order to analyse possible consequences of such a market setting. Here we argue with an initial heterogeneity of farms. We find that in this case under the additional assumption of differentiated scale effects that large farms grow more than small farms. Furthermore, the lower the total supply of land is, the higher is the expected further differentiation of farm sizes. Nevertheless, large farms' probability to exit is very low and it is the small farms, that increasingly leave the market in the presence of many large farms. For the empirical analysis we rely on data from the farm structure survey, which have been analysed in a regional context. The analyzed relation between the regional farm size structure and observed growth as well as exit rates reveals empirical support of the theoretically derived hypotheses.

The presented analysis has to be judged as a first, preliminary approach in order to reach some primary understanding of possible relations between conditions on the land market and structural change in agriculture. There is still a need of further improvement. The formal analysis has to be elaborated with the aim to show the possibility of an endogenous evolution of heterogeneity. The theoretical modelling can also be improved by allowing for strategic bidding behaviour in land markets. Particularly, it can be interesting to analyse the commitment effect of ex-ante investments on the bidding behaviour. Furthermore, the assumption of an auctioneer should be relaxed in a double auction framework. The empirical evidence should be based on a structural model based on micro-data about land market transactions.

Beyond the methodological issue of this paper, our findings have practical implications. Policy-makers are interested in structural change that is compatible with social concepts and policy aims. If policy-makers had a better understanding of the impacts of the respective policy programs on structural change, it would be possible to define better and more efficient agricultural policy. Due to interaction on the land market the changes in policies need not have the same structural effects in different regions. Policies themselves as well as their analysis need to be adopted on a disaggregated regional level if structural development is among their aims. In models that are used to guide and to evaluate political interventions the possibility of strategic interaction on the land market should be taken into account. However, the results do not necessarily represent a justification for policy interventions. Under the described complex circumstances a huge amount of detailed information would be necessary in order to create effective policies with certain structural goals. The necessary discrimination between different farmers in such an intervention might not just create practical but also ethical and judicial problems.

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APPENDIX A NUMERICAL RESULTS FOR THE PROOFS

Table A: Numerical results

N = 20; α_s = 1/4 α_l = 1 $k_s = 0.25$ $k_l = 0.5$	Number of exits e_s	Profit if continuing $\pi_i\left(q_i, k_i+\tilde{k}_i, \cdot\right)$	Profit if exiting $\varpi k_s+\psi$	Market clearing price ρ^c	Add. capacity of large farms $\tilde{k}_l^*$	Add. capacity of small farms $\tilde{k}_s^*$
m=6	3.0	0	0.1420	0.5391	0.1250	0
	3.5	0	0.1365	0.5202	0.1458	0
	4.0	0.0673	0.1307	0.5000	0.1667	0
	4.5	0.1018	0.1245	0.4785	0.1875	0
	5.0	0.1234	0.1227	0.4561	0.2080	0.0002
	5.5	0.1235	0.1211	0.4500	0.2134	0.0111
	6.0	0.1236	0.1193	0.4429	0.2196	0.0228
	6.5	0.1239	0.1171	0.4348	0.2265	0.0355
	7.0	0.1243	0.1146	0.4256	0.2343	0.0492
	7.5	0.1250	0.1117	0.4148	0.2431	0.0641
	8.0	0.1260	0.1083	0.4024	0.2530	0.0803
m=7	3.0	0	0.1467	0.5542	0.1071	0
	3.5	0	0.1424	0.5391	0.1250	0
	4.0	0	0.1379	0.5230	0.1429	0
	4.5	0.0451	0.1331	0.5059	0.1607	0
	5.0	0.0896	0.1280	0.4879	0.1786	0
	5.5	0.1120	0.1226	0.4689	0.1964	0
	6.0	0.1234	0.1220	0.4539	0.2100	0.0043
	6.5	0.1235	0.1200	0.4465	0.2164	0.0169
	7.0	0.1238	0.1177	0.4380	0.2238	0.0306
	7.5	0.1242	0.1150	0.4281	0.2321	0.0455
	8.0	0.1249	0.1118	0.4166	0.2416	0.0617
m=8	3.0	0	0.1499	0.5649	0.0938	0
	3.5	0	0.1464	0.5524	0.1094	0
	4.0	0	0.1428	0.5391	0.1250	0
	4.5	0	0.1389	0.5250	0.1406	0
	5.0	0	0.1348	0.5103	0.1563	0
	5.5	0.0784	0.1305	0.4948	0.1719	0
	6.0	0.1018	0.1260	0.4785	0.1875	0
	6.5	0.1189	0.1213	0.4615	0.2031	0
	7.0	0.1235	0.1209	0.4508	0.2127	0.0097
	7.5	0.1236	0.1184	0.4418	0.2205	0.0246
	8.0	0.1240	0.1155	0.4312	0.2295	0.0409

Table A: Numerical results (continued)

N = 20; $\alpha_s = 1/4$ $\alpha_l = 1$ $k_s = 0.25$ $k_l = 0.5$	Number of exits e_s	Profit if continuing $\pi_i\left(q_i, k_i + \tilde{k}_i, \cdot\right)$	Profit if exiting $\varpi k_s + \psi$	Market clearing price ρ^c	Add. capacity of large farms $\tilde{k}_l^*$	Add. capacity of small farms $\tilde{k}_s^*$
m=9	3.0	0	0.1522	0.5729	0.0833	0
	3.5	0	0.1493	0.5622	0.0972	0
	4.0	0	0.1463	0.5509	0.1111	0
	4.5	0	0.1430	0.5391	0.1250	0
	5.0	0	0.1396	0.5266	0.1389	0
	5.5	0	0.1361	0.5136	0.1528	0
	6.0	0.0673	0.1323	0.5000	0.1667	0
	6.5	0.0925	0.1285	0.4858	0.1806	0
	7.0	0.1099	0.1244	0.4711	0.1944	0
	7.5	0.1234	0.1220	0.4560	0.2081	0.0005
	8.0	0.1235	0.1193	0.4464	0.2165	0.0171

N=20; $\alpha_s = 1/4$ $\alpha_l = 1$ $k_s = 0.25$ $k_l = 0.4$	Number of exits e_s	Profit if continuing $\pi_i\left(q_i, k_i + \tilde{k}_i, \cdot\right)$	Profit if exiting $\varpi k_s + \psi$	Market clearing price ρ^c	Add. capacity of large farms $\tilde{k}_l^*$	Add. capacity of small farms $\tilde{k}_s^*$
m=6	3.0	0	0.1610	0.6116	0.1250	0.2525
	3.5	0	0.1573	0.5989	0.1458	0.2546
	4.0	0	0.1532	0.5850	0.1667	0.2574
	4.5	0	0.1487	0.5698	0.1875	0.2609
	5.0	0	0.1438	0.5532	0.2083	0.2651
	5.5	0	0.1385	0.5354	0.2292	0.2702
	6.0	0	0.1328	0.5163	0.2500	0.2761
	6.5	0.0921	0.1267	0.4958	0.2708	0.2830
	7.0	0.1198	0.1203	0.4741	0.2917	0.2910
	7.5	0.1250	0.1236	0.4635	0.3014	0.0103
	8.0	0.1252	0.1213	0.4555	0.3086	0.0248

APPENDIX B: DETAILED DATA INFORMATION AND RESULTS

Table B1: Summary statistics the explanatory variables used to explain farm exits

Variable	Mean	Standard deviation	Min	Max
Gini coefficient	0.55	0.08	0.31	0.75
Centered Gini coefficient	0.00	0.08	-0.23	0.21
Share of exiting farms	0.14	0.04	0.05	0.30
Share of shrinking farms	0.03	0.02	0.00	0.09
Share of exiting/shrinking farms	0.17	0.04	0.05	0.30
Centered share of exiting/shrinking farms	0.00	0.04	-0.12	0.13
Growth of permanently large farms	9.16	5.65	-30.93	47.25

Source: Own calculation based on RDC data 1999-2007.

Table B2: Summary Statistics of the structural cluster regions

Cluster	N	Average farm size	Gini coefficient	Share of farms <30 ha	Share of farms >100 ha	Share of part time farms
Small - equal	79	22.64	0.46	0.74	0.01	0.5
		(3.25)	(0.05)	(0.06)	(0.01)	(0.09)
Small - unequal	134	20.12	0.59	0.8	0.03	0.59
		(6.09)	(0.07)	(0.08)	(0.02)	(0.15)
Large - equal	49	31.85	0.51	0.59	0.04	0.36
		(4.21)	(0.05)	(0.06)	(0.02)	(0.10)
Large - unequal	26	36.03	0.58	0.62	0.09	0.58
		(4.22)	(0.03)	(0.04)	(0.03)	(0.06)
Very large	39	53.23	0.54	0.45	0.15	0.36
		(10.24)	(0.07)	(0.10)	(0.05)	(0.09)
All regions	327	27.7	0.54	0.7	0.05	0.51
		(12.24)	(0.08)	(0.14)	(0.05)	(0.15)

Note: Standard deviation in brackets.
Source: Own calculations based on RDC 1999-2007.

Table B3 Summary statistics of the main explanatory variables differentiated by the cluster regions

Variable	Cluster Region	Mean	Standard Deviation	Min	Max
Growth of permanently large farms	large equal	9.51	6.37	-3.33	43.93
	large unequal	9.10	2.87	3.12	16.53
	small equal	9.61	4.57	-11.81	29.48
	small unequal	9.18	6.85	-30.93	47.25
	very large	7.77	2.70	2.01	16.47
Share of exiting/shrinking farms	large equal	0.18	0.04	0.08	0.25
	large unequal	0.19	0.04	0.08	0.30
	small equal	0.15	0.02	0.08	0.20
	small unequal	0.17	0.04	0.05	0.28
	very large	0.18	0.03	0.10	0.30
Gini coefficient	large equal	0.52	0.05	0.39	0.71
	large unequal	0.59	0.03	0.51	0.67
	small equal	0.47	0.05	0.31	0.60
	small unequal	0.60	0.06	0.38	0.75
	very large	0.53	0.06	0.42	0.66
Centered share of exiting/ shrinking farms	large equal	0.01	0.04	-0.09	0.09
	large unequal	0.03	0.04	-0.09	0.13
	small equal	-0.02	0.02	-0.09	0.03
	small unequal	0.00	0.04	-0.12	0.11
	very large	0.01	0.03	-0.07	0.13
Centered Gini coefficient	large equal	-0.03	0.05	-0.15	0.16
	large unequal	0.04	0.03	-0.03	0.12
	small equal	-0.07	0.05	-0.23	0.05
	small unequal	0.05	0.06	-0.17	0.21
	very large	-0.01	0.06	-0.13	0.11

Source: Own calculation based on RDC data 1999-2007.

Table B4: Estimated coefficients for the models explaining the rate of exiting/shrinking farms and the growth of the large farms

Variables	Interaction of the variable with…	Cluster Characteristic	Model 1 Share of exiting/ shrinking farms	Model 2 Growth of the large farms
Intercept			0.184	6.95
			(0.007) ***	(1.21) ***
Centered Gini coefficient			0.054	-5.08
			(0.085)	(19.30)
Year			-0.018	2.63
			(0.003) ***	(0.44) ***
Centered Gini coefficient	Year		-0.02	--
			(0.118)	
Centered share of exiting/shrinking farms			--	32.49
				(6.68) ***
Centered share of exiting/shrinking farms	Centered Gini coefficient		--	-310.43
				(76.60) ***
Regional clusters with respect to the farm size structure		large equal	0.006	2.96
			(0.006)	(0.91) **
		large unequal	0.009	0.58
			(0.008)	(1.34)
		small equal	-0.019	2.56
			(0.006) **	(1.04) **
		small unequal	-0.012	2.19
			(0.005) **	(0.81) **
		very large	0.000	0.00
Regional cluster indicator with respect to the farm size structure	Centered Gini coefficient	large equal	0.120	40.09
			(0.120)	(14.65) **
		large unequal	0.560	8.46
			(0.189) **	(24.33)
		small equal	0.199	-3.92
			(0.099) *	(14.52)
		small unequal	0.298	-5.96
			(0.096) **	(12.24)
		very large	0.000	0.00
Regional cluster indicator with respect to the farm size structure	Centered Gini coefficient & Year	large equal	0.059	--
			(0.162)	
		large unequal	-0.771	--
			(0.215) ***	
		small equal	-0.080	--
			(0.132)	
		small unequal	-0.131	--
			(0.133)	
		very large	0.000	--

Table B4: Estimated coefficients for the models explaining the rate of exiting/shrinking farms and the growth of the large farms (continued)

Variables	Interaction of the variable with…	Cluster Characteristic	Model 1 Share of exiting/ shrinking farms	Model 2 Growth of the large farms
Regional cluster indicator with respect to the general economic situation		Rural regions with negative economy	-0.001 (0.005)	-1.51 (0.85) °
		Rural regions with positive economy	-0.005 (0.004)	-1.65 (0.71) *
		Purely rural regions	0.008 (0.005) °	-1.06 (0.77)
		Urban regions with negative economy	-0.020 (0.005) ***	-3.53 (0.90) ***
		Urban regions with positive economy	0.000	0.00 (0.00)
Regional cluster indicator with respect to the general economic situation	Centered Gini coefficient	negative rural	--	12.66 (10.62)
		positive rural	--	5.65 (8.70)
		purely rural	--	8.46 (9.36)
		negative urban	--	-26.59 (11.02) **
		positive urban	--	0.00 (0.00)
Regional cluster indicator with respect to the characteristic production type		Grassland	0.010 (0.005) *	1.03 (0.82)
		Horticulture	-0.021 (0.007) ***	-1.02 (1.40)
		Intensive Pig&Poultry	0.008 (0.008)	-1.35 (1.97)
		Cash Crop	-0.001 (0.006)	1.75 (1.02) °
		Mixed	0.009 (0.005) °	1.78 (0.85) *
		Pig & Poultry	0.000	0.00
Regional cluster indicator with respect to the characteristic production type	Centered Gini coefficient	Grassland	--	 -9.24
		Horticulture	--	(14.38) 19.94
		Intensive Pig&Poultry	--	(18.60) -8.47
		Cash Crop	--	(32.60) 39.12
		Mixed	--	(17.17) * -4.55
		Pig & Poultry	--	(15.68) 0.00
R-square			0.34	0.24

Note: Standard errors are in brackets. °, *, ** and *** denotes significance at 10%, 5%, 1% and 0.1%, resepctively.
Source: Own calculation based on RDC data 1999-2007 using SAS 9.2 Proc GLM.