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Katharina Vantomme

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Summary

After the breakdown of the Soviet Union many socioeconomic, but also demographic changes took place in Kazakhstan. The large collective farms have partly been broken up. The result was a tri-partitioned farm structure with agricultural enterprises including agroholdings, individual farms as well as household farms. Furthermore, a strong exodus especially from northern Kazakhstan took place, which included many skilled workers, leading to a scarcity of labour and to mismatches between skills offered and skills needed in agriculture. However, the potential of the Kazakh agriculture cannot be fully tapped without suitable labour. Thus, at present low productivity prevail. Therefore, a central term of the dissertation is the term "labour rationing". An agricultural unit is labour rationing if it is not able to find enough suitable workers even though it would be willing to pay a higher wage than the real wage. This dissertation focused on investigating labour rationing in the rural areas of Kazakhstan using two cross-sectional farm level data sets from 2003 and 2011 with data collected in the two oblasts, Akmola and Almaty. Besides, the production model under factor constraint was applied. From this model the shadow price analysis was derived with help of the Lagrangian method. Three Heckman models, for 2003, 2011 as well as for 2003 and 2011 together were estimated as well as the respective shadow prices of the different farm types. The latter were then compared with the real wages. All farm types faced an excess demand for labour. However, agroholdings suffered from the strongest labour rationing and thus, had most problem finding suitable workers, skilled workers in particular. Regarding the reasons for labour rationing, the analysis suggests mainly the following:

- In 2011, agricultural producers that carried out joint activity with other agricultural units were less likely to be labour rationed than those that did not carry out any joint activity together with others.
- Agricultural units with a peripheral and poorly connected location were more likely to be rationed on the labour market. Moreover, in Akmola oblast labour shortages were more severe than in Almaty oblast.
- Regarding the value of machinery and movable equipment, it can be said that these factors normally rather attract workers, especially in Kazakhstan. However, in order to operate more sophisticated machinery more skills are needed. But skilled workers were particularly scarce.

- Regarding education it cannot be clearly observed that more educated managers have fewer problems or more problems finding workers in Kazakhstan.

Finally, it can be said that according to the data wages in agriculture in Kazakhstan did rise if 2003 and 2011 are compared, but so did the shadow wages. Thus, an excess demand for labour and the problem of labour rationing persist. Nevertheless, it seems that the labour productivity increased which might be due to investments in machinery. At the same time this means that especially skilled workers are in demand.

Zusammenfassung

Nach dem Zerfall der Sowjetunion fanden in Kasachstan nicht nur viele sozioökonomische Umbrüche, sondern auch demographische Veränderungen statt. Die großen kollektiven Landwirtschaftsbetriebe wurden teilweise aufgelöst, was zu einer Koexistenz von hauptsächlich drei Organisationsformen führte, nämlich Agrarunternehmen inklusive Agroholdings, Einzelbetrieben und Hauswirtschaften. Außerdem kam es zu einem Exodus, insbesondere aus Nordkasachstan, der viele ausgebildete Arbeiter betraf, was zu Arbeitskräftemangel und einer Diskrepanz zwischen zur Verfügung stehenden Qualifikationen und benötigten Qualifikationen führte. Das Potential der kasachischen Landwirtschaft kann ohne passende Arbeitskräfte jedoch nicht vollständig ausgenutzt werden. Daher blieb die Produktivität bisher niedrig. Ein zentraler Begriff dieser Dissertation ist der Begriff der "Arbeitsrationierung". Ein Betrieb ist auf dem Arbeitsmarkt rationiert, wenn er nicht genug geeignete Arbeiter finden kann, obwohl er zu der Zahlung eines höheren Lohns als des Reallohns bereit wäre. Der Schwerpunkt der Dissertation liegt darin, Rationierung auf dem ländlichen Arbeitsmarkt in Kasachstan mithilfe von zwei Querschnittsdatensätzen auf Betriebsebene aus den Jahren 2003 und 2011, die in den Oblasten, Akmola und Almaty gesammelt wurden, zu untersuchen. Das Produktionsmodell mit Faktorbeschränkung wurde angewendet. Von diesem Modell wurde mithilfe der Lagrange-Methode die Schattenpreisanalyse abgeleitet. Drei Heckman-Modelle, für 2003, 2011 sowie 2003 und 2011 zusammen, wurden geschätzt, eine Schattenpreisanalyse wurde für die verschiedenen Betriebsformen durchgeführt. Alle Betriebsformen wiesen eine Überschussnachfrage nach Arbeitskräften auf, dennoch waren die Agroholdings am stärksten von Rationierung auf dem Arbeitsmarkt betroffen und taten sich insbesondere schwer, ausgebildete Arbeiter zu finden. Als Gründe für die Rationierung auf dem Arbeitsmarkt schlägt die Analyse hauptsächlich folgende Gründe vor:

- Überbetriebliche Kooperation beeinflusste 2011 die Wahrscheinlichkeit der Rationierung auf dem Arbeitsmarkt negativ.
- Geografische Faktoren, wie eine günstige Lage des Betriebes sowie eine intakte Infrastruktur vor Ort, beeinflussten die Wahrscheinlichkeit der Rationierung auf dem Arbeitsmarkt negativ. Außerdem war die Knappheit an Arbeitskräften in Akmola stärker ausgeprägt als in Almaty.

- Der Wert der beweglichen Ausstattung und der Maschinen wirken eher anziehend auf Arbeitskräfte, insbesondere in Kasachstan. Dennoch wird mehr Kompetenz benötigt, um anspruchsvollere Maschinen bedienen zu können. Gleichzeitig sind gut ausgebildete Arbeiter besonders rar.
- Für den Fall Kasachstan konnte anhand der Ergebnisse nicht festgestellt werden, dass gebildetere Manager mehr oder weniger Probleme hätten, Arbeitskräfte zu finden.

Abschließend lässt sich sagen, dass die Löhne in der kasachischen Landwirtschaft von 2003 bis 2011 gestiegen sind. Allerdings sind dies auch die Schattenpreise. Daher bleibt das Problem einer Überschussnachfrage und einer Rationierung auf dem Arbeitsmarkt bestehen. Dennoch scheint es, dass die Arbeitsproduktivität möglicherweise durch Investitionen in Maschinen gestiegen ist. Gleichzeitig bedeutet dies, dass besonders gut ausgebildete Arbeitskräfte verstärkt nachgefragt warden.

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LIST OF ABBREVIATIONS

OECD	Organization for Economic Co-operation and Development
Acepas	Analytical Center for Economic Policy in the Agricultural Sector
VAT	Value Added Tax
GDP	Gross Domestic Product
Bisam	Business Information, Sociological and Marketing Research Center
IQR	Interquartile Range
BLUE	Best Linear Unbiased Estimator
FTE	Full-Time Equivalent

1 Introduction

1.1 Background

The Central Asian country, Kazakhstan, is already now among the top ten largest producers and top five largest exporters of wheat. Furthermore, Kazakhstan is believed to have a high agricultural potential. Terms like "bread basket" are to be heard regularly in relation to Kazakhstan. Especially in world grain supply its importance is expected to grow. Even though the last ten years have been characterized by enlargement of cropland area, rising capital input and doubling of real agricultural value added, productivity in agriculture is still low (Petrick et al., 2013). Besides, the productivity of labour is rather low as well (Lerman et al., 2003). Kazakhstan is also an interesting case to look at because of its diverse farm structure that emerged after the breakdown of the Soviet Union. Furthermore, the contribution of the different farm types to agricultural output should not be neglected. Besides, labour employment within the framework of agricultural organization has so far not been thouroughly analysed. Moreover, it would be crucial to analyse the reasons for the low productivity. After the breakdown of the Soviet Union not only the above mentioned socio-economic changes took place, but also demographic changes. A scarcity of labour especially in the northern part of the country resulted from these changes. Thus, agricultural units experience problems finding suitable labour for there farming activities.

In the following section I will briefly present what can be found in the literature about the topics, factors of production, factor productivity and farm organization. After that, the special case of Kazakhstan will be presented. Moreover, labour rationing will be defined and the resulting research questions introduced. Furthermore, the objective and the contribution of this dissertation will be presented. Finally, the structure of the dissertation will be explained.

1.1.1 Synthesis of the topics factors of production, factor productivity and farm organization

Firstly, numerous authors discuss which farm types are profitable and how to improve agricultural production. However, many of them admit that size alone is not the key explanation. As further crucial determinants of the success of a specific farm type issues like access to factors of production, infrastructure, technology, but also the complementary use of different types of labour were named.

Collier states that the only way to feed the world population is through "…large, technologically sophisticated agricultural companies…" (Collier, 2008). Deininger

(1995) counters that collective farming may be profitable when infrastructure for individual farms is missing and when access to credits, information or technology is very limited, and where competitive markets for inputs and outputs are absent. But even then collective farming still remains inefficient (DEININGER, 1995). When infrastructure improves, the potential benefits of service cooperatives such as economies of scale, the increase of competitiveness or the introduction of innovation fade away, DEININGER (1995) cautions. Besides, REARDON et al. (2009) emphasize the importance of having access to infrastructure in order to benefit from the globalization and liberalization. When enterprises are interested in purchasing products from a specific smallholder they sometimes provide themselves access for the latter to infrastructure (REARDON et al., 2009). However, REARDON et al. state that in general enterprises rather prefer to purchase products from larger farms. Moreover, HALLAM (1991) adds that factors like value added, technical progress, and improvements in management and information systems and opportunity costs play an important role as well. Economies of size alone cannot explain the structure of farms or changes of the farm structure (HALLAM, 1991).

In addition to that, many researchers are convinced that the access to and the use of labour, land and capital differ between farm types; and they discuss these factors of production in more detail. The ratio between land and labour differs according to farm size (ESWARAN and KOTWAL, 1986). LERMAN et al. (2004) explain that a high labour intensity leads to a low labour productivity. TOMICH et al. (1995) are convinced of an inverse relationship between labour per hectare and farm size, which implies that land productivity should be higher on smaller farms. Smaller farms pay less for labour and thus, can employ more workers per hectare, which leads to higher land productivity of small farms, FEDER (1985) mentions. Nevertheless, other authors point out that large farms are more successful on the land and capital market. This evens out the problems they have on the labour market (FEDER, 1985; CARTER and WIEBE, 1990; ESWARAN and KOTWAL, 1986). According to CARTER and WIEBE (1990) small farmers often have to deal with credit constraints. If all farmers could borrow an unlimited amount of money at a fixed interest rate all farms would be equally big and would use land and labour at the same ratio (ESWARAN and KOTWAL, 1986). Furthermore, CARTER and WIEBE (1990) are trying to understand why farmers decide for a specific farm size. The threshold for using more inputs is reached when marginal factor productivities and real economic costs or opportunity costs are equal. The shadow price of working capital determines the opportunity cost. The market wage times the marginal employment probability mark the direct cost of labour for the one that supplies labour. The one that hires labour has to pay the market wage (CARTER and WIEBE, 1990).

Moreover, according to ESWARAN and KOTWAL (1986) reallocating resources can lead to a higher output. ALCHIAN and DEMSETZ (1972) point out that on one hand, the common use of inputs, can lead to a higher output than the sum of outputs produced with individual use of inputs. On the other, imperfect information makes it difficult to measure the effort of every single worker, they caution. Furthermore, supervision becomes necessary. But competition on the market can be seen as a kind of supervision for team production as well (ALCHIAN and DEMSETZ, 1972). FRISVOLD (1994) affirms that family labour and hired labour are not perfect substitutes without supervision. Besides, he reveals that supervision of hired labour by family members is necessary to improve productivity of employees. In case of no supervision there is the risk of shirking by employees (FRISVOLD, 1994). However, ROUMASSET and UY (1980) point out the advantage of hired labour, namely, that it can specialize better. The difference between hired labour and family labour is that the former usually specialize in specific jobs. It is not uncommon that they carry out those jobs on different agricultural units. Family labour mostly works on the family farm, where they usually take care of various tasks (ROUMASSET and UY, 1980). The comparative advantages of family and hired labour in specific jobs decide which jobs will be performed by which type of labour (ROUMASSET and LEE, 2007). ESWARAN and KOTWAL (1985) suggest using seasonal labour for jobs where the individual labour effort can be check more easily, without monitoring. ALLEN and LUECK (1998) counter that the advantage of specialization in agriculture is not as big as in other industries, but supervision costs are high. BENJAMIN (1992) in turn did not find any significant differences between the productivity of hired and family labour.

However, not only family and hired labour can be distinguished, but also skilled and unskilled workers. The fact that qualifications of the rural population and the skills demanded by agricultural units are not always matching may be a cause of labour shortages in agriculture e.g. as described in TOLEUBAYEV et al. (2010). VAN DEN BAN (1999) emphasizes the role of farmers' education for agricultural productivity and agricultural development. Education of farmers can be enhanced through effective extension services. Besides, according to TOMICH et al. (1995) effective agricultural extension can contribute to higher returns to investment. Nevertheless, agricultural extension services often turn out to be ineffective because next to excluding women and small-scale farmers the quality of the services is often poor (TOMICH et al., 1995).

1.1.2 Labour, farm organization and production in Kazakhstan

During the socialist times agriculture in Kazakhstan was organized in large collective and state farms, kolkhozes and sovkhozes. After the breakdown of the Soviet Union in 1991, restructuring of these large farms began. The previously state-owned farms were distributed among private farmers (PETRICK et al., 2013; QAMAR and SWANSON, 2012). At the same time corporate farms have not entirely been broken up yet, especially not in the north of Kazakhstan (DUDWICK et al., 2007). The result was a co-existence of different farm types such as huge agricultural enterprises, individual farms and household farms.

According to DUDWICK et al. (2007) yields in individual farms were higher than in corporate farms. Moreover, VISSER and SPOOR (2011) argue against large agroholdings, especially the international ones. The authors see the acquisition of large areas of land by huge agricultural enterprises as "land grabbing". The resulting situation for farm workers worries VISSER and SPOOR (2011) since the managers of agroholdings often rely on agro-industrial operations and as a consequence reduce the demand for labour. In the northern part of the country, where mostly crops e.g. wheat are being produced, in detail two-thirds of the country's wheat, farm enterprises play a significant role, since more capital is required for this type of farming (ASIAN DEVELOPMENT BANK, 2011; PETRICK et al., 2013). According to WANDEL (2009) agroholdings are most effective in wheat growing in northern Kazakhstan. Moreover, PETRICK (2013) claims that the productivity in Kazakhstan was highest for agroholdings and that they were more competitive on land and labour markets than other farm types. On the other hand, he found a smaller group of family farms that was highly competitive on the land market. Thus, he thinks that it is still too early to consider one farm type generally superior to others (PETRICK, 2013).

Another challenge in the Kazakh agriculture is that the longer farmers worked in a collective system the more they forgot how to work in a market economy (PRYOR, 1992). Besides, the skills and knowledge gathered during Soviet times by agro-technicians has not been passed on to the new generation (TOLEUBAYEV et al., 2010). According to TOLEUBAYEV et al. (2010) technologies, knowledge and skills can be considered relatively inflexible. The knowledge, technology and skills acquired for collective agriculture during Soviet times may not fully fit to the "new" conditions of private farming (TOLEUBAYEV et al., 2010). According to TOLEUBAYEV et al., (2010) at present a strong deficit of skilled agricultural workers can be witnessed in Kazakhstan.

1.2 Definition of labour rationing and resulting research questions

Labour is one production factor amongst others such as e.g. land, capital and education that agricultural producers need in the production process to produce an agricultural output e.g. revenue with a specific production technology. Labour shortage may occur in agriculture as well. If an agricultural producer cannot find over a longer period as many workers as he needs even though he is willing to offer higher wages than the actual wage paid at that moment, he is rationed on the labour market. The fact that an agricultural producer is labour rationed has an effect on the output produced by his agricultural unit and on the productivity of the respective agricultural unit as well. A shortage of labour may occur when rural inhabitants move from rural areas to bigger cities in order to seek employment in other sectors than agriculture e.g. because of better payment or working conditions or if they leave the country e.g. as repatriates to Russia. Further shortages may arise if a mismatch between skills demanded and skills supplied exists in agriculture (Toleubayev et al., 2010). After having depicted the literature review on factor rationing, farm organization and production as well as having introduced the term labour rationing, the resulting research questions will be introduced in the following.

I use farm-level data from 2003 and 2011 from Almaty Oblast and Akmola Oblast in order to tackle issues of labour scarcity and labour rationing of different farm types. Keeping in mind the explained background, the following research questions result:

How can labour rationing be defined and explained?

Which factors influence the position of an agricultural unit on the labour market? What are reasons for labour rationing in Kazakhstan?

What are the consequences of labour rationing of different farm types? Which farm types are mostly affected by labour rationing?

1.3 Objective and contribution

The objective of this dissertation is to contribute to the existing literature on labour rationing of different farm types as well as productivity, especially marginal productivity of labour in Post-Communist countries. More concretely, I specifically aim at scrutinizing in more detail what makes an agricultural unit labour rationed. Here, I consider amongst others the cooperation between different farm types, the role of geographic factors and the relation between different factors of production such as skilled labour, seasonal labour, education and capital. The fact that I analyse the reasons and consequences of labour rationing of different farm types in the country of Kazakhstan is another distinctive feature of the study since the case of Kazakhstan is somewhat specific with its

diverse farm structure, geographical differences as well as a scarcity of labour in rural areas. Furthermore, I am aiming at scrutinizing differences between different farm types in terms of reasons for labour rationing, the strength of the labour constraint and consequences such as the marginal productivity of labour.

Regarding productivity and constraints of the agricultural sector in Post-Communist countries, the problems of farm restructuring and land reform and thus, the role of the factor of production land have been oftentimes studied e.g. by GRAY (2000) or DUDWICK et al. (2007). Furthermore, the insufficient access to credits is often considered an obstacle in agriculture in transition countries and has been examined numerous times e.g. by PETRICK (2004) or CARTER and WIEBE (1990). Nevertheless, it is often assumed that rural areas experience an excess supply of labour, and that they are full with potential workers. For these reasons, problems regarding the access to the factor of production labour are often neglected in studies. Nevertheless, the potential of the Kazakh agriculture cannot fully be tapped without suitable labour. However, the demographic developments in rural areas of Kazakhstan, but also potential mismatches between skills required and skills available are often ignored. For the Kazakh countryside the statement that FEDER (1985) makes, namely "While the wage rate may be considered exogenous, assuming that a large pool of landless labour is available, the rental rate for land is endogenously determined in the model." (FEDER, 1985, p. 308) does not hold true. In fact, as explained, in Kazakhstan the opposite is the case, land rental rates are about the same across farm types due to the inflexibility of the Kazakh land market. However, for the Kazakh countryside a labour constraint can be assumed as explained earlier. Thus, many agricultural units cannot hire more labour even if they would be willing to pay higher wages.

1.4 STRUCTURE OF THE DISSERTATION

The monograph is structured as follows:

Chapter 2 deals with agricultural production and labour markets in Kazakhstan. After that, it gives a brief overview over the agricultural policies that have been introduced after the independence of Kazakhstan. Furthermore, the chapter describes the agricultural production and explains characteristics of the labour market, especially giving reasons for labour shortages in the rural areas of Almaty and Akmola oblasts. In more detail this means that in chapter 2 different agricultural policies and their role for agricultural production will be presented. After that, the regions of our survey will be introduced, followed by the different farm types and their role in the Kazakh agriculture. Finally, some aspects of the labour market in Kazakhstan such as demographic development, employment and earnings in Kazakhstan will be unveiled.

Chapter 3 concentrates on labour rationing from a theoretical perspective. The objective of this chapter is to address the research questions posed in 1.2 from a theoretical perspective. How can labour rationing be defined and explainned from a theoretical perspective? How does labour rationing affect the productivity of different farm types? Which factors determine the probability of an agricultural unit to be labour rationed? Furthermore, in chapter 3 a brief definition of labour rationing will be given. Then, access to factors of production and factor productivity from a theoretical point of view will be presented. After that, the household and production model will be first introduced without labour constraint and then, with labour constraint. Subsequently, the shadow price calculation will be explained. Lastly, the shadow price calculation will be related to the Kazakh case.

Chapter 4 deals with the research methodology. Its aim is to illuminate the methodological foundation of the empirical analysis. The methods used for the empirical analysis are based on the theory elaborated in chapter 3. Chapter 4 begins with an introduction of the methods used for analysis. Furthermore, this chapter presents the data used for the analysis and challenges connected with that such as outlier control and endogeneity. Once the methods of analysis and challenges are clear, the empirical strategy will be introduced. Firstly, labour rationing will be defined, and then the Heckman model will be explained as well as the reasons why certain individual farms, agricultural enterprises or agroholdings may be labour rationed and what the consequences of being labour rationed are. Lastly, limitations of the empirical approach will be pointed out.

In chapter 5 the results of the empirical analysis on labour rationing and production in agriculture in the rural areas of Almaty oblast and Akmola oblast will be revealed. Firstly, an overview of labour rationing is given. After that, the empirical results on reasons and consequences of rationing on the labour market will be introduced, namely the results of the Heckman model including the Probit model for the probability of being labour rationed and the results of the production function estimation. These results will be followed by a presentation of different labour indicators including the results of the shadow wage analysis. After that, further descriptive results of issues that help to explain differences between labour rationed and not rationed agricultural units will be scrutinized. Finally, this chapter will concluded with a summary of major findings.

Chapter 6 starts with theoretical conclusions. These are followed by empirical conclusions. After that, policy recommendations will be given.

2 Agricultural production and rural labour markets in Kazakhstan

The following chapter describes the situation regarding agricultural production and labour markets in the rural areas of Kazakhstan. Furthermore, I present different agricultural policies such as land reform and restructuring, subsidies, concessional loans and further financial concessions, infrastructure, resource management, education and knowledge and their role for agricultural production. Next, the latter will be explained in more detail. After that, the regions of the survey will be introduced, followed by the different farm types and their role in the Kazakh agriculture. Finally, I unveil some aspects of the labour market in Kazakhstan such as demographic development, employment and earnings in Kazakhstan as well as the labour employment and different farm types.

2.1 Different agricultural policies for production improvement

According to the OECD's review of agricultural policies in Kazakhstan (2013), Kazakhstan has to find ways to enhance its agricultural sector despite the current constraints. Current constraints are e.g.: harsh climate, water availability, lack of developed food chains, problems accessing external markets, scarcity of qualified labour as well as financial constraints and difficulties connected to credits. In order to reach agricultural growth it is crucial to improve agricultural productivity. In Kazakhstan some policies were designed to boost productivity and consequently, to improve agricultural development (OECD, 2013).

After the breakdown of the Soviet Union in 1991 Kazakhstan had to manage the transition from a planned to a market economy. This was a challenge for the whole economy as well as for the agricultural sector. As a consequence, in the early 1990s the Kazakh economy including the agricultural sector was in recession. During the 1990s the agricultural sector was more or less disregarded by policy makers and thus, began to shrink until the early 2000s (Pomfret, 2007).

During the first ten years after the independence of Kazakhstan agricultural policy focused on land reform and farm restructuring as well as the reform of the finance and support systems in agriculture. All these reforms accompanied the transition to a market-based economy (OECD, 2013). Afterwards, several agricultural development programs with different goals were introduced. In the first program between 2000 and 2002 the goal was to stabilize the agricultural production by supporting promising sectors in agriculture. The aim of the next development program from 2003 until 2005 was food security as well as making

the agricultural sector more efficient and competitive. Thus, it was seen as crucial to modernize the agricultural sector to amongst others reach food security (OECD, 2013). The agricultural development program from 2010 until 2014 focused more on export and thus, on agricultural production that could serve foreign markets as well. Consequently, the agricultural budget was increased to pay for the agricultural development programs (OECD, 2013). Different agricultural policies that were supposed to improve the productivity of the agricultural sector and the agricultural development will be presented below.

After the independence of Kazakhstan in 1991, restructuring of the large state-owned farms began (PETRICK et al., 2013). Nevertheless, in the early 1990s little profound restructuring took place. The changes took mostly place on the paper, but in practice farms continued to operate like before. During the mid-1990s shares have been privatized and limited partnerships emerged. During the years 1998 until 2002 bankruptcy procedures accelerated the restructuring process. However, only the new land code of 2003 allowed private land ownership (PETRICK et al., 2013). Before the new land code the state basically remained the owner of the land and was just issuing land use rights. Therefore, this land could not be used by farmers as collateral for credits (GRAMZOW and SULEIMENOV, 2011). Furthermore, a new farm type emerged in Kazakhstan, namely the agroholdings. These agricultural units may own up to hundred thousands of hectares and often consist of several farms. Most agroholdings are located in the north of Kazakhstan (OSHAKBAYEV, 2010; PETRICK et al., 2013). Furthermore, after the introduction of the law "on land" agricultural enterprises under the legal form of limited liability partnerships as well as joint stock companies and producer cooperatives appeared (GRAY, 2000; PETRICK et al., 2013). In addition to that, individual farms started to spread. Moreover, subsistence farming has played a significant role in Kazakhstan since the socialist times. The result of the reforms was a co-existence of different farm types, namely huge agricultural enterprises including agroholdings, individual farms and household economies. The different farm types will be analysed thoroughly at a later point of my dissertation. The main steps of the land reform are summarized in Table 1 below.

Table 1: Main steps of land reform after the independence of Kazakhstan in chronological order

Year	Policy initiatives	Main outcomes
1991	Independence of Kazakhstan; first reform steps	Sovhozes and kolkhozes were formally converted into other legal forms, little substantial restructuring.
1995	Law "On land" institutes share privatisation. Withdrawal to form individual farms is allowed.	Government ownership of land, but rural residents obtain up to 99-year leasehold of "conditional land shares" without specific demarcation of plots. Three options: (1) creation of an individual farm, (2) formation of an agricultural enterprise, (3) sublease to other users. Inheritable private ownership of household plots is acknowledged.
1998	Application of bankruptcy procedures as response to widespread insolvencies.	Conversion of most producer cooperatives into limited partnerships, concentration of formal ownership in hands of management, but creation of individual farms is also accelerated.
2001	Terms of lease for existing and future contracts reduced to 49 years.	Increasing uncertainty about security of land tenure.
2003	New land code adopted, introducing private ownership of farmland. Sublease of shares prohibited, land either to be self-cultivated or contributed as capital share to agricultural enterprise, "merging small farms campaign".	Implementation in 2005, preferred option of former sub-lessors is to contribute to stock of agricultural enterprises, but creation of individual farms is also exercised.

Source: PETRICK et al., 2013.

Even though after the land code of 2003 land purchases increased, the majority of the land in Kazakhstan is being rented from the state for a low price down to the present day (PETRICK et al., 2013). According to OSHAKBAYEV (2010) the land rental payments almost equal tax on land ownership. To date the state is renting out the land for 100-450 Tenge (0.5-2.0 Euros) per hectare. Hence, especially the large agricultural enterprises that are leasing in land for these low prices are not very interested in buying land. In the south of Kazakhstan, where smaller farms dominate, the interest in buying land is still low as well, but somewhat higher than in the North (GRAMZOW and SULEIMENOV, 2011).

Besides, the transformation in Kazakhstan like in other Central Asian countries brought rapid changes in the socio-economic framework to which farmers were forced to adapt. For the "new" private farmers it was difficult to farm in a profitable way, since they were lacking experience and did not have sufficient extension services at hand (QAMAR and SWANSON, 2012).

Since the government benefitted considerably from the oil boom and hence, had more money at its disposition, it engaged more in supporting the agricultural sector and in making it more competitive. (POMFRET, 2007; GRAMZOW and SULEIMENOV, 2011).

One form of support from the government to agricultural producers after the independence of Kazakhstan was paying subsidies or other types of payments. Thus, farmers received per unit of output payments for livestock. How much payment an agricultural producer got was calculated based on the cost for animal feed and the amount of output sold on the domestic market. The akimats, the provincial governments, were in charge of these payments. Furthermore, per hectare payments were introduced for so-called priority crops such as grains, potatoes, sugar beet, oilseeds, cotton, horticultural crops, and forage crops. The per hectare payments that farmers received for these crops were calculated based on the estimated production costs of the respective crops. However, this program was quickly abolished because after having received the payments numerous producers did not carry on with harvesting the crops. One of the support programs, that started right after independence, was sponsoring part of the procurement costs for buying seeds or perennial fruit crops and thus, reduced the input costs (OECD, 2013).

Moreover, the government was paying subsidies for fertilizer, chemicals and herbicide use to compensate part of the costs to purchase them. These measures were introduced in 2001 and were part of the agricultural development program to increase agricultural productivity. Later, they were substituted by per hectare payments. In addition to that, agricultural producers could buy a certain amount of diesel fuel for a fixed price (OECD, 2013).

There was the possibility for farmers to get loans with lower interest rates than the commercial ones for a comparable credit from the KazAgro Credit agency, a state agency responsible for providing credits in the agricultural sector. The interest rates were fixed then (OECD, 2013). Shortly after the independence of Kazakhstan many agricultural producers were lacking working capital, modern equipment and machinery and hence, the concessional credits helped the agricultural producers to deal with these issues. There were various types of concessional credits e.g. for agricultural producers, processors or the rural population. Furthermore, short as well as long term credits were offered. Moreover,

the possibility existed that rural households with low income could get micro-credits via the Fund for Financial Support for Agriculture (OECD, 2013).

Apart from that, agricultural producers could benefit from concessions for machinery leasing. They paid a significantly lower average leasing fee than if they would lease from a commercial leasing company (OECD, 2013).

Further financial advantages that agricultural units got were e.g. tax concessions. Hence, there were special tax regimes for agricultural units where they got specific tax waivers on key business taxes. Regarding the taxes, distinction was further made between different farm types, namely agricultural enterprises and co-operatives, individual farms and rural households. Furthermore, food processors could get tax concessions as well. In general, agricultural producers could get tax concessions on the principal taxes in agriculture e.g. land use payments, land tax, property tax, social tax, VAT, corporate income tax and tax on vehicles (OECD, 2013).

One of the general measures undertaken by the government to enhance the situation of the agricultural sector was the financing of several projects concerning the infrastructure for agriculture. Since most irrigation systems in Kazakhstan were not managed by private companies, these measures encompassed amongst others water management. In 1994, irrigation fees were introduced in Kazakhstan. The fees were calculated for every oblast based on the volume of water used and the value added that the production would bring to the agricultural producer. Nevertheless, the fee was always lower than the actual cost of maintaining and operating the irrigation system (OECD, 2013). Moreover, projects were financed in some regions of Kazakhstan to improve water management and to modernize irrigation systems. The National Program of Accelerated Industrial and Innovative Development for 2010-2014 focused on the amelioration of land by introducing advanced irrigation systems as well as on the use of water resources (OECD, 2013).

Besides, the Kazakh government established in 2007 two state-holdings, KazAgro and KazAgroInnovation that are responsible for extension services and agricultural research, respectively. Agricultural research is represented by more than twenty research institutes with more than twenty-five branches as well as six innovation and analytical centers and fourteen experimental stations. KazAgroInnovation e.g. is financially supporting research and development and is in charge of research institutions, experimental centers, innovation and extension centers. They are responsible for bringing up new scientific products that can be used in commercial agriculture. Furthermore, KazAgroInnovation is responsible for research and development policies in agriculture as well as for fitting new technologies to local conditions. The Agricultural Ministry finances mostly the agricultural education (OECD, 2013). There are ten institutions of higher education

that provide training for the agri-business sector and over 150 vocational schools (OECD, 2013). It is crucial to train people in agriculture because in agriculture in Kazakhstan skilled workers like farm managers, tractor operators and agro-technicians are scarce. Reasons for these shortages are amongst others the low salaries in agriculture and the worse living and working conditions in rural areas compared to urban areas.

The Ministry of Agriculture through KazAgro is responsible for an extension system funded by a loan from the World Bank (JOHNSON, 2011). KazAgro is further responsible for investments of the Kazakh state in agriculture. KazAgro consists of six joint-stock companies. One of them is KazAgroMarketing which is in charge of training and education and extension services for farmers as well as internationally promoting Kazakh food products. Furthermore, KazAgroMarketing is monitoring food and livestock prices and issuing information on that (OECD, 2013). However, its budget is only 0.03 % of the total KazAgro budget (MANDLER, 2010).

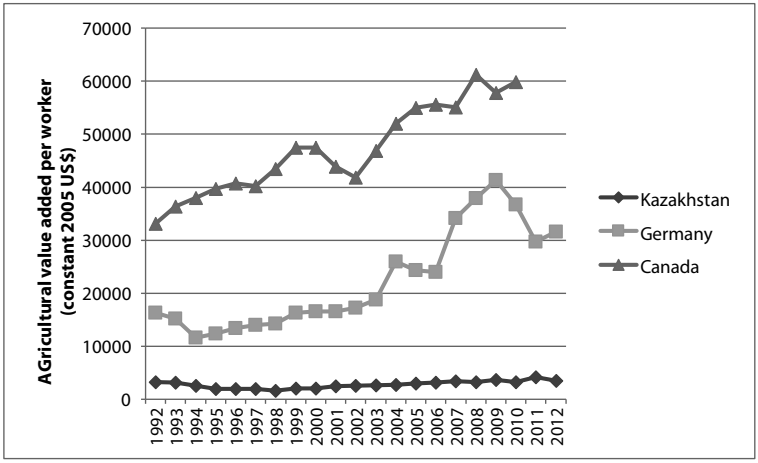
Even though the Kazakh government is making an effort, a full extension service system has not yet been developed (QAMAR and SWANSON, 2012). Besides, top down policy approaches dominate in Kazakhstan which makes extension services disconnected from small farmers at the bottom. Besides the Ministry of Agriculture there are a number of other organizations engaging in one or the other way in giving advice to farmers, but they are all neither well-coordinated nor well connected with farmers or rural areas (JOHNSON, 2011).

2.2 AGRICULTURAL PRODUCTION IN KAZAKHSTAN

Furthermore, Kazakhstan is an interesting case to look at because of its high agricultural potential. Nevertheless productivity in agriculture is still low (PETRICK et al., 2013). If I compare the value added per worker as a measure of productivity like in Figure 1, I notice that the values for Kazakhstan are rather low compared to more developed countries e.g. Germany or Canada and that they have not changed very much within the twenty years presented in Figure 1. It makes sense to compare Kazakhstan with Canada, since there are parallels regarding the harsh climate, the vast land and therefore, large-scale farming, as well as sparse population. Furthermore, a remarkable cooperation in agriculture has already been established between those two countries. Hence, even though the agricultural value added in absolute numbers doubled within the last ten years the productivity (agricultural value added per worker) was decreasing from 3,305 $ in 1992 until it reached its lowest level of 1,684 $ in 1998 and in the following years started then to increase with slight ups and downs to 3,533 $ in 2013, which is also broadly the double of the lowest value in 1998. However, compared to the level of the agricultural value added just after the independence

of Kazakhstan in 1992 ($ 3,305) it is about the same. Furthermore, compared to industrialized countries the productivity of the agricultural sector is still on a relatively low level. Furthermore, in many rural areas low incomes and high unemployment persist.

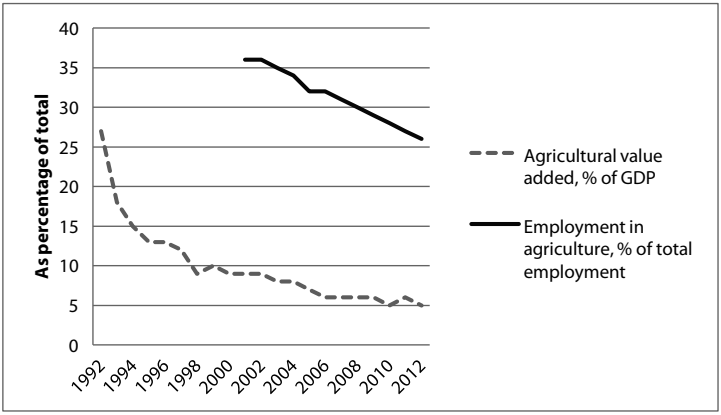
Figure 1: Development of agricultural value added per worker in constant 2005 US$



Source: Own depiction; data from World Bank database; http://data.worldbank.org/indicator/EA.PRD.AGRI.KD.

Figure 2 shows that even though the share of employees that worked in agriculture decreased over the last years, it was still on a high level in 2012, with twenty-six percent of all employees working in agriculture. As a comparison, employment in agriculture as percentage of total employment was two percent in Germany in 2012 and in the previous years. The share of the agricultural value added as percentage of total GDP dropped as well from twenty-seven percent in 1992 after the independence of Kazakhstan to five percent in 2012. However, seems to have more or less stabilized around this share. Figure 2 also exposes a significant disparity between e.g. in 2012 still twenty-seven percent of employees working in agriculture, but generating only five percent of the total GDP.

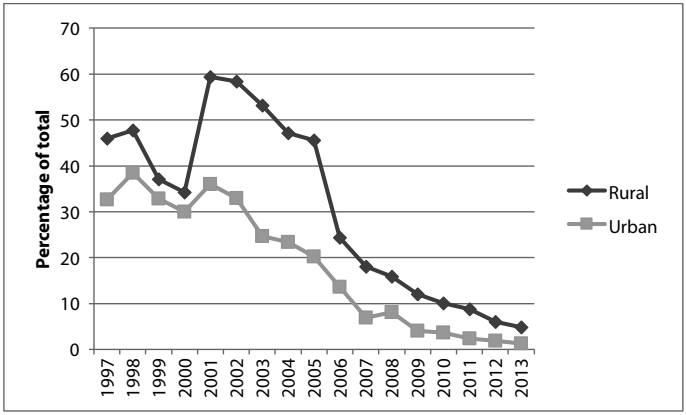
Figure 2: Agricultural value added and employment in agriculture



Source: Own depiction; data from World Bank database; http://data.worldbank.org/indicator/SL.AGR.EMPL.ZS; http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS.

Hence, overall a rather positive trend in agricultural production and employment can be observed even if the improvements happen sometimes slowly. Furthermore, these positive developments are also reflected in the incomes and wealth of the rural population. Figure 3 compares e.g. the share of the rural and urban population below the national poverty line and national urban poverty line, respectively. Starting with 1997, the share of the population in the rural areas reached the highest level in the early 2000s, at that time more than fifty percent of the rural population were living below the poverty line. After 2005 the percentage of the rural population below the poverty line has been dropping constantly and reached 4.9 percent in 2013. The share of the urban population below the national urban poverty line has always been lower than the rural equivalent, but in the early 2000s the gap was highest, namely more than twenty percent difference between the percentage of rural and urban inhabitants below the poverty line. After 2005 the gap has started to narrow, but in urban areas the share of people living below the poverty line remains the level in the countryside, namely only 1.3 percent in 2013.

Figure 3: Percentage of rural and urban population below the national poverty line

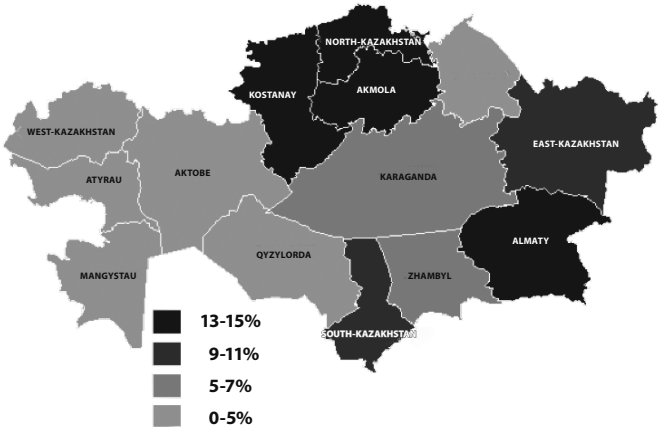


Source: Own depiction; data from World Bank database;
http://data.worldbank.org/indicator/SI.POV.RUHC/countries;
http://data.worldbank.org/indicator/SI.POV.URHC/countries.

2.3 Regions in the survey

In this study the focus is in particular on Akmola oblast and Almaty oblast. The North Kazakh Grain Region including Akmola, Kostanay and North-Kazakhstan as well as Almaty are the regions with the highest share in agricultural output, namely thirteen to fifteen percent each as shown in Figure 4. Akmola was chosen as a representative of the North Kazakh Grain Region.

Figure 4: The share of the regions in agricultural output



Source: OSHAKBAYEV, ACEPAS, 2010.

Choosing the two oblasts Akmola and Almaty for the survey has another advantage, namely that the type of farming and organization of farming in those two oblasts are different from each other. As Figure 5 shows, most agricultural producers in the north of Kazakhstan are specialized in plant growing, mostly wheat to be precise. Furthermore, in this area more large agricultural enterprises or agroholdings can be found, since this type of farming is land-intensive, but less labour-intensive. In Almaty oblast like in South-Kazakhstan oblast and Zhambyl oblast livestock as well as plant farming is dominating. However, the plants cultivated in this region are rather vegetables and fruits. In the South rather small-scale farming with many individual farms is dominating. This type of farming is more labour-intensive and less land-intensive Furthermore, it seems that the mentality in the South is somewhat more entrepreneurial (USAID, 2005).

Figure 5: Specialization of the regions

Source: OSHAKBAYEV, ACEPAS, 2010.

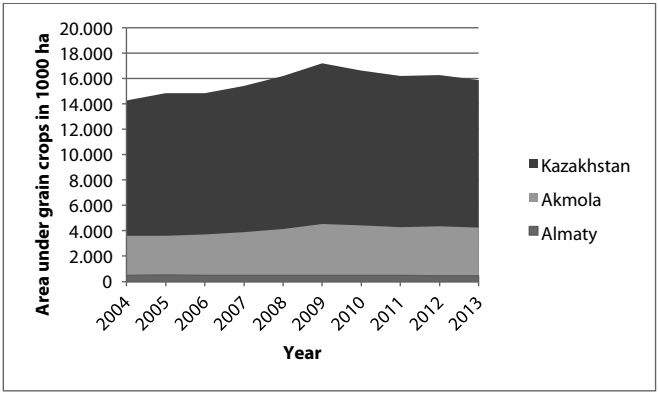
2.4 DIFFERENT FARM TYPES AND THEIR ROLE IN THE KAZAKH AGRICULTURE

In 2011, the agricultural landscape consisted of more than 200,000 farms in total, of which 6,197 were agricultural enterprises and 182,419 were individual farms. In addition to that, 2,253,475 households were engaged in farming (GRAMZOW and SULEIMENOV, 2011). Furthermore, the agricultural enterprises and especially agroholdings can be found predominantly in northern Kazakhstan, where they are mostly engaged in crop farming. In 2011, agricultural enterprises used more than ten million hectares for grain production.

Grain is mostly produced by agricultural enterprises, which produced in 2011 around 18.5 million tons of grain (including rice and legumes). In contrast to that, individual farms produced about 8.5 million tons of grain and household plots around 35,000 tons of grain. For the former two farm types grain production slightly increased compared to the last years except for the rather bad year 2010. However, the household farms produce less and less grain. Compared to 2007 their grain production almost halved over the following four years (STATISTICAL YEARBOOK, 2011). When comparing the two oblasts Akmola and Almaty in 2011, it can be realized that Akmola with its 4.28 million hectares under grain production accounts for more than a quarter of the total area under grain in Kazakhstan, whereas only 470 thousand hectares are used for grain production in Almaty oblast. This is shown in Figure 6.

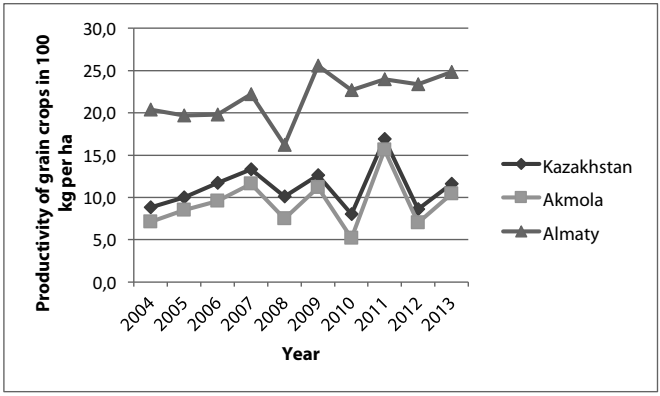
However, when comparing the productivity of the grain crops in 2011 in Almaty oblast, Akmola oblast and Kazakhstan as a whole, different picture appears. Namely that the productivity in Akmola with 1.6 tons per hectare was below the Kazakh average, which in turn was 1.7 tons per hectare. On the contrary, the productivity in Almaty was with 2.4 tons per hectare above the national average, see Figure 7.

Figure 6: Area under grain production



Source: Own depiction; data from Statistical Agency of Kazakhstan: "Area under grain crops (including rice) and legumes cultures".

Figure 7: Productivity of grain crops

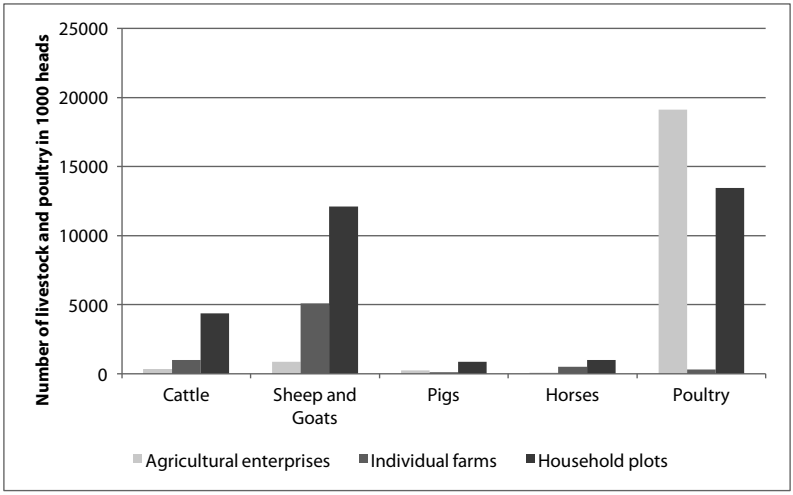


Source: Own depiction; data from Statistical Agency of Kazakhstan: "Productivity of grain crops (including rice) and legumes cultures".

Furthermore, livestock farming is common as well in Kazakhstan. In livestock farming a different distribution across farm types prevails than in crop farming. The role of household plots needs to be underlined. Except for poultry farming,

household plots are keeping more animal stock (cattle, sheep and goats, pigs and horses) than agricultural enterprises and individual farms as presented in Figure 8. The livestock and dairy farming household plots and individual farms are mostly situated in the south of Kazakhstan, including Almaty oblast.

Figure 8: Number of livestock and poultry in 2011



Source: Own depiction; data from STATISTICAL YEARBOOK 2011, p.165.

2.5 REASONS FOR THE LABOUR SCARCITY IN RURAL KAZAKHSTAN

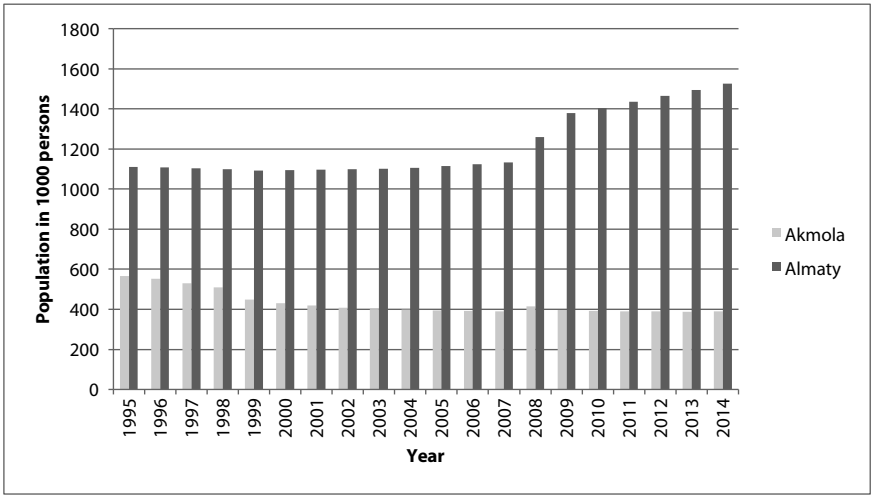
The following section presents some demographic aspects as well as aspects of the Kazakh labour market such as employment and unemployment, average monthly earnings by region, monthly earnings by activity and employment by economic activities in Kazakhstan, as well as labour employment by different farm types. All of these topics contribute to the explanation of labour scarcity in the rural areas of Kazakhstan.

2.5.1 Demographic developments

Labour has become a scarce factor in rural areas of Kazakhstan, especially in the north of the country. In the 1990s, after the independence of Kazakhstan many people especially from the Russian minority and from other minorities emigrated. Many of the emigrants were skilled workers or administrative workers. TOLEUBAYEV et al. (2010) continue that at present a lack of agronomist, veterinarians, as well as agro-technicians with specialized technical knowledge can be witnessed. Many representatives of these professional categories emigrated as repatriates after the breakdown of the Soviet Union. The crisis in Russia in 1998 decelerated the emigration pace. Furthermore, after 2000 the Kazakh economy

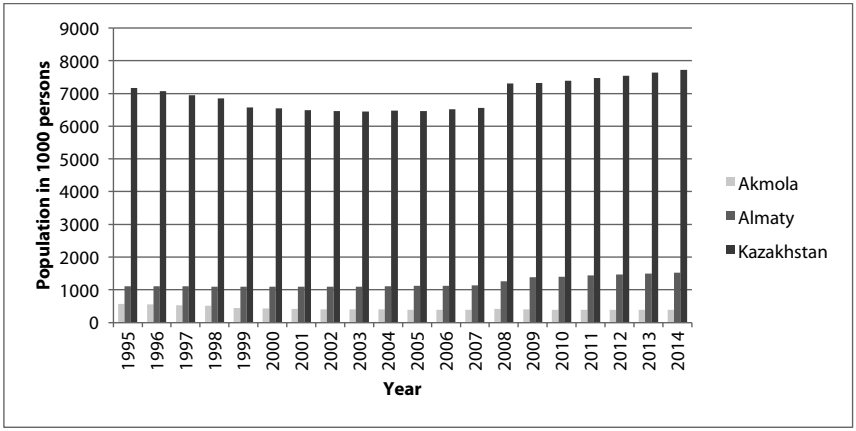
started to grow, which led to a decrease of emigrants (OECD, 2013). When looking at the population statistics of the rural areas of Kazakhstan, in this study the focus is on Akmola and Almaty oblast, it can be noticed that in the rural areas of Almaty oblast the population started to slightly grow again from the early 2000s as shown in Figure 9 and Figure 10. This could be partly due to new incoming immigrants from the neighboring countries of Uzbekistan and Kyrgyzstan (LARUELLE, 2008). Another aspect is that the share of Kazakhs and other Muslim populations is higher in south Kazakhstan. These ethnicities have on average higher fertility rates than the Slavic population. Furthermore, in the exodus after the independence of Kazakhstan Slavic and other minorities were represented disproportionally high. Most of these peoples have lived in northern Kazakhstan. Hence, e.g. around one third of the inhabitants of the North Kazakh Grain Region left the area (PETRICK, 2013). Figure 9 and Figure 10 show the different developments in the rural areas of Akmola and Almaty oblast and compare those developments with the whole of Kazakhstan.

Figure 9: Population development in rural areas of Akmola oblast and Almaty oblast



Source: Own depiction; data from STATISTICS AGENCY OF KAZAKHSTAN and Statistical Yearbook: "Dinamycs [sic] of population".

Figure 10: Population development in rural areas of Akmola oblast, Almaty oblast and the whole of Kazakhstan



Source: Own depiction; data from STATISTICS AGENCY OF KAZAKHSTAN and Statistical Yearbook: "Dinamycs [sic] of population.

2.5.2 Aspects of the labour market in Kazakhstan

The following subchapter provides information on the employment and unemployment situation in Kazakhstan as well as employment according to region and sector. Besides, earnings by region and activity will be shown. The idea is to compare the situation on the rural labour market or in agriculture, respectively with the situation in other economic sectors. This can amongst others explain why apart from more general demographic challenges labour is scarce in agriculture. Thus, because of better payments and better working conditions people move to the cities to e.g. perform office jobs.

Table 2: Employment and unemployment in Kazakhstan (2001-2014), in 1000 persons

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Economically active population, thsd. persons	7479.1	7399.7	7657.3	7840.6	7901.7	8028.9	8228.3	8415	8457.9	8610.7	8774.6	8981.9	9041.3	8962
Employed population, thsd. persons	6698.8	6708.9	6985.2	7181.8	7261	7403.5	7631.1	7857.2	7903.4	8114.2	8301.6	8507.1	8570.6	8510.1
Employees, thsd. persons	3863.3	4030.2	4229.6	4469.9	4640.5	4776.6	4973.5	5199.4	5238.8	5409.4	5581.4	5813.7	5949.7	6109.7

Source: Own modification; STATISTICAL AGENCY OF KAZAKHSTAN, "Main indicators of the labour market of the Republic of Kazakhstan".

Table 2 shows that the economically active population of Kazakhstan has grown over the last decade. At the same time the unemployment rate decreased. In fact, it halved from 2001 until 2014, falling from 10.4 percent to five percent. More suitable jobs were found for the economically active persons. However, Table 2 speaks about Kazakh averages not taking into account differences between regions and sectors. To get a more differentiated picture Table 3 illustrates the number of employed persons from 2010 until 2014 in several sectors of the economy one of them being agriculture. Furthermore, the respective situation of several regions, namely Almaty oblast and Akmola oblast as well as Almaty city and Astana is presented. Hence, looking at Table 3 it can be observed that the number of employed in agriculture in Akmola oblast more or less stagnated between 2010 and 2014. In Almaty oblast it slowly increased until 2013, but decreased from 2012 to 2014. Nevertheless, agriculture is still one of the sectors where the most people work, especially in Akmola and Almaty oblast. In Akmola more than one third of the employed population worked in agriculture between 2010 and 2014. Other major sectors that employed many people were e.g. industry and education. The number of persons employed in information and communication and science grew, but mainly in the cities, and especially in Almaty city. Such jobs could for example be more tempting for educated people from rural areas than agriculture, but are often entailing a move to the city.

In addition to that, Figure 2 shows how the share of people employed in agriculture has dropped over the last decade, reaching a level of a bit more than one quarter of persons being employed in agriculture. Thus, the share of persons employed in agriculture in Almaty oblast and Akmola is above the national average. This makes sense since when looking e.g. at Figure 4 it is evident that Almaty oblast and Akmola oblasts are among the principal agricultural areas of Kazakhstan.

In Almaty oblast the number of employed persons increased steadily from 843,000 to over one million between 2010 and 2014, whereas the number of employed in agriculture increased between 2010 and 2012, but decreased then, reaching a lower level in 2014 than in 2010 as pointed out in Table 3. Mostly, the development of the numbers of employed people in Akmola and Almaty oblasts can be explained by the demographic development in Akmola and Almaty as presented in section 2.5.1 as well as in Figure 9. The decrease in employed persons in agriculture in Almaty oblast between 2012 and 2014 may have happened because more employed persons moved from agriculture to other sectors with better payment and working conditions. Furthermore, an increase in employed persons in Astana and Almaty city that work e.g. in financial and insurance services or in information and communication (source like Table 3) can be observed. This is amongst others due to the much higher salaries in the cities pointed out in Table 4 as well as due to better working conditions.

Table 3: Employment by economic activities and regions of Kazakhstan (2010-2014) in 1000 persons

	2010			2011			2012		
	Republic of Kazakhstan	**Akmola oblast**	**Almaty oblast**	**Republic of Kazakhstan**	**Akmola oblast**	**Almaty oblast**	**Republic of Kazakhstan**	**Akmola oblast**	**Almaty oblast**
Total persons employed	8114.2	413.3	843	8301.6	418.5	899	8507.2	416.4	969.7
Agriculture, forestry & fishing	2294.9	158.3	393.8	2196.1	149.6	402.6	2172.7	149.6	428.2

	2013			2014		
	Republic of Kazakhstan	**Akmola oblast**	**Almaty oblast**	**Republic of Kazakhstan**	**Akmola oblast**	**Almaty oblast**
Total persons employed	8570.6	419	993.1	8510.1	422.7	1013.3
Agriculture, forestry & fishing	2073.6	148.9	423	1605.1	150.3	323.5

Source: Own modification; STATISTICAL AGENCY OF KAZAKHSTAN; "Employment by economic activities (quarterly) and regions of the Republic of Kazakhstan 2010-2015".

The salaries in Almaty oblast and Akmola were below the Kazakh average. However, they increased between 2003 and 2010. The salaries in Almaty oblast were slightly above the ones in Akmola oblast. The salaries in Astana city and Almaty city were almost the double of the salaries in the respective oblasts.

Table 4: Average monthly earnings by regions (2003-2012)

	Repulic of Kazakhstan	Akmola oblast	Almaty oblast	Astana city	Almaty city
2003	23128	14954	15933	33002	32622
2004	28329	18729	20180	41921	39614
2005	34060	22740	24436	51001	49201
2006	40790	27687	29779	63001	59240
2007	52479	36540	39483	79210	78021
2008	60805	41944	44327	89631	90239
2009	67333	47794	49715	98864	95139
2010	77611	54557	58430	110838	106597
2011	90028	64495	67638	132612	121674
2012	101263	74685	77320	148287	134378

Source: Own modification; STATISTICAL AGENCY OF KAZAKHSTAN; "Main indicators of labour remuneration by region for 2003-2011".

Looking at Table 4 it can be observed that even though the monthly earnings grew fast from 2003 until 2012 in every region presented, there are still significant differences between the regions as well as between rural and urban areas. In the cities of Almaty and Astana the earnings were far above the national average in all of the years illustrated in the table and mostly around the double of the respective oblast, namely Almaty oblast or Akmola oblast. These findings are in line with Figure 3 which shows that the share of the rural population below the poverty line is still higher than the share of the urban population below the national poverty line. Nevertheless, the disparities between the rural and the urban population have shrunk significantly within the last years. For further information regarding differences in earnings it is helpful to have a look at Table 5, where the average monthly earnings according to activity are described. Even though the earnings in agriculture have been on the rise like in most other sectors, and even though they almost doubled from 2010 until 2013, the earnings remained far below the average earnings. Compared to other sectors the earnings in agriculture, forestry and fishing were from 2010 until 2013 the lowest of all sectors presented in the table below. Low salaries persisted in education as well followed by arts, recreation, entertainment followed by human health and social work activities. The highest earnings were reached in mining, quarrying followed by professional, scientific and technical activities and followed then by financial and insurance activities. Thus, these findings fit in with the findings

presented in Table 4. Since many people still work in agriculture, the worst paid sector, in Akmola and Almaty oblast, the earnings in those oblasts are low. This in turn is another explanation why these areas are suffering from labour shortages. Many people move away from the agricultural sector, that is badly paid and that is often characterized by harsh working conditions, to other sectors, that are better paid or that have better working conditions. Furthermore, people often do not only change the sector they work in, but also move to other areas e.g. to the cities, where payments are on average higher.

Table 5: Monthly earnings by activity (2010-2013), in tenge

	2010	2011	2012	2013
Total	62979.2	68648.7	102051.5	105865.9
Agriculture, forestry and fishing	29343.8	29183.9	45552.8	52566.3
Industry	74859.8	65578.9	113259.1	132502.9
Information and communication	89753.3	87694.6	131778.4	150653.9
Financial and insurance activities	130339.4	119338	175730.9	194823.1
Professional, scientific and tech-nical activities	113718	121033.8	181402.1	200103.6
Education	40722.1	42406	63141.2	69956.7
Human health and social work activities	44555.1	47904.9	71435.8	80230.7

Source: Own calculations; STATISTICAL AGENCY OF KAZAKHSTAN; "Average monthly earnings by economic activity".

Note: Averages calculated based on monthly data from January until December for 2010-2012 and from January until July 2013.

3 LABOUR RATIONING: A THEORETICAL PERSPECTIVE

The objective of this chapter is to address the research questions posed in 1.2 from a theoretical perspective. How can labour rationing be defined and explained from a theoretical perspective? How does labour rationing affect the marginal labour productivity of different farm types? Which factors determine the probability of an agricultural unit to be labour rationed? Furthermore, this chapter is supposed to give an overview over the findings other researchers made regarding access to factors of production and regarding the advantages or disadvantages of different farm types on the factor markets as well as regarding factor productivity from a theoretical point of view.

The higher the partial marginal productivity of labour of an agricultural unit, the higher the wage paid to the employees (ROUMASSET and LEE, 2007). Nevertheless, production depends on the input factors. There are exogenous and endogenous factors that limit production. These constraints can be cost related e.g. supervision of hired workers or scarce labour or land as well as credit constraints. Furthermore, it should be kept in mind that labour is not a homogenous factor, but that different types of labour have different roles and cannot always easily be substituted one with another e.g. skilled and unskilled labour, seasonal and permanent labour.

In the following firstly a brief theoretical definition of labour rationing will be given. Then, factors that determine labour will be presented and different types of labour such as family versus hired labour or skilled and unskilled labour will be distinguished. Furthermore, a connection to other factors that play an important role for agricultural production will be made. After that, the household and production model will be introduced without labour constraint and then, with labour constraint. Subsequently, the shadow price calculation will be explained. Lastly, the shadow price calculation will be related to the Kazakh case.

3.1 A THEORETICAL DEFINITION OF LABOUR RATIONING

The term labour rationing has already been briefly introduced in 1.2. With a perfect market present the demand for labour and the supply of labour are in equilibrium at the equilibriuim wage. When the demand for labour increases, the wage paid rises as well, this in turn leads to an increased labour supply. The labour market then clears at a new equilibrium wage. The equilibrium is called market equilibrium (PINDYCK and RUBINFELD, 2012). Thus, an agricultural producer is labour rationed if his demand for labour is permanently exceeding the supply of labour. Even if the agricultural producer is willing to pay a higher

wage per labour unit than the actual wage paid, the supply of labour will not change. This means that the market mechanisms of demand and supply are not working with rationing (PINDYCK and RUBINFELD, 2012).

3.2 ACCESS TO FACTORS OF PRODUCTION AND FACTOR PRODUCTIVITY

There are different types of labour such as family versus hired workers or seasonal versus permanent workers. All these types of labour have different advantages and disadvantages. Furthermore, workers differ regarding their level of skills. ROUMASSET and LEE state that whether a farm manager selects hired or family labour is determined endogenously (ROUMASSET and LEE, 2007). However, in the case of Kazakhstan it cannot generally be assumed that the selection of labour is endogenous since many areas face a shortage of labour, especially skilled labour. Besides, in the model for Kazakhstan in the empirical part of the dissertation only exogenous labour will be accounted for in order to avoid endogeneity in the regression model. But this problem will be described in more detail in chapter 4. However, for completeness the topic is being shortly picked up here. Family and hired labour are not perfect substitutes. Besides, these two types of labour resort different skills and thus, are used for different types of jobs. An advantage of hired labour over family labour is that it is rather specialized (ROUMASSET and UY, 1980). Nevertheless, ALLEN and LUECK (1998) counter that specialization in agriculture does not bring as many benefits as in other industries, but monitoring costs of hired workers are high. This is for ALLEN and LUECK (1998) an argument in favour of family farms. The comparative advantages of family and hired labour in specific jobs decide which jobs will be performed by which type of labour. In a household model, when the shadow price for family labour exceeds the cost of a hired worker for the same quality of work, the farm would rather hire labour (ROUMASSET and LEE, 2007). Moreover, there are not only differences between family and hired labour, but also between permanent and seasonal workers. ESWARAN and KOTWAL (1985) state that seasonal labour could be used for tasks that need less monitoring and where the labour effort is easily visible like harvesting. When analyzing labour, shirking is an important factor to consider. Shirking in turn entails supervision costs.

ROUMASSET and LEE (2007) underline that rural development and reducing poverty are strongly related to employment on a farm or agricultural enterprise. Moreover, for many rural inhabitants that work in agriculture their entire daily life as well as their earnings circle around the rural labour market. Furthermore, ROUMASSET and LEE (2007) see the fact that labour is transferred from traditional to commercial agriculture or when labour is leaving agriculture for other activities as a sign of progress. However, traditionally the more common belief has been that family labour is more efficient than hired labour since the family members are not only working on the farm, but they are also residual claimants

(BINSWANGER and ROSENZWEIG, 1986; BINSWANGER et al., 1995; DEININGER, 1995). Since labour markets are mostly imperfect due to transaction costs e.g. lacking information of an employer on the real effort that an employee making at the job. Because of the lack of information the employees need to be monitored by a supervisor in order to prevent shirking. This however costs money since the supervisor needs to be paid. Further costs occur when recruiting employees. In addition to that, asymmetric information makes it difficult for the employer to choose the right employee (ROUMASSET and LEE, 2007). ALCHIAN and DEMSETZ (1972) deal with the supervision theme as well. In addition to that, they focus on team production. Hence, they suggest that team production can bring a higher output than the sum of outputs produced by individual use of the input factors. But they mention the problem of shirking as well, in team production it is hardly possible to comprehend which individual worked how much. Therefore, a monitor is necessary, which is however costly. According to ALCHIAN and DEMSETZ (1972) supervision costs lower the wages and can thus be seen as a tax. Moreover, they see competition on the market as a kind of supervision for team production as well. In addition to that, FRISVOLD (1994) opposes the idea that family labour and hired labour are perfect substitutes without supervision, since with hired labour there is always the risk of shirking. He further underlines the importance of supervision to increase productivity as well. ALLEN and LUECK (1998) add to the discussion that even though compared to other industries fewer advantages are reached in agriculture by specialization, supervising workers is costly. Moreover, ESWARAN and KOTWAL (1986) go even further stating that without the necessity of supervising workers, family and hired workers would be perfect substitutes, and the relation of land used and labour used would be the same across all farms. Furthermore, the agricultural units would be pareto-efficient. The same would have held true if farmers had had the option of borrowing an unlimited amount of money at a fixed interest rate (ESWARAN and KOTWAL, 1986). However, the result of BENJAMIN'S (1992) analysis is opposed to that, namely that the productivity of hired and the productivity of family labour do not differ significantly.

In the literature on farm size and productivity mainly three different types of relationships between the former and the latter were pointed out. For some authors e.g. farm size and labour productivity have an inverse relationship, but for other authors the relationship between productivity and farm size depends on the access of different farm types to input factors. The farm size plays a significant role for the access of an agricultural unit to input markets such as the labour market, the land market and the credit market. A third group of authors points out that supervision of employees plays a significant role for the inverse relationship between farm size and productivity to hold true.

TOMICH et al. (1995) claim that labour per hectare is inversely related to farm size. Thus, larger farms employ relatively less workers. Furthermore, large farms are mostly operating in crop farming, which is land-intensive, but not labour-intensive. On the other hand, smaller farms dominate in labour-intensive farming. Moreover, LIPTON (2009) agrees that farm size and productivity are inversely related with each other. In addition to that, DEINIGER (1995) supports the argument that farm size and production are negatively related. According to FEDER (1985) there is no relationship between farm size and land productivity unless the agricultural production function has constant returns to scale.

Furthermore, FEDER (1985) suggests that the farm size affects the access to factor markets and that that is why there is a relationship between farm size and land productivity. For him the access to factor markets is responsible for this relationship instead of the technology difference (FEDER, 1985). Furthermore, farms and agricultural enterprises of different size pay different amounts of money for the input factors. Hence, these variations in input prices are responsible for e.g. differing land productivity and differing use of input factors. The lower labour costs of smaller farms allow the latter to employ more workers per hectare. Because of that small farms are capable of achieving higher land productivity (FEDER, 1985). However, various authors suppose that the inverse relationship between farm size and productivity and the disadvantage of larger farms on the labour market, can be offset by advantages of large farms on the land and capital market (FEDER, 1985; CARTER and WIEBE, 1990; ESWARAN and KOTWAL, 1986).

FEDER (1985) points out a third explanation for an existing relationship between farm size and factor productivity, land productivity in particular besides the explanation of different production technologies and different prices for input factors. He mentions the role of supervision. Thus, FEDER (1985) continues that the farm size is not related to yields if labour productivity is not affected by supervision. Hence, he observes that farm size and land (factor) productivity are either positively or negatively related under the condition that the efficiency of hired labour increases by supervision. The more motivated family members are supervising hired labour and the more land a household farm owns, the easier for the farm to get a credit, since land is the best collateral (FEDER, 1985). However, FEDER (1985) points out limits in getting a credit. According to him even if a household or enterprise is willing to pay a higher interest rate at some point it will not be able to get a higher credit even if the household or enterprise would like to (FEDER, 1985). As a consequence FEDER (1985) includes a credit market imperfection in his model.

It is important to supervise and motivate workers but also to educate and consult them. According to VAN DEN BAN (1999) the education of farmers is crucial for agricultural productivity and agricultural development. Furthermore, effective

extension services are a means of improving the education of farmers. However, he further underlines that extension services need to be effective in order to have a lasting positive impact. In addition to agricultural extension services, research, input and credit supply, the marketing of products as well as price policies play a significant role for agricultural development (VAN DEN BAN, 1999). Nevertheless, policymakers often do not value the potential returns from agricultural research enough. Further common problems include the lack of financial resources for agricultural research, poor research programs, the lack of qualified agricultural scientists, exclusion of small-scale farmers and women. These problems contribute to making agricultural extension ineffective (TOMICH et al., 1995). In many Post-Soviet countries extension services are underdeveloped. But many researchers claim that in those countries farmers do not have any experience in farming in a market economy and hence, have even a higher need for extension services. TOLEUBAYEV et al. (2010) state that nowadays previous experience in farming is crucial for farmers in Kazakhstan to be successful. The idea is that most farmers do not know how to farm and only those that are experienced have networks with other experienced farmers. TOLEUBAYEV et al. (2010) and QAMAR and SWANSON (2012) hold the opinion that in most of the Post-Soviet countries many private farmers worked earlier in different professions than farm management e.g. as teachers or in the public sector, and thus do not have any experience with farming or managing farms. Hence, they lack many of the competences a successful farmer should have. Moreover, they cannot draw on any experience in working in a market economy. According to VAN DEN BAN (1999) decisions such as how to increase profits and decrease costs are for those farmers completely new territories. Besides, farmers do not always trust extension agents because specialists during the communist times were often working exclusively for their own benefit (VAN DEN BAN, 1999). Many farmers in post-communist countries do not value extension services and show a low willingness to pay for them (RAJALAHTI and SWANSON, 2010; SHTALTOVNA, 2013).

Besides, the transformation in Kazakhstan like in other Central Asian countries brought rapid changes in the socio-economic framework to which farmers were forced to adapt. For the "new" private farmers it was difficult to farm in a profitable way, since they were lacking experience and did not have sufficient extension services at hand (QAMAR and SWANSON, 2012). TOLEUBAYEV et al. (2010) report that many private farmers did not have any farming background and did not really know how to farm. Hence, the most prospering farms in Kazakhstan have mostly been managed by farm managers that worked as agronomists, veterinarians or agricultural engineers during Soviet times. In addition to their better knowledge of farming practices, they further had the opportunity to exchange knowledge through their networks of contacts from Soviet times (TOLEUBAYEV et al., 2010). The loss of knowledge as well as the lack of knowledge were key for the crisis in

agriculture after the breakdown of the Soviet Union (TOLEUBAYEV et al., 2010). The analysis of TOLEUBAYEV et al. (2010) presents a different view on the question how productive and efficient different types of labour are. Hence, as described earlier, family labour may mostly be more reliable than hired labour, since family members are also residual claimants. However, a different question is whether the latter are also more qualified. According to TOLEUBAYEV et al. (2010) family labour is often lacking skills for working properly on a farm or for managing a farm. Thus, the scarcity of skilled labour appears to be particularly severe. For skilled jobs more qualifications are needed and less people have those qualifications. If a farm or agricultural enterprise works with new technologically advanced machinery and uses an advanced production technology, they cannot just hire any kind of labour, but need qualified labour for those specific tasks. Unqualified labour could e.g. cause damage on machinery. Hence, it seems that the more technologically advanced an agricultural unit is and the more modern machinery it uses the more difficult it is for them to find labour that can deal with those circumstances.

3.3 MODELLING LABOUR DEMAND AND SUPPLY

3.3.1 Household model without labour rationing

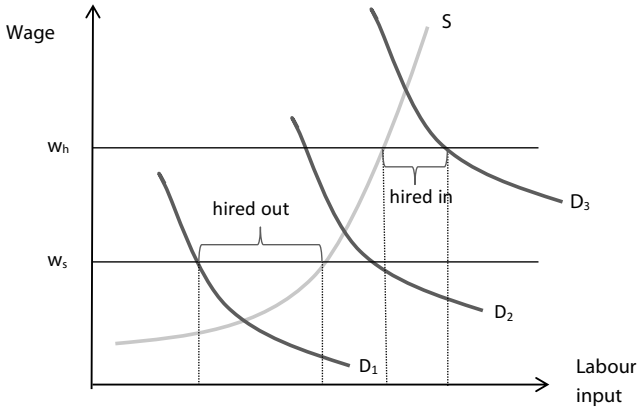
After having elaborated on several aspects of labour and labour availability, a household model will now be presented. The household model is one option to analyse production and consumption.

In the household problem the agent has to take simultaneously decisions about production, consumption and work. Hence, it means that the consumer, producer and worker problem cannot be analysed seperately, but all of them at the same time in the household model (SADOULET and DEJANVRY, 1995; SINGH et al., 1986). With regard to household models separable and non-separable household models can be distinguished. Firstly, I will present the separable household model and explain under which circumstances the consumer, producer and worker problem can be analysed separately.

If perfect markets exist, all products and factors can be traded with the market price which is the opportunity cost of every product or factor that the household owns. Under such circumstances the households face no transaction costs, and the prices are all exogenous for the households. Hence, the household takes decisions based on the prices (SADOULET and DEJANVRY, 1995). Perfect markets and perfect substitutability of family and hired labour (and other types of labour used) are sufficient but not necessary conditions for a household model to be separable (SKOUFIAS, 1994). In fact, the necessary condition for separability is that prices are exogenous and that the households use markets, but the prices for example for selling or purchasing labour may differ (SADOULET and DEJANVRY, 1995). Under these conditions the production and consumption side of the model can be ana-

lysed separately, and consumption and production decisions are not made simultaneously. The absence of transaction costs and the working of markets make decisions such as whether to consume their own products or to sell them and to buy consumption products instead as well as decisions such as whether to use family labour or to hire out labour and then to hire in labour for production irrelevant (SADOULET and DEJANVRY, 1995). The process of hiring labour in and out is illustrated in Figure 11 below. When the specific household has an excess supply of labour, they will hire out labour to work for example at a different agricultural unit. In the figure below this would be the case for demand function D_1 at wage w_s. When on the contrary the demand for labour of the specific household is higher than the supply of family workers they would hire in more labour (ROUMASSET and LEE, 2007). In the figure below that is the case for demand curve D_3 and wage w_h.

Figure 11: Households hiring labour in and out



Source: ROUMASSET and LEE, 2007.

The model presented here is based on the model of BARNUM and SQUIRE (1979) and SADOULET and DEJANVRY (1995).

Moreover, in the household model a household is mostly defined as the people living under the same roof. Besides, for this type of model it can be assumed that there is only one decision maker in each household (SADOULET and DEJANVRY, 1995). It is assumed that the labour market is competitive. Households are active in the labour market either by selling their workforce or by buying labour. Because of the assumption of a perfect market all products and factors including labour can be traded referring to market prices or market wage, respectively. Hence, the wage rate is given exogenously (SADOULET and DEJANVRY, 1995).

3.3.2 Household model with labour rationing

In order to be able to separate the production and consumption decisions from each other perfect markets are a precondition. A common violation for the separability is e.g. an imperfect labour market (BENJAMIN, 1992). Thus, when labour is constrained the separability of production and consumption decisions does not hold anymore. Consequently, households allocate labour depending on their preferences and choose their consumption levels according to the production technology. However, it is also common that workers prefer working on their own farm rather than as hired labour on other farms. Furthermore, in the theory of agricultural economics it is often assumed that family and hired labour are not perfect substitutes (BENJAMIN, 1992). The difference between family and hired labour is explained in more detail in section 3.2.

Under the condition of an imperfect labour market or of transaction costs, respectively the decision of a farm whether or not to hire labour and the decision of the household whether or not to offer its manpower depend on each other. The reason is that transaction costs are faced (ROUMASSET and LEE, 2007). Transaction costs for the farm when hiring labour are e.g. costs of recruitment, information gathering, supervision costs (FRISVOLD, 1994). For the household on the other hand the transaction costs are e.g. that the specific worker cannot be used for on-farm labour anymore as well as working more means less leisure time for the worker (SADOULET and DEJANVRY, 1995).

3.3.3 Production model

In the analysis I however focus on the production model. In contrast to the household model, where ultimately the utility of the household is maximized taking into account leisure, consumption and income, the production model concentrates on the producer side. Income is e.g. needed for consumption, but on the other hand more income means dedicating more time for work, which in turn means less leisure time (ROUMASSET and LEE, 2007). Hence, these aspects need to be taken into consideration when maximizing the utility of the household within the framework of the household model.

The production model on the other hand focusses on the production side. In this study of different agricultural producers in Kazakhstan, I am interested in the production side. Consequently, I examine agricultural producers, namely, individual farms, agricultural enterprises and agroholdings. Household producers are not being taken into account in the following analysis. The only ones (from my sample) that could possibly employ family labour are the individual farms, if they are run by a family. Generally, I am looking at commercial agricultural producers. Especially in the case of agricultural enterprises and agroholdings there is no family behind the company that has to be taken into account. Furthermore,

commercial agricultural producers do not take decisions regarding consumption or leisure time; they take decisions regarding inputs used in the production with the goal to maximize the output, e.g. the revenue. Furthermore, the production technology used to reach this goal needs to be defined by the production function. Depending on what the producer aims at maximizing, e.g. profit or revenue, an objective function needs to be defined. In this case the revenue of an agricultural unit should be maximized. In my analysis the objective function is as follows:

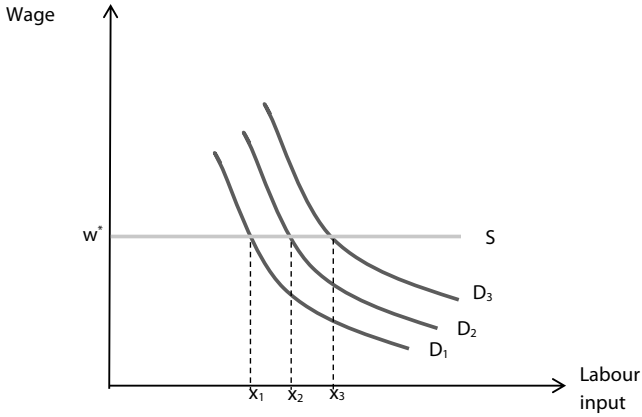
$$\boldsymbol{max_x \pi = pf(x) - wx} \qquad (3\text{-}1)$$

π is the profit, x is the amount of labour that the farmer decides to use, output price p and production technology f are given, w denotes the input price (CARTER and WIEBE, 1990).

As explained for the household model, the factor markets in the production model, the standard model without constraints, are assumed to be competitive. Because of the assumption of a perfect market all products and factors including labour can be traded referring to market prices or market wage, respectively. Hence, the wage rate is given exogenously. In a competitive market without constraints the market mechanism of demand and supply is at work. If no constraints or interventions exist in the market, the supply of a good and the demand for a good find equilibrium. This equilibrium further gives information on the market price and the total quantity produced (PINDYCK and RUBINFELD, 2007). Looking at the labour market this means that the market wage and the quantity of the input factor labour are determined at the point where the supply of and the demand for labour are in equilibrium.

In Figure 12 below the market mechanism of supply of and demand for the production factor labour without constraint is illustrated. An elastic labour supply is assumed. In the case of an elastic labour supply the wage rate stays constant when the supply of labour increases.

Figure 12: Supply of and demand for labour without constraint



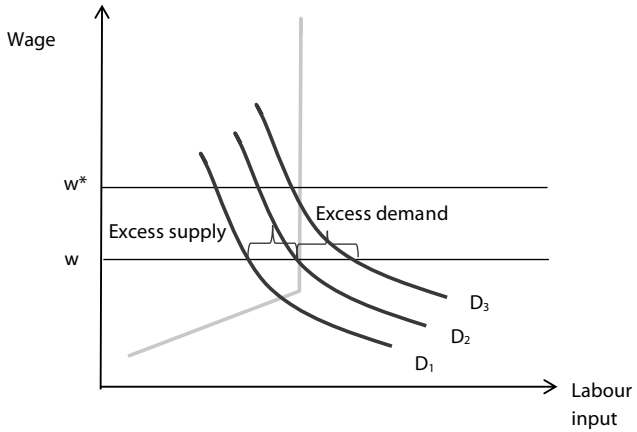
Source: Own depiction.

D_1, D_2 and D_3 are demand curves of three different agricultural units, and S is an elastic supply curve of labour. When a competitive market without constraints or interventions can be assumed, the market clears for agricultural unit 1 at wage w^* and labour input x_1, which is the intersect of S and D_1. Referring at agricultural unit 2, its demand curve D_2 is shifted to the right compared to D_1 and intersects with the supply curve at the same wage (w*) and at a higher amount of labour (x_2) than D_1. This intersect marks the equilibrium for agricultural unit 2. The demand curve of agricultural unit 3 (D_3) lies even further to the right than D_2 and the equilibrium is reached at the same wage (w^*) and a larger amount of labour (x_3) than in the other two cases. In Figure 12 a perfect labour market with elastic labour supply was assumed. In such a case the wage rate is constant and exogenous. Even when the demand for labour as well as the supply of labour increase the wage rate stays constant. The demand for labour is however only one factor amongst others when an agricultural producer aims at maximizing the profit. Another important issue is the production technology reflected by the production function. However, I assume in this case that all agricultural units use the same production technology. Furthermore, other factors of production such as land, capital and eventually the education of the farm manager are important.

Nevertheless, a perfect market can mostly not be assumed, especially not in the Kazakh case, but agricultural producers face rather labour shortages which means that labour is a constrained factor. This constraint entails that the market mechanism does not work anymore like described in the above example. Demand and supply are not always in equilibrium at the market wage, but excess demand of labour appears regularly. Furthermore, transaction costs and asymmetric

information are present (ROUMASSET and LEE, 2007). When analyzing the labour market with a constraint, a situation like in Figure 13 results.

Figure 13: Supply of and demand for labour with constraint



Source: Own depiction.

When w is the market wage, the market equilibrium, where the supply curve S and the demand curve D_2 intersect, is reached at the market wage w. D_3 is the demand curve of another agricultural unit which demands more labour at market wage w than D_2. In the presence of a labour constraint e.g. because of a labour shortage the households will not offer more labour, even, if the agricultural units demand more labour and are willing to offer a higher compensation, because there is just not more labour available (ROUMASSET and LEE, 2007). This is a case of excess demand for labour. The difference between the supply of labour at wage w and the demand D_3 for labour at this wage is the excess labour demand. In the face of a labour shortage, the agricultural producer with demand curve D_3 is willing to pay a higher wage than market wage w, namely the shadow wage w*, which can be found at the intersect of the demand curve D_3 with the supply curve S (ROUMASSET and LEE, 2007). The shadow wage will be explained in more detail in the next section. Briefly, it is the willingness of the respective agricultural producer to pay for one more unit of labour. On the contrary, for demand D_1 excess supply of labour at market wage w is present. The difference between the case of a perfect labour market with elastic labour supply and the one with a labour constraint is that in the case of an elastic labour supply the wage rate is exogenous and stays constant no matter which amount of labour is supplied or demanded.

On the contrary, as Figure 13 shows with a labour constraint the situation looks as follows. At first the labour supply is rising with rising labour demand. Thus, the wage and the amount of labour used are rising as well. Then, the labour

constraint comes into play. The agricultural units are willing to pay more than the equilibrium wage for one more unit of labour. But because labour is constraint, the amount of labour input does not change. This means that the supply of labour is perfectly inelastic. Thus, the supply curve of labour is a vertical line. No matter how much labour is demanded by agricultural producers and which price they are willing to pay for an additional unit of labour, the supply of labour remains constant. Market imperfections hinder the wage rate from rising; and at a low wage rate workers are not willing to offer there services.

3.4 Shadow price approach under factor constraints

As already mentioned in the previous section agricultural producers that are facing labour shortages are often willing to pay more for one additional unit of labour than the market wage, namely the shadow wage (Roumasset and Lee, 2007). In the following section it will be elaborated on how to calculate the shadow price under factor constraints.

However, it is particularly interesting to scrutinize the production factor labour in more detail in Kazakhstan, since the situation on the labour market in the rural areas of Kazakhstan is somewhat specific with labour shortages and lack of qualified labour as explained in 2.5. Furthermore, in order to better explain the constraints and shortages on the labour market in Kazakhstan as well as the behaviour of farm managers regarding input allocation and constraints we the shadow wages of the different farm types are calculated. Moreover, the results provide the information, how much farm managers of different farm types are willing to pay for the factor of production labour. The amount they are currently paying can be compared with the respective shadow wages. The shadow price of a production factor defines the opportunity cost (Carter and Wiebe, 1990). The optimal amount of one input factor can be found at the equilibrium of marginal factor productivities and opportunity costs (Carter and Wiebe, 1990).

In the following the different steps of the shadow price analysis are explained. Firstly, a production function is estimated. I chose a logarithmized Cobb-Douglas production function since the same production technology across all farm types is assumed. Moreover, the production elasticity of labour, that results from estimating the production function combined with the labour productivity provide the necessary information to calculate the shadow wage.

A shadow price provides information on the willingness to pay for input factors and on input constraints. If the shadow wage is higher than the actual wage paid, labour is constraint. In such a case agricultural producers could afford to pay employees more. But there are not enough suitable workers available. Thus, they experience exess demand. The opposite is the case when the shadow wages are lower than the actual prices paid for the input factors. In that case excess supply

is present. The shadow price gives further information about the strength of the labour constraint (PETRICK, 2013) (CARTER and WIEBE, 1990).

Moreover, for the Kazakh case labour rationing can be assumed. As explained in sections 2.5 and 3.2 some agricultural units may be willing to employ more labour, but due to shortages are not able to do so. In the model this restriction on the labour market is reflected in the labour constraint, $\bar{x} - x \geq 0$. Agricultural producers are maximizing their profit under the labour constraint. Therefore, the profit of the farm or agricultural enterprise results from subtracting the labour cost, namely the wage multiplied with the amount of labour employed, from the revenue, namely the output price multiplied with the output. The shadow price of labour is higher than the market wage (PETRICK, 2013; CARTER and WIEBE, 1990).

The Lagrangian method is used in order to maximize the following objective function:

$$\boldsymbol{max_x \pi = pf(x) - wx} \text{ under input constraint } \boldsymbol{\bar{x} - x \geq 0} \qquad (3\text{-}2)$$

π is the profit, x is the amount of labour that the farmer decides to use, $\bar{x}$ denotes the labour constraint, output price p and production technology f are given, w denotes the input price. Furthermore, the equation above is monotonically increasing and twice differentiable and concave in x. I assume that x>0.

Generally, when using the Lagrangian method to maximize a function, the first derivatives of the Lagrangian function with respect to the independent variables as well as the Lagrangian multipliers represent the first-order conditions of the maximization. The method of Lagrange multipliers allows only equality constraints. However, the above equation (3-2) is an inequality equation. Thus, the Kuhn-Tucker conditions, which generalize the Lagrange method, have to be used (SADOULET and DEJANVRY, 1995; BENJAMIN, 1992).

$$\boldsymbol{L = pf(x) - wx - \lambda(x - \bar{x})} \qquad (3\text{-}3)$$

The first order condition according to the Lagrange method is as follows:

$$\boldsymbol{\partial\pi/\partial x = p\,\partial f/\partial x - w - \lambda = 0} \qquad (3\text{-}4)$$

The Kuhn-Tucker conditions are as follows:

$$\boldsymbol{\frac{\partial L}{\partial \lambda} = \bar{x} - x \geq 0} \qquad (3\text{-}5)$$

$$\boldsymbol{\lambda \geq 0} \qquad (3\text{-}6)$$

$$\boldsymbol{\lambda(\bar{x} - x) = 0} \qquad (3\text{-}7)$$

Then, the following results for the shadow price:

$$\boldsymbol{p\partial f/\partial x = w + \lambda = w*} \qquad (3\text{-}8)$$

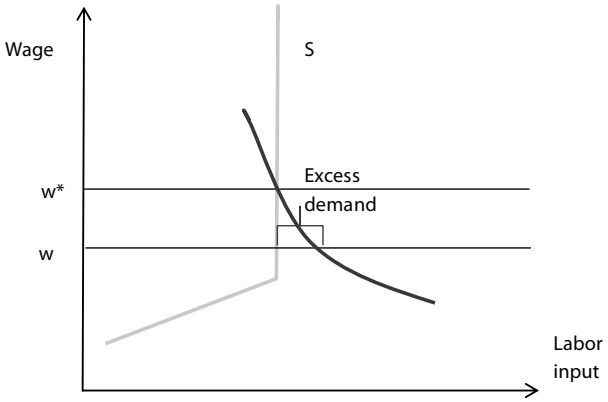
λ-marginal value of the rationing constraint in the optimization

w*- shadow price

(PETRICK, 2013; CARTER and WIEBE, 1990).

As already mentioned, the case of Kazakhstan and the Kazakh labour market are specific. For the Kazakh countryside a labour constraint can be assumed. Below the case of the shadow wage in Kazakhstan is explained.

Figure 14: Excess labour demand in Kazakhstan



Source: Own depiction.

In the case of Kazakhstan an excess demand for labour can be witnessed. When observing the supply curve above in Figure 14, it can be noticed that the supply of labour increases with rising wage until a certain point, when the maximum labour supply is reached. After this point the supply curve for Kazakhstan is a vertical line, since labour is lacking in the rural areas of Kazakhstan. The reasons were explained before in sections 2.5 and 3.2. At the market wage w supply and demand for labour are differing. Excess demand is the result. The agricultural producer in the example would be willing to pay more than the market wage, namely the shadow wage w* in order to satisfy his demand for labour. Exactly this case can be observed in Kazakhstan; the agricultural producers could and would pay more for one more unit of labour than the market wage, if they could find suitable workers in return. However, market imperfections hinder the wage rate from rising. Next to transaction costs and asymmetric information, labour scarcity prevails in Kazakhstan. Furthermore, labour is not a homogenous factor. Thus, an agricultural unit cannot easily substitute skilled labour with unskilled labour. In addition to that, the fact that technology, skills and knowledge are rather inflexible, and that workers are relatively inflexible and not mobile are further obstacles.

4 EMPIRICAL RESEARCH METHODOLOGY

The aim of the following chapter is to illuminate the methodological foundation of the empirical analysis. The methods used for the empirical analysis are based on the theory elaborated in chapter 3. In the following chapter first the data used for the analysis will be introduced. Furthermore, this chapter presents the methods used for analysis and challenges encountered during the analysis. Among those challenges are outlier control, endogeneity and sample selectivity. Once the methods of analysis and challenges are clear, the empirical strategy will be introduced. Firstly, an operational definition of labour rationing will be given, then the Heckman model will be explained as well as the reasons why certain individual farms, agricultural enterprises or agroholdings may be labour rationed and what the consequences of being labour rationed are. Lastly, limitations of the empirical approach will be pointed out.

4.1 METHODS OF ANALYSIS

4.1.1 Functional form

Given the micro data that I have, the relationship between the input factors such as land, labour, capital, material inputs, education as well as rayon and year dummies and the output, which is in this case the revenue of the agricultural unit, is illustrated by a production function. Furthermore, it is supposed that the different farm types in Kazakhstan use the same production technology. Thus, a Cobb-Douglas production function is estimated; $Y = bx_1^{\beta_1}{x_2}^{\beta_2}x_3^{\beta_3}x_4^{\beta_4}x_5^{\beta_5}$ with Y being the output, thus in this case the revenue of the agricultural unit, x_1 being land, x_2 being labour, x_3 being capital, x_4 being material inputs and x_5 being education. The superscripts $\beta_1, \dots, \beta_5$ represent the production elasticities, b is the intercept. The partial production elasticity of an input factor indicates by how much the output of an agricultural unit changes when one more unit of this production factor is used in the production. The partial production elasticities are further of particular importance for the shadow price analysis. The latter will be explained below. Since the interest of this study is especially in labour rationing and the marginal product of labour ${x_2}^{\beta_2}$, the factor of production labour is of utmost relevance. Thus, the production elasticity of labour β_2 is needed to calculate the shadow wage. In order to easily get the production elasticities, next the log of the Cobb-Douglas production function is taken. This procedure linearizes the function and simplifies it such that it is easier to separate the different components of the production function. Moreover, the logarithmization of the Cobb-Douglas production function makes it possible to read off the production elasticities

straight from the equation. The logarithmized Cobb-Douglas production function looks as follows: $lnY = \beta_0 + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \beta_4 lnx_4 + \beta_5 lnx_5 +$ u.

Moreover, BHANUMURTY (2002) points out further advantages of the Cobb-Douglas function. Hence, imperfections in markets do not distort the Cobb-Douglas function. Obviously, from one side it would be better to use a more flexible production form, but on the other hand common econometric problems become more probable to appear (COELLI et al., 2005). Furthermore, it is simpler to deal with common problems like heteroscedasticity, multicollinearity and correlation when estimating a Cobb-Douglas function (BHANUMURTY, 2002). Last but not least, the Cobb-Douglas function was commonly used in the literature.g. by PETRICK (2013) and CARTER and WIEBE (1990).

4.1.2 Shadow price calculation

After having performed the estimation of the production function, the production elasticity of labour will be used to calculate the shadow price of labour. The calculation of the shadow wage provides information on how much individual farms, agricultural enterprises and agroholdings are willing to pay for one more unit of the factor of production, labour and which agricultural producers are rationed on the labour market. Thus, if the shadow price of an input is higher than the actual price paid there is a constraint on that specific input factor for the respective farm type. Furthermore, in such a case agricultural producers are willing to pay more than they are paying at present, but there is not more of that input factor available. Hence, the shadow price or shadow wage is the maximum price or wage the agricultural producer is willing to pay for one more unit of the specific input factor e.g. one more hour of work. So, the shadow price is the marginal product of one additional unit of the input factor. Regarding the optimal amount of one input factor, it is reached when marginal factor productivities equal opportunity costs (CARTER and WIEBE, 1990).

The shadow prices for observation i of input factor X can be derived from the Cobb-Douglas production function as follows:

$$MPX_i = \frac{\partial revenue_i}{\partial X_i} =$$

$$= \left(\frac{\partial lnrevenue_i}{\partial \mathrm{lnX}_i}\right)\left(\frac{revenue_i}{X_i}\right) =$$

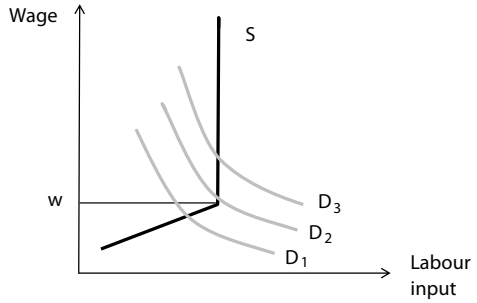
$$= \beta_x * revenue / X_i$$

(CARTER and WIEBE, 1990).

In an optimization problem a shadow price for each constraint can be calculated.

Figure 15 presents another explanation of the shadow wage or shadow price, respectively. The farm labour demand curves D_1, D_2, D_3 represent the different shadow wages that agricultural unit 1, 2, and 3 are willing to pay at a specific point for an additional unit of labour. Thus, it can be noticed that market wage w is at the same time the shadow wage that agricultural unit 2 is willing to pay. Thus, at that wage demand for and supply of labour of agricultural unit 2 are in equilibrium. However, agricultural unit 3 has a higher demand for labour at wage rate w and would be willing to pay a higher shadow wage. The demand for and supply of labour would be in equilibrium at a higher wage. Hence, at the current situation agricultural unit 3 is experiencing excess demand for labour, since the real wage is not rising due to market imperfections. A more detailed explanation can be found in 3.4.

Figure 15: Shadow wage



Source: Own depiction.

4.2 Data issues

4.2.1 Data description

In this dissertation farm-level data from two surveys carried out in Almaty oblast and Akmola oblast in Kazakhstan was used. The first survey was carried out in 2003 for a World Bank project. The original survey comprised in addition data from the oblasts Pavlodar and West-Kazakhstan, which was however not used for this dissertation. In 2012, a comparable survey was carried out for IAMO. However, this time only in Almaty oblast and Akmola oblast. Bisam Central Asia, a company for data collection, was responsible for both surveys. For the first one 150 rural households and fifty farm managers were interviewed per oblast. In 2012, 150 rural households and 150 farm managers were interviewed per oblast. In both surveys interviews were carried out in the same villages if it was possible. But not exactly the same households or managers were interviewed, since this information was not available in 2012 anymore. Hence, the data set is not a panel,

but cross sectional data from two years. In addition to that, for the 2012 data collection a quota was set to interview at least fifty managers of registered agricultural enterprises and not only managers of individual farms. This quota was important because there are more individual farms than agricultural enterprises or agroholdings, and it is often easier to schedule an interview with a manager of an individual farm. Nevertheless, for the analysis it was crucial to have data from agricultural enterprises and agroholdings as well since the goal is to distinguish between farm types and to include all of them in order to get a more complete picture. The questionnaires used in the surveys included questions regarding land ownership and land transactions, farm production and marketing, farming inputs, equipment and access to information, investments and finances as well as an assessment of changes over time.

4.2.2 Outlier control

When making estimations with data, one has to be careful that the results or descriptive statistics will not be distorted by extreme values for certain observations. Especially in the case of analysing different farm types in Kazakhstan, this risk is very prominent since a broad variety of different farm types and sizes can be observed such that one needs to be careful that the most extreme values will not impact the descriptions, estimations and calculations disproportionately. In order to prevent such distortions the rather common empirical boxplot rule or interquartile range (IQR) has been used in order to detect outliers. According to this rule an observation is conside red an outlier if it lies either 1.5 times the IQR below the lower quartile or 1.5 times the IQR below the upper quartile of the sample (PETRICK, 2004; MUKHERJEE et al., 1998). Since the IQR criterion has been used for detecting outliers, some outliers regarding the wages, farm sizes, revenue, labour input etc. have been omitted from the estimations.

4.2.3 Endogeneity

Furthermore, when estimating a production function, endogeneity is a common challenge. The reasons for endogeneity can be several. It can emerge from omitted variables, measurement error or simultaneity (WOOLDRIDGE, 2012). In the following the focus will be mostly on explaining endogeneity due to simultaneity. In order for an OLS estimator to be BLUE (Best Linear Unbiased Estimator) the Gauss-Markov assumptions must not be violated. Moreover, one of the assumptions is $E(u_i|X) = E(u_i) = 0$. If this assumption is fulfilled, the dependent variables are exogenous, but if the assumption is violated, endogeneity is faced. The former equation means that the error term u and the independent variable x are stochastically independent, thus, they should not be correlated. The problem of the correlation of the independent variables with the error term is that the relation between dependent variable y and independent variable x_i will be distorted by the correlation between x_i and u. Coefficient β_1 that is measuring this relation

between y and x will be biased. Due to this correlation u depends on the independent variable x and thus, there is a direct and indirect relation between x and y. So, the coefficient β_1 measures in this case actually $\beta_1 + \frac{du}{dx}$ which creates the bias in the OLS estimator.

As mentioned before variables are also endogenous when there is simultaneity, meaning that not only the independent variable x is explaining the dependent variable y, but also vice versa. This means e.g.:

If a multiple regression model is used with Y being the output, x_1 being the endogenous independent variable, $z_1,\ldots, z_{k-1}$ being the exogenous independent variables the following results:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 z_1 + \cdots + \beta_{k-1} z_{k-1} + u$$

In the case of simultaneity when x is also explained by y, the second relation is as follows:

$X = \gamma_0 + \gamma_1 v + \gamma_2 y$ with γ_i being the coefficients and v being an independent variable.

Furthermore, in case of endogeneity because of omitted variable bias the omitted variable is in the error term. If the OLS estimation is used, the estimators will be biased. In this case Cov(x; u) ≠ 0, the error term and the independent variable are correlated.

Looking again at the multiple regression model
$Y = \beta_0 + \beta_1 x_1 + \beta_2 z_1 + \cdots + \beta_{k-1} z_{k-1} + u$ with this time x_1 being the omitted independent variable, z_1, ..., z_{k-1} being the exogenous independent variables, if x_1 is omitted, the following results:
$Y = \beta_0 + \beta_2 z_1 + \cdots + \beta_{k-1} z_{k-1} + u$ with x_1 being represented in the error term (WOOLDRIDGE, 2012).

Possible solutions are to find proxy variables for the endogenous variables, fixed effects or instrumental variable regression. In the following subchapter the instrumental variable method will be discussed in more detail, since it may be suitable. It is often difficult to find good proxy variables. Furthermore, the fixed effects approach, where unobserved fixed effects can be displayed as dummy variables, can only be used when the specific independent variable does not change across various observations (BEHRMAN and OLIVER, 2000). In order to tackle the endogeneity problem with cross sectional data an instrumental variables regression with the two stage least square method has been performed.

The following multiple regression model with Y being the output, x_1 being the endogenous independent variable, z_1, ..., z_{k-1} being the exogenous independent

variables, that are treated like instruments and β_0,..., β_{k-1} being the production elasticities has been used.

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 z_1 + \cdots + \beta_{k-1} z_{k-1} + u$$

Next, I need to search for an instrumental variable z_k for endogenous variable x_1, that

$Cov(z_j, u) = 0$ (1) for all j=1,...,k

$Cov(z_k, x_1) \neq 0$ (2)

z_k should be exogenous in the original equation

(1) cannot be tested

(2) can be tested by estimating:

$$x1 = \pi_0 + \pi_1 z_1 + \cdots + \pi_{k-1} z_{k-1} + \pi_k z_k + v$$

$$\pi_k \neq 0$$

Source: WOOLDRIDGE, 2012.

For the instrumental variables regression to be unbiased strong instruments are needed. Furthermore, at least as many instrumental variables as endogenous dependent variables are required. However, too many instrumental variables create bias. Moreover, two stage least square estimates can have large standard errors. For the production function estimation no strong instruments could be found. Hence, the estimation was biased. Thus, for this case the instrumental variables regression cannot be used.

Moreover, the standard error and the confidence interval may be larger than the ones from OLS, especially in the case of weak instrumental variables (WOOLDRIDGE, 2012). Weak instruments, too many overidentifying restrictions and small samples aggravate the problem of biasedness of the two stage least square estimator (ANGRIST and PISCHKE, 2008).

Another solution to the endogeneity problem is to omit the endogenous variables if possible. Otherwise, since e.g. the main variables of the production function (labour, land, capital) cannot be deleted, it can be checked whether they are under certain circumstances exogenous. If the originally endogenous variables were exogenous under certain circumstances and if an OLS regression was performed with the exogenous observations only, the result would be biased. The reason is that the exclusion of certain observation, namely the endogenous ones would not be random. In that case sample selection bias would appear. Such a non-random sample would not be representative. Some groups would be more likely to appear in the sample than others (HECKMAN; 1974; WOOLDRIDGE; 2012). Since I am particularly interested in the labour variable, if I considered that labour was exogenous, when an agricultural unit was rationed on the labour market, the

sample would consist of the labour rationed agricultural units only and the agricultural units that were not labour rationed would be ignored. This would create bias. Thus, in order to avoid such a biased sample controlling for sample selection bias is necessary. This can be done by using the Heckman model, which will be explained in more detail in section 4.3.2.

4.3 Empirical strategy

In this subchapter the goal is to describe the empirical approach used in this dissertation. Firstly, the different steps will be shortly summarized and after that more details will be presented.

The different steps of the empirical analysis of the labour rationing and shadow wage analysis are the following:

1. Firstly, it will be clarified why agricultural producers tend to be labour rationed by doing a Probit estimation within the Heckman Model.
2. A production function will be estimated within the Heckman Model in order to get the production elasticities, which are needed to calculate shadow prices. The Heckman Model is used, since observations of the labour variable that are endogenous have to be excluded. This exclusion can create sample selection bias. Hence, the Heckman Model has to be used instead of a simple OLS estimation. This will be explained in more detail in the following, and in particular in 4.3.2.
3. Next, the shadow wage will be calculated and hence, the willingness to pay for one more unit of labour. Furthermore, the results of the shadow wage calculation provide information on whether there is excess demand for or excess supply of labour. In addition, results across different farm types will be compared and consequences for agricultural production will be analysed.

4.3.1 Operational definition of labour rationing

An agricultural unit was considered labour rationed in 2003 if it did not employ seasonal labour. The reason is that seasonal labour can be hired and fired at any time by the manager of the farm. So, the manager can decide when to do what with seasonal labour. In that case the labour variable would be endogenous in our model. But if an agricultural unit does not hire seasonal labour, it is assumed that labour is exogenous, since with permanent labour and especially family labour changes can only be made in a rather long term perspective. Usually, permanent workers do have labour contracts and are rather appointed to tasks that are planned in the mid-or long term or that require more trust because the risk of shirking is higher; such a task would be for example seeding. The same accounts even more for family members. The manager of an individual farm can only hire

as many family members as exist. But typically he is at the same time kind of obliged to hire all the family members that want to work on the farm, since the manager of a family farm is mostly not the sole owner of the farm, but the whole family is. So, in the case of hiring family members the manager cannot freely choose either, who to hire and how many family members to hire. That is why in such a case the labour variable is also considered exogenous. Nevertheless, it is possible that some agricultural producers just do not want to hire seasonal labour. However, the situation in the Kazakh countryside is rather characterized by a shortage of labour and by difficulties for agricultural units to find seasonal workers. Thus, under these circumstances it seems appropriate to use the fact whether agricultural producers employed seasonal labour or not in 2003 as valid approximation for being labour rationed or not in 2003.

In 2011, agricultural producers were considered labour rationed, when they did not hire seasonal labour and in addition to that reported problems finding workers for simple and/or skilled tasks. Thus, with this definition it is clearer that agricultural units were really not able to find workers and did not just for some reason not hire seasonal workers. Alternatively, the definition that an agricultural unit was labour rationed when it had trouble finding workers for simple and/or skilled tasks was considered for 2011.

The questionnaire that managers of agricultural units filled in comprised in 2003 and in 2011 a question about how many workers the farm hired and for how many hours. Managers were asked what labour they used in the last 12 months. Furthermore, they were asked to include those workers that receive wage in cash or kind for work undertaken. A distinction between permanent and seasonal labour as well as between members of household, relatives, friends or neighbors, hired labour in production and administrative staff including the farm manager was made. Moreover, it was inquired how many persons the respective agricultural producer used from each type of labour and for how many hours. Hence, those respondents that did not employ any kind of seasonal labour were considered to employ exogenous labour. Furthermore, in 2011 in order to be more clear a question was added to the questionnaire asking managers of farms, agricultural enterprises and agroholdings to rate on a scale from 1 (unproblematic) to 5 (very problematic) the difficulty to hire workers for skilled jobs. After that respondents were asked to rate on a Likert scale the difficulty to hire workers for simple jobs. Basically, agricultural producers were regarded as labour rationed when they answered that it was difficult or very difficult (4 or 5) to find labour for skilled jobs and for simple jobs. The other respondents were regarded as not labour rationed.

Since all observations where labour was not considered exogenous were excluded, the production function would be estimated with a non-random subsample.

In such a case it is possible that sample selection bias might occur as explained in 4.2.3. Because of that, an OLS estimation should not be performed. In order to check and if necessary control for sample selection bias the two stage Heckman model should be used. Sample selection bias can be seen as a kind of omitted variable bias. For this sample size the two stage Heckman model is more suitable than the maximum likelihood model (HECKMAN, 1979; HECKMAN, 1974; WOOLDRIDGE, 2012).

4.3.2 Reasons for rationing on the labour market

If the classification of agricultural producers as labour rationed was random, the fact that the dependent variable would not be observed for all farms and agricultural enterprises could just be ignored, and an ordinary regression could follow. However, this selection is not random. The following equation will be estimated below.

The dependent variable for observation j is observed if $z_i\gamma + u_{2i} > 0$

$u_1 \sim N(0,\sigma)\ and\ u_2 \sim N(0,1);\ corr\ (u_1, u_2) = \rho$

z_i is a vector of independent variables that explain why a farm or agricultural enterprise is rationed on the labour market e.g. characteristics of the farm or of the production. γ is a vector of parameters and u_{2i} is the error term (HECKMAN, 1979).

Thus, variables that strongly affect whether or not an agricultural producer is labour rationed and thus, whether the dependent variable of the regression equation is observed need to be found. This is the first stage of the Heckman Model. At this stage a Probit estimation with the binary variable (1; 0) being labour rationed (1) or not labour rationed (0) as dependent variable is being performed. Basically, it is investigated what restricts individual farms, agricultural enterprises and agroholdings on the labour market and what are the causes of this factor constraint. The selection of independent variables in the Probit model that explain the likelihood of being constraint on the labour market results from the theory discussion in chapter 3. Hence, some farm characteristics that could make a farm on one hand more attractive to work on e.g. specific facilities, and on the other hand characteristics that could require more labour e.g. farm size were taken into account. As suggested in 3.2 by FEDER (1985), the farm size plays a role for the access to factor markets, too. Small farms have a more favorable position on the labour market, whereas large farms are advantaged on the land and capital market (FEDER, 1985; CARTER and WIEBE, 1990; ESWARAN and KOTWAL, 1986).

Furthermore, some management or production characteristics should not be neglected either e.g. whether or not the agricultural unit cooperates with others or specific management competences. Based on these considerations the following independent variables for the Probit part of the Heckman Model were selected:

Land used was chosen as an indicator for farm size. The sign was expected to be negative in the Probit estimation which means that a bigger farm would be less probable to be rationed on the labour market. This is because in Kazakhstan like in some other Post-Soviet countries people are used to more large-scale or collective agriculture and often prefer to be employee of an agricultural enterprise than to own their own farm. Hence, to them bigger farms may look like attractive employers. According to TOLEUBAYEV et al. (2010) and QAMAR and SWANSON (2012) many private farmers in most Post-Soviet countries are neither experienced in farming nor in farm management. Besides, joint activity with other farms was used as an indicator for whether the agricultural unit had good networks and was cooperating with other farms, which should reduce the risk of being rationed on the labour market. In section 3.2 the advantages of team production for productivity are explained for example by ALCHIAN and DEMSETZ (1972). However the problem of shirking could appear (ALCHIAN and DEMSETZ, 1972). A positive effect could be expected from the education of the farm manager as well, which was used as a proxy for management and organization skills e.g. better educated managers may be more capable to lead a farm and to build networks. As elaborated in more detail in the theory section 3.2, VAN DEN BAN (1999) points out that agricultural productivity and agricultural development depend amongst others on farmers' education. Besides, TOLEUBAYEV et al. (2010) state that previous experience in farming is crucial for farmers in Kazakhstan to be successful. Experienced farmers have networks with other experienced farmers. Furthermore, regarding the capital of the agricultural unit the value of buildings and fixed equipment and the value of movable equipment, respectively were used as indicators. The signs of these two indicators could be negative, and hence, reduce the risk of being labour rationed of the agricultural unit because new machinery and modern facilities similarly to the size of the farm give an impression that the respective farm is prospering and well-off. Therefore, workers could be encouraged to work on this specific agricultural unit. On the other hand, the value of buildings and equipment could also have a positive sign in the Probit estimation because the manager of such a modern farm may have higher requirements for workers, and workers may need more skills e.g. to operate modern machinery. These requirements would already exclude unskilled workers as potential employees. Hence, for such modern and well equipped farms it might be more difficult to find workers that match their requirements. As mentioned in 3.2 hired labour is on average more suitable for more specialized jobs, since the hired workers could carry out the same type of job on different agricultural units becoming very specialized, while family labour tends to be responsible for various tasks on the same farm (ROUMASSET and UY, 1980). Furthermore, real material inputs stand for working capital which could supposedly have a negative sign, since the more costs an agricultural producer had during the production e.g. for seeds, repairs or

advisory services the more productive it could be and the more labour force it might need. Again such a farm could seem prospering and attractive for potential employees. On the other hand, real material inputs could have a positive sign as well in the Probit equation, since managers that spend more money on keeping the equipment in working condition and on input factors may have higher expectations regarding the qualifications of their future employees and thus, may have more problems finding suitable workers.

4.3.3 Consequences of labour rationing

In the Heckman Model two stages are estimated. In the first stage a Probit function is estimated in order to explain why certain agricultural producers are rationed on the labour market. In the second stage a production function of labour rationed agricultural units is being. For the production function estimation OLS is used. The production function is represented by the regression equation. Thus, the following equation will be estimated below.

The regression equation is as follows: $y_i = x_i\beta + u_{1i}$

In this case the dependent variable (y_i) is the output produced by agricultural units. Thus, the dependent variable is not always observed, but only if an agricultural unit is labour rationed. x_i is a vector of independent variables, β is a vector of parameters and u_{1i} is the error term (HECKMAN, 1979). As independent variables in the production function estimation land used was used as an indicator for farm size. A positive sign was expected, which means that the more land an agricultural unit used the more revenue it was able to generate. However, the exact value of the coefficient is interesting as well in order to see the strength of the effect, since e.g. LIPTON (2009) explains that an inverse relationship between farm size and productivity exists. DEININGER (1995) supports the former argument. On the other hand e.g. FEDER (1985) is convinced that farm size and land productivity are only related if the agricultural production function has no constant returns to scale. Furthermore, labour measured as full time equivalent (FTE) was included in the production function. An FTE of 1.0 means that the person is equivalent to a full-time worker; while an FTE of 0.5 means that the employee is equivalent to a half-time worker. Next, depreciation served as a proxy for fixed capital and real material inputs as indicator for working capital. The variable real material inputs was calculated from total costs of production which included e.g. costs for seeds, fuel, machinery services, insurances and other costs. The capital variables measure the flow of capital in order to generate the output. For labour and capital a positive sign was expected in our regression. Furthermore, the level of education of the farm manager was considered. Respondents were asked during the survey which type of education they had completed. The possible answers ranged between "none" (1) and "higher" (8). Education is commonly used in regressions as a proxy for management abilities. For the variable education a positive sign was

expected in the regression. VAN DEN BAN (1999) underlines the importance of education. Furthermore, according to TOLEUBAYEV et al. (2010) the most successful farm managers in Kazakhstan have been those that gathered experience and contacts during the Soviet times. Moreover, the lack of education can be an obstacle to adopting new technology (TOMICH et al., 1995). However, there are studies as well that state that the education of a farmer does not make him necessary a better farm manager. Furthermore, a dummy variable for the year 2003 was added as a control variable. It seemed plausible that the sign of this coefficient should be negative, because the year 2011 was a prosperous year for agriculture in Kazakhstan with high yields. Moreover, one dummy for each rayon that was part of the survey, namely Talgarsky, Karatalsky, Esilsky and Ermentausky rayon, was added as an independent variable to the regression. All the rayon dummies were included, since the distribution of observations among rayons was more or less equal. The purpose of considering the rayons in the production function estimation was to use them as control variables in the first place and to find out whether or not the location of an agricultural unit made a difference for the production. Besides, as explained in 2.3 considerable differences regarding farm structure, demographics and climate between regions can be observed in Kazakhstan. Hence, as explained before, in the north of Kazakhstan like in Esilsky and Ermentausky oblast a strong exodus of ethnical minorities, who were often skilled and experienced agricultural workers, took place (TOLEUBAYEV et al., 2010). In addition to that, the birth rates in the north of the country are somewhat lower. These facts have a negative impact on the availability of qualified labour and thus, may affect the revenue of a farm or agricultural enterprise negatively. Consequently, the sign of the coefficients for the dummies for Talgarsky and Karatalsky in the somewhat more entrepreneurial South with smaller scale agriculture and higher birth rates might be positive.

As already mentioned before in 4.2.3 one reason for using the Heckman Model and not an ordinary regression model was that the sample was not a random anymore since the sample was divided into labour rationed and not rationed farms and agricultural enterprises. This is sample selectivity. In order to avoid endogeneity as explained in section 4.2.3 the estimation was continued with the labour rationed sample. Therefore, I had to test for selection bias and correct for the potential selection bias. In the second stage, the Heckman Model calculates the Inverse Mills ratio (m_i) and adds it as additional independent variable to the regression. The (m_i) can be calculated as follows:

$$m_i = \frac{\emptyset(z_i \hat{\gamma})}{\Phi(z_i \hat{\gamma})}$$

$\emptyset(z_i\hat{\gamma})$ describes the density function of the normal distribution, and $\Phi(z_i\hat{\gamma})$ describes the distribution function of the standard normal distribution. If the

t-test in the second stage of the Heckman Model is significant for the coefficient of the Inverse Mills ratio sample selectivity bias can be observed (HECKMAN, 1979).

4.3.4 Limitations of the empirical approach

Firstly, some specific limitations regarding the data availability and regarding the definition of labour rationed agricultural units appear in our data set. In 2003, the questionnaire did not include any direct question whether the managers had problems finding workers for various tasks or not. Only the information which agricultural producers did not employ seasonal workers is available for 2003. In this case labour can be assumed to be an exogenous variable, because as explained in 4.3.1 seasonal workers can be employed or laid off in a short term and the manager can decide himself how many seasonal workers to employ and when to do so. But of course there is always the possibility that an agricultural unit did not employ seasonal labour, because they did not want or did not need to. On the other hand, some managers despite of hiring seasonal labour may still have actually had problems finding workers. They may just have hired as much labour as was available. But maybe would have hired more otherwise. However, as elaborated in chapter 2 agricultural units in the Kazakh countryside is face rather a shortage of labour. Thus, under these circumstances it seems appropriate to use the fact whether agricultural producers employed seasonal labour or not in 2003 as valid approximation for whether an agricultural unit was labour rationed or not. Besides, two questions regarding labour availability were added to the questionnaire in 2012, namely whether managers had problems finding labour for skilled and simple tasks. Of course for such questions there is no other option than trusting the judgement of the respondents. It could be that some managers have very high expectations and evaluate the situation on the labour market much worse than other managers with lower expectations. Nevertheless, knowing the labour market situation of the country side in Kazakhstan it is justifiable to assume that most managers that reported problems finding workers were labour rationed.

5 EMPIRICAL RESULTS ON LABOUR RATIONING OF DIFFERENT FARM TYPES IN KAZAKHSTAN

In the following chapter the results of the econometric analysis on labour rationing and production in agriculture in the rural areas of Almaty oblast and Akmola will be introduced. Besides, relevant descriptive statistics, results of the Heckman model including the production function estimation and the Probit model for labour rationing will be presented. Furthermore, labour rationing and the production function should be estimated as precisely as possible and thus, it should not be relied on a single estimation only. Hence, three estimations with different definitions of a labour rationed agricultural unit (see section 4.3.1) were performed and the results were compared. The Heckman model and alternative models are explained in sections 4.2.3, 4.3.2 and 4.3.3. In the following sections the results of three different models will be presented and analysed. Hence, one Heckman model for the year 2003 and 2011 together as well as one separate model for 2003 and 2011, respectively will be estimated. Besides, since cross-sectional data from two years is available, the results from the separate estimations of the two years can be compared. However, if I compare the three different models regarding their explanatory power it can be said that the first model for the years 2003 and 2011 together has the biggest explanatory power because it has the biggest sample size and it considers two different years as well as the being labour rationed is defined more precisely than in the other two models. The second biggest explanatory power has the model with the 2011 data, where an agricultural unit was labour rationed when it had trouble finding suitable workers. The sample size is significantly larger than for the 2003 model. The definition of being labour rationed is more precise and lastly, in 2003 there are no agroholdings considered.

The mentioned models are useful in order to find the reasons for and consequences of labour rationing. Next, the results of the shadow wage analysis, which shed light on the marginal productivity of labour of the different farm types and the strength of the labour constraint, will be introduced. After that, further descriptive results on issues that help to explain differences between labour rationed and not rationed agricultural units e.g. cooperation between agricultural units, performance-based salary and supervision will be presented. Finally, this chapter will be concluded with a summary of major findings.

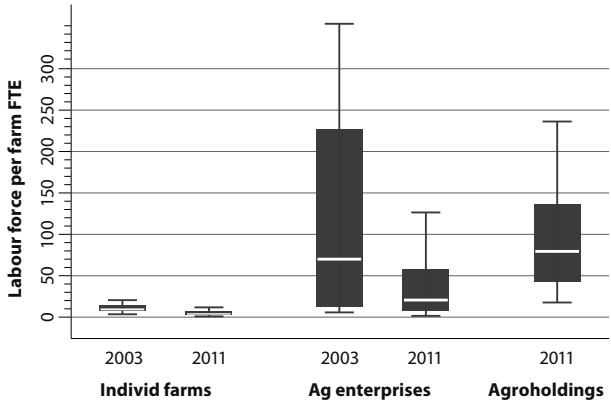
5.1 OVERVIEW OF LABOUR EMPLOYMENT AND LABOUR RATIONING

In this section firstly labour employment as well as labour employment per hundred hectares of different farm types will be presented. After that, an overview of

labour rationing will be shown. Furthermore, I distinguish between access to skilled and unskilled labour.

When comparing labour use per farm across farm types in 2003 and 2011 it can be noticed that even though 2011 was a year with high yields there was much less labour employed in agriculture than in 2003, especially in agricultural enterprises as Figure 16 shows. Data on agroholdings was only available for 2011.

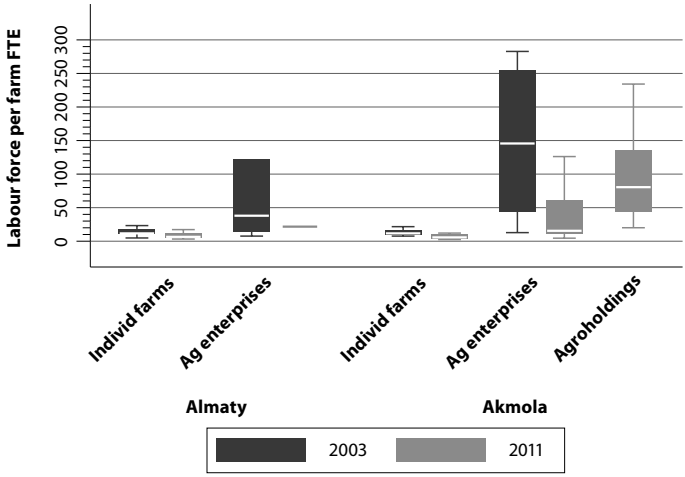
Figure 16: Labour force per farm



Source: Own depiction from survey data.

Figure 17 shows that that the labour force per farm decreased particularly strongly for agricultural enterprises in both Almaty and Akmola oblasts. In both oblasts individual farms were employing the least labour in 2003 and 2011, whereas agroholdings, of which only data from Akmola oblast in 2011 is available, were employing the most labour in absolute numbers, which sounds reasonable, since agroholdings were the largest and individual farms the smallest farms.

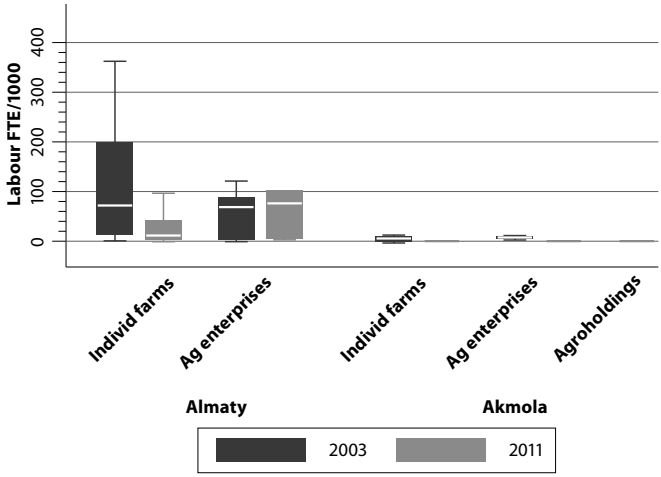
Figure 17: Labour force per farm in Almaty and Akmola oblasts



Source: Own depiction from survey data.

However, labour intensity decreased in particular for individual farms in Almaty oblast, increased slightly for agricultural enterprises in Almaty oblast and decreased slightly for individual farms and agricultural enterprises in Akmola oblast. Individual farms are commonly believed to be the most labour-intensive, but in 2011 agricultural enterprises in Almaty oblast employed more labour per hundred hectares than individual farms as shown in Figure 18. Moreover, labour intensity in Akmola has been very low and much lower than in Almaty, since in the former mostly less labour-intensive large-scale crop farming can be observed.

Figure 18: Labour force per 100 ha



Source: Own depiction from survey data.

After having investigated which farm types employ how much labour absolutely and per hundred hectares, it will be scrutinized which agricultural units would like to employ more labour, but have problems finding matching labour. It is also interesting to discover differences between skilled and unskilled labour.

Table 6 summarizes the frequency of labour rationed agricultural units based on the surveys in 2003 and 2011. I differentiate between 2003 and 2011, since the definition of being labour rationed is not the same in both years as explained earlier in section 4.3.1.

As explained previously in 4.3.1 in 2011 two possible definitions of a labour rationed agricultural producer were considered, namely that it did not employ seasonal labour and at the same time claimed problems finding workers for skilled and/or simple tasks (2011a). The second possible definition was that the agricultural unit reported problems finding suitable workers for simple and/or skilled jobs (2011b). Consequently, I get the following shares for the three different definitions of a labour rationed agricultural unit that I worked with (see Table 6).

Table 6: Share of labour rationed agricultural units (2003 and 2011)

Year	Percent of labour rationed units	Percent of non- rationed units
2003	62	38
2011 a	15.7	84.3
2011 b	20.7	79.2

Source: Own depiction from survey data.

Note: 2011a: An agricultural unit was labour rationed if it did not employ seasonal workers and had problems finding workers.
2011b: An agricultural unit was labour rationed if they could not find any worker for skilled or/and simple tasks.

Table 6 shows that more than sixty percent of the agricultural units in 2003 were labour rationed and almost forty percent of the agricultural units were not labour rationed. In other words, more than sixty percent of the managers interviewed in 2003 answered that they did not hire any seasonal workers, whereas forty percent of the managers claimed that they did hire seasonal workers.

According to the most precise definition for 2011 (2001a) around sixteen percent of farms and agricultural enterprises were rationed on the labour market and around eighty-four percent were not (see Table 6). According to the less precise definition (2001b) more than twenty percent of individual farms and agricultural enterprises were rationed on the labour market in 2011.

In order to get a clearer picture regarding the difficulty to hire workers, I scrutinize the answers given by agricultural producers on the question whether it was difficult to hire workers for skilled and simple tasks, respectively.

Thus the following tables (Table 7, Table 8 and Table 9) give more detailed information on whether agricultural units had problems finding workers for skilled and simple tasks as well as for simple tasks only or for skilled tasks only. The difficulty of finding workers was rated on a Likert scale ranging from unproblematic until very problematic. Those agricultural units that stated that it was problematic or very problematic to hire workers for skilled and/or simple tasks were considered to have problems finding workers.

Table 7: Difficulty to hire workers for skilled and simple tasks

	Skilled tasks	Simple tasks
	Percent	Percent
Unproblematic	16.3	33.3
Pretty unproblematic	15.3	20
Medium	17.3	12.7
Problematic	25	18.3
Very problematic	26	15.7

Source: Own depiction based on survey data.

When looking at labour for skilled tasks, it can even be noticed that more than half of all agricultural producers reported problems finding labour for such tasks. Moreover, the following two tables show the distribution by farm type of agricultural producers that had problems finding workers for skilled and simple tasks. There is a distinction made between individual farms, agricultural enterprises and agroholdings.

Table 8: Difficulty to hire workers for skilled tasks by farm type

	Individual farms	**Agricultural enterprises**	**Agroholdings**
Degree	Percent	Percent	Percent
Unproblematic	17.6	10.6	12.5
Pretty unproblematic	15.9	14.9	0
Medium	14.3	34	12.5
Problematic	26.1	17	37.5
Very problematic	26.1	23.4	37.5

Source: Own depiction based on survey data.

Table 9: Difficulty to hire workers for simple tasks by farm type

	Individual farms	**Agricultural enterprises**	**Agroholdings**
Degree	Percent	Percent	Percent
Unproblematic	36.3	17	37.5
Pretty unproblematic	18.4	29.8	12.5
Medium	9.8	23	37.5
Problematic	20	12.8	0
Very problematic	15.5	17	12.5

Source: Own depiction based on survey data.

Even though all three farm types had significant problems finding workers for skilled tasks, seventy-five percent of agroholdings reported problems, which was the highest share, while only forty percent of agricultural enterprises reported problems finding workers for skilled tasks, which was the lowest share. Interestingly, the situation regarding workers for simple tasks was vice versa. Most problems finding workers for simple tasks were reported by individual farms. Thirty-six percent of this group had problems. Out of the agroholdings only thirteen percent indicated problems finding unskilled workers. The data reflects the problems described in chapter 2.5 that not only many potential agricultural workers left the Kazakh countryside, but that many of them were also skilled workers that are now missing.

5.2 Reasons for and consequences of rationing on the labour market

In the following subchapter firstly different reasons for labour rationing will be presented, starting with descriptive statistics of the variables used in the Probit part of the Heckman Model. After that, the consequences of labour rationing on production will be introduced by analysing the results of the production function estimation as part of the Heckman model. Mainly, the production elasticities of the estimation are needed to calculate the shadow wages of the different farm types. The latter provide information on the strength of the labour constraint and the marginal productivity of labour of the different farm types.

5.2.1 Reasons for labour rationing

Table 10 and Table 11 display the descriptive statistics of the explanatory variables used in the Probit part of the Heckman Model. These variables are factors that explain what makes an agricultural unit more or less likely to be rationed on the labour market. The choice of these variables and the expected signs of the coefficients of the variables are explained in the section 4.3.2.

Table 10: Descriptive statistics of variables used in the Probit part of the Heckman Model 2003

Variable	Mean (Median)	Standard deviation	Min.	Max.	Obs.
Land used (in 1000 ha)	1304.5	5040.1	1	41105	100
Value of buildings and fixed equipment (in million tenge)	82.6	272.1	0	1000	100
Value of movable equipment (in tenge)	92.1	287.1	0	1000	100
Joint activity with other farms (dummy)	0.2 (0)	0.4	0	1	100
Real material inputs (Million 2011 tenge)	6.4	26.4	0	209.7	82
Education level (low=1, high=8)	6.5	1.4	3	8	100

Source: Own depiction from survey data.

Table 11: Descriptive statistics of variables used in the Probit part of the Heckman Model 2011

Variable	Mean (Median)	Standard deviation	Min.	Max.	Obs.
Land used (in 1000 ha)	3536	8685.3	0	80000	300
Value of buildings and fixed equipment (in million tenge)	16.5	84.7	0	900	300
Value of movable equipment (in tenge)	30.2	116.7	0	1102.1	300
Joint activity with other farms (dummy)	0.4 (0)	0.5	0	1	300
Real material inputs (Million 2011 tenge)	7.9	23.9	0	223	300
Education level (low=1, high=8)	6.5	1.5	3	8	300

Source: Own depiction from survey data.

In the following section the results of the Probit estimation within the framework of the Heckman model will be presented. Firstly, the results of the model with data of the years 2003 and 2011 will be introduced. Secondly, the results of the model with 2011 data will be explained. Lastly, the results of the model with 2003 data will be elaborated on.

Table 12: Probit estimation with data of the years 2003 and 2011

Variable	Coefficient	Standard error	z-value	P>lzl
Selection equation: Probability that the agricultural units are rationed on the labour market				
lnland	-0.080	0.057	-1.39	0.164
lnmat	0.038	0.058	0.66	0.508
lnedu	0.720*	0.443	1.63	0.104
Y2003	1.813***	0.266	6.81	0.000
Dum_joint_act	-0.713*	0.286	-2.50	0.013
Lnfixed_equip	0.006	0.011	0.51	0.608
Lnmove_equip	-0.036***	0.012	-3.00	0.003
Dum_karat	0.950	0.796	1.19	0.233
Dum_talgar	0.467	0.637	0.73	0.464
Dum_esil	1.762***	0.481	3.66	0.000
Dum_ermen	0.455	0.603	0.75	0.451
Dum2	-0.099	0.508	-0.19	0.845
Dum4	0.172	0.503	0.34	0.732
Dum6	0.870**	0.412	2.11	0.035
Dum7	1.408***	0.448	3.14	0.002
Dum9	-0.943	0.582	-1.62	0.105
Dum12	-0.494	0.525	-0.94	0.346
Dum14	-0.001	0.872	-0.00	0.999
Dum15	-0.768	0.844	-0.91	0.363
Dum18	0.960	0.814	1.18	0.238
Dum8	0.650	0.553	1.17	0.24
Dum22	1.572***	0.635	2.48	0.013
Dum23	0.958	0.681	1.41	0.160
Dum27	2.133***	0.697	3.06	0.002
Dum29	0.890*	0.539	1.65	0.099
Dum33	1.141	0.758	1.51	0.132
Dum38	0.723	0.634	1.14	0.254
Dum40	1.254*	0.747	1.68	0.093
Dum68	1.955***	0.710	2.75	0.006
Dum69	0.312	0.539	0.58	0.563
Dum81	0.901*	0.534	1.69	0.092
Dum83	2.026***	0.598	3.39	0.001
Dum84	1.736**	0.837	2.07	0.038
constant	-2.887***	0.914	-3.16	0.002
Wald chi2	300.48			
Prob> chi2	0.000			
Obs.	381			

Notes: Significance levels: ***1 %, **5 %, *10 %.

Out of thirty-three independent variables presented in Table 12 the coefficients of fifteen as well as the coefficient of the constant are significantly different from zero, the coefficients of nine are statistically significant under the one percent significance level, the coefficients of two are statistically significant under the five percent significance level as well as the coefficients of four under the ten percent significance level. All coefficients that were statistically significant except for education have the expected signs. In section 4.3.2 it is theoretically explained why these specific variables are used and which signs the coefficients should have in the estimation. The dependent variable, the probability of an agricultural unit to be labour rationed is binary. The interpretation of the coefficients of the dependent variables in the estimation is not as straightforward as with e.g. a linear regression, but an increase in the variable leads to an increase in the probability of the agricultural unit to be labour rationed. A decrease in the variable leads to a decrease in the probability of the agricultural unit to be labour rationed.

Furthermore, apart from the control variables, the value of machinery and movable equipment that the agricultural unit owned as well as the fact that it carried out joint activity with other agricultural units decreased the probability of the respective agricultural unit to be labour rationed. Hence, the more expensive machinery an agricultural producer owns, thus, the higher the quality of their movable equipment and machinery, the lower the chance that an agricultural producer is labour rationed. Moreover, if an agricultural producer cooperated with other agricultural units they were less probable to be rationed on the labour market. The coefficient for land has a negative sign as well, but it is not statistically significant. When analysing causes of labour rationing, in section 4.3.2 it was mentioned that the land used by a farm may amongst other factors explain why an agricultural unit is labour-rationed or not, because a larger farm might seem more prospering and more attractive as a potential employer, especially in Kazakhstan, where people oftentimes prefer to work as an employee of an agricultural enterprise than to own their own farm. However, for my case study the results of the Heckman model show that it was not relevant how large a farm was. Hence, if an agricultural unit owns more land, it does not mean that they have fewer problems on the labour market. The coefficient of the variable "education" was only statistically significant under the ten percent significance level. Besides, the coefficient was positive, which means that the higher the education level of a manager was, the higher the probability of a farm to be rationed on the labour market. This sign of the education coefficient was somewhat unexpected. But it could be that the more educated managers have higher expectations regarding the qualifications of their employees, because they are aware of the fact that better qualified workers should be more efficient, but also of the fact that the latter are at the same time more difficult to find. Regarding the village dummies, dum7 is Karatalsk, a small village located in the area of Taldykorgan in Karatalsky oblast.

It is not surprising that the coefficient of this dummy was positive, since this city is far from Almaty or major hubs. Usually in such villages in the periphery there is much less labour available. However, detailed information on the infrastructure and village characteristics of the villages visited during the survey was not always at hand. But the village dummies are meant to be control variables that control for differences among villages such as infrastructure, size, and distance to markets. All the village dummies that were statistically significant had positive coefficients. Those dummies are the Esilsky rayon dummy that is composed of all villages in Esilsky rayon, where only one or two observations could be made and thus, these villages were pooled together. Moreover, another dummy for the villages of Karatalsky rayon, where only one or two observations could be made, pooled together had a positive coefficient. Furthermore, dum6, Kaz-zhazyk, dum22, Prirechnoye, dum27, Orlovka, dum29, Iglik, dum40, Moltobar, dum68, Tenlik, dum81, Ak Dala, dum83, Oskemir and dum84, Guldala were statistically significant with a positive sign. Most of these villages are rather small or located in the far province, relatively far from bigger markets. Furthermore, a dummy for the year 2003 was included. The coefficient of this dummy was positive and statistically significant. This result was to be expected since the definition of being labour rationed is broader for 2003 than for 2011 due to data limitations. Thus, it makes sense that the share of labour rationed agricultural units was higher in 2003. Nevertheless, the year dummy serves as a control variable for differences between the years 2003 and 2011 that were not caused by the other independent variables but by other factors.

The coefficients of the constant and the ones of the variables year dummy for 2003, Y2003, dum_esil, Esilsky rayon dummy and dum 83, Oskemir have the lowest probabilities of an estimation error, namely that the coefficients of the variables would be zero. This fact is shown by the highest z-value and the smallest P>Izl. The smaller the latter, the smaller the probability that the null hypothesis, namely that the respective coefficient is zero, would be erroneously rejected. In that case the coefficient would be in reality null and there would be no relationship between the respective variable and the probability of the agricultural unit to be rationed on the labour market. Thus, if the significance level is e.g. one, the probability of incorrectly rejecting the null hypothesis is one percent. Thus, if the p-value is below 0.001 the probability of this error to happen is one percent or lower.

Table 13: Probit estimation with the data of the year 2011

Variable	Coefficient	Standard error	z-value	P>lzl
Selection equation: Probability that agricultural units are rationed on the labour market				
Lnland	-0.046	0.056	-0.82	0.411
Lnmat	0.005	0.058	0.08	0.932
Lnedu	-0.284	0.388	-0.73	0.465
Dum_joint_act	-0.819***	0.245	-3.35	0.001
Lnfixed_equip	0.025**	0.011	2.31	0.021
Lnmove_equip	0.023*	0.012	1.92	0.055
dum_talgar	-0.354	0.469	-0.76	0.450
Dum_esil	1.113**	0.562	1.98	0.047
Dum_ermen	0.798*	0.471	1.69	0.090
Dum_rest	0.620	0.496	1.25	0.212
Dum2	-0.255	0.675	-0.38	0.706
Dum6	1.049**	0.446	2.35	0.019
Dum7	2.720***	0.604	4.51	0.000
Dum8	1.440***	0.529	2.72	0.007
Dum9	-0.207	0.640	-0.32	0.746
Dum11	0.096	0.524	0.18	0.854
Dum12	-0.276	0.553	-0.50	0.619
Dum22	1.259*	0.739	1.70	0.088
Dum23	-0.242	0.627	-0.39	0.700
Dum27	0.099	0.666	0.15	0.882
Dum28	0.332	0.711	0.47	0.640
Dum29	0.612	0.516	1.19	0.235
Dum30	0.162	0.547	0.30	0.766
Dum33	0.286	0.845	0.34	0.735
Dum38	0.118	0.474	0.25	0.882
Dum40	0.289	0.711	0.41	0.640
Dum42	0.192	0.760	0.25	0.235
Dum56	-1.070	0.591	-1.81	0.766
Dum68	2.063	0.703	2.93	0.735
Dum69	0.982	0.485	2.02	0.803
Dum77	-0.569	0.744	-0.77	0.685
Dum79	0.128	0.626	0.21	0.801
Dum80	0.945*	0.838	1.13	0.070
Dum81	-0.222	0.483	-0.46	0.645
Dum82	-0.082	0.521	-0.16	0.875
Dum84	0.544	0.769	0.71	0.479
Dum85	-0.390	0.549	-0.71	0.478
Dum86	0.50	0.847	0.59	0.555
Constant	-0.09	0.783	-0.11	0.912
Wald chi2	459.22			
Prob> chi2	0.000			
Obs.	299			

Notes: Significance levels: *** 1 %, ** 5 %, * 10 %.

As presented in Table 13 the coefficients of twelve out of the thirty-eight independent variables of the Probit estimation are significantly different from zero under the one, five or ten percent significance level, respectively. If an agricultural unit cooperated with others, it was less likely to be rationed on the labour market. The coefficients of the value of movable equipment and machinery as well as the one of the value of fixed equipment were statistically significant and had a positive sign. This means that the more valuable the machinery and equipment of the agricultural unit were, the more problems the latter had finding workers. As explained in section 4.3.2 a possible reason is that managers of well-equipped farms may have higher expectations regarding the skills of a worker, since workers need to be able to operate e.g. more expensive and technologically more advanced machinery. Hence, there are less rural inhabitants that come into consideration for such jobs. As explained in section 4.3.2 for the variable value of moveable equipment, the sign of the coefficient could be either positive or negative, because on one hand agricultural units with expensive machinery could attract employees because they might give a modern and innovative impression. But on the other hand, the employers might be more selective due to the fact that a potential worker would need more skills to operate such machinery as explained above. At first view it might seem surprising that the coefficient of the variable value of moveable equipment has a positive sign in this estimation, since it had a negative sign in the previous estimation. However, in the previous estimation data from 2003 and 2011 together was used. As will be presented later in Table 14, the sign of the coefficient of the variable, value of machinery and equipment was negative in the 2003 estimation. Thus, the stronger negative effect of 2003 evened out the positive effect of the 2011 estimation. A further possible reason for that could be that the definition of being labour rationed is different in 2003 than in 2011. Nevertheless, the definition was narrower in 2011, it was added that a labour rationed agricultural unit reported problems finding workers for various tasks. Hence, it might be that especially those units that claimed troubles finding workers for skilled tasks were particularly selective. Thus, maybe the share of very selective agricultural units among the labour rationed units was higher in 2011 than in 2003 due to differences in the definition. In order to operate more sophisticated machinery skilled workers are needed, and they were particularly scarce in 2011. Apart from that land, working capital and education was not statistically significant. Out of the control variables the dummies for the villages that were pooled together in Ermentausky and Esilsky rayon, respectively, had positive and statistically significant coefficients. This makes sense like described earlier; from northern Kazakhstan many skilled workers emigrated. Furthermore, since the coefficients of the value for movable and fixed equipment, respectively, were positive as well, it seems that skilled workers are particularly scarce. Furthermore, some of the village dummies, which are used as control variables, had statistically

significant coefficients with a positive sign, namely dum6, Kaz-zhazyk, dum7, Karatalsk, dum8, Chumry, dum22, Prirechnoye, dum68, Tenlik, dum69, Baisova. Most of these villages are very small and rather located in the far province. The coefficient of dum56, Belbulak was statistically significant with a negative sign. It seems that Belbulak may be relatively well connected, since it is located between Almaty and Talgar and not very far in the periphery. The probability of error indicated by the z-values and the P>lzl was lowest for the variables, dummy joint activity, dum 7, Karatalsk and dum 8, Chumry.

Table 14: Probit estimation with data of the year 2003

Variable	Coefficient	Standard error	z-value	P>lzl
Selection equation: Probability that agricultural units are rationed on the labour market				
Lnland	0.243**	0.101	2.40	0.016
Lnmat	0.038	0.090	0.38	0.706
Lnedu	0.342	0.892	0.38	0.701
Dum_joint_act	0.299	0.468	0.64	0.522
Lnfixed_equip	-0.384	0.027	-1.41	0.159
Lnmove_equip	-0.301	0.028	-1.07	0.287
Dum4	0.861	0.825	1.04	0.297
Dum5	0.440	1.067	0.41	0.680
Dum6	0.830	0.811	1.02	0.306
Dum12	0.316	0.742	0.43	0.671
Dum14	-0.652	1.002	-0.65	0.515
Dum15	-1.849*	1.079	-1.71	0.086
Dum18	0.291	0.953	0.30	0.760
Constant	0.319	1.753	0.18	0.856
Wald chi2	114			
Prob> chi2	0.000			
Obs.	82			

Notes: Significance levels: * 10 %, ** 5 %, *** 1 %.

As shown in Table 14 two out of thirteen independent variables have coefficients that are significantly different from zero on the five and ten percent significance level, respectively. The coefficient of the land variable has a positive sign, whereas the coefficient of the control variable dum15 for the village called Karakol had a negative sign. The reasons for using these independent variables and which signs are to be expected in the estimation can be found in section 4.3.1.1. However, a limitation for the 2003 estimation is that the sample size is rather small. In total there are only 82 observations and hence, only 35 censored and 47 uncensored observations. Furthermore, the definition of being labour rationed is not optimal in 2003, but it is the best approximation considering the available data for 2003. Given the fact that an agricultural unit is considered labour rationed if it did not

employ any seasonal labour, it seems plausible that the land coefficient in the Probit estimation is positive. This is because larger farms have on average a higher demand for seasonal workers as well as a higher demand for qualified workers, which are more difficult to find. The coefficient of the land variable has the lowest error probability.

5.2.2 Production of labour rationed agricultural units

Firstly, the descriptive statistics of the variables used in the production function part of the Heckman model will be presented in Table 15. After that, the results of the three different production function estimations within the Heckman model will be presented. The results of the production function estimation reflect the consequences of labour rationing on the output of the different agricultural units. The production elasticities will further be used to calculate the shadow wages of the different farm types.

Table 15: Variables used in the production function estimation

Variable	Mean	Standard deviation	Min.	Max.	Obs.
Land used (in 1000 ha)	2978.1	7985.5	0	80000	400
Labour (in fte)	21.2	71.2	0.1	867.8	398
Real material inputs (Million 2011 tenge)	7.6	24.4	0	223	382
Depreciation	2.4	14.9	0	200	388
Education level (low=1, high= 8)	6.5	1.5	3	8	400
Year dummy (2003)	0.3 (0)	0.4	0	1	400

Source: Own depiction from survey data.

In the following section the results of the production function estimation within the framework of the Heckman model will be presented. Firstly, the results of the model that was estimated with the data of both years, namely 2003 and 2011 will be introduced. Secondly, the results of the model with 2011 data will be explainned. Lastly, the results of the model with 2003 data will be analysed.

Table 16: Results of the production function estimation with data of 2003 and 2011

Variable	Coefficient	Standard error	z-value	P>lzl
Production function with the dependent variable, output of the agricultural units with exogenous labour in 2003 and 2011 (rationed on the labour market)				
lnland	0.251***	0.088	2.85	0.004
lnlabour_fte	0.554***	0.138	4.01	0.000
lnmat	0.125**	0.050	2.49	0.013
lndeprec	0.108***	0.041	2.62	0.009
lnedu	-0.502	0.446	-1.13	0.260
rayon 1	0.140	0.323	0.43	0.664
rayon 2	-0.897***	0.303	-2.96	0.003
rayon 3	-0.269	0.584	-0.46	0.646
y2003	-0.468	0.376	-1.24	0.213
constant	2.201**	1.001	2.21	0.027
Mills ratio lambda	0.366	0.311	1.18	0.239
Rho	0.429			
Sigma	0.854			
Wald chi2	300.48			
Prob> chi2	0.000			
Obs.	85			

Notes: Significance levels: *** 1 %, ** 5 %, * 10 %.

Out of the nine independent variables presented in Table 16 the coefficients of five are significantly different from zero; under the one percent significance level. The coefficient of the constant is statistically significant under the five percent significance level. In section 4.3.2 it is theoretically explained why these specific variables were used and which coefficients they should have in the estimation. Consequently, the statistically significant coefficients have the expected signs. The coefficients of the factors of production, that are at the same time the partial production elasticities, indicate the elasticity of the output (revenue) in relation to the amount used of a specific production factor. If one more unit of a specific factor of production is used in the production process, the revenue increases by the coefficient of that production factor if the sign is positive and decreases by the coefficient if the sign is negative. Thus, the key factors that lead to an increase or decrease in revenue in the production of a specific agricultural unit are Ermentausky rayon (dummy), the labour employed in the production and the land used in the production, in this order. Hence, the rayon dummy for Ermentausky rayon had a major negative impact on the revenue of the agricultural unit.

This negative sign of Ermentausky rayon was expected since compared to the other rayons of our survey the mentioned rayon has severe problems regarding the availability of labour e.g. many skilled workers emigrated from that area. Moreover, in Ermentausky rayon the climatic conditions are extreme with very cold winters. Furthermore, it is located in the very east of Akmola oblast, whereas Esilsky rayon is located more centrally. These factors have a negative impact on production. The coefficients of the other rayon dummies were not statistically significant. The coefficients of labour and land used in the production were positive. Thus, the more workers an agricultural unit employed and the more land it used in the production the more revenue it managed to generate. However, both coefficients are below one. Thus, one unit more of labour or land used generates less than one unit more of revenue. Furthermore, the factors of production fixed capital (depreciation) used in the production and the working capital (material inputs) have positive coefficients. This means that the more capital an agricultural unit used in their production process the higher the revenue generated. The coefficients of all of the factors of production were statistically significant under the one or five percent significance level, respectively with a positive sign and were of reasonable magnitude. The coefficient of education was not statistically significant. The probability of an estimation error, namely that the above mentioned coefficients would be zero was lowest for the coefficient of the variable, labour force used in the production. A coefficient of zero would mean no relationship between the respective independent variable and the revenue. The land used in the production, followed by the working capital (material inputs) had the second and third lowest probability of an estimation error.

Moreover the coefficient for the Mills ratio was positive but not statistically significant, which means that it can be assumed that there is no selection bias in the model.

The Wald Chi test is used to test the hypothesis that all of the coefficients are unequal zero. The number in parenthesis is the degrees of freedom. Prob> chi2 is the probability of obtaining the chi2-statistic, 300.48 or higher if the coefficients of the independent variables are all zero. In this case the p-value was < 0.001. The null hypothesis that all coefficients of our model excluding the constant are zero is rejected based on the chi2-statistic.

Table 17: Results of the production function estimation with data of 2011

Variable	Coefficient	Standard error	z-value	P>Izl
Production function with the dependent variable, output of agricultural units with exogenous labour in 2011 (rationed on the labour market)				
Lnland	0.097	0.062	1.57	0.117
Lnlabour_fte	0.423***	0.085	4.98	0.000
Lnmat	0.403***	0.067	6.06	0.000
Lndeprec	0.070**	0.030	2.33	0.020
Lnedu	-0.036	0.351	-0.10	0.918
Rayon 1	-0.374	0.235	-1.59	0.113
Rayon 2	-0.990***	0.252	-3.92	0.000
Rayon 3	-0.796**	0.366	-2.18	0.030
Constant	1.837*	0.681	2.70	0.007
Mills lambda	-0.037	0.229	-0.16	0.871
Rho	-0.041			
Sigma	0.9146			
Wald chi2	459.22			
Prob> chi2	0.000			
Obs.	139			

Notes: Significance levels: *** 1 %, ** 5 %, * 10 %.

Out of the eight independent variables of the 2011 estimation presented in

Table 17 the coefficients of five as well as the coefficient of the constant are significantly different from zero, four of the coefficients are significant under the one percent significance level and two are significant under the five percent significance level. The statistically significant coefficients have the expected signs. However, the probability of an estimation error varies. Here, the key factors that lead to an increase or decrease of the revenue of an agricultural unit are Ermentausky rayon (dummy), Talgarsky rayon (dummy) and the labour force used in the production followed by the working capital (material inputs). As already explained in section 4.3.2, the negative sign of the coefficient of Ermentausky rayon (rayon 2) was to be expected. On one hand, the climatic conditions in northern Kazakhstan are very harsh for agriculture and on the other hand, the scarcity of labour is more severe in northern Kazakhstan than in southern Kazakhstan. Furthermore, the location of Ermentausky rayon in Akmola oblast is not very central either. The latter applies for Talgarsky rayon (rayon 3) to a lesser extent, too. Talgarsky rayon is located in Almaty oblast, where the climate is more favourable for agriculture. However, it is also located rather peripheral e.g. compared to Karatalsky rayon. The coefficient of the labour variable was positive. The

more workers an agricultural unit employed the higher was the revenue. The same accounts for the variable working capital. Furthermore, fixed capital (depreciation) had a positive impact on revenue. The more fixed capital a farm or agricultural enterprise used in the production the higher the revenue. Regarding the education coefficient, it was once again not statistically significant, neither was the land coefficient. Hence, the amount of land used in the production did not play a significant role for the revenue generated. Thus, there were no economies of scale.

The error probability was lowest for the coefficient of the variable material inputs, followed by the coefficient of the labour force used in the production and the coefficient of the dummy for Ermentausky rayon (rayon 2).

The coefficient of the mills ratio was not significant. Hence, selection bias is not to be assumed.

Regarding the goodness of fit, the probability of obtaining the chi2-statistic, 459.22 or higher if the coefficients of the independent variables are all zero was <0.001. The null hypothesis that all coefficients of our model excluding the constant are zero is rejected based on the chi2-statistic. Further details regarding the Wald Chi test are explained above Table 17.

Table 18: Regression results of the production function estimation with data of 2003

Variable	Coefficient	Standard error	z-value	P>Izl
Production function with dependent variable, output of agricultural units with exogenous labour in 2003 (rationed on the labour market)				
Lnland	0.373***	0.142	2.64	0.008
Lnlabour_fte	0.673***	0.193	3.48	0.001
Lnmat	0.092	0.064	1.45	0.147
Lndeprec	0.566**	0.226	2.54	0.011
lnedu	-0.869	0.470	-1.85	0.309
Rayon 1	0.520***	0.511	1.02	0.008
Rayon 2	-3.230	1.225	-2.64	0.782
Rayon 3	0.268***	0.97	0.28	0.003
Constant	5.467*	1.852	2.95	0.064
Mills ratio lambda	0.106	0.444	0.24	0.811
Rho	0.171			
sigma	0.621			
Wald chi2	114			
Prob> chi2	0.000			
Obs.	47			

Notes: Significance levels: * 10 %, ** 5 %, *** 1 %.

In the production function estimation represented in Table 18 the coefficients of five out of the eight independent variables as well as the coefficient of the constant are significant under the one, five or ten percent significance level, respectively. As already explained in 5.2.2 below Table 16 the coefficients of the factors of production indicate the elasticity of the output (revenue) in relation to the amount used of a specific production factor. Next to the constant, the key factors of the production were the labour force used in the production, the fixed capital (depreciation) and the dummy Esilsky Rayon (rayon 1). All of them had a positive coefficient. As explained in section 4.3.2 these signs were expected. Furthermore, the coefficient of the land used and the coefficient of Talgarsky rayon (dummy) had positive signs and hence, those variables had a positive impact on the revenue. The coefficients of material inputs (working capital) and education were not statistically significant. The lowest probability of an estimation error, namely that their coefficients would be zero, had the coefficient of the variable, labour force, followed by the coefficient of the variable, land used and the coefficient of the dummy variable Esilsky rayon (rayon 1). The coefficient of the mills ratio was not significant. Therefore, no selection bias is assumed.

The probability of obtaining the chi2-statistic, 114 or higher if the coefficients of the independent variables are all zero was <0.001. Thus, it can be concluded that at least one of the coefficients in the production function estimation should be unequal zero.

In the next step, the production elasticities of labour obtained from the production function estimations will be used to calculate the shadow wages.

5.2.3 Labour indicators of different farm types

The following section will present various labour indicators of different farm types. Special focus will be on the shadow wages of the different farm types. The calculation of the latter will be based on the production elasticities obtained from the production function estimations, 2003 and 2011 together, 2011 only and 2003 only. The shadow wages provide information on which farm type was mostly constrained on the labour market and about the willingness to pay for one more unit of labour of the different farm types.

Table 19 displays different labour indicators for the different farm types in 2003 and 2011 (based on the Heckman model for 2003 and 2011 together).

Table 19: Median of different labour indicators (based on Heckman model for 2003 and 2011 together)

	2003				2011			
Farm type	**Shadow wage**	**Real wage**	**Labour input**	**Obs**	**Shadow wage**	**Real wage**	**Labour input**	**Obs**
Individual farm	583.2	345	2.5	68	2169.5	1188.2	0.8	211
Agricultural Enterprise	730.9	154.2	19.6	12	2232.3	1500	4.5	38
Agroholding	no data	no data	no data	0	6327.3	2015.1	19.3	5

Source: Labour indicators calculated based on survey data; data on all types of labour was considered.

Notes: Wages: 2011 tenge/day.
Exchange rate: 200 tenge= 1 euro.
Labour input: in 1000 days/year.

Table 19 the medians of the shadow wages by farm type in 2003 and 2011 are compared with the real wages paid by the respective farm type for one day of work in 2003 and 2011, respectively. For the calculation of the shadow wages the production elasticity of labour estimated in the Heckman model for 2003 and 2011 together in the previous section were used. In 2003 as well as in 2011 the shadow wages were much higher than the real wages for all farm types. This means that the agricultural units pay less for one more unit of labour than they would actually be willing to pay. In 2003, the individual farms had a median shadow wage of 583.2 Tenge per day (2.7 €) compared to a real wage paid of 345 Tenge per day (1.7 €). This shows that the individual farms had an excess demand for labour. For the agricultural enterprises the difference between the median shadow wage and the wage paid was even larger with the first one ranging at 730.9 Tenge per day (3.7 €) and the latter being only 154.2 Tenge per day (0.78 €). In 2003, no data for agroholdings was available.

In 2011 the real wages paid were already much higher than in 2003, namely the median for individual farms was 1188.2 Tenge per day (5.9 €), the median for agricultural enterprises was 1500 Tenge per day (7.5 €) and for agroholdings 2015. 1 Tenge per day (10.1 €). Nevertheless, the shadow wages were on average exceeding the real wages paid in 2011. This shows that in 2011 an excess demand for labour prevailed with agricultural units willing to pay more for one more labour day than they were actually paying. In 2011 the discrepancies between real wages paid and shadow wages were particularly large for agroholdings, followed by individual farms and then agricultural enterprises. Furthermore, the

discrepancy between shadow wages and real wages paid rose for individual farms from 2003 until 2011. Concretely, the median shadow wage for an agroholding was 6327.3 Tenge per day (31.6 €), the one for individual farms was 2169.5 Tenge per day (10.9 €) and the one for agricultural enterprises was 2232.3 Tenge per day (11.2 €).

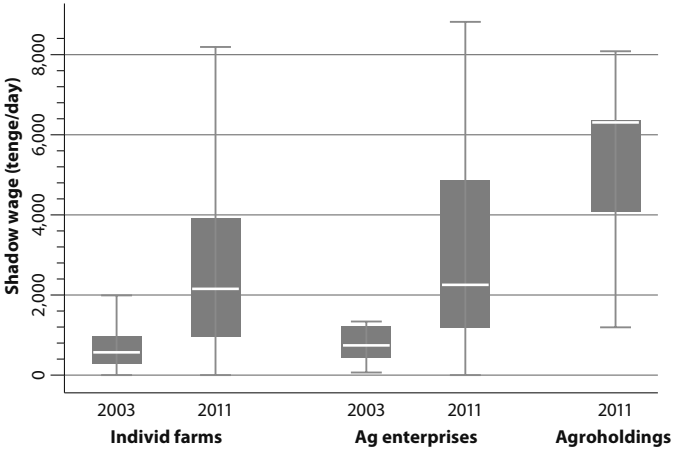
Regarding the labour days used, in 2003 an individual farm used on average 2490 labour days and an agricultural enterprise used 19,580 labour days. In 2011, an average individual farm used 820 labour days per year, an agricultural enterprise 4530 labour days per year and an agroholding 19,300 labour days per year. These averages were calculated from the sample that was used for the Heckman model. The fact that the amount of labour employed on the agricultural unit decreased for all farm types in 2011 suggests that farm managers were able to increase labour productivity. The reason could be that managers invested in more machinery and thus reduced the amount of labour needed in the production. Nevertheless, on one hand more machinery substitutes labour, but on the other, more skilled labour is needed that is able to operate the machinery. Since skilled labour is particularly scarce, the problem of finding suitable labour does not seem to be solved by buying more machinery. On the contrary, this could explain why agroholdings were particularly labour rationed, namely because they own on average more sophisticated machinery than the other farm types and thus, they have a higher demand for the particularly scarce skilled workers.

As analysed earlier the real wages in agriculture rose in 2011 compared to 2003. So, the managers probably paid workers more in 2011 in order to attract more workers. Nevertheless, the shadow wages increased, too and with them the discrepancy between real and shadow wages in some cases, making agricultural units even more labour rationed than in 2003. The problem is in particular the skills of the workers. The real wages paid represented inTable 19 are average wages of all types of labour such as skilled, unskilled, hired, family labour etc. Thus, it could be that if I would look at skilled workers only the real wages would be higher. However, I do not have this information. Thus, managers are willing to pay more for skilled workers, but they are not willing to pay too much for any random worker. They specifically target skilled workers, because it makes no sense to e.g. employ someone that has not idea about how to operate a specific machine. Such a worker could even cause damage. Thus, the agricultural units are not willing to pay high wages to workers that are not useful.

The boxplots in Figure 19 show the distribution of shadow wages of agricultural units in 2003 and 2011. The first and third quartile of the distribution of the shadow wages are represented by the lower and upper limit of the box. Furthermore, to get the lower whisker 1.5 times the interquartile range needs to be subtracted from the lowest shadow wage. The upper whisker marks the highest

shadow wage plus 1.5 times the interquartile range. The distribution of the shadow wages gives a more detailed picture. If the shadow wages are compared with the respective real wages it can be seen that for agricultural enterprises the median real wage was far below the first quartile of the shadow wages in 2003. In 2011, the variation of the shadow wages of individual farms and agricultural enterprises was rather large, especially on the upper end. The real wage of individual farms, 1188.2 Tenge (5.9 €) was just above the first quartile of the shadow wages which. The latter reached even up to more than 8000 Tenge (40 €). For agricultural enterprises the distribution looked similar. The median of the real wages 1500 Tenge (7.5 €) was far below the median of shadow wages. The latter even reached around 8500 Tenge (42.5 €) per day. For agroholdings the first quartile of the shadow wages was around the double of the median real wage. The latter was 2015.1 Tenge (10.1 €) per day. However, the values varied slightly less than for individual farms and agricultural enterprises. The maximum shadow wage of agroholdings was below 8000 Tenge (40 €) per day.

Figure 19: Distribution of the shadow wages according to farm type and year (2003 and 2011 together)



Based on Cobb Douglas prod function estimate, 200 tenge = 1 euro

Source: Own depiction based on survey data.

Table 20: Median of different labour indicators (based on Heckman model for 2011)

Farm type	Shadow wage	Real wage	Labour input	Obs.
Individual farm	1675.4	1188.2	0.8	212
Agricultural Enterprise	1705.1	1500	4.8	38
Agroholding	5491.9	2015	19.3	8

Source: Labour indicators calculated based on survey data; data on all types of labour was considered.

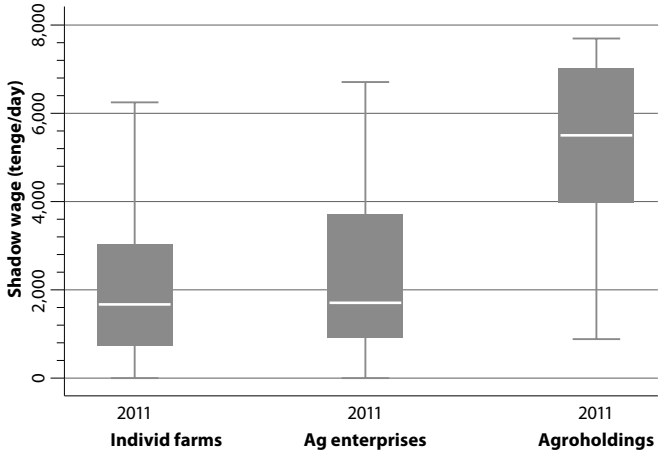
Notes: Wages: 2011 tenge/day.
Exchange rate: 200 tenge= 1 euro.
Labour input: in 1000 days/year.

Table 20 represents the results of the shadow wage calculation in 2011. The shadow wage of each farm type can be compared with the real wage paid. For additional information the median of labour input was added. As expected, the individual farms used the least labour, namely 820 labour days per year and agroholdings use the most labour, namely 19,300 labour days per year. As in the previous case the median labour input was calculated based on the sample used in the Heckman model. As expected, the use of labour is comparable to the one in the previous case; and the real wages paid are the same. The part that changed is the shadow wages. When comparing the shadow wages of Table 20 (2011 only) with the results in Table 19 it can be noticed that for all the farm types the shadow wages are lower in Table 20 where everything was calculated based on 2011 only. The reason is that in the second model the definition for an agricultural unit to be labour rationed was loosened, thus an agricultural unit was labour rationed if they reported problems finding workers for simple and/or skilled tasks regardless of whether they employed seasonal labour or not. So, in the first case (Table 19) with the narrower definition mostly those agricultural units were covered that were rather strongly constrained on the labour market. Hence, it makes sense that they are willing to pay even more for one extra day of labour because they are facing an even higher excess demand for labour. But even in the second case the median shadow wages of all farm types were above the corresponding real wages. This means that even if the definition of a labour rationed agricultural unit is loosened, excess demand of labour and a willingness to pay higher prices than the real wages prevails. Thus, the median shadow wage for individual farms in 2011 was 1675.4 Tenge (8.4 €) per day, agricultural enterprises would be willing to pay 1705.1 Tenge (8.5 €) for an extra day of labour, and the median of the shadow wages of agroholdings was 5491.9 Tenge (27.5 €) per day. Once again, the agroholdings were paying the highest wages, but were even willing to pay around three times as much as the real wage. This result suggests that the agroholdings had the highest excess demand for labour and were

rationed the strongest on the labour market. Basically, the reason is the same as described for the previous case (Table 19). On one hand they need on average more employees. Furthermore, they have the most problems finding suitable employees for their needs because on average agroholdings are using more technologically advanced machinery and thus, need rather skilled workers. Earlier it was presented that agroholdings reported the most problems finding skilled labour (Table 8).

Figure 20 below illustrates the distribution of the shadow wages. The variation between shadow wages within one farm type was large, especially in the case of agroholdings. The first quartile of the shadow wages of the latter farm type was almost the double of the average real wage paid by agroholdings. The highest shadow wage that an agroholding would be willing to pay reached almost 8000 Tenge (40 €) per day. The shadow wages of individual farms and agricultural enterprises ranged between 0 Tenge (0 €) and above 6000 Tenge (30 €) per day with the ones of agricultural enterprises being a bit higher than the ones of individual farms.

Figure 20: Distribution of the shadow wages according to farm type in 2011



Based on Cobb Douglas prod function estimate, 200 tenge = 1 euro

Source: Own depiction based on survey data.

Table 21: Median of different labour indicators (based on Heckman model for 2003 only)

Farm type	Shadow wage	Real wage	Labour input	Obs
Individual farm	607.7	345	2.5	61
Agricultural enterprise	754.6	154.2	19.6	11
Agroholding	no data	no data	no data	no data

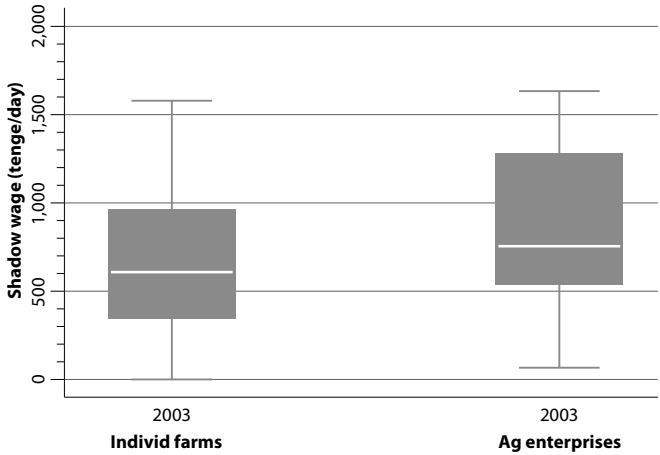
Source: Labour indicators calculated based on survey data; data on all types of labour was considered.

Notes: Wages: 2011 tenge/day.
Exchange rate: 200 tenge= 1 euro.
Labour input: In 1000 days/year.

Table 21 depicts the median shadow wages and real wages as well as the median labour input for the year 2003 of different farm types. When comparing the shadow wages of the different farm types with the real wages, it can be noticed that each farm type paid on average less than it would be willing to pay for one more unit of labour. It can be noticed that individual farms as well agricultural enterprises had a strong excess demand for labour. Individual farms paid on average around 345 Tenge (1.7 €) per day but could pay around 608 Tenge (3 €) per day, which was almost the double. For agricultural enterprises the difference between shadow wage and wage paid was even larger. Hence, the average agricultural enterprise paid 154.2 Tenge (0.8 €) per day but could even pay 754.6 Tenge (3.8 €) per day. The reasons for the discrepancy between shadow wages and real wages are basically the same as explained for Table 19 and Table 20, just that, compared to 2003 the real wages were considerably higher in 2011, but so were the shadow wages. On average, individual farms used 3000 labour days per year and agricultural enterprises 20,000 labour days per year.

The boxplots in Figure 21 show the distribution of shadow wages of individual farms and agricultural enterprises in 2003. Comparing the shadow wages with the respective real wages, it can be observed that for individual farms the median real wages equal approximately the first quartile of the shadow wages. For agricultural enterprises the situation is more extreme. The median real wage is only slightly above the lower whisker of the boxplot. Nevertheless, it can further be summarized that the variation of the shadow wages within one farm type was much smaller in 2003 than in 2011. This fact combined with the fact that for certain farm types the discrepancy between real and shadow wages even increased in 2011 suggest that the labour scarcity and the excess demand for labour aggravated in 2011 or that at least certain agricultural units were strongly labour rationed and desperate to find suitable workers in 2011.

Figure 21: Distribution of the shadow wages according to farm type in 2003



Based on Cobb Douglas prod function estimate, 200 tenge = 1 euro

Source: Own depiction based on survey data.

5.3 Further descriptive results on labour rationing

Whether or not an agricultural unit carried out any farming activity jointly with other farms or farmers played an important role in explaining the probability of being labour rationed of an agricultural unit. In 2003 relatively few agricultural units cooperated, thus, it is difficult to draw conclusions for 2003. The dummy variable, joint activity carried out with other farms or farmers was included as an independent variable in the Probit estimation of the Heckman model in section 5.2.1. It can be summarized that cooperating with other agricultural units had a negative effect on the probability of being labour rationed. Still some labour rationed agricultural units can be detected that cooperated with other agricultural units. It is interesting to scrutinize the difference in cooperation patterns of labour rationed and not rationed agricultural units. Thus, the fields in which agricultural units cooperated were examined and the results of individual farms, agricultural enterprises and agroholdings that were rationed on the labour market and of those that were not were compared (Table 22).

Table 22: In which activities did the individual farms, agricultural enterprises or agroholdings cooperate?

Activity	Yes, % all farms 2011	Yes, % labour rationed 1, 2011	Yes, % labour rationed 2, 2011	Yes, % of all farms 2003	Yes, % of labour rationed, 2003
Crop production	39	22	58	.	.
Livestock production	1	44	4	.	.
Processing	1	11	0	13	20
Sale of products	41	22	20	0	0
Joint use of machinery/equipment	31	44	59	75	70
Purchase of farm inputs	46	11	12	44	30
Mutual credit	6	22	0	7	10
Consulting and professional advice	4	0	0	0	0

Source: Own depiction from survey data.

Labour rationed 1 in 2011 stands for the first definition of labour rationed agricultural units, namely that an agricultural producers were labour rationed if they did not employ any seasonal labour and at the same time had problems finding workers for simple or/and skilled jobs. On the other hand, labour rationed 2 in 2011 stands for the second definition of a labour rationed agricultural producer, namely one that reported problems finding workers for simple and skilled tasks. The percentages in Table 22 were calculated from all farm types together. That is because for most activities there were only minor differences between farm types. Thus, the results were not differentiated by farm type. Besides, only a few particularly interesting results will be presented below.

As already explained in 2.5, according to TOLEUBAYEV et al. (2010) managers with experience from the Soviet times are usually better linked to other managers and thus, can exchange ideas, which helps them to farm better. According to TOLEUBAYEV et al. (2010) interaction between different farm types in fields such as labour supply, inputs or marketing of products plays a crucial role. Having a closer look on cooperation between different agricultural units, it can be observed that the fields in which farm managers cooperated changed between 2003 and 2011. Hence, agricultural producers cooperated in 2011 much less in processing, joint use of equipment and machinery than in 2003. Cooperation shifted to fields such as sale of products and purchase of farm inputs. Especially those

farms which cooperated regarding these issues were less likely to be rationed on the labour market. The labour rationed agricultural units that cooperated, continued to do so in production of crops or livestock and regarding joint use of machinery.

According to QAMAR and SWANSON (2012) for many farmers the marketing of their products is a major problem since during the communist times it was assured. However, marketing of agricultural products is also a crucial component for agricultural development. So, one reason for the shift in cooperation patterns of certain agricultural units could be that their managers realized how important e.g. marketing of agricultural produce is and hence, started to organize themselves. Such kind of cooperation seems also like a win-win situation for all participants. When a trader comes to the village to buy products it can anyways not be avoided that other agricultural units benefit, too. But it could be that the managers of other farms and agricultural that do not have networks; do not always know about the arrival of such a trader. The same applies for purchase of farm inputs.

Table 23: Share of individual farms that cooperated regarding the sale of products

	2003		2011		
	All	**Labour rationed**	**All**	**Labour rationed 1**	**Labour rationed 2**
	0	0	55	25	20

Source: Own depiction from survey data.

When comparing whether or not the individual farms cooperated regarding the sale of products, it can be noticed that in 2003 none of them cooperated regarding this issue, just like none of the other farm types did. However, especially for the individual farms the share of farms that cooperated regarding sale of products in 2011 was particularly large, fifty-five percent of all individual farms, compared to forty-one percent of all farm types together. Furthermore, among those individual farms that were labour rationed according to both definitions in 2011 only twenty-five and twenty percent, respectively cooperated regarding sales of products. Thus, more than twice as many of the individual farms that were not labour rationed cooperated than labour rationed farms, in relative terms.

Table 24: Share of individual farms that cooperated regarding machinery and equipment

2003		2011		
All	**Labour rationed**	**All**	**Labour rationed 1**	**Labour rationed 2**
83	75	33	38	66

Source: Own depiction from survey data.

It can be summed up that cooperation between different agricultural units, especially more strategic and effective cooperation, has in general a negative effect on the probability of being labour rationed.

Another interesting aspect is to scrutinize which agricultural units were paying workers according to performance in order to e.g. boost competition or to motivate workers to work harder and not to shirk.

Table 25: Average fraction of a worker's salary that was performance-based (data available for 2011 only)

Variable	Mean	Min	Max	Std. Dev.	Obs
all indiv farms	50.1	0	100	43.1	245
indiv farms labour rationed 1	17.1	0	100	34.7	66
indiv farms labour rationed 2	54.8	0	100	45.4	130
indiv farms labour rationed 2 but with seasonal labour	71.8	0	100	38.2	89
all agri enterprises	54.2	0	100	37.7	47
agri enterprises labour rationed 1	41.5	0	100	35.5	13
agri enterprises labour rationed 2	59.8	0	100	36.5	20
agri enterprises labour rationed 2 but with seasonal labour	62.9	0	100	38.7	14
all agroholdings	89.8	80	100	9.1	8
agroholdings labour rationed 1					0
agroholdings labour rationed 2	88.8	80	100	9.4	6
agroholdings labour rationed 2 but with seasonal labour	88.8	80	100	9.4	6

Source: Own depiction from survey data.

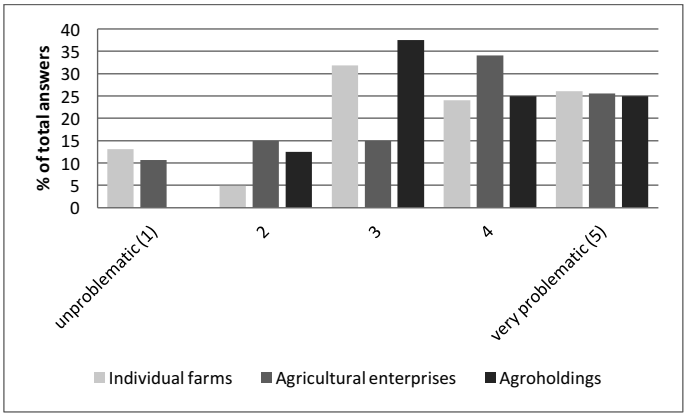
Agroholdings paid in 2011 on average almost ninety percent of a worker's salary based on performance. Individual farms paid on average fifty percent of the wor-

ker's salary according to performance, and agricultural enterprises around fifty-four percent. However, it can be realized that for individual farms and agricultural enterprises the difference regarding the share of performance-based salary payment was not differing significantly between labour rationed individual farms, agricultural enterprises or agroholdings and the ones that were not rationed. Whether or not agricultural units employed seasonal labour or not made the difference. Individual farms that did not employ seasonal labour and had problems finding workers paid on average only seventeen percent of the salary based on performance, while individual farms that reported that they had trouble finding workers for skilled and unskilled tasks, but that employed seasonal workers paid on average around seventy-two percent of the salary according to performance. For agricultural enterprises the difference was not as big, but still the enterprises that did not employ seasonal workers and had trouble finding workers paid on average forty-two percent based on performance, while those enterprises that employed seasonal labour paid on average sixty-three percent of the salary according to performance. Thus, it appears that seasonal workers were rather paid according to performance, whereas permanent workers were paid a smaller share of their salary based on performance. One reason could be that most permanent workers have already been working since some time on the respective agricultural unit, such that the managers know them already and trust them more. It seems that agroholdings pay in general a higher share according to performance and that the climate is more competitive there. Agroholdings employ on average more workers than individual farms or agricultural enterprises. In 2011, the median labour input was 1000 days for individual farms, around 5000 labour days for agricultural enterprises and around 20,000 for agroholdings. According to the theory explained in 3.2 the more workers an agricultural unit employs, the more problems it may have with monitoring and supervising them, because the workers may shirk or free ride. As I further pointed out in 3.2 the labour productivity is commonly believed to be negatively related to the amount of labour employed, because of the more difficult monitoring of workers. Thus, supervision problems can harm the labour productivity of an agricultural unit. But it is not only interesting to analyse whether specific farm types in the survey, especially agroholdings with their numerous workers had more problems supervising workers, but it is also interesting to scrutinize whether or not labour rationed agricultural units had more problems supervising workers.

However, in the survey the managers of agroholdings did not report more problems supervising workers than the managers of other farm types. As already elaborated on previously, it seems that the agroholdings interviewed in the framework of the survey chose performance-based salaries as a way to motivate and somehow control their employees. Probably this measure helped

the agroholdings to reduce supervision problems as well. On the question how difficult it was to supervise workers on a 1 to 5 Likert scale the median for individual farms and agricultural enterprises was 4 (problematic), whereas for agroholdings the median was 3.5. The distribution is presented below in Figure 22. The figure illustrates that most agricultural units regardless of farm types reported certain problems of supervision and only a minority had no problems. The figure below shows that individual farms and agroholdings reported on average slightly fewer problems than agricultural enterprises, but on the contrary there were more agricultural enterprises than individual farms and agroholdings that had no problems regarding supervision of workers. Thus, contrary to the theory, the analysis of the survey data does not support the conclusion that larger farms or specific farm types have generally more problems with supervision of workers. One important factor against supervision problems seems to be to pay at least part of a worker's salary according to performance, especially for seasonal workers.

Figure 22: Difficulty to supervise workers



Source: Own depiction from survey data.

Furthermore, different groups of individual farms, agricultural enterprises and agroholdings such as those that were labour rationed and those that employed seasonal labour with regard to their problems supervising labour were analysed. No significant differences regarding problems of supervision could be found between the different farm types. Within one farm type the assumption that the more labour a farm employed the more problems it had to supervise it held true to some extent. However, there were exceptions. When comparing across farm types, the assumption that larger farms or farms that employed more labour had more problems supervising workers did not hold. In this case study it seemed that individual farms had on average rather more problems supervising workers

than agricultural enterprises, and agroholdings seemed to have the least problems supervising workers. It appears that since agroholdings employed on average more than ten times more workers than individual farms, their monitoring infrastructure was better, they possibly had also more experience and might invest more in supervisors or other measures. Furthermore, they paid on average a higher share of a worker's salary based on performance than individual farms or agricultural enterprises. This might pay off for motivating workers. In the models calculated in section 5.2 the variables performance pay and problems supervising workers were not considered, because they were either not significant or there was too few observations, and 2003 data on these issues was not available. But in general, performance pay should have a rather negative impact on the probability of being labour rationed, because it could give the workers the feeling that if they work hard, they will be rewarded by a higher payment. Thus, an agricultural unit that pays part of the salary according to performance may seem like a good employer. It might however be that if an agricultural unit pays the entire salary according to performance this fact would rather have a positive effect on the probability of being labour rationing, because workers might be afraid that if the business did not go well, they would be paid little or nothing at all. Regarding problems supervising workers it may be that an agricultural unit that has problems with the supervision of workers is rather more likely to be rationed on the labour market. The reason is that if the manager of such an agricultural unit already knows that he has problems monitoring workers and supervising them, he may not employ many new workers even if he actually needs them. In such a case the not employing more employees is not a free choice but due to previous supervision problems.

5.4 Summary of major findings

The results show that all farm types face excess labour demand in 2003 and in 2011, only the strength varies. Thus, agroholdings had by far the highest shadow wages and also the highest discrepancy between shadow wages and real wages. Which means that they were rationed the strongest on the labour market. Moreover, the peripheral location of an agricultural unit made the latter more likely to be rationed on the labour market. Furthermore, according to the results of the Heckman model for 2011 only, it can be noticed that the value of machinery and movable equipment and the value of fixed equipment and buildings affected the probability of being labour rationed positively. To operate more modern and more sophisticated machinery more skills are needed. But skilled workers were particularly scarce in 2011. In general, agroholdings were rather better equipped and in need of more skilled workers. Additionally, these results show that better equipment can reduce the amount of labour needed, but cannot substitute skilled workers. Furthermore, regarding the role of the facilities of an agricultural unit

the results of our models are differing. Thus, in our first model for 2003 and 2011 together, the more valuable the movable equipment and machinery of an agricultural unit were, the less likely the agricultural producer was to be constrained on the labour market. Apparently, well equipped agricultural units were to some point considered promising employers, especially in 2003. At the same time, no agroholdings were considered in 2003. Besides, the more land a farm or agricultural enterprise used in 2003, the higher was the probability of the respective farm or agricultural enterprise to be labour rationed. This result may partly be assigned to the definition of labour rationed in 2003, namely that being labour rationed meant not to employ any seasonal labour. It may be that enterprises hired more permanent labour, whereas individual farms supplemented family members with seasonal labour for peak times. In 2011, individual farms and agricultural enterprises that carried out joint activity with other farms or enterprises were less labour rationed than those that did not carry out any joint activity together with others. These relationships are explained in more detail in section 5.3. Moreover, which fraction of the salary was paid according to performance was rather a question of whether an agricultural producer employed seasonal labour or not. Moreover, contrary to the general belief, the agroholdings in the sample did not report more problems supervising workers than other farm types. Further information can be found in section 5.3. Apart from that, as described in 5.2.3 labour input per farm could be reduced in 2011 compared to 2003. This development hints at an increase in labour productivity that may have been reached due to investments in machinery. Nevertheless, with more sophisticated machinery workers with specific skills are needed. It is not possible to employ unskilled workers. Thus, the wages increased as well in 2011, but at the same time the shadow wages increased. The agricultural units seem to have targeted especially skilled workers of whom they apparently did not find enough in 2011.

6 Discussion

In this chapter the results and findings of my study will be summarized and discussed. Firstly, some theoretical conclusions will be drawn. After that, empirical results will be discussed. Finally, policy recommendations will be given.

6.1 Theoretical conclusions

A perfect labour market cannot be assumed in the Kazakh case. Transaction costs and asymmetric information are present in the labour market. Moreover, the fact that labour is not a homogenous factor plays a crucial role in the Kazakh agriculture, since the skilled workers cannot be easily substituted by unskilled labour. Frequently a mismatch between skills needed and skills offered can be observed. Moreover, skills and knowledge are relatively inflexible and so are many workers in Kazakhstan. Besides, labour, especially skilled labour is scarce. This fact means that labour is a constrained factor. The market imperfections hinder the wage rate from rising, which entails that the market mechanisms of demand and supply do not work anymore. In the presence of a labour constraint the agricultural units are not able to find enough labour in order to satisfy their demand even if they would be willing to offer a higher compensation for one additional unit of labour. In such a case demand and supply are not in equilibrium at the market wage, but excess demand for labour appears as explained in 3.3.

With a labour constraint the situation looks as follows. At first, with rising labour demand, the wage and the amount of labour supplied are rising as well. Then, when the labour constraint comes into play, there is not more labour available even if the labour demand is still rising. From this point on the labour supply curve is vertical. This means that the supply of labour is perfectly inelastic. The agricultural units would be willing to pay more than the equilibrium wage. But no matter how much labour is demanded by agricultural producers and which price they are willing to pay for an additional unit of labour, the supply of labour remains constant.

Furthermore, in order to better explain the constraints and shortages on the labour market in Kazakhstan the shadow wages of labour of the different farm types were calculated. If the shadow price exceeds the actual price paid for an input factor there is a constraint on this input factor. Hence, in such a situation excess demand can be observed. More information can be found in section 5.2.3.

Generally, in the literature about agricultural production under factor constraints the case of a credit constraint is more commonly discussed than the one of a labour constraint, further authors analysing the credit constraint by carrying out a shadow price analysis are e.g. CARTER and WIEBE (1990) and PETRICK (2004). It can be noticed that the topic of labour employment within the framework of agricultural organization has so far not been thoroughly analysed. The issue of rural labour has often been neglected assuming that rural areas are full with potential workers such as e.g. FEDER (1985) assumes. This study is supposed to contribute to filling this gap. Furthermore, it is not always clear whether their abilities match the skills demanded by agricultural enterprises as TOLEUBAYEV et al. (2010) explain. Thus, in my analysis the aspect of matching skills plays a crucial role as well. Furthermore, PETRICK (2013) compares the factor productivity of different farm types in Kazakhstan and concludes that "it is too early to conclude that large corporate farms are superior to individual farms" but he rejects the claim that family farms are generally the better organizational form.

6.2 EMPIRICAL CONCLUSIONS

The questionnaire that managers of agricultural units filled in comprised in 2003 and in 2011 a question about how many workers the farm hired and for how many hours. Managers were asked what labour they used in the last 12 months. Furthermore, they were asked to include those workers that receive wage in cash or kind for work undertaken. It was distinguished between permanent and seasonal labour as well as between members of household, relatives, friends or neighbours, hired labour in production and administrative staff including the farm manager. However, there was no distinction made regarding the skills of the workers. Moreover, it was inquired how many persons the respective agricultural producer employed from each type of labour and for how many hours. Hence, those respondents that did not employ any kind of seasonal labour were considered to employ exogenous labour, thus, to be labour rationed in 2003.

Furthermore, in 2011 a question was added to the questionnaire asking managers of farms, agricultural enterprises and agroholdings to rate the difficulty to hire workers for skilled jobs on a scale from 1 (unproblematic) to 5 (very problematic). After that, respondents were asked to rate the difficulty to hire workers for simple jobs on a Likert scale. Basically, agricultural producers were regarded as labour rationed if they answered that it was difficult or very difficult (4 or 5) to find labour for skilled jobs and for simple jobs. Another scenario was that agricultural units in 2011 were considered labour rationed if they did not hire any seasonal workers and reported problems finding workers. More information can be found in section 5.1.

Besides, the high share of agricultural units that had problems finding workers for skilled tasks was particularly striking. Thus, seventy-five percent of agroholdings, fifty-two percent of individual farms and more than forty percent of agricultural enterprises had problems finding workers for skilled tasks. Further details are presented in section 5.1.

All three variants of the Heckman model and the shadow wage calculation in 5.2 show that all farm types faced excess labour demand in 2003 and 2011. In 2011, agroholdings had by far the highest shadow wages and also the highest discrepancy between shadow wages and real wages, which shows that for this farm type it was particularly difficult to find suitable workers. This means that they had the highest excess demand for labour and the highest willingness to pay for one additional day of labour. Moreover, in 2011 according to both models the shadow wages of agricultural enterprises were on average slightly higher than the ones of individual farms, but the gap between shadow wages and real wages was higher for individual farms, which means that they had a higher excess demand for labour and thus, more problems on the labour market.

If the results for individual farms and agricultural enterprises in 2003 are compared, it can be noticed that in 2003 in both models the shadow wages of agricultural enterprises were higher than those of the individual farms, but the real wages paid by agricultural enterprises were below the ones paid by individual farms. Moreover, the labour scarcity partly even aggravated in 2011 even though the real wages increased and the labour employment could be reduced. It could be that the managers invested in machinery in order to reduce the amount of labour needed. At the same time they increased the wages as a reaction on earlier problems finding labour. However, with more sophisticated machinery they were mostly in need of skilled workers, who they would be willing to pay the shadow wages. Nevertheless, they did not increase the real wages in order to match the shadow wages since they did not want to pay unskilled workers too much and they could not make use of them either for specific tasks. Besides, it would be even dangerous for the agricultural producers to employ unqualified workers as they could destroy machinery. Thus, the former targeted skilled workers in particular. Further details concerning the Heckman models and the shadow wage calculation can be found in section 5.2.

Regarding the reasons for labour rationing, the analysis suggests mainly the following reasons, which were explained in more detail in section 5.2.1 as well:

- In 2011, agricultural units that carried out joint activity with other farms or enterprises were less likely to be labour rationed than those that did not. It makes sense since cooperation can reduce costs and effort for the single agricultural unit. Moreover, networks help agricultural producers

to cooperate more strategically which in turn lowers the probability of being labour rationed.

- Even though not many details are known about every single village, a trend that agricultural units in small and peripheral villages with rather bad infrastructure were more likely to be rationed on the labour market was definitely visible. Moreover, in Akmola oblast labour shortages were more severe than in Almaty oblast as explained in 2.5
- Regarding the value of movable equipment, it can be said that these issues would normally rather attract workers, especially in Kazakhstan. However, in order to operate more sophisticated machinery more skills are needed. Thus, the expensive and sophisticated machinery might in certain cases be a disadvantage because such well-equipped farms need to hire more skilled workers. With strong labour scarcity, it is particularly difficult to find skilled workers. This was the case in 2011.
- For education it cannot be clearly observed that more educated managers had fewer problems or more problems finding workers in Kazakhstan.

Furthermore, some aspects that might explain which agricultural units had problems on the labour market or with their employees after hiring were checked. Regarding these issues more information can be found in section 5.3.

Regarding performance-based salaries, it can be summarized that agroholdings paid in 2011 on average almost the entire worker's salary based on performance, namely around ninety percent. For individual farms and agricultural enterprises the fraction of the salary that was based on performance was much lower. Thus, individual farms and agricultural enterprises paid seasonal workers rather according to performance, whereas permanent workers were paid a smaller fraction of their salary according to performance. It seems that the agroholdings used performance-based salaries also as a way to motivate and somehow control their employees. Thus, contrary to the general belief the agroholdings in my sample did not report more problems supervising workers than other farm types even though they employed on average more workers.

Twenty-five years after the independence of Kazakhstan labour rationing appears to be a highly relevant, but rarely studied issue. It seems that even though the labour input has been reduced, labour scarcity prevails. Especially skilled labour was scarce. Thus, as mentioned in 5.1 seventy-five percent of agroholdings, fifty-two percent of individual farms and forty percent of agricultural enterprises had troubles finding skilled workers. It appears that the gap created amongst others by the exodus of qualified labour after the breakdown of the Soviet Union has not yet been fully closed. Ineffective extension services and trainings (TOLEUBAYEV et al., 2010) do not seem to be the best remedy either. In the

following section some policy recommendations on how to improve the labour situation in Kazakhstan will be given.

6.3 Policy recommendations

As described in 2.1 different agricultural policies have been introduced in order to improve agricultural production. However, some policies were not far-reaching enough or focus on specific types of support. According to Gramzow and Suleimenov (2011) almost one third of the agricultural budget (2006-2010) was spent for the protection of natural resources, followed by expenses for credits and investments (25.8 %) and subsidies (20 %). A very small share of the agricultural budget was spent on research and development (2.5 %). It would be definitely recommendable to increase expenditure research and development. However, such investments in research and development should include education and extension services as well. Extension services and agricultural education should be effective and matching the needs of the farmers and should be accessible for everyone. In that way extension services and education can contribute to narrowing the gap between skills needed and skills available in agriculture. Furthermore, vocational trainings for agricultural workers should be introduced in order to make education more practical. Such investments will bring improvements in agricultural production in the long-term as well. Furthermore, according to Gramzow and Suleimenov (2011) only registered agricultural units but not household farms could get subsidies for livestock production even though the household farms produced the biggest share of livestock. This discrimination of household farms could entail that many household farms in livestock production might not be able to survive, which could lead to a further exodus of rural inhabitants and thus, aggravate the labour scarcity in rural areas. In order to stop emigration and labour scarcity it is important to improve the opportunities in rural areas, especially for young people and families e.g. by building schools, sport clubs etc. Furthermore, only 1.8 percent of the agricultural budget was spent on infrastructure. Nevertheless, it would be further essential to connect the villages e.g. to cities. This would make villages more attractive to live in. In the analysis I found that villages with a peripheral location were more likely to experience labour scarcity. Furthermore, better infrastructure would improve the access to markets. In addition to that, it would be important to introduce some government standards in order to improve working conditions on agricultural enterprises e.g. introduction of minimum wage and leave days such that labour does not move away from agriculture due to better working conditions in other sectors.

References

Agency of Statistics of the Republic of Kazakhstan (ed.): Area under grain crops (including rice) and legumes cultures. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersAgriculture?_afrLoop=22136672669517238#%40%3F_afrLoop%3D22136672669517238%26_adf.ctrl-state%3Dhafargcit_29, last seen: 16.12.2015.

Agency of Statistics of the Republic of Kazakhstan (ed.): Average monthly earnings by economic activity. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersLabor?_afrLoop=22137049493080577#%40%3F_afrLoop%3D22137049493080577%26_adf.ctrl-state%3Dhafargcit_63, last seen: 16.12.2015.

Agency of Statistics of the Republic of Kazakhstan (ed.): Dinamycs [sic] of population. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersPopulation?_afrLoop=22136914843435790#%40%3F_afrLoop%3D22136914843435790%26_adf.ctrl-state%3Dhafargcit_46, last seen: 16.12.2015.

Agency of Statistics of the Republic of Kazakhstan (ed.): Employment by economic activities (quarterly) and regions of the Republic of Kazakhstan 2010-2015. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersLabor?_afrLoop=22137049493080577#%40%3F_afrLoop%3D22137049493080577%26_adf.ctrl-state%3Dhafargcit_63, last seen: 16.12.2015.

Agency of Statistics of the Republic of Kazakhstan (ed.): Employment by economic activities (quarterly) and regions of the Republic of Kazakhstan 2010-2015. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersLabor?_afrLoop=22137049493080577#%40%3F_afrLoop%3D22137049493080577%26_adf.ctrl-state%3Dhafargcit_63, last seen: 16.12.2015.

Agency of Statistics of the Republic of Kazakhstan (ed.): Main indicators of labour remuneration by region for 2003-2011. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersLabor?_afrLoop=22137049493080577#%40%3F_afrLoop%3D22137049493080577%26_adf.ctrl-state%3Dhafargcit_63, last seen: 16.12.2015.

Agency of Statistics of the Republic of Kazakhstan (ed.): Main indicators of the labour market of the Republic of Kazakhstan. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersLabor?_afrLoop=22137049493080577#%40%3F_afrLoop%3D22137049493080577%26_adf.ctrl-state%3Dhafargcit_63, last seen: 16.12.2015.

AGENCY OF STATISTICS OF THE REPUBLIC OF KAZAKHSTAN (ed.): Productivity of grain crops (including rice) and legumes cultures. Available online: http://www.stat.gov.kz/faces/wcnav_externalId/homeNumbersAgriculture?_afrLoop=221366726695172 38#%40%3F_afrLoop%3D22136672669517238%26_adf.ctrl-state%3Dhafargcit_29, last seen: 16.12.2015.

AGENCY ON STATISTICS OF THE REPUBLIC OF KAZAKHSTAN (2012): Statistical Yearbook. Kazakhstan in 2011. Astana.

ALCHIAN, A., DEMSETZ, H. (1972): Production, Information Costs, and Economic Organization. *American Economic Review, 62 (5),* pp. 777-795.

ALLEN, D., LUECK, D. (1998): The Nature of the Farm. *Journal of Law and Economics, 41 (2)*.

ANDERSON, J. R., FEDER, G. (2007): Agricultural Extension. Handbook of Agricultural Economics, vol. 3, pp. 2343-2378.

ANGRIST, J. D., PISCHKE, J.-S. (2009): Mostly Harmless Econometrics. An Empiricist's Companion. Princeton: Princeton University Press.

ASIAN DEVELOPMENT BANK (2011): Central Asia Atlas of Natural Resources. Available online: http://www.adb.org/sites/default/files/pub/2010/central-asia-atlas.pdf, last modification: 01.02.2011, last seen: 12.09.2012.

BARNUM, H. N., SQUIRE, L. (1979): An Econometric Application of the Theory of the Farm Household. *Journal of Development Economics, 6*, pp. 79-102.

BEHRMAN, J. R., RAYLINN, O. (2000): Basic Economic Models and Econometric Tools. in: GROSH, M., GLEWWE, P. (eds.): Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 years of LSMS Experience. Washington D.C.

BENJAMIN, D. (1992): Household Composition, Labor Markets, and Labor Demand: Testing for Separation in Agricultural Household Models, *Econometrica*, *60 (2)*, pp. 287-322.

BHANUMURTY, K. V (2002): Arguing a Case for the Cobb Douglas Production Function. *Review of Commerce Studies*.

BINSWANGER, H., DEININGER, K., FEDER, G. (1995): Chapter 42 Power, distortions, revolt and reform in agricultural land relations. vol. 3: Elsevier (Handbook of Development Economics), pp. 2659-2772.

BINSWANGER, H., ROSENZWEIG, M. (1986): Behavioural and Material Determinants of Production Relations in Agriculture. *The Journal of Development Studies, 22 (3)*, pp. 503-539.

CARTER, M. R., WIEBE, K. D. (1990): Access to Capital and its Impact on Agrarian Structure and Productivity in Kenya. *American Journal of Agricultural Economics, vol. 72 (5)*, pp. 1146-1150.

COELLI, T. J., RAO, D. S. P., O'DONNELL, C. J, BATTESE, G. E. (2005): An Introduction to Efficiency and Productivity Analysis. 2nd ed. New York: Springer.

COLLIER, P. (2008): The Politics of Hunger. How illusion and greed fan the food crisis. *Foreign Affairs, November/December 2008*.

DEININGER, K. (1995): Collective Agricultural Production: A Solution for Transition Economies? *World Development, 23 (8)*, pp. 1317-1334.

DUDWICK, N. , FOCK, K., SEDIK, D. (2007): Land Reform and Farm Restructuring in Transition Countries. Washington: World Bank Publications.

ESWARAN, M., KOTWAL, A. (1986): Access to Capital and Agrarian Production Organisation. *The Economic Journal, 96 (362)*, pp. 482-498.

EVENSON, R., PINGALI, P. (eds.) (2007): Handbook of Agricultural Economics, vol. 3. Agricultural Development: Farmers, Farm Production and Farm Markets. 1st ed. Amsterdam: North-Holland (Elsevier).

EVENSON, R., PINGALI, P. (eds.) (2010): Handbook of Agricultural Economics, vol. 4. Amsterdam: North-Holland (Elsevier).

FEDER, G. (1985): The relation between farm size and farm productivity. The role of family labor, supervision and credit constraints. *Journal of Development Economics, 18 (2-3),* pp. 297-313.

FRISVOLD, G. B. (1994): Does supervision matter? Some hypothesis tests using Indian farm-level data. *Journal of Development Economics, 43,* pp. 217-238.

GRAMZOW, A., SULEIMENOV, A. (2011): Länderinformation Kasachstan. Agrarsektor. Astana: Deutsch-Kasachischer Agrarpolitischer Dialog

GRAY, J. (2000): Kazakhstan. A Review of Farm Restructuring. Washington, D.C: World Bank.

GROSH, M., GLEWWE, P. (eds.) (2000): Designing Household Survey Questionnaires for Developing Countries: Lessons from 15 years of LSMS Experience. World Bank. Washington D.C.

HALLAM, A. (1991): Economies of Size and Scale in Agriculture: An Interpretive Review of Empirical Measurement. *Review of Agricultural Economics, 13 (1)*, pp. 155-172.

HANSRA, B. S. (ed.) (1999): Globalising Indian Agriculture: Policies and Strategies. New Delhi: Classical Publishing Company.

HECKMAN, J. (1974): Shadow Prices, Market Wages, and Labor Supply. *Econometrica, 42 (4).*

HECKMAN, J. (1979): Sample Selection Bias as a Specification Error. *Econometrica, 47,* pp. 153-161.

JOHNSON, S. (2011): Kazakhstan and Ukraine Agriculture and Opportunities for Growth and Development Through Improved Knowledge Systems. National Center for Food and Agricultural Policy. Washington, D.C.

LARUELLE, M. (2008): Kazakhstan, the New Country of Immigration for Central Asian Workers: *Central Asia- Caucasus Analyst 2008*. Available online: http://www.cacianalyst.org/?q=node/4848.

LERMAN, Z., CSAKI, C., FEDER, G. (ed.) (2004): Agriculture in Transition: Land Policies and Evolving Farm Structures in Post-Soviet Countries. Lanham: Lexington Books (Rural economies in transition).

LERMAN, Z., KISLEV, Y., BITON, D., ALON K. (2003): Agricultural Output and Productivity in the Former Soviet Republics. *Economic Development and Cultural Change, 51 (4)*, pp. 999-1018.

LIPTON, M. (2009): Land Reform in Developing Countries: Property Rights and Property Wrongs: Taylor & Francis Group (Priorities for Development Economics Series). New York: Routledge.

PRYOR, F. L. (1992): The Red and the Green: The Rise and Fall of Collectivized Agriculture in Marxist Regimes. Princeton, N.J.: Princeton University Press, pp. 265-296.

MANDLER, A. (2010): Social and Political Context of Agriculture Advisory Services in the Republic Of Tajikistan. in: LABAR, K., PETRICK, M., BUCHENRIEDER, G. (eds.): Challenges of education and innovation. Proceedings of the Fourth Green Week Scientific Conference *Studies on the Agricultural and Food Sector in Central and Eastern Europe Vol. 56*, pp. 23-32.

MUKHERJEE, C., WHITE, H. , WUYTS, M. (1998): Econometrics and Data Analysis for Developing Countries. London: Routledge.

OECD (2013): OECD Review of Agricultural Policies. Kazakhstan 2013. eds: OECD. Paris.

OSHAKBAYEV, D. (2010): Kazakhstan-Country Presentation. Acepas. Saskatchewan, November 2010.

PETRICK, M. (2004): A Microeconometric Analysis of Credit Rationing in the Polish Farm Sector. *European Review of Agricultural Economics, 31 (1)*, pp. 77-101.

PETRICK, M. (2013a): Competition for Land and Labour among Individual Farms and Agricultural Enterprises. Evidence from Kazakhstan's Grain Region, *Discussion paper 141*, Leibniz Institute of Agricultural Development in Central and Eastern Europe.

PETRICK, M. (2013b): Reversing the Rural Race to the Bottom. An Evolutionary Model of Neo-endogenous Rural Development. *European Review of Agricultural Economics (2013b), 40 (4)*, pp. 707-735.

PETRICK, M. (2004): Credit rationing of Polish farm households. A theoretical and empirical-analysis. Halle (Saale): Universitäts- und Landesbibliothek Sachsen-Anhalt.

PETRICK, M., WANDEL, J., KARSTEN, K. (2013): Rediscovering the Virgin Lands: Agricultural Investment and Rural Livelihoods in a Eurasian Frontier Area. *World Development, 43,* pp. 164-179.

PINDYCK, R. S., RUBINFELD, D. L. (2012): Microeconomics. Saddle River: Prentice Hall.

POMFRET, R. (2007): Using Energy Resources to Diversify the Economy: Agricultural Price Distortions in Kazakhstan. CASE-Center for Social and Economic Research (0355).

PRYOR, F. L. (1992): When is Collectivization Reversible? in: PRYOR, F. L. (ed.): The Red and the Green: The Rise and Fall of Collectivized Agriculture in Marxist Regimes: Princeton University Press, pp. 265-295.

QAMAR, K. M., SWANSON, B. E. (2012): Kazakhstan. Global Forum for Rural Advisory Services (GFRAS). Available online: http://www.g-fras.org/en/world-wide-extension-study/97-world-wide-extension-study/asia/central-asia/296-kazakhstan.

RAJALAHTI, R., SWANSON, B. E. (2010): Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems. Washington, D.C (*Agriculture and Rural Development Discussion Paper, 45*).

REARDON, T., BARRETT, C. B., BERDEGUÉ, J. A., SWINNEN, J. F. M. (2009): Agrifood Industry Transformation and Small Farmers in Developing Countries. *World Development, 37 (11),* pp. 1717-1727.

ROUMASSET, J., LEE, S.–H. (2007): Labor. Decisions, Contracts and Organization. in: EVENSON, R., PINGALI, P. (eds.): Handbook of Agricultural Economics. Agricultural Development: Farmers, Farm Production and Farm Markets, vol. 3. Amsterdam: North Holland (Elsevier), pp. 2705-2740.

ROUMASSET, J., UY, M. (1980): Piece Rates, Time Rates, and Teams. *Journal of Economic Behaviour & Organization, 1 (4),* pp. 343-360.

SADOULET, E., JANVRY, A. DE (1995): Quantitative Development Policy Analysis. Baltimore: The John Hopkins University Press.

SHTALTOVNA, A. (2013): Knowledge Gaps and Rural Development in Tajikistan. Agricultural Advisory Services (AAS) as a Panacea? IAMO Forum. Halle (Saale), 23.06.2013.

SINGH, I., SQUIRE, L., STRAUSS, J. (eds.) (1986): Agricultural Household Models: Extensions, Applications, and Policy. Baltimore (John Hopkins University Press).

SKOUFIAS, E. (1994): Using Shadow Wages to Estimate Labor Supply of Agricultural Households. *American Journal of Agricultural Economics, 76,* pp. 215-227.

THE WORLD BANK (ed.): Agricultural value added (% of GDP). Available online: http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS, last seen: 16.12.2015.

THE WORLD BANK (ed.): Development of agricultural value added per worker in constant 2005 $. Available online: http://data.worldbank.org/indicator/EA.PRD.AGRI.KD, last seen: 16.12.2015.

THE WORLD BANK (ed.): Employment in agriculture (% of total employment). Available online: http://data.worldbank.org/indicator/SL.AGR.EMPL.ZS, last seen: 16.12.2015.

THE WORLD BANK (ed.): Rural poverty headcount ratio at national poverty lines (% of rural population). Washington, D.C. Available online: http://data.worldbank.org/indicator/SI.POV.RUHC/countries, last seen: 16.12.2015.

THE WORLD BANK (ed.): Urban poverty headcount ratio at national poverty lines (% of urban population). Washington, D.C. Available online: http://data.worldbank.org/indicator/SI.POV.URHC/countries, last seen: 16.12.2015.

TOLEUBAYEV, K., JANSEN, K., VAN HUIS, A. (2010): Knowledge and Agrarian De-collectivisation in Kazakhstan. *Journal of Peasant Studies, 37 (2)*, pp. 353-377.

TOMICH, T. P., KILBY, P., JOHNSTON, B. F. (1995): Transforming agrarian economies. Opportunities seized, opportunities missed. Ithaca: Cornell University Press.

USAID (2005): Assessment of the Implementation of the Interim Provisions, Land Code in Kazakhstan. Final Report. ed. USAID. Washington, D.C. Available online: http://pdf.usaid.gov/pdf_docs/PNADF080.pdf.

VAN DEN BAN, A. W. (1999): Problems of Agricultural Extension in Developing and Former Communist Countries. in: HANSRA, B. S. (ed.): Globalising Indian Agriculture: Policies and Strategies. New Delhi: Classical Publishing Company.

VISSER, O., SPOOR, M. (2011): Land Grabbing in Post-Soviet Eurasia: The World's largest Agricultural Land Reserves at stake. *Journal of Peasant Studies, 38 (2)*, pp. 299-323.

WANDEL, J. (2009): Agroholdings and Clusters in Kazakhstan's Agro-Food Sector. *Discussion Paper 126,* Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO).

WANDEL, J. (2010): The Cluster-based Development Strategy in Kazakhstan's Agro-Food Sector: A critical assessment from an Austrian perspective. *Discussion Paper 128,* Leibniz Institute of Agricultural Development in Central and Eastern Europe (IAMO).

WOOLDRIDGE, J. M. (2012): Introductory Econometrics. A Modern Approach. Fifth edition. Mason/USA: Thomson South-Western.

APPENDIX

A 1: Number of persons interviewed

	Survey in 2003 (World Bank)	Survey in 2012 (IAMO)
Number of managers interviewed	100	300
Regions	50 each in Almaty and Akmola Oblasts	150 each in Almaty and Akmola Oblasts

Source: Own depiction from survey data.

A.2: STATA code for the Heckman models and the shadow wage calculation

```
*Only Almaty and Akmola will be considered
keep if oblast==1 | oblast==3
*Generation of variables from raw data
replace year=2011 if year==2012
gen almaty = (oblast == 1)
gen akmola = (oblast == 3)
gen karatalsky = (rayon == 1)
gen talgarsky = (rayon == 2)
gen esilsky = (rayon == 3)
gen ermentausky = (rayon == 4)
gen y2003 = 0
replace y2003 = 1 if year==2003
gen edufarming=a3
label variable edufarming "Special education in farm management (0/1)"
replace edufarming=0 if edufarming==2
gen indivfarm=0
label variable indivfarm "Individual farm (0/1)"
replace indivfarm=1 if a4==9
```

```
label define Farmtype 1 "Individual farms" 0 "Other"
label values indivfarm Farmtype
```

***Models will be estimated for commercial agricultural units only**

```
gen hhfarm=0
label variable hhfarm "Household farm (0/1)"
replace hhfarm=1 if a4==10
label define Farmtype0 1 "Households" 0 "Commercial users"
label values hhfarm Farmtype0
keep if hhfarm==0
gen farmtype=0
label variable farmtype "Farm type"
replace farmtype=1 if indivfarm==0
replace farmtype=2 if a6a==1 & oblast==3
label define Farmtype2 2 "Agroholdings" 1 "Ag enterprises" 0 "Individ farms"
label values farmtype Farmtype2
replace farmtype=. if a4==10
gen farmtype1=1
label variable farmtype1 "farm type"
replace farmtype1=0 if a4==9
replace farmtype1=-1 if a4==10
replace farmtype1=2 if a6a==1 & oblast==3
label define Farmtype1 2 "Agroholdings" 1 "Ag enterprises" 0 "Individ farms" -
1 "Households"
label values farmtype1 Farmtype1
gen farmtype2=farmtype1
replace farmtype2=1 if farmtype1==2
label define Farmtype3 1 "Ag enterprises" 0 "Individ farms" -1 "Households"
label values farmtype2 Farmtype3
gen agroholding=0.
replace agroholding=1 if farmtype==2
```

```
label define Agroholding 0 "Einzelbetriebe & Agrarunternehmen" 1 "Agro-
holdings"
label values agroholding Agroholding
gen eduindex=a2
label variable eduindex "Education level (1=low 8=high)"
replace eduindex=1 if a2==8
replace eduindex=2 if a2==7
replace eduindex=3 if a2==6
replace eduindex=4 if a2==5
replace eduindex=5 if a2==4
replace eduindex=6 if a2==3
replace eduindex=7 if a2==2
replace eduindex=8 if a2==1
replace eduindex=1 if k1==12 & hhfarm==1
replace eduindex=2 if k1==11 & hhfarm==1
replace eduindex=3 if k1==10 & hhfarm==1
replace eduindex=4 if k1==9 & hhfarm==1
replace eduindex=5 if (k1==8 | k1==7) & hhfarm==1
replace eduindex=6 if (k1==6 | k1==5) & hhfarm==1
replace eduindex=7 if (k1==4 | k1==3) & hhfarm==1
replace eduindex=8 if (k1==2 | k1==1) & hhfarm==1
gen age = a1
replace age = a2_3_1 if hhfarm == 1
label variable age "Age of farm operator (years)"
replace a12_1=a12_1*100 if num==220
replace a12_3=a12_3*100 if num==220
replace a23_1_1=a23_1_1*100 if num==452
gen land=0
label variable land "Land used (ha)"
replace land=a12_1/100
replace land=b3_1/100 if hhfarm==1
```

```
gen farmsize = land/1000
label variable farmsize "Utilised area (thousand ha)"
```

*** Labour use on the agricultural unit**

```
* Insert zeros for household variables
replace c1_d1_1=0 if c1_m1_1==0 & hhfarm==1
replace c1_d2_1=0 if c1_m2_1==0 & hhfarm==1
replace c1_d1_2=0 if c1_m1_2==0 & hhfarm==1
replace c1_d2_2=0 if c1_m2_2==0 & hhfarm==1
replace c1_d1_3=0 if c1_m1_3==0 & hhfarm==1
replace c1_d2_3=0 if c1_m2_3==0 & hhfarm==1
replace c1_d1_4=0 if c1_m1_4==0 & hhfarm==1
replace c1_d2_4=0 if c1_m2_4==0 & hhfarm==1
replace c1_m1_5=0 if c1_m1_5==.
replace c1_m2_5=0 if c1_m2_5==.
replace c1_d1_5=0 if c1_m1_5==0 & hhfarm==1
replace c1_d2_5=0 if c1_m2_5==0 & hhfarm==1
replace c1_3_1=0 if c1_3_1==.
replace c1_3_2=0 if c1_3_2==.
replace c1_3_3=0 if c1_3_3==.
replace c1_3_4=0 if c1_3_4==.
replace c1_3_5=0 if c1_3_5==.
replace c1_d2_1=c1_d2_1/3 if hhfarm==1 & year==2003
```

***Different types of labour**

```
gen workers_fam_heads_perm = c1_m1_1
gen workers_fam_heads_seas = c1_m2_1
gen workers_fam_days_perm = c1_d1_1
gen workers_fam_days_seas = c1_d2_1
gen workers_fam_paym = c1_3_1
gen workers_rel_heads_perm = c1_m1_2
gen workers_rel_heads_seas = c1_m2_2
```

```
gen workers_rel_days_perm = c1_d1_2
gen workers_rel_days_seas = c1_d2_2
gen workers_rel_paym = c1_3_2
gen workers_neigh_heads_perm = c1_m1_3
gen workers_neigh_heads_seas = c1_m2_3
gen workers_neigh_days_perm = c1_d1_3
gen workers_neigh_days_seas = c1_d2_3
gen workers_neigh_paym = c1_3_3
gen workers_hired_heads_perm = c1_m1_4
gen workers_hired_heads_seas = c1_m2_4
gen workers_hired_days_perm = c1_d1_4
gen workers_hired_days_seas = c1_d2_4
gen workers_hired_paym = c1_3_4
gen workers_admin_heads_perm = c1_m1_5
gen workers_admin_heads_seas = c1_m2_5
gen workers_admin_days_perm = c1_d1_5
gen workers_admin_days_seas = c1_d2_5
gen workers_admin_paym = c1_3_5
gen labour_input_days = (work-
ers_fam_heads_perm*workers_fam_days_perm)+(workers_fam_heads_seas*
work-
ers_fam_days_seas)+(workers_rel_heads_perm*workers_rel_days_perm)+(w
ork-
ers_rel_heads_seas*workers_rel_days_seas)+(workers_neigh_heads_perm*w
ork-
ers_neigh_days_perm)+(workers_neigh_heads_seas*workers_neigh_days_se
as)+(workers_hired_heads_perm*workers_hired_days_perm)+(workers_hire
d_heads_seas*workers_hired_days_seas)+(workers_admin_heads_perm*wor
kers_admin_days_perm)+(workers_admin_heads_seas*workers_admin_days
_seas)
replace labour_input_days = (work-
ers_hired_heads_perm*workers_hired_days_perm) + (work-
ers_hired_heads_seas*workers_hired_days_seas) if year==2003 & hhfarm==0
```

```
replace labour_input_days =
242+(workers_hired_heads_perm*workers_hired_days_perm) + (work-
ers_hired_heads_seas*workers_hired_days_seas) if year==2003 &
farmtype==0

replace labour_input_days = . if labour_input_days==0

replace labour_input_days = labour_input_days/1000

label variable labour_input_days "Total labour input (thousand days)"

replace labour_input_days=. if labour_input_days==438.5

gen labour_fte = labour_input_days/242 * 1000

label variable labour_fte "Total labour input (persons, FTE)"
```

*** Eliminate labour FTE outliers in 2003**

```
gen fte2003 = labour_fte if year==2003

qui sum fte2003, det

scalar define iqr_fte=r(p75)-r(p25)

scalar define ub_fte=r(p75)+1.5*iqr_fte

scalar define lb_fte=r(p25)-1.5*iqr_fte

*replace labour_fte=. if (fte2003>ub_fte) & (year==2003)

*replace labour_input_days=. if labour_fte==.

gen lnlabour_fte= log(labour_fte)

* Labour days of different types of workers

gen labdays_fam = (work-
ers_fam_heads_perm*workers_fam_days_perm)+(workers_fam_heads_seas*
workers_fam_days_seas)

gen labdays_rel = (work-
ers_rel_heads_perm*workers_rel_days_perm)+(workers_rel_heads_seas*wor
kers_rel_days_seas)+(workers_neigh_heads_perm*workers_neigh_days_per
m)+(workers_neigh_heads_seas*workers_neigh_days_seas)

gen labdays_hired_perm = work-
ers_hired_heads_perm*workers_hired_days_perm

gen labdays_hired_seas = work-
ers_hired_heads_seas*workers_hired_days_seas

gen labdays_admin = (work-
ers_admin_heads_perm*workers_admin_days_perm)+(workers_admin_head
s_seas*workers_admin_days_seas)
```

```
gen wage = workers_hired_paym/((workers_hired_days_perm*workers_hired_heads_perm)+(workers_hired_days_seas*workers_hired_heads_seas))
label variable wage "Wage tenge/day"
```

*** Eliminate wage outliers in 2003**

```
gen wage2003 = wage if year==2003
qui sum wage2003, det
scalar define iqr_wage=r(p75)-r(p25)
scalar define ub_wage=r(p75)+1.5*iqr_wage
scalar define lb_wage=r(p25)-1.5*iqr_wage
replace wage=. if (wage2003>ub_wage | wage2003<lb_wage) & (year==2003)
replace wage=. if (wage>1000) & (year==2003) & (farmtype==1)
```

*** Eliminate wage outliers in 2011**

```
gen wage2011 = wage if year==2011
qui sum wage2011, det
scalar define iqr_wage=r(p75)-r(p25)
scalar define ub_wage=r(p75)+1.5*iqr_wage
scalar define lb_wage=r(p25)-1.5*iqr_wage
replace wage=. if (wage2011>ub_wage | wage2011<lb_wage) & (year==2011)
gen wageoutsider = c1_3_2 / ((c1_m1_2*c1_d1_2) + (c1_m2_2*c1_d2_2)) if year==2003
gen wagereal = wage
* Real wage CPI 2011/2003 = 1.99
replace wagereal = wage*1.99 if year == 2003
label variable wagereal "Wage (2011-KZT/day)"
gen wageUSD = wagereal/147
label variable wageUSD "Lohnsatz USD/Tag"
gen revenue=d5_1/1000
label variable revenue "Agricultural revenue (thousand tenge)"
gen revenue_crop=d5_1a/1000
```

```
gen real_mat_input = d6_2/1000000
* Purchase price index of productive & technical produce 2011/2003 = 2.54
replace real_mat_input = d6_2*2.54/1000000 if year==2003
label variable real_mat_input "Real materials input (million 2011-tenge)"
gen real_mat_perha = real_mat_input/land * 1000
label variable real_mat_perha "Real materials input (ths 2011-tenge/ha)"
```

*** Eliminate materials outliers in 2003**

```
gen mat2003 = real_mat_perha if year==2003
qui sum mat2003, det
scalar define iqr_mat=r(p75)-r(p25)
scalar define ub_mat=r(p75)+1.5*iqr_mat
scalar define lb_mat=r(p25)-1.5*iqr_mat
replace real_mat_perha=. if (mat2003>ub_mat | mat2003<lb_mat) &
(year==2003)
replace real_mat_input=. if (mat2003>ub_mat | mat2003<lb_mat) &
(year==2003)
```

*** Depreciation (fixed capital)**

```
gen real_deprec = d6_3/1000000
replace real_deprec = d6_3*2.54/1000000 if year==2003
label variable real_deprec "Real depreciation (million 2011-tenge)"
```

*** Eliminate depreciation outliers in 2003**

```
gen depr2003 = real_deprec if year==2003
qui sum depr2003, det
scalar define iqr_depr=r(p75)-r(p25)
scalar define ub_depr=r(p75)+1.5*iqr_depr
scalar define lb_depr=r(p25)-1.5*iqr_depr
replace real_depr=. if (depr2003>ub_depr | depr2003<lb_depr) &
(year==2003)
* Land used
gen grainarea=b6_1_1/100
label variable grainarea "Grain area (ha)"
```

```
* Productivity measures & factor ratios
gen revperha=revenue/land
label variable revperha "Revenue (1000 tenge/ha)"
gen labperha=labour_fte/land*100
label variable labperha "Labour use (FTE/100 ha)"
qui sum grainarea if oblast==3 & hhfarm==0 & year==2011
scalar define tot_area=r(sum)
scalar list tot_area
* Grain price index 2011/2003 = 157
gen realrevperha=revperha
replace realrevperha=revperha*1.57 if year==2003
label variable realrevperha "Revenue (1000 2011-tenge/ha)"
gen realrevenue=revenue/1000
replace realrevenue=revenue*1.57/1000 if year==2003
label variable realrevenue "Real revenue (million 2011-tenge)"
* Eliminate real revenue outliers of individual farms
gen revoutl = realrevenue
qui sum revoutl, det
scalar define iqr_rev=r(p75)-r(p25)
scalar define ub_rev=r(p75)+1.5*iqr_rev
scalar define lb_rev=r(p25)-1.5*iqr_rev
replace realrevenue=. if (revoutl>ub_rev) & (farmtype==0)
replace a26_1 = 1 if a26_1 == 2
replace a26_1 = 1 if a26_1 == 13
replace a26_1 = 1 if a26_1 == 14
replace a26_1 = 1 if a26_1 == 16
replace a26_1 = 1 if a26_1 == 17
replace a26_1 = 5 if a26_1 == 4
replace a26_1 = 5 if a26_1 == 6
replace a26_1 = 5 if a26_1 == 11
```

```
replace a26_1 = 5 if a26_1 == 12
replace a26_1 = 5 if a26_1 == 15
replace a26_1 = 8 if a26_1 == 7
replace a26_1 = 9 if a26_1 == 18
replace year=2011 if year==2012
```

*** Production function estimation**

```
keep if hhfarm==0
gen lnoutput = log(realrevenue)
gen lnland = log(farmsize)
gen lnlabour = log(labour_input_days)
gen lnmat = log(real_mat_input)
gen lndeprec = log(real_deprec)
replace lndeprec=log(0.001) if real_deprec==0
replace lnmat=log(0.001) if real_mat_input==0
gen lnedu = log(eduindex)
```

*** Oblast data**

```
label define Oblastlab 1 "Akmola" 2 "Almaty"
label values oblast Oblastlab
label define Branchlab 1 "Crops" 2 "Livestock"
replace farms=farms/1000
```

***Preparing data for the estimation of the Heckman model**

```
rename C15_4 c15_4
rename C15_5 c15_5
label define e1_1_1n 1 "unproblematic" 5 "very problematic"
recode e1_1_16 (1=5) (5=1) (2=4) (4=2)
tab e1_1_16
label values e1_1_16 e1_1_1n
tab e1_1_16
label define c21_n 1 "Totally disagree" 2 "I agree" 3 "I partly agree" 4 "I disa-
gree" 5 "Totally disagree"
recode c21_6 (1=5) (5=1) (2=4) (4=2)
```

```
label values c21_6 c21_n
generate fixed_equip=c5_1
generate move_equip=c5_2
gen lnmove_equip= log(move_equip)
replace lnmove_equip=log(0.001) if move_equip==0
gen lnfixed_equip= log(fixed_equip)
replace lnfixed_equip= log(0.001) if fixed_equip==0
rename e1_1_14 diff_worksk
recode diff_worksk (1=5) (5=1) (2=4) (4=2)
rename e1_1_15 diff_worksi
recode diff_worksi (1=5) (5=1) (2=4) (4=2)
label values diff_worksk e1_1_1n
label values diff_worksi e1_1_1n
gen labour_fte_exogenous= labour_fte if work-
ers_hired_heads_seas==0&year==2003| workers_hired_heads_seas==0&
diff_worksi>1& year==2011| workers_hired_heads_seas==0& year==2011&
diff_worksk>1
gen lnlabour_fte_exogenous= log(labour_fte_exogenous)
gen rayon3=0
replace rayon3=1 if rayon==2
gen rayon4=0
replace rayon4=1 if rayon==1
gen rayon1 = 0
replace rayon1 = 1 if rayon==3
gen rayon2 = 0
replace rayon2 = 1 if rayon==4
replace fixed_equip= fixed_equip/1000000
label variable fixed_equip "buildings (value in million tenge)"
label define rayon1 0 "0" 1 "Esilsky"
label define rayon2 0 "0" 1 "Ermentausky"
label define rayon3 0 "0" 1 "Talgarsky"
```

```
label define rayon4 0 "0" 1 "Karatalsky"
sort oblast
by oblast: tab rayon
label define OBL 1 "almaty oblast" 2 "pavlodar oblast" 3 "akmola oblast" 4
"west-kazakhstan oblast", replace
label values oblast OBL
```

***Wage**

```
gen lnworkers_hired_paym= log(workers_hired_paym)
replace lnworkers_hired_paym=log(0.001)if workers_hired_paym==0
gen wage_with_outl= work-
ers_hired_paym/((workers_hired_days_perm*workers_hired_heads_perm)+(
workers_hired_days_seas*workers_hired_heads_seas))
tab wage_with_outl
replace wage_with_outl=0.1 if wage_with_outl==0
gen lnwage_with_outl= log(wage_with_outl)
replace wageUSD=0.1 if wageUSD==0
gen lnwageUSD= log(wageUSD)
tab a3a, generate (dum)
tab dum1
tab dum2
rename dum2 spec_empl
drop dum1
tab dum3
drop dum3
tab dum4
drop dum4
tab dum5
drop dum5
tab dum6
drop dum6
tab dum7
```

```
drop dum7
tab dum8
drop dum8
tab dum9
drop dum9
tab dum10
drop dum10
tab dum11
drop dum11
tab dum12
drop dum12
tab dum13
drop dum13
tab dum14
drop dum14
generate farm_manag= a3
tab farm_manag
label define dummy 1 "yes" 0 "no"
recode farm_manag (2=0)
tab farm_manag
label values farm_manag dummy
replace labour_fte = labour_input_days/242 * 1000
label variable labour_fte "Total labour input (persons, FTE)"
gen labour_fte_exo_prob= labour_fte if diff_worksk>3&diff_worksk!=.|
diff_worksi>3&diff_worksi!=.
gen lnlabour_fte_exo_prob= log(labour_fte_exo_prob)
gen dum_labour_fte_exo= 0
replace dum_labour_fte_exo=1 if labour_fte_exogenous!=.
gen lnoutput_exo= lnoutput if dum_labour_fte_exo==1
gen dum_joint_act=0
replace dum_joint_act=1 if a30==1
```

```
tab dum_joint_act
label values dum_joint_act dummy
*second and broader definition of exogenous labor; possible for 2011 only
gen labour_fte_exo_prob= labour_fte if diff_worksk>3&diff_worksk!=.|
diff_worksi>3&diff_worksi!=.
gen lnlabour_fte_exo_prob= log(labour_fte_exo_prob)
gen dum_labour_fte_exo2= 0
replace dum_labour_fte_exo2=1 if labour_fte_exo_prob!=.
replace dum_labour_fte_exo2=1 if labour_fte_exo_prob!=.& year==2011
gen lnoutput_exo2= lnoutput if dum_labour_fte_exo2==1
tab e1_1_16
recode e1_1_16 (1=5) (5=1) (2=4) (4=2)
gen salary_perf= c18
tab salary_perf
gen lnsalary_perf= log(salary_perf)
replace lnsalary_perf= log(0.001) if salary_perf==0
gen diff_super=0
replace diff_super= e1_1_16
gen labour_fte_exo3= labour_fte if work-
ers_hired_heads_seas==0&year==2003| workers_hired_heads_seas==0&
diff_worksi>3& year==2011| workers_hired_heads_seas==0& year==2011&
diff_worksk>3
gen lnoutput_exo3= lnoutput if labour_fte_exo3!=.
replace move_equip= move_equip/1000000
label variable move_equip "value of machinery and equipment (in Million
tenge)"
gen labour_fte_exo4=labour_fte_exo3 if year==2003
tab labour_fte_exo4
gen lnoutput_exo4= lnoutput if labour_fte_exo4!=.
```

***Preparing village dummies and including village dummies as control variables**

```
tab village, generate (dum)

recode village (83=102) (84=103) (85=104) (86=105) (87=106) if rayon==3

recode village (88=107) (89=108) (90=109) if rayon==4

sort rayon

by rayon: tab village

label define village 2 "Karabulak" 3 "Malagorovka" 4 "Bakhtybay" 5 "Terekty-Malinovka" 6 "Kaz-zhazyk" 7 "Karatalsk" 8 "Abay village" 9 "Chumyr" 10 "Panfilovo" 11 "Tonkeres" 12 "Besagash" 13 "Kyzyl-Kairat" 14 "Zhalkamys" 26 "Aksay" 27 "Karakol" 28 "Zarechnoye" 29 "Svobodnoye" 30 "Buzuluk" 31 "Turgay" 32 "Sofiyevka" 33 "Novomarkova" 34 "Prirechnoye" 35 "Pavlovka" 47 "Kunshagal" 48 "Blagodatnoe (Olzhabai batyr)" 49 "Rzhyschevo (Balykty)" 50 "Orlovka" 51 "Krasivoe" 52 "Iglik" 53 "Yaroslavka" 54 "Kolochi" 55 "Krasnogorskiy" 56 "Leninskoe" 57 "Kuigeldy" 58 "Saraoba" 59 "Koitas" 60 "Tasoba" 61 "Ulenty" 62 "Azhe" 63 "Moltabar" 64 "Beloyarka" 65 "Novodolinka" 66 "Aksuat" 67 "Nikolaevka" 68 "Pavlovka" 69 "Yeiskoe" 70 "Dvurechnoe" 71 "Sochinskoe" 72 "Novorybinsk" 73 "Lozovoe" 74 "Konstantinovka" 75 "Mikhailovka" 76 "Azat" 77 "Aksuat" 78 "Makinsk" 79 "Belbulak" 80 "Kegen" 81 "Taldybulak" 82 "Tuzdybastau" 83 "Ak Dala" 84 "Taganbai" 85 "Oskemir" 86 "Elaman" 87 "Guldala" 88 "Nura" 89 "Alatau" 90 "Tunkurus" 91 "Tenlik" 92 "Baisova" 93 "Rakhat" 94 "Birlik" 95 "Ryskulova" 96 "Talgar" 97 "Almenek" 98 "Moskovskoe" 99 "Appalanvka" 100 "Zvenigorodskoe" 101 "Yubileinoe" 102 "Ak Dala" 103 "Taganbai" 104 "Oskemir" 105 "Elaman" 106 "Guldala" 107 "Nura" 108 "Alatau" 109 "Tunkurus", replace

tab village

drop dum60

drop dum61

drop dum62

drop dum63

drop dum64

drop dum65

drop dum66

drop dum67

gen dum_karat=1 if dum3==1|dum5==1
```

```
tab dum_karat

drop dum_karat

gen dum_karat=0

replace dum_karat=1 if dum3==1|dum5==1

tab dum_karat

gen dum_talgar=0

replace dum_talgar=1 if dum13==1| dum57==1| dum58==1| village==83|
village==86| village==87| village==88| village==89| village==90| dum70==1|
dum71==1| dum72==1| dum74==1

tab dum_talgar

gen dum_esil=0

replace dum_esil=1 if
dum16==1|dum17==1|dum31==1|dum32==1|dum46==1|
dum47==1|dum75==1|dum78==1|village==105

tab dum_esil

tab rayon if dum43==1

gen dum_ermen=0

replace dum_ermen=1 if
dum24==1|dum25==1|dum26==1|dum39==1|dum43==1|dum45==1|dum5
4==1|dum76==1

tab dum_ermen

gen dum_rest=0

replace dum_rest=1 if ray-
on==5|rayon==6|rayon==7|rayon==8|rayon==9|rayon==.

tab dum_rest

tab dum50

gen dum79=0

replace dum79=1 if village==84

gen dum80=0

replace dum80=1 if village==85

gen dum81=0

replace dum81=1 if village==102
```

```
gen dum82=0
replace dum82=1 if village==103
gen dum83=0
replace dum83=1 if village==104
gen dum84=0
replace dum84=1 if village==106
gen dum85=0
replace dum85=1 if village==107
gen dum86=0
replace dum86=1 if village==108
gen dum87=0
replace dum87=1 if village==109
```

*** Heckman models for 2003 and 2011 together, for 2011 only and for 2003 only**

```
heckman lnoutput_exo3 lnland lnlabour_fte lnmat lndeprec lnedu rayon1
rayon2 rayon3 y2003 if oblast==1| oblast==3, select(lnland lnmat lnedu
y2003 dum_joint_act lnfixed_equip lnmove_equip dum_karat dum_talgar
dum_esil dum_ermen dum2 dum4 dum6 dum7 dum9 dum12 dum14 dum15
dum18 dum8 dum22 dum23 dum27 dum29 dum33 dum38 dum40 dum68
dum69 dum81 dum83 dum84) twostep
vce, corr
estat vce
heckman lnoutput_exo2 lnland lnlabour_fte lnmat lndeprec lnedu rayon1
rayon2 rayon3 if year==2011& oblast==1| oblast==3, select(lnland lnmat
lnedu dum_joint_act lnfixed_equip lnmove_equip dum_talgar dum_esil
dum_ermen dum_rest dum2 dum6 dum7 dum9 dum11 dum12 dum8 dum22
dum23 dum27 dum28 dum29 dum30 dum33 dum38 dum40 dum42 dum56
dum68 dum69 dum77 dum79 dum80 dum81 dum82 dum84 dum85 dum86)
twostep
estat vce
vce, corr
heckman lnoutput_exo4 lnland lnlabour_fte lnmat lndeprec lnedu rayon1
rayon2 rayon3 if oblast==1| oblast==3, select(lnland lnmat lnedu
```

```
dum_joint_act lnfixed_equip lnmove_equip dum4 dum5 dum6 dum12
dum14 dum15 dum18) twostep

estat vce

vce, corr
```

***Shadow wages for 2003 and 2011 together**

```
heckman lnoutput_exo3 lnland lnlabour_fte lnmat lndeprec lnedu rayon1
rayon2 rayon3 y2003 if oblast==1| oblast==3, select(lnland lnmat lnedu
y2003 dum_joint_act lnfixed_equip lnmove_equip dum_karat dum_talgar
dum_esil dum_ermen dum2 dum4 dum6 dum7 dum9 dum12 dum14 dum15
dum18 dum8 dum22 dum23 dum27 dum29 dum33 dum38 dum40 dum68
dum69 dum81 dum83 dum84) twostep

gen labelast_3= _b[lnlabour_fte]

gen sample=0

replace sample=1 if e(sample)

gen r_labour_3=(labelast_3*(realrevenue/labour_input_days))*1000 if sam-
ple==1

label var r_labour_3 "Shadow wage (tenge/day)"

*outlier control

gen rate_3 = r_labour_3

qui sum rate_3, det

scalar define iqr_rate_3=r(p75)-r(p25)

scalar define ub_rate_3=r(p75)+1.5*iqr_rate_3

scalar define lb_rate_3=r(p25)-1.5*iqr_rate_3

replace r_labour_3=. if (rate_3>ub_rate_3 | rate_3<lb_rate_3)
```

***Shadow price for only 2011 labour rationed**

```
keep if year==2011

heckman lnoutput_exo2 lnland lnlabour_fte lnmat lndeprec lnedu rayon1
rayon2 rayon3 if year==2011& oblast==1| oblast==3, select(lnland lnmat
lnedu dum_joint_act lnfixed_equip lnmove_equip dum_talgar dum_esil
dum_ermen dum_rest dum2 dum6 dum7 dum9 dum11 dum12 dum8 dum22
dum23 dum27 dum28 dum29 dum30 dum33 dum38 dum40 dum42 dum56
dum68 dum69 dum77 dum79 dum80 dum81 dum82 dum84 dum85 dum86)
twostep

drop sample
```

```
gen sample=0
replace sample=1 if e(sample)
gen labelast_2= _b[lnlabour_fte]
gen r_labour_2=(labelast_2*(realrevenue/labour_input_days))*1000 if sample==1
tab r_labour_2
gen rate_2 = r_labour_2
qui sum rate_2, det
scalar define iqr_rate_2=r(p75)-r(p25)
scalar define ub_rate_2=r(p75)+1.5*iqr_rate_2
scalar define lb_rate_2=r(p25)-1.5*iqr_rate_2
replace r_labour_2=. if (rate_2>ub_rate_2 | rate_2<lb_rate_2)
```

***Shadow wages for only 2003 labour rationed**

```
keep if year==2003
heckman lnoutput_exo4 lnland lnlabour_fte lnmat lndeprec lnedu rayon1 rayon2 rayon3 if oblast==1| oblast==3, select(lnland lnmat lnedu dum_joint_act lnfixed_equip lnmove_equip dum4 dum5 dum6 dum12 dum14 dum15 dum18) twostep
drop sample
gen sample=0
replace sample=1 if e(sample)
gen labelast_4= _b[lnlabour_fte]
gen r_labour_4=(labelast_4*(realrevenue/labour_input_days))*1000 if sample==1
tab r_labour_4
gen rate_4 = r_labour_4
qui sum rate_4, det
scalar define iqr_rate_4=r(p75)-r(p25)
scalar define ub_rate_4=r(p75)+1.5*iqr_rate_4
scalar define lb_rate_4=r(p25)-1.5*iqr_rate_4
replace r_labour_4=. if (rate_4>ub_rate_4 | rate_4<lb_rate_4)
```

```
sum r_labour_4 if sample==1, det
sum wagereal if sample==1, det
```

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