Extended Abstract

Paper Title	**Parcel or Bundle? On the Effects of Transaction Composition on Farmland Prices**

Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.

Abstract	*200 words max*

Landowners with several parcels need to decide whether to sell their land as a bundle or each parcel separately. While transaction, search and bargaining costs may suggest cost savings from selling a bundle, for farmer buyers bundles appear less attractive. In thinly traded and locally specific farmland markets, distance cost for agricultural buyers can be price relevant, also their bargaining position. This makes the question for sellers a non-trivial one. We hypothesise that parcel bundles are less attractive, particularly for farmer buyers, and thus achieve lower prices. We investigate this hypothesis using a rich data set of 24,527 farmland transactions of single parcels and lot bundles in eastern Germany from 2000 to 2022. Doubly robust matching results indicate, on average, 6.7% lower prices for transactions of parcel bundles compared to similar transactions of single parcels. Landowners should carefully evaluate gains of selling parcels separately against time and transaction costs.

Keywords	Land market, farmland pricing, matching, hedonic model
JEL Code	Q15: Land Ownership and Tenure C21: Treatment Effect Models

Introduction	*100 – 250 words*

Farmland ownership is often fragmented, particularly in post-transition economies, where restitution has led to numerous private landowners (Hartvigsen, 2014). In our study region, the eastern German Federal State of Brandenburg, more than 170,000 private persons own 52% of farmland, on average 7 parcels per owner (Jänicke, 2023).

Landowners willing to sell need to decide whether to sell their land as a bundle or each parcel separately. In thinly traded and locally specific farmland markets, selling a bundle suggests transaction, search and bargaining cost savings. Given distance cost, farms prefer land in proximity to their farmstead (Graubner, 2018; Pennerstorfer, 2022). In bundles, not all parcels may be in preferred proximity. Potential farmer buyers may thus associate higher distance costs with spatially separated parcels, lowering their willingness to bid and pay. For non-farmer buyers, bundles may also incur higher transaction costs, e.g., finding tenants with the highest willingness to pay (Humpesch *et al.*, 2022). A parcel bundle may be attractive to buyers interested in specific parcels within the bundle. This group, however, is small, lowering competition. We hypothesise that parcel bundles are less attractive, particularly for farmer buyers, and thus achieve lower prices.

We investigate this hypothesis for Brandenburg using rich transaction data between 2000-2022. We adopt methods from causal inference to identify potential markdowns attributable to the transaction bundle. To the best of our knowledge, this question has not been discussed before. The results contribute to farmland transparency by identifying potential biases from bundles in available price publications.

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Methodology	*100 – 250 words*

We observe 17,112 transactions of single parcels and 7,416 bundles. Despite bundles and single parcels offer, on average, similar soil quality, bundles exhibit a higher transaction volume (see Table 1).

Table 1: Average transaction characteristics

	Parcel bundles (n= 7,416)	Single parcel (n= 17,112)
Price (€/m²)	0.59	0.59
Soil quality (Index)	32.95	32.32
Transaction volume (ha)	6.88	3.13

We identify the price effects of transaction composition by contrasting transactions of bundles (treated) with transactions of single parcels (control). We rely on a doubly robust two-step procedure (Ho *et al.*, 2007): In the first step, we use 2-nearest neighbour matching based on the Mahalanobis-distance to match treated and control transactions with similar land characteristics (volume and soil quality), traded in the same land market (latitude, longitude), and at the same time ($\pm$1 sales year).

In the second step, we use this matched sample in a post-matching hedonic regression to estimate average price differences between single parcels and bundles of parcels (δ^{pb}). To control for the remaining imbalances between treated and matched control units, we regress the log price (€/m²) on hedonic variables, agroclimatic conditions, locational factors, renewable energy intensity, and spatio-temporal control variables (see Table 2 for the complete list of x). For the functional form, we rely on the Box-Cox procedure, which has shown to reduce omitted variable bias (Kuminoff *et al.*, 2010).

$$log(price_i) = f(x_i'\beta) + \delta^{pb} d_{i,pb} + \varepsilon_i$$

The post-matching regression is estimated with weighted least squares where the weights reflect the matching frequency obtained in the first step. We analyse the robustness of our results with different matching algorithms and various subsamples.

Results	*100 – 250 words*

We match 7,416 treated with 7,707 control units at sufficient quality (see Figure 1). The standardised mean difference for all matching variables is below the recommended threshold of 0.1 (Stuart, 2010). Matched pairs are on average 12.96 km apart, i.e., treated and matched control transactions likely occurred in similar market environments.
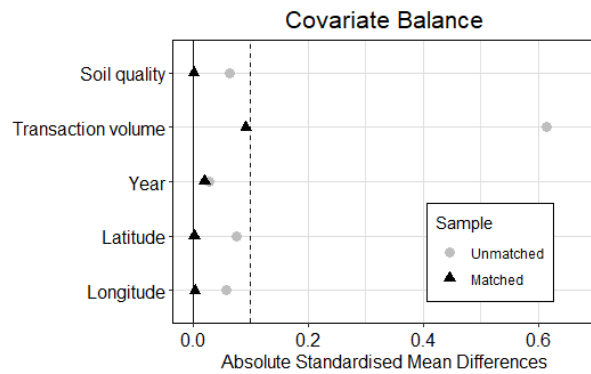
Figure 1: Matching quality

The post-matching regression shows that transactions of multiple parcels as a bundle achieve on average 6.7% lower prices than similar transactions of only one parcel. The 95%-CI based on standard errors clustered at the municipal level ranges from -8.0% to -5.5%, indicating some statistical uncertainty but robust negative effects. Effect sizes and signs of other variables are in line with other studies (e.g., Balmann *et al.*, 2021).

Table 2: Post-matching regression

	$log(Price\ in\ €/m^2)$	
Intercept	−0.688	(−1.932, 0.556)
Lot characteristics		
$\sqrt{\text{Soil quality}}$	0.112	(0.083, 0.140)
$\sqrt{\text{Transaction volume}}$	0.033	(0.018, 0.049)
$(\text{Transaction volume}/10)^2$	−0.016	(−0.025, −0.007)
$(\text{Soil quality}/10)^2$	−0.0003	(−0.004, 0.003)
Soil quality*Transaction volume/10	0.002	(0.001, 0.003)
Agroclimate		
Precipitation	−0.046	(−0.091, −0.0004)
Precipitation^2	0.0004	(−0.00003, 0.001)
Drought index	−0.131	(−0.383, 0.122)
Drought index^2	0.029	(−0.012, 0.071)
Location		
Metropolitan region Berlin	0.235	(0.201, 0.269)
Close to settlement	0.072	(0.056, 0.089)
Distance to center/10	0.062	(0.042, 0.082)
$(\text{Distance to center}/10)^2$	−0.007	(−0.010, −0.005)
Share UAA	0.003	(0.002, 0.003)
Share settlement	0.001	(−0.0001, 0.003)
Renewable energy		
Biogas density	0.013	(0.008, 0.019)
Wind density	0.001	(0.0005, 0.002)
Treatment		
Parcel bundle	−0.067	(−0.080, −0.055)
Weights	Yes	
County and year controls	Yes	
Treated	7,416	
Observations	15,123	
Adjusted R^2	0.707	

Note: Dependent variable is the log transaction price in €/m² deflated to Q4/2018 values using a quarterly GDP deflator of the German statistical office. 95%-Confidence intervals are based on heteroscedasticity-consistent standard errors clustered at municipal level and are reported in parentheses.

Discussion and Conclusion	***100 – 250 words***

Our findings indicate that bundle transactions achieve, on average, -6.7% lower sales prices compared to single parcel transactions with similar characteristics. This can be interpreted as the result of reduced competition and a lower willingness to pay for spatially separated farmland in bundles. Additional costs for parcels without options for alignment with a farm's operated farmland may outweigh gains from other parcels in a bundle (Latruffe and Piet, 2014). Compared to a situation where all parcels would have been sold individually, this corresponds to foregone revenues of 22 million € for private sellers who sold as a bundle in our sample.

Our study offers evidence of the transaction composition's impact on land prices. We suggest to offer this information in price publications and official statistics to prevent biases in future price formation (Seifert and Hüttel, 2023). Landowners and professional sellers may carefully evaluate gains of selling parcels separately against time and transaction costs. It might be worth considering an option for partial sales of parcels from the bundle.

As with every study, we acknowledge the following limitations: First, we lack detailed information about other parcels included in a bundle (e.g., size or distance to the main parcel). Second, unobserved heterogeneity may confound the treatment effect estimate, for instance, if a single parcel was bought for some specific reason other than farming (e.g., horse breeding). For more detailed insights, we want to explicitly consider the role of the local farming and farmland market structure in price formation in future work.

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