ECONOMIC RESEARCH INSTITUTE

"Mining Impact on Local Livelihood: A Case of Mongolia"

Draft Report

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ULAANBAATAR, 2018

“Mining Impact on Local Livelihood: A Case of Mongolia”

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Abstract

This study looked into the impact of the mining sector on the livelihoods of rural Mongolians using 2010-2016 mining sector data and micro-data from the Household Socio-Economic Survey conducted by the National Statistics Office. The study found that while mining activity had a short term positive effect on income, consumption and poverty reduction, it also had an adverse effect on employment and health indicators in rural communities. Additionally, as the demand generated by mining activity in rural communities is weak, there were no significant effects on the price of rural products and services, rural household businesses and agriculture income.

Key words: economic development, mining, natural resources, regional economic activity, rural analysis

JEL classification: O13, O18, Q32, Q33, R11

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*- Many thanks to Gansuld, professor at IFE, and Munkh-Ireedui, researcher at ERI, for their expertise and recommendations on the methodology utilized in this study. Special thanks to Unurjargal, researcher at ERI, for her help in processing the collected data.

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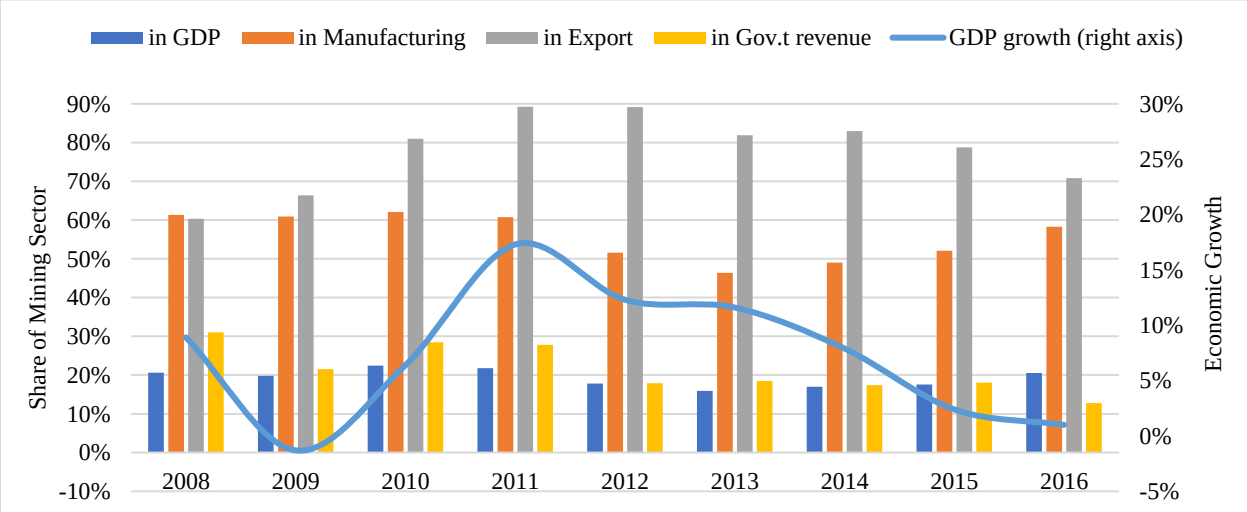
Introduction

In developing countries, the rapid growth of the mining sector has a positive impact on the overall economy in the short run, but is likely to lead to economic slowdown in the long run. This reliance on one sector – the mining sector – leads to economic weaknesses; in other words, the emergence of the "resource curse." Similar negative effects are observed at both the national and regional levels. In recent years, Mongolia's economy has been heavily dependent on its booming mining sector, making it vulnerable to fluctuations. In light of this, we aim to explore the following pertinent questions: Has the mining sector had a positive or negative impact on the livelihoods of rural households, and how strong was this impact?

The Mongolian economy continues to be strongly dependent on the mining sector. Currently, the mining sector accounts for over 20% of total GDP, a figure that has doubled in the last ten years (World Bank, 2017). This substantial increase is related to the sharp surge in global mineral resource prices in the mid-2000s. The price increase significantly changed the position of the mining sector in Mongolia, with its share of GDP growing from 9% in 2001 to 21% in 2008. Likewise, the mining sector's share of export revenue increased from 29% in 2001 to 60% in 2008. Since then, the prominent position of the mining sector in the economy has solidified even further (Figure 1). Additionally, during this period, the mining sector played an important role in providing employment, accounting for about 5% of the total labor force.

Figure 1. Mining sector economic contribution breakdown, 2008-2016

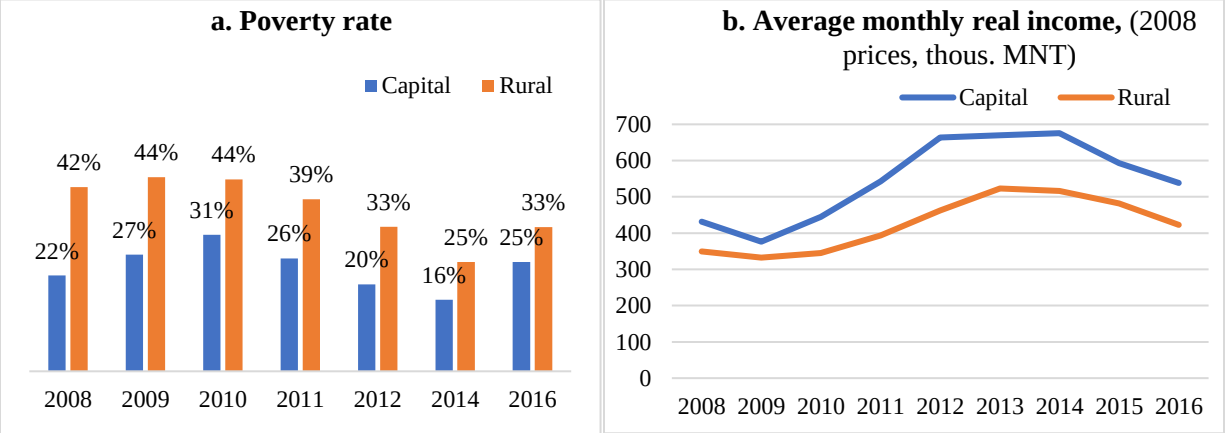


Source: National Statistics Office and Bank of Mongolia

Despite the immense growth in the mining sector, it is unclear how this affects the overall standard of living of the Mongolian population. What is the relationship between the recent developments in mining sector and household livelihood, particularly in rural areas? While average household income grew rapidly during this period with the poverty rate decreasing significantly within the last decade, the improvements in household livelihood was different for urban and rural areas. While the poverty rate steadily decreased in both areas, the bulk of the alleviation occurred in rural areas, reducing the poverty difference between urban and rural areas (Figure 2a).

Real household income in urban areas grew greatly at the beginning of the period but later slowed down while minimal fluctuations in real household income were observed in rural areas (Figure 2b).

Figure 2 . Poverty and Income, 2008-2016



Source: National Statistics Office

Empirical evidence is vital for policy makers in resource-rich countries in order to understand the effects of the mining sector, how it influences poverty reduction, and in what ways governments and mining companies can improve the livelihoods of local communities. As such, this study aims to explore these issues in detail and provide specific answers.

In order to accomplish this, the study will be divided into 4 main sections. Chapter 1 will consist of a review of available empirical studies on the impact of mining on household livelihood. Chapter 2 will explain in detail the research methodology employed as well as the data used. The research findings, the impact of the mining sector on rural households' income, consumption, prices, and other household socio-economic indicators will be presented in Chapter 3. Finally, the last section will consist of the study conclusion, as well as its implications, recommendations and further research suggestions.

1. Literature Review

The impact of mining on the economy and living standards has been studied intensively since the 1980s. Most studies focused on calculating the overall impact on a national level using cross-country datasets.

1.1. Economic impact of the mining sector: national level

The studies that look into the economic impact of the mining sector in mineral resource rich countries are usually done on a national scale using comprehensive and long-term data. These studies can be broadly divided into three main groups based on their proposed theories.

In the first group, Sachs and Warner (1995) put forth the theory that mineral resource rich countries suffered from a phenomenon dubbed "Dutch disease." According to their model, a spike in the export revenue of

the mining sector, either due to a boost in production or prices jumps, leads to an overall increase in demand with the relative price of non-tradable goods increasing compared to the price of tradable goods. As a result, resources such as capital and labor move to the non-tradable manufacturing sector where prices increased while output in the tradable manufacturing sector decrease. Additionally, real exchange rate appreciation leads to a drop in exports while imports rise. As technological innovation is driven mainly by the tradable manufacturing sector, a prolonged decrease in output can have a negative effect on the long-run economic growth. However, in another study, Sala-i-Martin and Subramanian (2003) found that an abundance of natural resource need not have a negative effect on economic growth depending on the quality of the institutions in the country.

Secondly, Rosser (2004) argued that the economies of resource rich countries are susceptible to commodity price volatility, leading to more risk. When the global commodity market is unstable, the flow of foreign currency in resource rich countries become unreliable, increasing the risks associated with private investment. This leads to a decline in overall investments and slower economic growth. Additionally, the volatility in commodity prices makes it difficult to implement stable economic policies (Manzano & Rigobon, 2001). As the budget revenue from mining exports rise, governments increase their expenditure and have an incentive to borrow more using future revenue from mineral resources as collateral. However, when commodity prices are low, governments are faced with huge debts and have difficulties repaying their loans.

Third, some economists theorize that the political factors or quality of governance in a country is the primary reason behind the resource curse. Institutions are the essential link needed to transform natural resources into economic development, but rent seeking and corruption are also triggered by an abundance of resources. This situation, in turn, hinders the strengthening of democratic ideals as well as the development of good institutional practices (Murshed, 2004; Ross, 2001; Leite & Weidmann, 1999). Moreover, resource rich countries are likely to have more conflicts among social groups, further undermining economic development (Collier, 2001).

1.2. Economic impact of the mining sector: local level

Academic studies on the local level economic impact of mining development have been gaining traction in recent years. Currently, there are several well detailed reviews of studies available (Aragon, Chuhan-Pole, & Land, 2014; Cust & Vaile, Is There Evidence for a Subnational Resource Curse?, 2016; Gamu, Billon, & Spiegel, 2015).

Local studies differ from the research studies mentioned in the previous section in that they focus on issues at the provincial and district level rather than at the national level. However, conceptually, the impacts of mineral resource usage at the local level are comparable to the impacts observed at the national level.

For instance, if a mine opens and commences operations in a province, the local community will have to accommodate the new sector. As a result, the community's labor and capital, which was previously employed by the agricultural, manufacturing and other sectors will start to shift their resources to the mining sector. The circumstances of this situation may cause Dutch disease, which has the same impact on the local level as it does at the national level (Aragon, Chuhan-Pole, & Land, The Local Economic Impacts of

Resource Abundance: Theory and Evidence, 2014). In line with this, in a US research study comparing states across the country, resource rich states were found to have a relatively lower level of income compared to other states (Papyrakis & Gerlagh, 2007; James & Aadland, 2011).

At the local level, the demand for goods and production inputs may increase as the mining sector becomes active. In particular, the mining industry could increase local employment and nominal income levels, attracting a larger labor force, intensifying migration and increasing the demand for housing and land in the affected areas. In turn, the labor supply will increase, causing real salary to decrease as migration intensifies according to the principle of general equilibrium. This was seen in a research study conducted in Peru that found that due to the effects of mining projects, apartment rent and the value of real estate in cities near the mining sites increased (Aragon & Rud, 2013). The price of goods which were produced in these regions and the cost of transportation of materials from nearby provinces increased as well. The demand for labor in non-mining sectors and the real salaries of unskilled workers both rose as the total demand at the local level increased. Similarly, in a study done on a coal mining area in the US, when mining activities intensified, the number of eligible working-age people available in the local area increased along with the employment and wages of other non-mining sectors. Conversely, all these assessments decreased when the mining sector became inactive again (Black, McKinnish, & Sanders, 2005).

In another empirical study done in Peru, mining sector activity was found to have a positive effect on the livelihoods of the local community in addition to benefitting highly educated urban population. On the other hand, mining sector activity was found to exacerbate inequality within rural areas and between rural and urban communities (Loyaza, Mier y Teran, & Rigolini, 2003). The study saw a need to evaluate and rethink the current mining tax revenue distribution policy and its implementation as well as improving the relationship between mining companies and local citizens.

The mining sector can be divided into 2 main sections, large scale mining and small artisanal mining, based on their operational scale. Large scale mining consists of mining companies basing their operations on capital investment while artisanal mining is based on unskilled labor. Due to these differences, the impact of large scale mining and artisanal mining on the economy differ. Gamu et al. (2015) reviewed 52 empirical studies focused on the relationship between mining sector activity and poverty, concluding that operations run by large mining companies increase poverty while small scale mining sector activity is likely to reduce poverty. They also concluded that on the whole, the mining sector tends to increase poverty at the national level while decreasing poverty at the local level where the mine is based (Gamu, Billon, & Spiegel, 2015).

The other main channel through which the mining sector impacts local livelihood is through taxes and fees paid to local government. However, according to a study done on the Brazilian oil market, the taxes and fees paid to the local government did not lead to better quality, more inclusive government programs and services nor did it improve the livelihoods of local citizens. Conversely, more activity in the oil sector seemed to encourage more corruption instead (Caselli & Michaels, 2013; Brollo, Nannicini, Perotti, & Tabellini, 2013). According to the research by Loyaza et al (2013) and Aragon and Rud (2013), in Peru, the tax revenue collected from mining companies by the local government does not effectively reach citizens. In fact, as the budget revenue from mining revenues increase, it creates a trend to re-elect ineffective politicians (Brollo, Nannicini, Perotti, & Tabellini, 2013), as those politicians who utilize the revenue for their own gains to boost their political position (Vicente, 2010).

Aside from influencing economic factors, the environmental destruction and pollution caused by mining sector activity directly effects the lives of local residents significantly. Research done in Chile illustrated that heavy metal deposits, caused by mine waste dumping, detrimentally affected local children's ability to learn and later their ability to work and their level of income (Rau, Reyes, & Urzua, 2013). Likewise, research done in Ghana found that the water and soil pollution generated by gold mining negatively impacted crop yields, the main source of livelihood of local households, increasing the level of poverty in the affected area (Aragon & Rud, 2013). On a global scale, research done using household information from 44 developing nations came to the conclusion that growing diagnoses of diseases such as anemia and stunted growth in children and women are related to mining activities (van der Goltz & Barnwal, 2014).

As for Mongolia, there are only a handful of empirical studies that look at the direct and indirect effects of mining sector activity on the local household livelihood. One of the available studies, led by Amarjargal, focused on the impact of mining on rural household migration using primary data from the Labor Force Survey in 2013 (Amarjargal, Zhang, & Chen, 2015). This study found that migration into mining regions was lower than the migration to non-mining provinces, suggesting that there was not a strong correlation between mining sector activity and the local economy. Additionally, a case study on Altain Khuder LLC found that the mining of the Tayannnuur iron ore deposit in Govi Altai province had a negative impact on household livelihood in the area (Steinweg & Schuit, 2014). A study focused on the economic contribution of artisanal mining found that based on the 15 soums with active artisanal mining, 18.4 billion MNT in tax revenue was collected from artisanal miners with a local economic multiplier of 1.7 (IRIM, 2016).

We aim to contribute to this body of research by looking into the differences between soums with large mining projects and soums with no mining sector activity to identify the short-term impact of the mining sector on local household livelihoods using data from the Household Socio Economic Survey (HSES).

2. Data and Methodology

The research team studied the impact of the mining sector on the livelihoods of local households using the open database compiled by Mongolia's Extractive Industries Transparency Initiative (EITI) and using data from the National Statistical Office of Mongolia's (NSO) HSES. The household data at the soum level was integrated with data from the mining sector along with an economic and geographic supplementary database in order to create a pooled cross-section. This pooled cross-sectional data was used for the main empirical analysis. In this study, households from Ulaanbaatar city were not involved.

In the open database compiled by Mongolia's EITI[2], information on the activities of mining companies are only available starting from 2009. Meanwhile, the HSES data consists of a stratified household sample that is representative of the national population and has been collected annually by NSO since 2007-2008. The NSO conducts an extended version of the survey every two years. For this study, the research team selected only the survey data from 2010, 2012, 2014 and 2016 in order to utilize the extended survey which allowed

[2] https://e-reporting.eitimongolia.mn/

for a deeper analysis of local living standards. In addition, it is worth mentioning that the period covered in this study coincided with the recent boom and bust cycle of the mining sector in Mongolia.

Table 1. Sample size

	2010	**2012**	**2014**	**2016**	**Total**
Number of observations or covered households	7,616	9,233	12,593	12,878	42,320
Number of covered soums	78	84	324	324	810
Of which: mining soums	17	39	111	130	297

Source: HSES, National Statistics Office

In order to determine the activities of the mining sector at the soum level, the revenue reports of taxes and fees collected from mining companies by the central and local government as well as relevant licensing information were compiled from the EITI website and merged together. For a summary of the tax payments made by mining companies, refer to Table A1 included in the Appendix. Unfortunately, the taxes payed to the local government were not broken down by soum, nor was there information on which soums the mining companies operated in. However, the data on the valid special licenses contained information on licenses at both the province and soum level. By combining the available information, the research team was able to estimate and compute the tax revenues of soums. In general, licenses covering many provinces and soums were relatively small in comparison to the total number of licenses awarded.

The research team then established which soums had mining sector activity based on whether a valid mining license for that soum was awarded to any mining companies. In order to accurately calculate the level of mining sector activity, the research team estimated a cutoff threshold of 50 million MNT[3] based on the mining exploration activities and taxes paid to local authorities by license holding firms using 2010 prices. If several large mining companies had mining licenses in a soum, that soum had a higher probability of being classified as a mining soum. Based on this classification, about one third of soums involved in the study shown in Table 1 were considered to have an active mining sector.

The effect of mining activities on the local livelihood have an one-year lag due to the time it takes for the local market to adapt to possible changes [4]. As such, in the study of local livelihood between 2010-2016, the research team used mining sector data from 2009-2015 in order to get an accurate representation of its economic impact. Other information at the soum level, such as number of livestock, population size, number of enterprises and soums' budgets were collected from the NSO database and other sources.

Household income per capita, income type, consumption, poverty, unemployment, food price, housing price and the health of household members were selected as the dependent variables that determine the

[3] In the reconciliation report 2010 of EITI Mongolia, a company that has paid over 50 million MNT in state and local taxes is classified as a major mining company. About 3% of the total tax paid is local taxes.

[4] According to a study done by Arogan & Rud (2013), this lag was chosen as 2 years.

overall standing of the household. In order to calculate the net effect of the mining sector, in addition to basic household data and the employment information of the head of household, the soum of residence, the local economic situation, geographic features as well as the year and quarter the surveys were conducted were selected as independent variables.

In order to assess the impact of the mining sector, the research team utilized the linear regression model using pooled cross sectional data put forth by Aragon and Rud (2013) in their study when assessing the local effects of a large gold mine in Peru. In other words, the research team focused on calculating the general relationship between mining sector activity and local household livelihood from 2010 to 2016.

Equation (1) shows the model below:

$$y_{hdt} = \beta \cdot M_{dt} + \propto \cdot a_{dt} + \delta \cdot b_t + \gamma \cdot X_{hdt} + \varepsilon_{hdt} \qquad (1)$$

Here, y_{hdt} is the dependent variable for *h* household's livelihood at *t* year in *d* soum. As mentioned above, the dependent variables can include the logarithm of households' income, household unemployment or household health. On the other hand, M_{dt} is the main indicator used to calculate mining impact and is the dummy variable that defines whether or not there was any mining sector activity in a particular soum that year[5].

b_t is a vector variable representing years while a_{dt} is a *fixed effect*, a vector variable representing the geographical and socioeconomic characteristics of soum *d* at year *t*. These characteristics include the soum's climate zone, its distance from the capital city, its distance from a border port, whether a railway passes through, number of residents, number of livestock, number of enterprises, geographical size and size of farmland.

X_{hdt} is a vector variable representing the socioeconomic characteristics of household *h* at year *t* in soum *d*. These socioeconomic characteristics such as size of household, number of employed household members, age, gender, education level, and sector of employment of the head of household, and type of housing. These factors are considered exogenous and are considered to have a significant effect on the level of poverty and overall livelihood of households (Haughton & Khandker, 2009). For instance, if the head of a large household is young, if the number of employed household members is low, if the sector of employment has low productivity and the type of housing is of low quality, overall household livelihood decreases in turn. The HSES of the select years used to calculate the base household data is shown in Table A2 of the Appendix.

[5] When calculating the impact of the Peruvian gold mine, Aragon and Rud (2013) used distance between a household and the mine as a dummy variable. If the distance was less than 100 km, the variable has a value of 1, otherwise, the variable had a value of 0. This dummy variable was then multiplied by the sum of mining wages and purchases. However, in this study, the dummy variable had a value of 1 if the value of the taxes paid by companies with mining and exploration licenses in the soum was over 50 million MNT in 2010 prices. Otherwise the dummy variable had a value of 0. As data on the wages and purchases of mining companies are not available in Mongolia, the research team was unable to calculate the impact of the mining sector based on its impact on local demand.

The linear regression that accurately estimates the impact on household income, consumption, and food price, was chosen using the ordinary least square's method. The impact on household members' illness and unemployment was assessed using an exponential regression model and impact on household poverty was assessed using a probit model. The models were checked using econometric tests and chosen accordingly. For all the estimations, the mean and standard errors were calculated using sample weights and clustered by province. For certain estimations variable interactions were used to improve model specifications.

3. Research findings

This section details the main empirical results for each chosen dependent variable. The first part will look into the impact of the mining sector on local households' nominal and real incomes. The second part will focus on the impact of the mining sector on local prices while the final section will detail the impact on key indicators of the household welfare.

3.1. Impact on income

The average nominal household income per capita doubled within the period of study. Compared to non-mining soums, between 2010-2014, the income of households in mining soums grew at a faster rate, while from 2014-2016, household income per capital dropped at similar rates (Figure 3). By separating the ratio of household income and the regional minimum living standard from the linear trend and comparing the main characteristics of housing and head of households in mining and non-mining soums, the research team found that household income in mining soums grew at a relatively faster rate than that of non-mining soums (Figure 4).

Figure 3. Monthly household income per person, MNT thousand

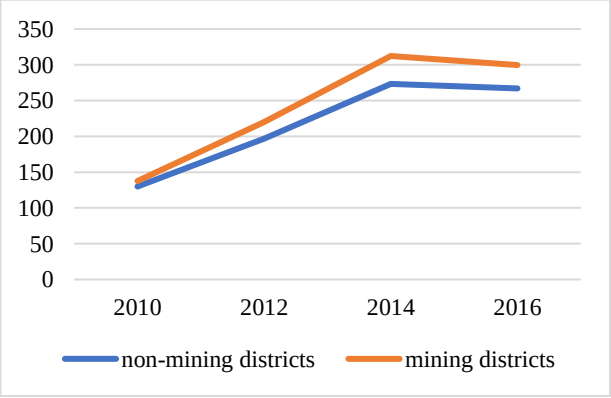
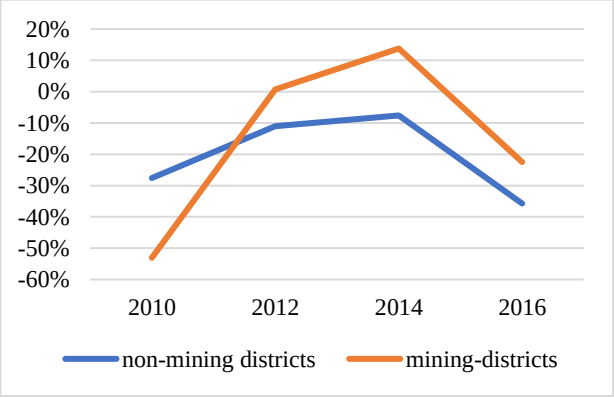


Figure 4. Conditional mean of relative income



Instead of concluding that the change in household livelihood during the period is connected to the development of the mining sector and overall economic growth shown in Figure 1, the research team used equation (1) utilizing micro data to make an estimation. In order to do this, nominal and real income per

capita were chosen as dependent variables in order to measure parameter β, the impact of the mining sector, as well as other variables. The results of this estimation are shown in Table 2.

Total household income was calculated using HSES primary data. However, as the HSES data separated household income into sections, there was a need to merge all relevant income data together to get total household income data. More specifically, income from labor, welfare income of household members, net household income from agriculture, income from farming and private business as well as the value of items used from their own farms and given by others were summed up in order to compute total income. Then, in order to compute real household income, an index was created using data on the household minimum living standard. The created index takes into account regional commodity prices and the purchasing power parity[6].

The first column of Table 2 shows the correlation between the chosen variables and real income while the following column shows the correlation between nominal income. These results show the general effect on income from 2010-2016 while the following columns display the yearly impact on nominal income.

Table 2. The impact of the mining sector on household income

	Log (real income)	**Log (nominal income)**	**Nominal income 2010**	**Nominal income 2012**	**Nominal income 2014**	**Nominal income 2016**
Mining soums	0.073**	0.072**	0.107	0.028	0.073*	0.062
	(0.032)	(0.032)	(0.064)	(0.039)	(0.038)	(0.042)
Other variables	Table A3	Table A3	Table A3	Table A3	Table A3	Table A3
Observations	23 223	23 223	4 368	5 316	7 074	6 547
R^2	0.393	0.493	0.299	0.349	0.350	0.437

*Note: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses*

According to the model, household income in soums with mining was about 7.2% greater than household income in soums without substantial mining sector activity. When real household income was then compared to the soum's minimum living standard and the province's commodity price index, the effect was essentially the same at 7.3%. As these results were statistically significant at a 95% confidence level, it can be concluded that the mining sector had a noticeable impact on household income in the short-run. However, when the overall impact was broken down by year, the effect dropped in statistical significance. This decrease was due in part to the drop in the number of observations as well as the increased standard deviations when calculating the impact by years. When looking at the effect of local mining activities on nominal household income, the impact was 10.7% in 2010, dropped sharply in 2012 and rose once again in 2014. On one hand, these results could be attributed to a number of circumstances. For instance, while the booming mining sector from 2010 to 2011 and the significant increase in the share of mining soums that took part in the survey in 2012 (Table 1) decreased the marginal impact on mining soums. However, since 2013, reduced economic activity in the mining sector and the lower share of mining soums that took part

[6] The results were the same when estimating real income using the consumer price index of provinces.

in the survey led to a higher marginal effect on mining soums. Despite these explanations however, it is necessary to analyze the sharp decrease in impact in 2012 in detail.

The model takes into account the households' residing region (west, khangai, central, east), geological region (gobi, steppe, forest steppe, etc.), location (center of aimags, center of soums, rural), population of soum, distance from capital city, whether it is close to a border port, whether the railway passes through it, year survey was taken, and household characteristics (number of family members, age of household head and spouse, education level, employment, number of people employed in household, type of housing and whether the housing is connected to centralized power and water supply). The detailed results are presented in Table A3 in the Appendix.

Based on the weighted average of rural households that participated in the survey, income is comprised of 32.2%- wage, 26.3%- welfare, 14.0%- agriculture income, 18.0%- own consumption, and 6.4%- business income. In order to clarify impact of income, the model is estimated utilizing these key components of rural household income (Table 3).

Table 3. The impact of the mining sector on components of household income

	Log (wage, household)	**Log (welfare)**	**Log (business income)**	**Log (agriculture income)**	**Log (own consumption)**	**Log (wage, individual)**
Mining soums	0.070*	0.043	-0.104	0.066	0.027	0.094***
	(0.034)	(0.025)	(0.075)	(0.077)	(0.042)	(0.019)
Other variables	Table A4	Table A4	Table A4	Table A4	Table A4	Table A4
Observation	17 656	21 795	4 921	13 773	22 617	26 736
R^2	0. 360	0.366	0.201	0.237	0.378	0.462

*Note: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses*

As shown in Table 3 above, the positive impact of the mining sector on local household income is mainly observed through increases in wage income. For instance, when other factors are held constant (ceteris paribus), the wage income of households in mining soums was 7% higher than the wage income in other soums. In addition, when looking at the impact of mining on individual wages, wages in mining soums were 9.4% greater than individual wages in soums without (last column of Table 3). Likewise, the wages of non-mining sector jobs in mining soums was on average 5.3% higher than the non-mining sector wages in soums with no mining sector activity. The positive impact on overall wage income is caused by the expansion of the mining sector and the total demand generated in turn. It may also be due to the fact that the local government has a more substantial budget to invest with due to more revenue from mining sector taxes.

While welfare, agriculture income and household consumption of own goods were shown to be positively impacted by mining sector activity, this impact was modest and statistically insignificant. On the other hand, household business income in mining soums was slightly lower than in other soums, though this finding was also statistically insignificant. This could be interpreted as a sign of "Dutch disease" as the

economic activity of non-mining sectors decline. However, rather than basing such conclusions on a household level survey, it would be more accurate to look into soum level production and economic surveys instead.

When calculating these findings, the residing region of households (west, khangai, central, east), geological region (gobi, steppe, forest steppe, etc.), location (center of aimags, center of soums, rural), population of soum, distance from the capital city, whether the railway passes through, year survey was taken, and household (the last column refers to individual characteristics) characteristics (number of family members, age of household head and spouse, education level, employment, number of people employed in household, type of housing and whether the housing is connected to centralized power and water supply) were taken into account. The impact of these variables are presented in detail in Table A4 in the Appendix.

3.2. Impact on prices

One way the mining sector can affect household livelihood is by increasing overall local demand. For instance, increased total demand can lead to higher prices for local goods and services. This in turn can positively impact household income. However, when analyzing microeconomic data at the household level, mining sector activity was not found to have a positive effect on household business and agriculture income (Table 3). A comparative analysis of the prices of key goods and services can provide some clarity on this finding.

The research team chose to analyze housing rent, the prices of agricultural products, and the prices of key food products that are not locally produced in mining soums. In order to compare rent, the research team utilized real housing rent cost data provided by the households who took part in the HSES. As for agricultural products, products such as mutton and milk, which make up the majority of food related household expenditure were chosen. Staple food products such as first-grade flour and white rice were used to compare the prices of major food products that are not locally produced in mining soums. It is important to note that in this assessment, differences in the prices of products due to differing levels of quality could not be taken into consideration when comparing prices.

One hypothesis that may be put forth is that if mining activities intensify in some soums, the migration of labor into these soum will increase as a response. In turn, this will boost the demand for housing and housing rent will increase as well in the short-run. The model results show that housing rent is 1.3% higher in mining soums than in soums with no mining (first column of Table 4). However, as number of real housing rent cost data points are relatively low (215) and the standard deviation is high, this is not a significant difference. Therefore, the mining sector does not have a noticeable effect on the housing rent.

Another hypothesis is that increased mining sector activity can cause a rise in the prices of other goods and services such as food products. However, according to this study, the impact of the mining sector on the price of locally produced agricultural food products is mixed. For instance, the mining sector had a negative effect on the price of mutton (a decrease of 115 MNT or 3% cheaper) but conversely had a positive effect on the price of milk (an increase of 126 MNT or 4% more expensive, this finding however, was not

statistically significant). This result is consistent with the finding discussed in the previous section that the mining sector does not have a significant impact on agriculture income (Table 3).

Table 4. The impact of the mining sector on prices

	Log(housing rent)	**Price of mutton**	**Price of milk**	**Log (Price of 1st grade flour)**	**Log (Price of white rice)**
Mining soums	0.013	-115*	126	0.004	-0.005
	(0.175)	(64)	(80)	(0.010)	(0.008)
Other variables	Table A5	Table A6	Table A6	Table A6	Table A6
Observation	215	10 485	13 371	26 721	27 194
R^2	0. 310	0.769	0.366	0.718	0.731

*Note: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses*

Likewise, the impact of the mining sector on the price of food products not produced locally was negligible. For instance, the mining sector had a 0.4% positive impact on the price of first-grade flour but had a 0.5% negative impact on the price of white rice. These findings were not statistically significant. Therefore, it is possible to conclude that the mining sector does not have an impact on the price of non-locally produced food products.

3.3. Impact on wellbeing indicators

The concept of wellbeing is a broad concept that takes into account numerous factors (UNDP, 2016; OECD, 2013). This section will focus on the relationship between mining sector activity and household consumption, poverty, employment, as well as certain health indicators. In order to evaluate this, the model created using Equation (1) was utilized. Due to the limited availability of data on this subject, the research team was unable to make a detailed assessment on the impact of the mining sector on local wellbeing.

As mentioned in the previous sections, mining sector activity can have both direct and indirect effects on household consumption and employment through its impact on household income, prices and the local budget. The table below illustrates the impact of mining sector activity on nominal and real household consumption, poverty and unemployment. The impact on household consumption was estimated utilizing a linear regression model while the impact on poverty was estimated using a probit model. Additionally, impact on the number of unemployed members of household was estimated using an exponential model.

Table 5. The impact of the mining sector on household consumption, poverty and unemployment

	Log (consumption)	**Log (real consumption)**	**Poverty**	**Number of unemployed household members**
Mining soums	0.109***	0.096***	- 0.075***	0.234*
	(0.035)	(0.033)	(0.022)	(0.136)
Other variables	Table A7	Table A7	Table A7	Table A8
Observation	29 891	29 891	30 158	42 101
R^2	0.550	0.453	0.218	-

*Note: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses*

As shown in the first two columns in Table 5, mining sector activity has a positive impact on consumption, with both real and nominal consumption about 10% higher in mining soums compared to non-mining soums. This finding also had a 99% confidence interval. Household consumption was calculated as the sum of household food consumption, non-food consumption, consumption of durable goods, rent, cost of fuel and energy consumption.

Similarly, the probability of a household being in poverty decreased by 7.5% in mining soums as compared to non-mining soums. This finding is also statistically significant. In order to determine whether a household was considered to be in poverty or not, the minimum living standard of the region was used as a criterion. If household consumption per capita was below this minimum standard, the household was considered to be in poverty.

However, as shown in last column of Table 5, the number of unemployed household members is higher in households residing in mining soums. In particular, the number of unemployed household members is 0.23 higher in mining soums. Here, unemployed household members are defined as people aged 18 to 55 years who have been unemployed for the past 12 months while actively searching for employment in the past week.

Table 6 shows the result of the exponential regression model that calculated the relationship between the number of sick and injured household members and children living in area with mining sector activity.

Table 6. The impact of the mining sector on health

	Number of sick household members	**Number of sick household members (under 5)**
Mining soums	0.224**	0.347**
	(0.109)	(0.136)
Other variables	Table A8	Table A8
Observation	29 891	11 106

*Note: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses*

As the table above depicts, mining sector activity has a negative effect on household health indicators. For instance, the number of household members who have been sick in the past month is 0.22 higher in mining

soums compared to non-mining soums. The number of sick children under 5 in a household is also higher by 0.35 in mining soums. These results are statistically significant at the 95% level.

In order to paint a comprehensive picture of the effects of mining sector activity on local wellbeing, it is important to look at indicators such as the environment as well as security and safety. Unfortunately, due limitation of data, these possible risk factors could not be assessed within this study.

4. Conclusions and recommendations

Conclusions

The results of this study show that total household income in mining soums is 7% higher compared to household income in non-mining soums. This increase is mainly a result of differences in wages. Mining sector activity also has a substantial effect on other livelihood indicators. For instance, in mining soums, household consumption is 11% higher and poverty is 8% lower than in non-mining soums. Overall, since 2010, the mining sector has grown significantly and has had positive short-term effects on household income and consumption. However, when compared to similar studies conducted in other countries, the magnitude of these positive effects is smaller in Mongolia. For instance, Aragon and Rud (2013) found that the expansion of Yanacocha, a large gold mine in Peru, increased local household consumption by 14% and decreased poverty by 11 percentage points.

On the other hand, while mining sector activity had a positive effect upon the indicators mentioned above, the number of unemployed and sick household members were noticeable higher in mining soums compared to non-mining soums. Business income as well as agriculture income were also not better in mining soums. The prices of key commodities in mining soums were not markedly higher than in non-mining soums. In some instances, prices were actually lower in mining soums showing that mining sector activity had little impact on increasing overall local demand.

However, these conclusions may be due in part to the economic characteristics of Mongolia and its mining sector. For instance:

1. As human resources and other factors of production are relatively weak in rural areas, mining companies or projects funded through mining tax revenues are unlikely to have crowded out non-mining sector businesses. Therefore, indicators of “Dutch disease” or “Peruvian disease” may not have been observed.

2. As mining companies are highly capital intensive and typically don’t employ many people, the number of local people employed in the mining sector are usually small. Additionally, jobs that offer consistent employment in the mining sector are also rare in rural areas, leading to more unemployment in mining soums. These factors may explain why demand driven by increased purchasing power did not increase with more mining sector activity. Furthermore, as mass migration to mining soums did not occur, local demand may not have risen as hypothesized.

3. Rather than attributing higher wage incomes and consumption in mining soums to the mining sector only, it should be noted that more local government investment, bolstered by increased mining tax revenue, also plays a part.

4. As mining companies have a tendency not to fulfill a significant portion of its consumption needs from the local market, mining sector activity may not have a noticeable effect on overall local demand. In this case, the local prices of goods and services and sales are not expected to increase and as a result, agriculture and business income will not be positively impacted.

5. While mining companies may not have any significant direct effect on the soum it operates in, through taxes, wages, and purchases, mining companies may have significant impact at the national level. These benefits will be equally distributed to non-mining soums, reducing the household livelihood difference between mining and non-mining soums. However, this effect is not strong enough to negatively impact mining soums.

6. On the other hand, the monopolization of factors of production by the mining sector may crowd out the activities of non-mining sectors. This would then depress the strong positive effects of the mining sector on total household income and consumption. However, additional analysis using data on local sectoral production is necessary in order to reliably make such an assumption.

7. Mining sector activities may have many direct and indirect negative effects on additional household income via environmental pollution, pastureland degradation, limiting water sources etc. Several such cases were studied in detail by other researchers (Steinweg & Schuit, 2014).

8. While Mongolia has employed several safeguards to reduce over-centralization as well as promote transparency, overall institutional and governance weaknesses may play a part in reducing the positive benefits of the mining sector on local livelihood.

Research limitations

When considering the conclusions made above, it is important to take into account the limitations of the research. These include:

a. As the HSES data used in this study is collected randomly from different households from different soums every year, it is impossible to calculate the detailed impact of mining sector activity on local livelihood using panel analysis methods. Additionally, as some of the mining soums included in the chosen surveys may not have been included in other surveys, the effects, both negative and positive, of long-term large mining projects have a tendency to be underestimated.

b. As the scope of the study is based on mining sector data from 2010 and beyond due to the limited data available, it does not include data from the mid-2000s where there was a strong revival of the mining sector as a whole.

c. It is also important to study the impact of mining on livelihood based on the type of operation. Particularly, artisanal mining has a significant effect on local livelihood. However, due to data

availability, only the impact of industrial mining was calculated. Although artisanal miners took part in the HSES, as the number of observations were too small and the data was not considered representative of the whole group, the impact of artisanal mining was not included in this study.

d. This study did not take into consideration the distances between mining sites and households, focusing only on the household's soum of residence. However, as most soums in Mongolia have large territories and are sparsely populated with rural households spread far apart, it might be that mining activity doesn't have a significant impact on the livelihoods of those households that live far from mining sites[7].

Recommendations and suggestions

Based on the results of the study, the researchers have put forth the following policy recommendations and suggestions:

- For the extractives industries to support local development and benefit the livelihoods of citizens, it is imperative to increase the transparency of the extractive industries and improve local institutions. It is also important to increase the capacity of civil servants, promote citizen participation in local decision-making, fight against corruption, focus on restoration and reduce the negative effects of mining on the environment.

- In order to ensure that the differences between mining and non-mining soums and aimags are not exacerbated, an optimal decision regarding mining revenue management needs to be made. Looking at case studies from Peru and Indonesia, rather than focusing on the mining sector, projects implemented with funding from mining sector tax revenue was shown to create more jobs. However, it is important to be cautious that this government expansion could lead to the crowding out effect, encourage corruption and lead to indicators of "Peruvian disease."

- In order to prevent the crowding out effect in mining soums and aimags, it is vital to focus on developing infrastructure as well as creating the conditions for the unrestricted migration of labor, goods and services.

- It is important not to blindly prioritize narrow local interests so as not to diminish the overall positive economic benefits of the mining sector. For instance, demanding that mining companies employ local workers and fulfill their consumption needs from local markets, or stipulate that they donate to the local government may negatively affect the company's efficiency and in turn reduce the total amount of taxes paid to the state.

[7] For example, in a study conducted in Indonesia, mining had a significant positive impact on the livelihoods of households within a 15 km range from the mining site (Cust & Vaile, "Is There Evidence for a Subnational Resource Curse?", 2016).

- Mining sector activities, production, income and tax information must be made available at the soum level. In the process of conducting this study, no annual data was found on the taxes paid by the mining sector to local governments. The government agencies tasked with collecting tax data do not publish this type of information.

Finally, the research team suggests the following areas for further research:

- Further research on this topic should be focused on studying the long-term impact of the mining sector on the local community. Currently, due to data limitations, long-term studies on the mining sector aren't possible. However, in the future, studies on issues such as economic diversification, technological advancement and population migration related to mining are vital to developing good policies.

- Another possible area for further research includes calculating the correlation between the mining sector and inequality in the local community, migration, shifts in sectoral employment and other indicators of wellbeing. The data used in this study can be further processed in order to study these effects.

- An assessment of the mining sector's impact on local livelihood could be made more comprehensive if it took into account the number of local people employed, the amount of local purchases made and total social investments made into the local community by mining companies. Rather than separating mining and non-mining soums by a single indicator, it would be more appropriate if the value of local purchases made by a mining company as well as additional indicators were used to calculate a more accurate threshold instead. However, gathering the necessary data needed to achieve this poses an additional challenge.

- When deciding whether or not a soum was considered to have an active mining sector, the same threshold was used for every soum. In this case however, there is a possibility that a large populous soum with a relatively smaller mining sector compared to its overall economy could reduce the total impact of the mining sector on livelihood. It would therefore be beneficial if the threshold for defining soums took the aforementioned into consideration and was suitably revised. If such the threshold was thus improved, the overall assessment could be more accurate.

- Funds allocated from the taxes and fees collected from the mining sector and distributed from the national budget to local soums may also be considered when calculating the impact of the mining sector. However, it is important to note that regulations related to royalties are a recent development, coming into effect in 2015.

- When calculating the impact of the mining sector, an area of possible interest includes separating mining companies by their type of ownership (foreign-owned, nationally owned, private, public, etc.) and extracted commodity (gold, coal, etc.) in order to estimate their individual impact on the local community.

- Rather than focusing on the overall impact of the entire mining sector on overall local livelihood, another area of study includes focusing on the impact of a few large mining projects such as Oyu Tolgoi, Erdenet, and Tavan Tolgoi. The results of this study can then be compared with other international studies on large mining projects and their impact on livelihood.

- Another area of further study includes comparing the effects of formal and informal types of mining on household livelihood by calculating the impact of artisanal mining operations in addition to industrial mining projects. In this case, the overall scale and level of artisanal mining activity for all soums need to be calculated for the past years.

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6. Appendix

Table A1. Taxes paid by mining companies covered by the survey

Year	Number of companies covered	Total taxes and fees paid by companies covered, billion ₮	Average of total taxes and fees paid, million ₮	Average taxes and fees paid to local government, million ₮	Total taxes and fees paid by the median company, million ₮
2007	103	728	7 077	157	57
2008	124	694	5 597	172	70
2009	176	878	4 990	161	52
2010	332	1 751	5 276	146	20
2011	360	4 352	12 100	303	32
2012	1499	2 056	1 371	94	13
2013	1206	1 655	1 372	98	13
2014	1036	1 324	1 278	91	14
2015	782	1 007	1 287	80	6

Source: Researchers' calculations based on data from the EITI electronic report database (https://e-reporting.eitimongolia.mn/)

Table A2. Households covered by the survey

	2010	2012	2014	2016
Total number of households	7 616	9 231	12 591	12 876
Of which:				
West region	24.2%	23.4%	24.8%	24.2%
Highland region	33.7%	32.8%	29.5%	30.3%
Central region	28.7%	30.6%	30.8%	30.9%
East region	13.5%	13.3%	14.9%	14.5%
Province center	34.6%	37.6%	42.9%	41.9%
Soum center	27.9%	28.9%	30.1%	33.4%
Rural	37.5%	33.5%	27.0%	24.7%
Average household size	3.8	3.6	3.5	3.4
Share of households with male heads of household	81.8%	81.0%	79.5%	77.6%
Breakdown by age of head of household				
Up to 30	14.5%	12.8%	12.0%	12.9%
30-39	26.2%	24.9%	25.5%	25.1%
40-49	25.7%	27.1%	25.7%	24.8%
50-59	17.5%	19.3%	20.3%	20.2%
60 and above	16.1%	15.8%	16.6%	17.0%
Education level of head of household				
Primary, or uneducated	24.1%	20.3%	20.3%	17.6%
Secondary	54.1%	54.8%	48.9%	47.2%
Technical, or vocational education	14.8%	17.9%	21.6%	24.4%
Higher	7.0%	7.0%	9.2%	10.8%
Average number of employed household members	1.52	1.51	1.46	1.33
Type of housing				
Ger	57.4%	53.6%	54.4%	52.0%
Detached house	22.2%	30.3%	32.1%	33.0%

Apartment	10.8%	11.4%	11.2%	12.4%
House	8.1%	2.4%	0.6%	0.6%
Other	1.6%	2.2%	1.8%	2.0%
Connected to central sewage	7.3%	9.2%	13.4%	14.4%
Connected to central power	58.2%	73.6%	72.5%	77.0%
Average income per household member, thous.MNT.	1 581	2 484	3 428	3 304
Average consumption per household member, thous.MNT.	1 601	2 810	3 929	3 621
Poverty level	40.1%	21.7%	15.2%	25.5%
Share of households with livestock	53.7%	49.3%	46.2%	41.0%
Of which, average number of livestock	163	167	229	228

Source: Researchers' calculations based on primary data from the HSES conducted by NSO

Table A3. The impact of the mining sector on household nominal and real income[1]

	Log (income per person)	Log (real income per person)
Mining soums	0.049 (0.029)	0.049 (0.029)
Region (West region = 0):		
Highland	-0.040 (0.100)	-0.042 (0.100)
Central	0.080 (0.135)	0.087 (0.135)
East	-0.013 (0.110)	-0.013 (0.110)
Location (Province center = 0):		
Soum center	0.119** (0.050)	0.116** (0.049)
Rural	0.142** (0.058)	0.140** (0.058)
Soum population ('000)	0.003 (0.002)	0.003 (0.002)
Climate zone (Desert = 0):		
Great Lakes Altai Gobi	-0.065 (0.073)	-0.068 (0.072)
Forest	-0.175*** (0.054)	-0.174*** (0.054)
Mountainous	-0.168** (0.065)	-0.168** (0.065)
Prarie	-0.028 (0.056)	-0.028 (0.056)
Near a border port	-0.033 (0.039)	-0.032 (0.038)
Railway passes through	-0.125** (0.054)	-0.123** (0.054)
Distance from Capital ('00 км)	0.002 (0.008)	0.002 (0.008)
Year (2010 = 0)		
2012	0.500*** (0.040)	0.275*** (0.040)
2014	0.816*** (0.040)	0.347*** (0.039)
2016	0.757*** (0.032)	0.173*** (0.031)
Number of people per household	-0.176*** (0.008)	-0.176*** (0.008)
Age of head of household	0.005*** (0.001)	0.005*** (0.001)
Male head of household	0.142*** (0.033)	0.143*** (0.033)
Age of spouse	0.006*** (0.001)	0.006*** (0.001)
Education of household head and spouse[2]		
Number of employed household members	0.170*** (0.012)	0.171*** (0.012)
Type of Housing (Other = 0):		
Ger	0.084** (0.039)	0.083** (0.038)

Detached House	0.146*** (0.030)	0.145*** (0.030)
Apartment	0.179*** (0.034)	0.178*** (0.033)
House	0.213*** (0.034)	0.208*** (0.033)
Connected to central sewage	0.164 *** (0.042)	0.165 *** (0.042)
Connected to central power	-0.071** (0.030)	-0.068** (0.031)
Fixed coefficient	13.342*** (0.173)	-0.588*** (0.179)
Sample size	23,223	23,223
R^2	0.493	0.391

Notes: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses

[1] – Only households in which the head of household were employed were included

[2] –The head of household and their spouse's education levels were divided into 9 separate levels and income increased noticeably as education level increased.

Table A4. Correlation between the mining sector and components of household income[1]

	Log (wage, household)	Log (welfare)	Log (business income)	Log (agriculture income)	Log (own consumption)	Log (wage, individual)
Mining soums	0.07* (0.03)	0.04 (0.03)	-0.10 (0.07)	0.07 (0.08)	0.03 (0.04)	0.09*** (0.02)
Region (West = 0):						
Highland	0.19* (0.09)	-0.19*** (0.03)	0.36** (0.15)	-0.03 (0.12)	0.04 (0.20)	-
Central	0.16 (0.10)	-0.09** (0.04)	0.48***(0.15)	0.29 (0.17)	0.21 (0.23)	-
East	0.04 (0.12)	-0.01 (0.05)	0.03 (0.16)	0.42** (0.16)	0.10 (0.21)	-
Location (Province center = 0):						
Soum center	0.01 (0.02)	-0.06** (0.03)	-0.03 (0.09)	-	0.98*** (0.11)	-0.00 (0.02)
Rural	-0.34*** (0.05)	0.02 (0.03)	-0.24* (0.14)	-	1.18*** (0.11)	-0.07 (0.02)
Climate zone (Desert = 0):						
Great Lakes/ Altai Gobi	0.12 (0.11)	-0.05 (0.04)	0.40***(0.09)	0.09 (0.10)	-0.11 (0.12)	-
Forest	-0.13* (0.07)	0.08** (0.04)	-0.11 (0.07)	-0.22** (0.08)	-0.07 (0.09)	-
Mountainous	-0.10 (0.08)	0.11*** (0.03)	-0.27***(0.07)	-0.12 (0.10)	0.00 (0.08)	-
Prarie	-0.04 (0.07)	0.08** (0.04)	-0.06 (0.09)	-0.15 (0.10)	0.12 (0.09)	-
Number of enterprises '000	0.04 (0.03)	-0.01 (0.03)	-	-	-	0.02** (0.01)
Soum population '000	-	-	0.04** (0.02)	-0.03 (0.02)	-0.04** (0.02)	0.02** (0.01)
Railway passes through	0.03 (0.06)	0.00 (0.03)	-0.18 (0.11)	-	-0.13 (0.08)	-
Distance from Capital ('00 km)	-	-	0.01 (0.01)	-0.03*** (0.01)	0.02 (0.02)	-0.01** (0.00)
Year (2010 = 0)						
2012	0.44*** (0.04)	1.11*** (0.08)	0.45*** (0.09)	0.39*** (0.10)	0.38*** (0.06)	0.45*** (0.03)
2014	0.70*** (0.05)	0.70*** (0.08)	0.79*** (0.11)	1.08*** (0.09)	0.53*** (0.05)	0.73*** (0.02)
2016	0.88*** (0.04)	0.70*** (0.10)	0.62*** (0.09)	0.79*** (0.06)	0.38*** (0.06)	0.76*** (0.02)
Number of people per household	-0.02*** (0.01)	0.18*** (0.01)	-	-	-	-0.01***(0.00)
Age of head of household	0.00* (0.00)	0.02*** (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00* (0.00)	0.00** (0.00)
Male head of household	0.23***(0.02)	0.01 (0.08)	0.18*** (0.06)	0.48*** (0.06)	0.32*** (0.03)	0.14*** (0.02)
Education of head of household /9 levels/	-	-	-	Statistically significant	Statistically insignificant	Statistically insignificant
Age of spouse	-	0.02*** (0.00)	-	-	-	-

Number of employed household members	0.32*** (0.02)	-0.17*** (0.01)	-	-	-	-
Type of employment /11 categories/	-	-	-	-	-	Statistically insignificant
Type of Housing (Ger = 0):						
Other	0.35*** (0.08)	0.06 (0.06)	0.16 (0.18)	-0.71*** (0.24)	-0.39***(0.10)	-
Detached House	0.31*** (0.03)	0.01 (0.03)	0.45*** (0.07)	-0.13** (0.06)	-0.04 (0.04)	-
Apartment	0.50*** (0.05)	0.06 (0.06)	0.47*** (0.10)	-0.23 (0.16)	-0.40*** (0.11)	-
House	0.40*** (0.05)	0.01 (0.07)	0.60*** (0.10)	0.29** (0.12)	0.10 (0.07)	-
Connected to central sewage	0.26*** (0.06)	-0.11* (0.05)	0.47 *** (0.11)	0.17 (0.18)	-0.11 (0.10)	-
Connected to central power	0.38*** (0.06)	-0.10*** (0.03)	0.26** (0.10)	-0.82*** (0.06)	-0.57*** (0.07)	-
Fixed coefficient	13.54*** (0.16)	10.90*** (0.14)	13.45*** (0.34)	13.58***(0.23)	12.42***(0.34)	12.89***(0.04)
Sample size	17,656	21,795	4,921	13,773	22,617	26,736
R^2	0. 360	0.366	0.201	0.237	0.378	0.462

Notes: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses

[1] –The first 5 columns include only households in which the head of household is employed.

Table A5. The impact of the mining sector on rent[1]

	Log (housing rent)
Mining soums	0.01 (0.17)
Region (West = 0):	
Highland	0.04 (0.39)
Central	0.12 (0.45)
East	-0.13 (0.39)
Location (Province center = 0):	
Soum center	0.15 (0.23)
Rural	-0.54** (0.25)
Number of enterprises ‘000	0.19 (0.17)
Soum population ‘0000	0.06 (0.05)
Railway passes through	-0.29 (0.33)
Area of soum (sq.km)	-0.05 ***(0.02)
Year (2010 = 0)	
2012	-0.21 (0.25)
2014	0.11 (0.23)
2016	0.01 (0.24)
Number of people per household	-0.00 (0.05)
Total floor area of housing	0.01 (0.01)
Connected to central sewage	0.32 (0.30)
Fixed coefficient	10.26***(0.43)
Sample size	215
R^2	0. 310

Notes: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses

[1] - Calculations based on data of renting households who took part in the HSES

Table A6. The impact of the mining sector on food prices

	Mutton (Price level)	Milk (Price level)	1st grade flour Log (price)	White rice Log (price)

Mining soum	-115* (64)	126 (80)	0.00 (0.01)	-0.01 (0.01)
Year × Quarter (2010 Q1 = 0):				
2010 Q2	1608***(112)	-194*** (48)	-0.14***(0.01)	0.13***(0.02)
2010 Q3	600*** (70)	-663*** (53)	-0.08***(0.02)	0.17***(0.02)
2010 Q4	374*** (64)	-177*** (50)	0.06** (0.03)	0.17***(0.02)
2012 Q1	2323***(105)	-42 (60)	0.06* (0.03)	0.21***(0.02)
2012 Q2	-132 (160)	-19 (74)	0.15***(0.02)	-0.12***(0.02)
2012 Q3	913***(111)	100 (63)	0.11***(0.03)	-0.16***(0.02)
2012 Q4	549***(109)	-7 (61)	-0.00 (0.04)	-0.16***(0.02)
2014 Q1	3969*** (93)	264*** (55)	0.21***(0.03)	0.41***(0.02)
2014 Q2	-914***(100)	21 (68)	0.19***(0.02)	-0.10***(0.02)
2014 Q3	-283*** (96)	3 (52)	0.22***(0.02)	-0.14***(0.02)
2014 Q4	-501*** (93)	9 (42)	0.13***(0.03)	-0.13***(0.02)
2016 Q1	2121*** (99)	424*** (68)	0.46***(0.02)	0.50***(0.01)
2016 Q2	-92 (93)	-101 (78)	0.14***(0.02)	-0.12***(0.01)
2016 Q3	356*** (99)	-45 (78)	0.08***(0.02)	-0.16***(0.02)
2016 Q4	-516***(104)	-134** (75)	-0.05* (0.03)	-0.16***(0.02)
Region × Location (West, Province center= 0)				
Highland, Province center	78 (428)	390* (222)	0.09** (0.04)	-0.03 (0.02)
Central, Province center	614** (327)	550* (303)	0.10** (0.05)	-0.04 (0.03)
East, Province center	-190 (327)	301 (192)	0.07* (0.04)	-0.07** (0.03)
West, Soum center	-395***(101)	-111 (74)	-0.04** (0.03)	0.06***(0.01)
West, Rural	-552 (372)	-104 (64)	-0.04** (0.02)	0.06***(0.01)
Highland, Soum center	-404** (179)	-217** (93)	-0.04* (0.02)	-0.03* (0.01)
Highland, Rural	-416 (399)	-281** (109)	-0.04* (0.02)	-0.03 (0.02)
Central, Soum center	341** (128)	-95 (140)	-0.01 (0.02)	-0.04***(0.01)
Central, Rural	452 (391)	-241 (164)	-0.03 (0.03)	-0.05***(0.02)
East, Soum center	-260* (155)	-107 (167)	0.03 (0.02)	0.01 (0.02)
East, Rural	144 (386)	-67 (134)	0.01 (0.03)	0.00 (0.02)
Region × Climate zone (West, Desert = 0)				
West , Forest	531*** (140)	-	-	-
West, Prarie	973***(216)	-	-	-
Highland, Prairie	-852* (456)	-	-	-
Central, Prairie	-1496***(287)			
(Other pairings)	Statistically insignificant	-	-	-
Population ‘0000	13 (14)	-44 (28)	-0.01 (0.00)	0.01** (0.00)
Livestock population ‘0000	-9.7** (4.8)	-0 (3)	-	-
Number of enterprises ‘000	-	-2 (77)	-0.01 (0.01)	0.01** (0.00)
Distance from Capital 100 km	46* (23)	61*** (21)	0.01** (0.00)	-0.00 (0.00)
Close to border port (<100 km)	-240** (104)	-338*** (60)	-0.04***(0.01)	-0.01 (0.01)
Railway passes through	42 (103)	-88 (222)	0.01 (0.02)	0.00 (0.02)
Fixed coefficient	1857***(397)	1076***(311)	6.46***(0.06)	7.26***(0.04)
Sample size	10 485	13 371	26 721	27 191
R^2	0.769	0.366	0.718	0.731

Notes: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses

Only households in which the head of household were employed were included

Table A7. The impact of the mining sector on household consumption and poverty

	Log (consumption per capita)	Log (real consumption per capita)	Poverty (Probit model, marginal effect)

Mining soum	0.109***(0.035)	0.096***(0.03)	-0.075***(0.02)
Year × Quarter (2010 Q1 = 0):			
2010 Q2	0.06** (0.03)	0.07** (0.03)	-
2010 Q3	0.16***(0.03)	0.16***(0.03)	-
2010 Q4	0.04 (0.04)	0.05 (0.04)	-
2012 Q1	0.46***(0.04)	0.26***(0.04)	-0.13***(0.02)
2012 Q2	0.00 (0.03)	-0.00 (0.03)	-
2014 Q1	0.86***(0.05)	0.42***(0.05)	-0.22***(0.03)
2014 Q2	-0.11** (0.04)	-0.11** (0.04)	-
2016 Q1	0.81***(0.06)	0.34***(0.06)	-0.08***(0.03)
2016 Q2	-0.11** (0.04)	-0.11** (0.04)	-
2016 Q3	-0.20***(0.05)	-0.20***(0.05)	-
2016 Q4	-0.12** (0.06)	-0.13** (0.06)	-
Region (West = 0):			
Highland	-0.10 (0.11)	-0.08 (0.09)	-
Central	-0.00 (0.16)	0.06 (0.14)	-
East	-0.11 (0.12)	-0.05 (0.11)	-
Location (Province center = 0):			
Soum center	-0.04 (0.04)	-0.04 (0.04)	0.01 (0.03)
Rural	-0.01 (0.05)	-0.01 (0.05)	0.02 (0.03)
Climate zone (Desert = 0):			
Great Lakes/ Altai Gobi	-0.11 (0.09)	-0.07 (0.09)	-
Forest	-0.15* (0.08)	-0.12 (0.07)	-
Mountainous	-0.16** (0.07)	-0.15** (0.07)	-
Prarie	-0.07 (0.08)	-0.06 (0.08)	-
Distance from Capital 100 km	-0.01 (0.01)	-0.00 (0.01)	-
Close to border port (<100 km)	-0.04 (0.04)	-0.04 (0.04)	-
Railway passes through	-0.12 (0.08)	-0.11 (0.08)	-
Number of enterprises ‘000	-	-	-0.00 (0.01)
Number of people per household	-0.38***(0.02)	-0.38***(0.02)	0.11***(0.01)
Number of people per household squared	0.02***(0.00)	0.02***(0.00)	-
Age of head of household (10 years)	0.03***(0.01)	0.03***(0.01)	-0.03***(0.01)
Male head of household	0.04** (0.02)	0.04** (0.02)	-0.06***(0.01)
Age of spouse (10 years)	0.03***(0.00)	0.03***(0.00)	-0.01***(0.00)
Number of employed household members	0.11***(0.01)	0.11***(0.01)	-0.06***(0.00)
Education of head of household /10 levels/	0.07-1 increase per higher level	0.07-1 increase per higher level	0.03-0.61 decrease per higher level
Type of Housing (House = 0):			
Ger	-0.30***(0.06)	-0.30***(0.06)	-
Apartment	-0.06 (0.06)	-0.06 (0.05)	-
Detached house	-0.14** (0.06)	-0.13** (0.06)	-
Other	-0.18***(0.06)	-0.17 (0.06)	-
Connected to central sewage	0.12***(0.04)	0.12***(0.04)	-
Connected to central power	0.02 (0.03)	0.02 (0.02)	-0.03 (0.02)
Fixed coefficient	12.43***(0.21)	12.37***(0.20)	-
Sample size	29 891	29 891	30 003
R^2	0.550	0.453	-

Notes: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses

Only households in which the head of household were employed were included

Table A8. The impact of the mining sector on household employment and health

	Number of unemployed household members		Number of sick household members in past month		Number of sick children in household in past month	
Mining soum	0.23*	(0.14)	0.22**	(0.11)	0.35**	(0.14)
Year × Quarter (2010 Q1 = 0):						
2010 Q2	0.12	(0.20)	-0.10	(0.11)	-0.47*	(0.24)
2010 Q3	0.01	(0.17)	-0.40***	(0.09)	-1.00***	(0.23)
2010 Q4	-0.06	(0.16)	-0.51***	(0.13)	-0.84***	(0.28)
2012 Q1	-0.33*	(0.16)	-0.18	(0.17)	-0.44*	(0.25)
2012 Q2	-0.10	(0.35)	-0.19	(0.14)	0.01	(0.37)
2012 Q3	-0.22	(0.28)	-0.37**	(0.18)	-0.31	(0.34)
2012 Q4	-0.11	(0.39)	-0.09	(0.17)	0.11	(0.33)
2014 Q1	-0.22	(0.19)	-0.16	(0.18)	-0.33	(0.22)
2014 Q2	-0.24	(0.24)	-0.05	(0.10)	-0.06	(0.27)
2014 Q3	-0.34	(0.21)	-0.19	(0.17)	-0.24	(0.34)
2014 Q4	-0.21	(0.26)	0.25*	(0.14)	0.64**	(0.32)
2016 Q1	-0.42**	(0.21)	-0.35	(0.23)	-0.57**	(0.25)
2016 Q2	-0.18	(0.29)	-0.17	(0.16)	0.08	(0.30)
2016 Q3	0.22	(0.21)	-0.33	(0.17)	-0.21	(0.40)
2016 Q4	0.18	(0.22)	0.05	(0.21)	0.25	(0.39)
Region × Location (West, Province center= 0)						
Highland, Province center	0.68	(0.42)	0.57	(0.38)	1.14***	(0.43)
Central, Province center	0.40	(0.42)	0.45	(0.47)	1.01*	(0.54)
East, Province center	0.85**	(0.38)	0.13	(0.47)	0.46	(0.53)
West, Soum center	0.25	(0.23)	-0.17	(0.19)	-0.57***	(0.18)
West, Rural	-0.23	(0.29)	-0.29	(0.28)	-0.57*	(0.34)
Highland, Soum center	-0.01	(0.30)	-0.81***	(0.26)	-0.38	(0.32)
Highland, Rural	-0.37	(0.26)	-0.47	(0.35)	-0.10	(0.39)
Central, Soum center	-0.35	(0.28)	-0.02	(0.26)	0.16	(0.31)
Central, Rural	-0.23	(0.50)	0.01	(0.34)	0.29	(0.45)
East, Soum center	-0.54**	(0.23)	0.18	(0.28)	0.96	(0.26)
East, Rural	-0.59	(0.50)	0.32	(0.36)	0.94	(0.43)
Climate zone (Desert = 0):						
Great Lakes/ Altai Gobi		-	-0.07	(0.32)	0.44	(0.30)
Forest		-	0.18**	(0.16)	0.13	(0.25)
Mountainous		-	0.12	(0.29)	-0.31	(0.31)
Prarie		-	0.07	(0.17)	-0.08	(0.26)
Population ‘0000	0.06**	(0.03)	0.01	(0.04)	0.02	(0.05)
Livestock population ‘0000	-0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Distance from Capital 100 km	0.04	(0.03)	0.03	(0.03)	0.04	(0.04)
Railway passes through	0.01	(0.20)	-0.35*	(0.19)	-0.53**	(0.26)
Age of head of household (10 years)	0.03	(0.03)	0.06***	(0.02)	-0.32***	(0.07)
Male head of household	-0.12	(0.08)	-0.02	(0.04)	0.18	(0.11)
Number of people per household	0.30***	(0.02)	0.20***	(0.02)	0.18***	(0.04)
Type of Housing (Other= 0):						
Ger	0.61***	(0.14)	-0.19	(0.15)	-0.10	(0.35)
Apartment	-0.00	(0.26)	-0.02	(0.12)	0.22	(0.36)
House	-0.02	(0.32)	-0.17	(0.21)	-0.27	(0.62)
Detached house	0.30*	(0.16)	-0.13	(0.13)	0.03	(0.29)
Connected to central sewage	1.41***	(0.16)	0.04	(0.10)	0.05	(0.17)
Connected to central power	0.03	(0.20)	0.14	(0.08)	0.38***	(0.13)
Fixed coefficient	-6.16***	(0.53)	-2.58***	(0.60)	-2.66***	(0.81)

Sample size	42 101	30 046	11 156

Notes: * p < 0.1, ** p<0.05, *** p<0.01 Standard deviations are in parentheses

Only households in which the head of household were employed were included