

When a Market Prefers to Be Informal: The Case of Kazakhstani Medicinal Plants

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1 Introduction

A third of the Kazakhstani economy is a shadow economy¹, which is comparable to countries in the lowest quartile of GDP per capita. The majority of households in former Soviet countries rely on both formal and informal labor participation in order to secure a living, and formal employment is not always accompanied by a decline in informal work, resulting in no change in the overall balance of formal and informal labor participation (Williams et al. 2013). According to Rutkowski (2014), close to 70 percent of all informal workers in Kazakhstan live in rural areas, and 62 percent work in agriculture. He further states that agricultural and rural informality is to a large extent "natural," reflecting the predominantly traditional character of the agricultural sector, and therefore can hardly be formalized in Kazakhstan. However, it might be the case that outside subsistence farming, which accounts for the majority of informal employment in agriculture, there are quasi-agricultural sectors of the economy, such as the herbal medicinal plant industry, that can and should be formalized.

There is no consensus on the definition of the informal economy. In my research I use the definition of the informal economy formulated by Enste & Schneider (2000), according to which an informal economy is "all economic activities that contribute to the officially calculated (or observed) gross national product but are currently unregistered." The informal economy is also known as the 'undeclared', 'grey', 'underground', 'hidden', and 'shadow' economy. Throughout this paper I use Hussmanns's² definition of employment in the informal economy as "all jobs in informal sector enterprises or all persons who, during a given reference period, were employed in at least one informal sector enterprise, irrespective of their status in employment and whether it was their main or a secondary job".

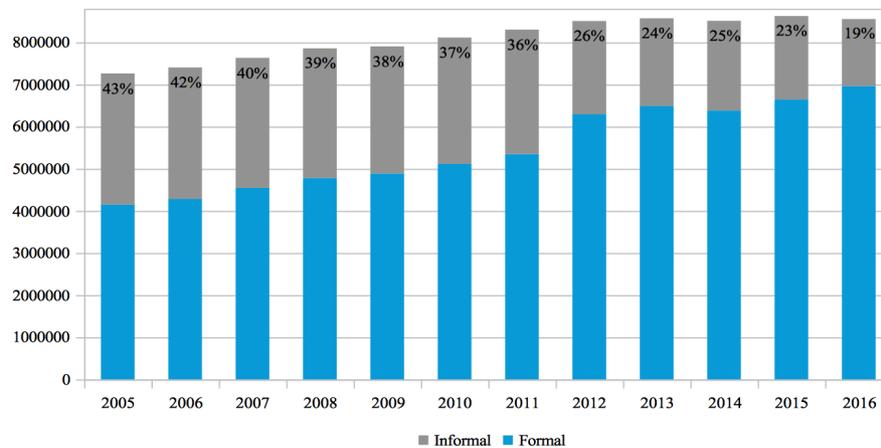
The decision to work in the formal or informal economy inevitably depends on the size of the shadow economy in the country. The size of the informal economy as a percentage of GDP in

¹According to Schneider (2016) the average size of the shadow economy in Kazakhstan between 1999 to 2015 was 35.8 percent.

²Hussmanns (2004)

Kazakhstan declined from 42.6 percent in 1999 to 33.8 percent in 2015 (Schneider 2016), which is still large for a middle-income country. However, the data from the Ministry of National Economy of the Republic of Kazakhstan, Committee of Statistics shows that the size of the unobserved economy has fallen from 28.3 percent in 2013 to 25.84 percent in 2016. A decrease in the size of the informal sector contributes to an improvement in living conditions and disposable incomes in developing economies and allows countries to fully benefit from integration into the world economy (Bacchetta et al. 2009). As for informal employment, it has declined from 43 percent in 2005 to 19 percent in 2016 (Committee of Statistics, Republic of Kazakhstan). In 2015, the share of informal employment in the states of Zhambyl and Almaty was 37 and 26 percent respectively. In 2016, the share of informal employment in the states of Zhambyl and Almaty was 33 and 16 percent respectively. It is not known what caused such a sharp decline in informal employment in Almaty state.³ Both states have vast resources of medicinal plants and high levels of informal employment. In fact, the second highest level of informal employment in Kazakhstan is in Zhambyl state.

Figure 1: Formal and informal employment in Kazakhstan



Source: Author's calculations based on data from Committee on Statistics, Republic of Kazakhstan

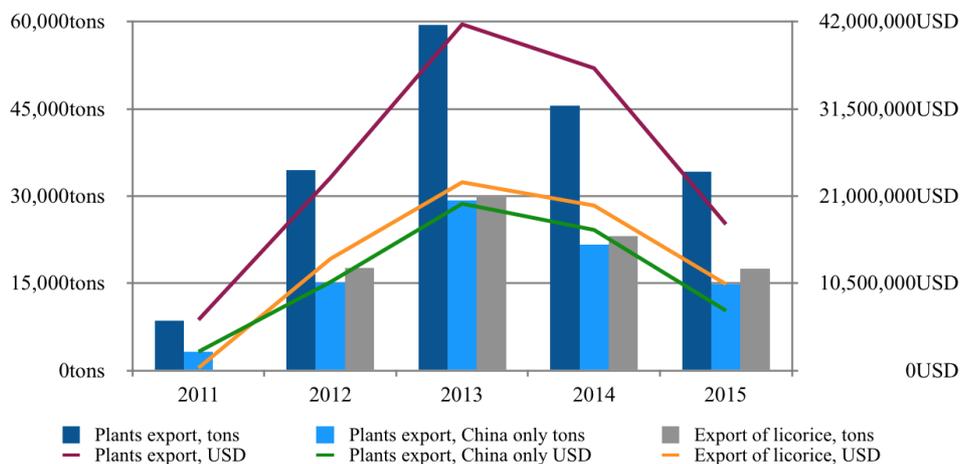
The percentages correspond to informal employment in Kazakhstan.

Kazakhstan is rich not only in natural resources but in vast flora and fauna. Kazakhstani flora consists of 6,000 species of vascular plants (Abdullina 1999), of which more than 1,500 species are characterized by medicinal properties (Grudzinskaja & Gemejiyeva 2012), and 175 are included

³Source: Committee of Statistics, Republic of Kazakhstan

in the Pharmacopeia of Kazakhstan. Medicinal herbal plants are used in the food, cosmetics, and pharmaceutical industries. In the Soviet era the herbal medicinal plant industry was part of the formal economy that fulfilled demand within the country, and the rest was exported abroad. The diversity of the herbal plant industry in Kazakhstan has been neglected ever since the collapse of the USSR. Currently the two main Kazakhstani pharmaceutical companies, Zerde and Kyzylmai, use primarily imported medicinal plants in their production, while the only legally registered company that collects and cultivates medicinal plants on an industrial scale, Aziagold, exports 600 tons of raw material abroad.⁴ However, UN ComTrade statistics on the export of herbal plants from Kazakhstan indicate a different story. The average trade value of plants and parts of plants used primarily in perfumes and pharmaceuticals was 25 million USD between 2011 and 2015, including an average of 11.4 million USD in exports to China. As for the export of licorice, the mean trade value amounted to 13.3 million USD between 2011 and 2015. The main export destination is China, the recipient of more than half of all exports of raw plants.

Figure 2: Exports from Kazakhstan of plants and parts of plants used primarily in perfumes and pharmaceuticals



Source: UN ComTrade

The objective of my research is to enhance understanding of the decision-making process in choosing between informal and formal sectors of employment. My research covers Moynkym village, an administrative centre of the Moynkum district, Zhambyl state and Bakanas village,

⁴According to an *Expert Kazakhstan* magazine article, Nikolaeva (2014).

district centre of Balkhash district, Almaty state. Due to climate and geographical location, locals are primarily engaged in the collection of two plants, *Cistanche deserticola* (CD) and licorice. The main motivation for studying precisely these plants is traditional Chinese medicine (TCM), where out of 50 fundamental plants, the first two places belong to ginseng and licorice (Popovich et al. 2011). Ginseng is a prototype of *Cistanche deserticola*. CD, known as desert ginseng, has been used in traditional Chinese, Korean, and Japanese medicine for the last 2,000 years. My current research aims to determine the underlying socioeconomic factors influencing the decision to be employed in the formal and/or informal sectors of the economy in rural areas of southern Kazakhstan. Following Heckman (1979), I use a bivariate probit model to avoid the self-selection problem of individuals entering the labor market.

The paper proceeds as follows. Sections 2 and 3 provide an understanding of the importance of the medicinal plant industry and a literature review. Section 4 discusses the data and methodology. Section 5 presents my empirical results, and Section 6 is the conclusion.

2 Why Medicinal Plants?

The global export of medicinal plant materials was estimated at USD 33 billion in 2014 (Vasisht et al. 2016). The main factor in wild harvesting is the availability of cheap labor to undertake the very labor-intensive work of gathering (Planning Commission 2000). The valuable plants in Kazakhstan are primarily gathered from the wilderness; their collection and sale provides a complementary source of cash for many extremely poor rural households. However, despite the fact that the plants collected can have a very high value in the final products, the collectors typically receive only a small share of the final value, because they are either unaware of the real value, unable to market the plants in the form wanted by buyers, or unable to market the plants to those buyers.

Medicinal plants are important for pharmacological research and drug development, not only when plant constituents are used directly as therapeutic agents, but also as starting materials for the synthesis of drugs or as models for pharmacologically active compounds. Almost 25 percent of all modern medicines are derived from herbal plants, many of which were first used in traditional medicine (WHO 2013). Herbal medicinal plants provide basic raw materials for medicines,

perfumes, flavorings, and cosmetics. These plants and their products serve as a valuable source of income for small entrepreneurs and another source of income for the country in the form of taxes and exports. Kazakhstan's imports of pharmaceutical products from all Eurasian Economic Union countries exceed exports by 65 times (Kulbayeva 2016). In Kazakhstan substances or starting materials for drug synthesis are still exported. Hence, the country has an underdeveloped pharmaceutical industry and a largely non-existing medicinal plant industry.

On the other hand, China, famous for its traditional Chinese medicine (TCM), has made substantial progress in making its medicinal herbal plant industry part of its formal trade and worldwide brand. The production of Chinese *materia medica* was estimated to amount to 83.1 billion USD in 2012 (WHO 2013). Most importantly, out of 50 fundamental plants in TCM, the first two places belong to ginseng and licorice. Ginseng is a prototype of *Cistanche deserticola*. *Cistanche deserticola* is known as desert ginseng. Desert ginseng is undervalued and less popular due to its limited supply. Although the mechanism of compound action is different in ginseng and desert ginseng, the stimulating effect of desert ginseng is five times stronger than traditional ginseng (Sarsenbayev et al. 2014). According to the Pharmacopeia of China, *Herba Cistanche* refers only to the species *Cistanche deserticola*. However, other *Cistanche* species (*salsa*, *tubulosa*, etc.) are also traded as *Herba Cistanche*. *Cistanche deserticola* is protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II, which was signed by Kazakhstan in 2000.⁵

Modern studies have demonstrated that CD possesses broad medicinal functions, especially for use in hormone regulation, for its aperient, immunomodulatory, neuroprotective, antioxidant, anti-apoptotic, antinociceptive, anti-inflammatory, and anti-fatigue effects, and for the promotion of bone formation (Li et al. 2016). Licorice is used in the tobacco, food, pharmaceutical, and cosmetic industries and as a remedy for bronchitis, peptic ulcers, eczema, dyspepsia, upper respiratory infections, and weight loss (IFPRI 2014). The export of cistanche from Kazakhstan is ongoing, and according to the Committee on Forestry of the Ministry of Agriculture, licenses were issued for the export of 390 tons of dried cistanche stems from Kazakhstan in 2015, 240.7 tons in 2014, and 375.9 tons in 2013. The UN ComTrade export data cannot be easily extracted, since the international export code HS1992-1211908500 that is used to export cistanche from Kazakhstan is

⁵ <https://www.cites.org/eng/cms/index.php/component/cp/country/KZ>

a general category that covers plants and plant parts, pharmaceuticals, perfumes, and insecticides. On the other hand, the export datum for licorice is known and was equal to 17,515 tons or 10.4 million USD.

Due to constant demand, China imports medicinal herbal plants from Kazakhstan and Uzbekistan (IFPRI 2014, Ma et al. 2017). Annual demand for cistanche in 1995 was estimated at 550 tons, and in 2002 it had increased to 3,500 tons, all due to improved standards of living in China and the accompanying increase in demand for tonics (Mulliken & Crofton 2008). The annual demand for licorice in China is approximately 300,000 tons for both domestic consumption and the export market (IFPRI 2014). Collectors in China obtain a maximum of 20 percent of the value, while middlemen receive 30-40 percent, and manufacturers and dealers on the other end of the trade chain another 40 percent (Mulliken & Crofton 2008).

Cistanche deserticola and licorice grow in the Moynkym and Karakym deserts and on the Mangyslak peninsula (Stefanova et al. 2011, Grudzinskaja & Gemejiyeva 2012, Sarsenbayev et al. 2014, Ishmuratova et al. 2016, Hayashi, Hattori, Inoue, Sarsenbaev, Ito & Honda 2003, Hayashi, Zhang, Nakaizumi, Shimura, Yamaguchi, Inoue, Sarsenbaev, Ito & Honda 2003). Harvesting season of *cistanche deserticola* is only two week, between end of April and beginning of May. Wild roots of licorice require 4 years to gather required weight. Harvesting season of licorice is in September or October, however unlike *cistanche deserticola* not all licorice can be gathered on yearly basis. This project specifically looks at Mounkym village in Zhambyl state and Bakanas village in Almaty state. The process of collection is similar to that in China, where collectors are ordinary villagers who rely heavily on income received from plant collection and sales to middlemen. Collectors are self-employed micro-entrepreneurs who do not pay taxes and therefore can be considered part of the informal economy. Collectors do not obtain any permits or licenses, although some middlemen do obtain permits. Harvesting is considered as passing or seasonal income in a village. Locals can act alone or unite in teams of up to 5-10 people. The labour is hard and underpaid, therefore most local collectors do it not on a regular basis. However, should a collector work hard during the season, he can earn above average yearly income. Individual collector have to incur transportation expense, therefore they unite in teams to decrease the expenses for truck hiring. Collectors are usually either locals or hired workers brought in by middlemen from Shymkent or Kyzylorda states or from Uzbekistan.

According to the middlemen in Moynkum, an intermediary brought 40 workers from Uzbekistan who collected 1,000 tons of cistanche for him. Even by the most conservative estimates, the Uzbek worker on average should have earned around 7,500 USD per worker in one season. This is an astonishing amount of money not only for Uzbekistan, but also for rural Kazakhstan. Another example is a middleman from Bakanas who paid his 700 collectors a total of 110,000 USD for cistanche in 2016. In 2016, 1 kg of raw CD plant was bought by middlemen for 200-300 tenge or on average 0.75 USD, and the export tax rate was 10 tenge per kilogram. After the raw plant is bought from collectors, middlemen dry the stems. The raw to dry ratio is 1 to 8. Hence local middlemen pay approximately 6 USD per 1 kg of dried CD stems to collectors and resell it for 8-10 USD. In 2016, middlemen received permits to collect up to 389 tons of dried CD stems, which is 3,112 tons of raw plants. Hence, middlemen had to pay at least 778 million tenge or 4.2 million USD to collectors. As for Chinese entrepreneurs, I do not know the total cost for them. Assuming that Chinese businessmen receive cistanche from Kazakhstan at a maximum cost of 50 USD per kilogram or 19.5 million USD, to be sold later on the Amazon or Alibaba websites for 30-46 USD per 100 grams of *Cistanche deserticola* extract powder, which is just ground, dried stems, then the profit from 390 tons of cistanche (export licenses in 2015) amounts to roughly 97.5 million USD.

The fact that the medicinal herbal plant industry is part of the informal economy also causes environmental damage. According to [Grudzinskaja & Gemejiyeva \(2012\)](#), the available inventory of raw cistanche in the Bakanas state forest, a territory of 3333.4 hectares, totals 840.0 tons, with a possible annual harvest of 168 tons. According to unofficial data, 100-150 tons of fresh raw materials were collected in 2012 in the Akzhar area alone, which implies a high depletion rate of the plant. Cistanche harvesting negatively affects the environment; it causes depletion of the plant at a high rate, soil erosion, land desertification, and damage to the forests of *Haloxylon ammodendron* and *Haloxylon persicum*, commonly known as saxaul (Gemejiyeva 2015). In Kazakhstan, forests cover 4.6 percent (or 12.3 million hectares) of the territory, and saxaul forest accounts for almost half of the forest area. According to Gemejiyeva (2015), collectors leave "traces" in the form of deep hollow pits, which need to be backfilled in order to prevent the roots of host plants such as *Haloxylon bunge*, *Calligonum l.*, and *Tamarix l.* from drying out. There is a similar problem with licorice overharvesting, which causes not only depletion of wild licorice reserves, but also environmental degradation. Implementation of strict environmental regulations is vital, but the presence

of a large informal economy represents a substantial obstacle (Baksi & Bose 2010).

In Kazakhstan, the primary purpose of harvesting medicinal plants is to export them to China and other countries. In contrast, in South Africa, 52 percent of harvested plants are utilized for cultural and medicinal purposes inside the country. In developing countries, it is common for local collectors to earn their "livelihood around the (formally illegal) wild harvest and informal trade of locally growing plants, animals and other natural materials" (Petersen 2014, Mulliken & Crofton 2008). Increased regulatory pressures may force entities to transfer their activities to the informal economy (Baksi & Bose 2010, Chaudhuri & Mukhopadhyay. 2006), which without any regulations negatively affects the environment.

3 Literature Review

Quasi-simultaneously, the concept of "informality" and/or "informal income opportunities" was born in 1971 with the works of Hart (1973) and Hans Singer and Richard Jolly as main editors of the ILO (1972) report. Hart (1973) indicated that countries with high inflation, inadequate wages, and an increasing surplus to the requirements of the urban labor market have a high degree of informality. ILO (1972) concluded that the informal sector creates employment and reduces poverty, making it vital for developing countries.

There are two main hypotheses regarding informal employment. First, there are traditional dual-labor-market theories (Lewis 1959) where informal employment is viewed as a last resort, something workers take on to escape unemployment once they are rationed out of the formal sector (Harris & Todaro 1970, Fields 1990, Stiglitz 1976). All individuals would like to work in the formal labor market with "good" well-paying jobs and fringe benefits, but there are entry barriers that force individuals to seek "bad" jobs in the informal sector. Although there are no entry barriers to informal employment, individuals are paid much less than identical workers in the formal sector. Due to practically non-existent unemployment benefits in developing countries, individuals who are seeking jobs in the formal sector survive by working in the informal sector (Harris & Todaro 1970, Loayza 1997, Lehmann & Pignatti 2008).

Second, the comparative-advantage hypothesis states that informal employment is a voluntary choice by workers based on income or utility maximization (Dickens & Lang 1985, Heckman &

Hotz 1986, Pratap & Quintin 2006). Informal-sector employment is voluntary and has desirable non-wage characteristics of the informal sector, where individuals maximize their utility rather than their earnings (Maloney 2004). Also, inefficiencies in the provision of public services, such as healthcare and pensions, could be a major reason for informal-sector employment, especially in developing countries (Maloney 1999). In less-developed countries, healthcare might be of low quality, and "government might be perceived as a potential 'raider' of pension funds in a future budgetary crisis,"⁶ thereby raising doubts about the preferability of formal-sector jobs . Since fringe benefits generate costs for the employer, which may be shifted to the employee, it is not clear that wages are lower in the informal sector (Lehmann & Pignatti 2008). As long as individuals are free to move between the informal and formal labor markets, the two sectors and their wage equations do not constitute a segmented labor market (Dickens & Lang 1985). However, a wage penalty for informal-sector employment may be due to sorting, where workers with lower levels of human capital do not fulfil the requirements for performance in the formal sector (Tokman 1982). This type of sorting may result from the fact that firms in the informal sector replace physical capital with low-skilled labor (Amaral & Quintin 2006).

Informal employment is related to insufficient information about profitable business opportunities, failure to acquire formal skills, and limited or absent insurance against adverse events (Bacchetta et al. 2009). Also, informality increases inequality and creates an obstacle for the emergence of dynamic comparative advantage in moving up the value chain and creating a diversified base for exports in a country. In the world of globalization, some form of the informal economy becomes more of a by-product of the formal sector and manifests "as a new form of work emerging in late capitalism as a direct by product of the advent and deregulated open world economy" (Williams & Round 2008). Although there are benefits to the informal economy, there are also costs, such as a lack of legal protection relative to formal businesses, an inability to develop and grow in an international market, and constraints on access to capital and securing the support available to formal businesses (Williams & Windebank 2005).

These conflicting views of informality can be reconciled by taking into account the heterogeneity of the informal sector or the upper and lower tiers of informal enterprises (Maloney 2004, Cunningham & Maloney 2001). Individuals excluded from the formal labor market are part of the

⁶Lehmann & Pignatti (2008).

lower tier, while upper-tier workers expect to earn more in the informal sector and hence enter it voluntarily (Fields 2005). Gunther & Launov (2012) studied voluntary and involuntary informal employment and found support for the hypothesis of a dual structure in the informal sector. By ignoring employment decisions, the labor-market segmentation test in developing economies can be misspecified (Dickens & Lang 1985, Cunningham & Maloney 2001, Gunther & Launov 2012), since the informal sector consists of both individuals who would like to switch to a formal job and individuals who currently have no incentive to do so. The objective of my research is to enhance understanding of the decision-making process in choosing between informal and formal sectors of employment. However, unlike Gunther & Launov (2012), I do not use data on earnings from formal and informal employment, but instead base my analysis only on individual and household characteristics.

Previous research on Kazakhstan related to informal employment is limited. Mussurov & Arabsheibani (2015) studied the reduction in informality levels in Kazakhstan over the period 2006-2011, by 12 percent among self-employed men and 16 percent among self-employed women, and found that informality propensities are affected by age, place of residence, occupation, and human capital. According to an OECD report, informal work represents low-paid, low-quality jobs in Kazakhstan. In 2014, 8.1 percent of the employed population was in informal, unproductive self-employment with income below minimum living standards (OECD 2016). Specifically for Kazakhstan, the main causes of informality are the high cost of doing business in the formal sector, high barriers of entry for new firms, high levels of corruption, which can be considered a form of investment tax (Mauro 1995), and distrust in government and government spending (Rutkowski 2014).

4 Data and Methodology

My current research aims to determine the underlying individual and household characteristics influencing the decision to be employed in the formal and/or informal sectors of the economy in rural areas of southern Kazakhstan. Following Heckman (1979), I use a bivariate probit to avoid the self-selection problem of individuals entering the labor market. Labor participation is a common selection problem in the literature. By controlling for selection, the labor participation decision is

divided into waged employment and an alternative of not entering the labor market or being self-employed or informally employed. Individuals in informal employment could be self-selected, because they could be more motivated or less risk-averse than the formally employed. Earnings datum is available for only two-thirds of the sample, so I use only individual and household factors in exploring informal employment. Following [Greene \(2012\)](#), the general specification for the bivariate probit two-equation model where the two dependent binary variables are participation in informal (y_1) and formal (y_2) employment is

$$\begin{cases} y_1^* = x_1' \beta_1 + \epsilon_1, y_1 = 1 \text{ if } y_1^* > 0, 0 \text{ otherwise} \\ y_2^* = x_2' \beta_2 + \epsilon_2, y_2 = 1 \text{ if } y_2^* > 0, 0 \text{ otherwise} \end{cases} \quad (1)$$

where x_1 and x_2 are identical and are vectors of the collector's specific characteristics, including collector's age, family size, total number of family members officially employed, number of children, whether respondent has an unsecured bank loan, a categorical variable for level of education (middle school, high school, or university), and dummy variables to control for the village (equal to one if the village is Moynkum) and gender.

$$E[\epsilon_1 | x_1, x_2] = E[\epsilon_2 | x_1, x_2] = 0 \quad (2)$$

$$Var[\epsilon_1 | x_1, x_2] = Var[\epsilon_2 | x_1, x_2] = 1 \quad (3)$$

$$Cov[\epsilon_1, \epsilon_2 | x_1, x_2] = \rho \quad (4)$$

The bivariate normal cumulative distribution function is

$$\text{Prob}(X1 < x1, X2 < x2) = \int_{-\infty}^{x_2} \int_{-\infty}^{x_1} \phi_2(z_1, z_2, \rho) dz_1 dz_2 \quad (5)$$

denoted as $\Phi_2(x_1, x_2, \rho)$. The density is

$$\phi_2(x_1, x_2, \rho) = \frac{e^{1/2(x_1^2 + x_2^2 - 2\rho x_1 x_2)/(1-\rho^2)}}{2\pi(1-\rho^2)} \quad (6)$$

In order to construct log-likelihood, let $q_{i1} = 2y_{i1} - 1$ and $q_{i2} = 2y_{i2} - 1$. Hence,

$$q_{ij} = \begin{cases} 1, & \text{if } y_{ij} = 1 \\ 0, & \text{if } y_{ij} = -1, \text{ for } j = 1 \text{ and } 2 \end{cases} \quad (7)$$

Let

$$z_{ij} = x'_{ij}\beta_j \text{ and } w_{ij} = q_{ij}z_{ij}, j = 1, 2 \quad (8)$$

$$\rho_{i^*} = q_{i1}q_{i2}\rho \quad (9)$$

$$\text{Prob}(Y_1 = y_{i1}, Y_2 = y_{i2}|x_1, x_2) = \Phi_2(w_{i1}, w_{i2}, \rho_{i^*}) \quad (10)$$

The log-likelihood for the bivariate probit model is

$$\log L = \sum_{i=1}^n \ln \Phi_2(w_{i1}, w_{i2}, \rho_{i^*}) \quad (11)$$

The Lagrange multiplier for testing the null hypothesis that ρ equals zero, i.e. the model consists of independent probit equations and can be estimated separately, in a bivariate probit model is

$$LM = \frac{\sum_{i=1}^n q_{i1}q_{i2} \left[\frac{\phi(\omega_{i1})\phi(\omega_{i2})}{\Phi(\omega_{i1})\Phi(\omega_{i2})} \right]^2}{\sum_{i=1}^n \frac{[\phi(\omega_{i1})\phi(\omega_{i2})]^2}{\Phi(\omega_{i1})\Phi(-\omega_{i1})\Phi(\omega_{i2})\Phi(-\omega_{i2})}} \quad (12)$$

The unconditional probabilities for three types of observations are:

$$y_2 = 0 : \text{Prob}(y_2 = 0|x_1, x_2) = 1 - \Phi(x'_2\beta_2), \quad (13)$$

$$y_1 = 0, y_2 = 1 : \text{Prob}(y_1 = 0, y_2 = 1|x_1, x_2) = \Phi_2[-x'_1\beta_1, x'_2\beta_2, -\rho], \quad (14)$$

$$y_1 = 1, y_2 = 1 : \text{Prob}(y_1 = 1, y_2 = 1|x_1, x_2) = \Phi_2[x'_1\beta_1, x'_2\beta_2, \rho] \quad (15)$$

For this project I have collected survey datum from two regions in Kazakhstan, Moynkym village in Zhambyl state and Bakanas village in Almaty state. Collectors in both villages participate in herbal plant harvesting. Random selection method is used in the sample. The collectors were selected randomly according to their addresses. The interviews with collectors were conducted in

Russian or Kazakh. The survey questionnaire included both quantitative and qualitative questions, and the data was gathered through face-to-face interviews with each household representative. Although the data is inherently noisy, being based on collectors' perceptions and subject to measurement errors, the survey is standardized and has a uniform sampling methodology, which makes it comparable across regions. In the rural area practically all households have subsistence farming, which is not considered as informal employment in this research paper. The question on interest is if the household representative is gathering herbal plants for further sale, which I classify as informal employment. Respondents involved in informal employment constitute 56.7 percent of the sample, and respondents involved in formal employment constitute 65.9 percent; 29 percent of the respondents work both formally and informally. In the survey 59 percent of participants are male; the average age is 39 years. The average education level in the survey is 12 years or a high school diploma. The average household in the survey has 4 family members and 2 children. I have asked if the any member of the household has a bank loan, and more than a half of the households have unsecured debt. From the conversation with the respondent, I came to the conclusion that villagers accumulate debt throughout the year and anticipate to completely or partially repay unsecured bank loans from the collection of medicinal plants during harvesting season. Questions on household income were asked, but only two-thirds of the respondents answered these questions. The total population of the two villages is 11,000 people. According to Ministry of Agriculture data, in Almaty and Zhambyl states 6 counties are engaged in cistanche plant harvesting, with a total population of 389,866 people or 2,756 households.⁷ A total of 184 households were interviewed.

⁷Source: Committee on Statistics, Republic of Kazakhstan.

Table 1: Summary Statistics

Variables	Mean	Standard deviation
Informal	0.568	0.497
Formal	0.659	0.475
Village	0.484	0.501
Male	0.59	0.493
Age	39.798	11.972
Age squared	1726.447	976.796
Middle school	0.420	0.495
High School	0.25	0.434
University degree	0.33	0.471
Family size	4.872	1.678
Total members employed	1.898	0.984
Number of children	2.283	1.387
Bank loan	0.558	0.498
Observations	184	

5 Empirical Results

Similar to [Gunther & Launov \(2012\)](#), I consider variables such as family size, number of active members in the household or total number of people in the household working in the formal sector of the economy, and number of children in order to estimate household-specific reasons to participate in the labor market. One of the main benefits of formal employment is access to financing ([Maloney 2004](#)), for which my proxy is the unsecured bank loan variable. Age and level of education have been found to be important characteristics for informal employment participation ([Mussurov & Arabsheibani 2015](#)). Tables 2 and 3 provide results of bivariate probit estimates on the determinants of formal and/or informal employment. Maximum likelihood estimators are included for both models, as well as the likelihood ratio test for the correlation estimator ρ . We have failed to reject the null hypothesis that $\rho = 0$, which means that the univariate probit models for informal and formal employment can separately generate consistent estimates.

Table 2: Bivariate Probit Regression Results

	Informal	Formal
Village	-0.142 (0.261)	0.471 (0.287)
Male	1.647*** (0.290)	-0.533* (0.321)
Age	-0.009 (0.054)	0.229*** (0.063)
Age squared	0.000 (0.001)	-0.003*** (0.001)
Middle school	0.923*** (0.316)	-0.780** (0.309)
University degree	-0.206 (0.297)	1.146*** (0.358)
Family size	0.255** (0.110)	0.044 (0.071)
Total members employed	0.043 (0.126)	0.335** (0.156)
Number of children	-0.371*** (0.126)	0.147 (0.107)
Bank loan	0.283 (0.249)	0.393 (0.248)
Constant	-1.754 (1.236)	-4.974*** (1.424)
athrho	-0.205 (0.169)	
N	184	

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The reference category for education is high school graduate

Male respondents with a middle-school education and without children are more likely to be informally employed. Formal employment participants are more likely to have university degrees, have more people in the household who are formally employed, have children, and have bank loans. The marginal effect results are in Table 3, with P00 indicating the probability of an individual being unemployed formally (y_2) and informally (y_1). Similarly, P01 is an indication of ($y_1 = 0$) and ($y_2 = 1$), meaning that the respondent is employed in the formal sector only. P11 is an indication of ($y_1 = 1$) and ($y_2 = 1$), meaning that the respondent is employed in both sectors. An individual who is engaged in the informal sector of the economy only is 24.3 percent more likely to be male

and 23 percent more likely to have a middle-school education. *Ceteris paribus*, one additional child in the household decreases the likelihood of working informally by 6 percent. On average, a respondent engaged in the formal sector of the economy only is 55.5 percent more likely to be female and has an 18.1-percent probability of having a university degree. On average, holding all other variables constant, one additional child in the household increases the likelihood of formal employment by 12.8 percent. Individuals who decide to work both formally and informally are 39.1 percent more likely to be male and 16.5 percent more likely to be credit-constrained.

Having a university degree makes it less likely that an individual is engaged in informal work; the probability of being unemployed in both sectors and having a university degree is 10.1 percent lower, and the probability of a university graduate working only formally is 13.8 percent higher. The age determinant of employment is vital, and my results indicate that young respondents are either unemployed or employed formally, while older men are 4.4 percent more likely, on average, to be employed both formally and informally. This may be due to larger family size and the number of active members in the household. This result supports the finding by [Williams et al. \(2013\)](#) that households rely on both formal and informal labor participation in order to secure a living and gives characteristics of those households. Overall, the results accord with dual-labor-market theories, where more educated, married men with children have a greater probability of formal employment.

Table 3: Marginal Effect

	P00	P01	P10	P11
Village	-0.037 (0.033)	0.092 (0.090)	-0.107* (0.064)	0.053 (0.090)
Male	-0.080* (0.046)	-0.555*** (0.105)	0.243*** (0.075)	0.391*** (0.096)
Age	-0.023** (0.009)	0.027 (0.018)	-0.047*** (0.014)	0.044** (0.022)
Age squared	0.000** (0.000)	-0.000* (0.000)	0.001*** (0.000)	-0.000* (0.000)
Middle school	0.005 (0.041)	-0.361*** (0.101)	0.234*** (0.075)	0.122 (0.112)
University degree	-0.102** (0.048)	0.181* (0.101)	-0.249*** (0.076)	0.170 (0.112)
Family size	-0.025** (0.013)	-0.073** (0.035)	0.012 (0.018)	0.086** (0.035)
Total members employed	-0.038** (0.019)	0.022 (0.043)	-0.064* (0.034)	0.081* (0.047)
Number of children	0.015 (0.016)	0.128*** (0.039)	-0.060** (0.024)	-0.083* (0.043)
Bank loan	-0.064* (0.035)	-0.045 (0.081)	-0.056 (0.056)	0.165* (0.089)
N	184	184	184	184

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusion

This study made an attempt to estimate empirically the informal and/or formal employment decision-making process and to explore whether the process is interrelated or independent in the rural area of Kazakhstan. I have analyzed two villages in Southern Kazakhstan where people as an alternative source of income harvest the herbal medicinal plants *Cistanche deserticola* and licorice. Tending livestock and subsistence farming are complementary to herbal plants collection, however in my research I consider informal employment related to harvesting. The purpose is to explore if the collection of herbal plants actually takes place in Kazakhstan and what are the characteristics of households engaged in harvesting. Villagers receive money per kg of the plant they have collected, no employment contracts nor insurance is provided. Both plants grow in abundance in Kazakhstan,

but the benefits of these plants are not fully capitalized. The herbal medicinal plant industry was part of formal employment in the Soviet era. However, the diversity of the herbal plant industry in Kazakhstan has been neglected ever since the collapse of the USSR. The plants provide basic raw materials for medicines, perfumes, flavorings, and cosmetics. Although practically informal, the industry still generates millions of dollars in annual sales volume.⁸ The average trade value of desert ginseng was 25 million USD between 2011 and 2015, out of which 11.4 million USD on average was exported to China. As for the export of licorice, the average trade value amounted to 13.3 million USD annually between 2011 and 2015. The main export destination is China, where more than half of all exports of raw plants are sent. Middlemen earn approximately 1.5 million USD in profits annually and pay another 4.2 million USD to collectors. When the raw herbal medicinal plants cross the border, they become 10 times more valuable.

I investigated desert ginseng and licorice because they have been used in traditional Chinese medicine for the last 2,000 years and both of them are included in the Pharmacopoeia of Kazakhstan, along with 173 other plants. The research covers Moynkym village in Zhambyl state and Bakanas village in Almaty state. In 2015, the share of informal employment in Zhambyl and Almaty was 33 and 16 percent respectively. Unemployment was 5 percent in Almaty and 5.1 percent in Zhambyl. Both states have vast resources of medicinal plants and high levels of informal employment. In fact, the second-highest level of informal employment in Kazakhstan is in Zhambyl state. Large regional differences in informality and the linkages between informality and skill levels can be related to differences in regional abilities to generate economic growth ([Bacchetta et al. 2009](#)).

The results show that the decision to work in the formal and/or informal sectors of the economy is independent, i.e. I failed to reject the null hypothesis that $\rho = 0$. An individual engaged in informal employment is more likely to be a young male with a low educational level. Education plays a vital role in attaining formal employment, so the education system has to go through structural reform to bridge the gap between market needs and the training offered in Kazakhstan ([Sondergaard et al. 2012](#)). Family size affects the decision to work informally. A larger family size and more children make it more likely that an individual will participate in informal employment. Interestingly, the results indicate that older men with credit constraints participate in both

⁸According to UN ComTrade data.

informal and formal employment. The results accord with dual-labor-market theories, where more educated, married men with children have greater chances of finding employment in the formal sector of the economy. My conclusion also supports the finding by [Williams et al. \(2013\)](#) that households in the Commonwealth of Independent States (CIS) rely on both formal and informal labor participation in order to secure a living and the finding by [Mussurov & Arabsheibani \(2015\)](#) that age and educational level affect the decision to work formally and informally in Kazakhstan.

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