Agricultural Land Prices and the Law of One Price

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***Abstract* - The focus of this paper is on spatial market integration in agricultural land markets. We scrutinize the applicability of the law of one price to land markets while distinguishing between absolute and relative versions of this "law". Panel data unit root and stationarity tests are applied to land sale prices in the German state Lower Saxony where we detect three main clusters with different price developments. Our results indicate that the law of one price holds only locally due to structural differences among regions.**

Introduction

The general objective of this study is to investigate the efficiency of agricultural land markets via spatial market integration. According to the law of one price (LOP), all goods on integrated markets are sold at the same price apart from transportation or transaction costs. While the concept of spatial market integration has been extensively applied to agricultural product markets, applications to land markets are rare. This may arise from special characteristics of the production factor "land". First, land is an extremely heterogeneous asset, which complicates price comparisons. Second, land is immobile and hence it is not obvious how trade and arbitrage processes will actually work. Compared with other markets, transaction costs are high (Shiha and Chavas, 1995). As a result, the convergence of land prices will take place much more slowly, if at all, and markets may appear separated though they are spatially integrated. Finally, and related to the second point, regional market power may exist that prevents land prices in different regions from convergence. However, despite of these peculiarities, Waights (2014) emphasizes that the LOP, in general, also applies to real estate prices. This is due to the fact that farmers as well as capital are mobile.

Methods and Data

Methods

To capture the price dynamics, we apply statistical tools that originate in market integration analysis, particularly unit root and stationarity tests. In the context of land market analysis, classical tests for integrated time series have little power because of the short length of land price series. This drawback can be overcome by using panel data tests, which exploit the panel structure of the land market data to enlarge the data set and hence the power of the test. The null hypothesis of a panel unit root test such as the Levin-Lin-Chu (LLC) test (Levin et al., 2002) is that the series contain a unit root. The general form is given by

$$\Delta y_{i,t} = \alpha_i + \beta y_{i,t-1} + \sum_{l=1}^{L} \theta_{i,l} \Delta y_{i,t-l} + \epsilon_{i,t},$$

where $y_{i,t}$ denotes the tested time series; $i = 1, \dots, N$ indexes cross-section units; $t = 1, \dots, T$ indexes time; $\Delta y_{i,t} = y_{i,t} - y_{i,t-1}$; α_i represents panel-specific means; β is the rate of convergence; L is the number of lags and $\theta_{i,l}$ are coefficients of lag terms; ϵ_{it} is stationary error term. The relative LOP suggests that price differences between locations will converge to a non-zero constant α_i, whereas the absolute LOP is characterized by a convergence to zero difference, i.e., $\alpha_i = 0$. It tests the null hypothesis H_0: $\beta = 0$ versus the alternative H_a: $\beta < 0$. However, because unit root tests typically are not very powerful with respect to the alternative hypothesis of stationarity, tests with reversed hypotheses such as the Hadri LM test (Hadri, 2000) are appealing when testing for stationarity. Therefore, we will combine unit root and stationarity tests to panels of average regional land prices on a county level.

One weakness of panel tests, however, is that they do not provide information which cross-section units are stationary on a joint null hypothesis. To classify the individual series into stationary and nonstationary sets, we used the Sequential Panel Selection Method (SPSM) (Chortareas et al., 2008), which carries out a sequence of Hadri LM tests on panels of decreasing size. Specifically, after a rejection, it removes the series with the highest evidence in favour of non-stationarity (based on individual stationarity test results) from the panel. The procedure continues until the joint test for the remaining series in the panel is no longer rejected. The resulting subpanels constitute homogenous regions that share a similar price development.

Data

We used a balanced panel dataset of average sale prices of agricultural land in Lower Saxony on a county level for the years 2002–2014. Lower Saxony is located in the northwest of Germany and consists of 38 counties leaving us with a total of 494 observations. Within the observation period, the counties exhibit different types of price development ranging from a moderate to a significant increase. This renders it unlikely that the LOP holds for all of them. Thus we chose three counties as benchmark regions

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representing these different price pattern, namely Lüneburg, Leer, and Cloppenburg. In contrast to common practice, we prefer to use absolute instead of relative prices differences between land prices in county i and in the benchmark region at time t as dependent variable, since the same relative price change may imply different absolute price changes. We do not adjust prices for different attributes such as land quality since most of these attributes are time invariant and thus captured by the constant α_i.

Results

The results of the empirical analysis, which are summarized in Table I and Figure 1, should be regarded with caution due to the short time series of price data. Nevertheless, it is possible to carve out some findings. First, it is quite obvious that the LOP does not hold for land prices in all counties in Lower Saxony. A Hadri test rejects the null hypothesis of price convergence irrespective of the chosen benchmark region if all counties are included in the panel. On the other hand, an LLC test cannot reject the null hypothesis that price differences are nonstationary among all counties. We conclude that the LOP may hold for some sub-regions. Using the SPSM in conjunction with the Hadri test, we are able to identify three regional clusters sharing a similar land price development (see Table I).

The largest group comprises most counties of eastern Lower Saxony with Lüneburg as a benchmark region (see Figure 1).

Table 1. Hadri and LLC test results and convergence rates.

LOP	Hadri probability	LLC probability	Coefficient β	Half-lives
Lüneburg group				
Absolute	-	0.0006	-0.07409	9.004
Relative	0.0622	0.0000	-0.73390	0.524
Leer group				
Absolute	-	0.0011	-0.26115	2.290
Relative	0.0774	0.0222	-0.62517	0.706
Cloppenburg group				
Absolute	-	0.8193	0.10560	-
Relative	0.0859	0.1222	-1.23572	-

In these counties, we observe only a slight increase in land prices within the last decade, despite the overall land price boom in Germany. The convergence parameter β translates into half-lives of 0.524 and 9.004 years with and without α_i, respectively. This means that half of the price differences compared with the benchmark region vanish in that time. The second, more scattered regional cluster is mainly located in the middle and northwest area of Lower Saxony and is characterized by a medium price increase (benchmark Leer). Finally, we identify a rather small group consisting of Vechta, Cloppenburg and Oldenburg by means of the Hadri Test (Note that this classification is not confirmed by the LLC in contrast to the previous ones.). These counties are well known for their high concentration of intensive livestock production, particularly hog fattening and poultry production. High returns from production in conjunction with the need to dispose manure manifest themselves in land prices that range far above the average price level and in the second half of the observation period they even soared further.

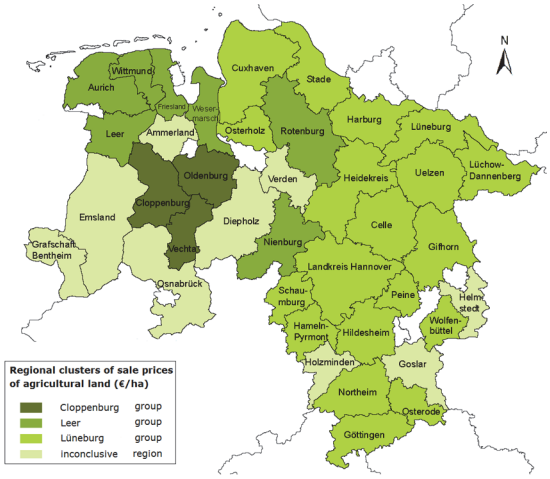

Figure 1. Homogenous regions with stationary price difference. *inconclusive regions could not be classified by the SPSM.

Conclusions

Our results contribute to the question how to measure market efficiency and market integration empirically in the case of agricultural land markets. Standard test procedures for commodity markets clearly reject the prevalence of the LOP for larger regions. This finding, however, should not instantaneously be interpreted as an indicator of land market inefficiency that calls for policy intervention and market regulation. Slow convergence of prices may simply reflect the immobility and heterogeneity of this production factor. Even temporal price divergence can be rationalized in a competitive market environment, similar to real estate markets where house prices drift apart between urban and rural areas.

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