Regional Asymmetries in Firm Size

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Structural Change in Western Agriculture

Observed

- Declining number of farms and increasing average farm size
- Substantial differences in the regional farm size structure
- Persistence of farms in their size classes
- Regionally differing patterns of structural change

Unsolved Questions

- How do such regional asymmetries in firm size arise?
- How can these be used to explain regionally differing patterns of structural change?

Regional Asymmetries, Structural Change and the Production Factor Land

- Growth - only if others decline or exit determining the land availability for growing farms
- Immobility and shortage of land

  $\Rightarrow$ interrelation of farmers' actions
- Conditions in the land market, like potential competitors, land availability

  $\Rightarrow$ impact on structural change in a region

Objectives

Show how the regional farm size structure...

- Determines exits that in turn induce free land capacities
- Impacts the allocation of the free land capacities in a region

By means of...

- Theoretical model
- Empirical illustration of the theoretical findings

Outline

- Theoretical background from the literature
- Theoretical modelling and results
- Empirical Illustration
- Concluding remarks

Industry Dynamics in the Literature

KNOWN STRUCTURE-CONDUCT-PERFORMANCE PARADIGM

- One-sided causality between market structure, the behavior of firms in the market and the efficiency of firms
- Concentrated market structure $\Rightarrow$ coordinated behavior of firms $\Rightarrow$ increase of firms' profits
- Problem: given market structure

BUT OBSERVED SKEWED FIRM SIZE DISTRIBUTION:

- Structure not exogenous
- Entry and exit to markets - driven by future expectations determined by competition in the market

Characteristics of Industry Dynamics

Literature with the aim to explain regional asymmetries in firm size

- Entry & exit under uncertainty/real options with re-allocation of resources in strategic games

  $\Rightarrow$ Higher survival probability of the large

- Competition in declining industries using deterministic models

  $\Rightarrow$ Strategic liability of the large

- Asymmetries result from
  - Initial differences in economic fundamentals and strategic positions in a capacity accumulation game
  - Ex-ante identical firms' interaction under uncertainty

$\Rightarrow$ Asymmetric market equilibrium

Idea: Endogenous Market Structure

- New: endogenously determined availability of capacity
- Land is not a freely trade resource
- Exit determines the availability of free land – crucial for growth of surviving farms
- Competition for scarce resources in the capacity market

Exit and Allocation of Capacity: Theoretical Framework

- Agricultural market with n price-taking firms
- Production q_i (homogenous), intermediate goods market with perfect competition at price p
- Large l and small firms s differing in
  - Initial capacity k_i (land endowment): $k_l > k_s$
  - U-shaped marginal production cost $c_i(q_i) = (1 - \alpha_k \cdot q_i + q_i^2)/2$ where $\alpha_l > \alpha_s$

    that is: larger firms benefit from investments: marg cost increase 'slower' in quantity
  - Additional capacity: $\tilde{k}_i$
- Total regional land capacity $K = \sum k_l + \sum k_s$
- Firms' production may be capacity constrained

The Three-Stage Game

1. Firms decide: quit production, sell their initial capacity **or** continue with production
2. If at least one firm has decided to exit: land market

   $\Rightarrow$ Capacity allocation: efficient Vickrey auction
3. Firms decide about their production quantities in the downstream market and the profits they realize

$\Rightarrow$ Solved via backward induction

Solving the Three-Stage Game

Step Three: Downstream Competition

- Decision about produced quantities
- Profit maximizing quantity subject to the capacity constraint:

  $q_i^* = \arg\max_q \pi_i(q_i, k_i + \tilde{k}_i, \cdot)$

  subject to $0 \leq q_i \leq \underbrace{k_i + \tilde{k}_i}_{\text{total capacity}}$
- If capacity constraint is binding: firms' production is determined by the capacity: $q^* = k_i + \tilde{k}_i$
- If capacity constraint is not binding: firms produce profit maximizing amount of the good $q^* = q^C$

Solving the Three-Stage Game

Step Two: The Land Market Auction

- Single auctioneer sells available land resources on behalf of exitors without incentives to act strategically
- Vickery mechanism:
  - ensures efficient allocation

    $\Rightarrow$ bidder with highest valuation wins and gets the land
  - bidder: no incentive to misrepresent his valuation as price cannot be affected
  - bid: revenue resulting from additional resources
  - winner has to pay amount according the highest losing bids - without his own
  - auctioneer pays exitors: average price weighted by the sold capacity ω

Solving the Three-Stage Game

Step Two: The Land Market Auction (con'd)

- Bid function $b(\tilde{k}_i) = \partial v(\tilde{k}_i)/\partial \tilde{k}_i$
  - Derived from individual valuation $v(\tilde{k}_i)$ for an add. unit of capacity = payoff of the capacity
  - Inverse demand function
- Land demand: aggregate individual demand functions
- Land supply: fixed to K
- Get: market clearing price ρ^c to obtain winner
- Bidders' payment ϕ_i according to highest loosing bids

  $\Rightarrow$ Reflects opportunity costs for the won units

Theoretical Results: Auction

$\Rightarrow$ Larger firms: bid more for additional land due to scale effects

$\Rightarrow$ Efficient allocation: a higher share of land goes to large farms rather than to the small farms

$\Rightarrow$ If capacity pool is small – only large farms may get additional capacity

Solution

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

Solving the Three-Stage Game

Step One: Exit

Exit, if

- Profits of continuing $\pi_i(q_i, k_i + \tilde{k}_i, \cdot)$ minus payment if additional capacity is bought ϕ_i

  equals the earnings leaving the market

  $$\varphi_i = \underbrace{\omega \cdot k_i}_{\text{payment auctioneer}} + \underbrace{\psi}_{\text{value outside option}}$$

- But:

  $\Rightarrow$ Large firms value additional land higher than small farms

  $\Rightarrow$ Large farms have a low incentive to leave the market

Corollary

Small firms are more likely to exit the market.

Theoretical Results: Exit

$\Rightarrow$ Higher valuation for additional capacity of the large firms
$\Rightarrow$ A higher number of initially large firms induces a higher exit rate of the small firms

Solution

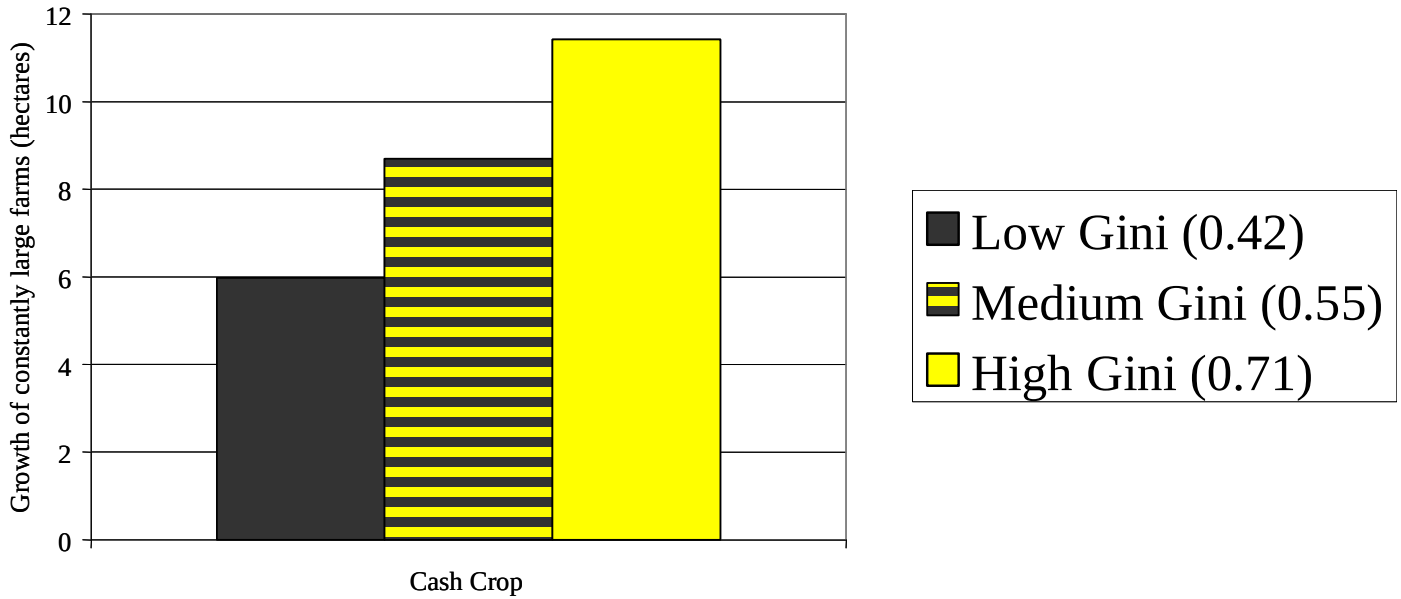
The more asymmetric the initial size distribution in a market is, the higher is the exit rate and the higher is the share of small firms leaving the market.

NOTE, PRELIMINARY $\Rightarrow$ Proofs still only numerical (!)

Data

- Illustrate the relationship between the farm structure, exits and growth of farms
- Farm-level data: agricultural census West Germany
- 321 districts for 2 time periods: 1999-2003 & 2003-2007
- Growth: measured in increase in land endowment
- Exit measured within each period
- Asymmetries measured by the *Gini-coefficient*: high Gini
  $\Rightarrow$ Strong asymmetries in firm size in a region
  $\Rightarrow$ Land is unequally distributed among farms

Growth of the Large Farms



- Low growth rates under symmetry
  $\Rightarrow$ Lower incentive to leave the market
- High growth rates under asymmetry
  $\Rightarrow$ Higher incentive of small to exit, availability of land higher
- Cash crop regions with low capital intensity (note, under higher capital intensity: growth rate lower at all under asymmetry)

Growth of the Large Farms (con'd)

Theoretical result:

- Larger firms get a higher share of newly available resources
- Interrelation: growth directly depends on exit
- But: if pool of newly available resources is small

  $\Rightarrow$ only large firms get additional capacity

  $\Rightarrow$ may foster further aymmetries

Empirical results:

- Significant positiv impact of the exit rate on the growth rate of the large under a low Gini
- I.e. under symmetry stronger dependency of growth on the exit rate
- But under asymmetric firm sizes:

  $\Rightarrow$ large farms grow irrespective of availability of land, impact not significant

Summing Up

SHOWN:

- Scarcity of newly available land & relatedness of farm exits and growth

  $\Rightarrow$ induce the availability of additional land to become endogenous
- Consequences are ...
  - large farms grow more than small farms
  - the lower the total supply of land is, the higher is the further differentiation of farm sizes
  - large farms' probability to exit is very low

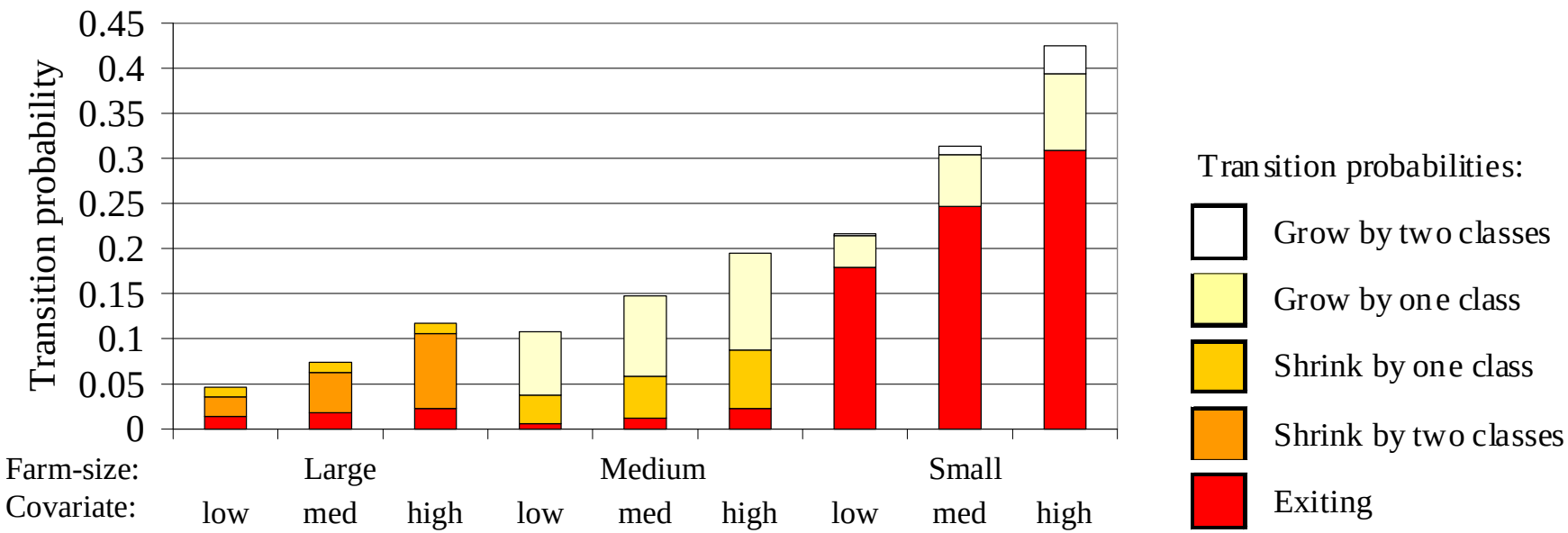
    $\Rightarrow$ small farms have higher exit probability

Critical Issues

- Theoretical result are mainly driven by assumptions
  - that farms are ex-ante heterogenous
  - wrt scale effects
- Endogenous valuation not yet modelled: decision about cost structure (investment) necessary
- So far only endogenous determination of the availability of newly available resources – still a novelty!
- Only empirical illustration, no structural model

Inter-Relation of Exit and Growth under Asymmetries

Markov Chain Model Adopted from Huettel/Margarian 2009



- Highest exit of the small, Gini ↑ exit rate ↑
- Medium farms shrink and grow if Gini ↑