IAMO
STUDIES ON THE AGRICULTURAL
AND FOOD SECTOR
IN TRANSITION ECONOMIES

Giorgi Chezhia

OLIGOPSONY POWER IN THE KAZAKH GRAIN SUPPLY CHAIN

Leibniz
Association

Leibniz Institute of Agricultural Development
in Transition Economies

OLIGOPSONY POWER IN THE KAZAKH GRAIN SUPPLY CHAIN

by Giorgi Chezhia

IAMO 2019

Studies on the Agricultural and Food Sector in Transition Economies

Edited by

Leibniz Institute of Agricultural Development in Transition Economies

IAMO

Volume 94

Bibliografische Information der Deutschen Bibliothek

Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über http://dnb.dnb.de abrufbar.

Bibliographic information published by Die Deutsche Nationalbibliothek

The German National Library (DNB) lists the publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the internet at: http://dnb.dnb.de.

This thesis was accepted as a doctoral dissertation in fulfillment of the requirements for the degree "doctor agriculturarum" by the Faculty of Natural Sciences III at Martin Luther University Halle-Wittenberg on 06.02.2018.

Date of oral examination:	09.07.2018
Supervisor and Reviewer:	Prof. Dr. Dr. h. c. Thomas Glauben
Co-Reviewer:	Dr. Oleksandr Perekhozhuk

Diese Veröffentlichung kann kostenfrei im Internet unter **www.iamo.de/publikationen/iamo-studies** heruntergeladen werden.

This publication can be downloaded free from the website **www.iamo.de/en/publications/iamo-studies**.

Leibniz-Institut für Agrarentwicklung in Transformationsökonomien (IAMO)
Theodor-Lieser-Straße 2
06120 Halle (Saale)
Tel.: 49 (345) 2928-0
e-mail: iamo@iamo.de
https://www.iamo.de

ISSN 1436-221X
ISBN 978-3-95992-082-7

Dedicated to my parents:

Demuri Chezhia and Nona Todua

ACKNOWLEDGEMENTS

This PhD thesis was conducted under the MATRACC project "The Global Food Crisis – Impact on Wheat Markets and Trade in the Caucasus and Central Asia and the Role of Kazakhstan, Russia and Ukraine" funded by the Volkswagen Foundation at the Leibniz Institute of Agricultural Development in Transition Economies (IAMO).

I would like to express my deepest gratitude to my supervisors Prof. Dr. Glauben and Dr. Perekhozhuk for their credence to pursue PhD at IAMO and professional support. Thanks to the encouragement of Prof. Dr. Glauben I was able to complete my thesis and due to the persistent support of Dr. Perekhozhuk I was able to overcome difficulties related to the research.

I would like to thank Antje Elsner and the administration department for their constant readiness to support all the administrative issues that arose throughout the course of my work. Thanks to them, the bureaucratic life at IAMO was much easier. I would also like to, particularly, underline their role in making IAMO Christmas and Summer Parties joyful, energizing and cheerful.

It was priceless experience to share the great moments of my PhD life with my dear friends in Halle-Saale: Andriy, Kachaber, Nizami and Gulmira, Miranda and Giorgi, Carla, Monserrat, Mohamed, Ilkay and Niko, Katharina and Siggi, Suli, Ivan and Milica, Vaso, Maria and Domenico, Lena and David, Aaron and Nargez, Ira and Slava, Sira, Eefje, Julia and Frederick, Kerstin, Pegah, Haider, Brett, Inna, and many others. I would like to express my special gratitude to my distinguished friend Natia Bursulaia.

I am lucky to have a special person next to me who shares my happiness and hardships, cares and is there for me in any situation. Thanks to Katharina Schwarz, her encouragement and support, I was able to find motivation under the hardest circumstances to proceed and complete my work.

I am greatly thankful to the outstanding person in my life Goga Todua, my uncle, who has tremendously contributed to my education, particularly in English and Mathematics. Thanks to him I was able to be exposed to many possibilities in my life and professional career.

I am lucky to have great family members constantly supporting, caring, loving and being there for me when it is needed. God protect Dato and Tatia, Vova and Sopo, Beqa, Mari, Andria and Saba.

SUMMARY

The Kazakh grain producing and processing sectors are prominent components of the Kazakh agriculture. Production and export of grain, especially of wheat and wheat flour, has demonstrated significant annual growth after the 1990's crisis. However, the grain market is highly regulated by the government and some of the implemented policy instruments cause local grain market distortions. For example, the wheat export ban imposed by the government in 2008 triggered local wheat price fluctuations, followed by the price spikes after the ban elimination.

In addition to the government interventions, the Kazakh grain sector is seriously challenged by production inefficiency, outdated production technology, low yields, limited access to financial recourses, landlocked position of the country and underdeveloped infrastructure. Furthermore, a non-competitive market structure, such as asymmetric price developments and antitrust law violations, is observed within the Kazakh grain supply chain. Evidence suggests that the grain processing sector, procuring roughly a third of the grain produced in the country, might be influencing the grain prices in Kazakhstan. Moreover, the grain sector became highly concentrated in recent years. Many processing companies exit the sector, enabling the remaining players to control the large share of the market.

Therefore, the focus of this study is to analyze the structure of the grain supply chain in Kazakhstan, followed by the examination of the competitiveness of the Kazakh grain processing sector using econometric analyses. The econometric analyses are conducted within the framework of the New Empirical Industrial Organizations (NEIO). The three approaches being applied for the market power analysis are Hall's approach, General Identification Method (GIM) and Production Theoretical Approach (PTA). The results are examined and reported in combination with the analysis of the grain supply chain.

The observations from 14 regions are used for all three models. The regional level panel data covers the time period of 2000–2011. The dataset

combines input and output prices and production quantities of the grain producers and processors. Econometric analyses within PTA and GIM rely on the full dataset, whereas within Hall's approach three data subsamples: 2000–2004, 2004–2007, and 2008–2011 are analyzed separately.

According to the estimation results from Hall's approach no market power is detected for 2000–2011. The low estimate of the market power parameter *(θ)* indicates that the grain processors were not able to influence the price formation on the grain supply market. However, the subsamples analyses suggest that the θ parameter increased for 2008–2011. Thus, the parameter might be reflecting the effect of the 2008 ban, when the grain producers could sell their grain only at the local market (mainly to the processors), while export of the wheat flour remained active during the wheat export ban. Similar results are obtained from the structural models. According to the PTA and GIM estimates, the market power parameter *(θ)* is too small to justify the existence of the oligopsony power in the Kazakh grain procurement market.

Overall, the econometric analysis suggests two main findings: 1) For the 2000–2011 timeframe, Kazakh grain processing industry did not exercise oligopsony power over the grain suppliers; 2) For the 2008–2011 timeframe, which includes period of grain export restrictions, grain processors have further increased their bargaining power over the suppliers. Nevertheless, the low market power parameter may indicate that the processors were not entirely able to exert oligopsony power and set the prices, as the grain suppliers expected the removal of the ban anytime soon, encouraging them to store, rather than to market their grain.

The increase of the market power for the time period 2008–2011 indicates that the government interventions can trigger noncompetitive tendencies on the Kazakh grain market. Export ban can result in increased oligopsony power for grain processors allowing them to influence the grain purchasing prices. Even though short-term restrictions might have, relatively, less severe consequences, yet in the medium and long terms such interventions can lead to oligopsonistic market structure. Oligopsony market, consequently, can be an additional barrier for the further development of currently inefficient Kazakh grain sector.

ZUSAMMENFASSUNG

Der kasachische Getreide- und Verarbeitungssektor ist ein wichtiger Bestandteil der kasachischen Landwirtschaft. Die Produktion und der Export von Getreide, insbesondere von Weizen und Weizenmehl, haben nach der Krise in den 90er Jahren ein starkes jährliches Wachstum gezeigt. Der Getreidemarkt ist jedoch stark von der Regierung reglementiert und einige der implementierten politischen Instrumente führen zu Verzerrungen auf dem lokalen Getreidemarkt. So löste beispielsweise das im Jahr 2008 von der Regierung verhängte Weizenexportverbot lokale Weizenpreisschwankungen aus, gefolgt von Preisspitzen nach der Aufhebung des Verbots.

Neben den staatlichen Maßnahmen ist der kasachische Getreidesektor mit Produktionsineffizienz, veralteten Produktionstechnologien, niedrigen Erträgen, begrenztem Zugang zu Finanzmitteln, Binnenlage des Landes und einer unterentwickelten Infrastruktur konfrontiert. Darüber hinaus ist innerhalb der kasachischen Getreidelieferkette eine nicht wettbewerbsfähige Marktstruktur wie zum Beispiel asymmetrische Preisentwicklungen und Kartellrechtsverletzungen zu beobachten. Es gibt Hinweise darauf, dass der Getreideverarbeitungssektor, der etwa ein Drittel des im Land produzierten Getreides verarbeitet, die Getreidepreise in Kasachstan beeinflussen könnte. Darüber hinaus hat sich der Getreidesektor in den letzten Jahren stark konzentriert. Viele Verarbeitungsunternehmen ziehen sich aus dem Sektor zurück, so dass die verbleibenden Akteure einen größeren Marktanteil kontrollieren.

Daher liegt der Schwerpunkt dieser Studie auf einer Analyse der Struktur der Getreidelieferkette in Kasachstan, gefolgt von der Untersuchung der Wettbewerbsfähigkeit des kasachischen Getreideverarbeitungssektors anhand ökonometrischer Analysen. Die ökonometrischen Analysen werden im Rahmen der Neue Empirische Industrieökonomik *(New Empirical Industrial Organization – NEIO)* durchgeführt. Die drei Ansätze, die für die Marktmachtanalyse verwendet werden, sind der Hall's Ansatz *(Hall's* *approach)*, die Allgemeine Identifizierungsmethode *(General Identification Method – GIM)* und der Produktionstheoretische Ansatz *(Production Theoretical Approach – PTA)*. Die Ergebnisse werden in Kombination mit der Analyse der Getreidelieferkette untersucht und dokumentiert.

Die Beobachtungen aus 14 Regionen werden für alle drei Modelle verwendet. Die Daten des Panels auf regionaler Ebene decken den Zeitraum 2000–2011 ab. Der Datensatz kombiniert Ein- und Verkaufspreise sowie Produktionsmengen der Getreideproduzenten und -verarbeiter. Die ökonometrischen Analysen des PTA und GIM Ansatzes bauen auf dem vollständigen Datensatz auf, während für den Hall's Ansatz drei Datenstichproben verwendet werden: 2000–2004, 2004–2007 und 2008–2011 werden separat analysiert.

Der Hall's Ansatz konnte für 2000–2011 keine Marktmacht feststellen. Der niedrige Schätzwert des Marktmachtparameters *(θ)* deutet darauf hin, dass die Getreideverarbeiter die Preisbildung auf dem Getreidemarkt nicht beeinflussen konnten. Die Teilprobenanalysen legen jedoch nahe, dass sich der Parameter θ für 2008–2011 erhöht hat. Der Parameter könnte die Wirkung des Verbots von 2008 widerspiegeln, als die Getreideproduzenten ihr Getreide nur auf dem lokalen Markt (hauptsächlich an die Verarbeiter) verkaufen konnten, wohingegen der Export des Weizenmehls während des Weizenausfuhrverbots aktiv blieb. Ähnliche Ergebnisse werden aus den Strukturmodellen gewonnen. Den PTA und GIM Schätzungen zufolge ist der Marktmachtparameter *(θ)* zu klein, um die Existenz der Oligopsonmacht auf dem kasachischen Getreidebeschaffungsmarkt zu rechtfertigen.

Insgesamt zeigt die ökonometrische Analyse zwei wesentliche Ergebnisse: 1) Für den Zeitraum 2000–2011 übte die kasachische Getreideverarbeitungsindustrie keine oligopsonistische Marktmacht über die Getreidelieferanten aus; 2) Für den Zeitraum 2008–2011, der auch die Periode der Ausfuhrbeschränkungen für Getreide umfasst, haben die Getreideverarbeiter ihre Verhandlungsmacht über die Lieferanten weiter erhöht. Der geringe Marktmachtparameter könnte jedoch darauf hindeuten, dass die Verarbeiter nicht in vollem Umfang in der Lage waren, oligopsonistische Marktmacht auszuüben und die Preise festzusetzen, da die

Getreidelieferanten mit der Aufhebung des Verbots jederzeit gerechnet hatten, was sie wiederum ermutigte, ihr Getreide zu lagern und nicht zu vermarkten.

Die Erhöhung der Marktmacht für den Zeitraum 2008–2011 zeigt, dass die staatlichen Interventionen wettbewerbswidrige Tendenzen auf dem kasachischen Getreidemarkt auslösen können. Ein Exportverbot kann zu einer erhöhten oligopsonistischen Marktmacht der Getreideverarbeiter führen, die es ihnen ermöglicht, die Einkaufspreise für Getreide zu beeinflussen. Auch wenn kurzfristige Restriktionen, relativ gesehen, weniger schwerwiegende Folgen haben, können solche Eingriffe mittel- und langfristig zu einer oligopsonistischen Marktstruktur führen. Der oligopsonistische Markt kann daher ein zusätzliches Hindernis für die weitere Entwicklung des derzeit ineffizienten kasachischen Getreidesektors darstellen.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES IN THE APPENDIX

LIST OF ABBREVIATIONS

2SLS	Two-Stage Least Squares
ACC	The Agricultural Credit Corporation
CAC	Central Asian Countries
CIS	Common Wealth of Independent States
CSMNERK	The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan
DW	Durbin–Watson statistic
FAO	Food Agricultural Organization of the United Nations
FCC	The Food Contract Corporation
FFSA	Fund for Financial Support of Agriculture
FIML	Full Information Maximum Likelihood
FOC	First Order Conditions
GIM	General Identification Method
GMM	Generalized Method of Moments
HHI	Herfindahl–Hirschman Index
I3SLS	Iterative Three-Stage Least Squares
ICCARKS	Information and Computing Centre of the Agency of the Republic of Kazakhstan on Statistics
KAF	KazAgroFinance
KAG	KazAgroGarant
KAM	KazAgroMarketing
KAP	KazAgroProduct

N3SLS	Nonlinear Three Stage Least Squares
NACE	Nomenclature des Activités Économiques dans la Communauté Européenne (Nomenclature of Economic Activities in the European Community)
NEIO	New Empirical Industrial Organization
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PF	Production Function
PTA	Production Theoretical Approach
SF	Supply Function

1 INTRODUCTION

1.1 PROBLEM STATEMENT AND MOTIVATION

Grain production has been increasing in Kazakhstan over the last decade and as a result it developed into the strategic sector of the country. Large resources of arable land, governmental subsidies, and world demand greatly contributed to the growth of the grain production after the sharp decline during the crisis caused by collapse of the soviet system and economic adversity. Consequently, Kazakh grain and flour sectors gained their dominant position in the Central Asian region and became listed among the world leaders of wheat flour exporters, as well. However, the grain market still suffers from structural problems, mainly related to underdeveloped infrastructure, inefficiency and low yields, landlocked position of the country limiting access to the world grain market and, thus, the export potential. Moreover, the government interventions to regulate the market cause distortions on grain market. Ultimately, these measures may create a barrier for competitiveness and further development of the grain sector.

Kazakhstan government intervenes on the domestic grain market with various policy instruments such as subsidies, price controls and regulations and tax concessions (OECD 2013, p. 24). Those interventions, in particular, the subsidies, played an important role in boosting the grain and grain flour production during 2000–2011, as the sectors grew rapidly. However, some of the implemented policy instruments had an adverse impact. Namely, the complete ban of wheat export imposed in 2008 and grain export restrictions in 2010, having negative consequences on farmers' income (FAO 2011, p. 16). Government agencies engaged in commercial transactions on the grain market and created additional obstacles for competitive market development (OECD 2013, p. 14). Similarly, local authorities still intervene in agricultural commodity markets by discriminating in grain export permissions in favor of large operators versus small producers, controlling the seed flow and fuel channels in grain production sector (Swinnen 2009, p. 728).

Government interference on the grain market causes price distortions along the grain supply chain, as well. Oskenbayev and Turabayev (2014) report about asymmetric price development in the Kazakh grain chain, while Pomfret (2007, p. 18) indicates about the variation of price gap and distortion on Kazakh grain market. Price distortions also occurred during the export ban, as well. Oshakbaev (2012, p. 53) emphasizes the effect of export ban on the wheat prices at the Kazakh market in comparison to the Mexican gulf wheat prices.

Additionally, the Kazakh grain sector is characterized with market imperfections and inefficiencies caused by high transaction costs and underdeveloped infrastructure. According to the OECD (2013, p. 21), infrastructural inefficiencies result in increased transactional costs for grain producers, increasing the costs of production and decreasing the profit for them.

On the other hand, the Kazakh grain processing industry, being one of the principal buyers of the Kazakh grain, undergoes a consolidation process. According to the Flour Millers Association of Kazakhstan (Lyddon, 2013), total number of flour mills has significantly decreased within the last 10 years as consolidation has occurred. Business Media Group (2011, p. 11) also notifies the consolidation processes, reporting companies mergers and small players leaving the market.

A reduction in the number of actors in the processing sector raises the questions regarding the competition. Moreover, large scale agricultural players, so called "agroholdings" dominate the grain market. The empirical studies (e.g. Lindeman, 2009; Prikhodko, 2009; Wandel and Kozbagarova, 2009) show that these players hold and control important share in Kazakhstan's wheat and grain market. The largest holding company in Kazakhstan controls 20 percent of the total sown area (900,000 hectares) in Kostanay province and owns 70 percent of the grain elevators (Lindeman, 2009). Furthermore, most of the agroholdings were initially involved in grain trading only, but gradually expanded into grain production sector (Wandel, 2009). Currently, they operate as vertically and horizontally integrated companies in the grain processing and production sectors.

The concerns regarding the competition are considered by The Agency of the Republic of Kazakhstan for Competition Protection

(Antimonopoly Agency) and FAO. The Antimonopoly Agency discovered 28 antitrust law violations in 2009–2010 in the grains and oilseeds product supply chains (Antimonopoly Agency of Kazakhstan, 2012). Furthermore, FAO (2011, p.16) suspects that oilseeds processors lobbied the export ban policy in 2008.

1.2 OBJECTIVES

The evidence provided in previous chapter suggests that some players dominating market might be able to gain the bargaining power and influence the grain price. In particular, concerns arise that grain processors are able to exert market power while purchasing grain, thus restraining the grain production sector by squeezing the price. The main argument in favor of this concern is that the consolidation process is observed in the grain processing industry. On the other hand, the grain market, as a strategic sector of the country, is highly framed by the government interventions. Price regulations, export ban and similar policy measures imposed by the government institutions cause distortions on the grain market. Accordingly, the main objective of this study is to analyze the supply chain of the Kazakh grain industry and test for its competitiveness. The focus is to examine the grain processing industry for the oligopsony power and to assess whether processors influence the grain price while purchasing grain. Consequently, the research questions can be summarized as follows:

- How is the Kazakh grain market structure organized? How is the grain supply chain constructed and who are the main market players?
- Are the dominant players (or group of players) on the grain flour market able to influence the grain price? Are processors the price takers on input market? If not, what is the degree of the exerted market power?
- If the grain processors are able to alter the grain price, can the market be described as oligopsony?

To examine the Kazakh grain processing industry for oligopsony market power I apply econometric methods and approaches proposed in the New Empirical Industrial Organization (NEIO) literature. The empirical approach was pioneered by Appelbaum (1979), who provided a statistical test for market power and tested the price taking behaviour in the U.S. crude petroleum and natural gas industry. The theoretical justification was later developed by Bresnahan (1982), indicating that the concept of oligopoly solution can be estimated econometrically. Afterwards, Lau (1982) proved a mathematical accuracy of Bresnahan's concept. The details of the approaches and the results obtained from the analyses are discussed in the following chapters.

1.3 STRUCTURE

Chapter 2 proceeds with the description of the grain sector by analysing the statistical data on grain production, processing, export and pricing. It also provides the detailed analysis of the grain supply chain and grain flows within the distribution channels. The chapter mainly focuses on demonstrating the grain market structure and the tendencies that developed after Kazakhstan's transformation from centrally planned to a free market economy.

Chapter 3 summarizes the literature on market power and the best practices from empirical studies emerged within the New Empirical Industrial Organization (NEIO), with a particular focus on the oligopsony power in the processing sector. Given every approach possesses certain limiting assumptions the emphasis are made on selecting the model that would apply to Kazakh grain sector studies with the most accurate empirical outcome. Accordingly, three main approaches are selected and analyzed in this chapter, i.e. Hall's approach, Production-Theoretical Approach (PTA) and General Identification Method (GIM). Based on the reviewed literature, theoretical framework is elaborated for oligopsony power analysis in the Kazakh grain processing sector.

The empirical part of the analysis is presented in Chapter 4. I use the dataset collected from various sources to analyze the models within the three different approaches. The descriptions of the models and data provide insights regarding the structure of dataset and variables used in each of the models separately. Similarly, Chapter 4 also summarizes the empirical results, provides their interpretations and conclusions for every model individually.

Chapter 5 elicits the results from three models and provides overall conclusions regarding the main findings of the study. Consequently, respective outlines are derived regarding the constraints of the Kazakh grain market structure and further policy recommendations. This chapter also discusses the limitations of the theoretical framework and models used in the study.

2 DESCRIPTIVE ANALYSIS OF THE KAZAKH GRAIN SECTOR

2.1 GENERAL OUTLOOK

After the Soviet Union's collapse, Kazakhstan, along with Russia and Ukraine, has become one of the main actors as an independent country in the world's grain, wheat and wheat flour markets. According to the FAO statistics, Kazakhstan was on the top of the flour exporter countries list, with exports of 1.5 million tons in 2006/2007 and 1.7 million tons in 2007/2008. Nevertheless, the transformation process from a strictly centrally planned to a free market economy was not smooth. Various agricultural sectors, including that of grain, had to tackle the challenges that had not been experienced before. Political and economic instability, hyperinflation, lack of investments, and underdeveloped infrastructure, have deteriorated the production of all grain products. As a result, the grain industry entered a deep crisis and could not develop for many years.

Despite the difficulties, the grain sector started to recover after 2000 and managed to gradually integrate with the world grain market. A new economic system and changed market structure led to creating private economic entities acting on competitive basis in a free market economy on local and international levels. The grain producers and processors could not have been longer directed solely by the government. Instead, they became self-sustainable and operated as profit-oriented companies. However, government intervention on grain market still prevailed in various policy instruments, such as subsidies, taxes, quotas, and export bans.

The government supported programs in the agricultural sector, especially in the grain sector, facilitated the recovery and growth in production and export of the agricultural products. Efforts were undertaken to establish state institutions providing various concessions to stimulate the agriculture. A good example is KazAgroHolding which comprises seven agencies, i.e. the Food Contract Corporation (FCC), KazAgroProduct (KAP), the Agricultural Credit Corporation (ACC), Fund for Financial Support of Agriculture (FFSA), KazAgroFinance (KAF), KazAgroMarketing (KAM) and KazAgroGarant (KAG).

Another important factor boosting grain production has been a high demand from the export markets, especially in the CAC region.

Kazakhstan became the main exporter of the wheat and wheat flour products not only at traditional markets, such as the CAC and the post-soviet union countries, but to new markets such as Afghanistan and Iran.

Consequently, the production of the agricultural products in Kazakhstan achieved new levels. The total agricultural output value, observed in Figure 2.1, has been increasing since 2000 and reached 2.28 trillion Tenges in 2011, in which the crop production held a significant part. In turn, the grain production has been growing, as well and its production value raised from 0.11 trillion Tenges in 2000 to 0.78 trillion Tenges in 2011. Hence, it was increased by 601%. The share of the grain production value varied from 25% to 35% in the total agricultural output value. Therefore, the production and export of wheat and wheat flour in the grain sector became one of the leading segments of agriculture, heavily subsidized by the Kazakh government.

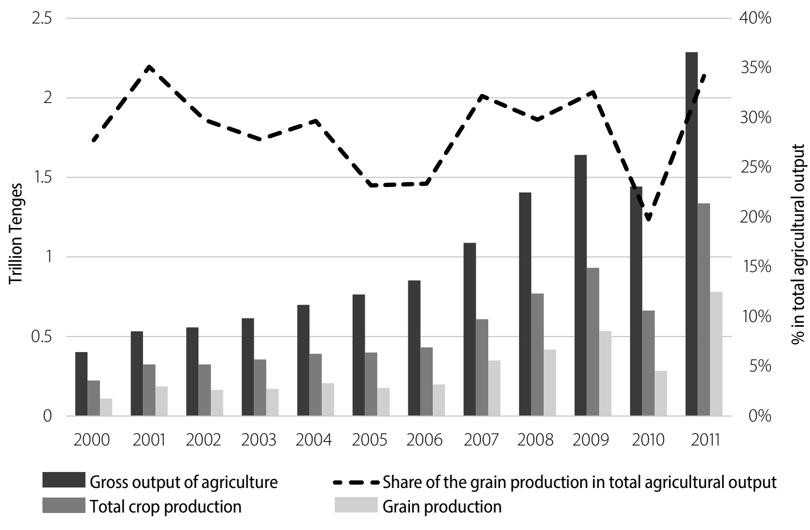

Figure 2.1: Total agricultural and grain output value

Source: Own illustration based on annual data published by CSMNERK (a [2012: 21, 2009: 26, 2005: 21])

The growth in production sector also influenced the structure of the grain producers. During the Soviet period all the agricultural enterprises have been owned and managed by the government. For the transition period in 1990’s and afterwards, some of the state agricultural enterprises from Soviet times were privatized which resulted in formation of new private agricultural entities. Nowadays, there exist three main types of producers operating on the Kazakh agricultural market: agricultural enterprises, individual farms, and households. Some of the enterprises are part of the large agroholdings, controlling considerable financial and capital resources, and even able to dominate the market. Few of them are integrated vertically and horizontally at every stage of the grain supply chain and are presented in production, processing, export, and bakery sectors, as well (Wandel, 2009). Individual farms mainly represent the small and medium scale farms mainly operating in production sector. Agricultural enterprises and individual farms produce around 20–30% each of the total agricultural value (see Figure 2.2). However, the major part, up to 55%, is still produced by the households. They mainly reflect the self-sustainable small farms, characterized by production inefficiency and labour intensity.

Despite the high rate of the development in agriculture, the employment has been diminishing over the decade. According to the statistical agency of Kazakhstan, employment decreased from 9% in 2000 to 3%[1] in 2011, whereas the total employment was increasing annually. The reasons behind this tendency can be the lower growth rate of the agricultural sector compared to the other sectors, or also the modernization within the agriculture that facilitated switching from labour to capital intensive farming. Overall 119,000 people were employed in agriculture in 2011.

In regard to agricultural wages, they grew from average 5,657 Tenges in 2000 to 44,986 Tenges in 2011. However, the average salary also increased for all the sectors in Kazakhstan amounting 90,028 Tenges in 2011. Hence, the average salary in agriculture constituted approximately

1 As it can be seen from the data and graph, the employment in agriculture is around 3%. However, according to the OECD 2013 report, employment in agriculture is around 26% (OECD 2013, p. 69 Figure 1.5, p. 70). The difference can be due to discrepancy in the definition of the employment.

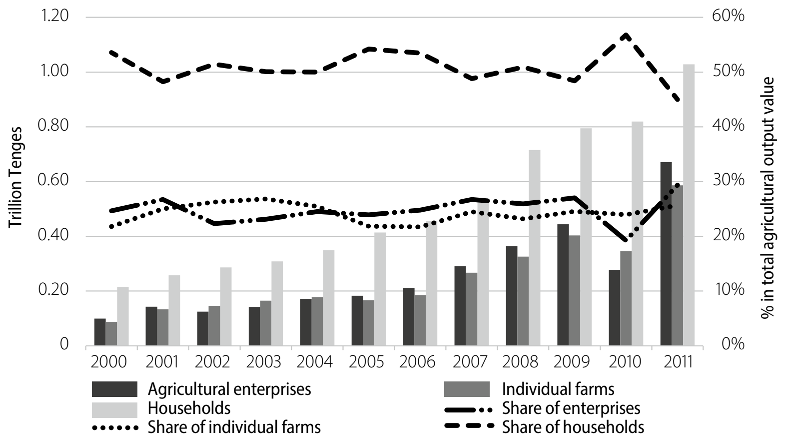

Figure 2.2: Agricultural output value by farm types

Source: Own illustration based on annual data published by CSMNERK (a [2012: 20, 2009: 25, 2005: 19])

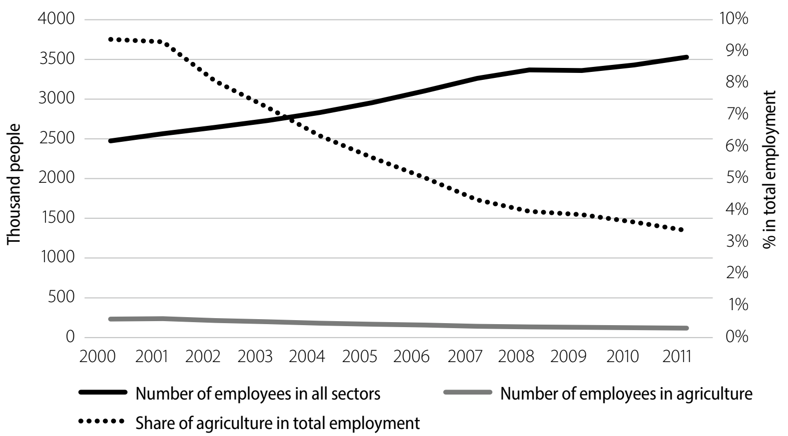

Figure 2.3: Employment in agricultural sector

Source: Own illustration based on annual data published by CSMNERK (k [2012: 131, 2009: 205, 2000–2003])

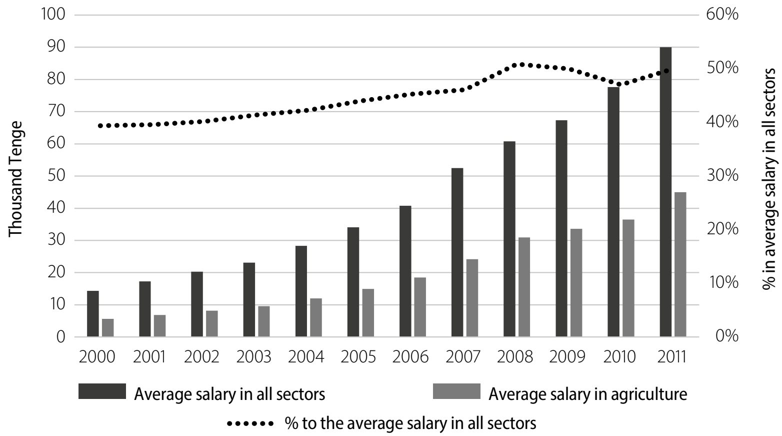

Figure 2.4: Wages in agricultural sector

Source: Own illustration based on annual data published by CSMNERK (k [2012: 127])

half of the average salary in the country and can be considered as low paid, compared to the national level.

In summary, the production in agriculture has been increasing annually from 2000 and has enlarged by 470% by 2011. Grain production, in line with overall agriculture, grew and comprises approximately 30% of the total agricultural output value. The production sector is represented mainly by three main types of producers: agricultural enterprises, individual farms and households. It employs 3% of the total labour and average salary in the sector amounts only half of the average salary in Kazakhstan.

2.1.1 Grain production

Kazakhstan's economy began to recover from the crisis after the 1990's and the grain sector, in line with the agricultural sector, started to attract investments, as well. The growing tendencies could be observed in many

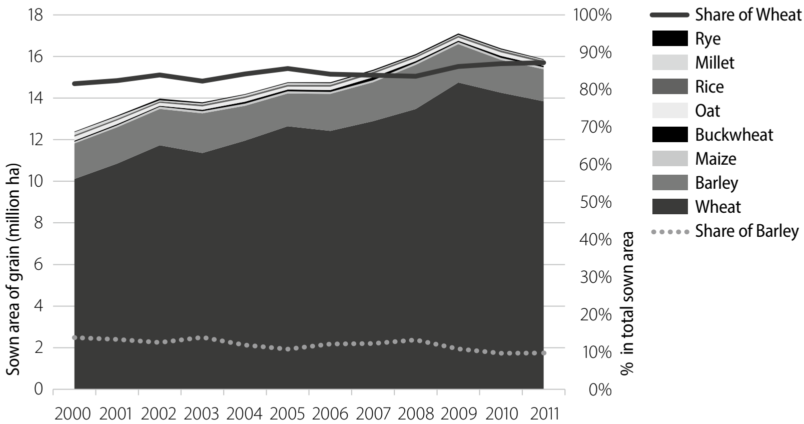

Figure 2.5: Grain sown area

Source: Own illustration based on annual data published by CSMNERK (a [2012: 57–61, 2007: 59–63, 2005:149–153])

areas, such as the total grain sown area, production, processing, and exports. Notable expansion occurred in the wheat production which became the strategic sector of the country. As a result, nowadays wheat and wheat flour products are exported to the CAC and other international markets. Yet, the sector still suffers from inefficiencies in production, and underdeveloped transportation infrastructure.

Nowadays, eight different crops are produced in the country that is: wheat, barley, maize, oat, millet, rye, rice, and buckwheat. Figure 2.5 depicts the development of the sown land area for eight types of grain produced in Kazakhstan for 2000–2011. The sown area has been increasing over the decade, reflecting the positive development and increasing investments in the sector. Many factors, such as government support programs, world wheat and wheat flour product prices, and the land resource availability greatly contributed to the progress. Consequently, by 2011 the sown area reached 15.9 million ha, despite being far below the 1990 level.

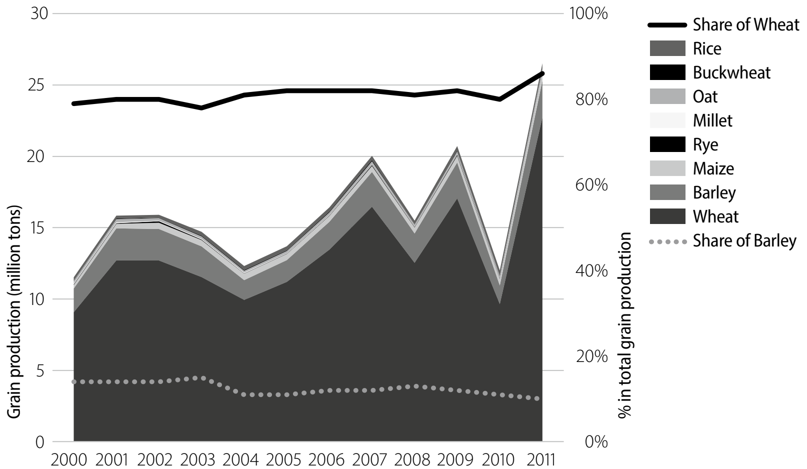

Figure 2.6: Grain production by types

Source: Own illustration based on annual data published by CSMNERK (a [2012: 107–111, 2009: 99–103, 2005: 188–194])

In line with the sown area the grain production has been increasing as well, and it has amounted to the record of 26.5 million tons in 2011. Compare to 2000 the increase has been up to 130%, however, due to non-stable yields it has been fluctuating and in 2004, 2008 and 2010 has dropped to 12.3, 15.5 and 12.0 million tons respectively as it is shown on Figure 2.6 Nevertheless, overall, for the time period 2000–2011, the production had increasing tendency and the sector was growing. Such an expansion stimulated the grain processing and export industries, as well, providing opportunities to enter new markets and get integrated in the world market. Along with focusing on international markets large scale producers started to invest at the local level as well as bringing new technologies for the production which, ultimately, resulted in formation of the grain cluster in northern regions of Kazakhstan.

Production is particularly notable in the wheat sector as it has become the most produced and exported grain from Kazakhstan. Evident

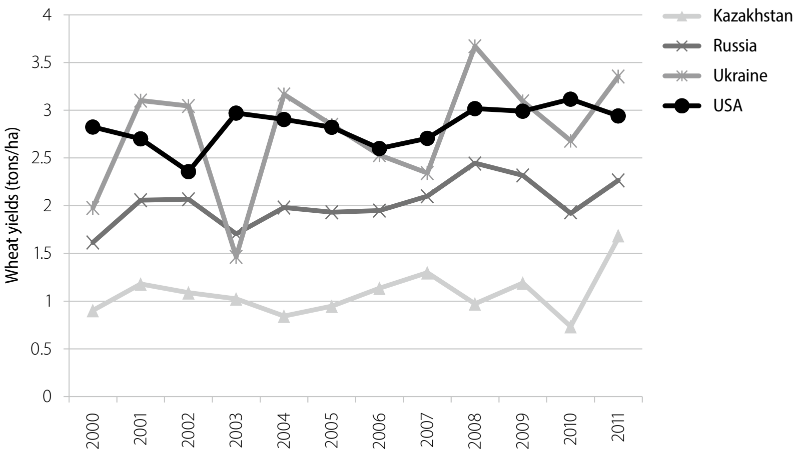

Figure 2.7: Wheat yields by selected countries

Source: Own illustration based on the data published by the FAO

from Figure 2.6, within the structure of the grain production, wheat is the dominant grain, on average, comprising 85.7% of the total grain production. The second most produced grain is barley (9.7%) followed by maize (1.3%) and rice (1.8%), respectively; the rest of the grains constitute less than 1%.

Despite the positive trends, inefficient technologies for the grain production remain one of the major problems. Wheat yields in Kazakhstan clearly outline the deficiency in grain production technologies. According to the FAO statistics, depicted in Figure 2.7, average yield for the period 2000–2011 has been reported 1.08 tons/ha, which is lower than yields in other post-Soviet Union countries, such as Russia (2.03 tons/ha) and Ukraine (2.77 tons/ha); and certainly it is far lower compared to the U.S. (2.82 tons/ha). Low yields in the grain production can be observed from Figure 2.5 and Figure 2.6, where the annual increasing trend of sown area does not, necessarily, lead to the increase in production. The main factors influencing yield are the low level of fertilizer use, weather dependency, old machinery, and losses in the production. Exception is the northern part of Kazakhstan where the grain cluster is developed with the enterprises applying modern technologies. The rest of the grain producers do not have access to the finance and necessary information critical for efficient production.

Grains are produced in different regions according to the climate conditions of the country. Wheat, for example, is grown in every region of Kazakhstan, but significant part of it originates in the northern part of Kazakhstan. In Figure 2.8, three largest grain producers are Akmola, North Kazakhstan and Kostanay regions, and the tendency does not change over the sampled years. For 2011, 25%, 28%, and 30% of the total grain production were produced in these regions overall accounting for 83% of the grain production. Since 2000, these shares have increased by 3%, 6% and 5%. It should be noted that these regions are the leaders in wheat production. In 2011, Akmola, Kostanay and North Kazakhstan regions produced 6,05 (27%), 7,34 (32%) and 6,57 (29%) million tons of wheat respectively given the total 22,73 million tons of wheat production. Regarding the other grains, barley is also produced in most regions of Kazakhstan, and the major producers of this grain are also located in the northern regions of the country. In 2011 North Kazakhstan produced (34%), Akmola (18%), and Kostanay (15%), and Almaty (12%) of barley. As for rice, it is produced only in three regions and Kyzylorda is the primary producer with 84% of the total rice; the other two regions are Almaty (13%) and South Kazakhstan (3%), respectively. Maize, just like the rice, is also cultivated mainly in three regions: in Almaty (71%), South Kazakhstan (18%) and Jambyl (11%). Oat is produced in most of the regions with North Kazakhstan (35%), Kostanay (33%) and in Akmola (15%). As for buckwheat, East Kazakhstan produces about 50%, Pavlodar (24%) and Kostanay (12%) of the total. The main millet producers are Kostanay (50%) and Pavlodar (15%); the rest of it originates in other regions. Rye is mainly produced in two regions, i.e. Kostanay (71%) and Western Kazakhstan (22%).

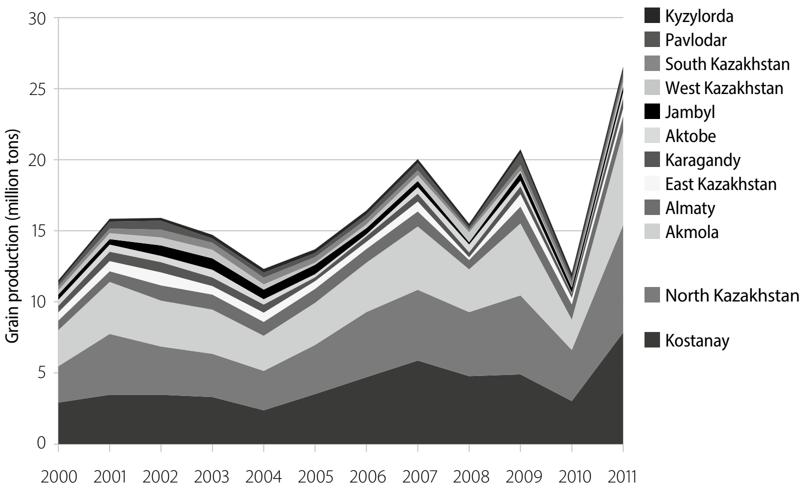

Figure 2.8: Grain production by regions

Source: Own illustration based on annual data published by CSMNERK (a [2012: 107–111, 2009: 99–103, 2003: 129–134])

Figure 2.8 elicits the years 2004, 2008 and 2010 characterized by the low level of grain production in every region of Kazakhstan, regardless of their location. Consequently, the influence of the weather on grain production can be strongly argued, especially in 2010, when the drought substantially reduced the harvest. However, the mandatory crop insurance policy, implemented and supported by the government, could partly compensate the loss for the grain producers.

The regional grain production is also important in the rural development. Various government programs are implemented in the regions to support the rural population. One example is micro loans for the low-income rural people with no access to financial sources. The program is financed and applied by the FFSA via microcredit organizations for crop-growing livestock production (OECD, 2013, p. 143).

In summary, the grain production sector recovered after the 1990's crisis and started to grow annually from 2000. The progress is reflected in an increase of the sown area and the production volumes. However, the main challenges remain with respect to the inefficiency in production technology leading to low yields, high transaction costs related to underdeveloped supply chain and infrastructure, and government interventions, such as the export ban in 2008. The production of the grain is heterogeneous, yet in some cases, several regions amass clusters producing one particular type of grain. Wheat, the most cultivated grain in the country, is primarily produced in three regions of the northern part of Kazakhstan: North Kazakhstan, Akmola, and Kostanay. The other grains are produced in various regions, mainly, for the local market.

2.1.2 Pricing and price volatility on grain markets

The world grain market prices have been volatile for the last decade. The world price fluctuations created instability. Kazakhstan, as one of the main grain exporters strongly linked to the world prices, was significantly influenced by the developments, as well. Increasing world grain prices provided incentives to invest in Kazakh grain production, especially, after 2000. However, high prices have been concerning the Kazakh government to stabilize the food prices, such as wheat bread, which is a socially important staple food. Therefore, price regulations were a common practice and state corporations were actively involved in it. Increasing world grain prices encouraged the Kazakh government to apply more intervention policies and secure the local grain market. Despite the government-supporting programs providing farmers with various input subsidies for the cost reduction, in some cases, government involvement intending to stabilize prices on the market, distorted competitive functioning of the market causing counter effects. Pomfret (2007) analyzes price distortions on the Kazakh wheat market in 2000–2004, comparing it to undistorted market during 1990's when farmers, in some cases, even had to deal with monopsonistic buyers for their agricultural products. The focus of the study is the analysis and estimation of the difference between farm-gate and border (reference) prices, caused by the high trade costs. Oskenbayev and Turabayev (2014) report asymmetric price developments in the Kazakh grain chain, as the consequence of government intervention in 2008 on the local market with the goal to stabilize wheat and wheat flour prices. Additionally, Kazakhstan is a landlocked country with underdeveloped infrastructure. This increases transaction costs for the grain production and export and creates additional barriers for stronger integration with the world grain market.

Figure 2.9 represents the average price development for eight grains on Kazakhstan grain market at a national level. The prices are following the parallel pattern over the sampled timeframe. However, a spike in the wheat price occurred in 2008 when Kazakhstan, in line with Ukraine and

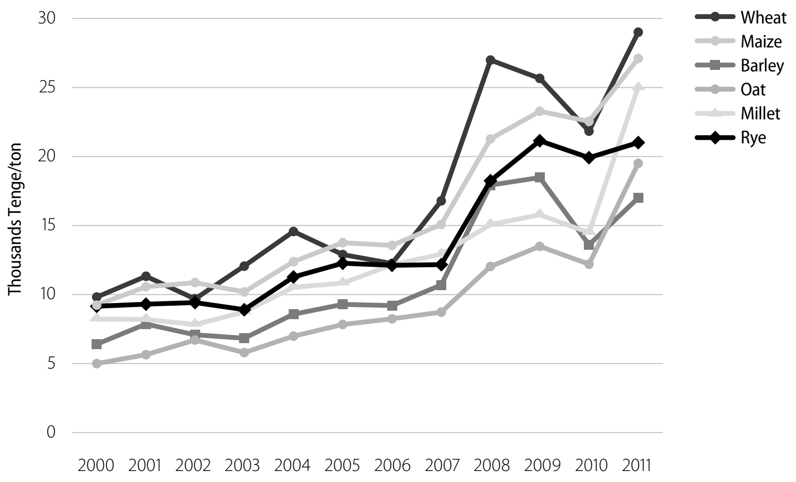

Figure 2.9: Annual average grain prices

Source: Own illustration based on annual data published by CSMNERK (d [2012: 35, 2008: 18])

Russia in 2008, introduced the ban on wheat export. The goal of the intervention was to stabilize the Kazakh wheat market, and thus, halt increase of the world wheat market prices. Nevertheless, the restrictions were not successful and the local wheat price still rose. Similarly, the world wheat price volatility was observed in 2010. However, this time Kazakhstan, unlike Russia and Ukraine, refrained to impose the ban even though the harvested amount of the wheat was significantly low due to the drought. Strikingly, the ban practice was still applied by the Kazakh government to other grains, such as buckwheat in 2010 that lasted six months (OECD, 2013, p. 175).

To analyze more closely the price developments during the ban period, the Kazakh wheat price is compared to the world prices. The reason for doing so is that the wheat is the main exporting commodity for Kazakhstan and as an important player on the world wheat market, local and export prices under unregulated conditions are strongly integrated.

Figure 2.10 depicts the wheat price development on Kazakh and world wheat markets, such as US (Gulf), EU (France), Russia and Ukraine during 2007–2011. The Kazakh wheat price, reflecting the effect of the government interventions, exceeded even the US Gulf price in 2008. Oshakbaev (2012, p. 53) explains it by the ban effect on Kazakhstan local market, having counter consequence instead of preserving the local prices from the impact of world market spikes. Intuitively, the significant part of the wheat, which was to be exported and remained on the local market, should have had the damping effect on the local prices, yet it had reverse effect. Possible causes are internal factors, since the external ones could not influence Kazakh markets due to the export ban. Two of the most influential determinants that can be emphasized are expectation and/or storage factors. With the expectations that the ban would be lifted, the suppliers managed to store their products and wait for the cancelation, instead of marketing them under unprofitable conditions. Consequently, it created shortage on the local wheat market pushing the prices further up.

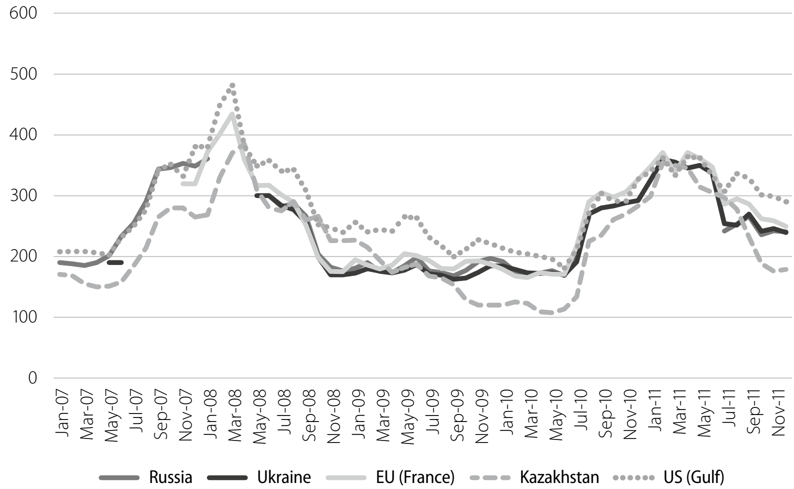

Figure 2.10: Development of international wheat prices

Source: Own illustration based on the data published by FAOSTAT

The prices of the grains vary on the regional level as well due to the weather and soil conditions. In this respect, favorable conditions for grain production are in the North region. There the grain sector is well developed and involved in the international trade. Correspondingly, the largest grain traders are found in these regions with well integrated prices with the world market prices. In the marginal grain production areas, such as oil and gas producing Mangystau region, the prices are influenced by other factors and determined by a few players operating on the market. Additionally, the underdeveloped infrastructure and its associated logistic problems can also influence the regional integration. According to the OECD (2013, p. 21) report, the infrastructural inefficiencies result in increased transactional costs for the grain producers.

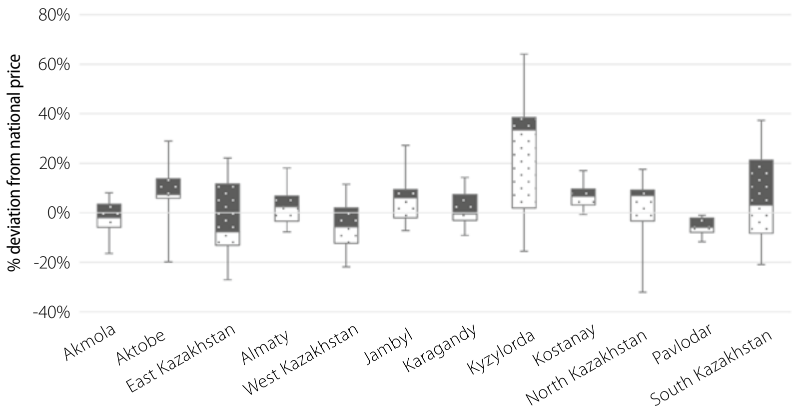

Figure 2.11: Relative producer prices of wheat by regions

Source: Own illustration based on the data published by CSMNERK (d [2012: 130; 2008: 119])

Figure 2.11 depicts the regional wheat price disparities for every region in Kazakhstan. The box plots show the regional price variations relative to national prices between 2000 and 2011. The price differences are calculated as a percentage deviation of a regional wheat price from the national price. Prices in regions like North Kazakhstan, Akmola, and Kostanay, which represent wheat clusters and are more strongly integrated to the national and world prices, fluctuate within a range of 20%. Conversely, Kyzylorda, where the wheat sector is underdeveloped, the local prices can be 64% higher than the national price.

The price developments are also analyzed along the wheat supply chain. In particular, margins along the various stages of the grain supply chain are assessed. Figure 2.12 describes average price developments between wheat, wheat flour, and wheat bread during 2000–2011. Until 2008 the prices follow the parallel pattern, however, the spikes are observed in 2008. During the same year, the Kazakh government introduced the wheat export ban that lasted for five months and, accordingly, influenced the whole supply chain as the prices wheat, wheat flour, and

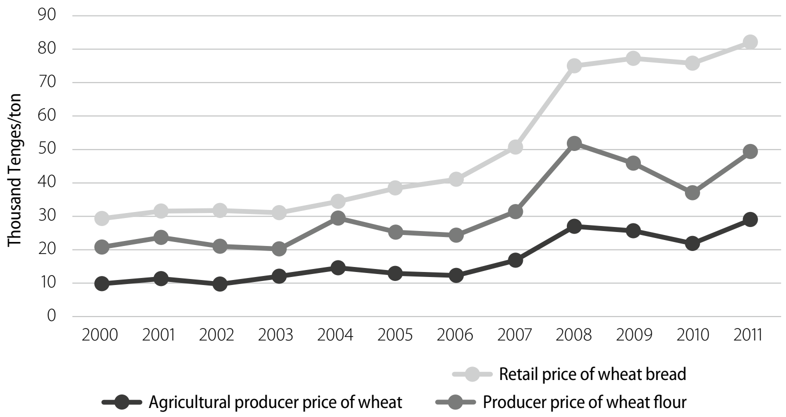

Figure 2.12: Average price development in grain supply chain

Source: Own illustration based on annual data published by CSMNERK (d [2012: 35, 2008: 18]; e [2012: 203, 207, 2008: 45])

wheat bread increased in this period. After lifting the ban, when export markets opened again, only wheat and wheat flour prices declined. Strikingly, the bread prices were maintained high, in contrast to the initial goal of government to ensure food price stability by introducing the wheat export ban.

Overall, the analysis shows that the grain prices in Kazakhstan differ across regions. Various factors may affect the price formation at domestic markets, including world grain prices, underdeveloped infrastructure, high transaction costs, weather conditions, government regulations and the grain production level. The wheat supply chain analysis and the local and world market price comparison indicate that the government intervention in 2008 had counter effects on the Kazakh wheat market. Predominantly, the prices increased during the export ban and declined after the cancelation of this ban for wheat and wheat flour products. Nevertheless, the mark-up did not decrease for the wheat bread even in the following years.

2.1.3 Structure of agricultural production sector

After the breakdown of the centrally regulated system, many new market actors have entered the Kazakh grain market. Privatization of the agricultural entities facilitated to creation of new privately-owned grain producers. Consequently, three main types of the producers emerged on the Kazakh grain market: agricultural enterprises, individual farms and households, varying according to the size and the market share, organization structure, ownership complexity and the degree of integrity in the supply chain.

During 2000–2003, 2004–2007 and 2008–2011 the total average grain production of Kazakhstan was 14.6, 15.7 and 18.9 million tons, respectively. Agricultural enterprises are the major grain producers in Kazakhstan (Figure 2.13) accounting for more than half of the total grain production. Individual farms produce roughly third, and households are responsible for less than 1% of total grain production.

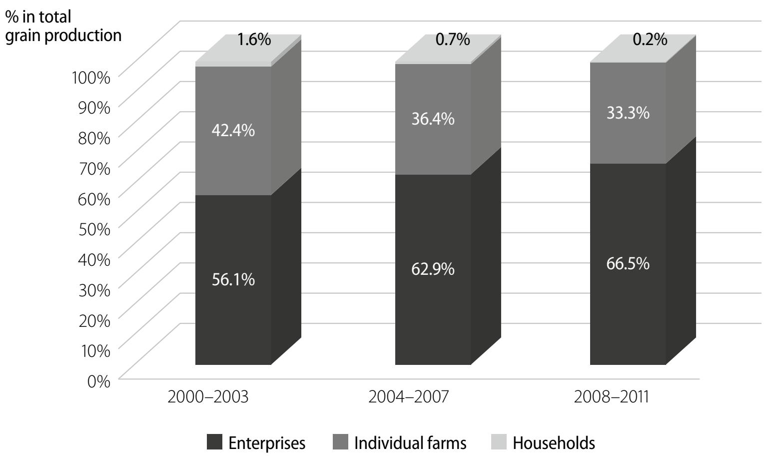

Figure 2.13: Average grain production by producer types

Source: Own illustration based on annual data published CSMNERK (a [2012: 106, 2009: 98; 2003: 129])

Furthermore, the agricultural enterprises increased their share by 10% in the total grain production over the last decade. This trend for enterprises can be explained by the increase in sown area from average 8.48 in 2000–2003 to 10.79 million ha (27%) in 2008–2011 (Figure 2.14). The similar tendency is observed for individual farms. Increase of the average sown area by individual farms amounted to 5.76 million ha in 2011 that represent 20% of total grain sown area. However, the growth rate of individual farms lags behind that of the enterprises, due to their limited access to financial resourses, new technology, machinery, and inefficient land market. Concerning the households, most of them represent inefficient yet self sufficient entities. Their production patterns are characterized by diminishing tendency. Overall, the total grain sown area increased from 12.44 million ha in 2000 to 16.22 million ha in 2011.

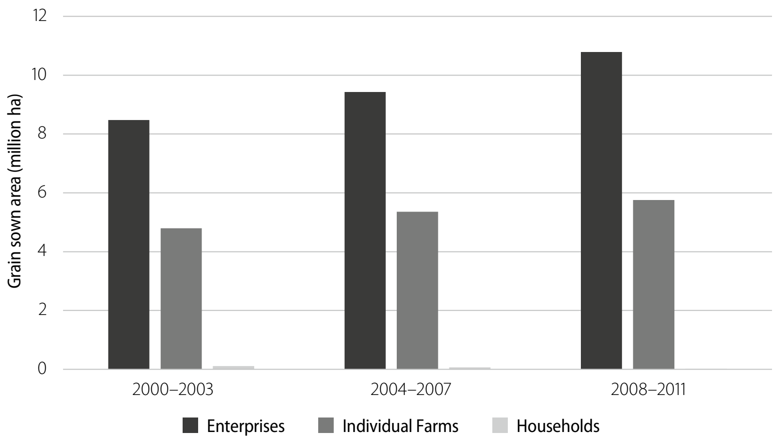

Figure 2.14: Average grain sown area by producer types

Source: Own illustration based on annual data published CSMNERK (a [2012: 54, 2008: 65; 2005: 147])

The structure of the size of grain producers varies by types. The enterprises own larger sizes of the arable lands compared to the individual farms. Figure 2.15 illustrates the structure of the crop producers regarding the size of the sown area in 2007. These data are not available for grain producers, however, as the grain sown area represented around 81% in the total crop production in 2007, the sample can be considered representative. Accordingly, analysing the structure of the crop sown area, the largest share of the sown area is controlled by the enterprises running 500–10,000 ha of land respresenting 42% of the all enterprises. The other significant proportion of the total 56.4% of land is utilized by producers with area from10,000–20,000 ha and over 20,000 ha, even though in number they constitute only 7.7%.

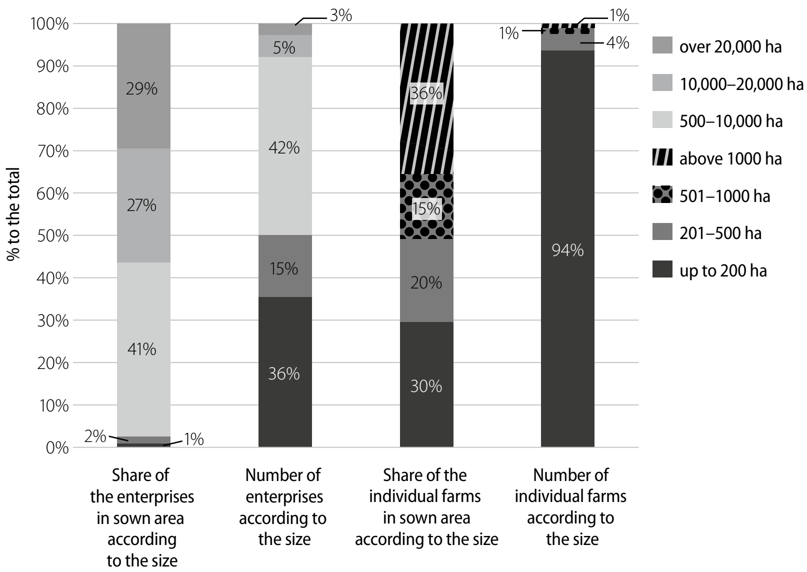

Figure 2.15: Crop sown area of agricultural enterprises and individual farms by size (2007)

Source: Own illustration based on annual data published by CSMNERK (a [2008: 59])

In regards to the individual farms, 93.7% of them own area up to 200 ha, which represents 29.6% of the total sown area. In contrast, 1% of them cultivate 35.5% of total sown area with land plots over 1,000 ha. Therefore, individual farms own arable land in smaller sizes compared to the enterprises.

To summarize, 50% of the grain enterprises use the land of less than 500 ha, representing only 2.0% of the total sown area. The other 50% of agricultural enterprises cultivate almost 98% of the total sown area with the size of more than 500 ha. In case of individual farms, 97.6% of the producers with land size up to 500 ha account for 50% of the total sown area. The other 50% is operated by the residual 2.4% with land sizes of 500 ha or more.

2.2 GRAIN PROCESSING INDUSTRY

2.2.1 Structural change in grain processing and animal feed industries

The increasing prices for wheat and wheat products on the world market, government interventions (subsidies, access to financial sources), modernization of production technology, favorable climate conditions, and soil availability for wheat production, facilitated a sharp development of the wheat flour production sector. As Figure 2.16 shows, in 2011 the total wheat flour production in Kazakhstan reached 3.85 million tons, which is almost the double of the level of 1.96 million tons in 1990 and 2.5 times the level of 1.6 million tons in 1995. Nevertheless, the transition period from a planned to free market economy significantly distorted the sector. The drastic fall in the grain production during 1990's led to a sharp downfall of the output of grain processors, as well.

Figure 2.16 portrays the output of flour products produced in Kazakhstan since 1995: "cereal crops and plant flour; finely ground mixtures"

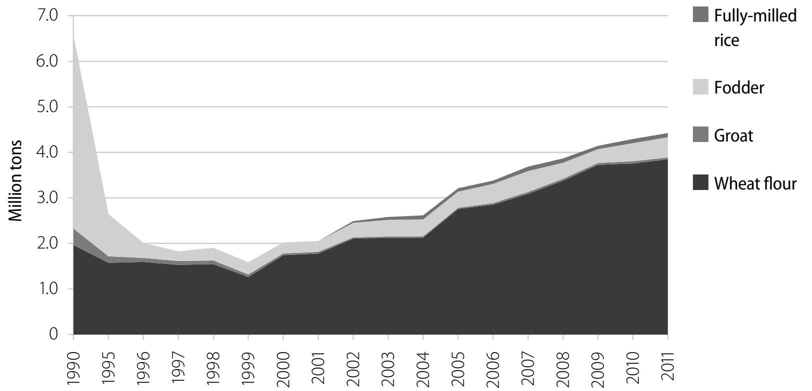

Figure 2.16: Annual output of the grain processing industry in Kazakhstan

Source: Own illustration based on annual data published by CSMNERK
(b [2002: 75–76; 2006: 99, 2008: 95–96, 2012: 82–86])

(NACE 10.61.2), where the major component is "wheat flour" and "groats, whole meal flour and pellets and other crops of cereals" (NACE 10.61.3). The other important types of the commodities are the fodder (NACE 10.9) for livestock production, and fully processed rice (NACE 10.61.12) for human consumption. Also, after 2000's processors started to produce maize oil with moderate quantity and based on the improved capital-intensive technologies, they were able to produce any type of products that can be received after grain processing. In the econometric analysis these products are not incorporated though due to the low production quantities. Nevertheless, wheat flour is the most produced commodity in Kazakhstan as it comprises around 65% of the total grain processing products. The main determinant for such a high share is the fact that wheat flour bread is the staple food in Kazakhstan. Another important aspect is the export; the export destinations of wheat flour have been extended from the neighbour countries, such as CAC countries, to Caucasian and other CIS countries, Iran, Afghanistan, and United Arab Emirates. According to the OECD (2013: 210) report, during 2011/2012 half of wheat exports were supplied as raw grain and the rest as wheat flour. Therefore, due to high export potential, wheat and wheat flour gained a strategic importance within agricultural sector in Kazakhstan.

The expansion of wheat export and wheat processing industries resulted in growing investments in the sector. Many companies entered the market and the number of processors started to increase. However, according to the "Business Media Group" report (2011), a consolidation process is notable on the grain processing market in recent years. The companies merge, and small players leave the market: According to the statistical data provided by Information and Computing Centre of the Agency of the Republic of Kazakhstan on Statistics (ICCARKS), the number of the processors decreased from 438 in 2005 to 301 by end of 2011, while the production of the wheat flour expanded significantly. This indicates that the remaining smaller number of entities control larger shares of the market, leading to a high concentration level. Figure 2.17 shows that the number of grain processors was increasing until 2005, followed by a sharp decline between 2006 and 2008, and that stabilized afterwards.

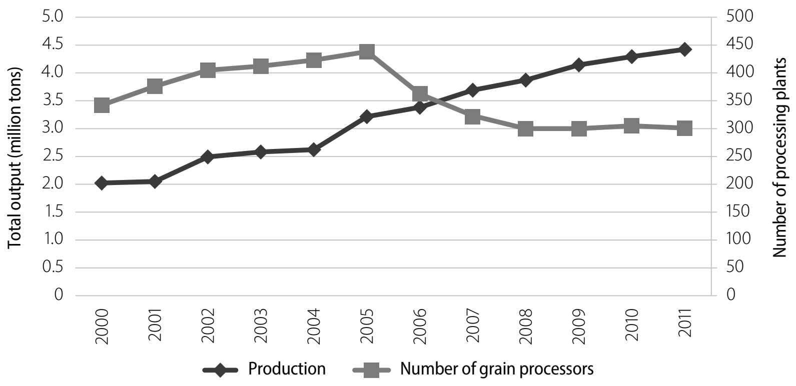

Figure 2.17: Annual output in grain processing industry and number of processing plants

Source: Own illustration based on data received from ICCARKS and annual data published by CSMNERK (b [2002: 75–76; 2006: 99, 2008: 95–96, 2012: 82–86])

As a further step, Herfindahl–Hirschman Index (HHI), characterizing the degree of market concentration, is calculated. However, there is no official data on the market or industry concentration. Assuming all the processing plants (firms) in industry have equal market shares, the index is calculated as follows: $H^*=1/N$, where N is the number of processing plants. H^* is calculated for 2000–2011, varying between 0.0029 and 0.0033. According to the Classification of the U.S. Department of Justice and the Federal Trade Commission for HHI scale, the Kazakh grain processing industry is identified as low concentrated industry.[2]

However, evaluating the number of grain processing plants against (Figure 2.17) the number of agricultural producers (agricultural enterprises and individual farms, Figure 2.15) implies that differences between these two numbers are large. For example, there were 323 grain processing plants and 161,962 agricultural producers in Kazakhstan in 2007. Respectively, the market structure in the Kazakh grain processing industry is more likely to be oligopsonistic.

For a more detailed understanding of the concentration in the processing industry, processors are analyzed both at the regional level and geographical areas. The number of the processors in Kazakhstan declined since 2005 in 8 out of 14 regions, remained unchanged in 3 regions, and increased after 2011 only in 3 regions (ICCARKS). In the regions Aktobe, West Kazakhstan, Atyrau, Jambyl, Kyzylorda, and Mangystau, the number of processors did not exceed 7 in 2011, whereas in Akmola, Almaty, Karaganda, Kostanay, South Kazakhstan, and East Kazakhstan there were 30 or more processors. At the regional level, the HHI ranges between 0.011 and 1.000, suggesting that the sector is highly concentrated in some regions such as, for example, Atyrau.[3] Hence, it is more likely that the grain suppliers located in the regions with few processors are price discriminated by the processors.

2 The U.S. Department of Justice and the Federal Trade Commission classify markets (industries) into three types: (1) HHI below 0.15 indicates low concentration, (2) HHI between 0.15 and 0.25 – moderately concentrated markets, and (3) HHI above 0.25 indicates highly concentrated markets.

3 For the detailed data and HHI regarding the number of processors on the regional level see Table A2.1 and Table A2.2 in appendix.

In regards to the geographical areas, the number of regional processors are aggregated in the North, South, East, and West samples, and analyzed in a similar manner as described above. Starting from 2000, the number of processors increased in North, South, and East geographically by 2005. However, afterwards it started to decline and by 2011 it was below the level of 2000. An opposite trend was observed for the West; the number of processors declined from 2000 to 2005 and afterwards increased till 2011. Overall the number of enterprises decreased in all four geographical areas by 2011, compared to the level of 2000. Similar to the national level, the HHI indicates the low level of concentration in all geographical areas during 2000–2011.[4]

In conclusion, the grain processing industry went through difficulties after the breakdown of the planned economy. Nevertheless, the sector did come out of the crisis, improved the performance after 2000's and, nowadays, wheat flour export is the milestone of the grain processing sector in Kazakhstan. Wheat flour industry is developed around the wheat production cluster in the northern part of the country and in Southern-Kazakhstan region where the spring wheat is traditionally produced. Yet, the concentration process is observed on the market. The number of the players on the wheat processing market is diminishing, while the sector output is growing. According to the HHI estimates, the concentration in the sector is low.

2.2.2 Grain supply chain

Most of the grain processed in the Kazakh grain processing industry is produced by the local grain producers. According to the statistics of the grain balance statement (CSMNERK [a [2003: 74, 2006: 62, 2008: 192, 2012: 212]]) during 2000–2011, on average, 64.1 thousand tons of the grain was imported annually in the country, whereas 16.4 million tons

4 For the detailed data and HHI regarding the number of processors according to the geographical area see Table A2.3 and Table A2.4 in appendix.

was produced locally. The producers vary in many aspects, which determine their position in the grain supply chain. One of the influencing factors is the size. According to the OECD (2013, p. 207–209) classification described in Figure 2.18, small producers (SP) control arable lands up to 3,000 ha. They mainly deliver grain to the small mills (SM) either directly or via small local traders (SLT) with turnover from 5,000 to 30,000 tons. On the contrary, the large producers (LP), operating over 20,000 ha and in many cases having direct contacts overseas, export the grain themselves or via international traders with turnover over 80,000 tons. In some cases, they supply grain to the large mills (LM) or own them, also. As for the medium sized producers (MP), while controlling arable lands from 5,000 to 20,000 ha, they supply grain to the SMs or LMs directly or export overseas by themselves and via large local traders (LLT) generating 30,000–80,000 tons.

The grain producers market their products through various distribution channels. Nevertheless, as described in Figure 2.19, the main grain purchasing industries can be outlined in the following way:
1. Feeding; 2. Seeding; 3. Processing; 4. Export; 5. Other–comprising personal consumption of grain in the country, industrial use and waste. The trade is, mainly, organized by the intermediate players, such as elevators and the local traders as described above. A part of the grain is exported overseas directly or supplied to the local market.

On the local market, the grain is further processed for food consumption by the processing industry and supplied as wheat flour or groats, primarily, to the bakery industry. The processors sell the flour products locally or export them overseas. A part of the grain is supplied to the livestock producers for feeding or used for seeding, as well. The rest of the grain is used for various purposes, such as, industrial use, or it also combines the grain directly sold to consumers via retailers and the amount of grain wasted while producing it.

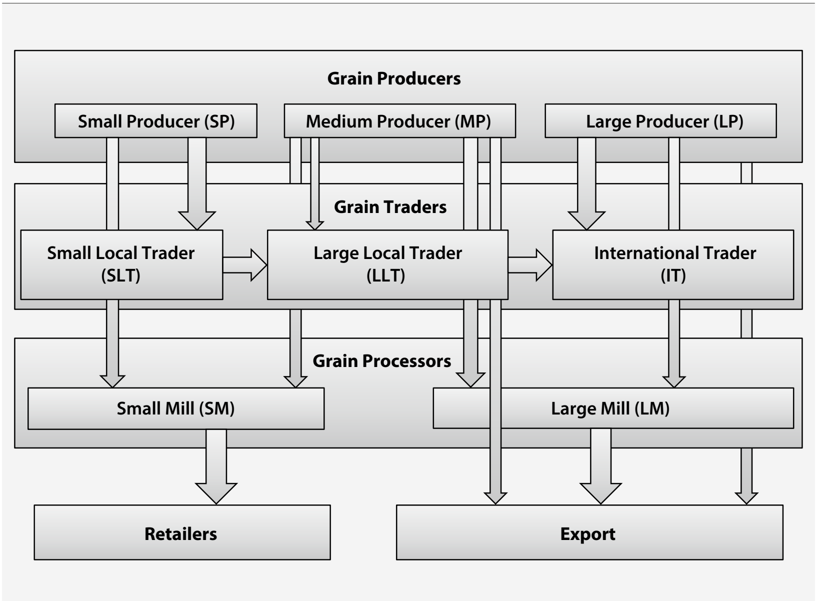

Figure 2.18: Grain supply chain structure

Source: Own representation based on the OECD (2013, p. 209)

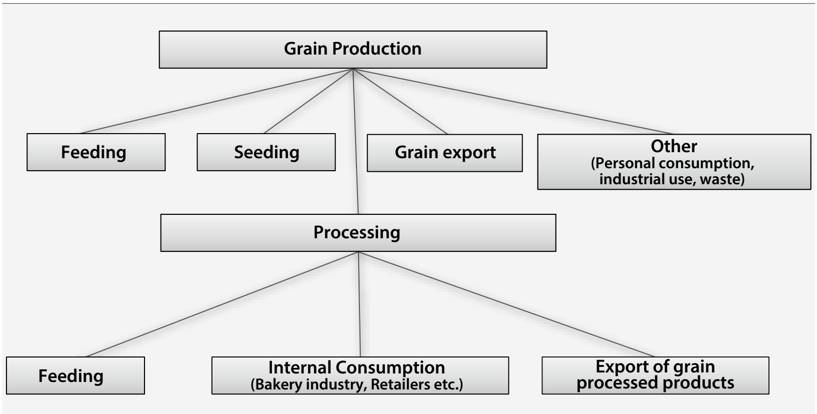

Figure 2.19: Grain distribution channels

Source: Own illustration based on annual data published by CSMNERK (a [2003: 74, 2006: 62, 2008: 192, 2012: 212])

To have a clearer understanding of the grain distribution within the channels, the respective statistics need to be analyzed. Figure 2.20 describes the grain flow within the channels and their shares with respect to the total grain utilization. During 2000–2011, on average, feeding and processing industries acquired 22% and 26% respectively of the total grain utilized in the country. The 29% was exported overseas, and 15% and 9% were used for seeding and other purposes correspondingly. The share of the grain export was reduced by almost 8% over the last decade, given that the grain production was increasing annually. The main determinant of the process was the country's increased production and export of the grain processed products, such as the wheat flour. Figure 2.20 reveals the share of the grain processing increased by 5% over the decade. Hence, more suppliers deliver their grain to the processing industry rather than export it.

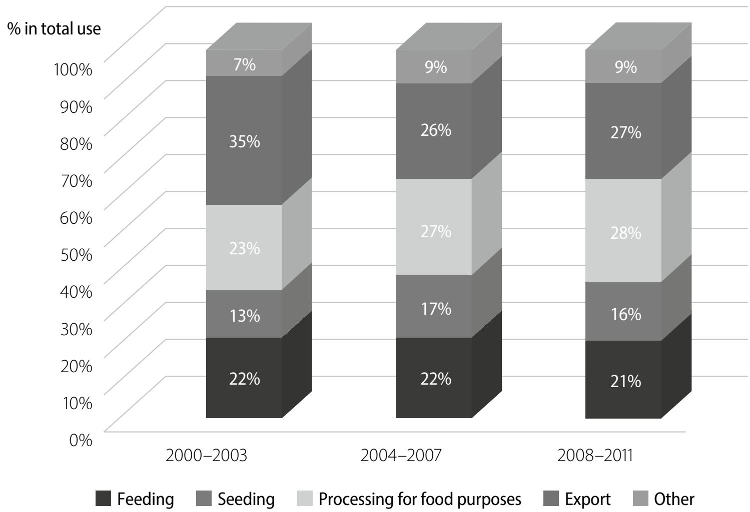

Figure 2.20: Grain distribution within the supply chain

Source: Own illustration based on annual data published by CSMNERK (a [2003: 74, 2006: 62, 2008: 192, 2012: 212])

As the country maintains grain stocks annually, the structure of the grain distribution is analyzed with respect to the grain production, as well. Figure 2.21 depicts the dynamics within the distribution channels. During 2001–2002, 2005–2007, 2009, and 2011, the grain production exceeds its consumption, indicating that the country made buffer grain stocks. In contrast, in 2000, 2003–2004, 2008 and 2010 the utilization of the grain is higher than production, demonstrating the release of the state grain stocks on the market. In this regard, the state-owned FCC had the priority to purchase wheat from farmers for regulating the state stocks and used storage and transportation facilities (OECD, 2013, p. 213).

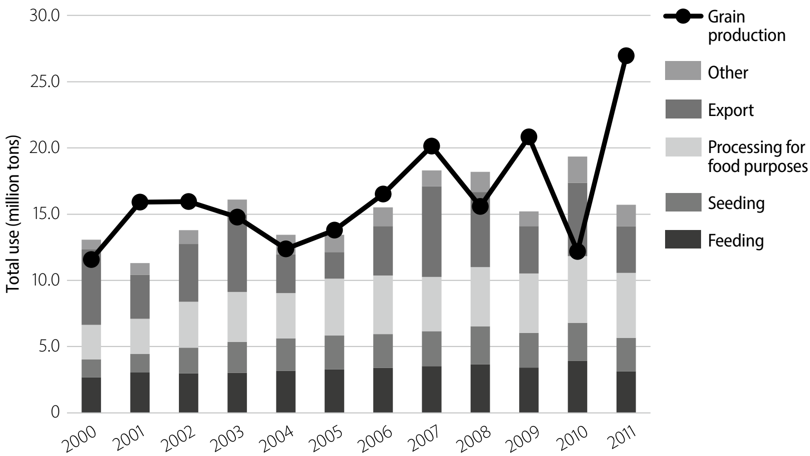

Figure 2.21: Grain distribution in grain production

Source: Own illustration based on annual data, published by CSMNERK (a [2003: 74, 2006: 62, 2008: 192, 2012: 212])

It is also noticeable that in 2008, when the restrictions were imposed due to the bad harvest, the grain export was still surpassed that of 2009 or even 2011 with the record grain harvest. Overall, on average, 25% of the grain production was purchased by the processing industry and 29% exported as raw grain during 2000–2011.

The growing demand, especially, from the CAC and CIS countries, facilitated to gradual growth in the Kazakh grain processing sector. The export of the flour products, such as wheat flour, started expanding since 2000. The dynamics observed in Figure 2.22, explicitly, indicate the role of the export in the distribution of the grain processed products. It increased by 526% from 0.3 million tons in 2000 to 1.9 million tons in 2011, comprising 17% and 48% of the total utilization in the respective years.

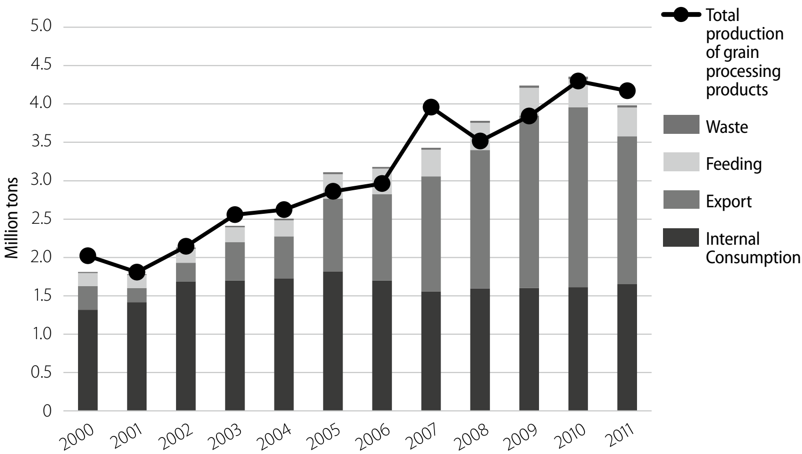

Figure 2.22: Utilization of grain processed products

Source: Own illustration based on annual data published CSMNERK (a [2003: 74, 2005: 62, 2007: 195, 2012: 213])

Conversely, the internal consumption did not change drastically with the increase of 25% from 1.3 million tons in 2000 to 1.6 million tons in 2011. Its share in total use fell from 73% to 41%, respectively, and still remains the main component in the total utilization structure. The production of the grain processed products itself grew annually and rose by 106% from 2.0 million tons in 2000 to 4.2 million tons in 2011. Similar to grain, in some years, the total use of the flour products exceeded its production; hence the state stocks of the flour products were released accordingly.

In summary, the Kazakh wheat flour export significantly increased and expanded to new markets during 2000–2011. Due to the substantial increase in export of wheat flour, the structure of the distribution channels of processing industry has been transformed largely within the export sector. Consequently, the increased demand on the flour products was vertically transmitted downwards through the supply chain to production level and, roughly, the third of the grain production was devoted to the processing industry in 2011. A significant part of the grain production was still either exported directly or distributed via feeding industry channels.

2.2.3 Market concentration and vertical integration

Looking at the increasing tendency of the wheat flour production industry from the regional perspective, evidently, the main contributors to the growth are the regions located close to the northern wheat production cluster of the country. The leading regions in wheat flour production are Kostanay, North Kazakhstan, and Karaganda where 45% of the total wheat flour are produced. The South Kazakhstan region traditionally remains as the major producer of winter wheat and wheat flour. Altogether these four regions comprise 63% of the total wheat flour produced in the country (CSMNERK [b [2012: 82–86]]). The other regions maintain a rather constant level of wheat flour production.

The processing companies operating on the market differ according to size, capacities, ownership and diversification. Some of them belong to so called agroholdings, entities vertically and horizontally integrated within the grain supply chain. They consolidate own grain producing enterprises, elevators, trading and retail companies and some of them are upstream integrated in the bakery industry, as well. Despite vertical integration, a few of these groups even possess financial institutions, such as banks, also transportation companies owning railway wagons and even seaport facilities (OECD, 2013, p.19). Wandel (2009) outlines five large agroholdings operating on Kazakhstan grain market, each one owning capital-intensive processing enterprises with backward integration in the grain production sector. A good example is "Ivolga holding" incorporating grain production, processing and trading enterprises. The holding controls over 1.5 million ha of arable land for agricultural production. Another instance is TOO "Cesna-Astyk" representing every stage of the value added chain in brewery industry. Similarly, Petrick et al. (2012) reports about vertically integrated agroholdings operating in the northern regions (Akmola, Kostanay and North Kazakhstan) and underlines that some of them are part of the business conglomerates engaged in various sectors of the economy. Such an example is "BATT-Grain", part of the "BATT Group", represented in oil, gas, construction, and alcohol sectors. These agents have better access to financial sources, elevators, new production technologies, machinery, transportation means, and trade contacts overseas. By controlling a large share of the grain market, they are able to influence the market, at least, on a regional level. Brosig (2012) indicates the weak wheat price integration between three different locations of Kazakhstan, which can be explained by the existence of market power. He emphasizes single agents' or cartels' ability to discriminate the price against individual peasant farmers compared to the large producers obtaining higher prices. Consequently, the regional (cluster) and structural heterogeneity in grain processing sector can be reflected in existence of the price gaps at the interregional level.

Besides the private enterprises, there are government organizations playing key role on the grain market. These organizations, mainly, provide service, such as access to finance and marketing of the products, to grain producers and processors. In addition, they have regulatory function and intervene on the market to stabilize the prices and control the state-owned grain stocks.

KazAgroHolding represents the central agency for the government intervention and support on grain market (FAO, 2012). Various institutions implement government agricultural policy under its umbrella, some of which are the Agrarian Credit Corporation (ACC), Food Contract

Corporation (FCC), Fund for Financial Support of Agriculture (FFSA), KazAgroProduct (KAP), KazAgroFinance (KAF), KazAgroMarketing (KAM) and KazAgroGarant (KAG). Despite the existing support programs, these entities engage in commercial transactions and, therefore, affect the market conditions.

In 2011, from the total assets of KazAgro, worth of 2.5 billion USD, 90% has been aggregated in FCC, KAF and ACC (OECD, 2013, p. 23). FCC, along with KAP, generates the state grain stocks in Kazakhstan. By intervening on grain market, they control the market price and manage stocks in the country. According to the regulations, the producers occupying above 250 ha of land must engage in setting the state grain stocks up by authorizing FCC to have a priority purchase. According to the OECD report (2013, p. 123) the Food Contract Corporation controls 550,000 tons of reserves comprising five types of grain stocks: food grain reserve, forage resources, seed resources, disposable grain resources, and stabilization (ad hoc local) resources. The Agrarian Credit Corporation together with FFSA provides concessional loans to local enterprises for various purposes within production. The interest rate differs according to the purpose of the loan, yet, stays below the commercial rates existing on the market. As for KazAgroFinance, it runs programs to finance the machinery leasing (OECD, 2013, p. 24). Similar to ACC, the interest rates are subsidized and maintained below the market premium.

2.2.4 Summary and conclusions

The grain production industry emerged as a growing sector after the crisis period during 1990's even though it still has not reached the level of 1990. The main barriers were the underdeveloped market and infrastructure, production technology, limited access to financial and other resources. Nowadays, Kazakhstan grain sector produces eight different grains where wheat is the most produced one. Other grains like rye, millet, rice, barley, buckwheat, maize, and oat comprise around 15% of the total grain production in the country. The grains are produced in regions favoring the respective climate. Consequently, the grain price formation has a heterogeneous character. Prices are influenced by various important factors, such as government regulations, world grain prices, weather conditions, and the level of trade integration. Moving from a centrally-planned to a market economy, created new organizational forms in the grain sector, as well; agricultural enterprises, individual farms and households are the main players on the production market. Agro holdings, entities vertically and horizontally integrated in the supply chain, appear as dominant large enterprises suspected in oligopsonistic behaviour, and to be able to influence the price.

The grain processing industry expanded along with the grain production sector during 2000–2011. The wheat flour export significantly increased and entered new markets. Growing flour export led to proportional demand on wheat and the processing industry became one of the important procurers on the market. However, an increasing concentration level is observed in the sector, where a few agroholdings control a large share of the market.

Overall, considering the structural changes, market concentration, and vertical integration of agroholdings in the Kazakh grain processing sector, it may be hypothesized that grain processing industry does exercise buyers' (oligopsony) market power in the input market for grain, but remain a price-taker in the output market.

3 THEORETICAL FRAMEWORK OF MARKET POWER ANALYSIS

3.1 OVERVIEW OF STUDIES

The market power analysis has been an interest of econometricians for the last decades. Various scholars devoted their work to detecting market imperfections and estimating the degree of market power. The topic became especially interesting within the New Empirical Industrial Organizational (NEIO) framework, where various econometric approaches and models were developed and applied in empirical studies.

The studies of oligopolistic markets emerged in 1980's when Appelbaum (1982) first provided the measure of the degree of the oligopolistic power. Many NEIO economists, like Bresnahan (1982), Lau (1982), Schroeter (1988), Azzam (1997), Griffit (2000), O'Donnell et al. (2007), devoted their research analysing oligopolistic markets in various sectors of economy as well, including the agricultural markets. The degrees of market power have been estimated on different agricultural markets using various approaches and methods, such as, the production-theoretical approach, general identification method, nonparametric analysis, and the reduced form approach.

The structural models were used for conducting many studies within the NEIO framework. They provide a possibility not only to test whether a market power is exercised on a market, but also to estimate its degree. Therefore, it's a useful tool to define whether a market has a competitive, monopoly or oligopoly type structure. The main principle of the structural approach is to estimate the parameter capturing difference between price and marginal cost, which consequently indicates the degree of the market power. The structural models are estimated in a system of equations including inverse demand and/or supply, profit, revenue or production functions, and the optimality conditions. Depending on the focus of studies they also provide a possibility to estimate the market power parameter simultaneously, on input and output markets.

Appelbaum (1982) developed a generalized framework for testing competition on markets. Within the framework, the conjectural variation was incorporated testing a hypothesis for a noncompetitive behaviour. It also provided a possibility to define the underlined market structure, estimate the degree of competition and, therefore, conclude not only whether it is a competitive or monopoly market, but also to estimate the degree of oligopoly.

Bresnahan (1982) provided a theoretical framework of finding solutions to identify market structures. Having focused on equilibrium price, he explained the principles of differentiating competitive markets from noncompetitive ones. He suggested that by introducing exogenous variables, such as a price of substitute goods and income in the demand equation, can define the behaviour of the demand curve. Demand curve behaviour, in turn, can explain the effect on the equilibrium price. He proved that within the competitive market, the equilibrium price remains constant, whereas the noncompetitive market reveals variations.

Following Bresnahan's (1982) model, Lau (1982) demonstrated that the estimation of the market power parameter cannot be identified for the linear and log-linear demand curves. It is only possible if inverse demand function is twice continuously differentiable, separable and has no constant elasticity with respect to output. Only under such assumptions, can market power parameter be estimated using price and output data.

The Appelbaum (1982) model was used as the basis for the Production-Theoretical Approach (PTA) and further elaborated by Lopez (1984) in the analysis of the Canadian food processing industry. Similarly, the General Identification Method (GIM) was formulated and theoretically substantiated by Bresnahan (1982) and Lau (1982). Nevertheless, the developed models suffered from some limitations, as well. Such an example was the assumption regarding fixed proportions technology that allowed the input and output market power parameters to be identical. However, the model later was applied by many scholars, such as Schroeter (1988), Griffit (2000) in their analyses. Consequently, the approach was modified by Azzam and Pagoulatos (1990) by introducing variable proportion technologies in the analyses, providing flexibility in estimating the market power parameters for input and output markets without fixing them. Muth and Wohlgenant (1999), O'Donnel et al. (2007) successfully used the variable proportion approach in their analyses. It is worthy to outline that in empirical studies, both alternatives were applied to the same agricultural market with similar output (Griffit, 2000 and O'Donnel et al., 2007). Griffit (2000) analyzed the Australian food supply chain for bread, breakfast cereal, and margarine end-product markets. Estimating the empirical model within NEIO framework, revealed that some of the processors in the industry exerted market power while purchasing grains and oilseeds from farmers. For the analyses, the assumption regarding fixed proportions of input-output ratio was introduced and only input sides of firms were assumed to be characterized with a noncompetitive behaviour, while holding the other side competitive. Furthermore, O'Donnel et al. (2007) modified the model developed by Griffit (2000), allowing the variable proportion technologies and incorporated the assumption of a noncompetitive behaviour at every stage of the marketing chain. After investigation of the same Australian grains and oilseeds sector, it was concluded that some of the food manufacturers exert oligopsony market power while purchasing agricultural products, such as wheat, barley, oats and triticale, thus confirming the results found by Griffit (2000).

Hyde and Perloff (1995) analyzed structural models and outlined their weaknesses. The models were estimated using the Cobb-Douglas, translog and linear specifications. According to the findings, structural models are sensitive in defining functional forms and, consequently, a misspecification might lead to biased results. Hence, accuracy in functional forms plays a significant role for adequate estimations.

Structural models provide a possibility to estimate the market power parameter on input and output markets, simultaneously. Therefore, they furnish a good opportunity to estimate parameters of the whole supply chain and capture welfare effects, as well. Such studies were conducted by many scholars, such as Azzam and Pagoulatos (1990), O'Donnel et al. (2007), Mei and Sun (2008). Sexton (2000) introduced the framework for analysing the oligopoly/oligopsony power effects over the producer and consumer surplus, and welfare efficiency. Nevertheless, within NEIO framework the structural models were applied for analysing only the input market of the supply chain. Lopez and You (1993), Murray (1995), Zheng and Vukina (2009) undertook studies where oligopsony power was estimated. In this respect, Roger and Sexton (1994) were some of the first to use market power models to utilize the US agricultural input markets. In the analysis, the concentration in the food processing sector has been highlighted and tested for the oligopsony power. In the model the first order conditions for processors have been measured as a function of market concentration, spatial dimension of the market and processors' conduct parameter. The findings illustrated farm-retail price disparities and necessity of empowering cooperatives and other types of farmers association to reduce the processors ability to exert market power on raw agricultural markets.

An alternative to structural models for market power analysis is reduced form approach represented by Hall (1988). The approach is based on comparative static analyses (Perloff et al., 2007), however unlike the structural models does not provide estimates regarding the degree of the market power without additional information (Shapiro 1987). It rather gives the possibility to simply detect whether a market is competitive or not, thus demonstrates market competitiveness and imperfection. However, it does not inform regarding the degree of imperfection if it exists. In this case, market competitiveness, as the main hypothesis, is tested. The critical assumption of the approach to be maintained is related to the constant returns to scale through the whole sector. The assumption is regarded as weakness of the approach, as well, as it is very sensitive even to minor deviations (Hyde and Perloff, 1995). Nevertheless, compared to the structural approach, the reduced form approach requires less data and allows more flexibility for estimations (Perloff et al., 2007).

Models that are applied for market power analyses use various degree of data aggregation. Appelbaum (1982), Azzam (1997), Azzam and Pagoulatos (1990), Lopez (1984), Hyde and Perloff (1998) applied national level data for analyses; however, other scholars used more disaggregated data. Regional data were used in the studies conducted by Koontz and Garcia (1997) to test market power in U.S. regional markets, such as, Iowa, Eastern and Western Nebraska, Eastern and Western Kansas, Texas. Anders (2008) employed regional data, as well, to analyze the German meat market, and found a noncompetitive behaviour from retailers on both input and output markets, thus, characterizing them as oligopolistic-oligopsonistic. Ukrainian regional dairy markets were analyzed by Perekhozhuk et al. (2015) by applying the regional data for estimating the structural model and, accordingly, finding oligopsony market power in the milk processing industry.

3.2 APPROACHES AND METHODS FOR ANALYSING MARKET POWER

3.2.1 Hall's approach

Hall, as one of the most famous authors of the reduced-form model, developed two similar yet slightly different methods for testing competitiveness of a market (Hyde and Perloff, 1995). Both approaches are based on the, so called, Solow residual θ, which is an index of Hicks-neutral technical progress, suggesting that technical progress is neither labour nor capital saving. In the instrumental variable approach, Hall argues that assuming constant returns to scale on the market, market power can be tested using instrumental variable(s), depending on its' correlation with Solow residual. If correlation is close to zero, then null hypotheses cannot be rejected, thus the market can be characterized as competitive. Otherwise, in case of a positive correlation, the null hypothesis is rejected and the alternative one of market power existence is accepted.

Yet, the weakness of the approach is it does not provide properties for estimation the degree of the market power. Accordingly, Hall developed alternative estimation approach which covering the estimation part, as well. In this case the price and marginal cost ratio is estimated, consequently, defining the degree of market power. However, in order to get nonbiased outcomes, additional information, such as demand elasticity is necessary. Holding the standard nonparametric approach assumptions in both methods, Hall showed that by introducing instrumental variable while estimating and testing the correlation with Solow residual, it can be examined whether the market is competitive or not.

Hall's methods tailored the possibility to be applied on both input and output markets. Accordingly, while testing input market for oligopsony power, a ratio of marginal product of a factor to marginal factor cost can be used as a good indicator of exercising market power (Perloff, 2007, p. 59). Of course, the assumptions related to the Hall's approach must hold, as well.

Hall (1986) undertook the market structure analysis of various U.S. industries. The main focus was identifying the differences between price and marginal cost. According to his findings, most of the analyzed industries were noncompetitive, yet, no results were provided regarding the degree of the market power.

Shapiro (1987) enhanced the Hall's (1986) study and estimated the degree of market power in the same industries, as well. He did so by incorporating the demand elasticities in the analysis. He argued that the ratio of elasticity of demand and the mark-up can be used for measuring the market power. He suggested that the ratio should range between zero and one indicating competition and monopoly respectively.

Crépon (2005) extended the Hall's (1986) approach and applied the factor productivity approach to estimate the degree of competition. Therefore, he analyzed the firm-level balanced panel data using 1,026 French manufacturing industries. The focus of the study was the bargaining power between employers and their workers. By estimating the parameter θ in the model, he assessed the degree of imperfect competition on the market. He concluded that firms' true mark-up was undervalued consequent to not taking into account the labour market imperfections.

Martins (1996) estimated mark-up ratios in the 36 manufacturing industries of the 14 OECD countries by combining the methodological approaches of Hall and Roeger. According to the findings, the mark-ups varied depending on industries and countries. The departures from perfect competition were identified in manufacturing industries. Similar studies have been conducted by Boulhol (2008) covering 13 OECD countries during 1970–2000.

Hall (1988), subsequently, analyzed seven industry groups and 26 industries in the US. He introduced a methodology with the assumption of constant returns to scale. The tested hypothesis combined both competition and constant returns to scale, by restricting covariance between the Solow residual and the instrumental variable to zero. According to the findings, monopsonistic behaviour was found in the labour market and noncompetitive structure in the product market.

Levinsohn (1993) analyzed Turkey's trade liberalization policy affects. In order to identify the consequences he examined the degree of competition using the market structure analysis. Similar to Hall (1988), he employed a one equation model to estimate the price-marginal cost ratios in different industries. Unlike Hall (1988) who utilized the industry aggregated data, the balanced firm-level panel data covered the greater Istanbul area during 1983–1986. According to the study, prior to liberalization, firms in two industries were able to set price above marginal cost, hence, having exerted a noncompetitive behaviour.

Norrbin (1993) re-estimated Hall's (1988) findings using the same data, but with some extension. He incorporated intermediate inputs in the original model. According to his findings, mark-ups by Hall were overestimated. Accordingly, small mark-ups were insignificant and, therefore, the results strongly deviated depending on the estimating technique applied.

Love and Shumway (1994) developed nonparametric approach testing for a monopsonistic market power. The model incorporated the Hicks-neutral technical change and allowed testing the ability of processors to exert the market power over agricultural producers. It assumed the possibility of processors being the price takers on non-agricultural inputs market but not on agricultural ones. Estimating the index of monopsony market power allowed to define a residual input supply curve processors faced and, accordingly, conclude whether the market power was exercised or not. Using simulated firm level data, the authors proved the robustness of the model.

Hyde and Perloff (1995) compared three different approaches, that were structural, Hall and Panzar-Rosse, with simulation method. The results suggested that the Hall approach had advantageous pertinent to requiring less data and did not necessitate to examine functional forms of supply and demand. However, the results were not stable in respect of assumptions and responsive to deviations given constant returns to scale. Furthermore, Hall approach did not provide the estimations to describe the degree of market power without additional information.

Eden (1993) introduced the spot market analysis where he challenged Hall's (1988) marginal productivity assumption and argued that capacity, rather than output utilization should be included in the analysis. He also questioned the assumption regarding constant returns to scale and concluded that Hall's analysis was not robust.

Roeger (1995) derived alternative approach based upon the Hall's (1988) method. The proposed methodology had advantageous due to not entailed instrumental variables. In the analysis, he applied the model using Hall's (1988) dataset, and, in line with his findings, he also detected imperfect competition in the U.S. manufacturing industries. However, the estimated mark-ups from his study were much lower, compared to the ones from Hall which, he suggested occurred due to the poor instrumental variable choice.

Table 3.2.1: Overview of selected results from empirical studies using Hall's method

Author(s) (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Hall (1989)	USA	N	A	1953–1984	7 one-digit and 26 two-digit industry groups:
					Food products
					Tobacco manufactures
					Textile mill products
					Lumber and wood products
					Petroleum and coal products
					Leather and leather products
					Whole trade
					Retail trade
Boyle (2004)	Ireland	N	A	1991–1999	Food
					Textiles
					Wearing Apparel
					Wood & Wood Prods.
					Pulp & Paper
					Printing & Rec. Media
					Chemicals
					Rubber & Plastic
					Other Non-Metallic
					Fabricated Metals
					Machinery & Equipment
					Electrical Machinery
					Radio, TV & Comm. Equip.
					Med., Prec. & Opt. Instrum.
					Motor Vehicles
					Other Trans. Equip.
					Furniture

Method[d]	Estimated Parameter β	Conducted Parameter θ
2SLS		
	0.189	5.291
	0.362	2.766
	0.388	2.578
	0.555	1.801
	−0.007	−139.478
	0.476	2.100
	−0.271	−3.688
	0.425	2.355
OLS	0.60	—
	1.00	—
	1.50	—
	0.20	—
	0.50	—
	−0.10	—
	1.60	—
	0.15	—
	0.60	—
	0.10	—
	0.30	—
	0.30	—
	0.60	—
	−0.30	—
	−0.04	—
	−1.20	—
	1.50	—

Table 3.2.1: Overview of selected results from empirical studies using Hall's method (cont.)

Author(s) (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Levinsohn (1993)	Turkey	P	A	1983–1986	Manufacture of paper and paper products
					Manufacture of industrial chemicals
					Manufacture of other chemical products
					Manufacture of pottery, china, earthenware
					Non-ferrous metal basic industries
					Manufacture of metal products except
					Manufacture of machinery except el.
					Manufacture of electrical machinery
					Manufacture of transport equipment
					Manufacture of scientific equipment, etc.
Crespi et al. (2005)	USA	N	A	1978/79–2000/01	Rice milling
Crépon (2005)	France	F	A	1986–92	1026 manufacturing firms

Notes:
[a] DA=level of Data Aggregation: F=Firm, N=National, P=Plant, R=Regional, W=World;
[b] DF=Data Frequency: A=Annual, Q=Quarterly, M=Monthly and D=Daily;
[c] TP=Time Period;
[d] Method: BE=Bayesian Estimation, FGNLS=Feasible Generalized Nonlinear Least-Squares, FIML=Full Information Maximum Likelihood, GMM=Generalized Method of Moments, I3SLS=Iterative Three-Stage Least Squares, ILS=Iterative Least Squares, 2SLS=Two-Stage Least Squares, N2SLS=Nonlinear Two-Stage Least Squares, N3SLS=Nonlinear Three-Stage Least Squares, SUR=Seemingly Unrelated Regression, NISUR=Nonlinear Iterative Seemingly Unrelated Regression, NIV=Nonlinear Instrumental Variables, TEM=Taylor Expansion Method;
n.a.=not available.

Sources: Articles cited

Method[d]	Estimated Parameter β	Conducted Parameter θ
OLS	2.17	—
	1.05	—
	1.25	—
	1.06	—
	0.455	—
	1.27	—
	0.427	—
	1.14	—
	1.35	—
	1.15	—
2SLS	1.893	0.27
GMM	1.5	0.6

Boyle (2004) applied the Hall-Roeger approach to analyze Irish Manufacturing Industries. According to the author, the main motivation of employing this particular approach was to require less data compared to other approaches and to avoid demand specifying functional forms. The panel data with 872 observations for the time period 1991–1999 were used for the analysis. The findings proved the existence of the market power in certain industries in production input pricing.

The Hall's approach has been used by Crespi, Gao and Peterson (2005) while testing the U.S. rice milling industry for oligopsony behaviour. Assuming Hick's neutral technological change, the model was derived to estimate market power in input purchasing without specifying functional forms of input supply equations. The analyses covered the period of crop years 1978/79–2000/01. The following were the data utilized in the analyses:

1. National output quantities and prices aggregated and averaged from state-level data.
2. Quantities and prices of the raw rice paid to farmers – cost which account 85% of total input costs.
3. Labour, capital and energy expenditures as non-specialized input costs.

The estimations were conducted using OLS and 2SLS. Hausman tests examined the consistency of the estimated coefficients. Estimated parameter, comprising conjectural and input supply elasticities, allowed concluding whether the processors exerted market power while purchasing rice.

The Hall's approach was introduced to measure the price-marginal cost ratio in the U.S. industries. The main advantage of methodology was the requirement of less data and no need for defining functional forms. Nevertheless, the model was based on constant returns to scale and a perfect competition assumption, for which it has been heavily criticized. However, as it is summarized on Table 3.2.1, various scholars successfully applied the model for analysis and estimated market power in different industries across many countries.

3.2.2 Production-theoretical approach

The production-theoretical approach was developed according to the framework introduced by Appelbaum (1982). Based on inverse demand and conjectural elasticities estimated by the model, the degree of the oligopolistic power was estimated for the first time. The parameters were estimated in terms of the index combining the degree of the competition and demand elasticity. Parameter θ, a measure of the degree of the oligopolistic power, was introduced as a generalization of the Lerner Index. The models within the PTA framework are normally estimated using the system of equations of production function, supply and/or demand functions, and first order conditions. Thus, the PTA models incorporate the production technology data with respect to the production elasticities and elasticities of substitution between all factors of production and technical change in the industry (Perekhozhuk et al., 2015). Nevertheless, the PTA models were criticized for their limitations, especially, regarding fixed proportions applied by various researchers (Appelbaum 1982; Lopez 1984; Schroeter 1988; Schroeter and Azzam 1990), for assuming the market power estimates of input/output markets to be equal. Alternatively, variable proportions technology was incorporated in the approach later by Azzam and Pagoulatos (1990). Another important limitation of the PTA pertains to the fact that it suffers from sensitivity to deviations in specifications. In this regard Hyde and Perloff (1995) underlined that the market power parameter estimates could be biased if the functional forms are misspecified. Nevertheless, the approach was successfully modified and applied by many scholars in agricultural and non-agricultural studies.

Following Appelbaum (1982), the U.S. beef packing market was tested for competitiveness by Schroeter (1988). The model was modified, allowing simultaneous estimating of market power parameter on both input and output markets. Nevertheless, the model presumed a strong assumption regarding the fixed proportions of input and output in production technology, thus, fixing input and output quantities under one variable and, therefore, introducing equivalent conjectural elasticities for input and output markets.

Lopez (1984) developed oligopoly model based on Appelbaum (1982) approach, providing possibility to capture the concentration change effect on price mark up and oligopoly power. After analysing the Canadian food processing industry, a competitive behaviour of the processors was rejected. The findings demonstrated the increased degree of market power over the analyzed period and various levels of sensitivity of the factors' responses (labour, capital, raw materials and energy) to price fluctuations.

Azzam and Pagoulatos (1990) first proposed a model allowing variable proportions with non-restrictive conjectural elasticities. In this way it was possible to avoid assumption regarding identical conjectural elasticities on input and output markets. By estimating simultaneous equations of demand and supply functions, the first order condition and production function of the U.S. beef packing industry was tested for both oligopoly and oligopsony power.

Appelbaum's (1982) model later was extended by Azzam (1997) with the focus on deviating market power and cost efficiency effects in estimations and measuring the strength of their effects with respect to concentration. In the study the U.S. beef packing industry, the market characterized by high concentration, was analyzed. It was concluded that beef packers exerted market power on the cattle market; nevertheless, the market power effects were compensated by the benefits of slaughter cost-efficiency effects.

Murray (1995) used structural equation system to estimate oligopsony power in the U.S. wood processing industry. The system combined a profit function together with estimation of supply and factor demand elasticities. Along with quantity variables, input shadow prices were used for the analysis. According to the findings, the saw log and pulpwood markets were defined rather competitive than monopsonistic. Nevertheless, pulpwood processors have been more oligopsonistic compared to the ones from the saw log industry.

Mei and Sun (2008) examined the U.S. highly concentrated paper industry. For the analysis, the annual 1955–2003 data was applied in the model based on the PTA approach. According to the findings, market power was identified in both the paper products output and pulpwood input markets, with stronger emphasis on input markets. It was concluded, that oligopoly power was stable over the analyzed period while oligopsony power fluctuated.

Generalized structural models were applied to analyze different sectors of the economy at various levels. Nevertheless, the PTA models were successfully applied in agricultural industries, as well. The models were used to test input and output markets of food processing industries, or both markets simultaneously, for oligopsony and oligopoly power.

Schroeter and Azzam (1990) tested the U.S. meat (beef and pork) market for multi-product oligopolies and investigated cross market effects. The structural model was estimated using generalized the Leontief cost function, applying the assumption regarding fixed proportions. According to the results price taking behaviour was rejected and defined as monopoly/monopsony distortion.

Wann and Sexton (1992) examined the California pear processing industry for market power. Using structural production function model, the market was simultaneously tested for oligopsony and oligopoly. The annual 1950–1986 time series data was employed for analysis. The findings suggested that the output industry, particularly, canned pear and fruit cocktail markets could be characterized by moderate oligopoly power and hypothesis regarding competitive input market of raw pear has been rejected.

Bhuyan and Lopez (1998) tested the U.S. food and tobacco industries for oligopoly power and calculated the welfare losses. The model was developed following a NEIO approach estimating cost, demand and conducted parameters. According to the results, the allocative efficiency losses for flour and grain milling industry composed 26.17% of sales due to oligopoly market structure. Nevertheless, the model suffered from limitations excluding factors, such as endogenous productivity growth, product differentiation, and price leadership behaviour.

Millán (1999) performed a market power analysis in Spanish food, drink and tobacco industries including milling and bread and flour sectors for 1978–1992. The oligopoly market power was detected in most of the Spanish food processing sectors. Nevertheless, the results were cautiously interpreted considering the theoretical assumptions made and data availability for defining the demand functional form.

Gohin and Guyomard (2000) analyzed the French food retail industry, particularly, the dairy, meat and other food products. For the analysis of input supply functions, the inverse demand system and first-order profit maximization conditions were estimated separately. According to the findings the hypothesis regarding French food retail industry actors being competitive, was rejected and the wholesale-retail price margins in dairy and meat industries were of oligopoly-oligopsony character.

Quagrainie (2003) examined the Canadian meat packing industry. The model was estimated in a system of supply, derived demand, and translog profit functions. The industry level annual data for 1960–1997 was analyzed. In line with results, hog markets were defined as, generally, competitive; however, beef packers exercised market power in finished cattle market from 1978 to 1997.

Bakucs et al. (2009) investigated processors in German and Hungarian pork markets. A structural model simultaneously combined the estimation of supply, derived demand, and production functions. Although the markets especially, the German highly concentrated pork market, were characterized as concentrated, the estimates indicated low degree of the market power by processors. Furthermore, the bargaining power in the German hog market diminished over the analyzed period, while on the Hungarian market, a slight increase was detected.

A structural model was also applied by Perekhozhuk et al. (2015) to test the Ukrainian dairy market for market power. Characterized by high level of market power, dairy processors were suspected to exercise oligopsony power over dairy producers. The model was estimated simultaneously using the supply, production functions, and first order condition. The data combined the national and regional time series for 1996–2003. According to the findings, the oligopsony power has been detected on national level and in some administrative regions of Ukraine. Table 3.2.2 provides the list of the authors that used the PTA approach in their studies. As it can be observed for estimation, at least a system of three equations was incorporated in the model: a production function, first order condition and demand and/or supply function(s). However, instead of the production function cost, revenue and profit functions were utilized. As for the specifications, they varied depending on the scrutinized market and data. Appelbaum (1982), Lopez (1984), Schroeter (1988), Schroeter & Azzam (1990), Azzam (1997), Morrison Paul (2001) applied the generalized Leontief cost function, whereas Azzam & Pagoulatos (1990), Bakucs et al. (2009), Perekhozhuk et al. (2013, 2015, 2017), Scalco et al. (2017) defined translog linear production functional (TLPF) form of specifications in their analysis. The Translog revenue and profit functions were used by Hockmann and Vöneki (2009), and Quagrainie et al. (2003) in the estimations. As for the demand and supply functions, the commonly applied specifications are the double logarithmic (DL) and translog functions, respectively. For model estimation, the Nonlinear Three-Stage Least Squares (N3SLS) and Full Information Maximum Likelihood (FIML) methods are frequently used. Nevertheless, other methods, such as the Iterative Three-Stage Least Squares (I3SLS) and the Generalized Method of Moments (GMM) are employed, as well. As for the data applied for the analyses, they range from plant level to national level and frequency varied from monthly to annual.

Regarding the definition of the functional forms, Perloff et al. (2007), Hyde and Perloff (1997), proved that the specifications are sensitive to the deviations. In this respect, Perekhozhuk et al. (2017) provided the comparison of the estimates based on the TLPF and the translog nontruncated function (TLN), and the translog truncated function (TLT) supply functional forms. There were four different methods applied for the analysis that are the N3SLS, I3SLS, GMM, and FIML. According to the findings the results significantly varied with respect to the specifications, and methods applied.

Table 3.2.2: PTA studies of agri-food industries on market power

Study (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Appelbaum (1982)	USA	N	A	1947–71	Textile
					Tobacco
Lopez (1984)	Canada	N	A	1965–79	Food processing
Schroeter (1988)	USA	N	A	1951–83	Beef &Cattle
Azzam & Pagoulatos (1990)	USA	N	A	1959–82	Meat
					Livestock
Schroeter & Azzam (1990)	USA	N	Q	1976–86	Beef
					Pork
Wann & Sexton (1992)	USA	R	A	1950–86	Fruit cocktail
					Grade pack pears
Chirinko & Fazarri (1994)	USA	F	A	1973–86	Malt Beverages
					Textile
Bergman & Brännlund (1995)	Sweden	N	A	1960–88	Pulp & paper
Murray (1995)	USA	N	A	1958–88	Pulpwood
					Sawlogs
Azzam (1997)	USA	N	A	1970–92	Beef packing
Bhuyan & Lopez (1997)	USA	N	A	1972–87	Food
					Tobacco
					Food & Tobac.

Function forms[d]			NE[e]	Method[f]	Model[g]	Market power	Lerner Index[h]
P/C/R/PF	D	S					
GLC	DL	—	5	FIML	θ	0.0368	0.1960
					θ	0.4019	0.6508
GLC	SL	—	6	FIML	θ	0.192	0.504
GLC	DL	DL	4	FIML	θ/φ	0.0176	—
					θ	—	0.0333
					φ	—	0.0104
TLPF	—	—	5	I3SLS	θ	0.223	0.460
					φ	0.178	1.1
GLC	—	—	4	I3SLS	θ/φ	0.0475	0.553
					θ/φ	0.0558	0.477
GLMC	—	—	6	FIML	θ	0.482	—
					θ	0.076	—
TLC	—	—	3	N3SLS	θ	0.307	—
					θ	0.160	—
GLP	—	DL	3	N3SLS	φ	0.22	—
				FIML	φ	1.05	
GLP	—	—	5	NISUR	φ	0.174	0.2857
					φ	0.042	0.2435
GLC	—	DL	2	N3SLS	φ	−0.799†	0.238
TLC	DL	—	6	N3SLS	θ	0.180	0.330
					θ	0.211	0.369
					θ	0.183	0.334

Table 3.2.2: PTA studies of agri-food industries on market power (cont.)

Study (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Bhuyan & Lopez (1998)	USA	N	A	1972–87	Cereal Breakfast
					Pet Food Ind.
Millán (1999)	Spain	N	A	1978–92	Oils and fats
					Wine
					Brewing
					Tobacco
Morrison Paul (2001)	USA	P	M	1958–91	Beef packing
Quagrainie et al. (2003)	Canada	N	A	1960–97	Beef packers
					Pork packers
Hockmann & Vöneki (2009)	Hungary	N	M	1998–06	Raw milk
Bakucs et al. (2009)	Germany	N	M	1993–03	Hogs
	Hungary	N	M	1995–04	Hogs
Perekhozhuk et al. (2013)	Hungary	P	A	1993–06	Dairy industry
Perekhozhuk et al. (2015)	Ukraine	R	M	1996–03	Dairy industry
Perekhozhuk et al. (2017)	Ukraine	R	M	1996–03	Dairy industry

Function forms[d]			NE[e]	Method[f]	Model[g]	Market power	Lerner Index[h]
P/C/R/PF	D	S					
TLC	DL	—	6	N3SLS	θ	0.550	—
					θ	0.014	—
TLC	DL	—	5	ILS	θ	0.68	n.s.
					θ	0.45	n.s.
					θ	0.60	n.s.
					θ	0.26	n.s.
GLC	—	—	6	N3SLS	θ/φ	−0.0083	0.0075
TLP	—	—	4	N3SLS	φ	—	0.0050
					φ	—	0.0023
TLR	—	TL	3	N3SLS	φ	0.05	n.s.
TLPF	—	TL	3	N3SLS	φ	0.0724	n.s.
					φ	0.0284	n.s.
TLPF	—	—	2	FGNLS	φ	0.2219	n.s.
TLPF	—	TL	3	N3SLS	φ	0.1475	n.s.
TLPF	—	TLN	3	N3SLS	φ	0.011	0.031
				I3SLS	φ	0.010	0.038†
				GMM	φ	0.008	0.022†
				FIML	φ	−0.002	−0.003
TLPF	—	TLT	3	N3SLS	φ	0.148†	0.361‡
				I3SLS	φ	0.298‡	0.464‡
				GMM	φ	0.086‡	0.293‡
				FIML	φ	0.257†	0.463‡

Table 3.2.2: PTA studies of agri-food industries on market power (cont.)

Study (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Perekhozhuk et al. (2017) (cont.)	Ukraine	R	M	1996–03	Dairy industry
Scalco et al. (2017)	Brazil	R	M	2010–15	Milk market
Kumbhakar et al. (2012)	Norway	F	A	1974–91	Sawmilling industry

Notes:
[a] DA=Data Aggregation: F=Firm, N=National, P=Plant, R=Regional, W=World;
[b] DF=Data Frequency: A=Annual, Q=Quarterly, M=Monthly and D=Daily;
[c] TP=Time Period;
[d] Functional forms for Profit (P), Cost (C), Revenue (R), Production functions (PF) and input distance function (IDF): GLC=Generalized Leontief Cost function, TLPF=Transcendental Logarithmic (Translog) Production Function, GLMC=Generalized Leontief Multiproduct Cost function, GLP=Generalized Leontief Profit function, TLC=Transcendental Logarithmic (Translog) Cost function, TLR=Transcendental Logarithmic (Translog) Revenue function; Functional forms for Demand (D) and Supply(S) functions: DL=Double Logarithmic function, SL=Semi-Logarithmic (log-linear) function, LIT=Linear function with Interactive Terms, LIN=Linear function, LOG=Logarithmic function, EC=Error Correction, TL=Transcendental Logarithmic (Translog) function, TLN=Transcendental Logarithmic (Translog) Nontruncated function, TLT=Transcendental Logarithmic (Translog) Truncated function;
[e] NE=Number of Equation;

Function forms[d]			NE[e]	Method[f]	Model[g]	Market power	Lerner Index[h]
P/C/R/PF	D	S					
TLPF	—	—	3	N3SLS	φ	0.120‡	0.294‡
				I3SLS	φ	0.110‡	0.171‡
				GMM	φ	0.075‡	0.254‡
				FIML	φ	0.125‡	0.225‡
TLPF	—	—	1	—	θ	0.02	n.s.
					φ	0.06	n.s.
TLC	—	—	2		θ/φ	0.115	n.s.
TLIDF	—	—	2		θ/φ	0.113	n.s.

[f] Method: BM=Bootstrap Method, FGNLS=Feasible Generalized Nonlinear Least-Squares, FIML=Full Information Maximum Likelihood, GMM=Generalized Method of Moments, I3SLS=Iterative Three-Stage Least Squares, ILS=Iterative Least Squares, 2SLS=Two-Stage Least Squares, N2SLS=Nonlinear Two-Stage Least Squares, N3SLS=Nonlinear Three-Stage Least Squares, SUR=Seemingly Unrelated Regression, NISUR=Nonlinear Iterative Seemingly Unrelated Regression, NIV=Nonlinear Instrumental Variables, TEM=Taylor Expansion Method;

[g] The degree of market power is represented by either testing the parameter of conjectural elasticity or by the conjectural variation (†) on the output market (θ=oligopoly) or input market (φ=oligopsony), as well, as by the joint estimation of oligopoly and oligopsony market power (θ/φ) assuming the fixed proportions technology, that is, the input and output quantities, are represented by the same variables.

[h] The Lerner Index (LI) is estimated as the conjectural elasticity divided by the elasticity of demand and/or supply.

Sources: Own representation based on Perekhozhuk et al. (2017) and cited articles

3.2.3 General identification method

The General identification method along with other NEIO models provides a framework for estimating market power as a structural model. Similar to the PTA, the GIM models can also be estimated by simultaneous equations. In the model the functional forms of the equations should be defined, too. Nevertheless, compared to the PTA it provides more flexibility with respect to the equations incorporated in the model. Specifically, it enables a possibility to estimate the model without profit, cost, revenue or production functions (Perloff et al., 2007). Thus, the model within GIM framework can be estimated by the demand or supply functions, simultaneously, with the optimality condition. The GIM approach was initially, introduced by Bresnahan (1982). He proved that testing for market power can be undertaken even without production or a cost function and that it can be identified by exogenous shifters affecting price and quantity. According to the findings, it was concluded that exogenous shifters rotate the demand curves without affecting equilibrium given competitive market, and change the equilibrium in case of market power. Aggregate industry, as well as market-level data on quantities and prices, was used within the analyses.

Lau (1982) proved that it is possible to estimate the degree of competitiveness based on industry level price and output quantity data. Nevertheless, he showed that it is only possible under the assumption that inverse demand function is twice continuously differentiable, separable, and it does not take specific functional form.

Buschena and Perloff (1991) tested the Philippine coconut export market for market power. The highly concentrated and regulated market provided a solid basis for dominant companies to allow increased markups. Lerner index, as a measure of market power, was estimated using a three equation system of the world demand, fringe supply, and the Philippine export. In the model, the market power parameter varied over the time according to the market changes. Based on estimates, it was concluded that the gap between price and marginal costs doubled over the analyzed period, indicating market power existence in the industry.

Lopez and You (1993) tested the Haiti coffee market for oligopsony power. A strongly collusive market, characterized by exporters' coffee purchasing quota system, was expected to be noncompetitive. Lerner Index, as a measure of oligopsony power, was estimated based on conjectural variation elasticity and the price elasticity of export supply. Annual data for the time period 1954–1984 was applied for the analysis. According to the results, an establishment of export regulating institutions and quota system could not prevent the Haiti coffee market from being collusive. The coffee grain producers suffered from lower prices than it would have occurred if the market was competitive.

Deodhar and Sheldon (1997) investigated the world soymeal market for imperfect competition. The structural model was developed according to the Bresnahan (1982) framework and estimated, simultaneously, using export demand function and the first order conditions. The annual data that used for the analyses covered 1966–1993. No market power was detected and the world soymeal market was defined as perfectly competitive.

Hyde and Perloff (1998) introduced the market structure model in analysing the cross markets effect instead of a single market. The model allowed a simultaneous estimating of market power parameters in retail beef, lamb, and pork markets in Australia. The linear approximate version of the almost ideal demand system (LA/AIDS) was applied for estimation of the demand system. The market power parameter was estimated as a system of demand and optimality equations. Considering the high concentration, it was expected that the meat market would be uncompetitive. Nevertheless, according to the estimates received from analyses, no market power was detected.

The variable proportion approach was used by Muth and Wohlgenant (1999) to examine the U.S. beef packing industry. By applying the envelop theorem in the model, the relationship between value marginal product and factor costs was defined without employing the quantity data of nonspecialized inputs, such as labour, for example. Therefore, the market was tested using aggregate annual time-series data of the quantity and price data for beef cattle and the price data of nonspecialized inputs for 1967–1993. No evidence of oligopsony power was confirmed.

O'Donnel et al. (2007) questioned the assumptions made by Griffit (2000) regarding the fixed proportions. He argued that input-output were not of fixed proportions and extended the model that allowed estimating the variable proportion technologies. The model also incorporated the factor of noncompetitive behaviour at every stage of the marketing chain. It was used to investigate the Australian multiple-input, multiple-output grains, and oilseeds sector. The estimations based on conjectural, demand, and supply elasticities, and indexes of market power showed that some of the food manufacturers exerted oligopsony market power while purchasing agricultural products, such as wheat, barley, oats, and triticale.

Steen and Salvanes (1999) analyzed French fresh salmon market for market power. The model was developed from Bresnahan-Lau model. However, the within error correction framework, incorporated long run factors, such as demand side behaviour and cost adjustment for producers. According to the findings, Norway exerted market power in the short run when fresh salmon was not available on the market. Hence, it had seasonal character while in the long run the market was rather competitive, given the presence of other countries, like Scotland and North America.

Anders (2008) applied a structural conjectural-variation approach to test the German meat market. Considering the high market concentration ratio, noncompetitive behaviour from retailers was tested on both input and output markets, simultaneously. The retailers' profit maximization problem, in line with the supply and demand functions, was estimated assuming the fixed proportions production technology. Market power was confirmed based on a conjectural variation elasticity parameter θ identifying the degree of bargaining power. Regional level monthly data covered 1995–2000 timeframe for the German state Hessen. The analysis revealed retailers exercising the oligopsony market power while purchasing beef and pork from the processors and insignificant degree of oligopoly power on the output market.

Zheng and Vukina (2009) concluded the U.S. pork packers exercising oligopsony market power on the spot market for live hogs. The inverse demand and supply functions, along with the first order condition were estimated in their analysis. The quantity and price daily data for 2001–2007 were applied.

Merél (2009) applied a structural model for market power analyses in the French Comté cheese market. The quarterly data at the wholesale level for 1985–2005 were used for estimations. The substitute cheese price (Emmental cheese) was incorporated to capture the EU milk quota policy factor. The hypothesis regarding competitiveness was not rejected and the results were found to be robust to the demand specifications.

Perloff and Shen (2012) addressed the problems that existed in defining the functional forms of demand function and optimality equations in the structural market power models. In particular, it was found that the models that were developed within framework of Bresnahan (1982) and Lau (1982) suffered from multicollinearity in case of a linear functional form. However, this obstacle was solved when one of the equations had a loglinear or other type of functional form.

Table 3.2.3 provides a short summary of studies that applied the GIM approach. In case of the GIM approach, only demand or supply function with a first order condition can be estimated. Linear (LIN) and Double Logarithmic (DL) specifications are among the most frequently applied functional forms. Buschena and Perloff (1991), Gohin & Guyomard (2000), Deodhar & Sheldon (1995), Weerahewa (2003), O'Donnell et al. (2007) used those functional forms in their analyses.

However, other types of specifications were applied by other scholars, as well. Hovhannisyan and Gould (2012) defined the Generalized Quadratic Almost Ideal Demand System (GQAIDS), Chizari et al. (2018) used Linear Almost Ideal Demand System (LAIDS) for the model estimations. Like the PTA, the GIM approach also employees the N3SLS, FIML, GMM, and I3SLS methods. The national level data is used mostly for the analysis, however, O'Donnell et al. (2007), Anders (2008) and Chidmi et al. (2005) successfully applied regional data, as well. Furthermore, Deodhar & Sheldon (1997) used world level data to investigate world soymeal exports market. The analyses were conducted using weekly, monthly, quarterly, and annual data.

In line with the PTA approach, the conclusion regarding sensitivity of functional form deviations also applies to the GIM approach. According to Perekhozhuk et al. (2017), the estimates of the market power parameter in GIM are significantly lower than the ones from the PTA. However, both approaches have been successfully applied for oligopoly/oligopsony analyses by various scholars.

Table 3.2.3: GIM studies of agri-food industries on market power

Study (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Buschena & Perloff (1991)	USA	N	A	1959–87	Coconut Oil
Lopez & You (1993)	Haiti	N	A	1954–84	Coffee export
Deodhar & Sheldon (1995)	Germany	N	A	1966–93	Banana imports
Liu et al. (1995)	USA	N	Q	1975–92	Manufact. proces. Fluid processor
Deodhar & Sheldon (1996)	Germany	N	A	1970–92	Banana
Deodhar & Sheldon (1997)	World	W	A	1966–93	Soymeal Exports
Genesove & Mullin (1998)	USA	N	A	1890–14	Sugar industry
Hyde & Perloff (1998)	Australia	N	Q	1970–88	Meat retailing
Muth & Wohlgenant (1999)	USA	N	A	1967–93	Cattle
Steen & Salvanes (1999)	France	N	Q	1981–92	Fresh salmon

	Function forms[d]		NE[e]	Method[f]	Model[g]	Market power	Lerner Index[h]
	D	S					
	LIT	LIN	3	N3SLS	θ	0.578†	0.61
	SL	DL	2	FIML	φ	0.027	0.181
	LIT	—	2	2SLS	θ	0.29†	—
	DL	—	2	SUR	θ	0.1	—
					θ	0.176	—
	LIT	—	1	TEM	θ	0.20†	—
	LIT	—	2	N3SLS	θ	0.04†	—
	LIN	—	1	NIV	θ	0.05	0.11
	AIDS	—	5	N3SLS	θ	≈0†	≈0
	—	LIT	2	N3SLS	φ	0.00001	n.s.
	—				φ	0.00008	n.s.
	—				φ	−0.00015	n.s.
	—	EC	1	N2SLS	θ	−0.025†[d]	n.s.
					θ	−0.019†	n.s.

Study (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Bettendorf & Verboven (2000)	Dutch	N	M	1992–96	Coffee
Gohin & Guyomard (2000)	France	N	A	1977–93	Dairy products
					Meat products
					Other food products
Weerahewa (2003)	Sri Lanka	N	A	n.s.	Tea
	India				
	Kenya				
	ROW				
	Canada				
	UK				
	USA				
Chidmi et al. (2005)	USA	R	W	1996–00	Retail milk
Anders (2008)	Germany	R	M	1995–00	Retail beef
					Retail pork
Mérel (2009)	France	N	Q	1985–05	Comté cheese
Zheng & Vukina (2009)	USA	N	D	2001–07	Hogs & Pork

Function forms[d]		NE[e]	Method[f]	Model[g]	Market power	Lerner Index[h]
D	S					
LOG	—	2	GMM	θ	0.107	0.340
LIN				θ	0.031	0.147
Q				θ	0.016	0.069
DL	DL	3	I3SLS	θ/φ	−0.0187	0.2002
				θ/φ	−0.0338	0.1743
				θ/φ	0.0103	0.1184
—	LIN	2	2SLS	φ	0.1657	0.8043
	DL			φ	0.0516	0.6523
	DL			φ	0.0015	0.0066
	LIN			φ	0.0091	0.6363
DL	—			θ	0.1273	1.0291
DL				θ	0.1273	0.8181
DL				θ	0.1273	0.2697
DL	—	2	SUR	θ	0.1663	0.2609
LIN	LIN	3	n/a	θ	0.089	0.033
				φ	0.176	0.103
				θ	0.003	0.005
LIT	—	2	GMM	θ	0.001	n.s.
DL	—			θ	0.002	n.s.
DL	DL	1	GMM	θ/φ	0.3198†	n.s.

Study (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
O'Donnell et al. (2007)	Australia	R	A	1989–00	Grains & Oilseeds
					– wheat output
					– canola output
					Flour & Cereal
					– wheat flours
					– cereal foods
					– wheat input
					– canola input
					Bear & Malt
					– bear output
					– wheat input
					– barley input
					Oil & Fat
					– margarine output
					– canola input
					Bakery Product
					– cakes and biscuit
					– bread output
					– flour input
					Other Food
					– other food output
					– wheat input
					– canola input
					Consumers
					– wheat
					– canola
					– bread

Function forms[d]		NE[e]	Method[f]	Model[g]	Market power	Lerner Index[h]
D	S					
LIN	—	12	BE			
				θ	0.136	0.233
				θ	0.003	0.014
LIN	LIN	13	BE			
				θ	0.010	0.015
				θ	0.001	0.001
				φ	0.180	0.314
				φ	0.020	0.409
LIN	LIN	6	BE			
				θ	0.007	0.004
				φ	0.274	0.478
				φ	0.247	0.778
LIN	LIN	3	BE			
				θ	0.008	0.003
				φ	0.017	0.341
LIN	LIN	5	BE			
				θ	0.027	0.047
				θ	0.010	0.005
				φ	0.003	0.062
LIN	LIN	12	BE			
				θ	0.004	0.001
				φ	0.0164	0.588
				φ	0.035	0.705
LIN	LIN	13	BE			
				φ	0.054	0.108
				φ	0.004	0.072
				φ	0.078	0.156

Study (year)	Country	DA[a]	DF[b]	TP[c]	Industry/Market
Hovhannisyan and Gould (2012)	USA	R	W	2001–06	Fluid Milk (National Brand)
					Fluid Milk (Private label)
					Fluid Milk (Other National Brand)
Perekhozhuk et al. (2017)	Ukraine	R	M	1996–03	Dairy industry
Grau and Hockmann (2017)	Germany			2000–11	Dairy
					Raw milk
Chizari et al. (2018)	Iran	P	A	1992–02	Milk
					Yogurt
					Cheese
					Raw milk

Notes:
[a] DA=Data Aggregation: F=Firm, N=National, P=Plant, R=Regional, W=World;
[b] DF=Data Frequency: A=Annual, Q=Quarterly, M=Monthly and D=Daily; [c] TP=Time Period;
[d] Functional forms for Profit (P), Cost (C), Revenue (R) and Production functions (PF):
GLC=Generalized Leontief Cost function, TLPF=Transcendental Logarithmic (Translog) Production Function, GLMC=Generalized Leontief Multiproduct Cost function, GLP=Generalized Leontief Profit function, TLC=Transcendental Logarithmic (Translog) Cost function, TLR=Transcendental Logarithmic (Translog) Revenue function; Functional forms for Demand (D) and Supply(S) functions: DL=Double Logarithmic function, SL=Semi-Logarithmic (log-linear) function, LIT=Linear function with Interactive Terms, LIN=Linear function, Q=Quadratic function, LOG=Logarithmic function, EC=Error Correction, TL=Transcendental Logarithmic (Translog) function; LAIDS=Linear Almost Ideal Demand System; GQAIDS=Generalized Quadratic Almost Ideal Demand System, TLN=Transcendental Logarithmic (Translog) Nontruncated function, TLT=Transcendental Logarithmic (Translog) Truncated function. [e] NE=Number of Equation;
[f] Method: BE = BM=Bootstrap Method, FGNLS=Feasible Generalized Nonlinear Least Squares,

Function forms[d]		NE[e]	Method[f]	Model[g]	Market power	Lerner Index[h]
D	S					
GQAIDS	—	3	FIML	θ	0.000	0.000
				θ	0.000	0.000
				θ	0.022	0.009
—	TLN	2	N3SLS	φ	0.014	0.039
			I3SLS	φ	0.015	0.039
			GMM	φ	0.012	0.037
			FIML	φ	0.001	0.003
—	TLT	2	N3SLS	φ	0.033	0.065
			I3SLS	φ	0.070	0.218
			GMM	φ	0.010	0.018
			FIML	φ	−0.024	−0.040
	VECM	1	ML	φ	0.29–0.39	n.s.
				φ	0.04–0.07	n.s.
LAIDS		5	NML	θ	0.70	0.42
				θ	0.48	0.32
				θ	0.62	0.46
	LIN			φ	0.78	n.s.

FIML=Full Information Maximum Likelihood, NML=Nonlinear Maximum Likelihood,
GMM=Generalized Method of Moments, I3SLS=Iterative Three-Stage Least Squares, ILS=Iterative Least Squares,
2SLS=Two-Stage Least Squares, N2SLS=Nonlinear Two-Stage Least Squares, N3SLS=Nonlinear Three-Stage Least Squares,
SUR=Seemingly Unrelated Regression, NISUR=Nonlinear Iterative Seemingly Unrelated Regression,
NIV=Nonlinear Instrumental Variables, TEM=Taylor Expansion Method; VECM=Vector Error Correction Model.

[g] The degree of market power is represented by testing the parameter of conjectural elasticity or by the conjectural variation (†) in the output market (θ=oligopoly) or input market (φ=oligopsony), as well as, by the joint estimation of oligopoly and oligopsony market power (θ/φ) assuming the fixed proportions technology, that is, the input and output quantities are represented by the same variables.

[h] The Lerner Index (LI) is estimated as the conjectural elasticity divided by the elasticity of demand and/or supply.

Sources: Own representation based on Perekhozhuk et al. (2017) and cited articles

3.2.4 Summary

The market power studies are conducted with many approaches by different authors within the NEIO framework. The approaches differ with respect to data requirement, assumption complexity, and structure of system of equations. In this study, three different approaches are chosen for market power analysis in the Kazakh grain chain: Hall's approach, the PTA and the GIM. The Hall's approach is chosen, primarily, because of its advantages regarding the data requirements. It provides a possibility to estimate the model without defining functional forms of the demand or supply functions. Conversely, a strong assumption regarding constant returns to scale is a main limitation of the Hall's approach. Therefore, it is necessary to apply other models to confirm the robustness of the results. Consequently, the other approaches for market power studies, such as the PTA and the GIM are also employed. Both the PTA and the GIM approaches can be described as structural models allowing simultaneous estimations of a system of equations on input and output markets. Compared to the GIM, the PTA is more advantageous by incorporating full information on production technology. However, the GIM approach, unlike PTA, provides the possibility to estimate market power with merely the demand or supply functions and optimality condition. Nonetheless, both the PTA and the GIM approaches are limited in assumptions regarding functional specifications and fixed proportions technologies. The following chapters demonstrate the theoretical framework of the approaches and empirical models, and provide main findings of three approaches applied to test the Kazakh grain supply chain for oligopsony market power.

3.3 THEORETICAL FRAMEWORK

3.3.1 Hall's approach

Hall's approach is applied to measure oligopsony power and test for market competitiveness for processors on input level. Hall's approach gives possibility to undertake market power analysis with, relatively, few data based on the assumption of constant returns to scale (Hall, 1988).
Production function of the i-th grain processor using $j = 1, \dots J$ inputs can be defined in the following way:

$$q_{it} = \phi_{it} f_{it}\left(x_{i1t}, \dots, x_{iJt}\right) \quad (1)$$

where q_{it} is the quantity produced by processor i using x quantity of j inputs at time period t, ϕ_{it} which captures Hick's neutral technical progress factor of i processor at time t and based on Hall (1988) approach it follows random walk:

$$\phi_{it} = \phi_{it-1} + \varepsilon_{it};\ \varepsilon_{it} \sim N(0, \sigma_i^2), \quad (2)$$

ε_{it} representing productivity shock.
Using Taylor expansion (1) Crespi, Gao and Peterson (2005) rearrange the equation (1) in the following way:

$$\Delta q_{it} = \phi_{it}\left[\sum_{j=1}^{\mathrm{J}} \frac{\Delta f_{it}}{\Delta x_{\mathrm{ijt}}} \Delta x_{\mathrm{ijt}}\right] + f_{it}\Delta\phi_{it} \quad (3)$$

where the error terms, capturing the productivity shocks, were integrated within the difference equation (3).

Using the production function (1), the firm's profit maximization problem facing grain processor can be expressed as follows:

$$\max_{x_{i1t},\dots,x_{iJt}} \pi_{it} = p_{it}q_{it} - \sum_{j=1}^{J} w_{ijt}\left(X_{jt}(x_{jt})\right)x_{ijt} \tag{4}$$

where p_{it} is the output price of grain processor i in time period t, X_{jt} represents aggregated market supply of J input and deriving the first-order conditions will lead to:

$$p_t\phi_{it}\frac{\Delta f_{it}}{\Delta x_{ijt}} = w_{ijt} + \frac{\Delta w_{ijt}}{\Delta \mathrm{X}_{jt}}\cdot\frac{\Delta X_{jt}}{\Delta x_{ijt}}x_{ijt}, j = 1, \dots, J \tag{5}$$

In order to introduce conjectural elasticity as a measure of market power Crespi, Gao and Peterson (2005) rearranges equation (5) in the following way:

$$p_t\phi_{it}\frac{\Delta f_{it}}{\Delta x_{ijt}} = w_{ijt}\left[1 + \frac{\theta_{ijt}}{v_{ij}}\right] \tag{6}$$

where θ_{ijt} denotes the conjectural elasticity of processor i and

$v_{ijt} = \frac{\Delta \mathrm{X}_{jt}}{\Delta \mathrm{w}_{ijt}}\cdot\frac{\mathrm{X}_{jt}}{\mathrm{w}_{ijt}}$ is the market input-supply price elasticity of processor i while buying j input at time period t. θ_{ijt} equals to 0 indicates that marginal product of the factor equals to marginal costs thus conditions for perfect competition hold, otherwise if θ_{ijt} equals to 1 the market is monopsonistic (Love, 1994).

Dividing both sides of equation (6) by p_t, multiplying by Δx_{ijt} and, respectively, summing up, the profit maximization problem can be expressed as follows:

$$\phi_{it}\left[\sum_{j=1}^{J}\frac{\Delta f_{it}}{\Delta x_{ijt}}\cdot\Delta x_{ijt}\right] = \sum_{j=1}^{J}\frac{w_{ijt}}{p_{it}}\left[1 + \frac{\theta_{ijt}}{v_{ij}}\right]\cdot\Delta x_{ijt} \tag{7}$$

Crespi, Gao and Peterson (2005) pointed out the processor and period-specific technological shocks (ϕ_{it}) affect the relationship described in equation (7). Using Monto Carlo simulations Examining Hall's method in estimating market power based on Monto Carlo simulations Hyde and Perloff (1994, 1995) drew two conclusions from their findings that are very important for market power analysis, especially, in countries with transition economies. First, the market power estimates are underestimated with increasing return to scale. Second, by decreasing returns to scale the market power estimates are overestimated.

3.3.2 PTA and GIM approaches

PTA approach assumes estimating the system of multiple equations. In particular in most of the cases the equations estimated in the model are production function, inverse supply or demand function and first order conditions. Moreover, the equations are estimated simultaneously providing possibility to obtain estimates both for input and output markets. Nevertheless, since the focus of the research is only oligopsony power the framework will be designed accordingly.

Consider Kazakh grain processing industry where firms produce a homogeneous output Y (wheat flour and other cereal foods). For production, they use agricultural inputs M as grain raw materials and non-agricultural inputs $\mathbf{Z}$ in a manufacturing process. Then the production function of the grain processor can be represented in the following way:

$$Y = f(M, \mathbf{Z}) \tag{8}$$

In Kazakh grain processing industry the main outputs produced by processors are: grain flour and fodder, and it is assumed that they are homogenous among the actors. For agricultural inputs eight main types of grains have been utilized by processors: wheat, buckwheat, oat, maize, rye, rice, barley and millet. As for non-agricultural inputs, labour and capital were employed for production process.

On the other hand, the grain processors purchase grain locally from Kazakh grain producers and use it as agricultural inputs. Therefore, inverse grain supply function for the processing industry can be given by:

$$W_M = f(M, \mathbf{V}) \tag{9}$$

where W_M denotes the price of the grain purchased by processing industry and $\mathbf{V}$ is the vector of the non-agricultural inputs utilized by grain producers, such as fuel, pesticides and fertilizers, and machinery (tractors).
In line with production and inverse supply functions profit maximizing problem of grain processor can be defined accordingly:

$$\Pi = P \cdot f(M, \mathbf{Z}) - W_M \cdot M - \boldsymbol{W}_{\mathbf{Z}} \cdot \mathbf{Z} \tag{10}$$

where P is the output price and W_Z is a vector of prices of non-agricultural inputs of grain processors.

After differentiating the processors profit maximization problem with respect to W_M and rearranging the equation FOC for estimating oligopsony power can be represented in the following way:

$$W_M \left(1 + \frac{\theta}{\varepsilon}\right) = P \cdot f_M \tag{11}$$

where $\varepsilon = (\partial M / \partial W_M)(W_M / M)$ is the own price elasticity of the grain, f_M is the marginal product of grain and θ is the conjectural elasticity measuring the degree of market power. Ranging between 0 and 1, θ indicates weather the market is purely competitive if θ=0 or monopsonistic if θ=1. Accordingly, estimates between the extremes show the oligopsony market structure, thus indicating Kazakh grain processors having bargaining power while purchasing grain.

4 EMPIRICAL ANALYSIS OF OLIGOPSONY POWER

4.1 TEST OF OLIGOPSONY POWER: EVIDENCE FROM HALL'S APPROACH

4.1.1 Empirical specification of the model

Estimation model is based on a path developed by Crespi et al. (2005). Integrating equations (2) and (7) in (3), using production function for estimations (for the derivation of the model see Chapter 3.2.1), yields to the following equation:

$$\Delta q_{it} = \sum_{j=1}^{J} \beta_{ij} \frac{w_{ijt}}{p_{it}} \Delta x_{ijt} + f_{it}\, \varepsilon_{it}, i = 1, \dots, I, \quad (12)$$

where q_{it} is the output quantity produced by grain processors i, p_{it} output price of grain processors i, w_{ijt} price paid by grain processors i to purchase J agricultural inputs, x_{ijt} quantity of J agricultural inputs purchased by processors i, ε_t unexpected productivity shocks; β_{ij} is the estimation parameter defined as:

$$\beta_{ij} = 1 + \frac{\theta_{ijt}}{v_{ijt}} = 1 + \frac{\theta_{ij}}{v_{ij}} \quad \forall t, \quad (13)$$

where θ_{ij} is the conjectural elasticity of grain processor i, and v_{ij} is the market input-supply elasticity firm i faces with respect to input j. The hypothesis $\mathrm{H}_0: \widehat{\beta_{ij}} = 1$ assumes competitive purchase of the grain processors, while rejection indicates noncompetitive behaviour.

Three controlled variables of Labour, Capital and Grain inputs are incorporated in the model equation (12). Both, the independent and the dependent variables of the equation are represented as the first differences for the regression analysis. Accordingly, the following parameters are estimated: the parameter for Labour reported as "β^L" is defined as $(pLr/pQr) * dL$, where pLr is the real price index of the labour, pQr

price of aggregated output and dL change in labour. Similarly, the capital parameter "β^{C}" is estimated as $(pCr/pQr) * dCr,$ where pCr is the real price index of capital and dCr change in capital. As for β^{M} parameter, $\beta^{M} = (pMr/pQr) * dM,$ where pMr is the real price and dM change in the agricultural inputs accordingly. Parameter β^{M} is an indicator of the market power and is more than 1 in case if it holds. Estimations for every sample are conducted and reported with and without constant.

4.1.2 Data requirement

The data used for the analysis is obtained from the website of the Agency of the Republic of Kazakhstan on statistics. The dataset combines the data provided in statistical yearbooks, such as "Industry of Kazakhstan and its regions", "Agriculture, forestry and fishery in the Republic of Kazakhstan", "Prices in agriculture, forestry and fishery in the Republic of Kazakhstan", "Regions of Kazakhstan". Nevertheless, the compilations do not provide the full set of data necessary for analysis, particularly, at the regional level, and therefore the missing data is supplemented by other sources, such as Information and Computing Centre of the Agency of the Republic of Kazakhstan on statistics (ICCARKS).

The data contains observations from 14 regions: Akmola, North Kazakhstan, Atyrau, Aktobe, East Kazakhstan, Karaganda, Mangystau, South Kazakhstan, Kostanay, Almaty region, Pavlodar, West Kazakhstan, Jambyl, Kyzylorda and two cities, Almaty and Astana. Since grain production and processing industries are not significantly represented in these cities the observations are integrated in Almaty and Akmola regions respectively.

Our empirical analysis is based on a balanced regional panel dataset of output and input variables of processors for the time period 2000–2011. The list of the variables for the estimation of the model is summarized in the Table 4.1.1. This dataset combines the observations from the grain processors for fodder and flour production ("Manufacture of grain mill products, starches and starch products" NACE 10.6 and "Manufacture of prepared animal feeds" NACE 10.9), since grain processors produce both products in many cases. Therefore, the quantities and prices for input/outputs are given in aggregated form for both sectors. More precisely, the grain processors' output quantities (Q) used in the analysis combine following products:

1. Flour products—"Cereal and vegetable flour, mix of fine grindings";
2. Groats—"Groats, wholemeal flour and pellets and other cereal products;
3. Fodder—"Ready feed for farm animals, except flour and lucerne pellets";
4. Rice-peeled;
5. Rice-semi or fully milled.

The quantity values (QV) for the processor outputs are obtained from the website of The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan (CSMNERK [j]). The observations combine aggregated output values of all products produced by grain processors. Even though variable is not included in the model for analysis it is used to estimate average aggregate grain prices. Accordingly, average price for aggregated grain processor outputs (pQ) is estimated based on simple division of aggregated output value over output quantity.

The equation (12) also requires the processors' grain input quantities (M) for the estimation, as well. However, it is impossible to obtain the data from the sources. Hence, it is estimated in the following way: as a first step, the ratio of "Grain processing products" and "Grain used for processing purposes" balanced data is calculated at the national level provided by the Agency of the Republic of Kazakhstan on statistics. Next, the aggregated grain input quantities for processors on the regional level are estimated by multiplying the output quantity data by the ratio (since the output quantity data is available on regional level). As for the price of grain inputs (pM) wheat prices are taken as a proxy since the wheat is the most produced and processed grain in Kazakhstan.[5] The input data contains observations of eight different types of grains produced in Kazakhstan: wheat, rye, maize, oat, barley, buckwheat, rice, and millet.

5 "End of year" wheat prices due to regional level data availability in statistical journals.

Table 4.1.1: Variables used in the model

Variable	Definition	Unit	MIN	MAX	MEAN	Source
Q	Aggregated output quantities of grain	Ton	493.0	1,025,995.0	230,910.5	CSMNERK (b, 2012: 82–86; 2008: 95–96; 2006: 99; 2002: 76)
pQ	Price of output	Tenge/kg	3.7	81.3	22.5	Constructed based on QV and Q data
M	Grain input quantities	Ton	701.0	1,202,969.0	301,280.1	Constructed based on CSMNERK (j)
pM	Wheat producer price	Tenge/Ton	4,053.7	35,955.0	15,678.7	CSMNERK (d, 2012: 130; 2011: 84; 2006: 108)
L	Labour employed	Employees	16.2	2,299.0	831.3	ICCARKS
pL	Labour wage	Tenge	2,758.6	57,347.7	15,462.2	ICCARKS
C	Capital depreciation	Thousand Tenge	1,781.0	1,495,909.0	218,409.4	ICCARKS
pC	Capital price index	Percent (%)	100.0	205.1	134.2	CSMNERK (i, 2013: 214)
CPI	Consumer price index	Percent (%)	100.0	264.9	157.1	CSMNERK (g, 2013: 203)
NuE	Number of enterprises		1	98	25.6	ICCARKS

Source: Own illustration based on the panel data from the CSMNERK and the ICCARKS, respectively.

Regarding non-agricultural inputs, three main elements are included in the analysis: Electricity, Capital and Labour. However, it is possible to acquire only parts of the necessary electricity variable data. The other part of the data is either incomplete or not reliable. Therefore, since electricity costs represent only 3% in the total cost structure[6] it is excluded from analysis to avoid bias in estimations. The cost of capital variable (pC) "Price index in capital goods" is used from annual yearbooks "Regions of Kazakhstan". Depreciation data is employed for capital variable (C). The data for labour covers the number of employees (L) and average monthly salary of employees (pL) in grain processing industry. Variable for number of enterprises (NuE) combines records of registered active enterprises in flour and fodder production sectors. The capital quantity and labour, as

6 Empirical findings based on the correspondence with Kazakh grain experts.

well as, number of enterprises data are obtained from the Information and Computing Centre of the Agency of Statistics of the Republic of Kazakhstan.

Consumer Price Index (CPI) is obtained from the Agency of Statistics of the Republic of Kazakhstan and used for deflation of all the price observations provided in the dataset. To exclude the inflation factor in price development, all the price data are deflated to the base year 2000.

It should be noted that the data obtained from abovementioned sources are incomplete and contain missing values for Atyrau and Mangystau regions. Therefore, for filling the missing values, the linear interpolation and extrapolation techniques are employed in STATA.

Due to the wheat export ban in 2008, it is justified analysing the time period separately in order to capture the ban effects on the grain market structure. Therefore, the periodical samples are introduced. The total dataset is disintegrated into three period subsamples and, ultimately, four different samples are employed for the analyses:

1. Sample "I"—time period 2000–2011;
2. Sample "I.A"—time period 2000–2003;
3. Sample "I.B"—time period 2004–2007;
4. Sample "I.C"—time period 2008–2011.

The total dataset sample "I" covers the time period 2000–2011 and comprehends 154 observations. Accordingly, each of the subsamples comprises 42 observations and is analyzed separately. Samples "I.A" and "I.B" account for the time period 2000–2003 and 2004–2007, respectively, when the grain sector started to recover and grow annually. Consequently, sample "I.C" covers the time period 2008–2011, when the government restrictions were introduced.

In a similar manner the total dataset is analyzed according to the geographical areas, due to the heterogeneity in the regional grain sector development. Hence, the four different geographical areas are defined as follows:

1. Sample "North";
2. Sample "East";
3. Sample "South";
4. Sample "West".

Each of the geographical samples aggregates the data from certain regions. Sample "North" comprises Akmola, Kostanay, North Kazakhstan and Pavlodar regions. Sample "East" covers Almaty, East Kazakhstan, and Karaganda regions. Sample "South" aggregates the data from Jambyl, Kyzylorda and South Kazakhstan and sample "West" Aktobe, Atyrau, West Kazakhstan and Mangystau regions. "North" and "West" geographical areas incorporate four regions each and aggregate 48 observations each. Accordingly, "South" and "East" cover three regions each and combine 36 observations each.

4.1.3 Estimation results

In this subchapter the estimation results obtained from the tests using Hall's approach, are discussed. The analyses are undertaken using the Stata 14.1 software package and the estimations are presented according to the samples discussed in the data section. The main focus is on β and conducted θ parameters indicating the existence and the degree of the market power.

To estimate the degree of the market power, it is compulsory to estimate the grain supply elasticity. Since wheat and wheat flour products comprise the biggest share in the grain processing industry, wheat supply elasticity parameter is used as a proxy of the processors grain supply elasticity. Estimation of the supply function of the grain processors resulted in the wheat own price elasticity estimate of 0.2395. Consequently, the degree of market power is estimated using the conducted parameter $\theta = 0.2395*(\beta^M - 1)$.

The estimations are based on equation (12). The market power test is conducted by applying ordinary least squares (OLS). However, to eliminate endogeneity problem in the model 2SLS is introduced, as well. "The number of active enterprises in milling sector" is applied in 2SLS, as an instrumental variable. The variable denotes the aggregated registers for the active enterprises in two NACE 10.6 and NACE 10.9 sectors. The models are tested for heteroscedasticity and autocorrelation based on White and Wooldridge tests, respectively. Hausman test is employed to analyze the consistency of the estimated parameters.

Results are presented in three parameters for the following inputs: β^M for grain, β^L for labour and β^C for capital factor variables. The model is estimated with and without constant to exclude the constant factor in the model; however, in most of the cases where the constant factor is significant, exclusion of constant does not provide significantly different results. Results also combine estimations for conducted parameter θ which identifies the degree of market power.

Table 4.1.2 depicts the estimates for the sample of total time period 2000–2011. Sample comprises 154 observations. The parameter β for agricultural inputs fluctuates around 0.4 at 1% significance level, which means that there is no evidence of noncompetitive behaviour on the market. Taking into account formula (13), the estimation results of the conducted parameter β are negative, due to the fact that the β parameter is less than one. A similar problem is detected in the study of Hall (1988) and low parameter estimates are interpreted as an indicator of increased returns to scale. Hyde and Perloff (1995) also conclude that the results obtained by Hall's method are very sensitive to deviations from constant returns to scale: in the case of decreasing returns to scale the test results reveals overestimates of the price mark-up, in the case of increasing returns to scale they obtained underestimates and works well by the industry with constant returns to scale. Consequently, following Hyde and Perloff (1995), low estimates for the period samples till 2008 can be related to increased returns to scale, since Kazakh agriculture sector including milling sector went through wave of investments in grain processing sector after 2000. According to the UNECE (2014, p. 186) report, growth of the mill plants capacity during the period 1998–2009 facilitated to increased flour production and raise in flour exports by nine times. Therefore, investing in new machinery and growth in flour production and export could result in increased return to scales in flour production sector.

Similar estimates are received for other periodical samples. Just like in case of total sample the estimates for 2000–2003 and 2004–2007 range between 0.335 and 0.382 (for detailed results see Table A4.1 and Table A4.2 in the appendix) and are statistically significant.

From the obtained results it can be concluded that there is no evidence that processors exert market power when purchasing grain for the period samples "I" (2000–2011), "I.A" (2000–2003) and "I.B" (2004–2007). Furthermore, conducted parameter is negative which theoretically means that input suppliers are getting a higher price than they would get in case of perfect competition. The results can be partly explained by the fact that, after 1990's crisis period, the Kazakh grain sector government started to interfere in the market (Pomfret, 2007). By introducing heavy subsides, the government distorted the market in favor of grain producers. The distortions occurred in forms of higher subsidized grain price, from which the grain producers benefited and expanded their production. Therefore, it can be argued that the parameters estimated in the model for the given time periods, might reflect these market distortions.

Similar results are obtained from the samples of the geographical subsamples. None of the parameters indicate existence of market power. The parameters are either too low and/or statistically insignificant. The estimations of the geographical subsamples are summarized in the appendix in Table A4.3–Table A4.6.

In contrast, different results are obtained for the periodical sample "I.C" (2008–2011). In this sample, the parameter β^M estimates range from 1.234 to 1.296 at the 1% significance level. Consequently, estimated conducted parameter varies between 0.06 and 0.07. Even though θ parameter is closer to 0 rather than to 1, still it can be argued that the grain processors behaved noncompetitively.

Table 4.1.2: Estimation results of the sample "I"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	0.400*** [6.31]	0.381*** [9.27]	0.425*** [6.40]	0.375*** [9.02]
β^L	0.019 [0.84]	0.015 [0.72]	0.008 [0.38]	0.013 [0.67]
β^C	0.006 [1.06]	0.006 [1.52]	0.006 [1.07]	0.005 [1.50]
Constant	11158.298*** [3.31]	2493.444 [0.59]		
θ	−0.143 [−9.49]	−0.148 [−15.08]	−0.137 [−8.65]	−0.149 [−15.06]
Observations	154	154	154	154
R-squared	0.40	0.45	0.41	
Adjusted R-squared	0.39	0.43	0.40	
Wooldridge test	0.83 (0.38)	0.83 (0.38)	0.83 (0.38)	0.83 (0.38)
White test (Prob > chi2)	(31.89) 0.0002		(31.75) 0.0002	

Notes: The values in parentheses are asymptotic standard errors.
The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

The results for the time period 2008–2011 can be better explained by closely observing and analysing the processes occurring at that time. Particularly, after the government intervention in 2008, most of the grain produced in the country could only be sold at the local market since export was banned and traders were not be able to operate in foreign markets. The grain processors had opportunity to use the situation in their favor. Intuitively it is expected that increased grain supply in the Kazakh grain market would push the price down. Interestingly, that was not the case and, furthermore, the wheat price increase was observed in the market (Oskenbayev 2014). Along with the wheat price, wheat flour and wheat bread prices increased during the same time period, as well. As it can be seen from the price development graph on Figure 2.12, the price increase on wheat flour and wheat bread was much higher than wheat price shift. Furthermore, the bakery industry maintained increased prices in the following periods, despite the fact that flour and wheat prices decreased substantially during 2008–2011. Accordingly, even estimated θ parameter is relatively small, it can still be concluded that grain processors exerted oligopsony market power while purchasing grain.

Table 4.1.3: Estimation results of the sample "I.C"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	1.276*** [6.88]	1.234*** [11.89]	1.296*** [6.88]	1.241*** [12.03]
β^L	0.013 [0.49]	0.010 [0.34]	0.011 [0.45]	0.011 [0.39]
β^C	0.011 [1.03]	0.009 [1.49]	0.011 [1.03]	0.009 [1.55]
Constant	6848.553* [1.86]	−4547.414 [−0.88]		
θ	0.066 [1.49]	0.056 [2.26]	0.071 [1.57]	0.058 [2.34]
Observations	42	42	42	42
R-squared	0.83	0.85	0.82	
Adjusted R-squared	0.81	0.83	0.81	
Wooldridge test	4.36 (0.06)	4.36 (0.06)	4.36 (0.06)	4.36 (0.06)
White test (Prob > chi2)	(25.23) 0.0027		(25.64) 0.0023	

Notes: The values in parentheses are asymptotic standard errors.
The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

To summarize, the results suggest that grain processors do not exert market power for overall analyzed period 2000–2011. The only significant parameters indicating market power are found for 2008–2011, which can be explained as a consequence of the government intervention in the grain market. Export ban prompted the price spikes on wheat and flour product. Yet, shift in flour prices were higher compared to the local wheat prices, indicating that the processors benefited from increased profit margin more than grain suppliers.

The findings are similar to the results obtained by Hall (1988), Levinsohn (1993), Boyle (2004), Crespi et al. (2005), and Crépon (2005). According to their findings the estimates of β range from -1.2 to 2.17 and are statistically significantly different from zero, demonstrating that the prices paid for inputs by the processing industry are lower than would prevail under competitive conditions.

4.1.4 Conclusions

The analyses of the Kazakh grain processing industry covers the time period 2000–2011. The study employs the Hall's (1988) approach to test the industry for oligopsony market power. The model applied is originally developed by Crespi et al. (2005). The analyses are conducted by regional level data using OLS and 2SLS estimation tools. The results are reported and interpreted in estimated parameters.

The estimation results suggest that there is no evidence of oligopsony market power in the grain processing industry for the time periods 2000–2011, 2000–2003 and 2004–2007. Low market power parameter demonstrates that the grain processors were not able to influence the price on the grain market.

Yet, the estimations are different for 2008–2011. For the period, the analysis revealed statistically significant results of noncompetitive behaviour. Compared to the other time periods, the market power parameter has increased which can be explained by the export ban in 2008, probably having caused distortions on the grain market. The ban effects can be divided into two, short and medium term effects. In the short run, wheat, wheat flour and bread prices in Kazakhstan increased. However, the price changes were not symmetrically transferred along the supply chain. The flour and bread mark ups were much higher than the one of wheat. It means that the grain processors were able to influence the wheat price and push it down, as they were among few to purchase the grain on the local market as export of the wheat flour was still allowed. In the medium term, the ban was lifted and the world market started to influence the local prices. Local producers and processors had to adjust the prices. Yet, interestingly, the bread price remained at the same level as during the ban period, whereas wheat and wheat flour prices decreased.

Despite the fact that the local market received extra amounts of the grain during the ban period, the wheat price still went up. Considering that approximately half of the grain produced in Kazakhstan is exported raw, intuitively the wheat price should have been pushed down. Yet, it was not the case that can be explained by expectation effect. The ban lasted only six months and grain suppliers expected it to end soon, so they could store and keep grain before the market was stabilized.

Overall no market power was detected on Kazakh grain market for 2000–2011. However, the export ban in 2008 had destabilizing effect and distorted the market. Grain processors used export ban in their favor and were able to influence the wheat price on the local level.

4.2 MEASURING THE DEGREE OF OLIGOPSONY POWER: EVIDENCE FROM GIM APPROACH

4.2.1 Empirical specification of the model

The derivation of the empirical model is based on Perekhozhuk et al. (2017). Production function (8) defined in the theoretical framework is rewritten in the following way:

$$\ln Y = \alpha_0 + \sum_{m=1}^{3} \alpha_m \ln X_m + \frac{1}{2}\sum_{m=1}^{3}\sum_{n=1}^{3} \alpha_{mn}\, ln\, X_m \ln X_n + \alpha_T T$$
$$+\frac{1}{2}\alpha_{TT} TT + \sum_{m=1}^{3} \alpha_{mT} \ln X_m\, T \quad (14)$$

where X_m and X_n represent industry inputs (m, n=M, L, K,), accordingly, M, L, K, indicating grain inputs, labour employed and capital. Time trend variable T is used to capture the technical change factor.

In a similar way inverse supply function (9) defined in the theoretical framework can be rewritten in the following way:

$$\ln M = \beta_0 + \sum_{i} \beta_i \ln W_i + \sum_{j} \beta_j \ln I_j + \beta_{SA} \ln A + \beta_T T$$
$$+\beta_{iT} \ln W_i\, T + \beta_{jT} \ln I\, T + \beta_{SAT} \ln AT + \frac{1}{2}\beta_{TT} TT \quad (15)$$

where W_i (i=M, E, C, P) are (in respective order) the price of grain delivered from agricultural producers to the processing industry (W_M), the price for wheat exported from Kazakhstan to international markets (W_E), the price received for cattle (W_C), the price received for potatoes (W_P), j=(P_w, T_w, F_w, S_w) is the price for I=(P, T, F, S) inputs of agricultural producers. P, T, F, S represent pesticide-fertilizers, tractors, fuel, workers salary and P_w, T_w, F_w, S_w their relative prices respectively.

From production function (14) marginal product of grain can be estimated in the following way:

$$f_M = \left(\alpha_M + \sum_{n=1}^{3} \alpha_{Mn} \ln X_n + \alpha_{MT} T\right) \frac{Y}{M}, n = M, L, K \qquad (16)$$

For an estimating model in GIM approach minimum two equations are necessary both production or supply function, and FOC. Therefore, for deriving FOC for profit maximization marginal product (16) can be substituted in supply function (11) in the following way:

$$W_M = \left(\alpha_M + \sum_{n=1}^{3} \alpha_{Mn} \ln X_n + \alpha_{MT} T\right) P \frac{Y}{M} \Big/ \left(1 + \frac{\theta}{\varepsilon}\right) \qquad (17)$$

Own price elasticity and cross-price elasticities can be estimated by the partial derivatives of supply function with respect to prices:

$$\partial \ln M / \partial \ln W_i = \beta_i + \sum_n \beta_{in} \ln W_n + \beta_{iSA} \ln A + \beta_i T \qquad (18)$$

Similarly, elasticities for the quasi fixed factor sown area of the supply function can be derived in the following way:

$$\partial \ln M / \partial \ln SA = \beta_{SA} + \beta_{SA} \ln A + \sum_i \beta_{iSA} \ln W_i + \beta_{SAT} T \qquad (19)$$

And for time variable

$$\partial \ln M / \partial T = \beta_T + \beta_{TT} T + \sum_i \beta_{iT} \ln W_i + \beta_{SAT} \ln A \qquad (20)$$

And substituting the own price elasticity (18) in FOC (17) will lead to the following derivation:

$$W_M = \frac{(\alpha_M + \sum_n \alpha_{Mn} \ln X_n + \alpha_{MT} T) P \frac{Y}{M}}{(1 + \theta/(\beta_M + \sum_n \beta_{Mn} \ln W_n + \beta_{MSA} \ln A + \beta_{MT} T))} \tag{21}$$

Considering that supply elasticity is not constant and, therefore, $\varepsilon = \beta_M + \beta_{MT}\mathrm{T}$, FOC can be rewritten in the following way:

$$W_M = \left(\alpha_M + \sum_{n=1}^{3} \alpha_{Mn} \ln X_n + \alpha_{MT} T \right) P \frac{Y}{M} \Big/ (1 + \theta/(\beta_M + \beta_{MT} T)) \tag{22}$$

To maintain homogeneous degree of zero subsequent parameter restrictions are implemented in the model:

$$\sum_i \beta_i = 0 \sum_i \beta_{in} = 0 \sum_i \beta_i SA = 0 \sum_i \beta_i T \tag{23}$$

Applying the GIM approach, SF (15) and FOC (22) have been estimated simultaneously in a system of equations. However, theoretically, it is possible to estimate the FOC with PF, as well. By estimating structural model using two endogenous variables M and W_M it was possible to test the market power parameter.

4.2.2 Data and descriptive statistics

In the GIM approach the model consists of two equations: a supply function (SF) and first order conditions (FOC). Accordingly, the data employed in the analyses consists of the data necessary to estimate supply function together with the first order conditions. More specifically, apart from the variables used in the Hall approach (see Chapter 4.1.2), additionally, input price data of the grain production is employed for estimating supply function parameters.

Table 4.2.1 summarizes the complete variable set used in GIM approach, including ones for estimating supply function parameters. In order to estimate the parameter, the price data of five major factors on input side of the grain producers is collected for the analysis. The factor variables included in the model are the following:

1. Average salary of workers employed S_w;
2. Price index of tractors T_w;
3. Price index of pesticides and fertilizers P_w;
4. Price index for fuel F_w;
5. The total grain sown area SA.

Despite the variables described above, other factors that influence the price and quantity of the grain supplied to the processors, are also considered. Namely, grain export price index Ep, cattle price index Cp and price index for potatoes Pp are included in the analysis. That is due to the fact that the grain export and animal feeding industries, along with processing industry are the important distribution channels for grain producers (for the detailed grain supply chain distribution see Chapter 2.2.2). Hence, the prices in those sectors can compete with the processors purchasing price and impact the grain flow within the distribution channels including the quantity delivered to the processors.

As it regards to the potato price index the reason it is included in analysis is its potential to be substitute crop to grain produced on arable lands. Put otherwise grain producer can switch their arable land in potato production in case of higher profitability. The price data used in the analysis is deflated by consumer price index (CPI).

Table 4.2.1: Variables used in GIM approach

Variable	Definition	Unit	MIN	MAX	MEAN	Source
Q	Aggregated output quantities of grain processors	Ton	493	1,025,995	230,910.5	CSMNERK (b, 2012: 82–86; 2008: 95–96; 2006: 99; 2002: 76)
pQ	Output price of processors	Tenge/kg	3.7	81.3	22.5	Constructed based on QV and Q data
M	Grain input quantities for processors	Ton	701.0	1,202,969	301,280.1	Constructed based on CSMNERK (j)
pM	Wheat producer price	Tenge/Ton	4,053.7	35,955	15,678.7	CSMNERK (d, 2012: 130; 2011: 84; 2006: 108)
L	Labour employed	Employees	16.2	2,299	831.3	ICCARKS
K	Capital depreciation	Thousand Tenge	1,781.0	1,495,909	218,409.4	ICCARKS
CPI	Consumer price index	Percent (%)	100.0	264.9	157.1	CSMNERK (g, 2013: 203; 2008: 399; 2004: 476)
Pw	Price index for pesticides and fertilizers of grain producers	Percent (%)	98.6	251.4	133.4	CSMNERK (d, 2012: 127; 2005: 101)
Tw	Price for tractors of grain producers	Percent (%)	100.0	253.9	133.0	CSMNERK (d, 2012: 124; 2005: 99)
Fw	Price index for fuel of grain producers	Percent (%)	100.0	600.1	233.2	CSMNERK (d, 2012: 126; 2005: 100)
Sw	Average Salary of workers in grain production	Tenge	3,619.0	50,847.0	18,537.0	CSMNERK (k, 2012: 204; a, 2006: 111; 2003: 94)
SA	Total grain sown area	Thousand ha	0.1	4,537.1	1,058.8	CSMNERK (a, 2012: 57–61; 2010: 69–72; 2006: 150–155; 2003: 109–115)
Cp	Price index for cattle	Percent (%)	99.2	501.3	202.1	CSMNERK (d, 2012: 109; 2006: 95)
Ep	Wheat export price	Tenge/Ton	12,634.9	62,476.5	21,394.3	GTA (2017)
Pp	Potato price	Tenge/Ton	11,151.0	70,000.0	31,483.7	CSMNERK (d, 2012: 133; 2008: 121)

Source: Own illustration based on the panel data from the CSMNERK and the ICCARKS, respectively.

From the processors side the output data combines the quantity amount variable (Q) which represents the total production of the grain processed products; the price of the processors' output products (pQ). On the input side of processors quantity (M) indicates the amount of the grain supplied to processors; and the purchased grain price represented by the average wheat price (pM). The details how these variables are acquired and constructed are already explained in the Chapter 4.1.2.

The panel dataset covers the time period 2000–2011 and combines 168 regional level observations. Some variables suffered from missing values and they are either imputed by interpolation method or replaced by national level observations. Such an example is potato price data missing for Atyrau, Kyzylorda and Mangystau regions for the whole period and for West Kazakhstan and Jambyl regions for the years 2000 and 2003 years accordingly.

4.2.3 Estimation results

In this chapter the estimation results for GIM approach are discussed. The model is estimated using the software SAS (SAS, 2008), since it provides possibility for simultaneous estimation of system of equations.

The model is estimated applying two different N3SLS and GMM methods and, therefore, the results are presented and discussed for both cases. Supply function is specified as truncated translog function and hence in estimation supply function, the variables are used as exogenous variables along with the time trend interaction terms. Regional dummies are reported, as well to capture the regional effect in the grain supply function. The estimates of the full model with regional dummies are presented separately in appendix Table A4.7.

In total 53 parameters are estimated, out of which 33 parameters belong to SF and 20 parameters to FOC. As it can be seen from Table 4.2.2, in case of N3SLS, R-squared and adjusted R-squared are 0.97 and 0.96, respectively, for supply function and 0.79 and 0.76 for FOC. Similar picture can be observed in case of GMM method where the difference with

N3SLS is minor and provides high estimate of model explanation. DW test is applied to test for serial autocorrelation and it ranges from 1.4 to 1.71.

Market power parameter θ, unexpectedly, has a negative sign, however it is close to zero in both N3SLS and GMM cases, and is statistically insignificant. To test whether it is statistically zero, the Wald test is employed. Consequent estimations and discussion are provided at the end of the chapter.

Table 4.2.2: GIM model summary

	N3SLS	GMM
Number of observations	168	168
Objective Value	1.15	0.30
Total number of estimated parameters:	**53**	**53**
SF	33	33
FOC	20	20
R-Squared:		
SF	0.97	0.96
FOC	0.79	0.78
Adj R-Squared:		
SF	0.96	0.96
FOC	0.76	0.75
Durbin Watson:		
SF	1.40	1.44
FOC	1.71	1.71

Source: Own illustration based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table 4.2.3 summarizes the estimated parameters for the SF and FOC. SF parameters combine estimations of inputs, such as β^{Pw} for pesticides and fertilizers, β^{Tw} for tractors, β^{Fw} for fuel and β^{Sw} for salary in grain production. As for β^{M}, it is the estimate used for calculating own price elasticity, however significance of the parameter and negative sign is unexpected. Sown area parameter β^{SA} as quasi-fixed factor provides strong estimate ranging from 0.677 to 0.695 and is statistically significant in N3SLS and GMM cases, respectively. The rest of the SF parameters provide estimates of above discussed parameters in interaction with time trend variable.

Table 4.2.4 depicts the elasticities of the supply function. As it can be observed input price elasticities, ε_{Pw}, ε_{Sw} and ε_{Tw} are negative in both N3SLS and GMM methods, which is expected: intuitively, increased input prices should lead to increased price and reduced sales of grain accordingly. However, exception is the fuel price with positive sign, which can be reflecting the high subsidies directed in grain production for diesel purchases. The table also contains the parameters for estimation of the rate of technical change δ_T and production elasticities of the inputs of the processors α_I, the index I indicating the inputs of the processors ($I=M$, L, K). As it can be seen depending on the estimation method, the own price elasticity ε_M for the materials was estimated 0.023 and 0.033 in case of N3SLS and GMM, respectively.

All cross-price elasticities have negative signs, yet they are statistically insignificant. Exceptions are statistically significant elasticities for cattle. Theoretical explanation behind the negative sign for cattle is that higher price on cattle should yield to increase in cattle production and, therefore, increase grain purchase by this sector.

Table 4.2.3: Estimation results of GIM approach

		N3SLS		GMM	
Parameters		Coefficient	t-Stat.	Coefficient	t-Stat.
Supply Function	β^0	17.642*	1.67	20.719**	2.12
	β^M	−0.532***	−2.66	−0.493***	−3.09
	β^{Pw}	−1.976**	−1.98	−2.197***	−2.98
	β^{Tw}	1.459	1.14	1.340	1.33
	β^{Fw}	0.859	1.55	0.894**	2.02
	β^{Sw}	0.074	0.15	−0.072	−0.18
	β^{SA}	0.677***	2.79	0.695**	2.5
	β^{Cp}	−0.948	−1.49	−0.957**	−2.03
	β^{Ep}	−0.849**	−2.01	−1.075***	−3.95
	β^{Pp}	0.448	1.19	0.572*	1.85
	β^T	0.272	0.25	0.011	0.01
	β^{MT}	0.085***	2.72	0.081***	3.12
	β^{PwT}	0.253**	2.31	0.262***	3.04
	β^{TwT}	−0.279**	−2.21	−0.306***	−2.96
	β^{FwT}	−0.122*	−1.81	−0.096*	−1.85
	β^{SwT}	−0.073	−1.11	−0.040	−0.68
	β^{SAT}	0.002	0.59	0.003	0.87
	β^{CpT}	0.013	0.21	0.020	0.46
	β^{EpT}	0.114**	2.05	0.133***	3.85
	β^{PpT}	−0.077	−1.56	−0.099**	−2.15
	β^{TT}	0.016	0.92	0.011	0.68
FOC	α_M	−0.548**	−2.15	−0.494**	−2.23
	α_{MM}	0.127***	3.42	0.135***	4.93
	α_{ML}	−0.067	−1.28	−0.071*	−1.76
	α_{MK}	−0.021	−1.09	−0.030**	−2.39
	α_{MT}	0.013*	1.67	0.013**	2.07
	θ	−0.007	−0.6	−0.004	−0.47

Notes: The values in parentheses are asymptotic standard errors.
The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Consequently, increased grain flow to the cattle industry will lead to the decreased amount delivered to the processing sector. As it is depicted in the supply chain description the feeding industry for the time period analyzed was already consuming on average 22% of the total grain production. In a similar way, higher export prices can have negative impact on the amount of grain delivered to the grain processors. Potatoes, as substitutes to grain production, have influence on grain prices, as well reflected in the negative elasticity parameter.

Table 4.2.4: Supply function elasticities

	N3SLS		GMM	
Parameters	**Coefficient**	**t-Stat.**	**Coefficient**	**t-Stat.**
ε_M	0.023	0.73	0.033*	1.86
ε_{Pw}	−0.334	−0.71	−0.493	−1.59
ε_{Tw}	−0.356	−0.6	−0.650	−1.44
ε_{Fw}	0.068	0.22	0.267	1.04
ε_{Sw}	−0.399	−1.04	−0.331	−1.11
ε_{Cp}	−0.866**	−2.36	−0.825***	−2.97
ε_{Ep}	−0.105	−0.71	−0.208**	−2.06
ε_{Pp}	−0.051	−0.28	−0.073	−0.56
ε_{SA}	0.694***	2.74	0.716**	2.45
δ_T	0.378	0.32	0.082	0.08
a_I	0.377***	7.15	0.400***	10.07

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

As expected, supply elasticity of quasi-fixed factor for the total sown area (ε_{SA}) is positive and statistically significant at 1% confidence interval, indicating higher sown areas lead to the higher grain amount delivered to the grain processors.

Table 4.2.5: Market power test results

Market power parameter	Test	N3SLS		GMM	
		Statistics	Pr > ChiSq	Statistics	Pr > ChiSq
θ=0	Wald	0.37	0.545	0.22	0.637
θ=0.01	Wald	2.14	0.144	2.87	0.091
θ=0.02	Wald	5.38	0.020	8.49	0.004
Homogeneity of degree zero in price	Wald	6.13	0.013	12.93	0.000

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

As for the tests for the market power parameter, the estimate was tested for detecting the true value using Wald test. Therefore, the parameter θ was tested for different values. As it can be seen from Table 4.2.5 test results suggest with high degree of confidence that θ=0 in both N3SLS and GIM cases.

Therefore, the findings are in line with the results of Perekhozhuk et al. (2017) implying that oligopsony parameter from Ukrainian dairy market in most of the cases is close to zero. In a comparable manner the oligopsony power parameter for the tea market in Kenya and ROW obtained by Weerahewa (2003) is estimated as 0.0015 and 0.0091, respectively. The estimates are very close to the findings of Muth and Wohlgenant (1999) the oligopsony parameter ranging from –0.00015 to 0.00008. Similar estimates are obtained by Grau et al. (2017) while testing the German dairy supply chain. The range of the parameter for oligopsony power of processors on the raw milk market is ranging from 0.04 to 0.07, implying rather competition on the market. However, higher estimates were received by O'Donnell et al. (2007) on Australian Flour and cereal market, where the oligopsony parameter for wheat input is 0.180.

4.2.4 Conclusions

By applying the GIM approach, the equations of supply function and first order conditions are estimated in a system. The analyses are conducted at the regional level with GMM and N3SLS estimation methods. Total 53 parameters are estimated in a system and, accordingly, the elasticities are calculated.

Own price and cross price elasticities are in line with expected results. In both of the estimation methods, coefficients have a positive sign. However, they are low and statistically insignificant. The same applies to the other factor elasticities. All of them are negative and statistically insignificant. The only unexpected sign is fuel factor elasticity, which can be related to the subsidies provided to the producers. Similarly, as expected, the cross price elasticities are negative, as well. For sown area, the coefficients are positive and highly statistically significant.

Overall testing market power parameter results indicate that θ is statistically 0. Consequently, it suggests that the Kazakh grain processors do not have enough bargaining power to influence the grain prices for the time period 2000–2011. Hence, no oligopsony power exists on the market and it is competitive.

4.3 MEASURING THE DEGREE OF OLIGOPSONY POWER: EVIDENCE FROM PTA MODEL

4.3.1 Empirical specification of model

In case of PTA the estimation of the structural model occurs with three equations. That is PF, SF and FOC are being estimated in a system. Since the GIM approach has been formulated in the same framework the derivation of the equations are not presented in this chapter (for derivation of the equations see Chapter 4.2.1). Therefore, below are presented only the equations estimated within PTA.

Hence the production function that has been already derived in case of GIM approach had the same equation:

$$\ln Y = \alpha_0 + \sum_{m=1}^{3} \alpha_m \ln X_m + \frac{1}{2} \sum_{m=1}^{3} \sum_{n=1}^{3} \alpha_{mn}\, ln\, X_m \ln X_n + \alpha_T T + \frac{1}{2} \alpha_{TT} TT + \sum_{m=1}^{3} \alpha_{mT} \ln X_m\, T \tag{14}$$

Supply function

$$\ln M = \beta_0 + \sum_i \beta_i \ln W_i + \sum_j \beta_j \ln I_j + \beta_{SA} \ln A + \beta_T T + \beta_{iT} \ln W_i\, T + \beta_{jT} \ln I\, T + \beta_{SAT} \ln AT + \frac{1}{2} \beta_{TT} TT \tag{15}$$

and FOC

$$W_M = \left(\alpha_M + \sum_{n=1}^{3} \alpha_{Mn} \ln X_n + \alpha_{MT} T \right) P \frac{Y}{M} \Big/ (1 + \theta / (\beta_M + \beta_{MT} T)) \tag{22}$$

Accordingly, by estimating structural model using three endogenous variables Y, M and W_M it is possible to test the market power parameter.

4.3.2 Data and descriptive statistics

In PTA three equations are estimated. Accordingly, the list of the variables estimated in the system is different from the one in GIM. In PTA, the production function is additionally estimated that provided the factor parameters and relative elasticities for the labour and capital. In the GIM approach the labour and capital data of processors is used, as well however, only as interaction terms with grain parameters in estimating FOC. In PTA these variables are used in PF and FOC, as well with their interaction terms. Also regional dummies are incorporated in the model. However, the number of equations required the same data set that is used in GIM.

Table 4.3.1 summarizes the variables used in the PTA approach. It is identical to the GIM approach variable list yet, for the informative point of view it is still provided in the chapter.

Therefore, the dataset applied for PTA analysis covers the time period 2000–2011 and combines 168 observations on regional level. Since the detailed explanation of the dataset and its sources with references is provided in the previous chapters (see Chapters 4.1.2 and 4.2.2), in this chapter further description is not repeated.

Table 4.3.1: Variables used in PTA approach

Variable	Definition	Unit	MIN	MAX	MEAN	Source
Q	Aggregated output quantities of grain processors	Ton	493	1,025,995	230,910.5	CSMNERK (b, 2012: 82–86; 2008: 95–96; 2006: 99; 2002: 76)
pQ	Price of output	Tenge/kg	3.7	81.3	22.5	Constructed based on QV and Q data
M	Grain input quantities for processors	Ton	701.0	1,202,969	301,280.1	Constructed based on CSMNERK (j)
pM	Wheat producer price	Tenge/Ton	4,053.7	35,955	15,678.7	CSMNERK (d, 2012: 130; 2011: 84; 2006: 108)
L	Labour employed	Employees	16.2	2,299	831.3	ICCARKS
K	Capital depreciation	Thousand Tenge	1,781.0	1,495,909	218,409.4	ICCARKS
CPI	Consumer price index	Percent (%)	100.0	264.9	157.1	CSMNERK (g, 2013: 203; 2008: 399; 2004: 476)
Pw	Price index for pesticides and fertilizers of grain producers	Percent (%)	98.6	251.4	133.4	CSMNERK (d, 2012: 127; 2005: 101)
Tw	Price for tractors of grain producers	Percent (%)	100.0	253.9	133.0	CSMNERK (d, 2012: 124; 2005: 99)
Fw	Price index for fuel of grain producers	Percent (%)	100.0	600.1	233.2	CSMNERK (d, 2012: 126; 2005: 100)
Sw	Average Salary of workers in grain production	Tenge	3,619.0	50,847.0	18,537.0	CSMNERK (k, 2012: 204; a, 2006: 111; 2003: 94)
SA	Total grain sown area	Thousand ha	0.1	4,537.1	1,058.8	CSMNERK (a, 2012: 57–61; 2010: 69–72; 2006: 150–155; 2003: 109–115)
Cp	Price index for cattle	Percent (%)	99.2	501.3	202.1	CSMNERK (d, 2012: 109; 2006: 95)
Ep	Export price for wheat	Tenge/Ton	12,634.9	62,476.5	21,394.3	GTA (2017)
Pp	Potato price	Tenge/Ton	11,151.0	70,000.0	31,483.7	CSMNERK (d, 2012: 133; 2008: 121)

Source: Own illustration based on the panel data from the CSMNERK and the ICCARKS, respectively.

4.3.3 Estimation results

The estimation results from the PTA approach are being presented and analyzed below. Similar to the GIM approach, the PTA model is also estimated as system of simultaneous equations using the software SAS (SAS, 2008).

For estimation, N3SLS and GMM methods are used and the results compared. Production function estimated within PTA is specified as translog function (equation 14) and supply function is specified as truncated translog function (equation 25). Regional dummies are incorporated in both supply and production functions, and the parameter estimates are summarized in appendix Table A4.8.

Table 4.3.2: PTA model summary

	N3SLS	GMM
Number of observations	168	168
Objective Value	1.78	0.37
Total number of estimated parameters:	**76**	**76**
TPF	25.5	25.5
TSF	33	33
FOC	17.5	17.5
R-Squared:		
TPF	0.99	0.98
TSF	0.96	0.97
FOC	0.77	0.79
Adj R-Squared:		
TPF	0.99	0.98
TSF	0.96	0.96
FOC	0.75	0.76
Durbin Watson:		
TPF	1.98	1.73
TSF	1.44	1.46
FOC	1.87	1.78

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

From total 76 parameters estimated, 34 parameters refer to the translog supply function (TSF) and 28 parameters to the translog production function (TPF). The FOC (equation 22) has 18 parameters, of which two are shared by the TSF (equation 15) and five by the TPF (equation 14).

As Table 4.3.2 shows, high R^2 and adjusted R^2 indicate high explanatory power of the model. For FOC, the estimates are lower however the model explanatory power still remains high. The estimates for DW test for serial autocorrelation are relatively strong ranging between 1.44 and 1.98, rejecting the hypothesis of the presence of serial autocorrelation.

The estimated parameters are depicted in Table 4.3.3. The parameters are presented in three sections since the estimated structural model combines three equations. Production function estimates include factor parameters with interaction terms and most of them are statistically significant in GMM method. A similar picture can be observed in case of supply function estimated parameters. The parameters also provide the factor estimates with interaction terms. Slightly different estimates are received by N3SLS method, where not all the parameter estimates are statistically significant. The grain parameter α_M in production function is negative in both estimation methods, however statistically significant only in GMM. Similarly, β_M in supply function is also negative and statistically significant in both estimation methods. Moreover, it is close to the value obtained in GIM approach. At the end of the table, the θ parameter is given which is the indicator of the oligopsony power. As it can be observed, its estimates range from −0.019 to −0.009, and are statistically significant. Normally, θ parameter is 0 or positive; however, in some empirical analysis it can be negative, as well (Azzam, 1997).

In the PTA approach, unlike to GIM, the factor elasticity estimates for production function are additionally received. The estimates are statistically significant and positive for grain as main factor in processing production function. The other factors, such as labour and capital generated contrasting results in case of N3SLS and GMM. In case of N3SLS, the estimates are positive and statistically significant only for labour, however in case of GMM the estimates are negative and statistically significant.

Negative factor estimates can be explained by unutilized capacities existing in grain processing industry.

Table 4.3.3: Estimation results of PTA approach

		N3SLS		GMM	
Parameters		Coefficient	t-Stat.	Coefficient	t-Stat.
Translog Production Function (TPF)	a_0	−0.875	−0.64	3.162***	5.57
	a_M	−0.015	−0.09	−0.238***	−2.72
	a_L	1.061***	3.16	0.464***	3.15
	a_K	0.449*	1.74	−0.126	−1.1
	a_T	−0.093*	−1.73	−0.061***	−3.03
	a_{MM}	0.060***	9.57	0.104***	24.31
	a_{ML}	0.004	0.22	−0.044***	−4.08
	a_{MK}	−0.037**	−2.49	−0.037***	−5.49
	a_{MT}	0.013**	2.19	0.015***	4.97
	a_{LL}	−0.098**	−2.25	0.032	1.52
	a_{LK}	0.018	0.41	−0.030	−1.56
	a_{LT}	−0.012	−1.09	−0.023***	−4.86
	a_{KK}	−0.004	−0.21	0.030***	3.05
	a_{KT}	−0.001	−0.08	−0.003	−0.88
	a_{TT}	0.003	1.44	0.006***	4.54

Table 4.3.3: Estimation results of PTA approach (cont.)

		N3SLS		GMM	
Parameters		Coefficient	t-Stat.	Coefficient	t-Stat.
Translog Supply Function (TSF)	β^{0}	12.153	1.26	17.990***	2.76
	β^{M}	−0.518***	−2.87	−0.413***	−4.02
	β^{Pw}	−1.582*	−1.73	−2.260***	−4.48
	β^{Tw}	1.720	1.47	1.461**	2.19
	β^{Fw}	0.357	0.71	1.021***	3.81
	β^{Sw}	0.271	0.61	0.086	0.33
	β^{SA}	0.615***	2.76	0.687***	4.01
	β^{Cp}	−0.835	−1.43	−1.088***	−3.74
	β^{Ep}	−0.476	−1.24	−1.029***	−5.48
	β^{Pp}	0.398	1.16	0.583***	2.76
	β^{T}	0.728	0.72	0.409	0.69
	β^{MT}	0.083***	2.89	0.066***	4.02
	β^{PwT}	0.220**	2.2	0.274***	5.06
	β^{TwT}	−0.295**	−2.52	−0.293***	−4.44
	β^{FwT}	−0.073	−1.18	−0.141***	−4.18
	β^{SwT}	−0.082	−1.35	−0.063	−1.55
	β^{SAT}	0.002	0.48	0.004*	1.72
	β^{CpT}	0.016	0.28	0.016	0.59
	β^{EpT}	0.076	1.49	0.140***	5.92
	β^{PpT}	−0.081*	−1.79	−0.108***	−3.55
	β^{TT}	0.017	1.01	0.022**	2.14
FOC	θ	−0.019*	−1.66	−0.009*	−1.76

Notes: The values in parentheses are asymptotic standard errors.
The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

In this case the estimate can be considered 0 since its values in both N3SLS and GMM are close to zero. Nevertheless, to test the values statistically, the Wald test is applied and the results are presented at the end of the chapter.

Table 4.3.4: Production and Inverse Supply Function Elasticities

	N3SLS		GMM	
Parameters	**Coefficient**	**t-Stat.**	**Coefficient**	**t-Stat.**
ε_{PM}	0.389***	9.7	0.385***	17.88
ε_{L}	0.622**	2.32	−0.353***	−2.66
ε_{K}	0.072	0.30	−0.436***	−3.64
Y_{RTC}	1.083**	2.41	−0.404*	−1.72
ε_{M}	0.023	1.29	0.018**	1.88
ε_{Pw}	−0.151	−0.35	−0.481**	−2.09
ε_{Tw}	−0.199	−0.37	−0.446	−1.45
ε_{Fw}	−0.115	−0.41	0.107	0.74
ε_{Sw}	−0.265	−0.74	−0.323*	−1.80
ε_{Cp}	−0.734**	−2.19	−0.985***	−5.23
ε_{Ep}	0.017	0.13	−0.119*	−1.64
ε_{Pp}	−0.128	−0.76	−0.120	−1.60
ε_{SA}	0.628***	2.70	0.716***	3.95
δ_{T}	0.835	0.76	0.550	0.084

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Contrasting results are received for the returns to scale estimates. The N3SLS result is positive and statistically highly significant, implying increasing returns to scale. Conversely, the GMM estimate is negative and statistically insignificant. None of the statistically significant factor elasticity estimates are received for the supply function. However, all of them are negative as expected, except fuel prices in case of the GMM estimation method. The own price elasticities for grain are positive, however statistically significant with the GMM approach only. From cross price elasticities, statistically significant estimates are obtained for cattle price and export prices and the latter only in case of the GMM estimation method. In case of N3SLS the estimates are statistically insignificant except cattle price elasticity. Sown area estimates are positive and highly statistically significant in both N3SLS and GMM methods.

Table 4.3.5: Market Power Estimation Results

Market power parameter	Test	N3SLS		GMM	
		Statistics	Pr > ChiSq	Statistics	Pr > ChiSq
θ=0	Wald	2.74	0.098	3.11	0.078
θ=0.01	Wald	108.67	0.000	501.85	0.000
Constant returns to scale (CRS)	Wald	0.03	0.854	35.84	0.000
homogeneity of degree zero in price	Wald	4.34	0.037	26.65	0.000

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

As it was described above in this chapter, the market power parameter is negative, but close to zero. Consequently, to test the parameter value statistically, the Wald test is used. Two different values 0 and 0.01 were taken as possible options for the estimates. As it can be observed from Table 4.3.5, in both N3SLS and GMM estimation methods parameter θ is statistically 0 which implies that for the analyzed period, there is no evidence of market power.

The findings from the PTA approach stand very close to the one of Morrison Paul (2001), who also obtained low negative, but close to zero, estimate −0.0083 analysing the U.S. beef packing market. Negative estimates are also detected by Azzam (1997) and Perekhozhuk et al. (2017) in investigating the U.S. beef packing and Ukrainian dairy markets, respectively. Low estimates for oligopsony power are received by Quagrainie et al. (2003), Hockmann & Vöneki (2009) and Bakucs et al. (2009), as well. The results are also similar to the finding of Hovhannisyan and Gould (2012), testing the U.S. dairy market for oligopsony power. The estimated parameters range between 0.000 and 0.022.

4.3.4 Conclusions

In this chapter, the PTA approach is discussed and applied to the Kazakh grain processing sector testing for oligopsony market power. The analyses are conducted using 168 regional level observations and applying N3SLS and GMM estimation methods. Production and supply functions, and first order conditions are estimated in a system of structural model. For the estimation, the structural model estimates 76 parameters and relative factor elasticities for the production and supply functions.

Regarding the factor analysis, the grain production and supply functions elasticities approximate to 0.38 and 0.018, and are statistically significant. The coefficients can be considered low and the supply defined as, relatively, inelastic. On the other hand, the estimates of the other negative factor elasticities for production function indicate that processors did not utilized capacities with respect to labour and capital. Similar outcome is received with the GIM approach and the reasons regarding surplus in capacities are discussed in details in the Chapter 4.1.3.

The main finding of the PTA analysis is that for the time period 2000–2011 the Kazakh grain processors did not have oligopsony power over the grain suppliers. The value of market power parameter θ being statistically 0 implies that the grain processing industry does not have oligopsony characteristics. These results are in line with the estimations obtained from the from Hall's and GIM approaches estimated in previous chapters.

5 SUMMARY, DISCUSSION, AND CONCLUSION

5.1 DISCUSSION OF THE THEORETICAL FRAMEWORK

After examining empirical studies, three different approaches are revealed compatible for market power analysis in the Kazakh grain processing sector. The Hall's approach, the General Identification Method (GIM) and the Production-Theoretical Approach (PTA) are chosen for their advantages in testing agricultural markets, including grain markets, for oligopsony power. However, the models endure limitations, which are analyzed and taken into account.

The Hall's approach provides possibility to undertake analysis based on only one equation demanding, relatively, smaller range of the dataset. However, the strong assumption regarding the constant returns to scale appears to be the Achilles heel of the approach. The analysis shows the low or even negative estimates of a market power parameter, which contradicts the normally assumed parameter range between 0 and 1, and the assumption regarding constant return to scale. As empirical literature suggests, negative parameters may indicate increasing returns to scale that also characterized Kazakh grain processing sector during 2000–2011. This implies that the assumption of constant returns to scale within the Hall's approach cannot be justified for the Kazakh grain market.

Estimating two equations in the GIM approach, supply function and first-order conditions, provides more detailed results. Specifically, estimates regarding the supply function and its input and output elasticities, returns to scale and test of the market power parameter are obtained. GIM provides possibility to conduct more comprehensive analysis of the supply side of the grain processors compared to more parsimonious Hall's approach.

The PTA approach allows more solid analyses. A three equation system, incorporating supply and production functions and first order condition, is estimated simultaneously. Thus, in comparison to GIM approach, production function is estimated additionally allowing estimations of the input elasticities of the grain processors and determination of the functional forms.

Despite the fact that the GIM and PTA approaches cover wider range of dataset required for analyses, they also have their limitations. The models are sensitive to functional specifications (Hyde and Perloff, 1995; Perekhozhuk et al., 2016) and deviations might result in biased estimates. Therefore, to avoid misspecifications of two different estimation methods, N3SLS and GMM, are applied additionally for the analyses and the results are compared. The differences in results are insignificant.

5.2 SUMMARY OF THE FINDINGS

The aim of the study is to analyze the market power in Kazakh grain supply chain. More specifically, emphasis is on the grain processors exerting oligopsony power on grain suppliers. The study is motivated with the fact that a) the consolidation process has been observed in the grain processing sector for the last decade; b) the intensive government interventions on each level of the grain supply chain distorts the grain market; c) underdeveloped infrastructure and limited accessibility of the grain producers to financial resources and markets. Accordingly, the research question is formulated to test whether there is oligopsony market power exerted by grain processors on the local grain market.

According to the results, the processing industry does not have enough bargaining power to influence the price when purchasing grain for the total time period analyzed (2000–2011). The results are confirmed by the three different approaches applied for the analyses. However, the contrasting estimates are obtained for the time period 2008–2011. The increased market power parameter indicates that during the period with the wheat export ban between 2008 and 2011 processors had the possibility to influence the grain price, since the export ban limited an access of the grain suppliers to the international market. Moreover, the grain processing sector was the only distribution channel that could purchase the grain, since during the ban period wheat flour export was still allowed. Even though statistical results could not confirm the oligopsonistic behaviour of grain processors, the increase in the parameter during 2008–2011 compared to the time period before suggests that the processors increased their bargaining power.

Overall, the main findings of the study can be that split in two parts: 1) The grain processing market does not have oligopsonistic structure for the time period 2000–2011; 2) During the government interventions for the time period 2008–2011, when the grain export restrictions were introduced, the grain processors managed to the increase their the bargaining power. Yet, the market distortions were not enough to confirm the oligopsonistic market structure.

5.3 CONCLUSIONS AND FURTHER RESEARCH

The increase in bargaining power of grain processors for the time period 2008–2011 indicate that the government interventions can trigger non-competitive tendencies on the Kazakh grain market. Export bans can result in increased oligopsony power for grain processors allowing them to influence the grain purchasing prices. The short and medium term restrictions might have, relatively, severe consequences due to the producers' expectations on the duration of the export ban. Furthermore, maintaining such interventions in long term can lead to oligopsony market structure, if the export ban is not lifted. Oligopsony market, consequently, can be additional barrier for the further development of inefficient Kazakh grain sector.

Market power research in the Kazakh grain supply chain can be further enhanced. For the comprehensive analyses, it will be valuable to cover the grain trading sector, as well. It will provide the complete picture of the grain supply chain structure. Since around 26–27% of the grain is exported annually, large agroholdings represented in the trading sector might have possibility to influence the grain price, as well. Moreover, the cooperation in the Kazakh grain production sector is not developed and individual enterprises are too small to have bargaining power against the grain processors. Therefore, investigating the grain trading sector separately or in combination with the processing sector will lead to more comprehensive outcomes of the Kazakh grain supply analysis.

The bakery industry could be the focus of interest, as well. As the current study shows, after 2008 wheat bread prices increased and remained high in the following years, despite the fact that the wheat and wheat flour prices eventually decreased. Particularly, testing the Kazakh bakery industry for market power over the grain processors might provide solid results for the grain supply chain analysis. Moreover, the bread is considered as staple food in the country and strictly regulated by government for social stability reasons.

REFERENCES

Anders, S.M., 2008. "Imperfect competition in German food retailing: evidence from state level data". Atlantic Economic Journal, Vol. 36, No. 4, pp. 441–454. doi:10.1007/s11293-008-9136-8

Appelbaum, E., 1982. "The estimation of the degree of oligopoly power". Journal of Econometrics, Vol. 19, No. 2–3, pp. 287–299. doi:10.1016/0304-4076(82)90006-9

Azzam, A.M., 1997. "Measuring market power and cost efficiency effects of industrial concentration". The Journal of Industrial Economics, Vol. 45, No. 4, pp. 377–386.

Azzam, A.M., Pagoulatos., E., 1990. "Testing oligopolistic and oligopsonistic behaviour: An application to the US meat-packing industry". Journal of Agricultural Economics, Vol. 41, No. 3, pp. 362–370. doi:10.1111/j.1477-9552.1990.tb00652.x

Bakucs, Z.L., Fertö, I., Hockmann, H., Perekhozhuk, O., 2009. "Market power on the edge? An analysis of the German and Hungarian hog markets". Agrarwirtschaft, Vol. 58, No. 8, pp. 337–345.

Bhuyan, S., Lopez, R.A., 1998. "Oligopoly power and allocative efficiency in US food and tobacco industries". Journal of Agricultural Economics, Vol. 49, No. 3, pp. 434–442. doi:10.1111/j.1477-9552.1998.tb01283.x

Boulhol, H., 2008. "The upward bias of mark-ups estimated from the price-based methodology". Annales d'Économie et de Statistique, No. 89, pp. 131–156. doi:10.2307/27715165

Boyle, G.E., 2004. "Hall-Roeger tests of market power in Irish manufacturing industries". The Economic and Social Review, Vol. 35, No. 3, pp. 289–304.

Bresnahan, T.F., 1982. "The oligopoly solution is identified". Economics Letters, Vol. 10, No. 1–2, pp. 87–92.

Brosig, S., Yahshilikov, Y., 2005. "Interregional integration of wheat markets in Kazakhstan", Discussion Paper No. 88, Institute of Agricultural Development in Central and Eastern Europe. https://www.iamo.de/fileadmin/documents/dp88.pdf

Buschena, D.E., Perloff, J.M., 1991. "The creation of dominant firm market power in the coconut oil export market". American Journal of Agricultural Economics, Vol. 73, No. 4, pp. 1000–1008.

Business Media Group, 2011. "The report on the market research in industry with NACE 10.61 "Production of the milling industry". LP "Business Media Group", Almaty.

Crépon, B., Desplatz, R., Mairesse, J., 2005. "Price-cost margins and rent sharing: evidence from a panel of French manufacturing firms". Annales d'Économie et de Statistique, No. 79/80, pp. 583–610.

Crespi, J.M., Gao, Z., Peterson, H.H., 2005. "A simple test of oligopsony behaviour with an application to rice milling". Journal of Agricultural & Food Industrial Organization. Vol. 3, No. 2, pp. 1117–1134.

CSMNERK (a), Agriculture, forestry and fishery in Kazakhstan Republic (in Russian: Сельское, лесное и рыбное хозяйство в Республике Казахстан), Statistical Yearbooks 2000–2011 (various issues), The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (b), Industry of Kazakhstan and its regions (in Russian: Промышленность Казахстана и его регионов), Statistical Yearbooks 2000–2011 (various issues), The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (c), Kazakhstan in figures (in Russian: Казахстан в цифрах), Statistical Yearbooks 2000–2011 (various issues), The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (d), Prices in agriculture, forestry and fisheries in the Republic of Kazakhstan (in Russian: Цены в сельском, лесном и рыбном хозяйстве в Республике Казахстан), Statistical Yearbooks 2000–2013 (various issues), The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (e), Prices in industry and tariffs for production services in the Republic of Kazakhstan (in Russian: Цены в промышленности и тарифы на услуги производственного характера в Республике Казахстан), Statistical Yearbooks 2000–2013 (various issues), The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (f), Prices on consumer market in Kazakhstan (in Russian: Цены на потребительском рынке Республики Казахстан), Statistical Yearbooks 2000–2011 (various issues), The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (g), Regions of Kazakhstan (in Russian: Регионы Казахстана), Statistical Yearbook 2000–2013, The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (h), Regions of Kazakhstan in 2007 (in Russian: Регионы Казахстана в 2007 году), Statistical Yearbook 2008, The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (i), Regions of Kazakhstan in 2012 (in Russian: Регионы Казахстана в 2012 году), Statistical Yearbook 2013, The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

CSMNERK (j), Balance of resources and utilization of main agricultural products of the Republic of Kazakhstan for the years 2000–2013 (in Russian: Баланс ресурсов и использования основных продуктов сельского хозяйства Республики Казахстан), online database, The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana. http://stat.gov.kz

CSMNERK (k), Remuneration of labour in the Republic of Kazakhstan (in Russian: Оплата труда в республике Казахстан), Statistical Yearbook 2000–2012, The Committee on Statistics of Ministry of National Economy of the Republic of Kazakhstan, Astana.

Deodhar, S.Y., Sheldon, I.M., 1997. "Market power in the world market for soymeal exports". Journal of Agricultural and Resource Economics, Vol. 22, No. 1, pp. 78–86.

Eden, B., Griliches, Z., 1993. "Productivity, market power, and capacity utilization when spot markets are complete". The American Economic Review, Vol. 83, No. 2, pp. 219–223.

FAO, 2011. "Summary of proceedings: Europe and Central Asia Region". FAO Regional Office for Europe and Central Asia, Istanbul.

FAOSTAT, http://www.fao.org/giews/food-prices/tool/public/index.html#/dataset/international

Gohin, A., Guyomard, H., 2000. "Measuring market power for food retail activities: French evidence". Journal of Agricultural Economics, Vol. 51, No. 2, pp. 181–195.

Global Trade Atlas (GTA), 2017. Global Trade Information Services, Inc. Online database: www.gtis.com/gta

Griffith, G.R., 2000. "Competition in the food marketing chain". The Australian Journal of Agricultural and Resource Economics, Vol. 44, No. 3, pp. 333–367. doi:10.1111/1467-8489.00115

Hall, R.E., 1988. "The relation between price and marginal cost in U.S. industry". Journal of Political Economy, Vol. 96, No. 5, pp. 921–947.

Hall, R.E., Blanchard, O.J., Hubbard, R.G., 1986. "Market structure and macroeconomic fluctuations". Brookings Papers on Economic Activity, Vol. 1986, No. 2, pp. 285–338. doi:10.2307/2534476

Hovhannisyan, V.H., Gould, B.W., 2012. "A structural model of the analysis of retail market power: the case of fluid milk". American Journal of Agricultural Economics, Vol. 94, No. 1, pp. 67–79. doi:10.1093/ajae/aar124

Hyde, C.E., Perloff, J.M., 1994. "Can monopsony power be estimated?". American Journal of Agricultural Economics, Vol. 76, No. 5, pp. 1151–1155. doi:10.2307/1243408

Hyde, C.E., Perloff, J.M., 1995. "Can market power be estimated?". Review of Industrial Organization, Vol. 10, No. 4, pp. 465–485.

Hyde, C.E., Perloff, J.M., 1998. "Multimarket market power estimation: the Australian retail meat sector". Applied Economics, Vol. 30, No. 9, pp. 1169–1176.

ICCARKS, Information and Computing Centre of the Agency of the Republic of Kazakhstan on Statistics.

Koontz, R.S., Garcia, P., 1997. "Meat-packer conduct in fed cattle pricing: multiple-market oligopsony power". Journal of Agricultural and Resource Economics, Vol. 22, No. 1, pp. 87–103.

Kumbhakar, S.C., Baardsen, S., Lien G., 2012. "A new method for estimating market power with an application to Norwegian sawmilling". Review of Industrial Organization, Vol. 40, No. 2, pp. 109–129. doi:10.1007/s11151-012-9339-7

Lau, L.J., 1982. "On identifying the degree of competitiveness from industry price and output data". Economics Letters. Vol. 10, No. 1–2, pp. 93–99.

Levinsohn, J., 1993. "Testing the imports-as-market-discipline hypothesis". Journal of International Economics, Vol. 35, No. 1–2, pp. 1–22. doi:10.1016/0022-1996(93)90002-F

Lindeman, M., 2009. "Kazakhstan: Wheat Production Prospects and Trip Report". United States Department of Agriculture, Foreign Agricultural Service, Commodity Intelligence Report. http://www.pecad.fas.usda.gov/highlights/2009/08/kaz_05aug2009/

Lopez, R.A., You, Z., 1993. "Determinants of oligopsony power: The Haitian coffee case". Journal of Development Economics, Vol. 41, No. 2, pp. 275–284. doi:10.1016/0304-3878(93)90059-V

Lopez, R.E., 1984. "Measuring oligopoly power and production responses of the Canadian food processing industry". Journal of Agricultural Economics. Vol. 35, No. 2, pp. 219–230. doi:10.1111/j.1477-9552.1984.tb02048.x

Love, H.A., Shumway, C.R., 1994. "Nonparametric tests for monopsonistic market power exertion". American Journal of Agricultural Economics Vol. 76, No. 5, pp. 1156–1162. doi:10.2307/1243409

Lyddon, C., 2013. "Focus on Kazakhstan". Country Focus Department, World Grain Report. https://www.world-grain.com/articles/9846-focus-on-kazakhstan

Martins, J.O., Scarpetta, S., Pilat, D., 1996. "Mark-up ratios in manufacturing industries: estimates for 14 OECD countries", OECD Economics Department Working Papers, No. 162, OECD Publishing. doi:org/10.1787/18151973

Mei, B.M., Sun, C.S., 2008. "Assessing time-varying oligopoly and oligopsony power in the U.S. paper industry". Journal of Agricultural and Applied Economics, Vol. 40, No. 3, pp. 927–939.

Merél, P.R., 2009. "Measuring market power in the French comté cheese market". European Review of Agricultural Economics, Vol. 36, No. 1, pp. 31–51. doi:10.1093/erae/jbp004

Millán, J.A., 1999. "Short-run equilibrium and market power in the Spanish food, drink and tobacco industries". European Review of Agricultural Economics, Vol. 26, No. 2, pp. 229–243. doi:10.1093/erae/26.2.229

Morrison Paul, C.J., 2001. "Market and cost structure in the U.S. beef packing industry: a plant-level analysis". American Journal of Agricultural Economics, Vol. 83, No. 1, pp. 64–76. doi:10.1111/0002-9092.00137

Murray, B.C., 1995. "Measuring oligopsony power with shadow prices: U.S. markets for pulpwood and sawlogs". The Review of Economics and Statistics, Vol. 77, No. 3, pp. 486–498.

Muth, M.K., Wohlgenant, M.K., 1999. "A test for market power using marginal input and output prices with application to the U.S. beef processing industry". American Journal of Agricultural Economics, Vol. 81, No. 3, pp. 638–643. doi:10.2307/1244027

Norrbin, S.C., 1993. "The relation between price and marginal cost in U.S. industry: A contradiction". Journal of Political Economy, Vol. 101, No. 6, pp. 1149–1164. doi:10.1086/261918

O'Donnell, C.J., Griffith, G.R., Nightingale, J.J., Piggott., R.R., 2007. "Testing for market power in the Australian grains and oilseeds industries". Agribusiness, Vol. 23, No. 3, pp. 349–376. doi:10.1002/agr.20128

OECD, 2013. "OECD Review of Agricultural Policies: Kazakhstan 2013". OECD Publishing. http://dx.doi.org/10.1787/9789264191761-en

Oshakbayev, R., 2012. "Economy of grain export in Kazakhstan, perspectives and analysis of wheat export". FAO Regional Office for Europe and Central Asia, Research on the policy of transition of agriculture No. 6, 2012.

Oskenbayev, Y., Turabayev, G., 2014. "Price transmission analysis along the food chain in Kazakhstan". Modern Economy, Vol. 5, No. 3, pp. 175–187. http://dx.doi.org/10.4236/me.2014.53019

Perekhozhuk, O., 2007. "Marktstruktur und Preisbildung auf dem ukrainischen Markt für Rohmilch". Studies on the Agricultural and Food Sector in Central and Eastern Europe, Vol. 41, Halle (Saale), IAMO. https://www.iamo.de/fileadmin/documents/sr_vol41.pdf

Perekhozhuk, O., Hockmann, H., Fertö, I., Bakucs, L.Z., 2013. "Identification of market power in the Hungarian dairy industry: A plant-level analysis". Journal of Agricultural & Food Industrial Organization, Vol. 11, No. 1, pp. 1–13. doi:10.1515/jafio-2012-0005

Perekhozhuk, O., Glauben, T., Teuber, R., Grings, M., 2015. "Regional-level analysis of oligopsony power in the Ukrainian dairy industry". Canadian Journal of Agricultural Economics / Revue canadienne d'agroeconomie, Vol. 63, No. 1, pp. 43–76. doi:10.1111/cjag.12037

Perekhozhuk, O., Glauben, T., Grings, M., Teuber, R., 2017. "Approaches and methods for the econometric analysis of market power: A survey and empirical comparison". Journal of Economic Surveys, Vol. 31, No. 1, pp. 303–325. doi:10.1111/joes.12141

Perloff, J.M., Karp, L.S., Golan, A., 2007. "Estimating market power and strategies". New York: Cambridge University Press.

Perloff, J.M., Shen, E.Z., 2012. "Collinearity in linear structural models of market power". Review of Industrial Organization, Vol. 40, No. 2, pp. 131–138. doi:10.1007/s11151-012-9336-x

Petrick, M., Wandel, J., Karsten, K., 2012. "Economic and social impacts of recent agro-investment in Kazakhstan's grain region". Annual World Bank conference on land and poverty, Washington DC. https://pdfs.semanticscholar.org/742c/f08fcb70e1ce97942dd21a1dd4a113420aec.pdf

Pomfret, R., 2007. "Distortions to agricultural incentives in Kazakhstan: Main report". Agricultural Distortions working paper, No. 3, Washington, DC: World Bank. http://documents.worldbank.org/curated/en/297141468148508238/Main-report

Prikhodko, D., 2009. "Grain markets in Kazakhstan, the Russian Federation and Ukraine". European Bank for Reconstruction and Development (EBRD), Food and Agriculture Organization of the United Nations. http://www.eastagri.org/files/Grain-Markets-KZ_RU_UA.pdf

Quagrainie, K., Unterschultz, J., Veeman, M., Jeffrey, S., 2003. "Testing for processor market power in the markets for cattle and hogs in Canada". Canadian Journal of Agricultural Economics, Vol. 51, No. 3, pp. 397–411. doi:10.1111/j.1744-7976.2003.tb00182.x

Roeger, W., 1995. "Can imperfect competition explain the difference between primal and dual productivity measures? Estimates for U.S. manufacturing". Journal of Political Economy, Vol. 103, No. 2, pp. 316–330.

Rogers, R.T., Sexton, R.J., 1994. "Assessing the importance of oligopsony power in agricultural markets". American Journal of Agricultural Economics, Vol. 76, No. 5, pp. 1143–1150. doi:10.2307/1243407

Scalco, P.R., Lopez, R.A., He, X., 2017. "Buyer and/or seller power? An application to the Brazilian milk market". Applied Economics Letters, Vol. 24, No. 16, pp. 1173–1176. doi:10.1080/13504851.2016.1262515

Schroeter, J., Azzam, A., 1990. "Measuring market power in multi-product oligopolies: the US meat industry". Applied Economics, Vol. 22, No.10, pp. 1365–1376. doi:10.1080/00036849000000107

Schroeter, J.R., 1988. "Estimating the degree of market power in the beef packing industry". The review of Economics and Statistics, Vol. 70, No. 1, pp. 158–162. doi:10.2307/1928165

Sexton, J.R., 2000. "Industrialization and consolidation in the U.S. food sector: Implications for competition and welfare". American Journal of Agricultural Economics, Vol. 82, No. 5, pp. 1087–1104.

Shapiro, D.M., 1987. "Measuring Market Power in U.S. Industry". National Bureau of Economic Research, Working Paper No. 2212.

Steen, F., Salvanes, K.G., 1999. "Testing for market power using a dynamic oligopoly model". International Journal of Industrial Organization, Vol. 17, No. 2, pp. 147–177. doi:10.1016/S0167-7187(97)00025-8

Swinnen, J.F.M., 2009. "Reforms, globalization, and endogenous agricultural structures". Agricultural Economics, Vol. 40, No. s1, pp. 719–732. doi:10.1111/j.1574-0862.2009.00410.x

Committee on Regulation of Natural Monopolies and Protection of Competition under the Ministry of National Economy of the Republic Kazakhstan, 2012. Corruption response issues of the Agency of the Republic of Kazakhstan for Competition Protection (Antimonopoly Agency of Kazakhstan). http://www.kremzk.gov.kz/eng/

UNECE, 2014. "United Nations Economic Commission for Europe Regulatory and procedural barriers to trade in Kazakhstan". United Nations and International Trade Centre, ECE/TRADE/407. https://www.unece.org/fileadmin/DAM/trade/Publications/ECE-TRADE_407E-Kazakhstan.pdf

Wandel, J., 2009. "Agroholdings and clusters in Kazakhstan's agri-food sector". IAMO Forum, Discussion Paper No. 126. https://www.iamo.de/fileadmin/documents/dp126.pdf

Wandel, J., Kozbagarova, B., 2009. "Kazakhstan: Economic transformation and autocratic power". Mercatus Policy Series, Country Brief No. 4. http://mercatus.org/uploadedFiles/Mercatus/Publications/Kazakhstan%20-%20Economics%20Transformation%20and%20Autocratic%20Power.pdf

Wann, J.J., Sexton, R.J., 1992. "Imperfect competition in multiproduct food industries with application to pear processing". American Journal of Agricultural Economics, Vol. 74, No. 4, pp. 980–990. doi:10.2307/1243196

Weerahewa, J., 2003. "Estimating market power of tea processing sector". Sri Lankan Journal of Agricultural Economics, Sri Lanka Agricultural Economics Association (SAEA), Vol. 5, No. 1, pp. 1–15.

Zheng, X., Vukina, T., 2009. "Do alternative marketing arrangements increase pork packers' market power?". American Journal of Agricultural Economics, Vol. 91, No. 1, pp. 250–263. doi:10.1111/j.1467-8276.2008.01185.x

APPENDIX

Table A2.1: Number of processors at regional level (2000–2012)

Regions	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Republic of Kazakhstan	342	376	405	412	423	438	362	323	300	300	305	301	281
Akmola	62	72	76	72	65	67	57	46	42	38	34	37	35
Aktobe	9	8	7	9	8	6	5	5	6	3	5	6	5
Almaty	81	98	92	78	94	98	93	62	56	56	59	56	37
Atyrau		1				1	2	2	2	1	1	1	
West Kazakhstan	10	9	11	9	8	3	4	3	4	5	7	6	5
Jambyl	15	16	17	11	10	11	7	14	9	8	3	5	7
Karaganda	16	14	23	21	21	21	19	17	23	25	31	31	32
Kostanay	35	39	58	71	63	72	56	61	55	62	54	48	49
Kyzylorda	7	32	17	20	25	26	14	7	6	4	6	7	7
Mangystau	3	3	3	3				2	3	4	3	5	3
South Kazakhstan	42	25	31	25	36	43	43	47	40	37	41	34	35
Pavlodar	23	14	13	18	21	16	17	13	14	16	15	16	14
North Kazakhstan	21	18	22	29	24	26	15	14	13	15	18	16	21
East Kazakhstan	18	27	35	46	48	48	30	30	27	26	28	33	31

Source: Statistical data regarding the number of grain processing plants provided the Information and Computing Centre of the Agency on Statistics of the Ministry of National Economy of the Republic of Kazakhstan. This plant-level data include the number of actively operating legal entities, which according to the general classifier of economic activities (OKED) relating to the production of flour products, starches and starch products (OKED 106) and the production of ready-made animal feeds (OKED 109) for time period from 1999 to 2011.

Table A2.2: Regional level concentration of grain processing industry (2000–2012)

Regions	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Republic of Kazakhstan	0.003	0.003	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.004
Akmola	0.016	0.014	0.013	0.014	0.015	0.015	0.018	0.022	0.024	0.026	0.029	0.027	0.029
Aktobe	0.111	0.125	0.143	0.111	0.125	0.167	0.200	0.200	0.167	0.333	0.200	0.167	0.200
Almaty	0.012	0.010	0.011	0.013	0.011	0.010	0.011	0.016	0.018	0.018	0.017	0.018	0.027
Atyrau	—	1.000	—	—	—	1.000	0.500	0.500	0.500	1.000	1.000	1.000	—
West Kazakhstan	0.100	0.111	0.091	0.111	0.125	0.333	0.250	0.333	0.250	0.200	0.143	0.167	0.200
Jambyl	0.067	0.063	0.059	0.091	0.100	0.091	0.143	0.071	0.111	0.125	0.333	0.200	0.143
Karaganda	0.063	0.071	0.043	0.048	0.048	0.048	0.053	0.059	0.043	0.040	0.032	0.032	0.031
Kostanay	0.029	0.026	0.017	0.014	0.016	0.014	0.018	0.016	0.018	0.016	0.019	0.021	0.020
Kyzylorda	0.143	0.031	0.059	0.050	0.040	0.038	0.071	0.143	0.167	0.250	0.167	0.143	0.143
Mangystau	0.333	0.333	0.333	0.333	—	—	—	0.500	0.333	0.250	0.333	0.200	0.333
South Kazakhstan	0.024	0.040	0.032	0.040	0.028	0.023	0.023	0.021	0.025	0.027	0.024	0.029	0.029
Pavlodar	0.043	0.071	0.077	0.056	0.048	0.063	0.059	0.077	0.071	0.063	0.067	0.063	0.071
North Kazakhstan	0.048	0.056	0.045	0.034	0.042	0.038	0.067	0.071	0.077	0.067	0.056	0.063	0.048
East Kazakhstan	0.056	0.037	0.029	0.022	0.021	0.021	0.033	0.033	0.037	0.038	0.036	0.030	0.032

Source: Own calculations based on plant-level data provided by the Information and Computing Centre of the Agency on Statistics of the Ministry of National Economy of the Republic of Kazakhstan (see Table above)

Table A2.3: Number of processors by geographical area (2000–2012)

Geographical area	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
North	141	143	169	190	173	181	145	134	124	131	121	117	119
South	64	73	65	56	71	80	64	68	55	49	50	46	49
West	22	21	21	21	16	10	11	12	15	13	16	18	13
East	115	139	150	145	163	167	142	109	106	107	118	120	100
Kazakhstan	342	376	405	412	423	438	362	323	300	300	305	301	281

Source: Own calculations based on plant-level data provided by the Information and Computing Centre of the Agency on Statistics of the Ministry of National Economy of the Republic of Kazakhstan (see Table above)

Table A2.4: Concentration of grain processing industry by geographical area (2000–2012)

Geographical area	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
North	0.007	0.007	0.006	0.005	0.006	0.006	0.007	0.007	0.008	0.008	0.008	0.009	0.008
South	0.016	0.014	0.015	0.018	0.014	0.013	0.016	0.015	0.018	0.020	0.020	0.022	0.020
West	0.045	0.048	0.048	0.048	0.063	0.100	0.091	0.083	0.067	0.077	0.063	0.056	0.077
East	0.009	0.007	0.007	0.007	0.006	0.006	0.007	0.009	0.009	0.009	0.008	0.008	0.010
Republic of Kazakhstan	0.003	0.003	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.004

Source: Own calculations based on plant-level data provided by the Information and Computing Centre of the Agency on Statistics of the Ministry of National Economy of the Republic of Kazakhstan (see Table above)

Table A4.1: Estimations of sample "I.A"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	0.362*** [4.34]	0.352*** [6.36]	0.382*** [4.58]	0.342*** [6.31]
β^L	−0.014 [−0.61]	−0.022 [−1.17]	−0.018 [−0.70]	−0.017 [−0.91]
β^C	0.005** [2.65]	−0.003 [−0.63]	0.006** [2.63]	−0.001 [−0.12]
Constant	5375.927 [1.17]	−9315.388 [−1.53]		
θ	−0.15 [−7.66]	−0.16 [−11.7]	−0.15 [−7.4]	−0.16 [−12.16]
Observations	42	42	42	42
R-squared	0.50	0.53	0.55	
Adjusted R-squared	0.46	0.48	0.51	
Wooldridge test	9.06 (0.01)	9.06 (0.01)	9.06 (0.01)	9.06 (0.01)
White test (Prob > chi2)	(7.9) 0.54		(8.4) 0.49	

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table A4.2: Estimations of sample "I.B"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	0.335*** [3.60]	0.361*** [6.35]	0.338** [2.55]	0.366*** [6.55]
β^L	0.174** [2.21]	0.139*** [2.72]	0.097 [1.26]	0.127*** [2.66]
β^C	−0.006 [−0.59]	−0.006 [−0.89]	0.001 [0.09]	−0.005 [−0.83]
Constant	29,235.758*** [3.49]	6381.444 [0.68]		
θ	−0.15 [−7.14]	−0.15 [−11.24]	−0.15 [−5.01]	−0.15 [−11.36]
Observations	42	42	42	42
R-squared	0.44	0.63	0.32	
Adjusted R-squared	0.39	0.58	0.26	
Wooldridge test	2.33 (0.15)	2.33 (0.15)	2.33 (0.15)	2.33 (0.15)
White test (Prob > chi2)	(23.4) 0.0054		(24) 0.0043	

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table A4.3: Estimations of sample "North"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	0.345*** [3.67]	0.325*** [4.11]	0.366*** [3.64]	0.321*** [4.05]
β^L	−0.001 [−0.02]	−0.003 [−0.07]	−0.012 [−0.40]	−0.003 [−0.09]
β^C	0.016 [1.12]	0.015 [1.55]	0.017 [1.08]	0.015 [1.53]
Constant	16,347.692* [1.80]	3018.155 [0.23]		
θ	−0.16 [−6.97]	−0.16 [−8.53]	−0.15 [−6.3]	−0.16 [−8.56]
Observations	44	44	44	44
R–squared	0.37	0.41	0.38	
Adjusted R-squared	0.32	0.35	0.33	
Wooldridge test	2.75 (0.20)	2.75 (0.20)	2.75 (0.20)	2.75 (0.20)
White test (Prob > chi2)	(14.98) 0.09		(14.98) 0.09	

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table A4.4: Estimations of sample "East"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	0.402*** [4.27]	0.397*** [4.86]	0.448*** [4.41]	0.422*** [5.14]
β^L	0.068 [1.20]	0.071 [1.32]	0.046 [0.73]	0.057 [1.05]
β^C	0.001 [0.20]	0.001 [0.16]	0.001 [0.16]	0.001 [0.26]
Constant	15,197.223* [2.03]	20,591.784 [1.55]		
θ	−0.14 [−6.34]	−0.14 [−7.38]	−0.13 [−5.43]	−0.14 [−7.03]
Observations	33	33	33	33
R-squared	0.44	0.44	0.46	
Adjusted R-squared	0.39	0.36	0.40	
Wooldridge test	6.50 (0.126)	6.50 (0.126)	6.50 (0.126)	6.50 (0.126)
White test (Prob > chi2)	(7.76) 0.559		(16.52) 0.057	

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table A4.5: Estimations of sample "South"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	0.458*** [3.18]	0.443*** [4.83]	0.517*** [3.09]	0.436*** [4.69]
β^L	0.099* [1.78]	0.066 [0.97]	0.057 [1.08]	0.051 [0.79]
β^C	0.011 [0.95]	0.01 [0.84]	0.013 [0.86]	0.009 [0.80]
Constant	12,576.444* [1.96]	3756.688 [0.60]		
θ	−0.13 [−3.77]	−0.13 [−6.07]	−0.12 [−2.89]	−0.13 [−6.07]
Observations	33	33	33	33
R-squared	0.57	0.65	0.58	
Adjusted R-squared	0.53	0.60	0.54	
Wooldridge test	31.72 (0.03)	31.72 (0.03)	31.72 (0.03)	31.72 (0.03)
White test (Prob > chi2)	(7.53) 0.58		(9.99) 0.35	

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table A4.6: Estimations of sample "South"

Coefficient	OLS	2SLS	OLS	2SLS
β^M	0.310*** [6.14]	0.305*** [4.30]	0.326*** [5.15]	0.284*** [4.01]
β^L	0.023** [2.54]	0.022* [1.72]	0.021** [2.23]	0.015 [1.31]
β^C	0.006** [2.06]	0.005** [1.98]	0.006** [1.92]	0.005** [1.82]
Constant	2369.468** [2.21]	1975.225 [1.14]		
θ	−0.17 [−13.67]	−0.17 [−9.82]	−0.16 [−10.67]	−0.17 [−10.11]
Observations	44	44	44	44
R-squared	0.36	0.38	0.36	
Adjusted R-squared	0.32	0.32	0.31	
Wooldridge test	61.60 (0.004)	61.60 (0.004)	61.60 (0.004)	61.60 (0.004)
White test (Prob > chi2)	(0.86) 1.00		(0.63) 1.00	

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table A4.7: Estimation results of GIM approach

		N3SLS		GMM	
Parameters		Coefficient	t-Stat.	Coefficient	t-Stat.
Supply Function	β^{0}	17.642*	1.67	20.719**	2.12
	β^{M}	−0.532***	−2.66	−0.493***	−3.09
	β^{Pw}	−1.976**	−1.98	−2.197**	−2.98
	β^{Tw}	1.459	1.14	1.340	1.33
	β^{Fw}	0.859	1.55	0.894**	2.02
	β^{Sw}	0.074	0.15	−0.072	−0.18
	β^{SA}	0.677***	2.79	0.695**	2.5
	β^{Cp}	−0.948	−1.49	−0.957**	−2.03
	β^{Ep}	−0.849**	−2.01	−1.075***	−3.95
	β^{Pp}	0.448	1.19	0.572*	1.85
	β^{T}	0.272	0.25	0.011	0.01
	β^{MT}	0.085***	2.72	0.081***	3.12
	β^{PwT}	0.253**	2.31	0.262***	3.04
	β^{TwT}	−0.279**	−2.21	−0.306***	−2.96
	β^{FwT}	−0.122*	−1.81	−0.096*	−1.85
	β^{SwT}	−0.073	−1.11	−0.040	−0.68
	β^{SAT}	0.002	0.59	0.003	0.87
	β^{CpT}	0.013	0.21	0.020	0.46
	β^{EpT}	0.114**	2.05	0.133***	3.85
	β^{PpT}	−0.077	−1.56	−0.099**	−2.15
	β^{TT}	0.016	0.92	0.011	0.68
	β^{rd2}	−0.124	−0.28	−0.028	−0.06
	β^{rd3}	1.656***	3.07	1.739***	2.88
	β^{rd4}	1.725	0.82	2.118	0.85
	β^{rd5}	0.990*	1.92	1.091**	1.83
	β^{rd6}	0.104	0.17	0.092	0.12
	β^{rd7}	−0.065	−0.13	−0.026	−0.05
	β^{rd8}	0.860**	1.99	0.910**	1.89
	β^{rd9}	0.918	0.95	1.119	0.98
	β^{rd10}	0.619***	3.31	0.594***	3.92
	β^{rd11}	1.314	0.51	1.586	0.53
	β^{rd12}	−0.137	−0.27	−0.053	−0.1
	β^{rd13}	0.203	1.2	0.240**	1.83
	β^{rd14}	1.788**	2.43	1.889***	2.29

		N3SLS		GMM	
Parameters		Coefficient	t–Stat.	Coefficient	t–Stat.
FOC	α_M	−0.548**	−2.15	−0.494**	−2.23
	α_{MM}	0.127***	3.42	0.135***	4.93
	α_{ML}	−0.067	−1.28	−0.071**	−1.76
	α_{MK}	−0.021	−1.09	−0.030**	−2.39
	α_{MT}	0.013*	1.67	0.013	2.07
	θ	−0.007	−0.6	−0.004	−0.47
	c^{rd2}	11,636.62***	7.54	11,385.6***	7.68
	c^{rd3}	−67.44	−0.05	−159.47	−0.18
	c^{rd4}	13,625.03***	12.08	13,023***	8.72
	c^{rd5}	8746.70***	7.01	8398.26***	10.09
	c^{rd6}	8216.22***	5.57	8109.65***	9.22
	c^{rd7}	9268.90***	7.53	8934.08***	10.57
	c^{rd8}	8396.31***	6.37	8335.75***	9.39
	c^{rd9}	9590.17***	6.18	9422.37***	7.07
	c^{rd10}	7889.96***	5.85	7563.81***	9.3
	c^{rd11}	13,422.51***	9.3	12,197.5***	7.71
	c^{rd12}	9886.17***	7.83	9334.11***	11.1
	c^{rd13}	9922.68***	8.98	9528.95***	11.75
	c^{rd14}	7221.06***	5.44	6846.1***	5.97

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

Table A4.8: Estimation results of PTA approach

		N3SLS		GMM	
Parameters		Coefficient	t-Stat.	Coefficient	t-Stat.
Translog Production Function (TPF)	α_0	−0.875	−0.64	3.162***	5.57
	α_M	−0.015	−0.09	−0.238***	−2.72
	α_L	1.061***	3.16	0.464***	3.15
	α_K	0.449*	1.74	−0.126	−1.1
	α_T	−0.093*	−1.73	−0.061***	−3.03
	α_{MM}	0.060***	9.57	0.104***	24.31
	α_{ML}	0.004	0.22	−0.044***	−4.08
	α_{MK}	−0.037**	−2.49	−0.037***	−5.49
	α_{MT}	0.013**	2.19	0.015***	4.97
	α_{LL}	−0.098**	−2.25	0.032	1.52
	α_{LK}	0.018	0.41	−0.030	−1.56
	α_{LT}	−0.012	−1.09	−0.023***	−4.86
	α_{KK}	−0.004	−0.21	0.030***	3.05
	α_{KT}	−0.001	−0.08	−0.003	−0.88
	α_{TT}	0.003	1.44	0.006***	4.54
	α^{rd2}	0.238*	1.8	0.727***	7.95
	α^{rd3}	0.059	0.55	−0.012	−0.13
	α^{rd4}	0.516**	2.21	1.300***	10.45
	α^{rd5}	0.057	0.54	0.215***	3.43
	α^{rd6}	0.301*	1.93	0.634***	5.8
	α^{rd7}	0.161	1.16	0.665***	9.08
	α^{rd8}	−0.018	−0.14	−0.215***	−2.85
	α^{rd9}	0.169	1.06	0.889***	10.51
	α^{rd10}	−0.057	−0.56	−0.249***	−2.89
	α^{rd11}	0.658**	2.18	1.293***	9.65
	α^{rd12}	0.198	1.38	0.490***	5.89
	α^{rd13}	−0.069	−0.62	−0.310***	−4.12
	α^{rd14}	0.011	0.11	−0.124*	−1.83

Table A4.8: Estimation results of PTA approach (cont.)

		N3SLS		GMM	
Parameters		Coefficient	t-Stat.	Coefficient	t-Stat.
Translog Supply Function (TSF)	β^{0}	12.153	1.26	17.990***	2.76
	β^{M}	–0.518***	–2.87	–0.413***	–4.02
	β^{Pw}	–1.582*	–1.73	–2.260***	–4.48
	β^{Tw}	1.720	1.47	1.461**	2.19
	β^{Fw}	0.357	0.71	1.021***	3.81
	β^{Sw}	0.271	0.61	0.086	0.33
	β^{SA}	0.615***	2.76	0.687***	4.01
	β^{Cp}	–0.835	–1.43	–1.088***	–3.74
	β^{Ep}	–0.476	–1.24	–1.029***	–5.48
	β^{Pp}	0.398	1.16	0.583***	2.76
	β^{T}	0.728	0.72	0.409	0.69
	β^{MT}	0.083***	2.89	0.066***	4.02
	β^{PwT}	0.220**	2.2	0.274***	5.06
	β^{TwT}	–0.295**	–2.52	–0.293***	–4.44
	β^{FwT}	–0.073	–1.18	–0.141***	–4.18
	β^{SwT}	–0.082	–1.35	–0.063	–1.55
	β^{SAT}	0.002	0.48	0.004*	1.72
	β^{CpT}	0.016	0.28	0.016	0.59
	β^{EpT}	0.076	1.49	0.140***	5.92
	β^{PpT}	–0.081*	–1.79	–0.108***	–3.55
	β^{TT}	0.017	1.01	0.022**	2.14
	β^{rd2}	–0.215	–0.53	–0.042	–0.14
	β^{rd3}	1.501***	3.02	1.750***	4.61
	β^{rd4}	1.201	0.63	1.958	1.28
	β^{rd5}	0.833*	1.75	1.097***	3.01
	β^{rd6}	–0.053	–0.09	0.192	0.42
	β^{rd7}	–0.134	–0.29	0.010	0.03
	β^{rd8}	0.755*	1.89	0.900***	2.97
	β^{rd9}	0.643	0.73	1.099	1.56
	β^{rd10}	0.582***	3.23	0.681***	6.68
	β^{rd11}	0.643	0.27	1.564	0.85
	β^{rd12}	–0.235	–0.5	–0.112	–0.34
	β^{rd13}	0.164	0.99	0.229***	2.74
	β^{rd14}	1.639**	2.43	1.871***	3.66

Table A4.8: Estimation results of PTA approach (cont.)

		N3SLS		GMM	
Parameters		Coefficient	t-Stat.	Coefficient	t-Stat.
	c^{rd2}	10,178.260***	8.16	11,184.93***	12.91
	c^{rd3}	206.779	0.17	483.71	0.86
	c^{rd4}	12,741.570***	12.17	12,965.43***	16.16
	c^{rd5}	8846.273***	7.73	8643.77***	14.35
	c^{rd6}	7589.316***	6.04	7664.80***	14.77
	c^{rd7}	8974.123***	7.86	8978.81***	13.01
	c^{rd8}	9383.796***	8.96	8884.79***	18.62
	c^{rd9}	8888.295***	6.36	9396.36***	11.75
	c^{rd10}	88,11.330***	7.47	8228.42***	16.33
	c^{rd11}	11,660.300***	9.06	11,973.52***	15.65
	c^{rd12}	10,212.650***	9.4	9884.39***	16.8
	c^{rd13}	10,520.290***	10.63	10,142.98***	16.79
	c^{rd14}	7487.909***	6.18	7552.77***	10.18
FOC	θ	–0.019*	–1.66	–0.009*	–1.76

Notes: The values in parentheses are asymptotic standard errors. The superscripts ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Own estimation based on the panel data from the CSMNERK and the ICCARKS, respectively.

IAMO

STUDIES ON THE AGRICULTURAL AND FOOD SECTOR IN TRANSITION ECONOMIES

Edited by

Leibniz Institute of Agricultural Development in Transition Economies

IAMO

ISSN 1436-221X

Vol. 1 **The importance of institutions for the transition in Central and Eastern Europe with emphasis on agricultural and food industry**
ed. by Klaus Frohberg and Witold-Roger Poganietz
1998, 137 pages, ISBN 3-8175-0258-3

Vol. 2 **The significance of politics and institutions for the design and formation of agricultural Policies**
ed. by Klaus Frohberg and Peter Weingarten
1999, 254 pages, ISBN 3-8175-0289-3

Vol. 3 **Food processing and distribution in transition countries. Problems and perspectives**
ed. by Monika Hartmann and Jürgen Wandel
1999, 349 pages, ISBN 3-8175-0293-1

Vol. 4 **Die private Nachfrage nach Nahrungsmitteln im Transformationsprozeß Tschechiens und Polens**
Stephan Brosig (PhD)
2000, 171 Seiten, ISBN 3-8175-0319-9

Vol. 5 **Integrating Estonia into the EU: Quantitative analysis of the agricultural and food sector**
Achim Fock (PhD)
2000, 286 pages, ISBN 3-8175-0320-2

Vol. 6 **Competitiveness of agricultural enterprises and farm activities in transition countries**
ed. by Peter Tillack and Frauke Pirscher
2000, 216 pages, ISBN 3-8175-0322-9

Vol. 7 **Конкурентоспособность сельскохозяйственных предприятий и фермерской деятельности в странах переходного периода**
под редакцией Петера Тиллака и Фрауке Пиршер
2000, 253 страницы, ISBN 3-8175-0324-5

Vol. 8 **Perspectives on agriculture in transition: Analytical issues, modelling approaches, and case study results**
ed. by Witold-Roger Poganietz, Alberto Zezza, Klaus Frohberg and Kostas G. Stamoulis
2000, 433 pages, ISBN 3-8175-0323-7

Vol. 9 **Land ownership, land markets and their influence on the efficiency of agricultural production in Central and Eastern Europe**
ed. by Peter Tillack and Eberhard Schulze
2000, 485 pages, ISBN 3-8175-0325-3

Vol. 10 **Landwirtschaft und Industrie in Russland – Der Transformationsprozeß in der Ernährungsindustrie**
Jürgen Wandel (PhD)
2000, 361 Seiten, ISBN 3-8175-0334-2

Vol. 11 **Food consumption in Russia. An econometric analysis based on household data**
Karin Elsner (PhD)
2001, 256 pages, ISBN 3-8175-0335-0

Vol. 12 **Alexander Wasiljewitsch Tschajanow – Die Tragödie eines großen Agrarökonomen**
hrsg. u. übers. von Eberhard Schulze
2001, 192 Seiten, ISBN 3-8175-0342-3

Vol. 13 **Analysis of food consumption in Central and Eastern Europe: Relevance and empirical methods**
ed. by Stephan Brosig and Monika Hartmann
2001, 253 pages, ISBN 3-8175-0349-0

Vol. 14 **Wettbewerbsprozesse und Firmenwachstum in der Transformation am Beispiel der polnischen Fleischindustrie**
Agata Pieniadz (PhD)
2002, 291 Seiten, ISBN 3-8175-0360-1

Vol. 15 **Agricultural enterprises in transition: Parallels and divergences in Eastern Germany, Poland and Hungary**
ed. by Ludger Hinners-Tobrägel and Jürgen Heinrich
2002, 455 pages, ISBN 3-8175-0366-0

Vol. 16 **Agricultural technology and economic development of Central and Eastern Europe. Results of the workshop in Halle, 2nd-3rd July 2001**
ed. by Peter Tillack and Ulrich Fiege
2002, 160 pages, ISBN 3-86037-199-1

Vol. 17 **Региональные аспекты аграрных преобразований: Политика, реструктуризация, рыночная адаптация**
под редакцией Петера Тиллака и Виталия Зиновчука
2003, 236 страницы, ISBN 3-928466-55-0

Vol. 18 **Alexander Vasilievich Chayanov – The tragedy of an outstanding agricultural economist**
ed. by Eberhard Schulze
2003, 188 pages, ISBN 3-86037-201-7

Vol. 19 **Development of agricultural market and trade policies in the CEE Candidate Countries**
by the Network of Independent Agricultural Experts in the CEE Candidate Countries
2003, 72 pages, ISBN 3-86037-212-2

Vol. 20 **Large farm management**
ed. by Alfons Balmann and Alexej Lissitsa
2003, 396 pages, ISBN 3-86037-213-0

Vol. 21 **Success and failures of transition – The Russian agriculture between fall and resurrection**
ed. by Eberhard Schulze, Elke Knappe, Eugenia Serova, Peter Wehrheim
2003, 521 pages, ISBN 3-9809270-1-6

Vol. 22 **Subsistence agriculture in Central and Eastern Europe: How to break the vicious circle?**
ed. by Steffen Abele and Klaus Frohberg
2003, 233 pages, ISBN 3-9809270-2-4

Vol. 23 **Pfadabhängigkeiten und Effizienz der Betriebsstrukturen in der ukrainischen Landwirtschaft – Eine theoretische und empirische Analyse**
Andriy Nedoborovskyy (PhD)
2004, 197 Seiten, ISBN 3-86037-216-5

Vol. 24 **Nichtmonetäre Transaktionen in der ukrainischen Landwirtschaft: Determinanten, Spezifika und Folgen**
Olena Dolud (PhD)
2004, 190 Seiten, ISBN 3-9809270-3-2

Vol. 25 **The role of agriculture in Central and Eastern European rural development: Engine of change or social buffer?**
ed. by Martin Petrick and Peter Weingarten
2004, 426 pages, ISBN 3-9809270-4-0

Vol. 26 **Credit rationing of Polish farm households – A theoretical and empirical analysis**
Martin Petrick (PhD)
2004, 254 pages, ISBN 3-9809270-6-7

Vol. 27 **Drei Jahrhunderte Agrarwissenschaft in Russland: Von 1700 bis zur Gegenwart**
Alexander Alexandrowitsch Nikonow und Eberhard Schulze
2004, 232 Seiten, ISBN 3-9809270-8-3

Vol. 28 **Russlands Weg vom Plan zum Markt: Sektorale Trends und regionale Spezifika**
Peter Voigt (PhD)
2004, 270 Seiten, ISBN 3-9809270-9-1

Vol. 29 **Auswirkungen des Transformationsprozesses auf die sozioökonomischen Funktionen ukrainischer Landwirtschaftsunternehmen**
Helga Biesold (PhD)
2004 182 Seiten, ISBN 3-938584-00-9

Vol. 30 **Agricultural policies and farm structures – Agent-based modelling and application to EU-policy reform**
Kathrin Happe (PhD)
2004, 291 pages, ISBN 3-938584-01-7

Vol. 31 **How effective is the invisible hand? Agricultural and food markets in Central and Eastern Europe**
ed. by Stephan Brosig and Heinrich Hockmann
2005, 361 pages, ISBN 3-938584-03-3

Vol. 32 **Erfolgsfaktoren von landwirtschaftlichen Unternehmen mit Marktfruchtanbau in Sachsen-Anhalt**
Kirsti Dautzenberg (PhD)
2005, 161 Seiten, ISBN 3-938584-06-8

Vol. 33 **Agriculture in the face of changing markets, institutions and policies: Challenges and strategies**
ed. by Jarmila Curtiss, Alfons Balmann, Kirsti Dautzenberg, Kathrin Happe
2006, 544 pages, ISBN 3-938584-10-6

Vol. 34 **Making rural households' livelihoods more resilient – The importance of social capital and the underlying social networks**
ed. by Gertrud Buchenrieder and Thomas Dufhues
2006, 106 pages, ISBN 3-938584-13-0

Vol. 35 **Außerlandwirtschaftliche Diversifikation im Transformationsprozess. Diversifikationsentscheidungen und -strategien ländlicher Haushalte in Slowenien und Mazedonien**
Judith Möllers (PhD)
2006, 323 Seiten, ISBN 3-938584-14-9

Vol. 36 **Accessing rural finance – The rural financial market in Northern Vietnam**
Thomas Dufhues (PhD)
2007, 166 Seiten, ISBN 3-938584-16-5

Vol. 37 **Страхование посевов в Казахстане: Анализ возможностей эффективного управления рисками**
Раушан Бокушева, Олаф Хайдельбах, Талгат Кусайынов
2007, 82 Seiten, ISBN 3-938584-17-3

Vol. 38 **Rethinking agricultural reform in Ukraine**
Zvi Lerman, David Sedik, Nikolai Pugachov, Aleksandr Goncharuk
2007, 167 Seiten, ISBN 3-938584-18-1

Vol. 39 **Sustainable rural development: What is the role of the agri-food sector?**
ed. by Martin Petrick, Gertrud Buchenrieder
2007, 293 pages, ISBN 3-938584-22-X

Vol. 40 **Efficiency of selected risk management instruments – An empirical analysis of risk reduction in Kazakhstani crop production**
Olaf Heidelbach (PhD)
2007, 223 Seiten, ISBN 3-938584-19-X

Vol. 41 **Marktstruktur und Preisbildung auf dem ukrainischen Markt für Rohmilch**
Oleksandr Perekhozhuk (PhD)
2007, 274 Seiten, ISBN 978-3-938584-24-8

Vol. 42 **Labor market behavior of Chinese rural households during transition**
Xiaobing Wang (PhD)
2007, 140 Seiten, ISBN 978-3-938584-25-5

Vol. 43 **Continuity and change: Land and water use reforms in rural Uzbekistan. Socio-economic and legal analyses for the region Khorezm**
ed. by Peter Wehrheim, Anja Schoeller-Schletter, Christopher Martius
2008, 211 Seiten, ISBN 978-3-938584-27-9

Vol. 44 **Agricultural economics and transition: What was expected, what we observed, the lessons learned (Vol I and II)**
ed. by Csaba Csáki, Csaba Forgács
2008, 634 Seiten, ISBN 978-3-938584-31-6

Vol. 45 **Theoretical and methodological topics in the institutional economics of European agriculture. With applications to farm organisation and rural credit arrangement**
Martin Petrick
2008, 223 Seiten, ISBN 978-3-938584-31-6

Vol. 46 **Agri-food business: Global challenges – Innovative solutions**
ed. by Thomas Glauben, Jon H. Hanf, Michael Kopsidis, Agata Pieniadz, Klaus Reinsberg
2008, 152 pages, ISBN 978-3-938584-33-0

Vol. 47 **Eine Analyse der Transformationsberatung für die „kollektive Landwirtschaft“ während der ersten Transformationsphase (1989-1991) am Beispiel Ostdeutschlands: Lehren für Korea**
Jeong Nam Choi (PhD)
2009, 225 Seiten, ISBN 978-3-938584-36-1

Vol. 48 **Croatia's EU accession. Socio-economic assessment of farm households and policy recommendations**
Judith Möllers, Patrick Zier, Klaus Frohberg, Gertrud Buchenrieder and Štefan Bojnec
2009, 196 Seiten, ISBN 978-3-938584-35-4

Vol. 49 **Structural change in Europe's rural regions. Farm livelihoods between subsistence orientation, modernisation and non-farm diversification**
ed. by Gertrud Buchenrieder Judith Möllers
2009, 166 Seiten, ISBN 978-3-938584-39-2

Vol. 50 **Motive beim Weinkonsum – Unterschiede zwischen deutschen und ukrainischen Konsumenten**
Astrid Lucie Rewerts (PhD)
2009, 267 Seiten, ISBN 978-3-938584-40-8

Vol. 51 **Rural development as provision of local public goods: Theory and evidence from Poland**
Andreas Gramzow (PhD)
2009, 203 Seiten, ISBN 978-3-938584-41-5

Vol. 52 **Multi-level Processes of Integration and Disintegration. Proceedings of the Third Green Week Scientific Conference**
ed. by Franziska Schaft, Alfons Balmann
2009, 216 Seiten, ISBN 978-3-938584-42-2

Vol. 53 **Zur Bestimmung der Wettbewerbsfähigkeit des weißrussischen Milchsektors: Aussagefähigkeit von Wettbewerbsindikatoren und Entwicklung eines kohärenten Messungskonzepts**
Mikhail Ramanovich (PhD)
2010, 202 Seiten, ISBN 978-3-938584-44-6

Vol. 54 **Die Internationalisierung landwirtschaftlicher Unternehmen. Das Beispiel deutscher, dänischer und niederländischer Direktinvestitionen in den ukrainischen Agrarsektor**
Henriette Stange (PhD)
2010, 296 Seiten, ISBN 978-3-938584-45-3

Vol. 55 **Verhandlungsverhalten und Anspruchsanpassung im internationalen Verhandlungsprozess: Die WTO-Agrarverhandlungen zum Abbau exportwettbewerbsfördernder Maßnahmen**
Ildiko Lajtos (PhD)
2010, 195 Seiten, ISBN 978-3-938584-48-4

Vol. 56 **Challenges of education and innovation. Proceedings of the Fourth Green Week Scientific Conference**
ed. by Kelly Labar, Martin Petrick, Gertrud Buchenrieder
2010, 155 Seiten, ISBN 978-3-938584-49-1

Vol. 57 **Agriculture in the Western Balkan Countries**
ed. by Tina Volk
2010, 249 Seiten, ISBN 978-3-938584-51-4

Vol. 58 **Perspectives on Institutional Change – Water Management in Europe**
ed. by Insa Theesfeld, Frauke Pirscher
2011, 127 Seiten, ISBN 978-3-938584-52-1

Vol. 59 **Der ukrainische Außenhandel mit Produkten der Agrar- und Ernährungswirtschaft: Eine quantitative Analyse aus Sicht traditioneller und neuer Außenhandelstheorien**
Inna Levkovych (PhD)
2011, 232 Seiten, ISBN 978-3-938584-53-8

Vol. 60 **Regional structural change in European agriculture: Effects of decoupling and EU accession**
Christoph Sahrbacher (PhD)
2011, 244 Seiten, ISBN 978-3-938584-58-3

Vol. 61 **Structural Change in Agriculture and Rural Livelihoods: Policy Implications for the New Member States of the European Union**
ed. by Judith Möllers, Gertrud Buchenrieder, Csaba Csáki
2011, 247 Seiten, ISBN 978-3-938584-59-0

Vol. 62 **Improving the functioning of the rural financial markets of Armenia**
Milada Kasarjyan (PhD)
2011, 121 Seiten, ISBN 978-3-938584-60-6

Vol. 63 **Integrierte Strukturen im Agrar- und Ernährungssektor Russlands: Entstehungsgründe, Funktionsweise, Entwicklungsperspektiven und volkswirtschaftliche Auswirkungen**
Jürgen Wandel
2011, 758 Seiten, ISBN 978-3-938584-61-3

Vol. 64 **Goal Achievement in Supply Chain Networks – A Study of the Ukrainian Agri-Food Business**
Taras Gagalyuk (PhD)
2012, 204 Seiten, ISBN 978-3-938584-63-7

Vol. 65 **Impacts of CAP reforms on farm structures and performance disparities – An agent-based approach**
Amanda Sahrbacher (PhD)
2012, 284 Seiten, ISBN 978-3-938584-64-4

Vol. 66 **Land fragmentation and off-farm labor supply in China**
Lili Jia (PhD)
2012, 143 Seiten, ISBN 978-3-938584-65-1

Vol. 67 **Ausprägung interregionaler Disparitäten und Ansätze zur Entwicklung ländlicher Räume in Mittel- und Osteuropa**
Sabine Baum (PhD)
2012, 214 Seiten, ISBN 978-3-938584-68-2

Vol. 68 **Patterns Behind Rural Success Stories in the European Union: Major Lessons of Former Enlargements**
ed. by Axel Wolz, Carmen Hubbard, Judith Möllers, Matthew Gorton, Gertrud Buchenrieder
2012, 190 Seiten, ISBN 978-3-938584-69-9

Vol. 69 **Motives for remitting from Germany to Kosovo**
Wiebke Meyer (PhD)
2012, 142 Seiten, ISBN 978-3-938584-70-5

Vol. 70 **Effizienz russischer Geflügelfleischproduzenten: Entwicklung und Determinanten**
Elena Epelstejn (PhD)
2013, 272 Seiten, ISBN 978-3-938584-72-9

Vol. 71 **Econometric impact assessment of the Common Agricultural Policy in East German agriculture**
Patrick Zier (PhD)
2013, 172 Seiten, ISBN 978-3-938584-73-6

Vol. 72 **Determinants of non-farm entrepreneurial intentions in a transitional context: Evidence from rural Bulgaria**
Diana Traikova (PhD)
2013, 136 Seiten, ISBN 978-3-938584-75-0

Vol. 73 **Human capital differences or labor market discrimination? The occupational outcomes of ethnic minorities in rural Guizhou (China)**
Bente Castro Campos (PhD)
2013, 266 Seiten, ISBN 978-3-938584-76-7

Vol. 74 **Identifying and understanding the patterns and processes of forest cover change in Albania and Kosovo**
Kuenda Laze (PhD)
2014, 152 Seiten, ISBN 978-3-938584-78-1

Vol. 75 **Flexibilität von Unternehmen. Eine theoretische und empirische Analyse**
Swetlana Renner (PhD)
2014, 194 Seiten, ISBN 978-3-938584-79-8

Vol. 76 **Impact of policy measures on wheat-to-bread supply chain during the global commodity price peaks: The case of Serbia**
Ivan Djuric (PhD)
2014, 160 Seiten, ISBN 978-3-938584-80-4

Vol. 77 **Marktwirtschaftliche Koordination: Möglichkeiten und Grenzen. Symposium anlässlich des 75. Geburtstages von Prof. Dr. Dr. h.c. mult. Ulrich Koester**
ed. by Jens-Peter Loy
2014, 94 Seiten, ISBN 978-3-938584-82-8

Vol. 78 **Participatory governance in rural development: Evidence from Ukraine**
Vasyl Kvartiuk (PhD)
2015, 200 Seiten, ISBN 978-3-938584-84-2

Vol. 79 **Agricultural transition in Post-Soviet Europe and Central Asia after 25 years. International workshop in honor of Professor Zvi Lerman**
ed. by Ayal Kimhi, Zvi Lerman
2015, 314 Seiten, ISBN 978-3-938584-95-8

Vol. 80 **Three essays on the Russian wheat export**
Zsombor Pall (PhD)
2015, 150 Seiten, ISBN 978-3-938584-86-6

Vol. 81 **Milchproduktion zwischen Pfadabhängigkeit und Pfadbrechung: Partizipative Analysen mit Hilfe des agentenbasierten Modells AgriPoliS**
Arlette Ostermeyer (PhD)
2015, 335 Seiten, ISBN 978-3-938584-88-0

Vol. 82 **Competitiveness and performance of EU agri-food chains**
ed. by Heinz Hockmann, Inna Levkovych, Aaron Grau
2016, ISBN 978-3-95992-006-3

Vol. 83 **Market uncertainty, project specificity and policy effects on bioenergy investments. A real options approach**
Lioudmila Chatalova (PhD)
2016, 202 Seiten, ISBN 978-3-95992-017-9

Vol. 84 **Too much but not enough: Issues of water management in Albania in light of climate change**
Klodjan Rama (PhD)
2016, 222 Seiten, ISBN 978-3-95992-034-6

Vol. 85 **Business groups in agriculture. Impact of ownership structures on performance: The case of Russia's agroholdings**
Andriy Matyukha (PhD)
2017, 128 Seiten, ISBN 978-3-95992-039-1

Vol. 86 **Russian demand for dietary quality: Nutrition transition, diet quality measurement, and health investment theory**
Christine Burggraf (PhD)
2017, 225 Seiten, ISBN 978-3-95992-040-7

Vol. 87 **Trade policy impacts on net wheat importers in the CIS: Three essays**
Nurzat Baisakova (PhD)
2017, 154 Seiten, ISBN 978-3-95992-041-4

Vol. 88 **Labour rationing of different farm types in Kazakhstan: A shadow price analysis**
Katharina Vantomme (PhD)
2017, 152 Seiten, ISBN 978-3-95992-043-8

Vol. 89 **Factor productivity in EU agriculture: A microeconometric perspective**
Mathias Kloss (PhD)
2017, 196 Seiten, ISBN 978-3-95992-054-4

Vol. 90 **Market power in the German dairy supply chain**
Aaron Grau (PhD)
2018, 184 Seiten, ISBN 978-3-95992-057-5, pdf: ISBN 978-3-95992-062-9

Vol. 91 **A Comprehensive Analysis of Current State and Development Perspectives of Russian Grain Sector: Production Efficiency and Climate Change Impact**
Maria Belyaeva (PhD)
2018, 154 Seiten, ISBN 978-3-95992-058-2, pdf: ISBN 978-3-95992-068-1

Vol. 92 **The brink of poverty. Efficiency and effectiveness of targeted social assistance for poverty reduction in rural China**
Lena Kuhn (PhD)
2018, 228 Seiten, ISBN 978-3-95992-060-5, pdf: ISBN 978-3-95992-061-2

Vol. 93 **Analysis of impediments to grain export from Russia, Ukraine and Kazakhstan: Three Essays**
Iryna Kulyk (PhD)
2019, 248 Seiten, ISBN 978-3-95992-079-7, pdf: ISBN 978-3-95992-080-3

Vol. 94 **Oligopsony power in the Kazakh grain supply chain**
Giorgi Chezhia (PhD)
2019, 176 Seiten, ISBN 978-3-95992-081-0, pdf: ISBN 978-3-95992-082-7

Die **Studies on the Agricultural and Food Sector in Transition Economies** sind erhältlich beim Leibniz-Institut für Agrarentwicklung in Transformationsökonomien (IAMO) oder im Internet unter **www.iamo.de**.

The **Studies on the Agricultural and Food Sector in Transition Economies** can be ordered from the Leibniz Institute of Agricultural Development in Transition Economies (IAMO). Use our download facility at **www.iamo.de/en**.

ISSN 1436-221X
ISBN 978-3-95992-082-7

IAMO

Leibniz Institute of Agricultural Development
in Transition Economies

In der Schriftenreihe **Studies on the Agricultural and Food Sector in Transition Economies** werden durch das IAMO Monografien und Tagungsberichte herausgegeben, die sich mit der Analyse von agrarökonomischen, sozialen und politischen Veränderungsprozessen beschäftigen. Das Untersuchungsgebiet erstreckt sich über die Transformationsregionen Mittel-, Ost- und Südosteuropa bis nach Zentral- und Ostasien. Wissenschaftlerinnen und Wissenschaftlern, die in diesem Bereich forschen, steht die Schriftenreihe als Diskussionsforum offen.

In its series **Studies on the Agricultural and Food Sector in Transition Economies** IAMO publishes monographs and proceedings focusing on agricultural economic, social and political issues. The geographic focus covers transition regions of Central, Eastern and South Eastern Europe, as well as Central and Eastern Asia. This series offers a forum to researchers studying this area.