Do farmland sales markets price in weak property rights enforcement? Evidence from Ukraine

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Abstract

Imperfect land-related institutions may exacerbate welfare uncertainties related to holding land and, as a result, affect land sales prices. The Ukrainian 2021 land reform launched a restricted agricultural land sales market, causing social turbulence as Ukrainians had concerns about property rights enforcement within land transactions. We argue that weak land-related institutions lead to distributional uncertainties and lower sellers' willingness to pay (WTP) and buyers' willingness to accept (WTA). Using two unique datasets from Ukraine, we estimate the effect of local institutions on farmland sales prices. We find that worse land-related institutions were associated with lower land sales prices. However, the institutional effect appears to transpire only in areas with relatively competitive land markets. The results call for a holistic approach to liberal reforms with an explicit focus on institutional quality and its promotion.

Keywords: property rights, land market, institutional quality, land concentration, Ukraine

1. Introduction and Motivation

While the significance of secure land property rights for agricultural productivity has been widely acknowledged as a stylized fact, the connection between perceived property rights and land prices is less readily apparent. The evidence on the effect of tenure security on the incentives to conduct land-related investments contributing to overall development is overwhelming (Bellemare et al., 2020; Besley, 1995; Deininger et al., 2011, 2014; Deininger & Ali, 2008; Holden & Otsuka, 2014; Li et al., 1998; Place, 2009; Rao et al., 2016). Landowners are assumed to be incentivized to invest in land if they believe they can effectively avoid expropriation (Besley & Ghatak, 2009). Moreover, there is emerging empirical evidence that landowners will be more willing to rent out their land if property rights are better enforced (Ito et al., 2016; Min et al., 2017; Wang et al., 2015). However, the incentives for landowners who wish to sell their land plots are less clear. In particular, higher perceived risks of expropriation or doubts about the long-term protection of tenure rights may push them into unfavorable deals. These transactions might manifest premature sales at prices below the economic value, or, from an aggregated perspective, can lead to an increased supply of plots in the market. Subsequently, an asymmetric lack of trust in the protection of property rights on behalf of the landowners may lead to price discounts on the land sales market. The effect of tenure security on land sales transactions has remained outside of the scholarly inquiry so far, and this study addresses this gap.

We use Ukraine's 2021 land reforms as a case study and argue that welfare uncertainties due to weak property rights enforcement represented a concern for landowners that was priced in by the newly established land markets. As a result of the de-collectivization and land distribution (privatization) during the 1990s, ca. 74% of the agricultural land was owned by ca. 7 million individuals in 2022 (Deininger & Ali, 2023). At the same time, farms typically rented land as it was the only way to access agricultural land in the absence of a sales market. Ukraine

launched a restricted farmland market on July 1, 2021. The reform process involved an active public debate among various stakeholders about the market design. One of the central criticisms of the reform was the imperfect institutional infrastructure that would facilitate the land sales market. In particular, the fear was that landowners would not be able to enforce their property rights, and powerful market stakeholders would take advantage of their weak bargaining position. The inaccessibility of legal help and the imperfect Ukrainian court system represented real barriers for citizens to enforce their property rights in case of a dispute (Nizalov et al., 2016). Large farms may be better positioned to enforce property rights in an imperfect institutional setting and use their advantageous bargaining position. Substantial land concentration may make local markets more thin and, as a result, further reduce the prices (Balmann et al., 2021). Thin markets may inhibit the effect of institutional quality which naturally relies on the assumption of a sufficient market liquidity. We discern these effects by examining the determinants of land sales prices shortly after the land reform.

This study analyzes how the quality of land-related institutions affected farmland sales outcomes after the 2021 land reform. In particular, we hypothesize that insufficient property rights enforcement, as well as land concentration before the reform, may be reflected in the farmland sales prices. We contribute to the emerging literature on the link between incomplete property rights and asset prices. A number of studies argues that informal housing arrangements in China result in lower housing prices in comparison to the formal counterparts (Cheng & Chen, 2023; He et al., 2019; Lai et al., 2017). However, to the best of our knowledge, no research has examined the property rights effect on the prices for agricultural land.

We test these hypotheses using two unique datasets from Ukraine. First, we use a country-wide representative survey of individual perceptions of the quality of land-related institutions conducted by the World Bank in 2019. Second, we use the official data from the State Service of Geodesy, Cartography, and Cadaster (SGC) on all the sales transactions across Ukraine

starting with July 1, 2021, as well as municipality-level land registration rates. These data helped us generate proxies for institutional quality and monetary metrics of the sales prices. The temporal sequence of our datasets with institutional proxies measured before the reform and prices afterward identify our models and help establish a causal link.

Estimation results suggest that the quality of institutions facilitating land relations in Ukraine is priced in by the land sales market. First, we find evidence that both perceptions of land-related institutions and land registration rates affect land prices. Second, this effect appears to be conditioned by the competitiveness of local land markets. Results highlight the imperative role of transparency and capacity not only of the political agents implementing the reform but also of the institutions facilitating the post-reform operation. This calls for a holistic approach to a reform process involving a comprehensive revision of the stakeholders involved.

2. Reform context

2.1. Evolution of Ukraine's land institutions

Ukraine stepped on a path of liberal land reforms right after gaining independence in 1991. Former collective farms were privatized via so-called "conditional land shares" (CLS) – a certificate that gave the holder a right to a certain amount of land. However, it was impossible to physically allocate this land until the late 1990s when respective procedures were developed (Lerman et al., 2007). This hasn't changed much for the restructured collective farms that continued to farm on previously utilized land despite the CLS distribution (Pugachov & Pugachov, 2017). The Presidential Decree of 1999 gave CLS-holders the right to convert their certificates into physical plots eventually creating roughly 7 million landowners.

A major breakthrough was marked by the Land Code of 2002, which clearly defined property rights for land for the first time in Ukrainian history. However, shortly after that, a moratorium for land sales was introduced prohibiting the holders of newly distributed land from selling their land plots. This left roughly 7 million landowners with two major options: either to self-

cultivate their plots or rent them out to agricultural enterprises. Without a land sales market, land rental prices were lower than the marginal product of land incentivizing large-scale cultivation with short-term business models due to tenancy uncertainties (Kvartiuk, Bukin, et al., 2021; Kvartiuk & Herzfeld, 2019). Initially thought as a temporary measure, the moratorium had been prolonged 11 times before the partial launch of the land sales market in mid-2021.

The absence of a land sales market facilitated the emergence of a dualistic agricultural sector with small and large farming modes. Ca. 20.3 million hectares were cultivated by large farms with a median size of ca. 2,000 ha, consisting of an average of 500 rental contracts (Deininger, 2020). On the other hand, 12 million ha were cultivated by households and small farms. Although they produced half of the Gross Agricultural Output, they stayed in the "shadow" of the Ukrainian political agenda (Deininger et al., 2018). Large farms, having access to foreign finance, outcompete their small counterparts in terms of using modern machinery and assembling large land holdings. Land use uncertainties played a role in the choice of crops as large farms typically focused on low-value-added bulk commodities like corn, soy, or sunflower. Higher-value crops as well as processing were a rare phenomenon.

The moratorium also affected 10.5 million ha of state-owned land that could not be privatized but was often used in a non-transparent way (Accounting Chamber of Ukraine, 2018). A small amount of state-owned enterprises often had access to this land based on outdated contracts or informal agreements making them prone to misuse (Accounting Chamber of Ukraine, 2018; Ministry of Agriculture of Ukraine, 2016). According to the 2018 audit, 51.5% of the rental contracts for state-owned land dated back before 1991 (Accounting Chamber of Ukraine, 2018). As a result, state farms were widely perceived as archaic and inefficient.

Ukrainian institutions related to property rights enforcement remained in their infancy up to the launch of the land sales market. Cadastral records were outdated and mistakes related to plot boundaries were common. Importantly, the ownership and rental rights registration process was

dysfunctional being prone to misuse. In particular, discrepancies in these registries create vulnerability to hostile land expropriation which typically has bleak prospects to be disputed in courts that typically lack public trust. These circumstances fuel the public's fears about illegal land expropriation by powerful farms also after the launch of the land sales market or forced sales at large discounts.

2.2. Land sales market design

Addressing the major societal concerns, the Ukraine government launched a highly restricted version of the land sales market. Thus, the Law on Land Circulation allowed the sales of ca. 31 million ha of privately-owned agricultural land on July 1, 2021. However, in response to the central public concern about excessive land concentration, the market was restricted to individuals with a maximum ownership cap of 100 ha. Starting with July 1, 2024, a more liberal version of the market was envisaged where all stakeholders, including legal entities, could purchase any type of land with a general ownership cap of 10 thousand ha. Because another salient concern was related to distress sales, the Law on Land Circulation stipulated that no land plot could be sold for a price below the so-called "normative monetary valuation" (NMV) of land. NMV is calculated by a pre-determined methodology and reflects soil quality and pre-set average monetary value generated by a given land area.[1] This mechanism guaranteed a minimum sales price for the landowners and intended to compensate for their weak bargaining position.

The mandate of implementing the above-mentioned restrictions (among others) was given to the Ukraine-wide network of notaries. In particular, at the time of the transaction, they were supposed to check whether an individual exceeded the 100-ha limit and check whether the sales price was below the NMV. The rollout of notary services on land transaction registration was

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[1] NMV has been used as the basis for calculation of minimal rental prices and it is not based on market signals but represents an artificial construct that served land valuation in the absence of functional land sales markets.

challenging and uneven across the country. Importantly, the notaries are mandated with the input of the sales prices in the State Registry of Property Rights on Real Estate (SRPRRE), which often does not occur.

3. Conceptual framework

A natural departure point of our analysis is the standard hedonic pricing model that is widely used in the related literature (Palmquist, 2005; Rosen, 1974). The idea is to model a plot's price P as a function of its distinct characteristics q_i: $P = (q_1, q_2, ..., q_n)$. These are typically reflected in the soil quality, location, and plot size. A central assumption of this model is the existence of a competitive markets, i.e. the participation of many sellers and buyers (Nesheim, 2008). The competitive equilibrium ensures that transactions occur at a point where the buyer's willingness to pay (WTP) aligns with the seller's willingness to accept (WTA), reflecting an equilibrium state where the price accurately mirrors the plot's intrinsic and perceived value.

Imperfect institutions may increase distributional uncertainties and push landowners into unfavorable deals. Property rights effectively allocate resources in the absence of transaction costs (Coase, 1960). However, institutions play a crucial role in reducing these transaction costs and ensuring that property rights are recognized and enforced (North, 1990). These institutions, encompassing legal, regulatory, and social norms, fundamentally shape economic interactions and outcomes (Acemoglu et al., 2004). First, the inefficiencies introduced by imperfect institutions, such as cumbersome plot registration processes, add to the transaction costs, which can further depress land prices (Djankov et al., 2002; Williamson, 1985). These transaction costs are a critical factor in market transactions, reflecting the broader economic principle that uncertainty and inefficiency impose costs that are ultimately borne by landowners and market participants (Arruñada, 2011). Second, weak property rights enforcement increases the risk of losing land and may disincentivize landowners from productive use of land (Besley & Ghatak, 2009). For instance, discrepancies in registries' records may motivate hostile overtakes and

expropriation. The risk of expropriation, a concern in many post-socialist countries, can lead to a lower WTA among sellers, as they anticipate potential losses from unclear or unenforceable property rights (Libecap & Lueck, 2011; Soto, 2000). Regardless of the mechanism, we hypothesize that enhanced institutional quality positively influences land sales prices, reflecting the premium placed on security and predictability in land transactions.

However, if land markets are less competitive, the effect of institutional quality on land prices can be significantly diluted (Deininger & Feder, 2009). If potential buyers exert market and bargaining powers, the effects of improvements in institutional quality may be offset by their incentives to utilize their position and minimize land sales prices. Thus, the presence of oligopolistic or monopolistic market structures can lead to a decoupling of land prices from the underlying institutional framework, as the bargaining dynamics overshadow the intrinsic value derived from effective property rights enforcement. As a result, we expect the institutional effect to be conditional on the local competitiveness of the land markets.

On the other hand, land concentration may generate a direct negative effect on land prices where hedonic pricing of a plot i may be directly affected by local market power (Balmann et al., 2021). Concentrated land ownership may reduce the number of potential buyers lowering the remaining buyers' WTP (Martinelli, 2014). This implies downward shifts in the hedonic price function representing price discounts not due to the lack of value in the land's attributes but due to the distorted market dynamics favoring a few powerful farms (Cotteleer et al., 2008). Moreover, the influence of large farms and concentrated land ownership extends beyond mere transactional power. In particular, it encompasses the ability to influence local politics and bureaucracies, thereby shaping the institutional landscape in which these markets operate (Mamonova, 2015; Olper, 2007; Spoor, 2012). This dynamic interaction between market power and institutional quality suggests a feedback loop where dominant market players can not only influence prices directly through their bargaining power but also indirectly by shaping the

institutional environment to their advantage. Such a situation can further entrench their market position, creating barriers to entry for new buyers and perpetuating a cycle of uncompetitive market practices that hinder the proper functioning of the land sales market. Thus, we posit that local land concentration should be associated with price discounts manifesting a direct negative effect on land prices.

4. Data and Methods

4.1. Data

To test our hypotheses, we work with two datasets to obtain proxies of institutional quality. First, we use a unique dataset based on a 2019-2020 representative country-wide survey stratified by sex, age, and employment status conducted by the World Bank. It includes all Ukrainian regions except for the occupied territories at the time of the interviews.[2] Sampling was based on the population distribution data of the State Statistics Service of Ukraine as of January 1, 2018. All of the cities with a population above 100,000 made it in the sample whereas the probability proportional to size approach was applied to sampling from the settlements with a population below 100,000 inhabitants. Respondent selection within each village or city was based on a random walk approach suggested by Bennett et al. (1994) where a random starting point was determined to select the first household. Then, the enumerators chose a random direction with a certain increment to select the next one. At the final stage of respondent selection, a random member of a household was determined.

The questionnaires contained modules on attitudes towards reforms related to land relations, their perceptions of the related institutional quality as well as political preferences and demographics. Our key explanatory variables reflect the respondents' degree of her/his agreement with the statement that "ordinary/influential people can get redress in case of their

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[2] Temporarily occupied territories are defined as separate rayons of Donetsk and Luhansk regions as well as Autonomous Republic of Crimea with borders along the contact lines before February 24, 2022

land rights violations". Based on these variables, we construct a so-called "property rights enforcement index" that measures individual perceptions of the gap between influential and ordinary people being able to defend their land rights. In particular, it is an inverse of the ratio of the two variables above with higher values indicating better perceptions of property rights enforcement. We aggregate the responses on the rayon level (similar to NUTS2 level of government and represents an intermediary level between municipalities and oblasts) to obtain a snapshot of local perceptions about land-related institutions. We use this level of aggregation because local key institutions typically operate on the rayon level: notaries, local State Service for Geodesy, Cartography, and Cadaster (SSGCC) branches, etc. On the other hand, we follow Deininger & Ali (2023) and complement our perception-based proxies with the municipality-level share of unregistered agricultural land provided by the SSGCC. Unregistered agricultural land was often associated with shadow land use and potential misuse in Ukraine. Moreover, landowners may fear tax or other state obligations in case of registration. As a result, registration rates should reflect landowners' concerns about the quality of local land-related institutions. It is important to point out that in contrast to the survey-based proxies, registration rates are calculated on the municipality level covering the whole country.

Another important source of data is the SSGCC which was mandated with publishing plot-level data on each transaction since the launch of the sales market on July 1, 2021. We include all the transactions up until the beginning of the full-scale war with Russia on February 24, 2022, which represents a large disruptive factor for the land market. The dataset includes all of the plots' characteristics including the size, location, transaction date, NMV, and, most importantly, the sales price.

Table 1 presents the descriptive statistics for the whole of Ukraine and four major parts: East, West, North, and South. We see that the land market appears to be the most active in the central parts of the country with the most of transactions. The highest prices are observed in the western

and central regions whereas the lowest are in the East and South. Importantly, we observe a number of land plots with relatively high prices close to Kyiv and Lviv which probably reflect the potential to use the land for non-agricultural purposes. Average country-wide prices totaled 46,600 UAH/ha which was equivalent to ca. 1,713 USD/ha on December 31, 2021. Median price was ca. 33,000 (1,213 USD/ha). Interestingly, the reference prices, NMV, reflecting the soil quality and agricultural revenue potential are very similar across the regions. Thus, price differences are likely to reflect regional market conditions.

We observe a substantial variation in the key explanatory variables. The perceived quality of land-related institutions is higher in the eastern regions. Thus, the property rights index as well as the average agreement with the statement that ordinary people can enforce their land rights appear to be higher in Donetska, Luhanska, and Kharkivska oblasts. We find that in the western and eastern oblasts, the shares of unregistered land are lower than in other areas. Finally, it is important to note that we use Herfindahl-Hirschman (HHI) index of owned land within a municipality as a proxy for land concentration. It is calculated by squaring the market shares of all landowners and is defined on the range between zero and one. It is often preferred to alternatives as it is more nuanced in reflecting concentration than simple shares (Golan et al., 1996). Land ownership appears to be concentrated in the western regions as HHI indices range between 0.39 in the central and Northern regions and 0.51 in the Western regions.

Table 1. *Descriptive statistics.*

	Whole Ukraine			West			Center/North			South			East		
	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max
Dependent variable															
Price per ha (thsd UAH/ha)	46.60	.54	6000	62.77	1.82	5334	53.09	1.29	6000	27.08	3.91	737	33.18	.54	667
Key independent variables															
"Ordinary people can get redress if the lessee violates their rights" (1 - 4 scale)	1.88	1	4	1.86	1	4	1.92	1	4	1.83	1	4	1.92	1	4
Property rights enforcement index	2.78	1	4	2.76	1	4	2.77	1	4	2.77	1	4	2.90	1	4
Share of unregistered land (%)	17	0	97	14	0	97	21	0.1%	93	1%	0.5	89	14	0.2	91
HHI Index for owned land	.44	0	1	.51	0	1	.39	0	1	.43	0	1	.45	0	1
Control variables															
Population in rayon/city (thsd persons)	503	5.74	2925	140	5.74	728	866	15.51	2925	413	15.93	1011	612	14.98	1439
Dummy for possessing a pai	.13	0	1	.18	0	1	.13	0	1	.10	0	1	.08	0	1
Plot area (ha)	2.25	.0003	136	1.23	.0003	42.94	1.95	.001	136	3.61	.002	52.8	3.59	.005	67.05
Dummy for pastures and hayfields	.17	0	1	.16	0	1	.18	0	1	.15	0	1	.15	0	1
NMV per ha (thsd UAH/ha)	26.72	0.19	71.92	26.35	1.06	59.14	26.18	0.39	71.29	25.08	0.19	48.66	28.57	.92	54.61
Number of transactions		46,807			12,198			21,674			7,948			5,919	

Source: Own computation based on the data from the 2019-2020 World Bank survey, data from the SSGCC and State Statistical Service of Ukraine.

4.2. Methods

Our goal is to estimate the effect of institutional quality related to property rights enforcement on the land sales prices after the Ukrainian land reforms implementation with explicit consideration of land competitiveness. In particular, we estimate the following general hedonic-pricing model:

$$Price_i = \beta_0 + \beta_1 Quality_i + \beta_2 Conc_j + \beta_3 Quality_i x Conc_j + \beta_4 Controls_{ij} + \varepsilon_{ij} \qquad (2)$$

where $Price_{ij}$ is the natural logarithm of the price per ha in UAH for a plot i in district j. As our key explanatory variables, we use individual perceptions of the quality of land-related institutions ($Quality_{ij}$) and a so-called "property rights enforcement" index measuring a gap in land-related property rights enforcement between ordinary and influential people. As a non-cognitive alternative, we use the share of unregistered land within a given municipality as another proxy for the institutional quality because unregistered land is believed to be more prone to misuse. In addition, we control for the competitiveness of a local land sales market including the Herfindahl-Hirschman Index (HHI) based on owned land within a given municipality j ($Conc_j$). We also include an interaction term between the proxies for institutional quality and land ownership concentration. This allows us to explore how the effect of institutional quality may be facilitated by the competitiveness of the local land market. Finally, following the logic of the hedonic pricing models, we control for several land plot characteristics. First, the soil quality is reflected by the NMV (recall that it entails the soil quality and the expected earnings). At the same time, it represents a reserve price as agricultural land plots cannot be sold at a price below NMV. Furthermore, we include plot sizes as normal and squared term as it has been found a significant predictor of the plot value (Kvartiuk, Herzfeld, et al., 2021; Ritter et al., 2020). In particular, we expect larger fields to be more attractive for farmers because land consolidation reduces transaction costs. In addition, a dummy for hayfields and pastures controls for the attractiveness of a land plot as this type of

land can be used for less productive purposes than typical cropland in Ukraine. Finally, we include a set of oblast dummies to control for regional specificities of agricultural production.

The nature of our data dictates the selection of estimation methodology. The Tobit model is particularly suitable for the main estimations in this study because it addresses the issue of censored data inherent in land sales prices. In the context of the Ukrainian land market, some land plots may be sold for a relatively low price leading to a situation where a portion of its observations is very close to our minimal price in the dataset – 540 UAH per ha. The Tobit model is designed to handle such censored data.

The source of identification in our models is the temporal separation between our dependent and independent variables. Our perception-based proxies for institutional quality are based on a survey that was conducted in 2019-2020 – one year before the land reforms and the launch of the sales market. Shares of unregistered land were calculated based on 2018 Cadastral data. On the other hand, sales transactions were only possible starting with July 1, 2021. Thus, our models should be robust to reverse causation problems.

5. Results

Before turning to our estimations, it is instructive to observe the spatial distribution of the land sales prices. Figure 1 demonstrates average municipality-level land prices with at least one transaction across Ukraine. First, we find municipalities with higher land prices in the areas of intensive agricultural production: Poltava, Kyiv, Cherkasy, and Khmelnytskyi oblasts. These are the areas with cash crop cultivation with a mix of large and small producers. In addition, we observe clusters of high sales prices around large cities suggesting that agricultural land may be sold with the final aim of development for non-agricultural purposes. Although not possible after the reforms, many landowners anticipated legislative changes allowing land purpose conversion. This may have incentivized them to purchase agricultural land for further

development. Moreover, we observe areas with lower land prices in the Southern and Northern regions where agricultural production is typically less intensive.

There are a number of gaps in transactions that require further elaboration. Obviously, no sales took place in the occupied territories before February 24, 2022.[3] Transactions on these territories were made technically impossible. In addition, we observe virtually no sales in the north-western regions of Polissia and few transactions in the area of the Carpathian Mountains. These are predominantly forests with no agricultural production taking place.

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[3] Occupied territories before February 24, 2022, include Autonomous Republic of Crimea and several rayons of the Donbass region militarily annexed by the Russian regime.
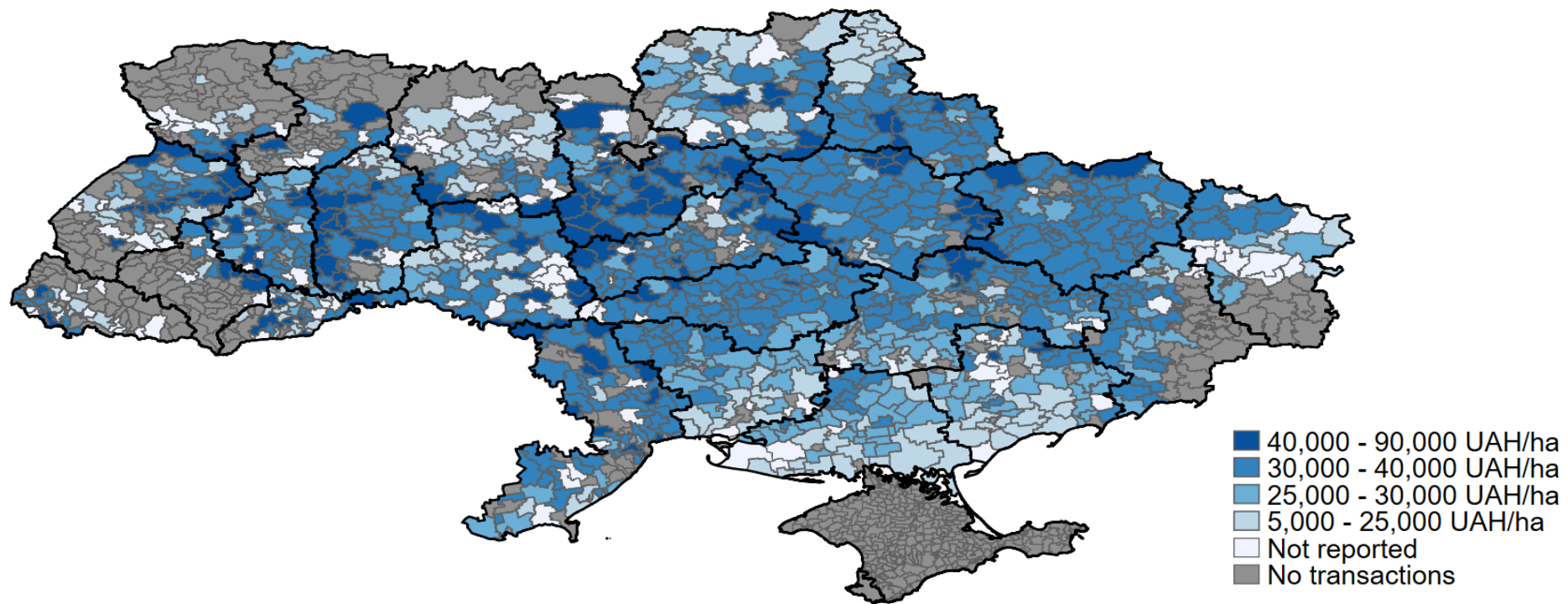
Figure 1. Spatial distribution of land sales prices and non-reported values.

Legend:
- 40,000 - 90,000 UAH/ha
- 30,000 - 40,000 UAH/ha
- 25,000 - 30,000 UAH/ha
- 5,000 - 25,000 UAH/ha
- Not reported
- No transactions

Table 3 presents the estimations of the land sales prices after the reform. We include the Tobit specifications with different key explanatory variables as well as with and without interaction terms. Before turning to the key explanatory variables, let us examine the control variables. First, as expected, NMV appears to be a good predictor of the plot's price. We also find evidence of a "small-plot premium" where smaller plots appear to be relatively more expensive than the larger ones, other characteristics held constant (Brorsen et al., 2015; Ritter et al., 2020). In particular, one additional hectare in size is associated with a 2% sales price discount. The positive and significant squared term of the plot's area suggests a price-dampening effect for larger plots. Ultimately, we observe that the prices for hayfields and pastures were only half as high as those for arable land.

Importantly, we observe that both survey- and registration-based proxies for institutional quality demonstrate a positive and significant effect across the specifications. In line with our hypotheses, we find systematically lower sales prices in the districts with worse perceptions of land-related institutions. Thus, according to the model (1), a one-point reduction in the property rights index defined on a 1-4 scale translates into 7.2% price reductions. A simple rayon-level agreement with the statement that "Ordinary people can get redress if their land rights are violated" resulted in an 8.2% price premium (model (3)). Similarly, models (5) and (7) suggest that a 10% increase in the municipality land registration is associated with ca. 1.6% price premiums for private and state-owned land. We find an almost identical effect because registration rates for private and state-owned land are typically correlated.

Pre-existing land ownership concentration appears to be an important factor in land sales price formation. First, we observe a uniform negative and significant effect across the specifications. In particular, a 10% increase in concentration implies ca. 2.5% price reductions. Thus, in areas with land controlled by large dominant farms, we expect to see substantial land price discounts. Second, land concentration appears to facilitate the negative effect of institutional quality

because we find the interaction terms between the respective variables to be negative and significant. In other words, high levels of land concentration tend to mitigate the positive effect on land sales prices. Figure 2 demonstrates the predicted effects of our institutional quality depending on the market competitiveness. In particular, we assume an HHI of 0.1 for municipalities with competitive markets and 0.9 for municipalities with concentrated land ownership. We see that for the survey-based proxies, the effect of better perceptions of land-related institutions is close to zero in situations with uncompetitive land allocation. The line gets substantially steeper in less concentrated areas, suggesting that the effect of institutional quality transpires only in a setting with competitive markets. The logic is that large farms with market power may be in a position to dictate their terms to landowners, and the institutional quality effect will be irrelevant in this situation. Remarkably, the positive effect of land registration rates is reversed in the municipalities with highly concentrated land ownership for both, private and state-owned land. A possible reason for this may be the fact that large landowners may be incentivized to register land after purchasing it. Thus, with substantial large farms operating in the area, registration rates may improve and the concentration effect will dominate.

Table 2. Estimation of the land sales prices.

	(1) Tobit	(2) Tobit	(3) Tobit	(4) Tobit	(5) Tobit	(6) Tobit	(7) Tobit	(8) Tobit
Property rights index	0.072***	0.076***						
	(0.000)	(0.000)						
Ordinary people can enforce property rights (1 to 4 scale)			0.082***	0.085***				
			(0.000)	(0.000)				
Share of registered private land within a municipality (0 to 1)					0.158**	0.201***		
					(0.029)	(0.006)		
Share of registered state-owned land within a municipality (0 to 1)							0.164**	0.207***
							(0.024)	(0.005)
Plot area (ha)	-0.020***	-0.020***	-0.021***	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Plot area squared	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Land concentration	-0.269***	-0.269***	-0.245***	-0.253***	-0.259***	-0.248***	-0.259***	-0.249***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dummy for pastures or hayfields	-0.547***	-0.548***	-0.546***	-0.546***	-0.515***	-0.507***	-0.514***	-0.506***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NMV per ha	0.022***	0.022***	0.023***	0.023***	0.020***	0.020***	0.020***	0.020***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Property rights index # Land concentration		-0.128***						
		(0.020)						
Ordinary people can enforce property rights # Land concentration				-0.075				
				(0.255)				
Share of unregistered land # Land concentration						-1.243***		
						(0.000)		
Share of registered state land # land concentration								-1.258***
								(0.000)
Constant								
Observations	12,478	12,478	12,478	12,478	18,188	18,188	18,063	18,063
Pseudo R^2	0.187	0.187	0.187	0.187	0.166	0.167	0.165	0.166

Note: Figures in brackets are p-values from the robust estimator of variance.
 *** significant at 1%; significant at 5%; * significant at 10%.
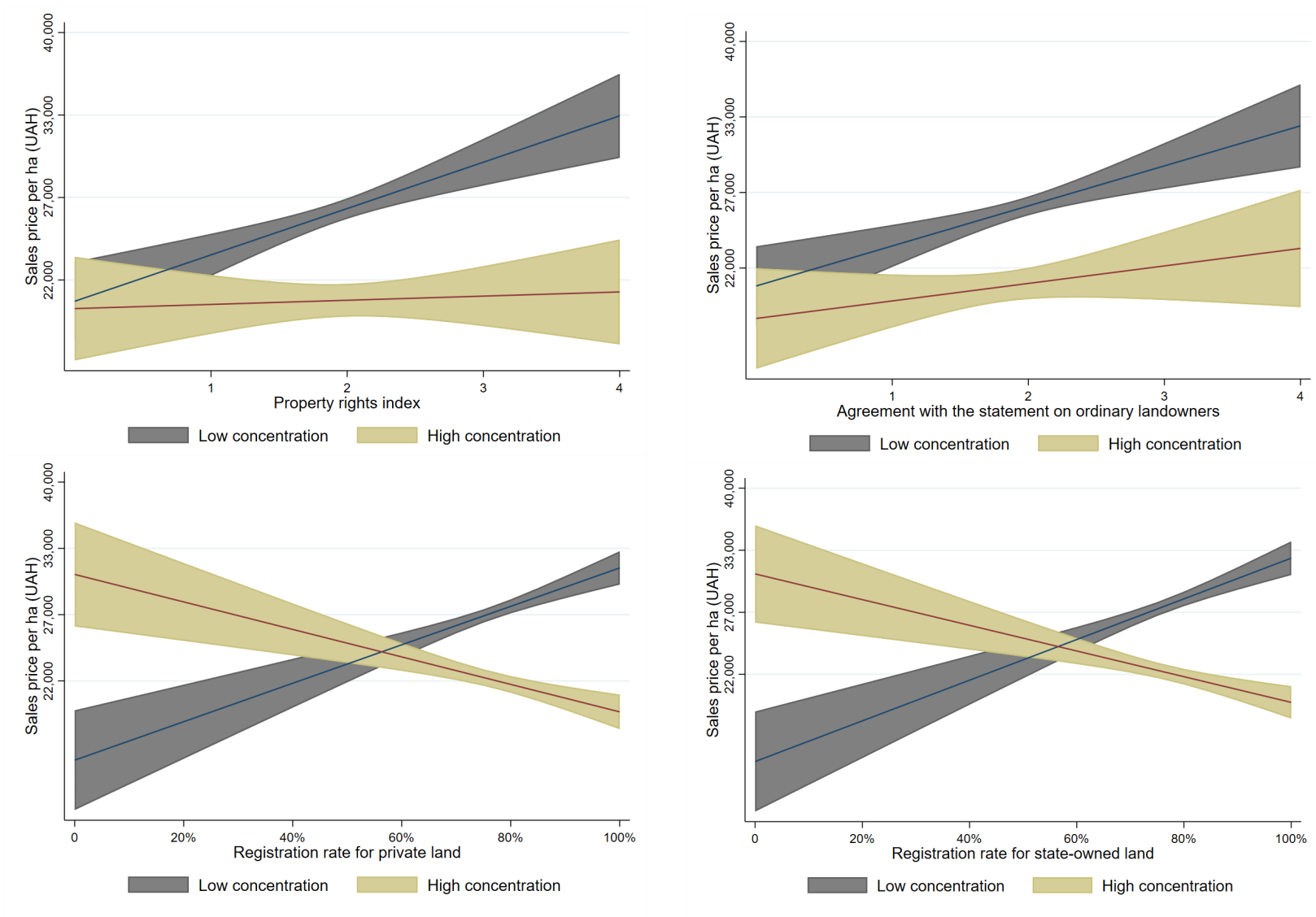Source: Authors' calculations.

Figure 2. Predicted effect of different institutional quality proxies depending on land market competitiveness.

6. Robustness check

First, we correct for the possible bias due to missing price values using the Heckman correction procedure (Heckman, 1979). Figure 1 demonstrates clusters of municipalities with no single price record suggesting that the prices may be missing not at random. We address these concerns and employ Heckman selection models (HSM). We identify the selection equation with the share of the rayon population that obtained free legal aid consultations on issues with land registration. Higher solicitation rates are likely to correlate with the quality of notaries' registration of land contracts and, thus, should be correlated with price disclosure rates as well. Table 3 presents the results of the HSM estimations. Wald-test suggests that there may indeed be a sample-selection challenge. Moreover, the inverse Mill's ratio indicates that we may be observing the non-missing prices below the true average of the whole sample. In other words, transactions with higher prices may remain undisclosed. Although slightly lower (HSM correction), all the coefficients appear to be very close to the estimations in Table 2. Thus, we conclude that our estimations are robust to the missing data challenges.

Table 3. Re-estimation of the land sales prices using the Heckman selection model.

	(1) HSM	(2) HSM	(3) HSM	(4) HSM	(5) HSM	(6) HSM	(7) HSM	(8) HSM
Property rights index	0.068*** (0.000)	0.070*** (0.000)						
Ordinary people can enforce property rights (1 to 4 scale)			0.073*** (0.000)	0.075*** (0.000)				
Share of registered private land within a municipality (0 to 1)					0.130* (0.063)	0.165** (0.020)		
Share of registered state-owned land within a municipality (0 to 1)							0.138* (0.051)	0.172** (0.016)
Plot area (ha)	-0.020*** (0.000)	-0.020*** (0.000)	-0.020*** (0.000)	-0.020*** (0.000)	-0.019*** (0.000)	-0.019*** (0.000)	-0.019*** (0.000)	-0.019*** (0.000)
Plot area squared	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)
Land concentration	-0.244*** (0.000)	-0.239*** (0.000)	-0.224*** (0.000)	-0.223*** (0.000)	-0.257*** (0.000)	-0.244*** (0.000)	-0.258*** (0.000)	-0.244*** (0.000)
Dummy for pastures or hayfields	-0.550*** (0.000)	-0.551*** (0.000)	-0.549*** (0.000)	-0.549*** (0.000)	-0.511*** (0.000)	-0.503*** (0.000)	-0.511*** (0.000)	-0.503*** (0.000)
NMV per ha	0.022*** (0.000)	0.022*** (0.000)	0.022*** (0.000)	0.022*** (0.000)	0.020*** (0.000)	0.020*** (0.000)	0.020*** (0.000)	0.020*** (0.000)
Property rights index # Land concentration		-0.127*** (0.021)						
Ordinary people can enforce property rights # Land concentration				-0.069 (0.289)				
Share of unregistered land # Land concentration						-1.254*** (0.000)		
Share of registered state land # land concentration								-1.269*** (0.000)
Observations	21,107	21,107	21,107	21,107	31,379	31,379	31,158	31,158
Selected/Nonselected	12,478/ 8,629	12,478/ 8,629	12,478/ 8,629	12,478/ 8,629	18,188/ 13,191	18,188/ 13,191	18,063/ 13,095	18,063/ 13,095
Wald-test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inverse Mill's Ratio	-0.191	-0.191	-0.187	-0.186	-0.132	-0.134	-1.131	-0.133

Note: Figures in brackets are p-values from the robust estimator of variance.
 *** significant at 1%; significant at 5%; * significant at 10%.
Source: Authors' calculations.

Land prices may be spatially correlated, requiring explicit methodological adjustments (Yang et al., 2019). For instance, landowners' pricing decisions may be correlated if they are in close proximity to each other. In response to this challenge, we construct a spatial inverse distance matrix on the municipality level (Fischer & Getis, 2009). In particular, we assign a distance of zero to the plots located within a given municipality as we cannot calculate the distance between plots within a given municipality and measure the distance between the municipality centroids. Having constructed the matrix, the aim is to estimate a "spatial autoregressive model with autoregressive disturbance" (SARAR) (Anselin & Florax, 1995). Thus, equation (2) in Section 4.2 is transformed in the following fashion:

$$P_i = \beta_0 + \rho \sum_k M_{ik} P_{ij} + \beta_1 Quality_i + \beta_2 Conc_j + \beta_3 Quality_{ij} xConc_{ij} + \beta_4 Controls_{ij} +$$

$$\lambda \sum_k M_{ik} u_k + \varepsilon_i \qquad (3)$$

where we estimate the coefficient ρ of the prices' spatial lag and λ of the weighted error term. Generalized spatial two-stage least-squares estimators (GS2SLS) are used to estimate equation (3). Moreover, to simplify the computational task of creating a spatial inverse distance matrix, we restrict the sample only to the land that was under the sales ban. This reduced the time required for the spatial calculations without a loss of generality.

Table 4 presents the results, which appear to largely parallel our primary estimations. First, we see that, indeed, regional average prices significantly affect land sales prices. Thus, a 100 UAH increase in local average price levels suggests a ca. 30 UAH increase in the sales price for a plot of our interest. With the explicit consideration of spatial correlation, we find that the magnitudes of the effect of our survey-based proxies for institutional quality as well as their significance have dropped. Thus, one standard deviation in the property rights index is associated with the 4.5% higher sales prices as opposed to 7.2% in our primary estimations. Interestingly, the magnitude of the registration effect appears to be higher than in the main estimations with a 20.1% increase due to a 10% increase in private land registration rates. The

rest of the variables look very similar to the main estimations in Table 3. Thus, we conclude that our estimates are robust to the spatial correlation.

Table 4. Re-estimation of the land sales prices using spatial regressions.

	(1) SARAR	(2) SARAR	(3) SARAR	(4) SARAR	(5) SARAR	(6) SARAR	(7) SARAR	(8) SARAR
Spatial lag	0.301***	0.300***	0.301***	0.300***	0.291***	0.287***	0.293***	0.290***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Spatial error term	0.207***	0.208***	0.208***	0.209***	0.437***	0.442***	0.437***	0.441***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Property rights index	0.045*	0.047**						
	(0.092)	(0.041)						
Ordinary people can enforce property rights (1 to 4 scale)			0.045	0.051**				
			(0.121)	(0.063)				
Share of registered private land within a municipality (0 to 1)					0.201**	0.229**		
					(0.024)	(0.033)		
Share of registered state-owned land within a municipality (0 to 1)							0.222**	0.237**
							(0.019)	(0.027)
Plot area (ha)	-0.010***	-0.010***	-0.010***	-0.010***	-0.021***	-0.021***	-0.021***	-0.021***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)
Plot area squared	0.000**	0.000**	0.000**	0.000**	0.001***	0.001***	0.001***	0.001***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.000)	(0.000)	(0.000)	(0.000)
Land concentration	-0.025	0.087	-0.018	0.092	-0.104***	0.301**	-0.104***	0.306**
	(0.401)	(0.307)	(0.551)	(0.405)	(0.000)	(0.042)	(0.000)	(0.039)
Dummy for pastures or hayfields	-0.510***	-0.510***	-0.510***	-0.510***	-0.513***	-0.510***	-0.517***	-0.515***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
NMV per ha	0.023***	0.023***	0.023***	0.023***	0.021***	0.021***	0.021***	0.021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Property rights index # Land concentration		-0.058						
		(0.162)						
Ordinary people can enforce property rights # Land concentration				-0.059				
				(0.302)				
Share of unregistered land # Land concentration						-0.515***		
						(0.006)		
Share of registered state land # land concentration								-0.520***
								(0.005)
Constant	6.683***	6.657***	6.687***	6.656***	6.904***	6.748***	6.892***	6.735***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	6,479	6,479	6,479	6,479	10,134	10,134	10,093	10,093
Pseudo R^2	0.589	0.589	0.589	0.589	0.470	0.471	0.471	0.472

Note: Figures in brackets are p-values from the robust estimator of variance.
 *** significant at 1%; significant at 5%; * significant at 10%.
Source: Authors' calculations.

7. Conclusion

This article explored how the land sales market may price in local institutional imperfections. Existing scholarship has predominantly examined the link between property rights and investment incentives, leaving the effects on land prices unexplored. We argue that land sales markets should price in market participants' concerns about the land-related institutions. Better institutions should reduce the risk of expropriation (Besley & Ghatak, 2009) and increase the expected utility from a land purchase. This should increase the WTP for land plots in the areas with better land-related institutions. On the other hand, the sellers' WTA may be lower in areas with bad institutions because the higher risk of expropriation may reduce the utility of holding land, pushing landowners into unfavorable deals. As a result, the quality of land-related institutions should correlate with land sales prices. However, we may need sufficiently competitive markets for these effects to transpire. Otherwise, negative effects of land concentration may dominate the formation of land sales prices. We test these hypotheses using unique datasets from Ukraine that help us generate proxies for institutional quality before the 2021 land reform that launched the land sales market. Observing the prices after the launch of the sales market helps us to single out the causal link between institutions and land sales prices.

Our evidence suggests that confidence in property rights enforcement appears to be priced in by the land sales market after the reform's implementation. In particular, we find that Ukrainian landowners were willing to accept lower prices for their land plots in areas with low institutional quality. Thus, a one-point reduction in our property rights index leads to a 7.2% price reduction. Similarly, a 10% increase in the municipality registration rates of private and state-owned land is associated with a 2% price increase. These findings appear to be robust accounting for potential biases related to missing values and spatial correlation. Importantly, this relationship appears to hold only for a competitive local land market. The interaction terms in our

specifications demonstrate that the institutional effect transpires only in the context of competitive land sales markets. If the land is concentrated by a few landowners, institutions do not matter for the price formation anymore as this effect is dominated by the negative effect of land concentration.

Ukraine's weak institutional environment appears to benefit large land users as they are better equipped to defend their property rights. We find that land ownership concentration appears to exert a negative and significant effect on local sales prices. In particular, a 10% increase in concentration means ca. 2.4% price reductions. Thus, in areas with land controlled by large dominant farms, we expect to see substantial land price discounts. Large farms may have superior bargaining power in comparison to individual landowners.

These findings have important implications for liberal reforms implementation. Thus, major reforms with large distributional consequences should be planned in a package with accompanying measures explicitly considering the quality of the institutions involved. The example of the Ukrainian land reform demonstrates that the capitalization of the land market may be severely plagued by weak institutions undermining land-based finance. Both, perceptions and actual institutional quality appear to be important predictors of the land reforms' success. Thus, apart from actual institutional infrastructure improvements, accompanying information campaigns may improve individual perceptions of institutional quality.

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