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Silke Hüttel, Simon Jetzinger
and Martin Odening

DFG-Forschergruppe 986
Strukturwandel im Agrarsektor

Herausgeber:
DFG-Forschergruppe 986, Humboldt-Universität zu Berlin
Philippstr. 13, Haus 12A, D-10099 Berlin
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Redaktion:
Tel.: +49 (30) 2093 6340, E-Mail: k.oertel@agrar.hu-berlin.de

Forced Sales and Farmland Prices*

Silke Hüttel, Simon Jetzinger and Martin Odening**
Humboldt-Universität zu Berlin

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Abstract

In this paper we analyse agricultural land prices in the German Federal State of Brandenburg within the period 2000-2011. Our objective is to understand the price formation process in foreclosures. One effect of foreclosures relates to pressured sales, which likely lead to a price discount, and another effect relates to public auctions leading to a price premium. The overall effect is derived using direct covariate matching. Our results show that on average, price premia rather than price discounts are realized in forced sales of farmland. The price differential, however, is not constant and depends on prevailing land market conditions.

Keywords: Forced sales, land prices, treatment effect
JEL-Codes: Q120, Q150, D490

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** Corresponding author

Zusammenfassung

In diesem Beitrag werden landwirtschaftliche Bodenpreise in Brandenburg analysiert. Ziel ist es, die Preisbildung bei zwangsversteigerten Flächen zu untersuchen. Die Wirkung einer Zwangsversteigerung kann in zwei Teileffekte zerlegt werden. Dem preismindernden Effekt eines Notverkaufes steht der preiserhöhende Effekt einer Auktion gegenüber. Die Kenntnis des Gesamteffekts ist unter anderem wichtig, um Beleihungswerte landwirtschaftlicher Flächen zu ermitteln. Die empirische Analyse stützt sich auf umfangreiche Einzeldaten des Oberen Gutachterausschuss für Grundstückswerte im Land Brandenburg zwischen 2000 und 2011. Um den Treatmenteffekt der Zwangsversteigerung kausalanalytisch erfassen zu können, wird ein Matchingverfahren angewendet. Es zeigt sich, dass bei Zwangsversteigerungen im Durchschnitt keine Preisabschläge, sondern Preisaufschläge gegenüber vergleichbaren, nicht zwangsversteigerten Flächen realisiert werden. Allerdings sind die Preisdifferenzen nicht konstant, sondern variieren in Abhängigkeit von der Lage auf dem Bodenmarkt.

Schlüsselwörter: Zwangsversteigerung, Landpreise, Treatmenteffekt

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1 Introduction

This paper is motivated by the simple but not trivial question: What is a reasonable mortgage lending value for agricultural land? It is essential for creditors to know this value when offering loans to farmers, since the mortgage lending value constitutes an upper limit for the loan. The idea behind this premise is that the mortgaged land can be sold at any time within the loan contract period, at least at the mortgaged lending value in case of a loan default. A starting point for deriving the mortgage lending value is the sale value (liquidation value) of land, which, in general, will deviate from bookkeeping values. The mortgage lending value, however, is usually smaller than the current sales value. There are at least two reasons to justify this price-shaving: first, the future sale value in the contract period is random and thus a risk-averse lender will discount the current sales value as a precautionary measure. Second, in case of a credit default, the liquidation of the mortgaged land will be a forced sale that takes place within a bankruptcy proceeding. It is frequently supposed that realized prices in forced sales are lower compared to "normal" land market transactions where sellers are not under financial stress (e.g., ALLEN and SWISHER, 2000). In this paper we focus on the second argument, that is, we want to explore if there is really a price discount in forced sales and if so, how large it is. This question has to be answered empirically. For that purpose we analyse land price data in the Federal State of Brandenburg that have been realized in forced sales from 2000-2011, and compare them with prices of unforced sales in that state. A direct comparison of these two groups and the identification of a forced-sales-effect is challenging for several reasons. First, land characteristics vary between the sold land plots and one must control for these differences carefully. Second, the land market in East Germany evolved dynamically within the last decade, showing high rates of price increase. This development may cover a price discount of forced sales. Finally, there might exist a self-selection problem such that land being sold in foreclosure auctions differs systematically from land in a control group. Thus, we have to create a proper counterfactual. The statistical approach that we pursue in this paper accounts for all three problems.

The paper is organised as follows: We start with a literature review in order to provide a theoretical foundation for our hypothesized impact of forced sales. Next, we briefly describe the land market in Brandenburg and the legal environment under which forced sales are carried out, followed by a description of our data. Section 4 discusses two statistical approaches and their respective results. The paper ends with conclusions about the determination of mortgage lending values for agricultural land.

2 Previous Research and Derivation of Hypotheses

Three strands of literature are relevant for our research question. The first one deals with the pricing of farmland. The objective of this strand is to identify factors that determine the level of land prices. Knowledge of these factors is helpful for understanding price differentials in cross-sectional data. This kind of analysis is usually conducted in a hedonic pricing framework (cf. PALMQUIST and DANIELSON 1989). HUANG et al. (2006) classify factors that are commonly used in hedonic studies on land prices into four groups, namely productivity characteristics, neighbourhood characteristics, location and environmental characteristics. Almost all empirical studies on farmland values include a measure of soil quality and parcel size to capture productive capacity (e.g., XU, MITTELHAMMER and BARKLEY, 1993). MENDELSON, NORDHAUS and SHAW (1994) focus on the effect of climatic variables on farmland values. For example, population density and per capita income are frequently used to represent non-farm factors and competing potential land uses. Location characteristics are, for example, distance to large cities, and environmental variables may refer to swine farm density or the number of biogas plants in a region (cf. BREUSTEDT and HABERMAN, 2010). Moreover, almost all recent hedonic studies on land prices emphasize the necessity of properly dealing with spatial effects (cf. PATTON and MCERLEAN, 2003).

The second strand of literature discusses the impact of forced or pressured sales on asset prices. It is consensually argued that knowledge about the fact that the current owner faces an urgent need to dispose of the asset for liquidity or health reasons leads to a price discount compared to unpressured sales (ALLEN and SWISHER, 2000). The decisive point here is that the asset market may face a temporal and/or regional illiquidity so that additional supply lowers the market clearing price. This effect is less pronounced in a booming market that is short in supply. Empirical evidence for this conjecture is provided by CAMPBELL et al. (2009) for the U.S. housing market. Further reasons for price discounts are vandalism or protection costs as long as houses are vacant. These reasons, however, are specific to the housing market and do not apply to the land market, where land does not usually fall idle before a forced sale. Analyses of pressured land sales in agriculture are rare. An exception is KING and SINDEN (1994) who surprisingly find no significant price discount in the Australian land market.

The third strand of literature analyses the role of the respective market mechanism in price formation. This literature is relevant here, because pressured sales are usually carried out in the framework of an auction. Therefore, it is necessary to disentangle two effects when analysing empirical price data: first, the impact of time and liquidity constraints of the seller, and second, the influence of the market mechanism. The latter aspect has been discussed in the auction literature both theoretically and empirically. LUSHT (1996) compares house prices realized in (English) auctions with prices that came out in private negotiations: He finds that prices brought out on auctions were about 8 per cent higher compared with private house sales. This finding is questioned by MAYER (1995, 1998), who argues that if auctioned assets sell at higher prices than in search markets, both market mechanisms could not co-exist because auctions also allow one to sell the asset sooner. Thus, sellers were always better off using auctions. Using data from real estate auctions in the U.S., MAYER finds price discounts for auctioned properties. These price discounts, however, are not constant over time. Rather, price discounts on auctions are relatively large in downturn markets and they almost vanish in booming markets. Significant price discounts on auctions are also reported by ALLEN and SWISHER (2000). However, QUAN (2002) offers a theoretical explanation for why auctions could offer price premia relative to search markets. He derives a partial equilibrium model where buyers and sellers can choose between an auction and a search market as a mechanism for real estate disposition. In equilibrium it is optimal for buyers incurring high search costs to attend an auction instead of participating in the search market. Due to this self-selection, buyers are willing to pay higher prices at auctions.

To sum up, there is no clear prediction on the size and the sign of a price discount/premium for enforced land sales from auctions. While it is undisputed that pressured sales will result in lower prices, this effect might be (over)compensated by using auctions as a market mechanism. In any case we expect price discounts to be lower in prospering market conditions.

3 Forced Sales in the Federal State of Brandenburg

3.1 Legal Framework of Forced Sales in Germany

In Germany, forced sale (or foreclosure) is a tool for creditors (e.g., banks) to dispose of loan securities whose debtors (e.g., farms) default on their debt service. Here, we focus on debtors who mortgaged their agricultural land. Important parameters in a forced sale process are the calculation of the regular market price, the minimum bid and the auction date, as well as the date of bid acceptance and the date of ownership transfer. Stakeholders in a forced sale process are the court-appointed appraiser, the judicial officer, the creditor and his estate agent (KOLKMANN, 2010). The responsibility of the appraiser is to calculate the open market price. This price is highly relevant because the expected price of the bidders and creditors aligns to the open market price estimation of the expert. The minimum bid marks the starting value of a forced sale auction, and takes into account the costs of the foreclosure, as well as the permanent rights of third persons to the farmland, e.g. the rights of way. The judicial officer guides the whole forced sale process; his principal duty is conducting the auction. In addition, the judicial officer is responsible for the period between initial request and the actual auction appointment. The appointment for the forced sale auction must be published at least six weeks and not earlier than six months prior to the auction date. The announcement of the forced auction is regularly distributed through an electronic information system or through newspapers that are appointed by the responsible court (§36(2), §39(1) & §43 (1) GESETZ ÜBER DIE ZWANGSVERSTEIGERUNG UND DIE ZWANGSVERWALTUNG (ZVG), last Revision 07.11.2011). Furthermore, the judicial officer must ensure a fair process for all participants. In most cases there is more than one creditor, but regularly the principal creditor is a bank because it normally has the largest amount of outstanding accounts.

3.2 Data and Descriptive Statistics

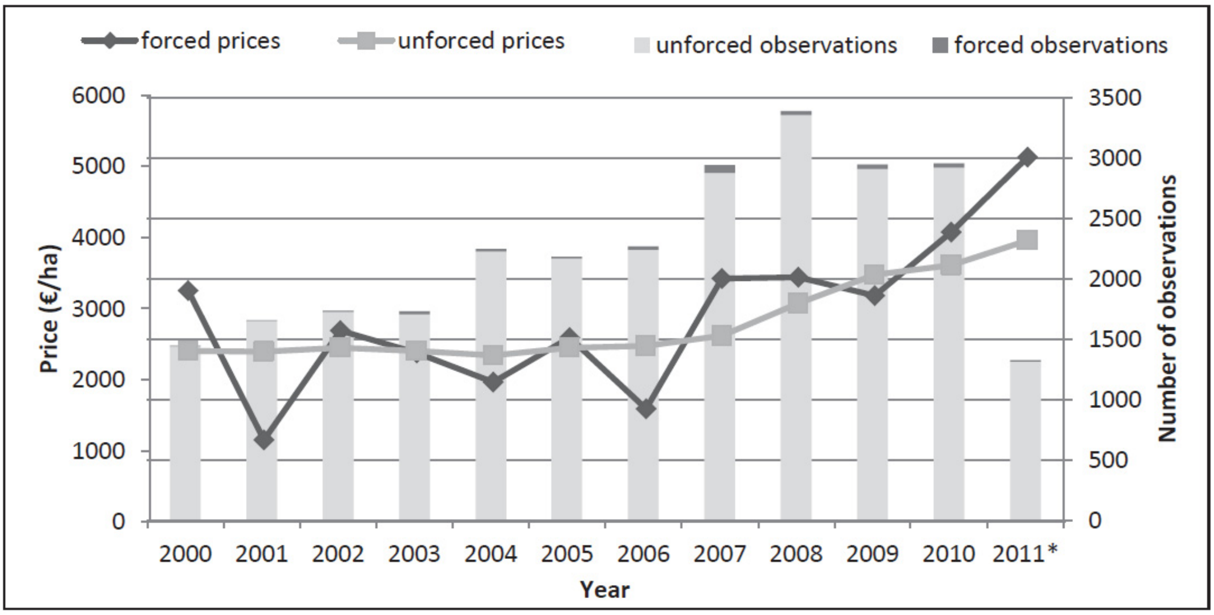
In general, farmland is an immobile and scarce production factor, and since all land is in use, land is only available on the market if some farms quit from agriculture and sell or lease their land. In the East German federal states, the land market has some peculiarities since the formerly state-owned land is privatized and sold by public auctions. The main seller on behalf of the German Ministry of Finance is the “Bodenverwertungs- und -verwaltungs GmbH” (BVVG). Moreover, the East German farmland market is a dynamically evolving market and offers an interesting opportunity to analyse farmland prices with several suppliers. The Federal State of Brandenburg seems representative here since land price data for Brandenburg are provided by the official committee of valuation experts for land “Oberer Gutachterausschuss für Grundstückswerte im Land Brandenburg”.[1]

The dataset contains information about land prices, soil quality, plot size and the date of sale. The observations can be classified into unforced sales and forced sales. The latter includes only cases with a foreclosure procedure. In the following we consider this group as the treatment group. The control group contains all other forms of land transactions, such as the ‘normal’ market sales that take place if one farmer ceases production and offers land either through a non-public auction or via negotiations with other farms, and also sales from auctions within the privatization process. This implies that in both groups – forced and non-forced sales – we observe prices from public auctions: the procedure of forced sales, and the auctions within the privatization process. Unfortunately, it is not possible to identify the BVVG land sales in the data. As a consequence, we cannot explicitly identify the effect of the public auction itself. The original data have been modified in several ways prior to our analysing the impact of forced sales. First, so-called unusual sales have been removed. These include transactions between relatives or similar cases which are supposed to be not representative for regular price building. This left us with 58,464 observations representing a total traded area of 324,145 hectares. Unfortunately, we had to omit more than half of the remaining observations due to missing information about price-relevant factors, e.g., soil quality. Furthermore, we eliminated observations which were sold at a price of exactly 1.00 €/m² since these observations can be assigned to highway compensation procedures (i.e., farmers who are forced to sell their land due to highway construction and receive a fixed compensation in return). We also exclude outlier observations in which land is expected to be used for residential development. Overall, the final sample includes 26,786 observations with a traded area volume of 116,787 hectares from January 2000 to September 2011. This makes up a share of about 46% of the original observations and 36% of the sold area during that period. The number of forced sales within this sample adds up to 284 (1%) observations over the entire period.

[1] Each federal state in Germany has such a committee endowed with some administrative power. Their task is to ensure market transparency by collecting all agricultural land sales prices and providing standard land values, which are disseminated through an annual market report. Moreover, this committee also provides expert opinions with regard to specific land values.

As shown in Figure 1, the farmland prices increased rapidly over the last 5 years. Figure 1 also depicts the price development of forced sales; they seem to be more volatile compared to non-forced sales over the years, which might also be partly due to the low number of observations. It can be further seen that prices start to increase from 2006 on, and in the last two years the prices are much higher compared to non-forced sales. This provides a first impression of the price differences between forced and unforced sales; it seems that there is no discount on forced sales. Both groups, however, may differ in price-relevant factors, so that a direct comparison may be misleading.

Figure 1. Development of farmland prices (Brandenburg)



2011: Observations only until September.

Source: Own calculations, data provided by OBERER GUTACHTERAUSSCHUSS BRANDENBURG.

Table 1 shows the descriptive statistics of the crucial farmland characteristics for the non-forced and the forced sales (treatment) group. Note that soil quality is measured on a scale from 1 to 102, which reflects the soils' productive capacity. The mean price of forced sales is higher; however, it also shows a higher standard deviation. Soil quality does not differ much between the groups, and interestingly, the average plot size is higher in the non-forced sales group. Note that forced sales occurred later in time, on average, than the non-forced sales, and thus they may be driven by the general market price increase since 2006.

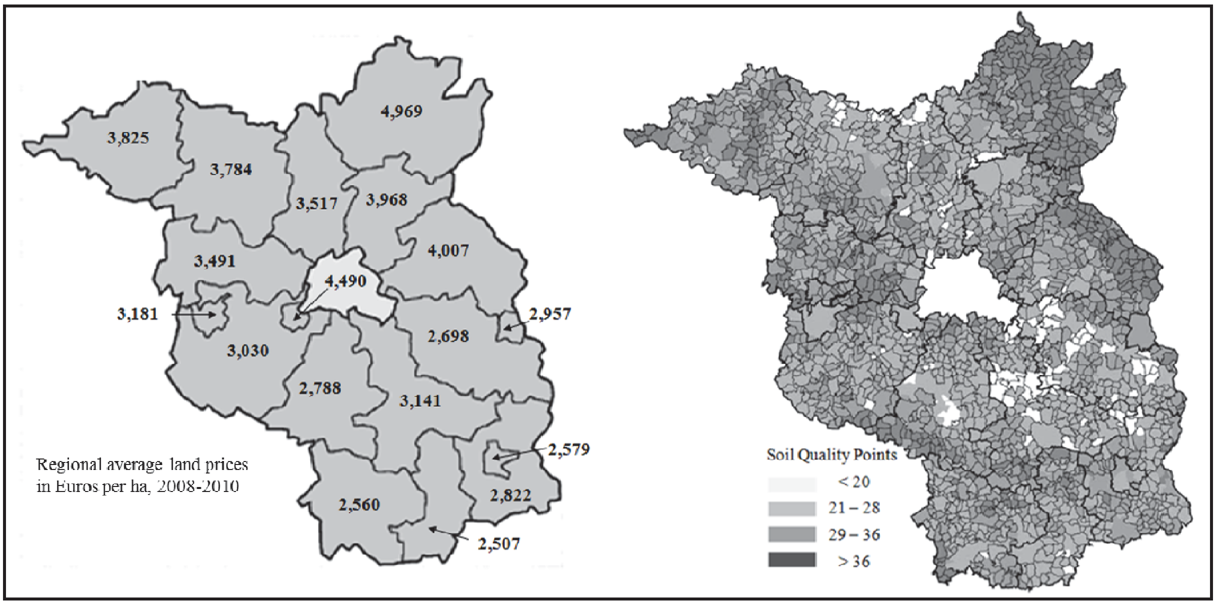
Table 1. Summary statistics of the farmland prices and characteristics

Group	Statistic	Price (€/hectare)	Soil quality arable land	Soil quality grassland	Area (hectares)
Non-forced sales N=26,502	Mean	2,844	26.34	25.51	4.38
	Std. deviation	1,572	11.19	7.03	10.22
	Min.	58	1	1	0,01
	Max.	19,397	80	60	427.77
Forced sales N=284	Mean	3,074	26.98	23.46	3.08
	Std. deviation	2,588	11.01	6.15	5.82
	Min.	154	1	8	0.01
	Max.	20,835	72	40	47.56
Total N=26,786	Mean	2,847	26.34	25.49	4.36
	Std. deviation	1,586	11.19	7.02	10.18
	Min.	58	1	1	0,01
	Max.	20,835	80	60	427.77

Source: Own calculations based on data from OBERER GUTACHTERAUSSCHUSS BRANDENBURG (2000-2011).

Figure 2 shows average prices for the years 2008-2010 for each county (Landkreis) in Brandenburg on the left-hand side. In addition, the right-hand side of this figure depicts the average soil quality points. Apparently there is a strong relation between soil quality and the price for agricultural land. In the north-east of Brandenburg, a higher average soil quality is observed, accompanied by comparably higher land prices. Visual inspection of the regional distribution of the land prices in Figure 2 suggests the existence of spatial dependency in this variable. Farmland plots with rather low prices are concentrated, and form low-price regions. It is also very likely that high land prices occur in high-price regions, i.e., neighbouring plots are also very likely sold at a high price level. In other words, there is no chessboard structure where high and low land prices are observed within smaller regions. The same holds for high-price regions. Similar findings are reported in previous studies on hedonic land pricing (e.g., PATERSON and BOYLE, 2002; PACE et al., 1998) describe similar phenomena. Unfortunately, we are unable to test for possible spatial correlation in the prices, since no spatial coordinates of the land plots are available in the data. In the subsequent analysis spatial dependence is taken into account by controlling for soil quality, and we additionally introduce county dummies when explaining the land prices.

Figure 2. Mean price (2008-2010) per county (Landkreis) and average soil quality in Brandenburg



Source: Own calculations; data provided by OBERER GUTACHTERAUSSCHUSS BRANDENBURG and LANDESAMT FÜR LÄNDLICHE ENTWICKLUNG, LANDWIRTSCHAFT UND FLURNEUORDNUNG.

4 Model and Results

4.1 Modelling the Treatment Effect

Based on insights from the literature review, it is very likely that two main but reversing effects are present when analysing forced sales. First, the public tender ensures market transparency and thereby increases the number of potential bidders. This may induce a positive price effect. Second, the procedure of a forced sale under time pressure may induce a negative effect. As mentioned above, our data set does not allow us to distinguish between forced auction sales and auction sales that occur, for instance, with the privatization of formerly state-owned land in East Germany. Thus, we can only determine the effect of a forced sale within a public tendering procedure and it is not possible to isolate those effects. To measure the impact of a forced sale on the farmland price, there is a need to create a counterfactual situation, i.e., what would have been the price if the land was not sold as a forced sale via a public auction? The potential price for a plot of land that was sold under forced sales conditions is never observed under non-forced conditions. Such observations are only available within experiments and hence, direct estimates of the individual forced-sales effects are not possible. Thus, we refer to the estimation of aggregated causal effects (MORGAN and WINSHIP, 2007).

In the following we use the terms of control (unforced) and treatment (forced) states. Since a plot of land cannot be observed at the same time as a non-forced and forced sale, we define an indicator variable d_i with:

$$d_i = \begin{cases} 1 & \text{if forced, and} \\ 0 & \text{otherwise} \end{cases}$$

where *i* indexes[2] the observations. The observed price can thus be written as:

$$p_i = d_i \cdot p_i^1 + (1-d_i) \cdot p_i^0$$

wherein the respective prices are accordingly denoted by p^1 (forced sales price) and p^0 (non-forced sales price).

We distinguish between the expected average treatment effect (ATE) and the average treatment effect on the treated (ATT). The ATE is defined as the difference between the expected prices in the treatment and control group:

(1) $$ATE = E[p^1 \mid d=1] - E[p^0 \mid d=0]$$

where $E[p^1 \mid d=1]$ denotes the expected price under forced sales conditions and $E[p^0 \mid d=0]$ the expected price under non-forced sales conditions. The ATT is defined as follows:

(2) $$ATT = E[p^1 - p^0 \mid d=1]$$

where $E[p^0 \mid d=1]$ denotes the expected hypothetical outcome of an observation in the treatment group under the assumption of the control state, i.e., the possibly-realized price for a plot that was sold via a forced-sale under normal (non-forced sales) conditions. The challenge now is to estimate the ATT. We are able to control for differences in plot size, quality or date of sale, but we cannot observe both outcomes for the same plot of farmland. This means we need to find a good estimate for the ATT conditional on the covariates using $E[p^0 \mid \mathbf{x}, d=1]$, which denotes the expected price of a plot that was in the forced-sales group under non-forced sales conditions conditional on the *k* covariates summarized in the $(k \times 1)$-vector $\mathbf{x}$.

Under the so-called conditional independence assumption (CIA) the treatment assignment while controlling for the covariates must be independent from the respective outcome. It follows that $E[p^0 \mid \mathbf{x}, d=0]$ equals the hypothetical price $E[p^0 \mid \mathbf{x}, d=1]$, i.e., the price and its expectation are equal no matter whether the piece of land was initially in the forced sales (treatment) group. This is why land sold via a forced-sale procedure does not affect the finally

[2] In what follows we will suppress the subscript *i* where possible.

realized price via the auction. This assumption is rather strict; in either case, we could not account for possible factors since such information is not available. Still, there might be some unobserved factors like regional patterns in the land market that may affect both the treatment assignment (being a forced sale) and the outcome (realized price). This means we cannot rule out any bias from omitting factors that affect both, even though we assume this bias to be low since the main determinants for the treatment assignment are not related to the plot of land itself.[3] The challenge is that only under the CIA can the ATT be consistently estimated, otherwise the 'selection bias' occurs. The latter becomes apparent by expanding equation (1):

$$\begin{aligned} &E[p^1 \mid d=1] - E[p^0 \mid d=1] + E[p^0 \mid d=1] - E[p^0 \mid d=0] \\ &= \underbrace{E[p^1 - p^0 \mid d=1]}_{ATT} + \underbrace{E[p^0 \mid d=1] - E[p^0 \mid d=0]}_{selection\,bias} \end{aligned} \tag{3}$$

In what follows we refer to two approaches to derive the ATT. First we define the counterfactual model, also known as potential outcome model, based on a regression analysis. Thereby, we estimate a price function for the control group and use the estimates to predict a hypothetical price using the forced sales observations. This approach ignores the selection bias; however, since we presume this bias to be low and cannot define any instruments, the ATT will be biased, though at a moderate level. Second, we refer to a matching procedure (nearest neighbour). The idea is to select close observations with similar characteristics defined through the covariates such that the counterfactual is taken from the observation sample.[4] This implies that for each forced sale observation, we seek a matched counterfactual price to directly compare the means. A rather simple mean comparison would be naïve, since it would neglect possible differences in the land characteristics such as soil quality and plot size.

4.1.1 ATT using Price Regressions

Deriving the ATT using price regressions in its simplest way would be just adding the indicator d_i as a dummy variable (additive or shift effect); however, this neglects different pricing mechanisms. This in turn leads to differing relations between the price and the characteristics of land (multiplicative effect). In both cases the possibly endogenous treatment indicator would not be accounted for. Since we have no information about reasons for the forced-sale and regional peculiarities that may affect both the treatment assignment and the outcome, it is impossible to control for the treatment decision. We proceed in a different way and estimate the price function using the observations from the control group. The estimated coefficients of the price function are then taken to predict a hypothetical price for the forced sales data. This creates counterfactual observations for the treatment group. The regression equation is defined as:

[3] See WOOLDRIDGE (2002) and the cited literature therein for further details.

[4] An excellent overview is given by HENNING and MICHALEK (2008).

(4) $$p_i^0 = \mathbf{x}_i^0 \beta^0 + u_i^0$$

where $\mathbf{x}_i^0$ denotes the *i*-th row (observation) of the matrix of covariates containing soil quality, plot size, as well as regional county (Landkreis) and year dummies. Symbol u_i^0 denotes the error term assumed to have a zero mean and being uncorrelated with the covariates. The hypothetical price of the forced sales under non-forced conditions is derived using

(5) $$E[p_i^0 \mid d_i = 1] = \frac{1}{n^1} \sum_{i=1}^{n^1} \mathbf{x}_i \hat{\beta}^0$$

wherein n^1 denotes the number of forced sales observations in the data set and $\hat{\beta}^0$ the vector of estimates from the regression in (4) using the control group data. The ATT is derived as the difference between the realized price and the predicted hypothetical price

(6) $$ATT_{reg} = \frac{1}{n^1} \sum_{i=1}^{n^1} p^1 - \frac{1}{n^1} \sum_{i=1}^{n^1} \mathbf{x}_i \hat{\beta}^0$$

4.1.2 ATT using Matching

Matching procedures can be applied as an alternative to regression analysis. The idea is to compare one individual from the treatment group with the individuals from the control group by finding similar and comparable observations. In the context of matching similarity is usually measured by means of propensity scores, i.e. the probability of being treated. Formally, it would be possible to apply propensity score matching; however, from an economic perspective we face the problem of interpreting the propensity score as a probability without data about the initial land owners and users, which seems crucial to explain the probability of being forced to sell land within a foreclosure. We apply direct covariate matching that allows us to find comparable pairs of observations from the treatment and control group with similar characteristics based on covariates like soil quality or size. The challenge is to define similarity between several covariates describing the characteristics of the plot, which in turn are crucial determinants for the realized prices. We use the Mahalanobis distance as a metric to define the similarity between the plots. The Mahalanobis distance reduces the dimensionality since it measures the distance between two observations based on the covariates in a one-dimensional metric. To ease notation we denote from here onwards the forced sales observations with $i = 1,...,n^1$ and the control observations are indexed with $j = 1,...,n^0$. Since for each treated observation the distance to each of the non-treated observations must be calculated, this results in a ($n^0 \times 1$) vector of distances for each treated observation i. The Mahalanobis distance between observation *i* and *j* is defined as follows:

(7) $$M_{ij} = (\mathbf{x}_i^1 - \mathbf{x}_j^0)'\Sigma_{\mathbf{x}}^{-1}(\mathbf{x}_i^1 - \mathbf{x}_j^0)$$

where $\Sigma_{\mathbf{x}}$ denotes the variance-covariance matrix of the covariates correcting for correlation of the covariates. Symbol $\mathbf{x}_i^1$ denotes the i-th row of the ($n^1 \times k$) matrix of covariates of the treated observations (indicated by 1) and $\mathbf{x}_j^0$ denotes the j-th row of the ($n^0 \times k$) matrix of covariates of the non-treated observations (indicated by 0). This metric takes into account the correlation between covariates and it has the "equal per cent bias reducing" property (RUBIN, 1980). Another advantage is its straightforward implementation.[5]

Based on this distance measure it is possible create a matched price for a plot that was sold under forced-sales conditions ($\hat{p}_i^{matched-0}$) using the outcome(s) of one or some similar plots for which prices are observed in the control group.

$$\hat{p}_i^{matched-0} = \sum_{j=1}^{n^0} w_{ij} \cdot p_j^0$$

where w_{ij} denotes the weights on the non-treated j being a comparison with the treated observation i and its definition depends on the respective matching algorithm. The average treatment effect of the treated is then given by (MORGAN and WINSHIP, 2007):

(8) $$ATT_{match} = \frac{1}{n^1}\sum_{i=1}^{n^1}\left[p_i^1 - \hat{p}_i^{matched-0}\right]$$

We use a Kernel matching algorithm which includes all control observations to construct the counterfactural for each treatment case. The weights w_{ij} are calculated using the Kernel-function of the Mahalanobis metric, $K\left[M_{ij}\right]$. Here we use the Gaussian distribution as a Kernel function. The weights are defined as follows:

$$w_{ij} = \frac{K\left[{M_{ij}}/{h}\right]}{\sum_j K\left[{M_{ij}}/{h}\right]} = \frac{\exp\left[\left(-\left({M_{ij}}/{h}\right)^2\right)\cdot\left(\sqrt{2\pi}\right)\right]}{\sum_j\left[\exp\left[\left(-\left({M_{ij}}/{h}\right)^2\right)\cdot\left(\sqrt{2\pi}\right)\right]\right]}$$

where h denotes the bandwidth parameter; it controls for the smoothness while estimating the weights.

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5 We use STATA 12 and the command psmatch2 developed by LEUVEN and SIANESI (2005).

4.2 Results

Starting with the derivation of the ATT based on regression results, we proceed as follows. We use the observations from the control group and estimate a price function. The price regression includes characteristics like quality of arable land and grassland, plot size, the squared plot size, year dummies in reference to 2000, and in order to reduce the possible spatial correlation, county dummies (Landkreise) were considered.[6] BoxCox[7] testing results reveal a log-linear model, i.e., we regress the logarithms of the land prices per square meter on the explanatory variables:

$$(9) \qquad \ln(p)_i = \beta_{AZ} AZ_i + \beta_{GZ} GZ_i + \beta_{area} area_i + \beta_{area2} area_i^2 + \sum_{l=1}^{18} \gamma_{county,l} D_i^l + \sum_{t=2001}^{2011} \gamma_{year,t} D_i^t + e_i$$

where *l* indexes the respective 18 counties in Brandenburg and *t* indexes time. The variables *AZ* and *GZ* denote the soil quality for arable and grassland, respectively, while *area* denotes the plot size and e_i denotes an error term.

The coefficient estimates for all β- and γ-parameters are given in table 2. The majority of the variables is significant at the 1% level (superscripted by ***). We used robust standard errors to account for possible heteroskedastic variances. Referring to Figure 1, it is not surprising that the year dummies from 2001 to 2006 are not significant, but price increases from 2007 onwards can be shown to be significant. The R-squared is rather high, at 0.90. Still, there might be some spatial correlation present which could not be accounted for.

6 As mentioned above, possible spatial correlation cannot be considered using spatial econometric techniques since no plot-specific spatial coordinates are available.

7 Details of this procedure can, for instance, be found in DAVIDSON and MACKINNON (2004).

Table 2. Regression results

Dependent Variable **Log price (€/m²)**	**Coefficient estimates**	**P-value**
Soil quality arable land (A*Z*)	0.006	0.000***
Soil quality grassland (*GZ*)	-0.002	0.000***
Area (hectares)	-0.002	0.000***
Area squared (hectares)	1.33e-05	0.001***
D^{2001}	-0.016	0.364
D^{2002}	0.013	0.462
D^{2003}	0.026	0.163
D^{2004}	-0.008	0.631
D^{2005}	0.0175	0.305
D^{2006}	0.025	0.133
D^{2007}	0.086	0.000***
D^{2008}	0.237	0.000***
D^{2009}	0.375	0.000***
D^{2010}	0.426	0.000***
D^{2011}	0.498	0.000***

Source: Own calculations based on data from OBERER GUTACHTERAUSSCHUSS BRANDENBURG (2000-2011).

The naïve mean comparison as shown in section 3.2 corresponds to the ATE of about 230 €/ha (all years). Based on the parameter estimates for the covariates, we predict a hypothetical price using only the forced sales observations. The mean difference between the hypothetical price from the prediction and the realized forced sales price is 600 €/ha. This effect corresponds to the average treatment effect of the treated. We further expect these effects to vary over time. In Table 3, the predicted hypothetical price and the means of the annually observed prices of both groups and the ATT are shown.

Table 3. Predicted hypothetical price and observed price for the forced sales group

Year	Hypothetical price (€/ha) (1)	Observed price forced sales (€/ha) (2)	Observed price non-forced sales (€/ha) (3)	Price difference (€/ha) (2)-(1)
2000	2,354	3,246	2,400	892
2001	2,445	1,151	2,390	-1,294
2002	1,958	2,692	2,450	734
2003	2,075	2,368	2,400	293
2004	1,878	1,960	2,340	82
2005	1,969	2,595	2,450	626
2006	2,279	1,589	2,470	-690
2007	2,237	3,418	2,620	1,181
2008	2,584	3,437	3,070	853
2009	2,902	3,183	3,470	281
2010	3,295	4,070	3,610	775
2011	3,159	5,125	3,960	1,966
Total	2,475	3,075	2,844	600

Source: Own calculations based on data from OBERER GUTACHTERAUSSCHUSS BRANDENBURG (2000-2011).

The message of the ATT concerns the price difference depending on the state (forced or unforced) of one forced observation, and therefore expresses the pure impact of the auction under compulsion. The ATE instead reveals the difference without any adjustments concerning other price-influencing factors like soil quality and plot size. As we observe that the ATE is smaller than the ATT, we conclude that forced sales are more expensive, even though their characteristics seem to have a lower price-increasing force compared to the characteristics of the unforced sales. In other words, the positive forced sale effect exceeds the effect of other characteristics.

We now compare the results based on the regressions to the findings based on matching. The Mahalanobis metric was calculated with regular price-influencing factors like soil quality, plot size (without the squared version), day of transaction, county dummies and the principal characteristic (arable or grassland). In contrast to the regression analysis, we consider the time differently; we use time as a continuous variable since we expected to have more precise matches with respect to time. The smaller the Mahalanobis metric between two observations is, the more similar are the two observations concerning the mentioned factors. Based on the Kernel matching algorithm using the Gaussian Kernel function, we find on average an ATT of 282 €/ha over the years. It should be noted that 3 observations are not within the common support range, i.e., their covariates differ that much from the observations in the control group that those could not be matched. The Kernel matching approach also carries out a positive forced sale effect, but the extent is only half of the ATT of the regression model. Since in the Kernel matching algorithm all observations from the control group are used to construct the weights the ATT may be interpreted as the difference between the treated prices and the weighted average of the non-treated ones. The derived price differences show more years with a negative effect but confirm the positive effect from 2007 onwards. The results are shown in Table 4.

Table 4. Mean observed prices and matched price observations using the Mahalanobis distance and Kernel matching (Gaussian Kernel, *h*=0.06)

Year	Matched price using M_{ij} (1)	Observed price forced sales (2)	Observed price non-forced sales	Price difference (2)-(1)
2000	2,764	3,246	2,410	744
2001	1,985	1,151	2,390	-835
2002	2,311	2,692	2,450	508
2003	2,477	2,368	2,400	-110
2004	2,355	1,960	2,340	-395
2005	2,177	2,595	2,450	412
2006	2,409	1,589	2,470	-884
2007	2,602	3,418	2,620	815
2008	2,956	3,437	3,070	481
2009	3,134	3,183	3,470	49
2010	3,629	4,070	3,610	440
2011	3,625	5,125	3,960	1500
Total	2,805	3,075	2,844	282

Source: Own calculations based on data from OBERER GUTACHTERAUSSCHUSS BRANDENBURG (2000-2011).

5 Discussion and Conclusions

By contrasting land prices realized in foreclosures with prices from regular land sales, we found that forced sales did not sell at a discount, on average. On the contrary, according to the most conservative estimate prices, quotes in forced sales were about 300 € higher than prices in non-forced sales in Brandenburg during the last decade. This result is somewhat surprising, but not contradictory to pricing theory. As mentioned in section 2, two opposite effects interact in the price formation of foreclosures, namely the (negative) liquidity effect of a pressured sale on the one hand, and the (positive) effect of auctions on the other hand. Our results reveal that the latter effect outweighs the former in Brandenburg's land market.

Another interesting finding is that the price premium related to foreclosures is not constant over time. We rather observe substantially higher price premia since 2006, i.e., the beginning of the price boom in land markets in the new federal states. This result is in line with earlier empirical findings reported in the auction and real estate literature.

What can we conclude from these outcomes regarding our initial research question, the appraisal of mortgage lending values? In view of the documented price premium of foreclosures, it is tempting to conclude that no price shaving from regular sale values is necessary at all. This ignores, however, the variability of the price differential between forced and non-forced sales, as well as the variability in the level of land prices. In 2001, for example, land put up for compulsory sale sold at a discount of approximately 50% compared with regular land market transactions. That means if the mortgage lending value of land in 2000 was fixed at the current sales price (i.e. 2,400 €/ha on average) creditors would have suffered a considerable loss in case of a debt default in 2001. This situation is the worst case that occurred in the observation period, but extremely risk-averse debtors may consider it relevant. As a general rule, one can state that price shaving of mortgage lending values should be more pronounced in a downturn market for two reasons: first, the expected price level is likely to decrease, and second, the price difference between foreclosure prices and normal sales prices may become negative. Moreover, one can conclude that a constant discount on a current land price is usually not appropriate. One should rather adapt the mortgage lending value to the expected conditions of the land market in the credit period.

Nevertheless, these findings must be interpreted considering the limitations of the matching procedure. It was not yet possible to test whether the found differences are statistically significant. Even though matching is a popular method for evaluating many types of effects, it remains a controversial issue in the evaluation literature. The reasons for being in the forced sales group cannot be assumed to be fully independent of the price formation process in local markets. HECKMAN et al. (1998) point to the necessity of considering the economic reasoning behind the treatment, and to account in an econometric sense for the endogenous treatment variable. A further critical assumption can be seen in the additive separable treatment effect. There might exist a different price function under forced sales that could not be identified due to data limitations. Since the available data permitted us to consider more sophisticated econometric models and evaluation methods, our findings can be interpreted as a first indication of price differences in a forced sales auction procedure. Future work must further disentangle the effects for public auctions and forced sales through public auctions. Also, the regional settings in the land market need to be taken into account since we cannot exclude any interaction, nor competitive issues that may affect both the local price for land and the reasons for insolvency.

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About the authors

JProf. Dr. Silke Hüttel is juniorprofessor and holds the chair for Quantitative Agricultural Economics at the Department of Agricultural Economics at Humboldt-Universität zu Berlin. Her research interests are structural change in the agricultural sector, farm investment and disinvestment decisions and applied econometrics.

Address:
Humboldt-Universität zu Berlin
Department für Agrarökonomie
Invalidenstr. 42, Nordbau
10115 Berlin
E-mail: silke.huettel@agrar.hu-berlin.de

Simon Jetzinger is a master student at the chair for Quantitative Agricultural Economics, Department of Agricultural Economics at Humboldt-Universität zu Berlin. His work focuses on land price formation.

Prof. Dr. Martin Odening holds the chair for Farm Management at Humboldt-Universität zu Berlin. He is head of the department of Agriculture Economics and coordinator of the DFG research unit "Structural Change in Agriculture". His research activities focus on investment and finance in agriculture, risk analysis, and efficiency analyses.