INSTITUTIONAL QUALITY AND LIVESTOCK PRODUCTION IN POST-SOVIET COUNTRIES: THREE ESSAYS

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EXECUTIVE SUMMARY

An inclusive institutional environment is crucial for the long-term success of the livestock industry as it improves animal health, ensures food security, contributes to trade expansion, as well as protects human health and economic resources. The quality of institutions is especially relevant for countries transitioning from a centrally planned regulatory environment to a market-oriented rule-based business climate as it enables market liberalization and farm transformation. In the post-Soviet region, the transition period has yielded some progress in livestock development, albeit with varying degrees of advancement. While institutional changes in European parts and Kazakhstan have driven progress in labor productivity, individualized farms in Transcaucasian and Central Asian countries have not experienced a commensurate increase in labor productivity, thereby impeding the improvement of rural incomes. As a result, the establishment of private property rights and the individualization of farming as the catalyst of driving productivity gains was called into question by the end of the third decade of transition. This dissertation is an initial step toward generating an evidence-based analysis of agriculture-specific institutional settings supporting livestock performance and industry transformation. The study aims to look at institutional roots for building efficient market systems and regulatory practices to assist livestock industries in production growth and integration into formal value chains through the comparative analysis of cross-regional variation of livestock industries in post-Soviet countries.

This dissertation examines why the institutional environment of meat markets may differ from what official regulatory practices predict. Through cross-country qualitative analysis of legislation and its enforcement, the study creates a metric that combines qualitative and quantitative aspects to measure the business environment of meat markets. By measuring the quality, efficiency, and implementation practices of regulations using data from former Soviet countries, the new metric identifies regulatory gaps and sources of poor enforcement. The study shows that the business climate in meat markets depends on the quality of written regulations and how they are implemented in practice. Regulations may appear similar on paper, but their implementation can vary significantly and lead to different institutional environments.

Next, based on the panel data analysis, the study identifies the drivers of livestock production growth, focusing on institutional support factors. Using a unique dataset at the subnational unit in Kazakhstan and Russia on corruption crimes and livestock production rates, the study defines that the relationship between livestock production growth and corruption control is non-linear. The findings suggest that the impact of corruption control on productivity differs across various organizational structures, ranging from household farms to peasant farmers and agricultural enterprises.

Finally, the study takes a closer look at the processes behind market-oriented livestock production and investigates the factors that impact market formalization at a micro-level.

The study provides a more comprehensive understanding of marketing decision-making by analyzing smallholders and larger livestock producers. The findings reinforce the previous analytical effort of the dissertation, highlighting the importance of institutional infrastructure in integrating livestock producers into formal value chains. The study also reveals that while increasing production can aid the transition to market-oriented livestock production, it can also push farmers into informal markets if they do not meet the scale requirements for the formal market.

ZUSAMMENFASSUNG

Ein integratives institutionelles Umfeld ist für den langfristigen Erfolg der Viehwirtschaft von entscheidender Bedeutung, da es die Tiergesundheit verbessert, die Ernährungssicherheit gewährleistet, zur Ausweitung des Handels beiträgt sowie die menschliche Gesundheit und die wirtschaftlichen Ressourcen schützt. Die Qualität der Institutionen ist besonders wichtig für Länder, die von einem zentral geplanten regulatorischen Umfeld zu einem marktorientierten, regelbasierten Geschäftsklima übergehen, da sie die Marktliberalisierung und die Umgestaltung der Landwirtschaft ermöglicht. In der postsowjetischen Region hat die Übergangszeit einige Fortschritte in der Entwicklung der Viehwirtschaft gebracht, wenn auch in unterschiedlichem Maße. Während institutionelle Veränderungen in den europäischen Ländern und in Kasachstan zu einer Steigerung der Arbeitsproduktivität geführt haben, ist die Arbeitsproduktivität in den individualisierten landwirtschaftlichen Betrieben in den transkaukasischen und zentralasiatischen Ländern nicht im gleichen Maße gestiegen, was die Verbesserung der ländlichen Einkommen behindert. Infolgedessen wurden die Einführung privater Eigentumsrechte und die Individualisierung der Landwirtschaft als Katalysator für Produktivitätssteigerungen am Ende des dritten Jahrzehnts der Transformation in Frage gestellt. Diese Dissertation ist ein erster Schritt zur Erstellung einer evidenzbasierten Analyse der agrarspezifischen institutionellen Rahmenbedingungen, die die Leistung der Viehwirtschaft und die Transformation der Branche unterstützen. Die Studie zielt darauf ab, die institutionellen Wurzeln für den Aufbau effizienter Marktsysteme und Regulierungspraktiken zu untersuchen, um das Produktionswachstum und die Integration der Viehwirtschaft in formelle Wertschöpfungsketten durch eine vergleichende Analyse der überregionalen Unterschiede in der Viehwirtschaft in den postsowjetischen Ländern zu unterstützen.

In dieser Dissertation wird untersucht, warum das institutionelle Umfeld der Fleischmärkte von der offiziellen Regulierungspraxis abweichen kann. Durch eine länderübergreifende qualitative Analyse der Gesetzgebung und ihrer Durchsetzung wird in der Studie eine Metrik entwickelt, die qualitative und quantitative Aspekte zur Messung des Geschäftsumfelds von Fleischmärkten kombiniert. Durch die Messung der Qualität, der Effizienz und der Umsetzungspraktiken von Vorschriften unter Verwendung von Daten aus den Ländern der ehemaligen Sowjetunion identifiziert die neue Metrik Lücken in der Gesetzgebung und Ursachen für eine mangelhafte Durchsetzung. Die Studie zeigt, dass das Geschäftsklima auf den Fleischmärkten von der Qualität der schriftlichen Vorschriften und deren Umsetzung in der Praxis abhängt. Die Vorschriften mögen auf dem Papier ähnlich erscheinen, aber ihre Umsetzung kann erheblich variieren und zu unterschiedlichen institutionellen Rahmenbedingungen führen.

Auf der Grundlage der Paneldatenanalyse werden in der Studie die treibenden Kräfte für das Wachstum der Viehproduktion ermittelt, wobei der Schwerpunkt auf institutionellen Unterstützungsfaktoren liegt. Unter Verwendung eines einzigartigen Datensatzes auf

subnationaler Ebene in Kasachstan und Russland zu Korruptionsdelikten und Viehproduktionsraten definiert die Studie, dass die Beziehung zwischen Viehproduktionswachstum und Korruptionskontrolle nicht linear ist. Die Ergebnisse deuten darauf hin, dass sich die Auswirkungen der Korruptionskontrolle auf die Produktivität in den verschiedenen Organisationsstrukturen unterscheiden, die von Haushaltsbetrieben über Kleinbauern bis hin zu landwirtschaftlichen Unternehmen reichen.

Schließlich wirft die Studie einen genaueren Blick auf die Prozesse hinter der marktorientierten Tierproduktion und untersucht die Faktoren, die die Marktformalisierung auf Mikroebene beeinflussen. Die Studie bietet ein umfassenderes Verständnis der Entscheidungsfindung bei der Vermarktung durch die Analyse von Kleinbauern und größeren Viehzüchtern. Die Ergebnisse untermauern die bisherigen analytischen Bemühungen der Dissertation, indem sie die Bedeutung der institutionellen Infrastruktur für die Integration von Viehzüchtern in formelle Wertschöpfungsketten hervorheben. Die Studie zeigt auch, dass eine Produktionssteigerung zwar den Übergang zu einer marktorientierten Viehhaltung erleichtern kann, die Landwirte aber auch in informelle Märkte drängen kann, wenn sie die Größenanforderungen für den formellen Markt nicht erfüllen.

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ACEPAS	Analytical Centre of the Economic Policy in Agricultural Sector
ANICANET	Revitalising animal husbandry in Central Asia: A five-country analysis. The project is funded by the German Federal Ministry of Education and Research
DTF	Distance to frontier
EBA	Enabling business for agriculture
EC	European Commission
EEC	Eurasian Economic Commission
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Statistics
GIZ	The German Agency for International Cooperation
GMM	Generalized method of moments
IAMO	The Leibniz Institute of Agricultural Development in Transition Economies
IFPRI	International Food Policy Research Institute
MinAgKaz	Ministry of Agriculture of the Republic of Kazakhstan
MinAgLith	Ministry of Agriculture of the Republic of Lithuania
MinAgRus	Ministry of Agriculture of the Russian Federation
MinAgUkr	Ministry of Agrarian Policy and Food of Ukraine
NR	Net returns
OECD	The Organization for Economic Cooperation and Development
OIE	The World Organisation for Animal Health was founded as the Office International des Epizooties
OLS	Ordinary least squares
USD	United States Dollar
WB	The World Bank
WGI	World Bank's Worldwide Governance Indicators dataset

1. INTRODUCTION

Strong institutions are widely recognized as crucial in promoting long-term economic development (Acemoglu et al., 2005). Formal economic models, which include institutions based on rules, such as regulatory quality and government effectiveness, have generated numerous testable hypotheses based on the theory (Assane & Grammy, 2003). However, despite the critical role of institutional quality in development, there is still a need for more clarity on optimizing industry-specific institutional infrastructure to enhance production and market exchange efficiency (Divanbeigi & Saliola, 2017; Lin et al., 2020). This limitation is particularly true for agricultural markets in post-Soviet countries with transitional economies, where outcomes in agricultural development vary significantly despite similar formal institutional reforms such as market liberalization and privatization (Lerman, 2001; Weder, 2001).

In the years following the dissolution of the Soviet Union, agricultural markets in many countries experienced significant disruption due to liberalization policies. The transition processes led to a lack of resources for farmers to obtain inputs, sell, store, and process output (Petrick et al., 2014). The protracted reason for the market dysfunction is attributed to insufficient institutional market infrastructure. The centrally planned economy that preceded the transition did not require the type of institutional infrastructure necessary for a market-oriented agricultural economy. To progress the transformation, agricultural producers needed access to a financial system that offers fast and affordable access to capital, a mechanism for the rapid and inexpensive transmission of market information, and a robust commercial law system that protects property rights and enforces contracts (Liefert & Swinnen, 2002).

Efforts to create market-oriented institutional infrastructure result in regulatory interventions that have significantly impacted agriculture (Swinnen, 2018). While some regulations enable a favorable institutional environment for agribusiness, others result in overregulation, leading to misallocation and resource misappropriation. For example, excessive regulations create bureaucratic hurdles, limit the access of vulnerable agricultural producers to public resources, and increase trade risks (Duvanova, 2014; EBA, 2016; Levchenko, 2007). The lack of efficient institutional infrastructure raises transaction costs, making it more difficult for producers to engage in agribusiness (Divanbeigi & Saliola, 2017). In promoting an inclusive business climate in agriculture, comparative evaluations should focus on effective agriculture-specific governance mechanisms to enhance understanding of the factors that contribute to best institutional practices.

In transition economies where the regulations in the agricultural sector are weakly consolidated, an endemic problem that poses transaction costs is extortion and bribery (Rigi, 2017). In dysfunctional legal systems, corruption serves as a market instrument, accelerating decision-making processes (Satpayev, 2014; Schulze et al., 2016). However, the impact of corruption on the agricultural industry is not clearly defined. While corruption may facilitate agricultural development by compensating for the lack of clear regulation, it may also impede

progress by creating obstacles for agricultural producers (Robinson et al., 2021a; Zeytoonnejad Mousavian et al., 2023). The effect of corruption on agricultural development is complex and may vary depending on the interests of different groups, which requires further investigation.

The discriminative institutional environment can distort trade and drive firms into the informal economy (Kotisalo et al., 2015; Ndraha et al., 2017). The shift of agricultural businesses from informal to formal markets as a step to integrate into global markets has received significant attention in recent empirical research (Sutter et al., 2017). Access to infrastructure and inclusive market regulations generate economic incentives, which promote the transition to formal markets (Dau & Cuervo-Cazurra, 2014). Nevertheless, transitioning from an informal institutional environment to a formal one follows a unique path for each business structure. More research is needed to understand how individual agricultural producers can successfully make this transition and integrate into formal markets that are highly regulated by veterinary and food safety standards.

This dissertation thoroughly examines the influence of the institutional environment on agriculture in countries with transition economies, specifically livestock markets in former Soviet republics, utilizing three unique analyses. The first analysis, presented in Chapter 2, assesses the quality of regulatory practices through qualitative means. The analysis evaluates the regulations governing livestock markets in four post-Soviet countries with various reform progress. Based on the analysis, a new index is developed to evaluate regulatory practices that support livestock production, including those that burden farmers, generate red tape, and foster corruption. Chapter 3 takes a regional-level approach to explore the impact of corruption control on livestock production in Kazakhstan and Russia. Quantitative methods are employed to understand how the growth of cattle and beef produced by different organizational forms of farmers is linked to anti-corruption efforts. Chapter 4 aims to identify the most influential factors that encourage cattle producers in Kazakhstan and Kyrgyzstan to participate in formal markets. Similar to the previous chapters, the importance of the business climate is highlighted as institutional forces that influence farmers with different scales of production to commercialize their produce formally. Finally, the last Chapter concludes and discusses policy implications, limitations, and prospects for future research.

1.1. OVERVIEW OF LIVESTOCK SECTOR IN POST-SOVIET COUNTRIES

In the pre-reform period in Soviet countries prevailed an agricultural system with many large and complex agricultural enterprises, sovkhozes (state farms) and kolkhozes (collective farms). The state and collective farms were required to supply live animal carcasses to large processing plants. Most of the produced meat was frozen and stored at the plants or refrigerator stations, while the remaining meat was processed into sausages and/or canned. Frozen meat and meat products were allocated to the military, supermarkets, and other retail store (Esenova & Dobson, 2000). The agricultural industry was maintained by high

administered prices, significant input and output price subsidies, and policies that were not agriculture-specific, such as cheap energy and transport (OECD, 2013). The Soviet agricultural system with central planning, resource allocation, procurement, and distribution systems in the meat industry had little resemblance to those of a free market-oriented economy.

The government supported the collective and state farms and provided full-service infrastructure not only to state-owned livestock but also to livestock owned by individual farmers. This support entailed access to high-quality feed and forage, veterinary care, animal production experts, and specialized artificial insemination services. Additionally, the collective farms acted as a market for meat, lambs, and calves raised by individual farmers (Wegren, 2014). As such, households helped the collective farms to meet the state-planed targets by supplying additional livestock products sourced from personal subsidiary plots (van Engelen, 2011).

After the Soviet Union's dissolution, livestock production became unprofitable as subsidies for input and price support for output were removed (Kobayashi et al., 2007; Lerman et al., 2004). Under the course of de-collectivization and privatization, illiquid enterprises either slaughtered most of their herds or distributed to member workers, leading to a fragmentation of the livestock industry into smaller household units (Petrick et al., 2014). Livestock production in almost all post-Soviet countries experienced a severe decline due to the loss of market interlinks between former socialistic republics and insufficient support for farmers in terms of input acquisition, output sales, storage, and processing (Gow & Swinnen, 1998; Robinson et al., 2021a).

The post-Soviet reform process exhibited a diverse and dynamic nature. In the former Soviet republics in the European part and Kazakhstan, the institutional changes resulted in the coexistence of family and corporate farms along with the agricultural workforce shift to other industries, yielding higher capital and better labor productivity. In Transcaucasian and Central Asian countries, the trend toward individualized farms has failed to yield significant improvements in labor productivity, resulting in low incomes for rural communities (Petrick, 2021).

The prevalent theory positing that establishing secure property rights and individualizing farming were the primary catalysts driving productivity gains was called into question in many former Soviet countries by the end of the third decade of transition (Petrick, 2021). The managers of former collective farms and regional government authorities had a strong incentive to maintain their status-quo rents, which hindered individualization in agriculture (Gunya et al., 2019; Koester & Petrick, 2010). The allocation of agricultural support and resources is heavily biased in favor of large producers (Robinson et al., 2021b; Uzun et al., 2019). Farm consolidation among more adapted managers is often facilitated by government favoritism or investor networks among a limited elite (Gagalyuk & Valentinov, 2019; Visser et al., 2012). Small livestock producers face numerous barriers, such as limited access to subsidies due to scale requirements, restricted access to public pastures due to land grabbing

by latifundistas, and transaction costs incurred from unofficial red tape created by local administration (Robinson et al., 2021b; Uzun et al., 2019). Agricultural businesses operating in many former Soviet countries face high transaction costs stemming from an endemic issue of institutional infrastructure and corruption, which are consequences of a dysfunctional legal system.

1.2. RELEVANCE OF INSTITUTIONS TO LIVESTOCK MARKETS

Institutions are the humanly devised constraints that structure human interaction (North, 1990), which matter for long-term economic growth and development (Acemoglu et al., 2005). These constraints encompass informal institutions (customs, tradition, and religious norms), formal institutions (laws, regulations, and property rights), governance, and resource allocation (Williamson, 2000). The institutions in planned economies have been proven to be inefficient. Therefore, for economic change and development to proceed, former Soviet countries have transitioned to institutions that allow more efficient market transactions across time and space (Fischer & Gelb, 1991).

The growth and sustainable livestock development are strongly influenced by an institutional environment that includes a wide range of enforceable formal and informal rules.[1] The shared purpose of these rules is to deliver animal health services, such as early detection, notification, and prevention of disease events, as well as to promote a business climate that prioritizes inclusive access to resources, markets, and value chains while avoiding waste or duplication (Batho et al., 2012). The quality of institutions must be backed by legislation, which requires the necessary physical capacity and human resources to perform their administrative and enforcement duties (Petitclerc, 2012). The governance of these services must be transparent and free from fraud and corruption (Msellati et al., 2012).

Literature suggests that the institutional environment that decreases the transaction cost of doing business in the livestock industry is an important determinant of how well the livestock market functions (EBA, 2016). The proper governance in the livestock industry at national, regional, and global levels enhances animal health and minimizes loss of production, contributing to food security and helping protect human health and economic resources (Connolly, 2017; Lee & Brumme, 2013). For instance, good regulatory practices in Slovenian beef and pork sectors are characterized by high processing and marketing margins, eliminated trade barriers, and contributed to trade expansion (Bojnec & Peter, 2005). The secure and

[1] Livestock refers to domestic or domesticated animals primarily raised for agricultural purposes. These animals include large ruminants such as cattle, small ruminants like goats and sheep, as well as pigs and horses. For the purpose of the dissertation poultry and aquaculture are not considered to be part of the livestock category.

enforceable marketing contracts are associated with the increased herd size of dairy livestock in Russia and Kazakhstan (Petrick & Götz, 2019).

The importance of the quality of institutions for the livestock industry's prosperity is especially relevant for countries with transition economies (Liefert & Swinnen, 2002). International observers view the livestock industry in the former Soviet countries as an important investment target, with its attraction stemming from rising incomes and a shift toward more protein-rich diets, allowing prospects for domestic meat and dairy production to have substantial growth potential (OECD, 2013; Petrick et al., 2017). However, not all institutional practices contribute to better performance in the livestock sector (Kasymov et al., 2016). Due to significant variations among the countries undergoing reforms, there is no one-size-fits-all roadmap to guide the establishment of new market systems in former Soviet countries. This phenomenon raises the question of how to identify those inclusive agriculture-specific institutional settings and what governance practices enable long-term growth in agriculture, particularly in the livestock sector.

1.3. OBJECTIVE AND STRUCTURE OF THESIS

During the past three decades of the transition period from centrally planned to market economies, the post-Soviet countries have undergone various institutional changes and reforms in the agricultural sector. Despite extensive efforts to ascertain which institutional changes are conducive to effective and sustainable agricultural development, it remains unclear why productivity dynamics, market formalization, and rural income acceleration vary considerably among post-Soviet countries (Petrick, 2021). One of the prominent analytical voids is the lack of quality metrics to analyze the institutional environment specific to the agricultural industry (Diaz-Bonilla et al., 2014). The institutional dimension has focused on policy changes rather than the institutional environment (Shirley, 2013). Formal institutions, or the rules of the game, have been the primary focus of institutional changes, whereas the informal aspects of rule implementation, or how the game is played, have been overlooked (Msellati et al., 2012; Sutter et al., 2017). Additionally, the impact of changes in the institutional environment on different organizational forms of agricultural producers remains ambiguous. Specifically, it is unclear why post-communist large agricultural enterprises continue to dominate the livestock markets while newly developed private businesses are less prosperous compared to their Western counterparts (Koester & Petrick, 2010).

Against this background, the current thesis aims to explore the role of the quality of the institutional environment in the context of livestock production changes. The study is based on the proposition by institutional economists that an inclusive institutional environment plays a pivotal role in augmenting production and formalizing markets in the former Soviet countries. Therefore, the study poses an overarching question: to what extent do changes in institutional quality in post-Soviet countries impact the framework of livestock markets? To address this question, the study has identified three specific objectives that include:

1. To comprehend the institutional environment specific to livestock markets and identify ways to measure its quality. This will focus on the role of national differences in meat market regulations and governance effectiveness.

2. To investigate how changes in the institutional environment impact livestock production among different organizational forms of livestock producers.

3. To analyze the institutional and socio-economic factors driving commercial-based livestock production and market formalization.

To fulfill the objectives of the thesis, the analytical approach requires different concepts, data, and methods, which will be answered in three chapters.

The first objective is addressed in Chapter 2, "Comparing meat market institutions: A new regulatory environment index." Existing literature suggests that the relevance of institutions for sustainable growth has been subjected to numerous criticisms due to the disregard for metrics of institutional quality (Shirley, 2013; Woodruff, 2006). This dispute is especially important for livestock because the industry-specific metrics are lacking (EBA, 2016; Msellati et al., 2012). The current study aims to fill a gap in the field by proposing a unique approach to evaluating the regulatory and business environment of the meat market industry. This Chapter aims to answer three main research questions. Firstly, I am interested in how to measure the institutional quality of meat markets. Secondly, I seek to ascertain the empirical evidence supporting the institutional roots of misgovernance in the livestock and meat markets. Lastly, I examine whether institutional arrangements unrelated to direct economic outcomes at the sector level, such as food safety concerns, are accountable for the opportunistic behavior of agents enforcing the arrangements. To address these questions, I developed an index combining qualitative and quantitative aspects using cross-national data. The newly developed index separates regulatory practices from implementation and assesses livestock monitoring, veterinary control, and meat marketing. Among other things, the findings show that the business climate in meat markets depends not only on the quality of regulations in force but also on how they are implemented. Second, the paper provides empirical evidence of the institutional roots of misgovernance. Partially enforced regulations nurture an extractive institutional environment where different forms of corruption exist.

Chapter 3 considers the second objective and explores the influence of corruption control on the productive activities of livestock producers with different organizational forms titled "Do bigger farms suffer less from corruption? Anti-corruption efforts and the recovery of livestock production". Firstly, I examine whether corruption acts as a deterrent or promoter of livestock production growth. Then, I investigate this debated phenomenon in relation to different organizational structures of livestock producers. Lastly, I explore whether corruption control has a stronger effect on downstream beef production growth than upstream cattle herd size growth. Using a unique panel dataset on corruption crimes and livestock production rates at the level of subnational units in Kazakhstan and Russia, through a quantitative dynamic data approach, I discovered that the relationship between production growth and corruption is non-

linear and differs across household farms, peasant farmers, and agricultural enterprises. In addition, I found that the anti-corruption effects change over time, with the contemporaneous effect differing from the cumulative long-run effect. Finally, I exemplify a context in which these premises vary significantly across different organizational forms of livestock producers in a long-term dynamic specification.

The fourth Chapter, "Participation in Formal Markets and Farm Performance: The Case of Cattle Producers in Central Asia," captures the third objective and contributes to the existing literature by identifying the structural processes that drive market-oriented cattle production and exploring the factors that influence market formalization. The evolution of supply chains, including liberalized international commerce and aggressive entrance, raises concerns about the viability of small-scale farming in emerging and developing countries. Institutional differentiation between production scales may encourage commercial-sized farming. However, the transition from an informal to a formal institutional market exchange arrangement follows a unique path for each business structure. This essay aims to contribute to the literature by investigating the relationship between the scale of production and formal cattle marketing. Based on a survey of 500 farmers of different sizes, I use a triple-hurdle approach to investigate the structural processes that underpin market-oriented cattle production, formal commercialization, and the intensity of cattle sales across various subgroups of livestock producers. The major findings indicate that the production scale primarily influences commercialization decisions, whereas price drives the intensity of sales. However, the production scale has a non-linear inverse relationship with commercialization and formal market selection. While increasing the herd size may facilitate a transition to market-oriented farming, it may also drive farmers to informal markets if they do not reach the formal market threshold.

The concluding Chapter of this report draws upon scientific findings and proposes policy recommendations aimed at enhancing the development of the livestock sector within transition economies. Additionally, the Chapter delves into the limitations of the study and presents future research ideas.

2. COMPARING MEAT MARKET INSTITUTIONS: A NEW REGULATORY ENVIRONMENT INDEX

The effect of regulations on enabling business has received great attention among scholars during the past two decades. The main findings highlight that the complexity of regulations prevents long-term investments, facilitates the informal sector, and decreases trade (Kotisalo et al., 2015; Ndraha et al., 2017). In contrast, comprehensive regulations reduce uncertainty, ensure contract enforcement, and enable productive decision optimization (Djankov et al., 2018). However, the link between agriculture-specific regulation and agricultural business has been far less explored.

The initiatives measuring agriculture-specific indicators confirm the link between the quality of regulatory practices and productivity outcomes. Divanbeigi and Saliola (2017) indicated that agricultural productivity is higher in countries with higher rankings in terms of regulatory practice. Diaz-Bonilla et al. (2014) determined the association between agriculture value added and the agriculture growth index, which comprises agriculture-rural factors, governance, capital availability, and market operation indicators. The effort to measure the quality of regulatory practices is encouraging, but the theoretical assumptions behind index-based metrics that measure the extent of state regulatory complexity have been subjected to numerous criticisms.

The critics of index-based metrics empirically detect the flaws in indicators that measure the quality of regulatory practices. These indicators are highly correlated, frequently used, and fail to reflect realities between regulatory requirements and individual practices (Hallward-Driemeier & Pritchett, 2011; Shirley, 2013; Woodruff, 2006). Despite persuasive theoretical justifications and empirical evidence on the role of institutions, scholars continue to associate regulatory practices with the institutional environment and enhance theoretical claims that better regulation equals better performance (Divanbeigi & Saliola, 2017; Djankov et al., 2018; Jalilian et al., 2007). We debate that even among countries with equivalent meat market regulations, business environments for animal husbandry and meat production may differ substantially if implementation mechanisms of the regulations are poor.

The bureaucrats' role and ability to interpret regulations during their implementation is a crucial determinant of institutional quality. Past research has conditioned the harmful effects of misgovernance on tenuous legal structures (Duvanova, 2014). However, bureaucrats' motives to aid or hinder regulatory implementations are influenced by multiple institutional constraints. The meat industry illustrates this well. On the one hand, governments must establish excessive rules that control negative externalities regarding public health and environmental damage (D. Long, 1995). On the other hand, these excessive rules may be a source for rent-seeking or economic incentives to break the rules. We want to look at other non-opportunistic incentives, like food safety and public health concerns, that might affect bureaucratic regulatory implementation.

This paper contributes to the empirical literature on the evaluation of business climate by separating regulatory practices from their implementation with agriculture-specific considerations (Duvanova, 2012; Hallward-Driemeier & Pritchett, 2011; Kydland & Prescott, 1977; Stone et al., 1992). We propose and empirically assess an alternative explanation for why an industry-specific business environment may differ from what official regulatory practices would predict. To address this question, we develop an index that allows us to measure the quality and efficiency of regulations as well as to separate regulatory requirements from their implementation. To ensure the variability in the index's indicators, our analysis purposefully focuses on four countries with a common socialist background but a wildly heterogeneous reform process: Lithuania, Kazakhstan, Ukraine, and Uzbekistan. The newly established index should help identify regulatory framework adjustments to meet policy goals.

2.1. COUNTRY SELECTION

The country selection criteria are based on differences in regulatory practices and variations in meat production at the national level. First, we aim to include restrictive and business-friendly countries to have a diversified range of regulatory regimes. Second, we looked at the factors associated with meat market performance: the total number of livestock animals used for meat production; the productivity of livestock, which indicates the variation in carcass weight of meat animals over time; and the production level of livestock, which approximates the total amount of fresh meat produced. Based on these criteria, Lithuania, Kazakhstan, Ukraine, and Uzbekistan were chosen.

The countries exhibiting considerable variation in regulatory practices but sharing common social, historical, and cultural characteristics often complement cross-national studies of the institutional environment (Anderson & Swinnen, 2008). Selected transition economies demonstrate this well. These countries share a common socialist background but followed wildly divergent trajectories in terms of policy and market reforms after the post-communist regimes: Lithuania, where the EU regulations prevail; Kazakhstan, which is part of the Eurasian Economic Union; Ukraine, which orients towards integration into the EU; and Uzbekistan, whose regulatory practices developed somewhat independently.

The divergence in regulatory practices in the selected countries shows that the misimplementation of regulations may occur in heavily and little-regulated environments. The Worldwide Governance Indicators (WGI, 2018), as evidenced by the ranking of regulatory quality and the rule of law dimensions, demonstrate that Kazakhstan and Ukraine are capable of formulating sound regulations, but enforcing them is challenging. In

Uzbekistan, however, rule-following ability outperforms regulation formulation competence. Lithuania excels equally high in the formulation and enforcement of regulation.[2]

The meat markets in selected countries demonstrated a similar trend during the Soviet period, but following independence, the meat markets experienced varying levels of development. For instance, cattle numbers had an increasing rate for all selected countries, but after 1992, only Uzbekistan maintained the upward tendency (Figure 1). In meat production, Lithuania and Ukraine experienced a net decline in meat output. At the same time, Uzbekistan went through a meat production increase, and Kazakhstan only partially recovered from a sharp decline after the post-communist period. The productivity of meat animals increased in Lithuania and Ukraine, while the average carcass weight of farm animals declined in Kazakhstan and Uzbekistan (Figure 2).

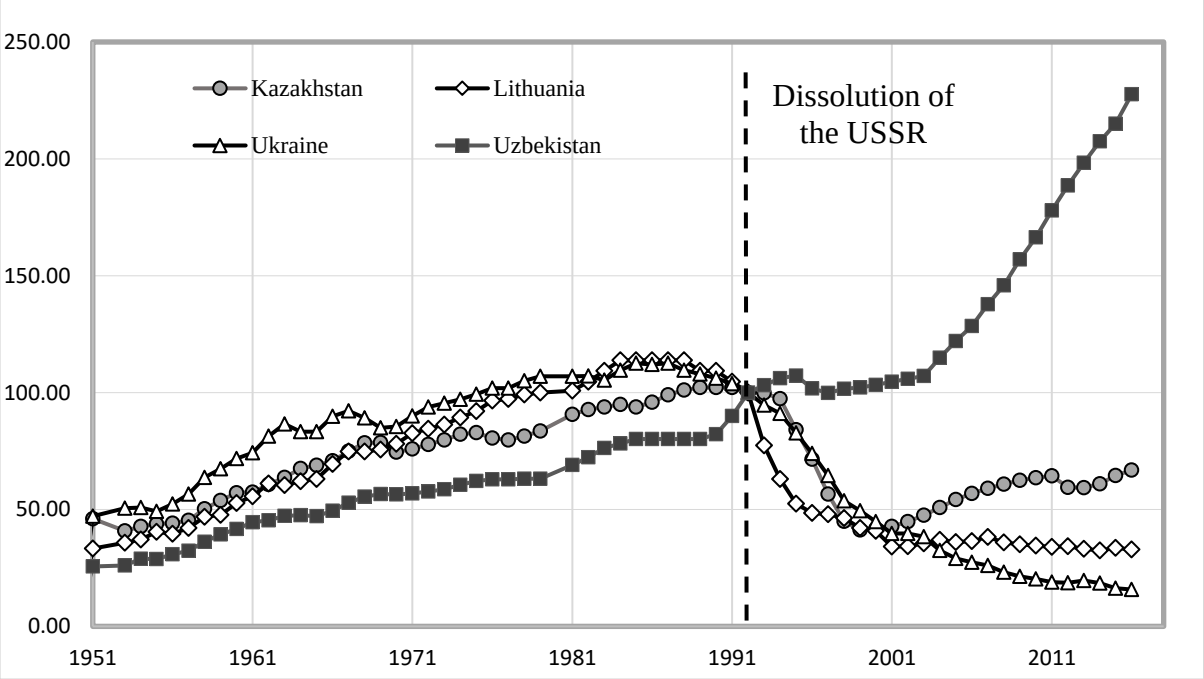


Figure 1. Cattle number index with base year 1992=100[3]

[2] In 2017 the country ranking for the regulatory quality was as follows: Kazakhstan (61.54), Lithuania (83.17), Ukraine (41.35), and Uzbekistan (8.65). And rule of law: Kazakhstan (33.65), Lithuania (80.77), Ukraine (23.56), and Uzbekistan (11.06).

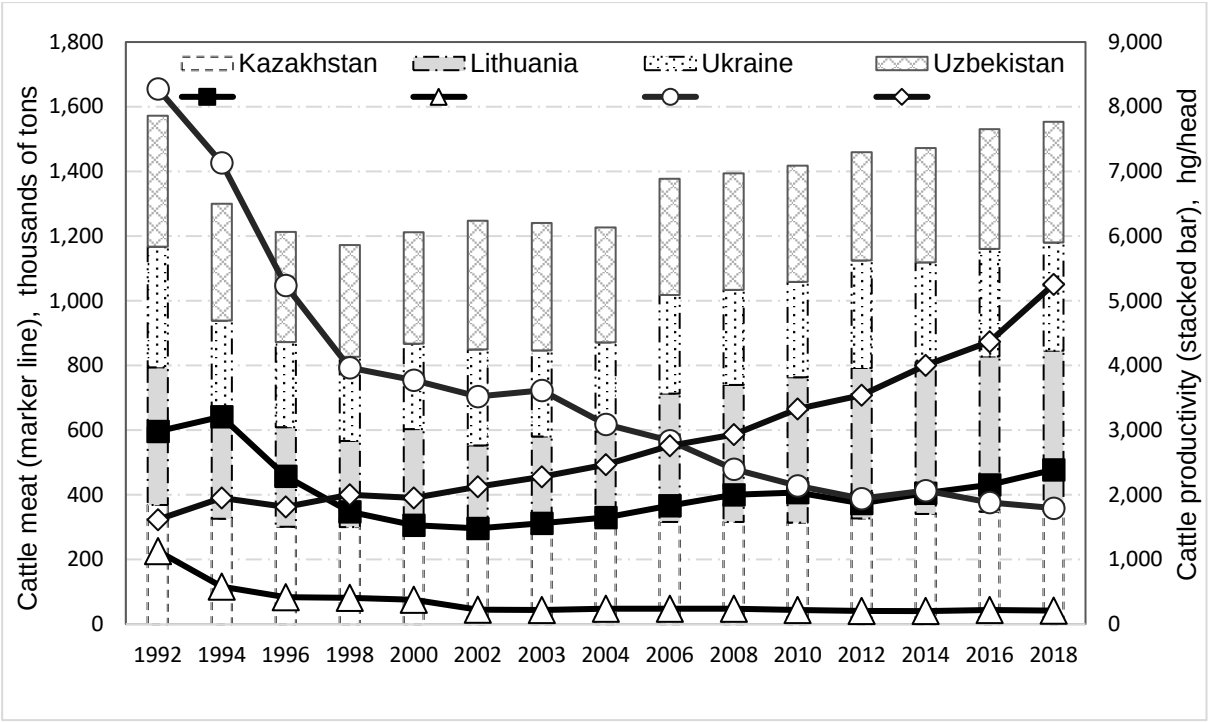


Figure 2. Cattle production and productivity[3]

Indeed, there may be various roots for the variation in the performance of the meat markets, such as the USSR's different infrastructural and technological heritage. Our analysis focuses on specific regulatory practices that apply to particular segments of the meat value chains. The regulatory practices that constrain interactions in the meat market must be better understood to enable the adoption of the best regulatory and implementation practices in countries with similar institutional backgrounds. For instance, the regulatory practices that limit misgovernance in Lithuania might be entirely ineffective in Kazakhstan but may work in Ukraine due to the Ukrainian focus on the EU integration policies, or effective policies that work in Kazakhstan may be targeted to the case in Uzbekistan (Rose-Ackerman, 2006). The heterogeneity of the market and institutional environments that dynamically developed during the post-Soviet transition period allows us to compare the country-specific factors contributing to misgovernance's persistence in particular market segments.

2.2. STRUCTURING REGULATORY PRACTICES FOR MEAT VALUE CHAINS

Meat markets refer to a broad composition of formal and informal institutions whereby parties engage in exchange. While these institutions imply the rules that constrain possible erratic

[3]Data source: http://www.fao.org/faostat/en/, National Statistical Offices, National Economy Statistical Yearbooks of the USSR

behavior in meat market interactions, we focus on the legal aspects of the institutional environment. The legal aspects are decomposed into specific indicators, such as quality, efficiency, and implementation of regulatory practices (Kasper & Streit, 1998).

The quality indicator of regulatory practices reflects de jure regulations. The indicator aims to capture the government's capacity to formulate sound regulations that permit and promote sustainable animal husbandry and meat marketing development. The efficiency indicator reflects transaction costs, which comprise the number of procedures, time, and expenses necessary to complete a bureaucratic process required by legal norms, such as animal identification (EBA, 2016). Finally, the implementation indicator reflects the practical application of legal and efficiency measures. The implementation methods reveal whether formal rules impose additional fees and time limits due to bureaucratic challenges, as well as whether regulations are transparent and consistent to avoid corruption risks and uncertainty.

The regulations in meat markets are unique and dynamic, making it challenging to reflect the regulatory practices just by the specific indicators; hence, distinct dimensions are defined to capture meat market segments. We examine the regulatory practices governing separate and sequential meat production value chain segments, beginning with animal birth and progressing through finishing operations, slaughtering, and meat retail. As a result, three comparable dimensions of regulatory practices in the meat markets emerge: livestock monitoring, veterinary control, and meat marketing (Figure 3). Therefore, we structure each regulatory indicator – quality, efficiency, and implementation of regulatory practices - by three dimensions.

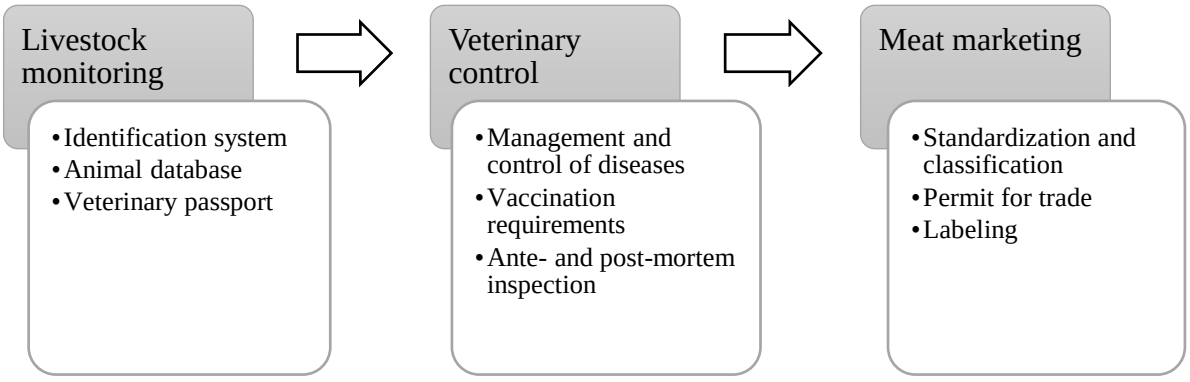


Figure 3. Dimensions and sub-dimensions of regulatory practices in meat markets

The first dimension, livestock monitoring, is motivated by concerns about traceability management. It captures the differentiation between actual animal monitoring and identification mechanisms in a country and the competence to monitor livestock. We assume that effective animal monitoring management facilitates livestock disease notification, outbreak control, animal selection management, the establishment of ownership rights, and the traceability of animal food products (Elbakidze, 2007; Shackell, 2008).

The veterinary control dimension refers to animal health and food safety. The dimension distinguishes regulations related to inspections, vaccinations, and veterinary control. We believe that veterinary control practices based on an inclusive, regular, and timely basis enable disease spread prevention and disable opportunities for rent-seeking entities.

The meat marketing dimension concerns meat retail, labeling, and trading permit acquisition. The objective of this dimension is to reflect the potential problems of adverse selection, unanticipated transaction costs, and information asymmetries resulting from regulatory practices, which influence meat marketing. We presume that well-designed regulations and their proper implementation enable formal commerce, facilitate long-distance transactions, and reduce food safety risks and hazards (Dimitri, 2003; Dunn, 2003; Herzfeld et al., 2011).

Meat markets account for an extensive range of animal husbandry types. For the purposes of this paper, meat markets refer to cattle, sheep, and pigs as food-producing animals. This livestock entails the involvement of actors from various segments of the meat value chains with similar operational functions. For instance, the raising, identification, finishing, and slaughtering processes are more similar among large farm animals than operational processes in the poultry industry.[4]

2.3. METHODOLOGY

The current study develops an index based on comparisons and contrasts of de jure and de facto regulatory practices that govern meat markets in four countries. The study applies a qualitative approach to data analysis that transforms the qualitative data into categorical values. Next, the categorical values are scored and aggregated into an index.

2.3.1. Data

The data collection for the study utilizes multiple sources of information. The regulatory practices data is collected from "soft" measures, which are based on expert evaluations, and "hard" measures, which are based on legal texts. The data includes information on the regulation quality, efficiency of regulatory practices, and implementation practices for livestock monitoring, veterinary control, and meat marketing dimensions.

The soft measures are based on expert evaluations from the public and private sectors. We conducted a survey covering 17 expert interviews that were guided by a closed-question questionnaire. To achieve convergent information on regulatory practices and enforcement, and to reduce the impact of any biases that may exist in a single source, we survey the experts from the public and private sectors that include veterinarians, association executives,

[4] Other regionally important animals such as camels and horses are less relevant to international trade and less integrated into modern retail

veterinary administrators, and farmers in the field. The experts were asked to identify the state agencies and core legislation that govern meat markets and present evidence on regulation enforcement, as well as perceptions of corruption.

The hard measures are based on 87 legal written documents. As primary hard measures, the legal documents derive information about the regulations in use from veterinary medicine laws, animal identification and registration rules, food safety and meat handling regulations, and meat marketing and transportation rules. The legal material for analysis was chosen based on references in core veterinary medical laws and references from the survey. Hard secondary sources, such as public media materials, were used to verify enforcement of and compliance with regulations.

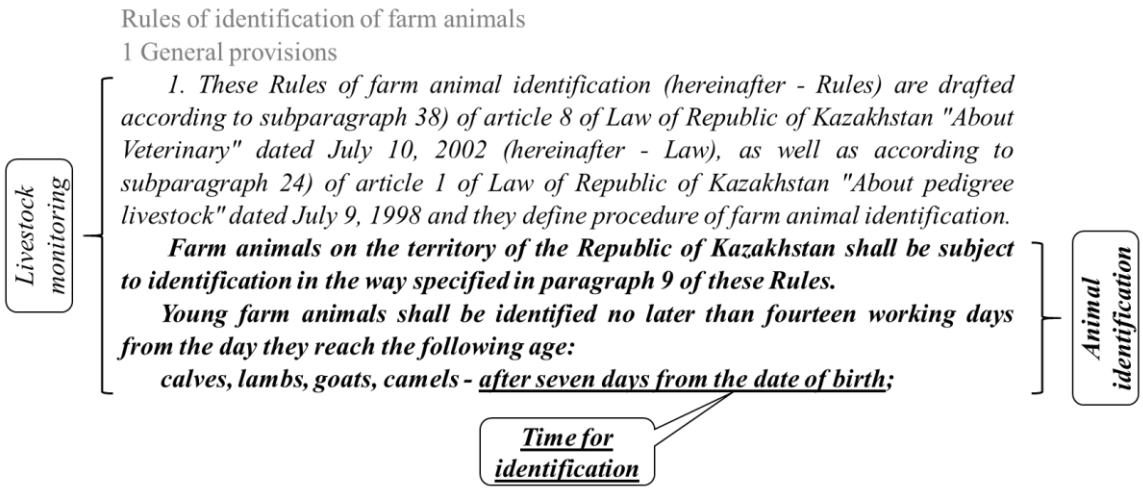
2.3.2. Data coding

Data coding is a process of qualitative analysis that aims to separate large amounts of information into smaller thematic categorical values with a common concept. The process applies to selecting keywords, phrases, sentences, or excerpts with particular characteristics from a text. For example, all articles in a veterinary law related to livestock identification, livestock registration, and livestock traceability would refer to a livestock monitoring category. The scope of each category is defined by a separate coding technique: open coding, axial coding, and selective coding (Bitsch, 2005).

The initial coding stage applied in the analysis is open coding, which involves selecting entire articles, chapters, or sections of legal documents. The open coding enabled differentiation between three broad dimensions: livestock monitoring, veterinary control, and meat marketing. Next, each text classified by open coding is subjected to more in-depth analysis and classification using the axial coding technique.

Axial coding establishes sequences and legal requirements within one dimension. These requirements are organized into more specific subcategories. For example, by utilizing axial coding, we were able to decompose the livestock monitoring dimension, produced by open coding, into smaller sub-dimensions, such as animal identification, animal registry, and animal data management (Figure 3).

The third type of coding, selective coding, focuses on the emergence of distinctive categorical values that can be scored and further aggregated to an indexed value for each indicator. For instance, the animal identification subdimension, produced by axial coding, was decoded into detailed values, including the methods, time, costs, standards, and implementation level of legal requirements. Figure 4 demonstrates the example of the text coding analysis. The coding was performed using the software Atlas.ti.



* All italic text is *open coding*; Italic and bold text is ***axial coding***; Italic, bold, and underline is ***selective coding.***

Figure 4. Example of a document coding excerpted from MinAgKaz (2015a)

The analytic effort of coding procedures involved the constant comparison of legal regulations between countries to uncover patterns and variations in the regulatory practices. The data acquired through structured surveys, interviews, and media documents helped to verify the extent of enforcement of regulations. This verification laid the groundwork for implementation indicators. Iterative data collection and analysis were done until data from all sources and parties were validated by multiple information sources and index construction requirements were met (Figure 5).

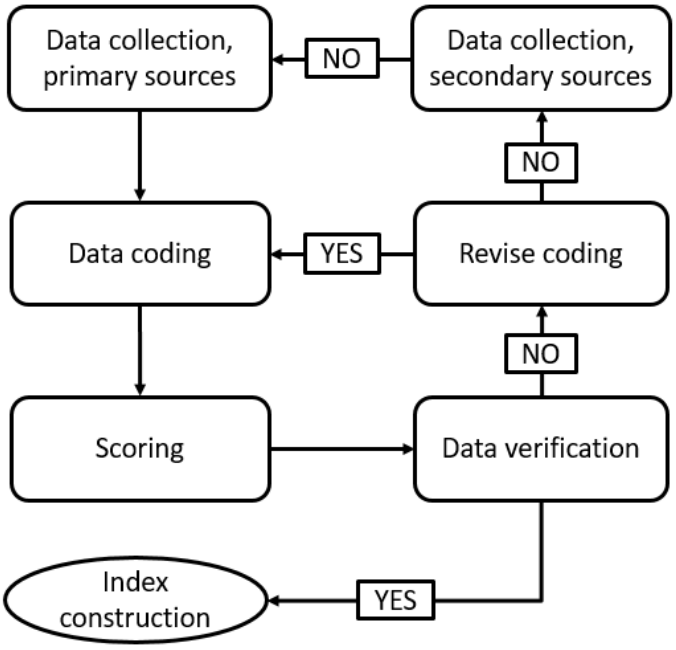


Figure 5. Data collection flow chart. Adapted from Bitsch, 2005

2.3.3. Scoring the indices

The scoring procedure converts qualitative categorical values, resulting from the selective coding, into a numerical score. The categorical values should satisfy the following criteria to achieve quantitative transformation: the categorical values are expected to have a direct impact on livestock and meat output; these values need to be quantifiable so that they can be scored on a ratio or binary scale from zero to one; objective measures of the categorical values should be preferable over subjective measures; and they need to vary across countries to define differences in national regulations (Voigt, 2013).

The scoring method considers not just regulations but also deregulation. Stricter animal identification and veterinary control rules receive higher scores, since the legal requirements must establish adequate rules to maintain animal health and traceability (EBA, 2016). For example, a country gets a "1" if animal identification is required, a "0.5" if partial animal identification is required, and a "0" if animal identification is not required (Table 1).

Table 1. Example of scoring

Selective code (subdimension)	Comparative dimension	Score	Country
Code: Identification requirements[5]	- Yes, identification and movement control in accordance with international standards	1	Lithuania
	- Partly, requirement covers specific types of animals that are identified and traced	0.5	Kazakhstan, Ukraine
	- No, neither animal identification nor animal movement control exist	0	Uzbekistan

The perceived corruption instances, such as bribery, extortion, or falsification of animal information reports, are assessed on a five-dimensional Likert scale ranging from very likely to very unlikely. Responses were rescaled between 1 (highly unlikely) and 0 (highly likely).

[5] Based on legal documents in force before December 1, 2017.

Extensive consultations with the expert board guided the scoring magnitude of each indicator. Higher scores were assigned to cases where a country complied with internationally recognized regulations or conformed with relevant international standards and programs such as the OIE Terrestrial Animal Health Code, the FAO Codex Alimentarius, Hazard Analysis and Critical Control Points.

2.3.4. Construction of the indices

Following the scoring of categorical values for each dimension, we employed a distance-to-frontier (DTF) indexing methodology pioneered by the World Bank's Doing Business to calculate the index. The DTF technique measures benchmarks, the country's aggregate scoring, in relation to a frontier or regulatory best practice. The frontier reflects the maximum potential score a country can achieve (EBA, 2016).

The quality indicator of regulatory practices is an indicator of the DTF index. The scoring sum for the quality of written regulations in a particular dimension represents an observed score of the quality indicator. For instance, the quality indicator of regulatory practices for the livestock monitoring dimension is the sum of scoring obtained from the evaluation of a country's legal documents on animal identification, animal registry, and animal data management. Calculating the quality indicator involves the normalization of the aggregate scores to a common unit where each country's aggregate score is rescaled by the linear transformation (Divanbeigi & Saliola, 2017):

$$DTF_i^{qual} = \frac{RP_i - RP_{min}}{RP_{max} - RP_{min}} \qquad (1)$$

where RP is an observed score of regulatory practices for economy i; RP_{min} is a minimum score of regulatory practices in the sample; and RP_{max} is the legal frontier—the highest possible score of regulatory practices.

The efficiency indicator of the regulatory practices approximates transaction costs expressed in time or monetary units. It reflects the efficiency of the legal framework businesses or individuals have to bear to comply with regulations (e.g., the number of procedures, time, and costs to complete animal registration). The cost and time estimates are derived from the official fee schedules. The time estimates for a particular regulatory process are divided into clearly defined steps (e.g., for livestock monitoring: time spent on animal identification, database fulfillment, and veterinary passport application). Unlike in the quality indicator of regulatory practices, in the efficiency indicator, the frontier is a country with the lowest transaction costs (EBA, 2016). The efficiency indicator is rescaled by the linear transformation (Divanbeigi & Saliola, 2017):

$$DTF_i^{eff} = 1 - \frac{TC_i - TC_{min}}{TC_{max} - TC_{min}} \quad (2)$$

where TC is an observed transaction cost a farmer bears due to regulations for economy i; TC_{min} is the frontier transaction costs a farmer could bear in a country with less restrictive regulations; and TC_{max} is the transaction costs a farmer could bear in a country with the most restrictive regulations.

The indicator of implementation practices measures the enforcement of veterinary and food safety regulations, corruption in the sector, and compliance with standards. The implementation practices are confirmed by responders who regularly manage the applicable regulations or carry out the relevant transactions. The linear transformation defines the indicator:

$$DTF_i^{gov} = \frac{GP_i - GP_{min}}{GP_{max} - GP_{min}} \quad (3)$$

where GP is an observed score of governance practices for economy i; GP_{min} is a minimum score of governance practices in the sample; and GP_{max} is the highest possible score of governance practices in the sample.

The overall DTF index is the arithmetic mean of the three indicators. It is rated from 0 to 100, with higher scores indicating better performance. Countries with scores near 100 are considered to have good regulatory practices. Once the data are quantified, indices analysis will indicate where a country has regulation gaps and where better regulation can be developed. The index analysis is ideally suited for cross-country comparison since regulatory gaps can be adopted by referring to other nations' experiences with regulatory issues.

2.4. RESULTS

Table 2 summarizes the major results by mapping the index indicators of the business environment in meat markets. Consistent with previous research focusing on economy-wide institutional quality, the overall ranking indicates that higher-income countries have the best regulatory practices (Divanbeigi & Saliola, 2017; Levchenko, 2007). According to the overall index, Lithuania, classified as a high-income country by the World Bank's World Development Indicators, is the top performer. Outside of the high-income group, Ukraine and Uzbekistan rank lowest. Kazakhstan, a country with an upper-middle income, ranks in the center. Thus, it does not come as a surprise that the evaluation of regulatory practices at sectoral and economy-wide levels are closely interrelated. However, when we examine the implementation indicator, a different picture emerges. While Lithuania continues to perform

at the highest level, Kazakhstan and Ukraine do substantially worse than their quality and efficiency of regulations would indicate. Uzbekistan's scores on all indicators are comparable.

Table 2. Summary results

Indicator/dimension	Kazakhstan	Lithuania	Ukraine	Uzbekistan
Meat market (DTF)	**43.12**	**69.91**	**17.02**	**27.04**
Quality of regulatory practices (DTF)	**33.09**	**90.28**	**38.13**	**22.22**
Livestock monitoring (0-30)	21.50	27.50	15.00	11.00
Veterinary control (0-25)	18.00	23.00	20.00	12.50
Meat marketing (0-12)	9.00	12.00	10.00	11.00
Efficiency of regulatory practices (DTF)	**86.67**	**52.78**	**10.00**	**33.89**
Livestock monitoring	21.00	31.00	36.00	32.00
Veterinary control	18.00	10.00	24.00	30.00
Meat marketing	8.00	11.00	12.00	9.00
Implementation practices (DTF)	**9.60**	**66.68**	**2.94**	**25.00**
Livestock monitoring (0-12)	4.50	9.25	4.25	3.50
Veterinary control (0-7)	1.75	5.00	1.50	1.50
Meat marketing (0-5)	1.50	3.75	1.00	4.00

2.4.1. Quality of regulatory practice

The quality indicator of regulatory practices indicates that Lithuania has a stronger capacity to formulate sound regulations that permit and encourage the development of business-oriented animal husbandry and meat marketing. Kazakhstan, Ukraine, and Uzbekistan still have regulatory gaps to fill. For each dimension, we address these incompletions in greater detail below.

1.1.1.1 Livestock monitoring

The quality indicator of regulatory practice for the livestock monitoring dimension shows that Kazakhstan and Lithuania have well-written regulatory practices, with scores of 21.5 and 27.5 out of 30, respectively. Ukraine and Uzbekistan score 15 and 11 points, respectively. The variation in the scores is related to the different stages of development of veterinary legislative bases. While the mechanism for monitoring farm animals in Ukraine and Uzbekistan is still in the planning stages for global integration, Kazakhstan and Lithuania have made significant progress in developing written regulations for animal identification, registration, and data record keeping.

All countries have legally binding requirements that farm animals be registered and identified for traceability purposes along the supply chains. However, countries where it is legally feasible to avoid animal identification in specific cases obtained lower scores. For instance,

imported animals for slaughter can avoid identification in Kazakhstan, Ukraine, and Uzbekistan for a limited time until the slaughter is carried out.

In Lithuania, internet services for animal registration are extensively developed, with animal registration and import licenses available via electronic government portals. Import and export permits as well as various veterinary certifications are listed as online services on government websites in Kazakhstan. However, online services are inaccessible because state veterinary organizations are not integrated into the national network services system. Guidelines for animal identification requirements are not available online in Uzbekistan. Only Lithuania and Ukraine give registry information on the website of the registering authority, whereas, in Kazakhstan, the information is not available on the website of the body tasked with registering animals.

The names, rights, and obligations of organizations implementing animal identification, maintaining animal databases, supplying identification devices, and issuing veterinary passports are all explicitly stated in Lithuanian regulations. For instance, regulations explicitly define that the State Food and Veterinary Service coordinates and controls the registration and identification of farm animals (MinAgLith, 2003, §2 (cl.6)). In contrast, the legislation in Kazakhstan, Ukraine, and Uzbekistan is very vague in expressing the names, roles, and tasks of the organizations undertaking animal monitoring. For example, the responsible organization for animal registration may be named as a "local administering organization" or a "veterinary organization."

The inconsistencies between the legally binding documents are an issue. For example, in Uzbekistan, slaughtering all animals without identification or with defective identification devices is forbidden (CabMinUzb, 2017, §2 (cl.15), §4 (cl.32), §5 (cl.41)). However, for unidentified imported animals the slaughter is permitted (CabMinUzb, 2017, §2 (cl.14)). Likewise, in Ukraine, animal identification regulations prohibit the slaughter of all unidentified animals (VerRadUkr, 1992, Art.5) and the veterinary medicine law prohibits the import of all animals without identification (VerRadUkr, 1992, Art.85 (cl.5)). However, according to the rules for bovine identification, an unidentified animal might be imported for slaughter reasons (MinAgUkr, 2018, §3 (cl.11,12)).

1.1.1.2 Veterinary control

The quality indicator for the veterinary control dimension shows that Lithuania and Ukraine have well-established regulations, with scores of 23 and 20 out of 25, respectively. Kazakhstan and Uzbekistan score 18 and 12.5 points and have regulatory gaps to close. The most noticeable distinction between the veterinary control rules is that, in Lithuania, compared to other countries, top-down supervision plays a more advisory function than a controlling one.

Veterinary inspections in Kazakhstan, Lithuania, and Ukraine are carried out following strategic planning and the state of the epizootic situation. In contrast, Uzbekistan lacks a

legally binding document that specifies the frequency and the sequence of veterinary controls and inspections. Except for Ukraine, an epizootic online database is available in all countries, albeit with a significant time lag in Kazakhstan. Furthermore, the name of the authority responsible for veterinary control and inspections is not stated in the legal documents in Ukraine and Uzbekistan.

Farm animal confiscation and compensation rules exist in Kazakhstan, Lithuania, and Uzbekistan. The Ukrainian legislative framework does not include a mechanism for compensating, confiscating, or forcing the slaughter of sick animals that endanger the health of animals and people. The animal confiscation regulation in Kazakhstan presents significant ex-post corruption concerns. A local state veterinary and sanitary inspector, the sole authority, can decide whether the diseased animal can be confiscated for disinfection or sanitary slaughter (MinAgKaz, 2014b, §3 (cl.18,19)).

Lithuania has extensive animal welfare legislation integrated with the EU standards based on the five freedoms of animal welfare: freedom from hunger and thirst; freedom from discomfort; freedom from pain, injury, or disease; freedom to express normal behavior; and freedom from fear and distress. There is also the recognition that animals are sentient beings (EC, 2012). Animal welfare regulations are issued for animal farming, transporting, and slaughtering (van Wagenberg et al., 2012). Animal welfare legislation in Kazakhstan and Ukraine is primarily concerned with anti-abuse measures, whereas standards for space, feed and water supplies, lighting, surgeries, and veterinarian aid are lacking. Uzbekistan has no laws governing farm animal welfare.

1.1.1.3 Meat marketing

The quality indicator for the meat marketing dimension evaluates the regulations related to slaughter, meat marketing permits, and traceability requirements. The scores reveal that the countries are relatively moderate in setting the written rules for meat marketing, with Kazakhstan scoring 9.0, Lithuania 12.0, Ukraine 10.0, and Uzbekistan scoring 11.0 out of 12.

In Kazakhstan, Ukraine, and Uzbekistan, the legal framework does not include hazard analysis and risk assessment regulations in the meat production sector. Kazakhstani regulations partially mention that inspectors shall evaluate the systems for controlling meat quality, but only if such a system exists. However, such quality control systems are not mandatory. At the same time, the names of the control systems are written in the national documents in English, which is not the state language in Kazakhstan and is beyond the comprehension of many residents (MinAgKaz, 2015b, §2 (cl.8(13)); §4 (cl.10(7))).

Moreover, regulations in Kazakhstan are risk-prone due to a lack of strict sanitary and humane animal slaughter requirements. For example, animal slaughter for commercial purposes should be carried out at specialized slaughter sites (MinAgKaz, 2015c, §2 (cl.5)). However, in the absence of such sites, slaughter can be carried out at an adapted location until a

specialized slaughter site is made available (MinAgKaz, 2015c, §2 (cl.6)). The sanitary and technical standards for the adapted location are not specified in the legal documents.

Meat traceability is regulated in all countries, albeit with some limitations. Farmers in Lithuania, Kazakhstan, and Ukraine must disclose information about the origin of their animals and meat to processors to maintain traceability. In Lithuania, information can be disclosed by electronic data exchange or in a standardized declaration (EC, 2004, Annex II (cl.4(b))). Similar actions can be accomplished in Kazakhstan and Ukraine using only paper certificates. In Uzbekistan, the meat traceability requirements are inconsistent. Traceability of food products, including meat and animal products, is mandatory (CabMinUzb, 2018, Ch.3 §1 (cl.22)). However, no legally binding document requires ante- and post-mortem inspection records to be kept.

Meat production standards differ among countries. Most meat production standards in Kazakhstan, Uzbekistan, and Ukraine are inherited from the Soviet past and are recognized primarily in the Commonwealth of Independent States. Unlike other countries, Kazakhstan has no legally binding meat classification standards based on the distinctive features of slaughter (e.g., Kosher, Halal meat).

2.4.2. Efficiency of regulatory practice

On paper, Kazakhstan has the most efficient regulations, which means that the number of procedures, time, and costs to obtain a permit or complete animal registration is lower than in other countries. Kazakhstan is a pioneer in establishing minimal regulations for meat marketing permits, with five essential documents to be submitted within two working days (Borisenko, 2018; Likhogay, 2018). The same procedure takes five days in Lithuania, with five mandatory documents to submit. In Ukraine, nine documents must be submitted within a one-day limit to grant the permit. Uzbekistan does not set a legal requirement for document submission, although obtaining a marketing permit takes seven days. The legal timeframes for animal identification range from seven days in Kazakhstan to 14 days in Uzbekistan. The regulations set a time limit of three days to obtain a veterinary passport in Kazakhstan and Uzbekistan, five days in Ukraine, and seven days in Lithuania. To receive compensation for sanitary animal confiscation in Kazakhstan, the applicant must provide seven documents from five organizations.

2.4.3. Implementation practices

The implementation practices indicator evaluates the practical application of veterinary and food safety regulations. Lithuania has the highest score, while Kazakhstan, Ukraine, and Uzbekistan lack transparency and execution of livestock monitoring, veterinary control, and meat marketing regulations. In Kazakhstan and Ukraine, respondents' assessments of the regulation's implementation differ greatly across the public and private sectors. We gave a

higher weight to private sector responses because we believe that private enterprises have more reasons to provide objective judgments on regulatory barriers.

1.1.1.4 Livestock monitoring

What is written in regulations does not always mirror reality. Although farm animal registration and identification are mandatory in the four countries, neither animal identification nor animal movement control might exist in practice. Respondents claimed that it is very likely in Kazakhstan and likely in Ukraine and Uzbekistan that farm animals are unidentified, while non-identified animals are very unlikely in Lithuania. The information regarding farm animals must be disclosed in Kazakhstan, Lithuania, and Ukraine. However, in practice, it is highly likely in Kazakhstan and likely in Ukraine that animals are not registered, and false information (e.g., nonexistent animals) is uploaded to the database. Both scenarios are unlikely in Lithuania. Irregular payments to expedite animal identification are possible in Kazakhstan, Ukraine, and Uzbekistan but unlikely in Lithuania. Farm animals without a veterinary passport are common in Kazakhstan, Ukraine, and Uzbekistan but rare in Lithuania.

Legal proceedings may take far longer than the term specified in the registration. For example, in Kazakhstan, registering a newborn animal in the national database might take up to 30 calendar days rather than the seven days specified by law. In contrast, the same procedure in Lithuania usually takes one day and has a legal time restriction of seven days. On average, obtaining a veterinary passport in Ukraine takes 14 days rather than the five-day legal restriction. In Uzbekistan, it takes five days rather than the three days specified by law, and in Kazakhstan, it takes three days, which is consistent with the legal text. In Lithuania, however, it takes one day out of the legally assigned maximum of seven days.

1.1.1.5 Veterinary control

Veterinary control is the sector most susceptible to corruption. Irregular payments to complete or expedite animal health inspections are likely in Kazakhstan and Uzbekistan, neither likely nor unlikely in Ukraine, and highly unlikely in Lithuania. In several Kazakhstani regions, the documented facts of double vaccination are used to fulfill the state strategy and disburse state funding (Shibarshin, 2017). In addition, there have been reports that state veterinarians and processors are engaging in opportunistic conduct by forcing some farm animals to be slaughtered without any health assessment. As a result, meat processors obtain the meat at a reduced market price, which is repaid to the farmer. Where, according to the rules, the state covers 30%, and the processor covers 70% of the repayment costs (MinAgKaz, 2014a, §3 (cl.9)).

In Kazakhstan, an animal is likely to be confiscated without any investigation or proof of its sickness, while it is highly unlikely in Lithuania and Ukraine and unlikely in Uzbekistan. Moreover, in Kazakhstan and Lithuania, where compensation mechanisms for confiscating unsanitary animals exist, the repayment process takes much longer than the law requires. For

example, instead of the allotted ten days in Kazakhstan, it may take up to 180 days, while in Lithuania, it could take up to 45 days instead of the five days stated in the regulations.

1.1.1.6 Meat marketing

For some countries, implementing the regulations is challenging. It is highly likely in Kazakhstan, likely in Ukraine, highly unlikely in Lithuania, and unlikely in Uzbekistan that unregistered, unlicensed, or uncertified companies sell meat. It is conceivable that the authority tasked with issuing licenses for the sale of meat in Kazakhstan and Ukraine requires additional documentation not listed in the legislation. However, this is highly unlikely in Lithuania and Uzbekistan. It is highly unlikely in Lithuania and Uzbekistan for unexamined meat to be marketed, although it is very likely in Kazakhstan. Farm animal slaughter in non-specialized areas is highly likely in Kazakhstan, Ukraine, and Uzbekistan but extremely uncommon in Lithuania. An animal is likely to be slaughtered without pre-slaughter inspection in Kazakhstan, Ukraine, and Uzbekistan, but it is highly unlikely in Lithuania. To sell meat in Kazakhstan and Ukraine, industrial livestock farms may avoid independent third-party veterinary inspections by obtaining a license for private veterinarian practice.

2.5. DISCUSSION

This paper assesses an alternative explanation for why an industry-specific business environment may differ from what official regulatory practices would predict. We develop an index that improves the accuracy of metrics for the business environment in agricultural markets, measuring not only the quality and efficiency of regulatory practices but also their practical implementation. This new metric of institutional quality allows us to identify regulatory gaps and sources of poor regulatory enforcement in the meat markets of four countries. Our metric shows that the legislation supports inclusive meat market institutions in Lithuania, where regulatory practices are well implemented. Similar legislation in Kazakhstan, Ukraine, and Uzbekistan is only partially enforced, nurturing an extractive institutional environment where different forms of corruption exist.

Analogous to other research, our analysis demonstrates that, although regulations may be similar on paper, variation in how they are implemented results in different institutional environments (Duvanova, 2014; Hallward-Driemeier & Pritchett, 2011). The primary obstacles to implementation include discretionary bureaucracy and bureaucracy distortion. Our results show that efficient regulation and good regulatory practices have little effect on implementation when institutional structures let bureaucrats generate an unofficial burden. The misimplementation of regulations occurs due to bureaucracy distortion, such as authorities requiring additional documents not listed in legally binding regulations. These bureaucracy-imposed unofficial regulatory obstacles are a significant source of ex-post corruption.

Inconsistency in regulations is another factor of poor implementation. For example, regulations that do not indicate the names and roles of supervising organizations have a poor implementation rate. Authorities with unclear responsibilities may delegate their responsibilities to other authorities or different entities with similar roles, via either a vertical or a horizontal hierarchy. As a result, farmers are directed back and forth to several authorities for a single request. Furthermore, these underregulations have more potential for ex-ante corruption, which occurs when an authority grants informal permission to break the rules.

Regulations requiring infrastructure improvements or that may not be coherent with economic incentives may result in violation or underreporting. Animal health monitoring regulations, for example, are less feasible if a government lacks a record-keeping system or does not mandate traceability for meat marketing. As a result, farmers are free to sell or slaughter animals without health inspections.

Our results add weight to the argument that state regulations defined by heavy state requirements are challenging to implement (Divanbeigi & Saliola, 2017; Djankov et al., 2002). We discovered a pattern of overregulation in Kazakhstan, Ukraine, and Uzbekistan in terms of quality control and meat marketing. Reliance on the state system of standards, GOST, inherited from the Soviet Union, is one obstacle to administering veterinary services and food safety regulations. The main disadvantages of the GOST system include a lack of scientific risk analysis, a high number of norms, and a lack of transparency. The GOST standards impose enormous costs on the private sector and the government, since it is difficult for the private sector to comply with regulations that are too complex and for state authorities to supervise and enforce them (Magistrelli, 2014). Lithuania updated its food safety management practices to meet the EU's integration commitments, adopting new EU and ISO standards (Paulauskas, 2014).

In addition, we add to the theoretical exploration of the institutional roots of good governance and debate whether excessive regulations unrelated to direct economic outcomes are only partially accountable for bureaucratic discretion. Overly burdensome sanitary norms when encountering unofficial obstacles are a source of non-implementation practices. For instance, farmers may carry out "certified" slaughter in their backyards to mitigate transaction costs associated with a remote or overloaded slaughterhouse. In cases where authorities combine controlling and executive functions, the likelihood of non-implementation increases. Animal health control, for example, may violate food safety regulations if the decision to sanitize animals is made by designated authorities rather than an independent third party.

Our findings contribute to the literature on the analysis of agribusiness regulatory practices and call into question the empirical assessment of business climate. The results of the data analysis suggest that using the data on the newly developed index to measure quality, efficiency, and implementation practices of regulations for meat markets may provide slightly different information for the business climate than indices that measure only the quality of regulations. Even though the sample size of countries may not represent the entire population,

the information presented here indicates that implementation measures may provide more accurate information on the business climate of the meat industry.

3. DO BIGGER FARMS SUFFER LESS FROM CORRUPTION? ANTI-CORRUPTION EFFORTS AND THE RECOVERY OF LIVESTOCK PRODUCTION

The influence of corruption on production has received great attention among scholars during the past decade (Aidt, 2009; Gründler & Potrafke, 2019). However, the relationship between corruption and productive activities is theoretically ambiguous. On the one hand, corruption impedes economic operations (Cole et al., 2009; Rose-Ackerman & Truex, 2012); on the other hand, corruption occasionally can help progress (Egger & Winner, 2005; Leff, 1964; Levy, 2007). If the evidence of corruption's inconsistency with productive activities does not imply that corruption is always detrimental, then what organizational form of businesses gains the most from an inclusive business climate?

Although the concentration of misgovernance and structural imbalances is typical for a particular industry (Levchenko, 2007; Shirley, 2013; Woodruff, 2006), previous research has revealed that in the agricultural sector, corruption is perceived as a major impediment to business operations to the same extent as in other industries (Herzfeld et al., 2018). Corruption in the agricultural sector has been investigated in many aspects, including the relationship between access to subsidies and rent-seeking (Kvartiuk & Herzfeld, 2021; Tambulasi, 2009; Teichmann et al., 2020), the link between bribery and efficient land use (Barbier, 2012; Bulte et al., 2007), the link association of corruption in organizational structure of the irrigation sector (Jacoby et al., 2021; Suhardiman & Mollinga, 2017). It is a crucial issue, however, that the research has not differentiated between legal and illegal forms of rent-seeking activities. These studies focus primarily on individual incentives for engaging in corrupt activities and do not address the government's role in preventing corruption.

More recently, the literature offers contradictory findings about the role of illegal rent-seeking activities, registered corruption crimes, or conviction-based corruption measures on economic progress. Despite the shortcomings of the anti-corruption effort, more vigorous anti-corruption efforts encourage foreign direct investments in regions with the strongest corruption control (Cole et al., 2009), increase the likelihood of firms making long-term investments (Xu & Yano, 2017), and improve firms productivity (Kong et al., 2020). In contrast, other research argues that regions with higher anti-corruption effort rates attract fewer investments (Zakharov, 2019).

The contrasting results for productive activities within different corruption control environments might be attributable to the fact that the utilized data covers all producers, regardless of their organizational form. Whereas data limitations prevent being more specific, this suggests significant nonlinearities in the relation between productive activities and anti-corruption efforts. In conjunction, when cross-industry analyses do not control for industry-fixed effects, they tend to find the relationship inconsistent across regions due to unobserved heterogeneity bias. This paper seeks to determine the viability of this line of research and

contributes to the theoretical exploration of the institutional roots of good governance by testing whether the organizational form of a business might matter.

The estimation approaches utilized in the evolved literature on anti-corruption efforts frequently occur in the absence of empirical support for the validity of restrictive dynamic specifications, potentially leading to biased conclusions and invalidated hypothesis testing. Scholars often connect estimation to fixing endogeneity problems, which restricts the capacity to utilize the econometric models to comprehend the dynamics of reforms. The conclusions are frequently limited to short-term impacts in the same principles as in static models. As such, projected effects prevent determining whether a relationship between variables is immediate or persists into the future (De Boef & Keele, 2008). Our analysis aims to establish an empirical response that allows determining contemporaneous and future effects of the anti-corruption level on production growth outcomes.

This study makes the most direct contribution to the literature on the institutional effects on agricultural activity. Using a unique dataset on corruption crime rates at the level of subnational units in Kazakhstan and Russia for 2010–2019, we debate those external institutional constraints, such as corruption control, influence productive activities depending on the producer's organizational structure. More specifically, we explore how registered corruption crimes affect cattle and beef production growth in different organizational structures of farms.

3.1. CORRUPTION IN KAZAKHSTAN AND RUSSIA

Kazakhstan and Russia inherited corruption from the Soviet era. In the Soviet Union, corruption was rooted in the contradictions of an over-centralized economy. When the Soviet system of government collapsed, but a replacement had not yet been established, corruption became an emerging mechanism of the market systems (Rigi, 2017). Corruption acted as a compensation instrument, accelerating the decision-making process without clear legal standards. In modern Kazakhstan and Russia, corruption is a means of extracting rent and ensuring the loyalty of subordinates in the administrative hierarchy (Satpayev, 2014; Schulze et al., 2016).

In Kazakhstan and Russia, corruption is entrenched in political and bureaucratic realms, yet higher-level corruption, i.e., by elites, is not systematically sanctioned (Janenova & Knox, 2020; Schulze & Zakharov, 2018). The legal framework governing corruption in independent Kazakhstan and Russia has been weakly consolidated. The anti-corruption legislation in Kazakhstan and Russia focuses on individualistic corruption cases. Appropriate regulation can be found in various legal acts that address corruption directly or indirectly (Janenova & Knox, 2020; Schulze & Zakharov, 2018).

Over the past decade, Kazakhstan and Russia attempted different measures to control corruption. The anti-corruption initiatives include prevention and control efforts such as stricter laws, digitalization, public accountability, and individualistic prosecution of high-

profile offenders (Janenova & Knox, 2020; Schulze & Zakharov, 2018). An increased position on the Worldwide Governance Indicator ranking is evidence of advancements in corruption control.[6] However, the mechanisms of regulatory implementation are still weak in both countries, where bureaucracy-imposed unofficial regulatory hurdles are an important source of corruption (Duvanova, 2014).

3.2. OVERVIEW OF CATTLE AND BEEF PRODUCTION

Studying the livestock sector, particularly the production of cattle and beef, is interesting and important for a variety of reasons. For many emerging and transitioning countries, livestock underpins the livelihoods of large parts of rural households as a supplementary income or a means of self-sufficiency.[7] In Kazakhstan and Russia, livestock production is used to be driven by the doctrine of economic diversification and the goal of ensuring national food security (Kvartiuk & Herzfeld, 2021; Oshakbayev & Bozayeva, 2019; Pomfret, 2016). Cattle farming is progressively being transformed into higher standards and quality production, necessitating more sophisticated processing along export-oriented value chains (Petrick et al., 2018), yet most cattle are raised by small farmers with limited resources (Koester & Petrick, 2010; Robinson et al., 2021b). As a source of sustainable development, the environmental and economic effects of the blue water footprint, desertification, and greenhouse gas emissions from intensive cattle farming have garnered considerable attention in both countries (Alimaev et al., 2008; Bityukova & Borovikov, 2021). Thus, assessing the role of the institutional roots of good governance in determining cattle production growth is relevant not only from an economic but also from an environmental and social perspective.

The evolution of cattle and beef production over the past three decades resembles a roller coaster. After the dissolution of the Soviet Union, large-scale livestock commodities production on formerly collective and state farms virtually ceased. Historically, significant state enterprises either sold and butchered their livestock or distributed it to independent farmers (Anderson & Swinnen, 2008; ur-Rahim et al., 2014). Kazakhstan's beef and cattle production output dropped annually between 1990 and 1999 due to the transitional slump. Kazakhstan began a sector recovery in 2000 but did not achieve the Soviet-era level so far (Figure 6). Between 1990 and 1999, Russia's beef and cattle production fell precipitously

[6] From 2009 to 2020 WGI Control of Corruption, percentile ranking in Kazakhstan increased from 18.6 to 39.9, and in Russia from 11 to 19.2

[7] According to National Statistic Offices (2019), 42% of the population in Kazakhstan and 25% of the population in Russia reside in rural areas.

(Figure 7). Following 1999, the industry started a further wave of consolidation by maintaining increasingly severe negative rates.

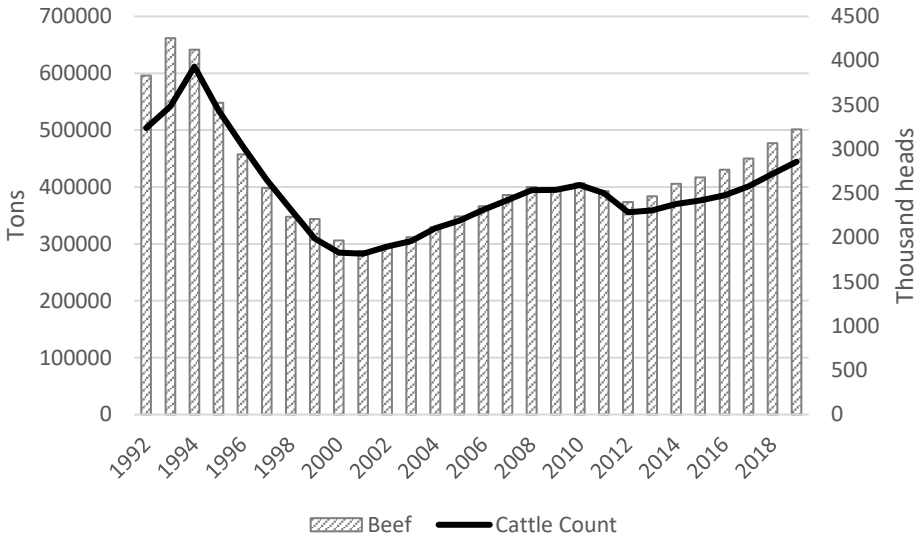


Figure 6. Beef production and cattle headcount, Kazakhstan 1992–2019

Source: FAOSTAT

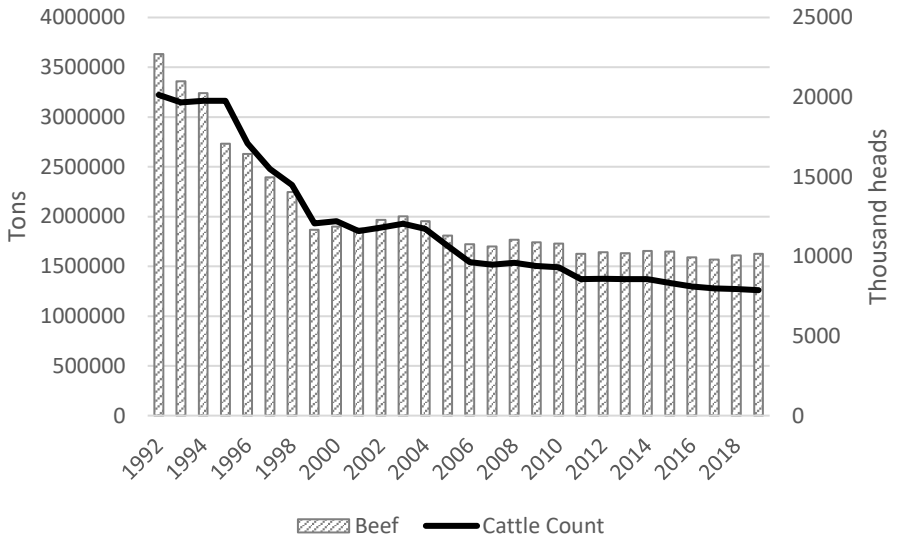


Figure 7. Beef production and cattle headcount, Russia 1992–2019

Source: FAOSTAT

Cattle production in Kazakhstan and Russia is governed by a traditional ideology of economies of scale that is unsupported by empirical evidence. In theory, large farms are

inferior to small farms for two reasons: first, they do not benefit significantly from economies of scale, and second, they incur greater transaction costs, primarily due to the cost of managing hired labor. However, in both countries, the allocation of agricultural support is heavily biased in favor of large producers (Koester & Petrick, 2010).

Small livestock producers are the most vulnerable. They cannot choose where to keep their cows, but larger producers have access to land and investment subsidies. Small households mainly stock around their settlements, resulting in environmental degradation and diminished livestock performance (Alimaev et al., 2008; Bityukova & Borovikov, 2021). The regulatory hurdles, such as minimum herd count and live weight thresholds, eliminate smaller producers that do not match the scale requirements of state support. Such discrimination creates an unprecedented competitive advantage for large enterprises over the rest of the agricultural sector and facilitates rent-seeking opportunities when obtaining the proof documentation required to receive subsidies (Robinson et al., 2021b; Uzun et al., 2019).

The agricultural support system is discriminatory not only between farm types but even within agricultural enterprises themselves. Only a few large farmers receive large amounts of subsidies, while the majority receive just little stimuli (Petrick & Götz, 2019; Robinson, 2020). In 2016, for instance, Bryansk Meat Packers, a subsidiary of the Miaratorg agroholding, received 90.7% of all beef development subsidies, while other subsidized credits were allocated to only three firms (MinAgRus, 2017). In conjunction with anecdotal evidence, such sentiments support the hypothesis that corrupted activity benefits more adapted farm organizations while retarding development for vulnerable farmers. This discrepancy may call for specific institutional provisions and rules for policy coordination that may reduce the conflicts when redistributing public goods and services.

In the rest of this chapter, we discuss anti-corruption efforts as one of the crucial factors of production growth in the cattle and beef industries. In addition, we focus our analysis on three types of agricultural producers: enterprises, peasant farms, and households, as these are the farm types that contribute heterogeneously to regional livestock production.

3.3. DATA

Our dataset encompasses data from 73 regions in Russia and 13 regions in Kazakhstan, spanning from 2011 to 2019[8]. We obtain livestock production data from the National Statistical and Ministry of Agricultural offices, as well as corruption open case crime rates from the Ministries of Internal Affairs. The expenditures on agricultural services and support

[8] We exclude certain regions for geographical reasons: for example, the Mangistau region in Kazakhstan, which is located in a desert zone; and the Kamchatka Krai in Russia's East-North, which is located in a freezing area. Additionally, we omit cities of administrative significance, which have the same status as regions but play only a minor role in livestock production.

were obtained from Ministries of Finance, while loan rates for agriculture were gathered from the Central banks of the countries.

We distinguish three cattle and beef producer types: enterprises, peasant farmers, and households. The enterprise farm type represents corporate farms of various legal forms, which are commonly associated with large farm organizations, though this is not always the case of scale. Among them are business partnerships, production cooperatives, unitary businesses, and subsidiary plots. Peasant farms typically refer to middle-sized farms, but infrequently, peasant farms may be larger than enterprises. These farms refer to a legal entity created by an individual or a group of individuals who share ownership and carry out production jointly or who are related by kinship and (or) property. The enterprises and peasant farms primarily focus on commercial aims. Household farms are the personal subsidiaries and other personal farms of rural and urban settlements (Mussayeva, 2019; Rosstat, 2021). Unlike enterprises and peasant farms, household farms are exempt from mandatory legal registration and taxation (Hajdu et al., 2021).

The main producers of cattle in Russia are enterprises and households, while in Kazakhstan, peasant farms and households hold the majority of the cattle herd size (Table 3). In Russia, enterprises produce more beef than peasant farmers, unlike in Kazakhstan. However, in both countries, households remain the main source of beef production. Upon closer examination of the varying dynamics among producers, it becomes evident that farmers of all types encounter regional fluctuations in both herd size and beef production: all farmer types are characterized by higher regional variation than variation over time in herd size and beef produced. The disparity at regional and country level dynamic suggests that the cattle and beef industry in these countries is structured differently, with varying factors contributing to the distribution of cattle ownership and level of beef production. Further research on the socio-economic and business environment factors, such as corruption control, at play would be valuable in understanding these patterns.

Table 3. Descriptive statistics of cattle number and beef produced by countries from 2011 to 2019

Variable	Mean	St. dev. overall	between	within
Cattle number, thous. heads				
Kazakhstan				
Enterprises	40,836.3	35,950.9	34,311.9	14,012.4
Peasant farms	136,851.0	115,098.2	106,701.2	51,455.2
Households	304,589.6	180,389.7	166,096.7	82,794.7
Russia				
Enterprises	118,868.1	119,233.4	118,038.5	21,179.4
Peasant farms	31,711.3	41,038.4	40,268.7	9,074.8
Households	121,031.9	140,851.4	140,459.0	17,664.7
Beef produced, thous. tons				
Kazakhstan				
Enterprises	2,490.1	2,685.6	2,111.3	1,750.0
Peasant farms	6,135.0	6,489.4	6,077.5	2,779.2
Households	24,035.2	13,541.0	13,920.1	1,718.1
Russia				
Enterprises	7,405.9	8,318.4	7,940.8	2,628.6
Peasant farms	1,737.4	2,185.5	2,050.9	788.4
Households	12,729.8	14,554.6	14,498.3	2,048.7

Source: Own calculation based on data from Statistical Offices of Kazakhstan and Russia

To quantify anti-corruption efforts, we use Svensson (2005) legalistic definition of corruption - 'the misuse of public office for private gain' - because it involves violations of legal standards. The registered cases of legal standards violations include those charged with corruption, bribery, extortion, and abuse of public power. Examples of corruption crimes include public officials accepting unofficial rewards to accelerate their duties, offering preferential treatment in granting government contracts, and citizens who pay bribes to get leniency in punishment, bypassing law enforcement, or expediting bureaucratic operations. These measures are the most applied quantitative indicators of anti-corruption efforts and have been used in previous studies to proxy corruption control (Cole et al., 2009; Johnson et al., 2011; Zakharov, 2019).

Based on official statistics, it can be seen that Kazakhstan records, on average, 89.5 cases of registered corruption crimes in each region, while Russia records 130.3 cases (Table 4). Based on the data, it appears that no regions are free from reported incidents of corruption. To ensure that the overall number of corruption crimes is a representative measure of anti-corruption efforts, we weight the registered cases, which are under direct investigation by procurator's offices, by the population (Solon et al., 2015). By doing so, we find that both countries have a comparable level of anti-corruption efforts for every 100,000 individuals. Additionally, the dynamic of corruption control shows that the overtime fluctuation of corruption control efforts is more frequent than across different regions.

Table 4. Descriptive statistics of corruption crimes by countries from 2011 to 2019

Variable	Mean	St. dev. overall	between	within
Kazakhstan				
Corruption per capita	8.76	5.43	3.43	4.30
Corruption crimes in total	89.53	53.83	31.66	44.33
Russia				
Corruption per capita	8.30	5.20	3.18	4.12
Corruption crimes in total	130.25	116.15	93.33	69.90

Source: Own calculations based on data from the Ministries of Internal Affairs of Kazakhstan and Russia

3.4. EMPIRICAL FRAMEWORK

In the empirical framework, we explain the growth of cattle and beef production by anti-corruption efforts, considering socioeconomic factors. We expect that easing corruption enables better performance in animal raising and meat production through increasing investments and promoting inclusive access to resources and services. We anticipate a greater impact for higher value-added products, such as high-quality meat, which will benefit from more transparent marketing conditions and business relationships. Our analysis exploits this feature of the corruption control effects and estimates the relationship between the anti-corruption efforts and agricultural output growth for each organizational form or farm type.

First, we assess the output growth in the cattle and beef sectors through the organizational lens. While regional differences in entrepreneurship exist, the share of the different organizational forms in output varies significantly more due to their allocation of resources between productive activities, such as innovative production, and unproductive activities or rent-seeking (Baumol, 1996). In Kazakhstan, farms with fewer opportunities to vertically integrate are more captive to corrupt practices of other actors in the supply chain. For example, the farmers may have to pay informal fees to processing and fattening firms for the proof-of-sale documentation necessary to secure the subsidy (Robinson et al., 2021a). We imply that anti-corruption efforts effectively influence the distribution of productive activities.

Further, we link anti-corruption to the productivity. As animals go from fattening to the slaughter stage, the production process involves several steps that can be handled within a farm or organized in different specialized places (Hobbs, 1996). The interactions between farm and public authorities encompass, for example, animal registration, inspecting and controling agents to ensure veterinary and food quality standards. However, farmers might choose to bypass the quality requirements by marketing their animals or beef informally. Furthermore, access to high-quality and high-price sales channels, either via domestic supermarkets or exports, often requires high on-farm investments. If a farm cannot vertically integrate slaughtering, processing and marketing, commercialization in high-quality segments also requires a higher trust among actors in the supply chain. We test whether more anti-corruption efforts result in a bigger impact on the growth of production for higher value-added

products, such as beef production, relative to the growth of output for lower value-added production, such as cattle.

By including anti-corruption efforts in the model, we anticipate that the estimated coefficient of anti-corruption efforts on output growth will be positive due to the inertia of corruption control. The primary justification for including this variable is that regions with historically high corruption crime rates are less likely to misallocate or misappropriate state-funded transfers because of a higher probability of punishment.[9] Thus, it is likely that output growth is connected with unobserved factors that influence corruption control. If we rely solely on cross-sectional analysis, it is unlikely that we will obtain an unbiased estimate of the effect of anti-corruption initiatives on output growth (Wooldridge, 2012). However, by including the corruption control parameter in the model, we can at least make the following observation: if two regions have identical corruption crime rates in the past, and all other factors are held constant, then the estimated coefficient measures the relationship between anti-corruption effort and production growth.

The dynamic development of cattle and beef production growth is evident not only among regions but also among different organizational forms of farmers. We assume that production growth is more likely to occur in regions with a more favorable investment climate and stronger anti-corruption measures regardless of the organizational form or the farmers. To account for the influence of anti-corruption efforts on production growth, the following equation has been developed to model the dynamic relationship between anti-corruption measures and the growth in cattle herd size (Windmeijer, 2005):

$$ln(\frac{Y_{i,t}^{f}}{Y_{i,t-1}^{f}}) = \alpha_0^f + \alpha_1^f\, ln(Y_{i,t-1}^{f}) + \beta_0^f AC_{i,t} + \beta_1^f AC_{i,t} ln(Y_{i,t-1}^{f}) + \beta_3^f AC_{i,t-1} + \beta_4^f AC_{i,t-1} ln(Y_{i,t-1}^{f}) + \sum_{j=0,\dots,m} \gamma_j^f Z_{i,t} + u_i^f + \mu_i^f + \varepsilon_{i,t}^f, \quad (4)$$

where $Y_{i,t}^{f}$ and $Y_{i,t-1}^{f}$ are cattle herd size for farm type *f*, in region *i*, and at a period *t*; $AC_{i,t}$ is anti-corruption effort; $Z_{i,t}$ is a vector of control variables; u_i is region-specific fixed effect; μ_t is time-specific fixed effect; and $\varepsilon_{i,t}$ represents an error term. The following equation depicts the relationship between anti-corruption efforts and beef production growth as well as other socio-economic factors:

[9] The probability of punishment is the most powerful deterrent against corruption. The likelihood that a corrupt public official would be detected, investigated, detained, convicted, and eventually sentenced, is extremely important. If the likelihood of corruption being punished is low, even the harshest punishment cannot effectively deter it Wang, L. (2018). *Punishment of public corruption in China and the United States* https://docs.lib.purdue.edu/dissertations/AAI10792724.

$$ln(\frac{V_{i,t}^{f}}{V_{i,t-1}^{f}}) = \delta_0^f + \delta_1^f\, ln\left(V_{i,t-1}^{f}\right) + \varphi_0^f AC_{i,t} + \varphi_1^f AC_{i,t} ln(V_{i,t-1}^{f}) + \varphi_3^f AC_{i,t-1} + \varphi_4^f AC_{i,t-1} ln(V_{i,t-1}^{f}) + \sum_{j=0,\dots,m} \lambda_j^f Z_{i,t} + \omega_i^f + \tau_i^f + \epsilon_{i,t}^f, \quad (5)$$

where $V_{i,t}^{f}$ and $V_{i,t-1}^{f}$ are beef production rates for farm type *f*, in region *i*, and at a period *t*; $AC_{i,t}$ is anti-corruption effort; $Z_{i,t}$ is a vector of control variables; ω_i is region-specific fixed effect; τ_t is time-specific fixed effect; and $\epsilon_{i,t}$ represents an error term.

Given these specifications, the core relationships can be expressed as interaction terms between anti-corruption efforts and production levels for each farm type. The interaction terms allow to derive the direction of magnitude for production growth:

$$\partial ln(Y_{i,t}^{f}/Y_{i,t-1}^{f})/\,\partial_1 ln(Y_{i,t-1}^{f}) = \alpha_1^f + \beta_1^f AC_{i,t} + \beta_4^f AC_{i,t-1}, \quad (6)$$

$$\partial ln(V_{i,t}^{f}/V_{i,t-1}^{f})/\,\partial_1 ln(V_{i,t-1}^{f}) = \delta_1^f + \varphi_1^f AC_{i,t} + \varphi_4^f AC_{i,t-1}, \quad (7)$$

where $\partial ln(Y_{i,t}^{f}/Y_{i,t-1}^{f})/\,\partial_1 ln(Y_{i,t-1}^{f}) < 0$ and $\partial ln(V_{i,t}^{f}/V_{i,t-1}^{f})/\,\partial_1 ln(V_{i,t-1}^{f}) < 0$ denotes a quicker growth within regions that produce the least. The direct influence of anti-corruption efforts is derived as:

$$\partial \ln\,(Y_{i,t}^{f}/Y_{i,t-1}^{f})/\partial\,\ln\left(AC_{i,t}\right) = \beta_0^f + \beta_1^f ln(Y_{i,t-1}^{f}) \quad (8)$$

$$\partial \ln\,(V_{i,t}^{f}/V_{i,t-1}^{f})/\partial\,\ln\left(AC_{i,t}\right) = \varphi_0^f + \varphi_1^f ln(V_{i,t-1}^{f}) \quad (9)$$

The above derivation shows that the faster growth in cattle herd size and beef production is linked to more frequent anti-corruption cases in a region when $\partial \ln\,(Y_{i,t}^{f}/Y_{i,t-1}^{f})/\partial\,\ln\left(AC_{i,t}\right) = \beta_0^f > 0$ and $\partial \ln\,(V_{i,t}^{f}/V_{i,t-1}^{f})/\partial\,\ln\left(AC_{i,t}\right) = \varphi_0^f > 0$.

Dynamic model specifications allow the calculation of short- and long-run effects. Following dynamic model computation, the short-run effects are readily available and represented by the estimated coefficients from Equation (4) for cattle production, β_0^f and β_3^f, as well as Equation (5) for beef production, φ_0^f and φ_3^f. The long-run effects can be derived as sums of β_0^f and β_3^f as well as φ_0^f and φ_3^f (Chudik et al., 2016).

However, given the dynamic nature of the model, it may suffer from serial correlation, which raises the issue of endogeneity. Thus, even in fixed or random effects situations, OLS estimates of the model will be inconsistent, as the dynamic term (i.e., the lagged dependent variable) will be correlated with the unobserved panel-level effects (Arellano & Bond, 1991). The lagged variables in Equation (4) and Equation (5) will be endogenous to the fixed effects in the error term.

As a strategy for the identification, we must equip the dynamic term with instruments that are exogenous to the region-level fixed effects to ease the problem (Blundell & Bond, 1998). Such issues can be handled by specifying a Generalized Method of Moments (GMM) estimator for the linear dynamic panel model (Arellano & Bond, 1991; Holtz-Eakin et al., 1988). The assumptions for system GMM estimation imply that instruments utilized as the lagged dependent variables among the regressors are uncorrelated with the fixed effects. As long as this assumption holds, the econometric model controls time-invariant unobserved effects, which allows for estimating the long-run effect of anti-corruption efforts in livestock production (Roodman, 2009).

Lagged variables demonstrate weak properties for first differences in GMM models (Dithmer & Abdulai, 2017). Utilizing instruments that account for a small proportion of the variance in possibly endogenous explanatory variables might result in inefficient and biased coefficient estimations (Bound et al., 1995). To address this problem, we use a two-step System-GMM estimator that incorporates finite-sample standard error correction (Windmeijer, 2005). The production effects of varying degrees on cattle raising and beef production are embedded into the theoretical assumptions of the two-step GMM with finite-sample corrected standard errors, which is selected as the empirical estimation strategy for analytical purposes. To explore the validity of the identifying assumptions, we specify Arellano and Bond (1991) tests of autocorrelation and Hansen (1982) test of over-identifying restrictions.

Following the theoretical review, we postulate that regional cattle and beef output is determined by a set of characteristics presented in Table 5. The specification of right-hand variables resembles methods by Deller et al. (2003) and Petrick and Götz (2019). The measures are centered to capture proxies for demand, such as output prices, and the capacity of the regional market to supply, such as input prices, labor machinery, and area of agricultural land as well as proxies for institutional support, such as credits, expenditure on agriculture, cooperation, and privately-owned land.

Table 5. Descriptive statistics of independent variables

Variable	Mean	Standard deviations overall	between	within
Registered corruption crimes per capita	0.84	0.52	0.32	0.41
Expenditure on agriculture, mln. USD	56.28	55.11	48.03	27.46
Credits in agriculture, mln. USD	175.34	275.10	232.47	148.98
Price of inputs (cattle feed) per kg, USD	0.28	0.16	0.12	0.10
Price of cattle per head, USD	1,551.22	668.27	524.52	426.26
Price of beef per kg, USD	5.49	1.47	0.64	1.33
Labor employed in agriculture, thous. people	19.70	18.44	18.22	3.42
Number of tractors, thous. units	7,058.76	6,924.00	6,913.16	598.52
Number of cooperatives, thous. units	0.32	1.24	0.40	1.18
Area of agricultural land, ha	5,076.38	6,421.78	6,173.35	1,877.09
Area of privately owned land, ha	1.49	1.76	1.77	0.04

Source: Own calculations based on data from multiple sources such as the Ministries of Agriculture, Central Banks, and Statistical Offices of Kazakhstan and Russia

3.5. RESULTS

Before moving to the estimation results, we look at how anti-corruption initiatives have evolved in relation to the cattle and beef production levels of different types of farms. Figure 8 illustrates the dynamics. The first observation depicts that total cattle and beef production change over time with anti-corruption efforts. After 2017, there appears to be a larger correlation between corruption control and beef production level compared to cattle production. For businesses run by enterprise farmers, there is a negative association between anti-corruption efforts and both cattle and beef production. Production levels for both commodities decline when corruption control measures are tightened. The relationship between anticorruption efforts and cattle as well as beef production is less evident for peasant farmers. The cattle production run by households shows a closer connection between output and anti-corruption efforts. Based on the basic correlation results, it seems that that anti-corruption efforts may closely relate to the production output of the agricultural commodities, especially for enterprise producers and households. However, it is not enough to base conclusions on comparing variables' means alone. Therefore, we must take into account various econometric specifications that consider the biases brought on by both observed and unobserved confounders.

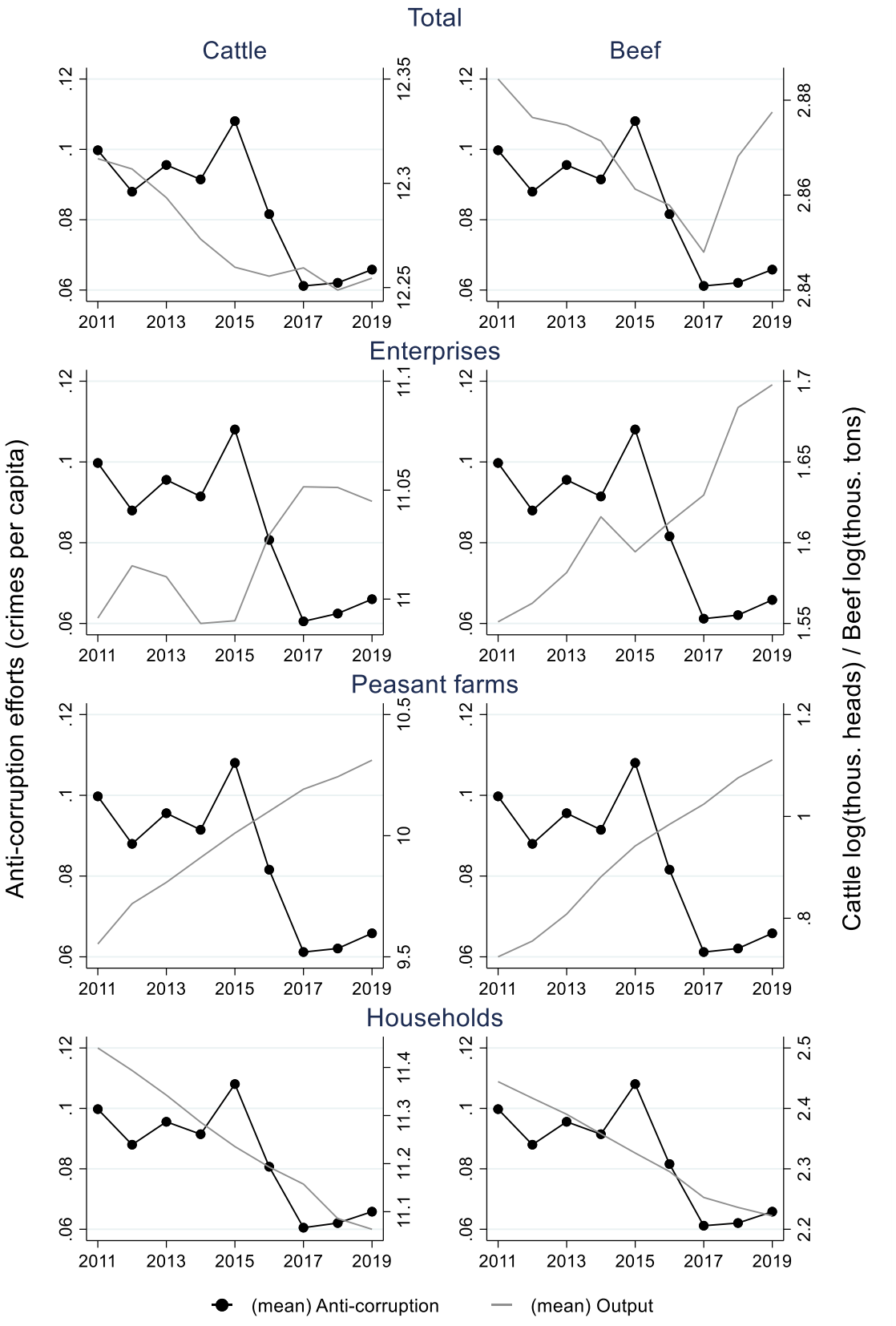


Figure 8. The relationship between the average estimation of anti-corruption efforts and cattle headcount and quantity of beef produced

The theory only gives a basic knowledge of how corruption control connects to the dynamics of production progress; therefore, the length of the lag must be discovered empirically. Prior to the selection of the empirical model, we explore methodological issues such as the model and dynamic specifications to answer the research questions appropriately. We specify different econometric models with the restriction that each places on the dynamic model's parameters. For instance, we perform t-tests and F-tests to verify whether the partial adjustment or static specifications are consistent with the dynamic model, Equation (4) and Equation (5).[10] By doing this, we aim to investigate the possibility that coefficients on weakly exogenous variables may exhibit large directional variations. In addition, this process helps prevent biased estimations of lag lengths and explore short- and long-run effects.

The estimation results of Equation (4) and Equation (5) applications to the regional panel dataset based on the dynamic model for the growth level of cattle headcount is shown in Figure 9, and the beef production growth rates are shown in Figure 10, respectively.[11] Columns (2)-(4) detail the output for each producer type. These are then compared to the aggregate production growth across all producers in Column (1). The statistical calculations suggest that the variables jointly explain the cattle and beef production growth, which is revealed by F-statistics equaling between 4.29 (p = .000) and 10.36 (p = .000) for all organizational structures of farmers.

In general, regions with greater financial inputs, as defined by agricultural expenditures and credit amounts, appear to demonstrate slightly better growth rates in cattle and beef production, as shown by the positive parameter discovered on the governance parameters. Particularly, enterprises experience higher growth in cattle and beef production in regions where the state invests heavily in agriculture. Peasant farmers witness better growth in cattle and beef production in regions where more resources are available for credits.

In the regions with greater input prices, cattle and beef production expand more slowly than in regions with lower input prices. Peasant farmers are the most sensitive to an increase in input prices compared to other organizational forms of farms. Negative parameters in the group of endowment factors suggest that in regions where more workers are employed in agriculture and have larger agricultural land areas, enterprises and households experience slower growth of cattle and beef production. In contrast, peasant farmers tend to thrive in regions with abundant agricultural land, a high number of cooperatives, and a strong agricultural labor force. Yet the enterprises increase production growth in cattle and beef in regions with higher levels of mechanization or a greater number of agricultural machineries.

[10] The table with specification analysis results and test statistics is presented in Table 11 of APPENDIX.
[11] The estimated coefficients with standard errors, the Arellano-Bond test for autocorrelation, and the Hansen test of overidentification restrictions are also presented in Table 12 and Table 13 of APPENDIX.

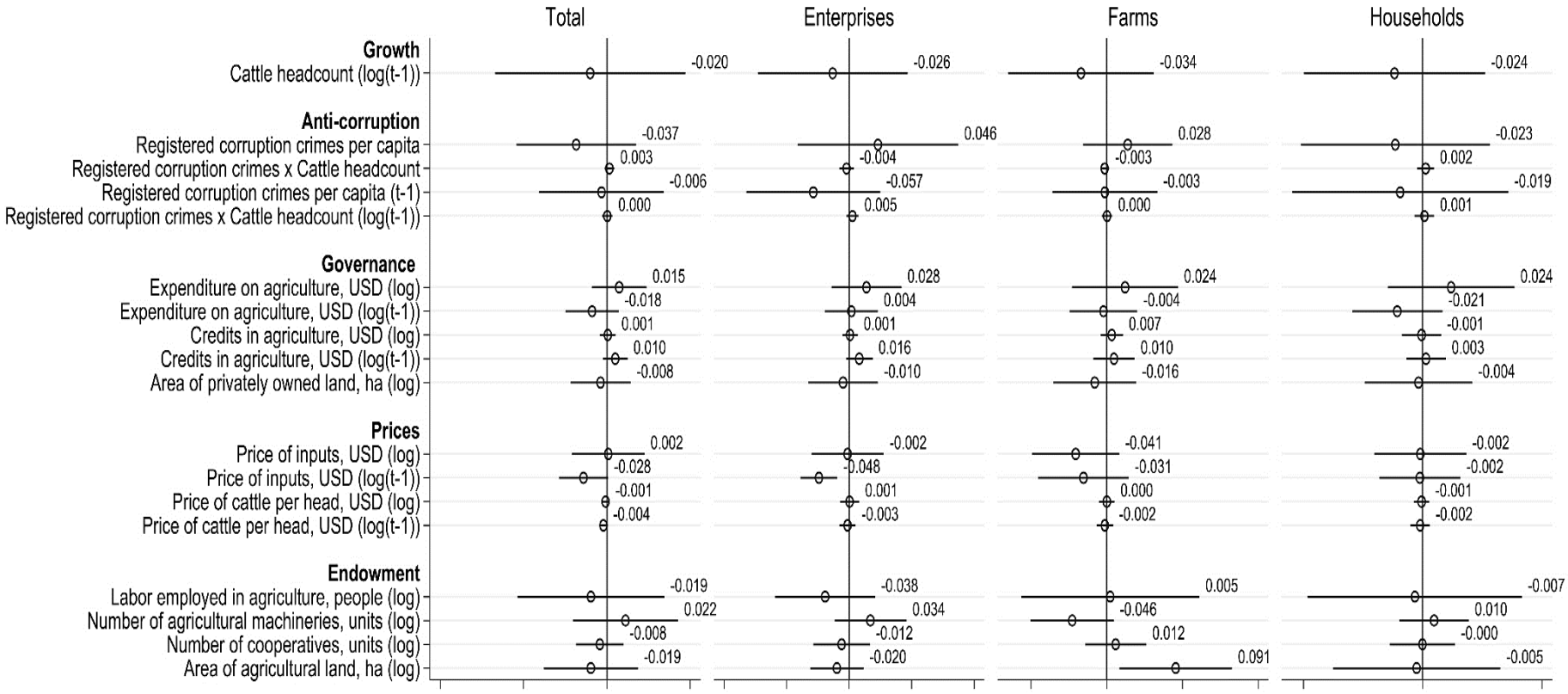


Figure 9. Estimates of cattle headcount growth across farm types

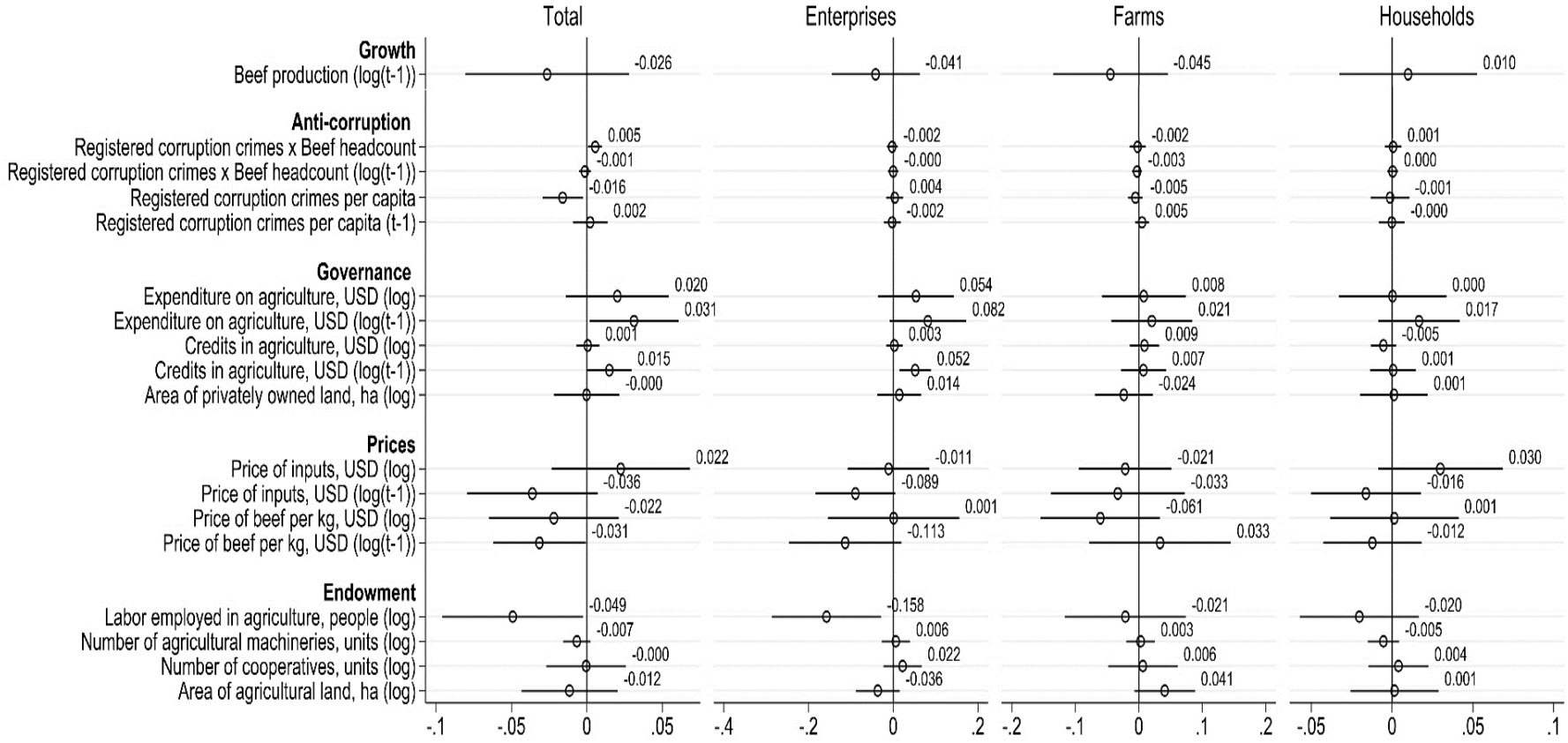


Figure 10. Estimates of beef production growth across farm types

One of the key findings directly relates to the production growth or the behavior of Equation (6) and Equation (7). The outcomes of these assessments are shown in the first rows of Table 6 under cattle and beef production subtitles. We observe that the estimated marginal effect for lagged log cattle headcount and lagged log beef volumes are negative and less than one for enterprises and peasant farms. These estimates indicate that beef production and cattle herd size, among enterprises and peasant farmers, grow more rapidly in regions with lower production levels than those with larger beef volumes and cattle numbers. The smaller magnitude of the absolute values of marginal effects for enterprises, indicates that larger farms tend to produce cattle and beef at lower levels of growth than peasant farmers. This line of result lends some credibility to the argument that large-scale production tends to contribute less to local production. Yet, higher overall reliance on financial support, as measured by state expenditure on agriculture and credits amount for agricultural needs, also exerts pressure on agricultural profits. These results show that regions defined by a predominance of large-scale agriculture production would expect slower growth rates in livestock output than regions characterized by a predominance of production by medium-scale farms.

The central findings of interest to the research hinges on the influence of anti-corruption efforts on rates of growth in cattle and beef production in Equation (8) and Equation (9). As can be seen in Table 6, the link between the anti-corruption level and the cattle herd size is inconsistent among farmer types. While the anti-corruption effort appears to exert an increase in cattle headcount growth for households and peasant farmers, this relationship is inverse for enterprises. Although the increase in anti-corruption efforts has a negative temporary association with enterprises' cattle production growth, the cumulative impact of corruption turns out to be positive, when we account for the estimated marginal effect of anti-corruption efforts at the presiding year. The positive sign of the lagged marginal effect of anti-corruption efforts on cattle herd size growth for peasant farmers demonstrates the increasing long-run effect of corruption control on cattle production growth. The positive sign of the contemporaneous effect and negative sign of delayed effect, as measured by marginal effects of anti-corruption efforts on households' cattle production growth, indicate a positive relation between stronger corruption control and cattle herd size growth, albeit at diminishing rates in the long-run. These results show that stronger corruption control contributes to an acceleration in the growth rate of cattle production, particularly, in regions where a greater proportion of cattle production is carried out by peasant farmers, as opposed to enterprises or household farms.

Table 6. Estimates of cattle and beef growth rates over ranges of anti-corruption efforts

VARIABLES	(1) Total	(2) Enterprises	(3) Peasant Farms	(4) Households
	Cattle production			
$\partial ln(Y_{i,t}^f/Y_{i,t-1}^f)/\ \partial_1 ln(Y_{i,t-1}^f)$				
Cattle number (log(t-1))	0.010	-0.016	-0.054	0.008
	(0.051)	(0.044)	(0.034)	(0.031)
$\partial \ln\ (Y_{i,t}^f/Y_{i,t-1}^f)/\partial \ln\ (AC_{i,t})$				
Registered corruption crimes	0.122	-0.036	0.111	0.469
per capita	(0.205)	(0.248)	(0.239)	(0.192)
Registered corruption crimes	-0.068	0.071	0.042	-0.350
per capita (t-1)	(0.183)	(0.228)	(0.169)	(0.280)
	Beef production			
$\partial ln(V_{i,t}^f/V_{i,t-1}^f)/\ \partial_1 ln(V_{i,t-1}^f)$				
Beef production, tons (log(t-1))	0.010	-0.043	-0.084	0.026
	(0.027)	(0.041)	(0.039)	(0.022)
$\partial \ln\ (V_{i,t}^f/V_{i,t-1}^f)/\ \partial \ln\ (AC_{i,t})$				
Registered corruption crimes	-0.012	-0.213	-0.733	0.016
per capita	(0.108)	(0.326)	(0.455)	(0.098)
Registered corruption crimes	-0.198	-0.173	0.279	0.078
per capita (t-1)	(0.118)	(0.302)	(0.387)	(0.083)

Standard errors in parentheses

It is noteworthy to observe that the connection between the anti-corruption level and upper-stream beef production is weaker than in lower-stream cattle production chains. This effect is observed by the magnitude of estimated marginal effects in Table 6. We observe that when the anti-corruption effort expands, the downward pressure is placed on beef production growth for all types of producers except households. The reason for the diminished impact of anti-corruption measures on upper-stream beef output may be attributed to the majority of the supporting measures being directed towards upper-stream cattle production owing to pedigree herd revitalization strategies implemented in Kazakhstan and Russia (Kobayashi et al.) Consequently, cattle production in the upper stream becomes more susceptible to resource misallocation and misappropriation as compared to upper stream beef production.

The effect of strengthening corruption control on production growth varies dynamically across different farm types. This discrepancy posits that in regions with stronger corruption control environments, peasant farmers, grow faster than similar farmers in regions with weaker corruption control. Anti-corruption efforts are associated with a negative immediate

effect on cattle production growth, yet this relation is inverse in the long run, where corruption control is associated with increasing growth. For households, the impact of the initial efforts to combat corruption continues to relate to faster growth, albeit at a diminishing rate in the long run. In beef production, the anti-corruption effort is associated with faster growth only for the household type of producers.

3.6. ROBUSTNESS CHECK

Finally, we examine the validity of our results, focusing on additional methodological concerns. First, we verify the specification of the econometric and dynamic specification. This process helps prevent uncertainty over which lags are important and enables us to verify the lag lengths that are most likely to have a long-term effect. To address this, we employ machine learning technique, least absolute shrinkage and selection operator, to test different dynamic restrictions of $AC_{i,t}$ impact on $Y_{i,t}^{f}$ and $V_{i,t}^{f}$.[12]

Next, we address the possibility of magnitude-direction variation between Kazakhstan and Russia by calculating separate effects for the anti-corruption effort within each country. Table 15 (APPENDIX) illustrates these consistent country coefficient estimates. We see that the direction of the effect of anti-corruption efforts on cattle production growth is preserved across the countries, while the magnitude of the effect is larger in Russia. Our findings indicate that each key finding shown in Table 6 holds.

The second crucial robustness test is whether our estimates hold with a more parsimonious model. Specifically, we re-estimate the model with a different specification that includes country and year dummy variables. Adding time and country-fixed effects to a panel model with a lagged endogenous variable may result in inconsistent estimates and a considerable rise in multicollinearity. However, excluding time and unit effects may cause bias when time series are short, and the number of cross-sections approaches infinity (Kiviet, 1995). Results from these fixed effects models reported in Table 16 (APPENDIX) - largely mirror those reported in Figure 9.

[12] Figure 15, APPENDIX, provides the visual representation of the path of each coefficient on lagged value over the search grid for the lasso penalty parameters as well as Table 14, APPENDIX, displays a table showing the selected lags after lasso estimation results.

4. FORMAL MARKET PARTICIPATION AND FARM PERFORMANCE: THE CASE OF CATTLE PRODUCERS IN CENTRAL ASIA

The transition of agricultural businesses from informal to formal markets as a means of integrating into global markets has received significant attention in recent empirical research (Sutter et al., 2017). The literature indicates that market formalization is motivated by a rational benefit-cost consideration (Ann Wheeler & Garrick, 2020; Gwiriri et al., 2019; Sehar & Oyekale, 2020). Access to infrastructure and inclusive market regulations generate economic incentives, which promote the transition to formal markets (Dau & Cuervo-Cazurra, 2014; Sutter et al., 2017). However, the path from an informal institutional environment to a formal one is unique for each business structure. Few studies have examined the factors that help integrate individual producers into formal domestic markets.

Institutional arrangements based on trust and "handshake contracts" govern economic exchange in informal markets (Ndubuisi, 2020). Although the governance mechanisms of formal control and trust can be interchangeable, informal arrangements in the agricultural industries can lead to increased food safety risks (Yang et al., 2011), as agents may bypass food safety standards and regulations. Informal markets are associated with subsistence activities, reduced supply to processing industries, and risky epizootic situations (Anderson & Swinnen, 2008; Maertens & Swinnen, 2009; Rakowski, 1994).

The evolution of supply chains and the liberalization of international trade call into question the viability of small-scale farming in emerging and developing countries (Hazell et al., 2010). In light of this theory, policies should focus on helping smallholders either shift to commercial-sized businesses or leave agriculture (Fan et al., 2013). While institutional differentiation across production scales may promote commercial-sized farming, we suggest that it might also exacerbate market formalization if farmers do not meet the formal scale threshold.

Most of the analytical work on market participation focuses on partial processes within a limited subset of the population, neglecting equally important groups of producers. For example, studies on smallholder livestock marketing leave out large- and medium-scale producers that might enter more sophisticated value chains (Alene et al., 2008; Gwiriri et al., 2019; Markelova et al., 2009). Likewise, research on contract farming concentrates only on the subset of the population already engaging in trading, either based on contracts or without formal agreements. Such a perspective excludes prospective market players solely involved in subsistence farming (Barrett et al., 2012; Ito et al., 2012). We aim to fill this gap by looking at a sample that includes farms of various sizes and at different production and marketing stages.

Kazakhstan and Kyrgyzstan are attractive venues for this research. Although both countries have promoted market-oriented farming over the last decade, they each have a large share of farmers of various production scales who produce for self-sufficiency or are engaged in informal trade (FAO, 2020; GIZ, 2017). The farm size variability in our data shows that small producers are more likely to engage in formal marketing than medium-sized farmers if they are commercially oriented. The presence of small-scale farmers engaged in formal marketing provides a unique opportunity for identifying strategies that can be used to improve the commercial viability of small-scale farmers.

This chapter analyzes the structural processes that drive market-oriented cattle production and explores the factors influencing market formalization in Kazakhstan and Kyrgyzstan. Based on a survey of 500 farmers of different sizes, we examine the determinants of participation in formal cattle marketing channels and the extent of farmer participation. Our empirical contribution suggests that an increase in farm size is associated with market-oriented farming but only partially relates to market formalization. The findings reveal that herd size does matter, but larger farms do not always engage in formal marketing, and smaller farms do not always choose informal commercialization.

4.1. THE CATTLE MARKETS IN KAZAKHSTAN AND KYRGYZSTAN

4.1.1. Sector background

Nomadic pastoralism developed in Kazakhstan and Kyrgyzstan around 1000 BCE. Due to the abundance of pasture resources in Central Asia, it remained the dominant production system until the mid-nineteenth century. During the Russian occupation of Central Asia's steppes, individual farmers were grouped into state-governed collective farms. The mobile grazing system of animal husbandry was reorganized into semi-sedentary settlements, with livestock herded in fixed locations during the colder seasons of the year (Aldashev & Guirkinger, 2017; FAO, 2007; Zhumanova, 2011).

The forced collectivization process established a support system that included high administered prices, significant input and output subsidies, and indirect policies that were not agriculture-specific (Kerven et al., 2011; OECD, 2013). As a result, state and collective farms were required to supply large processing plants with live animals (Esenova & Dobson, 2000). Soviet Kazakhstan and Kyrgyzstan, with planning, resource allocation, procurement, and distribution all subject to central governance in the livestock industry, bore little resemblance to a free-market-oriented economy.

After the dissolution of the Soviet Union, large-scale livestock commodity production on former collective and state farms almost vanished. The well-integrated input supply chains for industrial cattle production, downstream processing, and planned distribution were all

disrupted. Former large state enterprises either sold and slaughtered their livestock or distributed it to individual farmers (Anderson & Swinnen, 2008; ur-Rahim et al., 2014).

Between 1990 and 1999, during the transitional recession, Kazakhstan's cattle production output decreased every year. The sector began to recover in 2000 but has not yet reached its Soviet-era production level. Between 1990 and 1997, Kyrgyzstan's output decreased from year to year (Figure 11). However, after 1998, the industry recovered, with an annual increase of 3.5% in the cattle population, and by 2009, the industry had surpassed Soviet production levels (Niiazaliev & Tilekeyev, 2019).

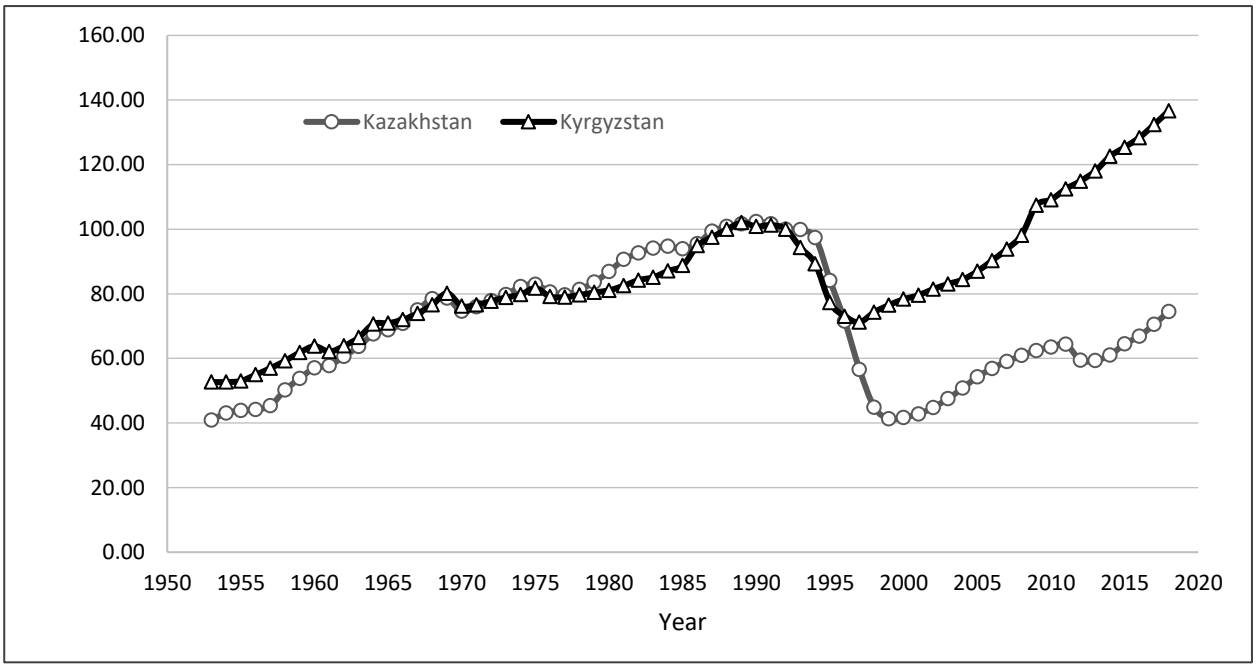


Figure 11. Cattle number index with base year 1991 (source: national statistical offices)

4.1.2. Access to animal markets

Livestock production and trade in modern Kazakhstan and Kyrgyzstan have been seen as a means of economic diversification and a way for farmers to increase their prosperity (Pomfret, 2016). In both countries, livestock was predominantly sold on the domestic market due to the dissolution of inter-republic market links between the former Soviet republics. Cattle production is fragmented between many small household producers, family farms, and fewer large enterprises. Livestock value chains are underdeveloped, with few mechanisms connecting small farmers to slaughterhouses, processors, and retail outlets. Insufficient cattle to ensure a consistent supply of high-quality meat to processing enterprises, combined with a lack of export-capable beef processing, constrains domestic supply and export prospects (Oshakbayev & Bozayeva, 2019; Robinson, 2020).

The primary sales channels for live animals vary significantly between producers with small and medium-sized herds and larger enterprises (Figure 12). Smaller farmers sell to local consumers, extended family members, or intermediaries. The latter may facilitate more vertically integrated value chains and the formation of more formal markets (Niiazaliev & Tilekeyev, 2019; Petrick et al., 2018). The marketing channels of smaller farmers are more characteristic of informal markets, where illegal activity restricts stringent quality and sanitary standards. For instance, backyard slaughter, which does not require veterinary certification, is quite common (EEC, 2018; GIZ, 2017; Petrick et al., 2014; Petrick & Pomfret, 2016).

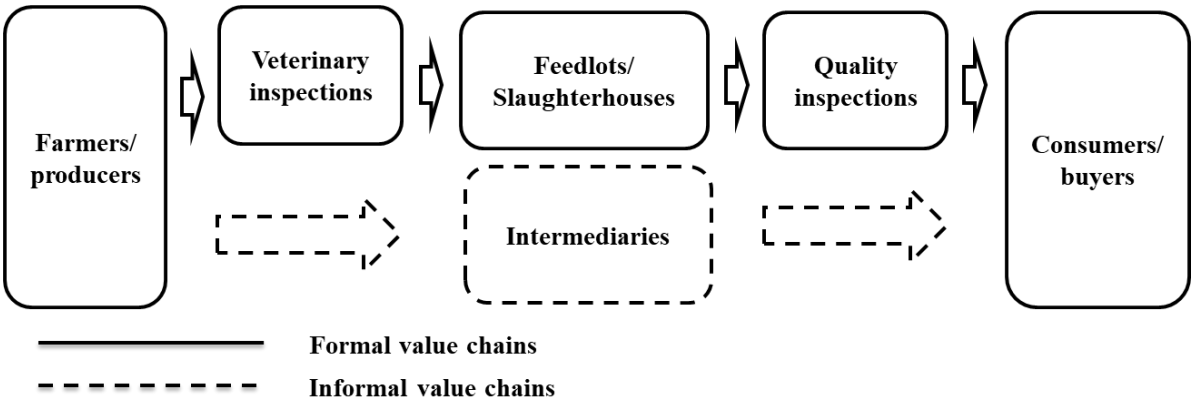


Figure 12. Cattle marketing value chains

A mismatch in expectations between farmers and processors impedes cattle market integration. While farmers claim that there is a lack of demand for livestock production, processors report insufficient quality of the supplied raw materials. Thus, in Kazakhstan, the capacity for sausage production is 70% underutilized, while only 35% of the industrial capacity for chilled meat production (except poultry) is used (ACEPAS, 2016). In Kyrgyzstan, the share of processing of livestock and poultry sold for slaughter remains low at about 7%. More than 93% of meat and meat products are produced in mini-slaughterhouses and small workshops (EEC, 2018).

There is a widespread perception that Kazakh and Kyrgyz societies negatively view informal market outlets, particularly intermediaries, as an oppressive force in the agricultural economy. More specifically, intermediaries benefit from bridging gaps in meat production value chains and are considered speculators, which borders on regulatory violations. This attitude dates back to the Soviet era when speculative price increases were seen as unjust and resulted in shortages (Shiller et al., 1991).[13] As a result, policies tend to target informal agents, such as

[13] In the USSR, "speculation" referred to behaviors that involved taking goods intended for certain individuals and selling them to others at a profit. Article 154 of the USSR's penal code categorized speculation as a crime.

intermediaries or door-to-door salespeople but fail to create an enabling environment for agricultural businesses.

4.2. THEORETICAL FRAMEWORK

The conceptual framework of the specified model considers the expected net returns, NR^*. Producers maximize their net returns by choosing between formal and informal market branches conditional on selling or non-selling decisions (Dubbert, 2019; Ma & Abdulai, 2016). Producers enter the formal market if the net returns from formal market participation, NR_F^*, outweigh the net returns from informal marketing, NR_I^*, so that $NR^* = NR_F^* - NR_I^* > 0$. However, NR^* are latent and not observable. Only the decision on market participation (D_i) can be observed and can be represented as:

$$NR^* = Z_i\beta + \mu_i, \text{with } D_i = 1 \text{ if } NR^* > 0, \quad (10)$$

where D_i is the formal market selection indicator that equals 1 for cattle producer *i*, and 0 for the informal market selection; Z_i is a vector of observable socioeconomic producer-level characteristics such as age, gender, education, and farm size; β is a vector of parameters to be estimated; and μ_i is the error term with $N\sim(0;\sigma^2)$. The probability of participation in formal markets can be expressed as:

$$\Pr(D_i = 1) = \Pr(NR^* > 0) = \Pr(\mu_i > Z_i\beta) = 1 - F(-Z_i\beta), \quad (11)$$

where F is the cumulative distribution function for μ_i. To link formal market participation with the potential outcomes, we employ the approach by Ma and Abdulai (2016), where a rational livestock producer is assumed to maximize net returns from cattle production:

$$NR_{max}^* = P^0 Q_i(P^I, Z_i) - P^I F_i, \quad (12)$$

where P^0 is the price per kg for live-weight cattle, Q_i is the total live-weight cattle output in kg; P^I is a vector of input prices, F_i is a vector of input quantities (e.g., feed, veterinary services, and labor), and Z_i is a vector of observable producer-level socioeconomic characteristics. Net returns (*NR*) can be specified as a function of input and output prices, market selection, M_i, and producer-level characteristics as follows:

$$NR = NR(P^0, P^I, M_i, Z_i) \quad (13)$$

Applying Hoteling's lemma to the maximization problem, Equation (13), we derive a reduced form of the cattle production output supply function:

$$Q = Q(P^0, P^I, M_i, Z_i) \quad (14)$$

Equations (13) and (14) show that net returns from cattle production (NR) and quantities of live-weight cattle sold (Q) are determined by the input and output prices, market selection, and producer-level socioeconomic characteristics.

4.3. DATA

The data were obtained from surveys of livestock producers conducted as part of the ANICANET[14] project. The data set comprises 250 livestock producers from Kazakhstan and 250 livestock producers from Kyrgyzstan.

A multistage random sampling approach was used to select livestock producers for the interviews. First, the Almaty region in Kazakhstan and the Chuy region in Kyrgyzstan were purposively selected based on the national intensity of livestock production. In the second step, three districts in each region with intensive livestock production were chosen. These are the Enbekshilkazakh, Kegen, and Rayimbek districts in Kazakhstan and the Jayil, Moscow, and Panfilov districts in Kyrgyzstan. Next, sub-districts were randomly selected using the probability proportional to size method. Finally, farms and households were selected randomly from the lists that were collected from the local authorities. Farmers answered a detailed questionnaire on individual sociodemographic data, farm and plot-level characteristics, farm management, marketing activities, and their perceptions and non-income wealth indicators. After cleaning the data and eliminating outliers, 492 observations remained. The sample is not representative of the whole of Kazakhstan or Kyrgyzstan. Thus, the results below cannot be generalized out of the sample.

Livestock producers in the sample produce and supply live-weight cattle to two groups of distinct buyers who operate in either formal or informal markets. Direct sales to processors, feedlots, other farmers, and exporters, as well as sales at district or regional markets (bazaars), are among the formal market outlets. The main provisions of the formal channel include legal requirements for animal identification and veterinary inspections. Informal channels include neighbors and intermediaries who engage in door-to-door marketing but are inactive in district or regional markets. These sales are not subject to inspection procedures (Table 7).

[14]ANICANET – Revitalising animal husbandry in Central Asia: A five-country analysis. The project is funded by the German Federal Ministry of Education and Research (BMBF).

Table 7. Number of farmers selling live-weight cattle through distinct marketing channels

	Kazakhstan	Kyrgyzstan	Total
Seller	120	175	295
Total formal sellers:	**48**	**120**	**168**
At district market	34	113	147
At regional market (outside local district)	14	3	17
Agro-processing enterprise	0	1	1
Stock fattening enterprise – feedlot	0	0	0
Other farmers	0	2	2
Direct sale to the neighboring country	0	1	1
Total informal sellers:	**72**	**55**	**127**
To neighbors/friends or door-to-door	5	7	12
Intermediaries	67	48	115
Non-seller	123	74	197

Most of the farmers in the sample (approximately 60%) are engaged in market-oriented farming. Almost half of them, or 34% of the sample, sell live-weight cattle through formal marketing channels, while the remaining 26% sell them through informal channels.[15] As their primary specialization, 67.7% of farmers report livestock production, 30.1% say mixed farming, and 2.2% name crop production. Farmers not selling their cattle, slaughter them on the farm for their own consumption, or distribute the carcass weight informally.

Table 8 presents the descriptive statistics on the differences in characteristics between formal and informal sellers across both countries. As this research investigates the factors that influence participation in formal marketing channels as well as the factors that influence the intensity of live-weight cattle sales, we draw on the existing literature in institutional economics and marketing to identify explanatory variables (Burke et al., 2015; Dau & Cuervo-Cazurra, 2014; Dubbert, 2019). The data indicate that the distinction between the two groups of farmers is related to the transaction costs of marketing attributes such as access to information, distance from a city, and access to grazing land. Institutional characteristics such as land ownership, degree of cooperation, and access to finance indirectly affect marketing decisions.

[15] In some cases, farmers use both forms of marketing, but the majority of sales are made through one market platform, either formal or informal.

Table 8. Farmer characteristics by marketing channel

Variable	Formal seller (N=168)		Informal seller (N=127)		Mean difference
Female-headed (1/0)	0.18	(0.39)	0.18	(0.39)	-0.003
Age of farm head, years	49.95	(12.91)	50.23	(14.05)	0.276
Higher education (1/0)	0.14	(0.35)	0.16	(0.37)	0.015
Area of land owned privately, ha	6.06	(11.87)	2.33	(5.14)	-3.737***
Cooperative member (1/0)	0.15	(0.36)	0.07	(0.26)	-0.0779**
Herd size, head	13.16	(14.22)	16.13	(15.20)	2.964*
Hay produced, kg	9.38	(14.01)	6.41	(12.44)	-2.968*
Grain produced, kg	3.35	(6.52)	2.71	(5.76)	-0.640
Total labor in livestock, person-hrs	3.59	(2.53)	3.11	(1.83)	-0.479*
Travel distance to a city, km	39.39	(40.20)	36.38	(42.82)	-3.001
Access to credit (1/0)	0.40	(0.49)	0.20	(0.41)	-0.200***
Access to veterinary services (1/0)	0.30	(0.46)	0.54	(0.50)	0.240***
Grazing sedentary, head	6.34	(11.22)	4.35	(6.17)	-1.985*

Note: Standard deviation in parenthesis; *, **, *** are the probability to reject H_0 of equal mean values less than 0.1, 0.05, 0.01

Table 9 displays descriptive statistics for cattle productivity, revenue from live-weight sales, and quantity sold, which were used as outcome variables. It shows that the amount of live-weight cattle sold through formal channels is relatively higher, while revenue from cattle sales is lower when compared to informal sellers.

Table 9. Performance characteristics by marketing channel

Variable	Formal seller (N=168)		Informal seller (N=127)		Mean difference
Quantity sold in kg	352.18	(246.991)	295.55	(170.102)	-56.63**
Average weight per head sold in kg	228.20	(109.258)	212.80	(89.902)	-15.4
Average price per head when sold in live weight in USD	576.40	(454.981)	570.77	(398.432)	-5.622
Average price per kg when sold in live weight in USD	2.79	(2.180)	2.95	(2.286)	0.158
Gross revenue from cattle sales per head in USD	3517.84	(4595.873)	4090.79	(8379.029)	572.9

Note: Standard deviation in parenthesis; *, **, *** are the probability to reject H_0 of equal mean values less than 0.1, 0.05, 0.01

In summary, the information presented in Table 8 and Table 9 suggests that formal and informal live-weight cattle sellers differ systematically across some observable characteristics, implying that participation in formal markets is motivated by potential

selectivity concerns. However, comparing the mean values of the two groups of cattle producers or performing a simple ordinary least squares regression will not account for unobserved characteristics. As a result, the econometric approach has to account for the biases caused by observed and unobserved factors related to the choice of formal markets.

4.4. ECONOMETRIC FRAMEWORK

The observable marketing decisions stem from prior decisions related to raising the animals and when, where, and how much to market. Technically speaking, the potential correlation between observed and unobserved factors would cause an endogeneity problem and result in inconsistent estimates. As the survey covers livestock farmers only, the first selection cannot be studied with the current sample. The remaining decisions can be adequately addressed with a triple-hurdle model. This model addresses the choice to market animals on the formal market as a binary choice and the quantity choice as a continuous left-truncated variable.[16]

In the analysis, we follow a modeling approach suggested by Burke et al. (2015). Given that X_i is a vector of observable socioeconomic producer-level characteristics, we can define the relationship between formal market participation decisions and outcome variables as a linear function of a vector of explanatory variables:

$$Y_i = X_i\gamma + D_i\eta + u_i \qquad (15)$$

where Y_i is the quantity of live-weight cattle sold in kg; X_i is a vector of explanatory variables such as producer characteristics (e.g., age, education, and herd size), farm and regional characteristics, and institutional variables (e.g., cooperation, access to credit, and veterinary services); D_i is a binary indicator for formal market participation; γ and η are parameters to be estimated, and u_i is the error term.

We extend the double-hurdle control function approach to include non-selling cattle producers. Existing market participation analyses are based on a population subset that only includes market-integrated livestock producers, leaving out economic agents who produce but do not commercialize the output (Gong et al., 2006; Hobbs, 1996). However, if a subset of the population is not integrated into the market but could be, then any factor that encourages market participation among commercialization-oriented producers may also influence non-market participants to join the market. When models exclude potential sellers, if such market participants exist, the analysis may not be generalizable to the entire population (Burke et al., 2015). Therefore, we theorize that farmers' decisions to participate in cattle markets in

[16] An alternative approach would be to model the number of animals to be sold as a count variable and the weight per animal as a continuous one. However, we assume that these two outcomes will usually not be optimized separately by farmers.

Kazakhstan and Kyrgyzstan include three steps: commercialization decisions, market participation decisions, and quantity-to-sell decisions (Figure 13).

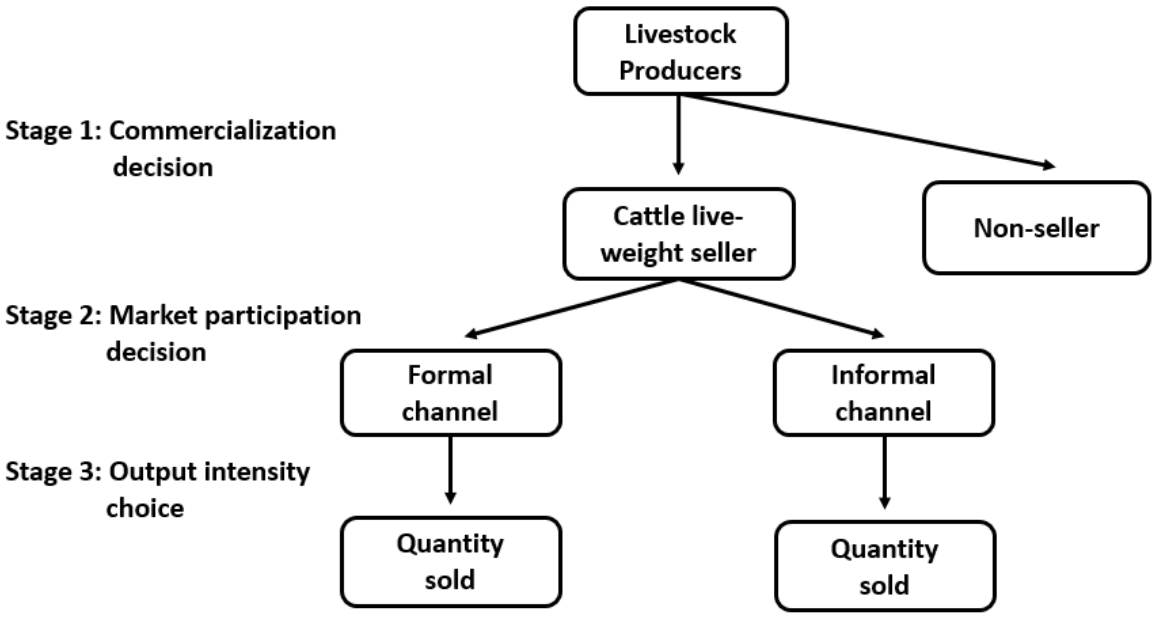


Figure 13. Decision tree of livestock producers

The decision to sell live-weight cattle results in the selection of formal or informal market channels. After choosing to sell and opting for either formal or informal market participation, the cattle producer then decides on output intensity. That lays a foundation for the triple-hurdle model, which can be mathematically expressed as:

Commercialization decision

$$Y_i^* = 1[X_{1i}'\theta_i + \varepsilon_{1i} > 0] \quad (16)$$

Formal/informal market participation decision

$$D_i = 1[X_{2i}'\delta_i + \varepsilon_{2i} > 0] \quad (17)$$

Output intensity decision

$$Y_i^{formal} = X_{3i}'\beta + \varepsilon_{3i} \;\; if\; Y_i^* > 0 \; and \; D_i = 1 \quad (18)$$

$$Y_i^{informal} = X'_{3i}\beta + \varepsilon_{4i} \;\; if \; Y_i^* > 0 \; and \; D_i = 0 \qquad (19)$$

where Y_i^*, D_i, Y_i are latent variables representing the probability of selling or non-selling, formal market participation, and marketed quantity, respectively; X_{ji} is a vector of exogenous variables that affect the likelihood of the decisions mentioned above; and ε_{ji} are the unobserved error terms.

Proper identification requires variability in the explanatory variables. Thus, the explanatory variables specified in the lognormal Equation (18) and Equation (19) are overlapped with the binary choice in Equation *(16)* and Equation *(17)*, which include additional instrumental variables. Any valid instrument in the first stage should influence the farmer's decision to sell live-weight cattle but should not affect the choice to participate in formal markets. The instrumental variable in the second hurdle model should influence the farmer's participation in formal markets but should not affect output intensity.

At the first hurdle (the decision to commercialize cattle), we employ farmers' perceptions of access to credit as an identifying instrument. The livestock producers that sell animals are likely to have guaranteed incomes and, therefore, to prove their creditworthiness (Dubbert, 2019; Ma & Abdulai, 2016). However, the expectation of creditworthiness is not expected to affect the decision to participate in formal market value chains.

At the second hurdle (the decision to sell on formal markets), the number of grazing sedentary cattle, common pastures, and perceptions of using common pastures are used as instrumental variables. Grazing on village pastures, combined with a lack of access to remote pastures, allows livestock producers to cluster in one location. Clustering around village pastures helps farmers exchange information and encourages them to operate in more densely populated areas (Barrett et al., 2012; Michelson, 2017). In addition, we assume that the proximity of livestock producers is more advantageous to formal procurement companies because they seek lower transaction costs, such as contract negotiation, information exchange, and quality monitoring costs, as opposed to informal buyers who may prefer remote or dispersed producers with lower standards and informal practices so that they can negotiate lower procurement prices.[17] Thus, we anticipate that the employed instrument, clustering around village pastures, will indirectly affect decisions on formal or informal markets.

The vector of variables X_{2i} and X_{3i} in specifications (17), (18), and (19) account only for observable factors to address the selection bias issue. However, unobservable factors could

[17] We infer that farmers have a choice between marketing platforms because, first, in the research sample, both platforms are available based on location and, second, no farmers from the same village sell informally.

still affect the decision to participate in formal markets and the intensity of sales, i.e., $\mathrm{Corr}(\varepsilon_{1i}, \varepsilon_{2i}) \neq 0$ and $\mathrm{Corr}(\varepsilon_{2i}, \varepsilon_{3i}) \neq 0$. To control for unobserved heterogeneity issues, the obtained generalized residuals, or the inverse Mills ratio, from the first hurdle, Equation (16), are calculated and inserted into Equation (17), and the inverse Mills ratio from the second stage, Equation (17), is calculated and plugged into output Equations (18) and (19), which yield the following control function equations:

$$Y_i^* = 1[X_i'\theta_i + z_{1i}'\pi_{1i} + \varepsilon_{1i} > 0] \quad (20)$$

$$D_i = 1[X_i'\delta_i + z_{2i}'\pi_{2i} + \widehat{IMR_\iota}\rho_{1i} + \varepsilon_{2i} > 0] \quad (21)$$

$$Y_i^{formal} = X_i'\beta_{1i} + \widehat{IMR_2}\rho_{2i} + \varepsilon_{3i} \;\; if\; Y_i^* > 0 \; and \; D_i = 1 \quad (22)$$

$$Y_i^{informal} = X_i'\beta_{2i} + \widehat{IMR_2}\rho_{3i} + \varepsilon_{4i} \;\; if\; Y_i^* > 0 \; and \; D_i = 0 \quad (23)$$

where $D_{i,}$ is the binary indicator of formal market participation; X_i is a vector of exogenous covariates; z_{ji} is instrumental variables; $\widehat{\mathrm{IMR}}_j$ is the generalized residual from the first and second stages of the selection decision; ρ_{ji} are parameters to account for unobserved heterogeneity and self-selection issues; $\theta_i, \delta_i, \beta_{ji}, \pi_{ji}$ represent the parameters to be estimated, and, finally, ε_{ji} are the error terms.

Figure 14 is a graphical representation of the econometric approach. In the first and second hurdle models, we estimate a control function of a probit model, Equations (20) and (21). Finally, in the third hurdle, we employ two lognormal models on the intensity of live-weight cattle sales, either formal or informal, Equations (22) and (23).

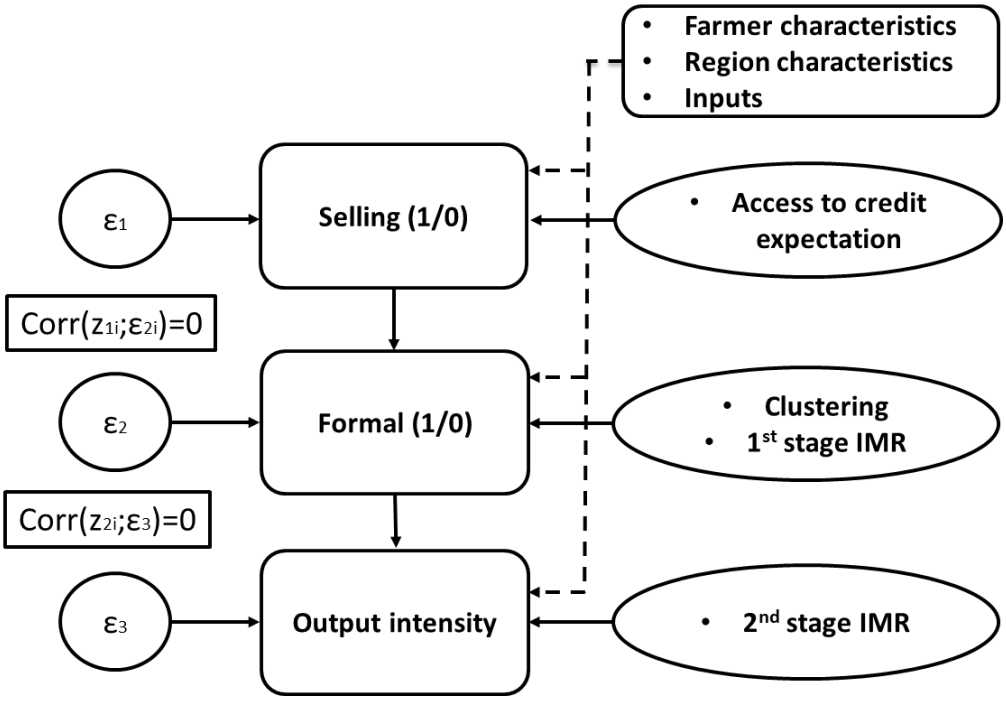


Figure 14. Graphical illustration of the control function approach

4.5. RESULTS AND DISCUSSION

The triple-hurdle model estimation results are presented in Table 10. Column (i) shows coefficient estimates for factors associated with the probability of selling live-weight cattle. Column (ii) displays coefficient estimates for factors related to the probability of participating in formal markets, conditional on being a cattle seller. Columns (iii) and (iv) present the results of the coefficient estimates for predicting sales quantities for formal and informal live-weight cattle sellers (stage 3), conditional on selling and market participation decisions. The results of the first two stages are not marginal effects since the likelihood function is non-linear, yet the estimates provide the direction and statistical calculations for each predictor. The effect sizes and standard errors have no inferential content and provide only descriptive evidence (Berry, 2017; Hirschauer et al., 2019). All estimations are done using Stata, version 16.

Table 10. Estimates for cattle selling decisions and formal market participation

Variables	Stage 1	Stage 2	Stage 3	
			Formal seller	Informal seller
	(i)	(ii)	(iii)	(iv)
Female (1/0)	-0.003	-0.001	0.181	-0.219
	(0.156)	(0.209)	(0.119)	(0.130)
Age, years	0.007	-0.013	0.020	0.019
	(0.028)	(0.039)	(0.027)	(0.018)
Age, years squared/100	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Higher education, 1/0	-0.334	-0.203	-0.159	0.242
	(0.166)	(0.237)	(0.124)	(0.152)
Land owned (1+log), ha	0.098	0.048	0.103	-0.010
	(0.094)	(0.146)	(0.073)	(0.084)
Cooperative membership, 1/0	-0.185	0.421	0.089	0.101
	(0.217)	(0.302)	(0.164)	(0.193)
Herd size, head	0.041	-0.050	0.006	0.004
	(0.013)	(0.018)	(0.014)	(0.016)
Herd size, head squared/100	-0.036	0.049	0.001	-0.007
	(0.016)	(0.023)	(0.015)	(0.020)
Quantity provided hay (1+log), tons	0.069	0.072	0.073	0.062
	(0.054)	(0.074)	(0.047)	(0.042)
Quantity provided grains (1+log), tons	0.092	-0.107	-0.032	0.045
	(0.080)	(0.105)	(0.057)	(0.060)
Labor (log), person-hrs	-0.103	0.340	0.254	0.094
	(0.119)	(0.166)	(0.115)	(0.114)
Distance to the nearest city (log), km	-0.052	0.245	0.014	0.018
	(0.048)	(0.072)	(0.069)	(0.056)
Veterinary services, 1/0	-0.330	-0.318	-0.080	0.140
	(0.155)	(0.207)	(0.147)	(0.131)
Live-weight price (log), USD per kg		-0.033	-1.155	-0.325
		(0.214)	(0.277)	(0.174)
Livestock marketing cost (log), USD		0.100	0.027	-0.007
		(0.029)	(0.023)	(0.030)
Kazakhstan (1/0)	-0.229	-0.278	-0.211	-0.349
	(0.200)	(0.292)	(0.202)	(0.153)
Grazing sedentary, head		0.018		
		(0.013)		
Perception of using common pastures		0.242		
		(0.210)		
Common pasture use, 1/0		-0.377		
		(0.212)		
IMR			0.798	-0.139
			(0.437)	(0.409)
Constant	0.180	-0.186	5.086	5.263
	(0.704)	(0.986)	(0.783)	(0.593)
Observations	492	295	168	127
R-squared			0.405	0.312

Standard errors in parentheses

The statistical calculations suggest that the variables jointly explain participation in cattle marketing and the intensity of the outputs, which is revealed by the LR-chi-squared equaling 54.75 (p = .000) at the first stage and 70.48 (p = .000) at the second stage, and F-statistics equaling 4.87 and 2.58 (p = .000) at the third stages (iii and iv, respectively).

We observe that herd size influences decisions related to both selling and market participation. However, the findings indicate that herd size and the decision to sell cattle have a non-linear concave relationship. Herd size is positively associated with selling when all other factors of production remain constant. However, this relationship weakens for farmers with herd sizes greater than 58 heads. The result is in line with observations in the field that larger farmers tend to have on-farm slaughtering facilities. Therefore, larger farmers are more likely to sell carcasses.

Interestingly, herd size and formal market choice have a convex relationship. For farmers with fewer than 52 heads, the likelihood of participating in formal markets decreases as the herd size increases. For farmers with herd sizes exceeding 52 heads, the likelihood of participating in formal markets increases with the herd size if all else is equal. Shifting from small- to medium-scale production could, therefore, promote cattle commercialization. However, such a policy would not result in more formal marketing if the herd size does not exceed the critical point of 52 heads. Anecdotal evidence suggests that inspections tend to be targeted toward small farmers because they are more compliant with regulations. Inspectors are hesitant to regulate medium-sized farms because they are unable to compel them to adhere to the regulations. Larger farmers adhere to the formal rules due to the availability of subsidy incentives.

The evidence suggests that formal market standards are too costly for small and medium farmers, forcing them to choose outlets with lower standards. Policies that promote market-oriented farming in the existing institutional environment would not similarly facilitate formal marketing for producers of different sizes since herd size is a relative factor in decisions to sell and to sell formally. Therefore, institutional differentiation between livestock producers is needed to ensure the effectiveness of various policies in addressing their specific needs and promoting formal value chains (FAO, 2020).

When looking at the intensity of sales, we cannot reject the hypothesis of no association between the quantity of live-weight cattle sold and herd size in both the formal and the informal markets. Yet we infer that the intensity of live-weight cattle sales is price-driven. The price per kilogram of live-weight cattle is associated with a lower sales quantity in both the formal and the informal markets. The negative correlation between live-weight cattle sales prices and the quantity of live-weight cattle sales could be explained by a regional effect where farmers in regions with higher prices tend to fatten animals over a more extended period (they tend to wait to market the animals). Another argument is that, when cattle are treated as capital goods, the price reaction is negative since the animals must be withheld to increase future output (Kobayashi et al., 2007). In addition, the results show that the price elasticity of supply in formal markets is more elastic than in informal markets. The less elastic supply of informal sellers could indicate that there are asymmetries; they can less easily switch options compared to formal sellers (who could more easily switch to informal channels).

We discover a positive relationship between distance to the nearest city and the decision to sell cattle formally. When the distance to the nearest city is 8.8 kilometers (the 25th

percentile), the average cattle producer has a 46% probability of participating in formal markets; if the distance is 85 kilometers (the 75th percentile), the farmer has a 67% probability. That means that the further farmers are from a city, the more likely they are to sell their cattle in a formal market. A plausible explanation of this counterintuitive result is that informal buyers purchase less and would therefore not want high transport costs. Thus, informal markets are not available in remote places.

Farmers with higher education are negatively associated with selling live-weight cattle. The findings imply that more-educated cattle producers are more likely to participate in longer-value meat market chains than in shorter live-weight cattle production. We do not observe any difference in the selection of formal markets between educated farmers and less educated farmers. In other terms, formal market participation is not based on the educational level of producers. Policies that encourage training and education are, therefore, less likely to influence farmers' decisions to participate in formal live-weight markets. This suggests that formal market participation necessitates a variety of triggers, including an inclusive institutional environment to gain access to formal markets, as well as third parties or institutional intermediaries who bridge the gap between informal sellers and market formalization to facilitate the necessary changes.

Healthcare interventions due to animal disease are negatively associated with selling cattle. Farmers with cattle health interventions are also less likely to participate in formal markets. However, they sell more intensively through informal markets than farmers whose cattle are in healthier conditions. The finding highlights the evidence that informal markets undermine food safety standards and might endanger a region's public health and epizootic situation.

Farmers employing additional labor are associated with formal market participation and higher live-weight cattle sales. Formal markets require higher-quality products with higher labor input costs, and more labor means more opportunities to sell formally. As a result, policies related to higher production and quality standards, such as access to increased labor productivity, may contribute to formal marketing.

Based on our observations, we found that the gender factor has an impact on the quantity of live-weight cattle sold through informal outlets. When comparing only those who sell informally, male farmers sell an average of 22% more live-weight cattle than female farmers when all other variables are held constant. However, in the formal market outlets, female farmers sell an average of 19% more live-weight cattle than male farmers. This difference in sales intensity between informal and formal markets implies that providing support for female producers would reduce the amount of sales made through informal channels.

The standard errors of the IMR estimate that account for unobserved heterogeneity and self-selection issues are high at the formal market decision component of the model. The standard errors of the ρ_{1i} estimate suggests that there is no selection bias arising from unobserved factors between selling and non-selling cattle producers when deciding between formal and

informal market choices. After the estimate ρ_{1i} was found to be statistically insignificant, it was omitted from the regression (Burke et al., 2015).

The low standard errors of the IMR, ρ_{2i}, indicate that the quantity of live-weight cattle sold in formal markets is associated with both the observable and the unobservable factors due to selection bias arising from market participation decisions. The positive sign of ρ_{2i} implies a negative selection bias, suggesting that cattle producers who, on average, sell less in terms of live weight are more likely to select formal markets for commercialization. This implies that switching to the formal market may reduce the sales output of farmers who previously sold cattle on informal markets (Dubbert, 2019).

Integrating the country dummy into the specification helps to control for unobserved country-specific characteristics. The estimated coefficient is negative in all four specifications. However, its size is the largest in the specification explaining the quantity of sales in the informal market. Our result suggests that, among the farmers who sell only informally, Kyrgyz farmers sell on average 35% more than their Kazakh counterparts, holding all other variables fixed. The difference in the farmers' regional locations has no relation to their selling decisions, market participation, or the intensity of formal sales.

Based on the estimated results, we can conclude that decisions related to selling and market participation are mainly driven by the scale of production and transaction cost attributes. At the same time, the intensity of live-weight cattle sales is mostly price-driven.

4.6. SENSITIVITY ANALYSIS

Finally, we re-examine the validity of the findings, focusing on methodological concerns. First, we address the magnitude-direction variation between Kazakhstan and Kyrgyzstan by recalculating the baseline results within each country using a more parsimonious model. Table 17 illustrates each country's coefficient estimates for selling decisions and market participation using a probit model, and intensity of sale decisions using a log-linear regression. The sensitivity analysis of the direction of the herd size effect on market platform selection closely reflects the baseline results presented in Table 10. One exception is the estimated direction of herd size on commercialization decisions for farmers in Kyrgyzstan, yet this finding does not contradict the main conclusion on further decisions relating to formal market participation and the intensity of sales through formal market outlets.

Second, we address whether our estimates hold with a different identification strategy. The most frequently used identification technique is to adjust for a set of observable covariates deemed adequate to minimize confounding. However, if an estimated coefficient accurately reflects a relationship between dependent and independent variables, it is difficult or impossible to defend the assumption of unobserved confounders in the majority of application scenarios (Urminsky et al., 2016). Fortunately, an observational study does not have to make the exact assumption of zero unobserved confounders to remain substantively valid.

Sensitivity analyses are advantageous in these instances because they enable quantification of the amount of unobserved confounders required to significantly alter a research conclusion and aid in deciding if such confounding is plausible.

The baseline results indicate the model's sensitivity to the herd size parameter distinguishing cattle producers from commercial and formally selling farms. Here, we explore the validity of our findings by including additional fixed parameters, with a particular emphasis on cattle headcount. Finally, we re-estimate the specifications in high-dimensional settings using a double-selection lasso logistic regression model.

The high-dimensional regression technique allows for inferences about parameters in the presence of confounding information. By approximating the sparsity, the specification enables inference on poor model selection (Belloni, Chernozhukov, Hansen, et al., 2014). A challenge in high-dimensional settings is that numerous explanatory variables obstruct relevant inference about model parameters. Constraining the estimated model enables variable selection, or "regularization," to achieve dimension reduction and outline processes for reliable inference, allowing for unforeseen variable selection errors (Belloni, Chernozhukov, & Hansen, 2014).

Table 18 depicts the double-selection lasso logistic regression results for the effect of herd size on decisions related to commercialization and market participation (stages one and two in Figure 13, respectively). Again, we extend the number of control variables to 68 in the commercialization decision stage and 71 in the formal market participation stage. As a result, while the number of the estimated coefficients differs from the base estimates, the direction of the estimated coefficients generally corresponds to the ones presented in Table 10. These findings underline the non-linear nature of the cattle headcount linkages between commercialization decisions and formal market participation.

5. CONCLUSION

A strong institutional framework is crucial for the long-term success of the livestock industry as it improves animal health, ensures food security, as well as protects human health and economic resources (Connolly, 2017; Lee & Brumme, 2013). International experts consider the livestock industry in the transition economies a promising investment opportunity due to the rising incomes and shift towards protein-rich diets, which presents growth potential and export opportunities for meat and dairy production (Liefert & Swinnen, 2002; Petrick et al., 2017). However, after over 30 years of independence and reform, the transition economies of ex-Soviet states have harnessed the potential of livestock development progress with different degrees of advancement. While in European parts and Kazakhstan, institutional changes have led to the coexistence of family and corporate farms, as well as an agricultural workforce shift to other industries, resulting in better capital and labor productivity, in Transcaucasian and Central Asian countries, individualized farms have not improved labor productivity, leading to low incomes for rural communities (Petrick, 2021). The variation in the success of livestock industries generates a scientific interest in finding drivers for building efficient market systems and regulatory practices to assist livestock industries in increasing production and integrating into formal value chains. This dissertation is an initial step toward generating an evidence-based analysis of the importance of inclusive, agriculture-specific institutional settings in supporting livestock performance and industry transformation. Chapters 2 to 4 outline the three essays that form the core of this dissertation's focus.

Chapter 2 presents the first essay, "Comparing Meat Market Institutions: A New Regulatory Environment Index." This study makes a noteworthy contribution to the existing literature on analyzing agribusiness regulatory practices, raising questions about the empirical evaluation of business climate. Firstly, I am interested in how to measure the specific regulatory and business environment of the meat market industry. Secondly, I provide empirical evidence of the institutional roots of misgovernance in livestock and meat markets. Lastly, I examine whether institutional arrangements unrelated to direct economic outcomes, such as food safety concerns, are accountable for opportunistic risks. To address these questions, I developed an index combining qualitative and quantitative aspects using cross-national data. The data analysis suggests that using the newly developed index to measure the quality, efficiency, and implementation practices of regulations for meat markets may provide more comprehensive information than indices that only measure the quality of regulations. Among other things, the findings show that the business climate in meat markets depends on the quality of written regulations in force and how the regulations are implemented in practice. The findings confirm that regulations may appear similar on paper, but their implementation can vary significantly, leading to different institutional environments(Duvanova, 2014; Hallward-Driemeier & Pritchett, 2011). The main implementation obstacles include discretionary bureaucracy and bureaucracy distortion. In addition, regulations are weakly implemented when the legislation is not supported by physical infrastructure and trained specialists. Likewise, in the previous literature, the findings support the argument that state regulations

defined by heavy state requirements pose a challenge to implementation. Next, the paper provides empirical evidence of the institutional roots of misgovernance. Partially enforced regulations nurture an extractive institutional environment where different forms of corruption exist. The findings show that even efficient regulation and good regulatory practices have little impact when institutional structures allow bureaucrats to create additional burdens. The root of such misgovernance lay in excessive regulations, duplication of official mandates, and unofficial requirements set by enforcing agents. Moreover, the study contends that excessive regulations unrelated to direct economic outcomes are only partially responsible for bureaucratic discretion.

Chapter 3, "Do Bigger Farms Suffer Less from Corruption? Anti-corruption Efforts and the Recovery of Livestock Production", explores the influence of corruption control on the productive activities of livestock producers with different organizational forms. First, I investigate whether corruption inhibits or promotes cattle production growth. Then, I examine this controversial issue in relation to variation between and within various organizational structures of cattle producers. Lastly, I explore whether anti-corruption efforts have a greater impact on downstream beef production in contrast to upstream cattle production. Using a unique panel dataset on corruption crimes and livestock production rates at the level of subnational units in Kazakhstan and Russia, I found that the relationship between production growth and corruption is non-linear and varies across household farms, peasant farmers, and agricultural enterprises. The data analysis reveals that in regions with higher corruption control, peasant farmers, also known as medium-sized producers, grow on average more quickly than other agribusiness structures in regions with less corruption control. Enterprises, the larger producers, produce less in regions with stronger anti-corruption levels, but the cumulative effect of corruption control is linked to increasing productivity in the long run. Small-scale producers or households initially have a positive association between anti-corruption efforts and production growth, but this relationship deteriorates over time. Unlike our expectations, the relationship between anti-corruption efforts and downstream beef production is weaker than in upstream cattle production. The findings contributed to the debated topic of the complex relationship between corruption control and development progress. While some scholars argue that corruption can facilitate development, others believe it hinders progress. The paper suggests that the impact of corruption control on productivity is not uniform and varies depending on the organizational structure of businesses as well as the immediate impact may differ from the delayed impact. The paper makes a more general contribution to the literature that the bottom-up approach against corruption enables production growth.

Chapter 4, "Participation in Formal Markets and Farm Performance: The Case of Cattle Producers in Central Asia," contributes to the existing literature by raising concerns about the viability of small-scale farming. This essay aims to contribute to the literature by investigating the structural processes that drive market-oriented cattle production as well as exploring the factors that influence market formalization at the micro-level. Based on a survey of 500 farmers of different sizes, I use a triple-hurdle approach to look into the structural factors

influencing farmers' decisions about whether or not to sell live-weight cattle, how to sell cattle, and how much to sell. The main contribution of the paper is that I expanded the population subset in order to provide a more complete picture for marketing decision-making. The data included those who engage in trading as well as those who raise livestock for self-subsistence and do not sell it. This allowed for a better understanding of the important subdivisions of producers, including both smallholder livestock producers and larger, more sophisticated producers involved in complex value chains. The key findings reveal that institutional factors such as access to education and access to veterinary services are associated with market-oriented cattle production. Access to skilled labor and transportation infrastructure are revealed as the most influential factors for formal market participation. The scale of production is found to be an important factor for commercialization decisions, whereas pricing is detrimental to the sales intensity. However, the production scale has a non-linear inverse relationship with commercialization and formal market selection. While increasing herd size may facilitate the transition to market-oriented cattle production, it may also force farmers into informal markets if they fall short of the scale threshold of the formal market.

Some general conclusions and implications can be drawn from the results of these chapters. First, I identified that institutional roots of misgovernance in the livestock sector come from excessive regulations, duplication of official mandates, unofficial requirements set by enforcing agents, as well as lack of physical infrastructure and trained specialists, all of which nurture opportunistic risks. Next, I confirm that the overall institutional environment matters for livestock production progress but not uniformly for each type of organizational structure of livestock producers. Different types of farmers respond to institutional quality differently. Finally, I support the findings from previous chapters on the importance of institutional quality at micro-level evidence. The research findings demonstrate that institutional factors as well as institutional differentiation between farmers' production scales, are both important for market-oriented livestock production and promotion of formal markets.

5.1. POLICY IMPLICATIONS

Mix-method used in the dissertation reveals the strong importance of the institutional environment for livestock production progress and market formalization. The findings allow for deriving policy recommendations related to the enhancement of business climate for livestock producers. While the research insights can be applied to most countries with transition economies, the empirical analysis allows for formulating detailed policy prescriptions specific to Kazakhstan, Kyrgyzstan, Ukraine, and Uzbekistan.

The regulations must be backed up by infrastructural capacities and expert-based human capital. Commonly, farmers do not have access to accredited laboratories and slaughterhouses. Animal health supervision, control, and inspections in Kazakhstan, Ukraine, and Uzbekistan are mainly based on the epizootic situation in a country. At the same time, best practices enable top-down supervision and control aligned with the Hazard Analysis and

Critical Control Points norms. Local slaughterhouses and accredited laboratories represent the missing link between livestock producers and high-value markets. The identification mechanism for farm animals in Ukraine and Uzbekistan should be improved following global standards.

Enhancing transparency in Kazakhstan, Ukraine, and Uzbekistan is critical to mitigating rent-seeking opportunities. To prevent overlapping areas of responsibility, it is advised to minimize the number of supervisory agencies handling veterinary and quality management. Legal documents must explicate the primary duties of veterinary and food safety organizations tasked with control and implementation. Digitalization of bureaucratic services in the livestock sector has a great potential to improve transparency. In this regard, Kazakhstan attempts to digitalize, but online services are inaccessible because state veterinary organizations are not integrated into the national network services system.

In Kazakhstan, instances have been reported where livestock keepers have had their animals confiscated or illegally slaughtered due to vague regulations. To prevent such occurrences, regulations concerning animal compensation should explicitly state when an animal must be confiscated or slaughtered for sanitary reasons. Local veterinarians should not possess the authority to make extreme decisions independently. Instead, greater scrutiny and laboratory testing should be conducted before taking critical measures. Kazakhstan and Uzbekistan should collaborate to establish a legal framework incorporating an insurance scheme for farm animals, which would smooth forced animal sanitation.

To promote formalization in market-oriented cattle production, policy implications should take into account both large-scale and small and medium-sized farmers. Instead of focusing on finding winners, combining support measures for the different production scales would benefit development and formal marketing. This would also promote the effectiveness of policies while targeting the specific needs of farmers of various sizes. Prioritizing anti-bribery and anti-extortion policies is imperative for ensuring sustainable growth in the livestock production sector. This necessitates a collaborative effort between policymakers, the community, and farmers to combat corruption and achieve long-term development in the industry.

It is important to note that informal markets should not be viewed as a negative force that stifles economic activity. On the contrary, they help overcome market failures, which allows more vulnerable agents to be integrated into markets. Informal markets indicate existing market failures, such as fragmentation of value chains, excessive regulations, or exclusive institutional environment. Therefore, policymakers should focus not on eradicating informal markets but on developing an inclusive institutional environment and enabling producers to integrate into more sophisticated value chains.

Market formalization occurs when farmers shift from a minimal standard-based institutional framework to a specified regulation-based one. The obstacles to the transition to a formalized cattle market in Kazakhstan and Kyrgyzstan extend beyond the farm gate and require indirect

policy implications and direct policy initiatives. Indirect policies involve institutional intermediary actors, such as NGOs or extension centers, to support the changes. This includes clarifying the formal market benefits, legal requirements, and standard compliance, which facilitate farmers' transition from one institutional arrangement to another. Direct policies include improvements in access to veterinary services and transportation infrastructure, as well as support for small and medium-scale producers, not just large-scale producers.

5.2. RESEARCH LIMITATIONS AND FUTURE RESEARCH AGENDA

Although there is clear evidence of the importance of the institutional environment for livestock production and marker formalization, the conducted analysis of the dissertation has some limitations. There are important lessons to be learned from these limitations, which can be addressed in future research. In the subsequent section, I will discuss the limitations and lessons I encountered while working on the three essays of my dissertation.

One of the challenges in developing an index is accurately calculating the transaction costs associated with implementing regulations. For instance, the attempt to measure the deviation of the duration of issuing animal passports from the number of days stated in legislation may be improved. Due to the qualitative nature of the survey, the sample size was small, with only six respondents per country - three from the public sector and three from the private sector. The public sector respondents stated that the time taken to complete official procedures was less than or did not deviate from the limits stated in official documents. Conversely, the private sector respondents indicated that official procedures take longer than the official documents state. Furthermore, responses from the private sector varied, with some farmers experiencing much longer waiting times than others. To address this issue in the future, in order to measure quantitative measures associated with transaction costs more accurately, proposed solutions may include increasing the sample size of private sector respondents or stratifying private sector respondents by animal species or farm sizes. Another solution may involve converting quantitative questions to qualitative ones.

Another limitation was related to deriving sensitive information, particularly questions related to corruption and the implementation of regulations. Although I never directly inquired about corrupt activities, I asked for any sentiments or anecdotal evidence of corrupt cases that may have occurred outside of the respondent's activity. Some of the responses I received were quite surprising. For example, respondents from countries with higher ratings of perceived corruption reported lower incidences of corruption than those from countries with lower perceived corruption ratings[18,19]. Additionally, respondents from countries with higher

[18] Assumption is based on the Transparency International's Corruption Perceptions Index, 2017.
[19] Literature shows that corruption perception in agribusiness is similar to other industries (Herzfeld et al., 2018).

perceived corruption ratings were reluctant to answer indirect questions about corruption. Furthermore, I observed that, in some countries, public and private sector respondents gave diametrically opposed responses. Generally, public sector respondents reported the absence of corrupt activities or proper implementation of regulations, while the private sector more often reported on corruption cases and misimplementation of regulations. In the future, it may be helpful to ask different questions to the private and public sectors. For example, private sector participants could be asked how well the public sector enforces regulations, while public sector participants could report on the private sector's compliance with regulations.

The newly developed index has proven effective in identifying the institutional roots contributing to misgovernance within the livestock industry. It has also highlighted regulatory practices utilized by countries with more efficient systems. However, it has yet been subjected to qualitative analysis. Additional research and surveys could be conducted to facilitate a more in-depth analysis. Furthermore, exploring the impact of changes in livestock-specific institutional environments on livestock development across countries or over a more extended period would be beneficial. In order to enable qualitative analysis, the number of countries included in the data collection should be expanded for cross-sectional data analysis. Alternatively, the same countries could be surveyed over extended periods, enabling panel data analysis.

In the second paper of my dissertation, a crucial matter that was tackled is the accessibility of data. The data utilized in the paper was obtained from official secondary data sources in Kazakhstan and Russia, which have been subject to criticism regarding the accuracy of their measurements. Nevertheless, Medvedev and Nefedova (2021) confidently affirm that the data on the livestock population used is reliable and reflects the data reported by official statistical offices. Their research revealed a strong correlation between the number of livestock farm constructions displayed in remote sensing images and the number of livestock animals reported by state agencies.

Another concern stemming from the lack of available data is the use of cattle headcount growth as the dependent variable. A more unbiased estimator of livestock development would be livestock productivity instead of merely tracking herd size increase. This notion is supported by literature, which suggests that one of the primary objectives of farm restructuring and transitioning to global markets is to enhance productivity, such as increasing the weight of carcasses per cow, rather than just scaling up herd size (Liefert & Swinnen, 2002). However, herd size is the only traceable and reliable variable in secondary sources for measuring livestock progress. Other studies on former Soviet countries have relied on livestock herd size growth as a dependent variable and proxy for gauging livestock progress (Petrick & Götz, 2019). Nonetheless, having data that offers a more accurate measurement of livestock productivity would undoubtedly contribute to a more informed discussion on livestock development progress.

Another potential avenue for further exploration concerning anti-corruption efforts could be proposed in future research. The current data in the paper only covers low-level cases of

corruption crimes, as the legislation in Russia and Kazakhstan focuses on individualistic corruption cases. Higher-level corruption, such as by elites or firms, is not systematically penalized (Janenova & Knox, 2020; Schulze & Zakharov, 2018). While this allows for identifying the effectiveness of a bottom-up approach against corruption in enabling livestock growth expansion, it also prevents defining the top-down effect of corruption control. Further research on corruption control, with high-level corruption data, could enrich ongoing debates on which approach is more effective and explore how combining bottom-up and top-down approaches can foster sustainable agricultural development.

I acknowledge the inability to address the heterogeneities between livestock producers in the second essay. While I highlight the role of anti-corruption efforts as a factor that influences regional livestock development, I do not account for the variation in transaction costs related to the institutional environment that each organizational structure of farmers encounters. For instance, I cannot identify which type of farmers are more susceptible to extortion or bribery risks. With the existing data, the only possibility is to compare livestock growth between regions with high or low anti-corruption efforts and examine the impact of changes in anti-corruption efforts on livestock production growth within regions. The data sources from Russia and Kazakhstan only allow for the differentiation of farm outputs by regions, making it impossible to distinguish the inputs used for livestock production among different farm structures. Therefore, the conclusions drawn from this analysis only apply to regional variations. Although the cross-regional analysis reveals beneficiaries of stricter corruption control, the study focuses solely on cattle farmers; hence, the findings cannot be generalized to other commodities or animal production systems.

The third essay focuses on the potential benefits livestock producers might gain from participating in formal markets. However, it remains unclear exactly how much an increase in income would be if the farmers participated in formal markets. While Gwiriri et al. (2019) and Sehar and Oyekale (2020) show that livestock market-oriented production and market formalization are motivated by a rational benefit-cost consideration; Rae and Zhang (2009) that income increase may divert their farmers' resources away from animal husbandry. A possible avenue for future research would be to investigate the specific conditions under which farmers can benefit from engaging in formal market activities.

The main concern in the analytical part of the third essay was the empirical modeling using a control function approach. To achieve unbiased results, the model requires the proper identification and variability in explanatory variables. Pre-analysis showed that instruments are weakly correlated with endogenous regressors. The post-estimation overidentification test confirmed the estimated model's validity, as specified by Hahn and Hausman (2003). Although universal agreement does not exist on the weak-instrument issue, better data regarding the instrumental variables could be collected for each analysis stage. Specifically, the new instrument should have a stronger correlation with the farmers' decision to sell live-weight cattle but should not be correlated with their choice to participate in formal markets.

Similarly, the instrumental variable used in the second hurdle model should be correlated with the farmers' participation in formal markets but not with output intensity.

Livestock development in post-Soviet countries is a topic close to my heart. My interest in this subject began during my master's program at UC Davis, where I conducted a capstone project on sheep production in Northern Kazakhstan. After that, I worked as a consultant at the World Bank, analyzing veterinary services and livestock production regulations for former Soviet countries. The Institutional Quality of Meat Markets in Transition Economies project aligns with my interests perfectly, although institutional economics was a new field for me. Exploring this unknown terrain taught me a lot and fueled my motivation. Research on the livestock sector offers exciting insights into this vital industry's role in economic diversification and agricultural production growth. It also sheds light on how the livestock industry develops based on the business environment farmers encounter in a given region. I hope that my study will inspire further research into livestock industry development.

REFERENCES

Acemoglu, D., Johnson, S., & Robinson, J. (2005). Institutions as a fundamental cause of long-run growth. In P. Aghion & S. N. Durlauf (Eds.), (Vol. 1, pp. 385-472). Elsevier. https://doi.org/10.1016/S1574-0684(05)01006-3

ACEPAS. (2016). *Balance of production capacities of the Republic of Kazakhstan. [Баланс производственных мощностей Республики Казахстан]* (Astana: Analytical Centre of Economic Policy in Agricultural Sector [ACEPAS]).

Aidt, T. S. (2009). Corruption, institutions, and economic development. *Oxford Review of Economic Policy*, *25*(2), 271-291. https://doi.org/10.1093/OXREP/GRP012

Aldashev, G., & Guirkinger, C. (2017). Colonization and changing social structure: Evidence from Kazakhstan. *Journal of Development Economics*, *127*, 413-430. https://doi.org/10.1016/j.jdeveco.2016.12.005

Alene, A. D., Manyong, V. M., Omanya, G., Mignouna, H. D., Bokanga, M., & Odhiambo, G. (2008). Smallholder market participation under transactions costs: Maize supply and fertilizer demand in Kenya. *Food Policy*, *33*(4), 318-328. https://doi.org/10.1016/j.foodpol.2007.12.001

Alimaev, I. I., Kerven, C., Torekhanov, A., Behnke, R., Smailov, K., Yurchenko, V., Sisatov, Z., & Shanbaev, K. (2008). The impact of livestock grazing on soils and vegetation around settlements in Southeast Kazakhstan. In R. Behnke (Ed.), *The socio-economic causes and consequences of desertification in Central Asia. NATO Science for Peace and Security Series.* (pp. 81-112). Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-8544-4_5

Anderson, K., & Swinnen, J. F. M. (2008). *Distortions to agricultural incentives in Europe's transition economies*. Washington, DC: World Bank. http://hdl.handle.net/10986/6502 License: CC BY 3.0 IGO

Ann Wheeler, S., & Garrick, D. E. (2020). A tale of two water markets in Australia: Lessons for understanding participation in formal water markets. *Oxford Review of Economic Policy*, *36*(1), 132-153. https://doi.org/10.1093/OXREP/GRZ032

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277-297. https://doi.org/10.2307/2297968

Assane, D., & Grammy, A. (2003). Institutional framework and economic development: International evidence. *Applied Economics*, *35*(17), 1811-1817. https://doi.org/10.1080/0003684032000152862

Barbier, E. B. (2012). Corruption, poverty and tropical land use. *Journal of Sustainable Forestry*, *31*(4-5), 319-339. https://doi.org/10.1080/10549811.2011.588455

Barrett, C. B., Bachke, M. E., Bellemare, M. F., Michelson, H. C., Narayanan, S., & Walker, T. F. (2012). Smallholder participation in contract farming: Comparative evidence

from five countries. *World Development*, *40*(4), 715-730. https://doi.org/10.1016/j.worlddev.2011.09.006

Batho, H. L., Logar, B., Mariner, J. C., Valder, W.-A., & Westergaard, J. M. (2012). Institutions: Stronger veterinary services for better governance. *Revue Scientifique et Technique*, *31*(2), 479-492. https://doi.org/10.20506/rst.31.2.2125

Baumol, W. J. (1996). Entrepreneurship: Productive, unproductive, and destructive. *Journal of Business Venturing*, *11*(1), 3-22. https://doi.org/10.1016/0883-9026(94)00014-X

Belloni, A., Chernozhukov, V., & Hansen, C. (2014). High-dimensional methods and inference on structural and treatment effects. *Journal of Economic Perspectives*, *28*(2), 29-50. https://doi.org/10.1257/JEP.28.2.29

Belloni, A., Chernozhukov, V., Hansen, C., & Kozbur, D. (2014). Inference in high-dimensional panel models with an application to gun control. *Journal of Business and Economic Statistics*, *34*(4), 590-605. https://doi.org/10.1080/07350015.2015.1102733

Berry, D. (2017). A p-value to die for. *Journal of the American Statistical Association*, *112*(519), 895-897. https://doi.org/10.1080/01621459.2017.1316279

Bitsch, V. (2005). Qualitative research: A grounded theory example and evaluation criteria. *American Journal of Agricultural Economics*, *23*(1), 75-91. https://doi.org/10.22004/ag.econ.59612

Bityukova, V. R., & Borovikov, M. S. (2021). Environmental impact of agriculture on regions in Russia and Kazakhstan. In L. Mueller, V. G. Sychev, N. M. Dronin, & F. Eulenstein (Eds.), *Exploring and optimizing agricultural landscapes. Innovations in landscape research.* (pp. 399-414). Springer International Publishing https://doi.org/10.1007/978-3-030-67448-9_18

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115-143. https://doi.org/10.1016/S0304-4076(98)00009-8

Bojnec, Š., & Peter, G. (2005). Vertical market integration and competition: The meat sector in Slovenia. *Agricultural and Food Science*, *14*(3), 236-249. https://doi.org/10.2137/145960605775013182

Borisenko, A. (2018). Почему производители в РК отказываются от экспорта? [Why do meat producers in Kazakhstan refuse to export?]. *Kapital.kz*. https://kapital.kz/economic/67897/pochemu-proizvoditeli-v-rk-otkazyvayutsya-ot-eksporta.html

Bound, J., Jaeger, D. A., & Baker, R. M. (1995). Problems with instrumental variables estimation when the correlation between the instruments and the endogeneous explanatory variable is weak. *Journal of the American Statistical Association*, *90*(430), 443-443. https://doi.org/10.2307/2291055

Bulte, E. H., Damania, R., & López, R. (2007). On the gains of committing to inefficiency: Corruption, deforestation and low land productivity in Latin America. *Journal of Environmental Economics and Management*, *54*(3), 277-295. https://doi.org/10.1016/j.jeem.2007.05.002

Burke, W. J., Myers, R. J., & Jayne, T. S. (2015). A triple-hurdle model of production and market participation in Kenya's dairy market. *American Journal of Agricultural Economics*, *97*(4), 1227-1246. https://doi.org/10.1093/ajae/aav009

CabMinUzb. (2017). *748-он Ҳайвонларни Идентификация Қилиш, Уларни Ҳисобга Олиш, Ҳисобдан Чиқариш Ва Сақлаш Тартибини Такомиллаштириш Тўғрисида [Rules №748 On the Procedure for Identification, Registration, Decontamination and Storage of Animals]*. Tashkent: Cabinet of Ministers of the Republic of Uzbekistan. Retrieved from https://lex.uz/docs/3359038

CabMinUzb. (2018). *36-сон Гўшт Ва Гўшт Маҳсулотларининг Хавфсизлиги Тўғрисидаги Умумий Техник Регламентни Тасдиқлаш Ҳақида [General technical regulations № 36 on the safety of meat and meat products]*. Tashkent: Cabinet of Ministers of the Republic of Uzbekistan. Retrieved from https://lex.uz/docs/3516470

Chudik, A., Mohaddes, K., Pesaran, M. H., & Raissi, M. (2016). Long-run effects in large heterogeneous panel data models with cross-sectionally correlated errors. *Advances in Econometrics*, *36*, 85-135. https://doi.org/10.1108/S0731-905320160000036013

Cole, M. A., Elliott, R. J. R., & Zhang, J. (2009). Corruption, governance and FDI location in China: A province-level analysis. *Journal of Development Studies*, *45*(9), 1494-1512. https://doi.org/10.1080/00220380902890276

Connolly, J. (2017). Governing towards 'One Health': Establishing knowledge integration in global health security governance. *Global Policy*, *8*(4), 483-494. https://doi.org/10.1111/1758-5899.12505

Dau, L. A., & Cuervo-Cazurra, A. (2014). To formalize or not to formalize: Entrepreneurship and pro-market institutions. *Journal of Business Venturing*, *29*(5), 668-686. https://doi.org/10.1016/j.jbusvent.2014.05.002

De Boef, S., & Keele, L. (2008). Taking time seriously. *American Journal of Political Science*, *52*(1), 184-200. https://doi.org/10.1111/j.1540-5907.2007.00307.x

Deller, S. C., Gould, B. W., & Jones, B. (2003). Agriculture and rural economic growth. *Journal of Agricultural and Applied Economics*, *35*(3), 517-527. https://doi.org/10.1017/s107407080002825x

Diaz-Bonilla, E., Orden, D., & Kwieciński, A. (2014). Enabling environment for agricultural growth and competitiveness: Evaluation, indicators and indices. *OECD Food, Agriculture and Fisheries Papers*, *No. 67*, OECD Publishing, Paris. https://doi.org/10.1787/5jz48305h4vd-en

Dimitri, C. (2003). Agricultural marketing institutions: A response to quality disputes. *Journal of Agricultural and Food Industrial Organization*, *1*(1). https://doi.org/10.2202/1542-0485.1035

Dithmer, J., & Abdulai, A. (2017). Does trade openness contribute to food security? A dynamic panel analysis. *Food Policy*, *69*, 218-230. https://doi.org/10.1016/J.FOODPOL.2017.04.008

Divanbeigi, R., & Saliola, F. (2017). Regulatory constraints to agricultural productivity. *World Bank Policy Research Working Paper No. 8199*. https://doi.org/10.1596/1813-9450-8199

Djankov, S., Georgieva, D., & Ramalho, R. (2018). Business regulations and poverty. *Economics Letters*, *165*, 82-87. https://doi.org/10.1016/j.econlet.2018.02.002

Djankov, S., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2002). The regulation of entry. *The Quarterly Journal of Economics*, *117*(1), 1-37. https://doi.org/10.1162/003355302753399436

Dubbert, C. (2019). Participation in contract farming and farm performance: Insights from cashew farmers in Ghana. *Journal of the International Association of Agricultural Economists*, *50*(6), 749-763. https://doi.org/10.1111/agec.12522

Dunn, E. C. (2003). Trojan pig: Paradoxes of food safety regulation. *Environment and Planning A*, *35*(8), 1493-1511. https://doi.org/10.1068/a35169

Duvanova, D. (2012). Bureaucratic discretion and the regulatory burden: Business environments under alternative regulatory regimes. *British Journal of Political Science*, *42*(3), 573-596. https://doi.org/10.1017/S0007123411000457

Duvanova, D. (2014). Economic regulations, red tape, and bureaucratic corruption in post-communist economies. *World Development*, *59*, 298-312. https://doi.org/10.1016/J.WORLDDEV.2014.01.028

EBA. (2016). Enabling the business of agriculture 2016: Comparing regulatory good practices. *Washington, DC: World Bank*. http://hdl.handle.net/10986/23691 License: CC BY 3.0 IGO.

EC. (2004). *Regulation (Ec) № 853/2004 of the European Parliament and of the Council of 29 April 2004 laying down specific hygiene rules for on the hygiene of foodstuffs*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32004R0853

EC. (2012). *Communication from the Commission to the European Parliament, the Council and the European economic and social Committee on the European Union strategy for the protection and welfare of animals 2012-2015*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52012DC0006

EEC. (2018). Overview of the cattle meat market of the Member States of the Eurasian Economic Union for 2013-2017 [Обзор рынка мяса крупного рогатого скота

государств – членов Евразийского экономического союза за 2013-2017 годы] [Обзор рынка мяса крупного рогатого скота государств – членов Евразийского экономического союза за 2013-2017 годы]. *Department of Agricultural Policy of the Eurasian Economic Commission*, Moscow. https://eec.eaeunion.org/upload/medialibrary/bc6/OBZOR-po-KRS_2013_2017.pdf

Egger, P., & Winner, H. (2005). Evidence on corruption as an incentive for foreign direct investment. *European Journal of Political Economy*, *21*(4), 932-952. https://doi.org/10.1016/J.EJPOLECO.2005.01.002

Elbakidze, L. (2007). Economic Benefits of Animal Tracing in the Cattle Production Sector. *Journal of Agricultural and Resource Economics*, *32*(1), 169-180. http://www.jstor.org/stable/40987357

Esenova, S., & Dobson, W. D. (2000). Changing patterns of livestock, meat, and dairy marketing in post-communist Kazakhstan. *Babcock Institute Discussion Paper No. 2000-1**, University of Wisconsin-Madison, Babcock Institute for International Dairy Research and Development. https://doi.org/10.22004/ag.econ.37659

Fan, S., Brzeska, J., Keyzer, M., & Halsema, A. (2013). From subsistence to profit: Transforming smallholder farms. *Food policy report*, Washington, D.C.: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/9780896295582

FAO. (2007). Subregional report on animal genetic resources: Central Asia. *Annex to The State of the World's Animal Genetic Resources for Food and Agriculture*, Rome. https://www.fao.org/3/a1250e/annexes/Subregional%20Reports/Asia/CentralAsia.pdf

FAO. (2020). *Smallholders and family farms in Europe and Central Asia. Regional synthesis report 2019*. FAO. Budapest. https://doi.org/10.4060/ca9586en

Fischer, S., & Gelb, A. (1991). The process of socialist economic transformation. *Journal of Economic Perspectives*, *5*(4), 91-105. https://doi.org/10.1257/jep.5.4.91

Gagalyuk, T., & Valentinov, V. (2019). Agroholdings, turbulence, and resilience: The case of Ukraine. *Journal of East European Management Studies*, *24*(3), 484-496. https://www.jstor.org/stable/26778309

GIZ. (2017). *Analysis of Priority Markets for diversification of export of products from Central Asia. Meat products: market access strategies and recommendations*. https://www.giz.de/de/downloads/GIZ%20-%20Euromonitor-%20Central%20Asia%20Trade%20Facilitation_Fresh%20Fruit%20report%20-%20Eng_s.pdf

Gong, W., Parton, K., Zhou, Z., & Cox, R. J. (2006). Marketing channel selection by cattle farmers in China: a transaction cost approach. Proceedings of ACESA 2006 International Conference. Emerging China: Internal Challenges and Global Implications, 13 -14 July 2006, Melbourne, VIC, Australia.

Gow, H. R., & Swinnen, J. F. M. (1998). Up- and downstream restructuring, foreign direct investment, and hold-up problems in agricultural transition. *European Review of Agricultural Economics*, *25*(3), 331-350. https://doi.org/10.1093/erae/25.3.331

Gründler, K., & Potrafke, N. (2019). Corruption and economic growth: New empirical evidence. *European Journal of Political Economy*, *60*. https://doi.org/10.1016/J.EJPOLECO.2019.08.001

Gunya, A., Gairabekov, U., Karaev, Y., Lysenko, A., Elmurzaev, R., & Janibekova, H. (2019). Post-Soviet transformations in pastoral systems in the North Caucasus: The development of hybrid institutions. *Mountain Research and Development*, *39*(4), R49-R59. https://doi.org/10.1659/MRD-JOURNAL-D-20-00047.1

Gwiriri, L. C., Bennett, J., Mapiye, C., Marandure, T., & Burbi, S. (2019). Constraints to the sustainability of a 'systematised' approach to livestock marketing amongst smallholder cattle producers in South Africa. *International Journal of Agricultural Sustainability*, *17*(2), 189-204. https://doi.org/10.1080/14735903.2019.1591658

Hajdu, A., Gagalyuk, T., Bukin, E., & Petrick, M. (2021). Determinants of corporate social responsibility among farms in Russia and Kazakhstan: A multilevel approach using survey data. *International Food and Agribusiness Management Review*, *24*(4), 697-716. https://doi.org/10.22434/IFAMR2020.0197

Hallward-Driemeier, M., & Pritchett, L. (2011). How business is done and the 'doing business' indicators : The investment climate when firms have climate control. *Policy Research Working Paper 5563*, World Bank. https://doi.org/10.1596/1813-9450-5563

Hansen, L. P. (1982). Large sample properties of generalized method of moments estimators. *Econometrica*, *50*(4), 1029-1054. https://doi.org/10.2307/1912775

Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2010). The future of small farms: trajectories and policy priorities. *World Development*, *38*(10), 1349-1361. https://doi.org/10.1016/J.WORLDDEV.2009.06.012

Herzfeld, T., Drescher, L. S., & Grebitus, C. (2011). Cross-national adoption of private food quality standards. *Food Policy*, *36*(3), 401-411. https://doi.org/10.1016/j.foodpol.2011.03.006

Herzfeld, T., Kulyk, I., & Wolz, A. (2018). Is agribusiness different? Firm-level evidence of perceived corruption in post-Soviet countries. *Eastern European Economics*, *56*(6), 504-521. https://doi.org/10.1080/00128775.2018.1503937

Hirschauer, N., Grüner, S., Mußhoff, O., & Becker, C. (2019). Twenty steps towards an adequate inferential interpretation of p-values in econometrics. *Jahrbücher für Nationalökonomie und Statistik*, *239*(4), 703-721. https://doi.org/10.1515/jbnst-2018-0069

Hobbs, J. E. (1996). Transaction costs and slaughter cattle procurement: Processors' selection of supply channels. *Agribusiness*, *12*(6), 509-523.

https://doi.org/10.1002/(SICI)1520-6297(199611/12)12:6<509::AID-AGR2>3.0.CO;2-7

Holtz-Eakin, D., Newey, W., & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. *Econometrica*, *56*(6), 1371-1395. https://doi.org/10.2307/1913103

Ito, J., Bao, Z., & Su, Q. (2012). Distributional effects of agricultural cooperatives in China: Exclusion of smallholders and potential gains on participation. *Food Policy*, *37*(6), 700-709. https://doi.org/10.1016/j.foodpol.2012.07.009

Jacoby, H. G., Mansuri, G., & Fatima, F. (2021). Decentralizing corruption: Irrigation reform in Pakistan. *Journal of Public Economics*, *202*. https://doi.org/10.1016/j.jpubeco.2021.104499

Jalilian, H., Kirkpatrick, C., & Parker, D. (2007). The impact of regulation on economic growth in developing countries: A cross-country analysis. *World Development*, *35*(1), 87-103. https://doi.org/10.1016/j.worlddev.2006.09.005

Janenova, S., & Knox, C. (2020). Combatting corruption in Kazakhstan: A role for ethics commissioners? *Public Administration and Development*, *40*(3), 186-195. https://doi.org/10.1002/PAD.1873

Johnson, N. D., LaFountain, C. L., & Yamarik, S. (2011). Corruption is bad for growth (even in the United States). *Public Choice*, *147*(3), 377-393. https://doi.org/10.1007/S11127-010-9634-5

Kasper, W., & Streit, M. E. (1998). *Institutional Economics: Social Order and Public Policy*. Edward Elgar Pub.

Kasymov, U., Undeland, A., Dörre, A., & Mackinnon, A. (2016). Central Asia: Kyrgyzstan and the learning experience in the design of pastoral institutions. *Revue Scientifique et Technique*, *35*(2), 511-521. https://doi.org/10.20506/rst.35.2.2538

Kerven, C., Steimann, B., Ashley, L., Dear, C., & ur-Rahim, I. (2011). Pastoralism and farming in Central Asia's mountains: A research review. Bishkek: University of Central Asia. https://doi.org/10.5167/uzh-52730

Kiviet, J. F. (1995). On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics*, *68*(1), 53-78. https://doi.org/10.1016/0304-4076(94)01643-E

Kobayashi, M., Howitt, R. E., Jarvis, L. S., & Laca, E. A. (2007). Stochastic rangeland use under capital constraints. *American Journal of Agricultural Economics*, *89*(3), 805-817. https://doi.org/10.1111/j.1467-8276.2007.00981.x

Koester, U., & Petrick, M. (2010). Embedded institutions and the persistence of large farms in Russia. *Discussion Paper*, Leibniz Institute of Agricultural Development in Central and Eastern Europe, No. 131. http://nbn-resolving.de/urn:nbn:de:gbv:3:2-10847

Kong, D., Tao, Y., & Wang, Y. (2020). China's anti-corruption campaign and firm productivity: Evidence from a quasi-natural experiment. *China Economic Review*, *63*. https://doi.org/10.1016/j.chieco.2020.101535

Kotisalo, N., Luukkanen, J., Fredriksson-Ahomaa, M., & Lundén, J. (2015). Effects of centralizing meat inspection and food safety inspections in Finnish small-scale slaughterhouses. *Food Policy*, *55*, 15-21. https://doi.org/10.1016/j.foodpol.2015.05.007

Kvartiuk, V., & Herzfeld, T. (2021). Redistributive politics in Russia: The political economy of agricultural subsidies. *Comparative Economic Studies*, *63*(1), 1-30. https://doi.org/10.1057/s41294-020-00131-2

Kydland, F. E., & Prescott, E. C. (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy*, *85*(3), 473-491. http://www.jstor.org/stable/1830193

Lee, K., & Brumme, Z. L. (2013). Operationalizing the One Health approach: The global governance challenges. *Health Policy and Planning*, *28*(7), 778-785. https://doi.org/10.1093/heapol/czs127

Leff, N. H. (1964). Economic development through bureaucratic corruption. *American Behavioral Scientist*, *8*(3), 8-14. https://doi.org/10.1177/000276426400800303

Lerman, Z. (2001). Agriculture in transition economies: from common heritage to divergence. *The Journal of the International Association of Agricultural Economics*, *26*(2), 95-114. https://doi.org/10.1111/j.1574-0862.2001.tb00057.x

Lerman, Z., Csaki, C., & Feder, G. (2004). *Agriculture in transition: Land policies and evolving farm structures in post-Soviet countries*.

Levchenko, A. A. (2007). Institutional quality and international trade. *The Review of Economic Studies*, *74*(3), 791-819. https://doi.org/10.1111/j.1467-937X.2007.00435.x

Levy, D. (2007). Price adjustment under the table: Evidence on efficiency-enhancing corruption. *European Journal of Political Economy*, *23*(2), 423-447. https://doi.org/10.1016/J.EJPOLECO.2007.01.001

Liefert, W. M., & Swinnen, J. F. M. (2002). Changes in agricultural markets in transition economies. *Agricultural Economic Report No. 806*. https://doi.org/10.22004/ag.econ.33945

Likhogay, O. (2018). Бегаем, чтобы взять ненужные бумажки [Unnecessary documents from multiple authorities]. *Наша Газета*. https://www.ng.kz/modules/newspaper/article.php?numberid=609&storyid=24213

Lin, J., Flachsbarth, I., & von Cramon-Taubadel, S. (2020). The role of institutional quality on the performance in the export of coconut products. *The Journal of the International*

Association of Agricultural Economics, *51*(2), 237-258. https://doi.org/10.1111/agec.12552

Ma, W., & Abdulai, A. (2016). Does cooperative membership improve household welfare? Evidence from apple farmers in China. *Food Policy, 58,* 94-102. https://doi.org/10.1016/j.foodpol.2015.12.002

Maertens, M., & Swinnen, J. F. M. (2009). Trade, standards, and poverty: Evidence from Senegal. *World Development*, *37*(1), 161-178. https://doi.org/10.1016/J.WORLDDEV.2008.04.006

Magistrelli, G. (2014). Introducing the Baltic experience in modernizing sanitary and phytosanitary measures. Modernizing Sanitary and Phytosanitary Measures to Expand Trade and Ensure Food Safety: 2nd CAREC Trade Facilitation Learning Opportunity - Sharing the Baltic Experience, Mongolia, Ulan Bator.

Markelova, H., Meinzen-Dick, R., Hellin, J., & Dohrn, S. (2009). Collective action for smallholder market access. *Food Policy*, *34*(1), 1-7. https://doi.org/10.1016/j.foodpol.2008.10.001

Medvedev, A. A., & Nefedova, T. G. (2021). Post-Soviet transformation of livestock in central Russia according to statistics, satellite imagery, and the authors' observations. *Regional Research of Russia*, *11*(4), 589-604. https://doi.org/10.1134/S2079970521040134

Michelson, H. C. (2017). Influence of neighbor experience and exit on small farmer market participation. *American Journal of Agricultural Economics*, *99*(4), 952-970. https://doi.org/10.1093/ajae/aaw097

MinAgKaz. (2014a). *Правила № 7-1/559 и условия возмещения физическим и юридическим лицам стоимости изымаемых и уничтожаемых больных животных, продукции и сырья животного происхождения, представляющих опасность для здоровья животных и человека [Rules № 7-1/559 and conditions for reimbursement to individuals and legal entities cost of seized and destroyed sick animals, products and raw materials of animal origin, which are dangerous for health of animals and humans, or neutralized (disinfected) and processed without withdrawal of animals, products and raw materials of animal origin, representing danger to animal and human health]*. Astana: Minister of Agriculture of the Republic of Kazakhstan. Retrieved from https://adilet.zan.kz/rus/docs/V14F0009891#z72

MinAgKaz. (2014b). *Правила № 7-1/559 обязательного изъятия и уничтожения животных, продукции и сырья животного происхождения, представляющие опасность для здоровья животных и человека, либо их обязательного обезвреживания (обеззараживания) и переработки без изъятия [Rules № 7-1/559 on Compulsory Withdrawal and Destruction of Animals, Products and Raw Materials of Animal Origin Posing a Danger to Animal and Human Health, or Their Compulsory Decontamination (Disinfection) and Processing Without Withdrawal]*. Astana: Minister of Agriculture of the Republic of Kazakhstan. Retrieved from https://adilet.zan.kz/rus/docs/V14F0009891#z27

MinAgKaz. (2015a). *Правила № 7-1/68 идентификации сельскохозяйственных животных [Rules № 7-1/68 for the identification of farm animals]*. Astana: Minister of Agriculture of the Republic of Kazakhstan. Retrieved from https://adilet.zan.kz/rus/docs/V1500011127

MinAgKaz. (2015b). *Правила № 7-1/347 осуществления государственного ветеринарно-санитарного контроля и надзора, а также определения соответствия животных, продукции и сырья животного происхождения ветеринарным нормативам в объектах производства, осуществляющих выращивание животных, заготовку (убой), хранение, переработку и реализацию животных, продукции и сырья животного происхождения, включая экспортеров (импортеров) [Rules № 7-1/347 for the implementation of state veterinary and sanitary control and supervision, as well as the determination of the conformity of animals, products and raw materials of animal origin to veterinary standards in production facilities that carry out the cultivation of animals, harvesting, storing, processing and selling animals, products and raw materials of animal origin, including exporters (importers)]*. Astana: Minister of Agriculture of the Republic of Kazakhstan. Retrieved from https://adilet.zan.kz/rus/docs/V1500011608

MinAgKaz. (2015c). *Правила № 7-1/370 организации проведения убоя сельскохозяйственных животных, предназначенных для последующей реализации [Rules № 7-1/370 for organizing the slaughter of farm animals intended for the subsequent sale]*. Astana: Minister of Agriculture of the Republic of Kazakhstan. Retrieved from https://adilet.zan.kz/rus/docs/V2000021482

MinAgLith. (2003). *Įsakymas Nr. 3d-234 Dėl Ūkinių Gyvūnų Laikymo Vietų Registravimo Ir Jose Laikomų Ūkinių Gyvūnų Ženklinimo Ir Apskaitos Tvarkos Aprašo Patvirtinimo [Order No. 3d-234 Regarding Registration of Holding Points and the Approval of the Labeling and Accounting Procedure for Farm Animals]*. Vilnius: Minister of Agriculture of the Republic of Lithuania. Retrieved from https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.213812/asr

MinAgRus. (2017). *Национальный доклад: О ходе и результатах реализации в 2016 году Государственной программы развития сельского хозяйства и регулирования рынков сельскохозяйственной продукции, сырья и продовольствия на 2013 - 2020 годы [National report: On the progress and results of the implementation in 2016 of the State Program for the Development of Agriculture and Regulation of Markets for Agricultural Products, Raw Materials and Food for 2013 - 2020]*.

MinAgUkr. (2018). *Наказ №166/31618 Про Затвердження Порядку Ідентифікації Та Реєстрації Великої Рогатої Худоби Та Порядку Оформлення І Видачі Паспорта Великої Рогатої Худоби [Procedure №166/31618 For the Identification and Registration of Bovine Animals]*. Kyiv: Ministry of Agrarian Policy and Food of Ukraine. Retrieved from https://zakon.rada.gov.ua/laws/show/z0166-18#Text

Msellati, L., Commault, J., & Dehove, A. (2012). Good veterinary governance: Definition, measurement and challenges. *Revue Scientifique et Technique (International Office of Epizootics), 31*(2), 413-430. https://doi.org/10.20506/rst.31.2.2130

Mussayeva. (2019). Agriculture of Kazakhstan in numbers [Сельское хозяйство Казахстана в цифрах]. *German-Kazakh Agricultural Policy Dialogue*, Astana. https://shorturl.at/HMNV4

Ndraha, N., Hsiao, H. I., & Chih Wang, W. C. (2017). Comparative study of imported food control systems of Taiwan, Japan, the United States, and the European Union. *Food Control*, *78*, 331-341. https://doi.org/10.1016/j.foodcont.2017.02.051

Ndubuisi, G. O. (2020). Contractual frictions and the patterns of trade: The role of generalized trust. *The Journal of International Trade & Economic Development*, *29*(7), 775-796. https://doi.org/10.1080/09638199.2020.1745259

Niiazaliev, B., & Tilekeyev, K. (2019). *Revitalising animal husbandry in Central Asia: Case of Kyrgyzstan. ANICANET Project Country Report. University of Central Asia, Bishkek.*

North, D. C. (1990). Institutions, institutional change and economic performance. *Institutions, Institutional Change and Economic Performance*. https://doi.org/10.1017/CBO9780511808678

OECD. (2013). *OECD Review of Agricultural Policies: Kazakhstan 2013*. OECD Publishing. https://doi.org/10.1787/9789264191761-en

Oshakbayev, D., & Bozayeva, Z. (2019). *Kazakhstan country report prepared within the research project "ANICANET – revitalizing animal husbandry in Central Asia: A five-country analysis. TALAP, Astana*.

Paulauskas, V. (2014). Lithuanian experience in modernizing sanitary and phytosanitary measures. Modernizing Sanitary and Phytosanitary Measures to Expand Trade and Ensure Food Safety: 2nd CAREC Trade Facilitation Learning Opportunity - Sharing the Baltic Experience, Mongolia, Ulan Bator.

Petitclerc, M. (2012). Governance, veterinary legislation and quality. *Scientific & Technical Review*, *31*(2), 465-477. https://doi.org/10.20506/rst.31.2.2126

Petrick, M. (2021). Post-Soviet agricultural restructuring: A success story after all? *Comparative Economic Studies*, *63*(4), 623-647. https://doi.org/10.1057/s41294-021-00172-1

Petrick, M., & Götz, L. (2019). Herd growth, farm organisation and subsidies in the dairy sector of Russia and Kazakhstan. *Journal of Agricultural Economics*, *70*(3), 789-811. https://doi.org/10.1111/1477-9552.12318

Petrick, M., Oshakbaev, D., & Wandel, J. (2014). Kazakhstan's wheat, beef and dairy sectors: An assessment of their development constraints and recent policy responses. *Discussion Paper, Leibniz Institute of Agricultural Development in Central and Eastern Europe, No. 145*, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Halle (Saale). http://hdl.handle.net/10419/92937

Petrick, M., Oshakbaev, D., & Wandel, J. (2017). More than pouring money into an ailing sector? Farm-level financial constraints and Kazakhstan's 'Agribusiness 2020' strategy. In S. Gomez y Paloma, S. Mary, S. Langrell, & P. Ciaian (Eds.), *The Eurasian Wheat Belt and Food Security: Global and Regional Aspects* (pp. 103-118). Springer International Publishing. https://doi.org/10.1007/978-3-319-33239-0_7

Petrick, M., & Pomfret, R. (2016). Agricultural policies in Kazakhstan. *IAMO Discussion Paper No. 193*, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Halle (Saale). http://nbn-resolving.de/urn:nbn:de:gbv:3:2-54045%0D

Petrick, M., Raitzer, D., & Burkitbayeva, S. (2018). Policies to unlock Kazakhstan's agricultural potential. In K. Anderson, G. Capannelli, E. Ginting, & K. Taniguchi (Eds.), *Kazakhstan: accelerating economic diversification* (pp. 21-72). Asian Development Bank. https://doi.org/10.22617/TCS189413-2

Pomfret, R. (2016). Modernizing agriculture in Central Asia. *Global Journal of Emerging Market Economies*, *8*(2), 104-125. https://doi.org/10.1177/0974910116634491

Rae, A. N., & Zhang, X. (2009). China's booming livestock industry: Household income, specialization, and exit. *The Journal of the International Association of Agricultural Economics*, *40*(6), 603-616. https://doi.org/10.1111/j.1574-0862.2009.00402.x

Rakowski, C. A. (1994). Convergence and divergence in the informal sector debate: A focus on Latin America, 1984-92. *World Development*, *22*(4), 501-516. https://doi.org/10.1016/0305-750X(94)90107-4

Rigi, J. (2017). Corruption in Post-Soviet Kazakhstan. In I. Pardo (Ed.), *Between Morality and the Law* (pp. 109-126). Routledge. https://doi.org/10.4324/9781315261683-12

Robinson, S. (2020). Livestock in Central Asia: From rural subsistence to engine of growth? *IAMO Discussion Paper No. 193*, 1-44, Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Halle (Saale). https://www.iamo.de/fileadmin/documents/dp193.pdf

Robinson, S., Bozayeva, Z., Mukhamedova, N., Djanibekov, N., & Petrick, M. (2021a). Obstacles to the revival of mobile grazing systems in Kazakhstan. The XXIV International Grassland Congress/XI International Rangeland Congress (Sustainable Use of Grassland and Rangeland Resources for Improved Livelihoods), 25-29 October, 2021.

Robinson, S., Bozayeva, Z., Mukhamedova, N., Djanibekov, N., & Petrick, M. (2021b). Ranchers or pastoralists? Farm size, specialisation and production strategy amongst cattle farmers in south-eastern Kazakhstan. *Pastoralism*, *11*(31). https://doi.org/10.1186/s13570-021-00217-1

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *9*(1), 86-136. https://doi.org/10.1177/1536867X0900900106

Rose-Ackerman, S. (2006). *International handbook on the economics of corruption*. Edward Elgar Publishing Limited. https://doi.org/10.4337/9781847203106

Rose-Ackerman, S., & Truex, R. (2012). Corruption and policy reform. *Yale Law & Economics Research Paper No. 44*. https://doi.org/10.2139/ssrn.2007152

Rosstat. (2021). *Agriculture in Russia 2021 [Сельское хозяйство в России 2021], Federal State Statistics Service*. https://rosstat.gov.ru/storage/mediabank/S-X_2021.pdf

Satpayev, D. (2014). Corruption in Kazakhstan and the quality of governance. *IDE Discussion Papers 475*, Institute of Developing Economies, Japan External Trade Organization (JETRO). https://doi.org/10.20561/00037696

Schulze, G., Sjahrir, B. S., & Zakharov, N. (2016). Corruption in Russia. *Journal of Law and Economics*, *59*(1), 136-171. https://doi.org/10.1086/684844

Schulze, G., & Zakharov, N. (2018). Corruption in Russia - Historic legacy and systemic nature. *CESifo Working Paper Series No. 6864*. https://doi.org/10.2139/SSRN.3143406

Sehar, M., & Oyekale, A. S. (2020). Effect of livestock farmers' access to formal markets on marketing inefficiency in Mpumalanga province, South Africa. *African Journal of Science, Technology, Innovation and Development*, *14*(1), 225-233. https://doi.org/10.1080/20421338.2020.1823610

Shackell, G. H. (2008). Traceability in the meat industry – the farm to plate continuum. *International Journal of Food Science & Technology*, *43*(12), 2134-2142. https://doi.org/10.1111/j.1365-2621.2008.01812.x

Shibarshin, E. (2017). 837 млн тенге истратили с нарушениями ветеринарные службы Костанайской области - Ревизионная комиссия. [Veterinary services of Kostanai region spent 837 million tenge with violations - Revision Commission]. *Наша Газета*. https://www.ng.kz/modules/news/article.php?storyid=28262

Shiller, B. R. J., Boycko, M., & Korobov, V. (1991). Popular attitudes toward free markets: The Soviet Union and the United States compared. *The American Economic Review*, *81*(3), 385-400. https://www.jstor.org/stable/2006509

Shirley, M. M. (2013). Measuring institutions: How to be precise though vague. *Journal of Institutional Economics*, *9*(1), 31-33. https://doi.org/10.1017/S1744137412000227

Solon, G., Haider, S. J., & Wooldridge, J. M. (2015). What are we weighting for? *Journal of Human Resources*, *50*(2), 301-316. https://doi.org/10.3368/jhr.50.2.301

Stone, A., Levy, B., & Paredes, R. (1992). Public institutions and private transactions : the legal and regulatory environment for business private transactions in Brazil and Chile (English). *Policy Research working papers; no. WPS 891*, Public sector management and private sector development Washington, D.C.: World Bank Group. https://shorturl.at/kloOY

Suhardiman, D., & Mollinga, P. P. (2017). Institutionalized corruption in Indonesian irrigation: An analysis of the upeti system. *Development Policy Review*, *35*(S2), O140-O159. https://doi.org/10.1111/dpr.12276

Sutter, C., Webb, J., Kistruck, G., Ketchen, D. J., & Ireland, R. D. (2017). Transitioning entrepreneurs from informal to formal markets. *Journal of Business Venturing*, *32*(4), 420-442. https://doi.org/10.1016/j.jbusvent.2017.03.002

Svensson, J. (2005). Eight questions about corruption. *Journal of Economic Perspectives*, *19*(3), 19-42. https://doi.org/10.1257/089533005774357860

Tambulasi, R. I. C. (2009). The public sector corruption and organised crime nexus: The case of the fertiliser subsidy programme in Malawi. *African Security Review*, *18*(4), 19-31. https://doi.org/10.1080/10246029.2009.9627555

Teichmann, F., Falker, M. C., & Sergi, B. S. (2020). Gaming environmental governance? Bribery, abuse of subsidies, and corruption in European Union programs. *Energy Research & Social Science*, *66*. https://doi.org/10.1016/J.ERSS.2020.101481

ur-Rahim, I., Maselli, D., Rueff, H., & Bonfoh, B. (2014). Market access and herders' strategies to pass through lean winter periods in post-Soviet Kyrgyzstan. *APCBEE Procedia*, *8*, 323-328. https://doi.org/10.1016/j.apcbee.2014.03.048

Urminsky, O., Hansen, C., & Chernozhukov, V. (2016). Using double-LASSO regression for principled variable selection. *SSRN Electronic Journal*. https://doi.org/10.2139/SSRN.2733374

Uzun, V., Shagaida, N., & Lerman, Z. (2019). Russian agriculture: Growth and institutional challenges. *Land Use Policy*, *83*, 475-487. https://doi.org/10.1016/j.landusepol.2019.02.018

van Engelen, A. (2011). Dairy reports: Dairy development in Kazakhstan. FAO. https://www.fao.org/3/al751e/al751e00.pdf

van Wagenberg, C., Brouwer, F., Hoste, R., & Rau, M. L. (2012). *Comparative analysis of EU standards in food safety, environment, animal welfare and other non-trade concerns with some selected countries*. Publications Office. https://doi.org/10.2861/90059

VerRadUkr. (1992). *Закон № 2498-XII Про Ветеринарну Медицину [Law № 2498-XII on Veterinary Medicine]*. Kyiv: Verkhovna Rada of Ukraine. Retrieved from https://zakon.rada.gov.ua/laws/show/2498-12#Text

Visser, O., Mamonova, N., & Spoor, M. (2012). Oligarchs, megafarms and land reserves: Understanding land grabbing in Russia. *The Journal of Peasant Studies*, *39*(3-4), 899-931. https://doi.org/10.1080/03066150.2012.675574

Voigt, S. (2013). How (Not) to measure institutions. *Journal of Institutional Economics*, *9*(1), 1-26. https://doi.org/10.1017/S1744137412000148

Wang, L. (2018). *Punishment of public corruption in China and the United States* https://docs.lib.purdue.edu/dissertations/AAI10792724

Weder, B. (2001). Institutional reform in transition economies: How far have they come? *IMF Working Paper No. 01/114*, Washington, D.C.: International Monetary Fund. https://ssrn.com/abstract=879853

Wegren, S. K. (2014). The Russian food embargo and food security: Can household production fill the void? *Eurasian Geography and Economics*, *55*(5), 491-513. https://doi.org/10.1080/15387216.2014.992449

WGI. (2018). *Worldwide Governance Indicators.* https://info.worldbank.org/governance/wgi/

Williamson, O. E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature*, *38*(3), 595-613. https://doi.org/10.1257/jel.38.3.595

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, *126*(1), 25-51. https://doi.org/10.1016/J.JECONOM.2004.02.005

Woodruff, C. (2006). Measuring institutions. In S. Rose-Ackerman (Ed.), *International Handbook on the Economics of Corruption* (1 ed., pp. 105-124). Edward Elgar Publishing Limited. https://doi.org/10.4337/9781847203106.00009

Wooldridge, J. M. (2012). *Introductory Econometrics a Modern Approach, 5th edition*.

Xu, G., & Yano, G. (2017). How does anti-corruption affect corporate innovation? Evidence from recent anti-corruption efforts in China. *Journal of Comparative Economics*, *45*(3), 498-519. https://doi.org/10.1016/j.jce.2016.10.001

Yang, Z., Zhou, C., & Jiang, L. (2011). When do formal control and trust matter? A context-based analysis of the effects on marketing channel relationships in China. *Industrial Marketing Management*, *40*(1), 86-96. https://doi.org/10.1016/j.indmarman.2010.09.013

Zakharov, N. (2019). Does corruption hinder investment? Evidence from Russian regions. *European Journal of Political Economy*, *56*, 39-61. https://doi.org/10.1016/J.EJPOLECO.2018.06.005

Zeytoonnejad Mousavian, S. R., Mirdamadi, S. M., Farajallah Hosseini, S. J., & Omidi NajafAbadi, M. (2023). Determinants of foreign direct investment inflow to the agricultural sector: A panel-data analysis. *Journal of Economic and Administrative Sciences*, *39*(3), 709-729. https://doi.org/10.1108/JEAS-11-2020-0196

Zhumanova, M. (2011). *A study on livestock and land management in Kyrgyzstan*

APPENDIX

Table 11. Restrictions of the dynamic model

Model	Restriction
$Y_{i,t} = \alpha_0 + \alpha_1 Y_{i,t-1} + \beta_0 AC_{i,t} + \beta_1 AC_{i,t-1} + \sum \beta_j Z_{i,t} + \theta_{i,t}$	None
$Y_{i,t} = \alpha_0 + \alpha_1 Y_{i,t-1} + \beta_0 AC_{i,t} + \sum \beta_j Z_{i,t} + \theta_{i,t}$	$\beta_1 = 0$
$Y_{i,t} = \alpha_0 + \beta_0 AC_{i,t} + \sum \beta_j Z_{i,t} + \theta_{i,t}$	$\alpha_1 = \beta_1 = 0$
$Y_{i,t} = \alpha_0 + \beta_0 AC_{i,t} + \beta_1 AC_{i,t-1} + \sum \beta_j Z_{i,t} + \theta_{i,t}$	$\alpha_1 = 0$
$Y_{i,t} = \alpha_0 + \alpha_1 Y_{i,t-1} + \beta_1 AC_{i,t-1} + \sum \beta_j Z_{i,t} + \theta_{i,t}$	$\beta_0 = 0$

* $\theta_{i,t} = u_i + \mu_t + \varepsilon_{i,t}$

Table 12. Estimates of cattle headcount across farm types

Variables	(1) Total	(2) Enterprises	(3) Peasant Farms	(4) Households
Cattle headcount (log(t-1))	-0.020	-0.026	-0.034	-0.024
	(0.057)	(0.060)	(0.048)	(0.038)
Registered corruption crimes	-0.037	0.046	0.028	-0.023
per capita	(0.036)	(0.065)	(0.030)	(0.040)
Registered corruption crimes x	0.003	-0.004	-0.003	0.002
Cattle headcount (log(t-1))	(0.003)	(0.006)	(0.003)	(0.004)
Registered corruption crimes	-0.006	-0.057	-0.003	-0.019
per capita (t-1)	(0.038)	(0.054)	(0.035)	(0.046)
Registered corruption crimes (t-1) x	0.000	0.005	0.000	0.001
Cattle headcount (log(t-1))	(0.003)	(0.005)	(0.004)	(0.004)
Expenditure on agriculture, USD (log)	0.015	0.028	0.024	0.024
	(0.017)	(0.028)	(0.035)	(0.027)
Expenditure on agriculture,	-0.018	0.004	-0.004	-0.021
USD (log(t-1))	(0.016)	(0.021)	(0.022)	(0.019)
Credits in agriculture, USD (log)	0.001	0.001	0.007	-0.001
	(0.005)	(0.006)	(0.007)	(0.008)
Credits in agriculture, USD (log(t-1))	0.010	0.016	0.010	0.003
	(0.007)	(0.011)	(0.014)	(0.008)
Area of privately owned land, ha (log)	-0.008	-0.010	-0.016	-0.004
	(0.018)	(0.028)	(0.027)	(0.023)
Price of inputs, USD (log)	0.002	-0.002	-0.041	-0.002
	(0.022)	(0.029)	(0.029)	(0.019)
Price of inputs, USD (log(t-1))	-0.028	-0.048	-0.031	-0.002
	(0.015)	(0.015)	(0.030)	(0.017)
Price of cattle per head, USD (log)	-0.001	0.001	0.000	-0.001
	(0.002)	(0.008)	(0.005)	(0.003)
Price of cattle per head, USD (log(t-1))	-0.004	-0.003	-0.002	-0.002
	(0.002)	(0.007)	(0.005)	(0.004)
Labor employed in agriculture,	-0.019	-0.038	0.005	-0.007
people (log)	(0.044)	(0.040)	(0.059)	(0.045)
Number of agricultural machineries,	0.022	0.034	-0.046	0.010
units (log)	(0.032)	(0.029)	(0.028)	(0.015)
Number of cooperatives, units (log)	-0.008	-0.012	0.012	-0.000
	(0.014)	(0.023)	(0.020)	(0.014)
Area of agricultural land, ha (log)	-0.019	-0.020	0.091	-0.005
	(0.028)	(0.021)	(0.037)	(0.035)
Constant	0.342	-0.305	-0.389	0.175
	(0.450)	(0.598)	(0.678)	(0.382)
Observations	603	601	603	601
Number of id	84	83	84	83
AR(1)	0.0906	0.0123	0.00404	0.0729
AR(2)	0.659	0.585	0.112	0.271
Hansen overID test	0.401	0.580	0.205	0.120

Standard errors in parentheses

Table 13. Estimates of beef production across farm types

Variables	(1) Total	(2) Enterprises	(3) Peasant Farms	(4) Households
Beef production (log(t-1))	-0.026	-0.041	-0.045	0.010
	(0.027)	(0.052)	(0.045)	(0.021)
Registered corruption crimes	0.005	-0.002	-0.002	0.001
per capita	(0.002)	(0.006)	(0.006)	(0.003)
Registered corruption crimes x	-0.001	-0.000	-0.003	0.000
Cattle headcount (log(t-1))	(0.002)	(0.006)	(0.004)	(0.002)
Registered corruption crimes	-0.016	0.004	-0.005	-0.001
per capita (t-1)	(0.007)	(0.010)	(0.006)	(0.006)
Registered corruption crimes (t-1) x	0.002	-0.002	0.005	-0.000
Cattle headcount (log(t-1))	(0.006)	(0.010)	(0.006)	(0.004)
Expenditure on agriculture, USD (log)	0.020	0.054	0.008	0.000
	(0.017)	(0.045)	(0.033)	(0.017)
Expenditure on agriculture,	0.031	0.082	0.021	0.017
USD (log(t-1))	(0.015)	(0.046)	(0.032)	(0.013)
Credits in agriculture, USD (log)	0.001	0.003	0.009	-0.005
	(0.004)	(0.010)	(0.012)	(0.004)
Credits in agriculture, USD (log(t-1))	0.015	0.052	0.007	0.001
	(0.007)	(0.019)	(0.018)	(0.007)
Area of privately owned land, ha (log)	-0.000	0.014	-0.024	0.001
	(0.011)	(0.026)	(0.023)	(0.011)
Price of inputs, USD (log)	0.022	-0.011	-0.021	0.030
	(0.023)	(0.048)	(0.037)	(0.019)
Price of inputs, USD (log(t-1))	-0.036	-0.089	-0.033	-0.016
	(0.022)	(0.048)	(0.053)	(0.017)
Price of beef per kg, USD (log)	-0.022	0.001	-0.061	0.001
	(0.022)	(0.078)	(0.047)	(0.020)
Price of beef per kg, USD (log(t-1))	-0.031	-0.113	0.033	-0.012
	(0.015)	(0.067)	(0.056)	(0.015)
Labor employed in agriculture,	-0.049	-0.158	-0.021	-0.020
people (log)	(0.023)	(0.065)	(0.048)	(0.019)
Number of agricultural machineries,	-0.007	0.006	0.003	-0.005
units (log)	(0.005)	(0.017)	(0.011)	(0.005)
Number of cooperatives, units (log)	-0.000	0.022	0.006	0.004
	(0.013)	(0.023)	(0.027)	(0.009)
Area of agricultural land, ha (log)	-0.012	-0.036	0.041	0.001
	(0.016)	(0.026)	(0.024)	(0.014)
Constant	-0.530	-2.008	-0.612	-0.251
	(0.249)	(0.622)	(0.464)	(0.213)
Observations	614	614	610	614
Number of id	84	84	84	84
AR(1)	0.00386	6.48e-05	1.68e-05	0.0002
AR(2)	0.874	0.127	0.463	0.514
Hansen overID test	0.850	0.745	0.963	0.797

Standard errors in parentheses

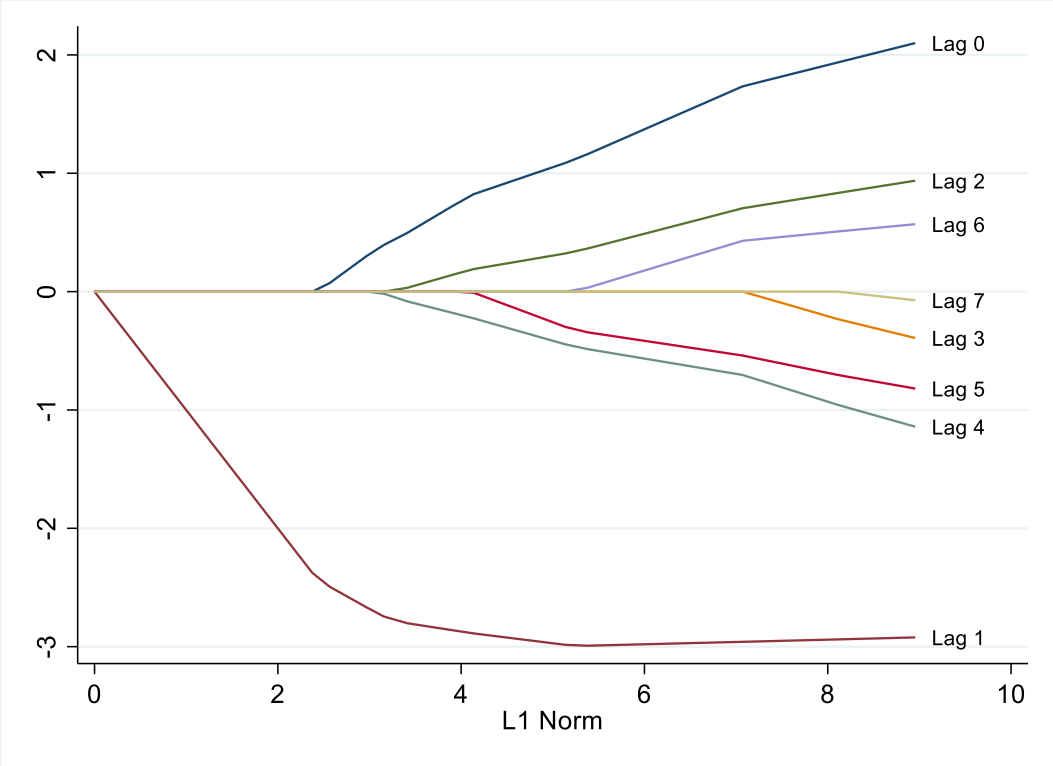


Figure 15. The coefficient path of each lagged value of anti-corruption efforts on total cattle production growth for the lasso penalty parameters

Table 14. Lag selection for anti-corruption efforts based on LASSO estimation results for total cattle production growth

	AIC	AICC	BIC	EBIC
Anticorruption efforts				
-.	x	x		
L1.	x	x	x	x
L2.	x	x		
L4.	x	x		
L5.	x	x		
L6.	x	x		

Table 15. Estimates of cattle growth rates over ranges of anti-corruption efforts by country

Variables	(1) Total	(2) Enterprises	(3) Peasant Farms	(4) Households
	Kazakhstan			
$\partial ln(Y_{i,t}^{f}/Y_{i,t-1}^{f})/\partial \ln(AC_{i,t})$				
Registered corruption crimes per capita	0.336	-0.450	0.067	0.214
	(0.582)	(0.433)	(0.251)	(0.420)
Registered corruption crimes per capita (t-1)	-0.247	0.079	0.035	-0.116
	(0.202)	(0.165)	(0.134)	(0.116)
	Russia			
$\partial ln(Y_{i,t}^{f}/Y_{i,t-1}^{f})/\partial \ln(AC_{i,t})$				
Registered corruption crimes per capita	0.008	-0.023	0.008	0.033
	(0.015)	(0.030)	(0.026)	(0.029)
Registered corruption crimes per capita (t-1)	0.006	0.022	0.060	0.006
	(0.015)	(0.031)	(0.035)	(0.037)

Standard errors in parentheses

Table 16. Estimates of cattle headcount across farm types using pooled OLS with fixed effects

Variables	(1) Total	(2) Enterprises	(3) Peasant Farms	(4) Households
Cattle number (log(t-1))	1.005	1.015	0.956	1.012
	(0.007)	(0.007)	(0.007)	(0.007)
Registered corruption crimes per capita	0.319	-0.304	0.054	0.480
	(0.101)	(0.122)	(0.146)	(0.146)
Registered corruption crimes per capita (t-1)	-0.346	0.160	0.267	-0.553
	(0.099)	(0.122)	(0.142)	(0.146)
Price of inputs, USD (log)	-0.001	0.025	-0.031	-0.009
	(0.010)	(0.013)	(0.014)	(0.014)
Price of cattle per head, USD (log)	0.001	0.006	-0.006	0.002
	(0.004)	(0.005)	(0.005)	(0.005)
Labor employed in agriculture, thsd people (log)	-0.005	-0.026	0.007	-0.003
	(0.006)	(0.009)	(0.009)	(0.009)
Area of pastures, thous. ha (log)	-0.009	-0.020	0.047	0.000
	(0.008)	(0.008)	(0.011)	(0.011)
Number of agricultural machinery	0.004	0.013	-0.011	-0.002
	(0.006)	(0.007)	(0.008)	(0.008)
2013.year	-0.016	-0.015	-0.087	-0.012
	(0.015)	(0.019)	(0.022)	(0.022)
2014.year	-0.023	-0.028	-0.079	-0.021
	(0.015)	(0.019)	(0.022)	(0.022)
2015.year	-0.021	-0.005	-0.082	-0.021
	(0.016)	(0.019)	(0.023)	(0.023)
2016.year	0.005	-0.005	-0.068	0.003
	(0.015)	(0.018)	(0.022)	(0.022)
2017.year	0.012	0.002	-0.063	0.017
	(0.015)	(0.018)	(0.022)	(0.022)
2018.year	-0.012	-0.019	-0.116	-0.025
	(0.016)	(0.019)	(0.023)	(0.023)
2019.year	-0.001	-0.036	-0.096	0.013
	(0.015)	(0.019)	(0.023)	(0.022)
1.country	0.046	0.160	0.048	0.011
	(0.020)	(0.024)	(0.029)	(0.029)
Constant	-0.017	-0.067	0.315	-0.185
	(0.065)	(0.075)	(0.073)	(0.074)
Observations	633	630	633	631
R-squared	0.990	0.990	0.990	0.990

Standard errors in parentheses

Table 17. Estimates for cattle selling decisions and formal market participation by countries

Variables	Stage 1		Stage 2		Stage 3 Formal seller	
	Kazakhstan	Kyrgyzstan	Kazakhstan	Kyrgyzstan	Kazakhstan	Kyrgyzstan
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Heard size, heads	0.073	-0.038	-0.029	-0.078	0.033	0.015
	(0.016)	(0.047)	(0.025)	(0.031)	(0.015)	(0.016)
Heard size, heads squared/100	-0.069	0.108	0.032	0.074	-0.023	-0.009
	(0.019)	(0.145)	(0.031)	(0.041)	(0.015)	(0.018)
Female (1/0)	0.374	-0.220	0.596	-0.521	0.080	0.331
	(0.258)	(0.209)	(0.406)	(0.269)	(0.259)	(0.143)
Age, years	-0.050	0.106	-0.031	-0.085	0.029	0.052
	(0.044)	(0.051)	(0.060)	(0.074)	(0.043)	(0.044)
Age, years squared/100	0.000	-0.001	0.000	0.001	-0.000	-0.001
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
High education, 1/0	-0.590	-0.164	0.656	-0.961	0.100	-0.150
	(0.233)	(0.278)	(0.368)	(0.357)	(0.227)	(0.144)
Land owned (1+log), ha	-0.161	0.045	-0.085	-0.242	-0.439	0.146
	(0.239)	(0.143)	(0.478)	(0.205)	(0.452)	(0.083)
Cooperative membership, 1/0	-0.014	-0.151	0.008	0.511	-0.253	-0.026
	(0.408)	(0.283)	(0.650)	(0.385)	(0.385)	(0.196)
Quantity provided hay (1+log), tons	0.009	0.154	-0.084	0.288	0.033	0.042
	(0.075)	(0.089)	(0.114)	(0.117)	(0.088)	(0.060)
Quantity provided grains (1+log), tons	-0.165	0.250	-0.045	-0.041	-0.208	0.027
	(0.137)	(0.110)	(0.199)	(0.134)	(0.159)	(0.057)
Labor (log), man-hr.	-0.221	0.106	0.366	0.417	0.175	-0.019
	(0.147)	(0.225)	(0.229)	(0.311)	(0.134)	(0.130)
Distance to the nearest city (log), km	-0.086	-0.049	0.175	0.460	-0.165	-0.069
	(0.058)	(0.128)	(0.090)	(0.192)	(0.075)	(0.076)
Live-weight price (log), USD per kg			-0.354	0.533	-1.199	-1.142
			(0.343)	(0.353)	(0.448)	(0.349)
Livestock marketing cost (log), USD			0.101	0.128	-0.031	-0.014
			(0.092)	(0.036)	(0.023)	(0.016)
Grazing sedentary, heads	-0.010	0.025	0.014	0.009	-0.005	0.002
	(0.010)	(0.016)	(0.016)	(0.015)	(0.007)	(0.006)
Veterinary services, 1/0	-0.427	-0.394	-0.145	-0.071	-0.015	-0.004
	(0.222)	(0.241)	(0.316)	(0.327)	(0.222)	(0.145)
Constant	1.596	-1.812	0.334	0.178	6.098	5.340
	(1.167)	(1.155)	(1.499)	(1.618)	(1.321)	(1.025)
Observations	243	249	120	175	48	120
R-squared					0.514	0.393

Standard errors in parentheses

Table 18. Estimates of cattle herd size on cattle selling decisions and formal market participation in high-dimensional settings

Variables	Stage 1	Stage 1
Heard size, heads	0.082	-0.130
	(0.027)	(0.054)
Heard size, heads squared/100	-0.073	0.036
	(0.031)	(0.057)
Observations	492	295

Robust standard errors in parentheses

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Experience

Project Manager — *Rompetrol*
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Kostanay, Kazakhstan — Dec 2022 – Nov 2023
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Publications in Progress

"Comparing meat market institutions: A new regulatory/business environment index", with Prof. Dr. Herzfeld

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"To cooperate or not to cooperate – why farm size matters for cooperation?", with Dr. Xhoxhi, Prof. Dr. Imami, and Prof. Dr. Herzfeld

"Do bigger farms suffer less from corruption? Anti-corruption efforts and the recovery of livestock production", with Prof. Dr. Herzfeld

Conference Presentations and Seminars

SIDE 2021, "The Italian Society of Law and Economics", Trento, Italy

EEGA Workshop 2020, "Agricultural Innovations, Rural Development and Globalization Processes in Central Asia", Halle (Saale), Germany

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Eidesstattliche Erklärung / *Declaration under Oath*

Ich erkläre an Eides statt, dass ich die Arbeit selbstständig und ohne fremde Hilfe verfasst, keine anderen als die von mir angegebenen Quellen und Hilfsmittel benutzt und die den benutzten Werken wörtlich oder inhaltlich entnommenen Stellen als solche kenntlich gemacht habe.
I declare under penalty of perjury that this thesis is my own work entirely and has been written without any help from other people. I used only the sources mentioned and included all the citations correctly both in word or content.

23.01.2025

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