

博士論文
Doctorate Thesis

Understanding Excess Volatility of Consumption in Commodity-Dependent Countries:
A Case of the Force of Trend Shocks in Mongolia

(資源依存国における消費の過剰ボラティリティ：
モンゴルにおけるトレンドショックの事例より)

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Doctorate Thesis Abstract

This thesis addresses how commodity-dependent countries are characterized by the excess volatility of consumption and how this feature is rationalized. I provide evidence on such volatility from cross-country panel data and investigate the potential driving force behind it using micro-data from Mongolia, a prototypical low-income, commodity-dependent country.

In Chapter 1, I revisit the excess volatility of the consumption puzzle, a feature often observed in developing and emerging economies. I assess how the excess volatility of consumption varies across countries by incorporating interrelation between countries' commodity dependence and income level. This is estimated in the context of the excess sensitivity of the consumption to output using the cross-country panel data. I find that the sensitivity of consumption on income level appears differently by the country's commodity dependence. The sensitivity is higher in the low-income groups for the commodity-dependent countries, whereas the opposite pattern is observed for the non-commodity-dependent countries.

In Chapter 2, moving on to the micro-level, I study the excess sensitivity of the consumption to income across income groups using Mongolian household survey data. I find heterogeneous excess sensitivity of consumption to income across income groups. Such behavior can be rationalized in the context of the stochastic trend hypothesis, given Mongolia's relatively unstable economic development and policy changes, dependent on the mining sector since the 2000s. Furthermore, contrary to the case where liquidity constraints are considered to be the bottleneck, I find higher sensitivity of the consumption in rather high-income groups than in the low-income groups.

In Chapter 3, I identify the nature of income shocks from the evolution in cross-sectional income and consumption dispersion. The estimation of changes in the variance of transitory and permanent shocks is conducted by cohorts and income groups using the Mongolian household survey data. I find that the increase in income dispersion in 2012 and 2017, associated with the expansionary and contractionary phases of Mongolia's economy, is driven by an increase in the variance of permanent shocks. Furthermore, I find that the nature of the income shocks appears differently across income groups. While the changes in the transitory shock variances appear for all income groups, the changes in the permanent shock variances appear dominantly for the high-income group.

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1 How Does Excessive Volatility of Consumption Vary Across Countries?

1.1 Introduction

Business cycle characteristics in developing and emerging countries are observed to be different from those of developed countries.¹ Those countries are featured with excess volatility of consumption, countercyclical current accounts, and dramatic reversal in capital flows, which typically are not observed in developed countries (see, e.g., Kaminsky, Reinhart, and Végh, 2004; Aguiar and Gopinath, 2007; Garcia-Cícco, Pancrazi, and Uribe, 2010; and Naoussi and Tripier, 2013).² Moreover, the features in those countries are usually accompanied by procyclical fiscal and monetary policies (Kaminsky, Reinhart, and Végh, 2004).

The excess volatility of consumption, one of the dominant features in developing and emerging countries, refers to the higher volatility of consumption than that of output. According to the well-known life cycle/permanent income hypothesis (LC/PIH), consumption is smoothed out, as opposed to volatile income, as one takes into account lifetime income and not the one-time income.³ The higher volatility of consumption, than that of output, is considered as the excess volatility of the consumption puzzle under the leading theory of consumption smoothing.

Two theoretical frameworks have been developed on the modern business cycle framework, formed by Mendoza (1991), to rationalize the business cycle features in developing and emerging countries. One is the stochastic trend hypothesis based on the LC/PIH. It differentiates between a transitory and permanent shock to the economy (Aguiar and Gopinath, 2007). When the economy is affected by the latter, the output trend growth rate is affected, it implies a stronger response of consumption as agents' expectation and consumption behavior change accordingly.⁴ The other framework introduces country risk spread or foreign interest

¹ A pioneering study of the business cycles for developed countries is first established by Kydland and Prescott (1990).

² Regarding the relation of the net exports and output, the relation appears to be ambiguous for low-income, developing countries, for example, in Sub-Saharan African countries (Ozbilgin, 2010; Naoussi and Tripier, 2013).

³ Modigliani and Brumberg (1954) and Friedman (1957) build a foundation on the idea.

⁴ Although Aguiar and Gopinath (2007) do not specifically mention what the permanent shock could be, their idea is developed on the frequent policy regime changes observed in developing and emerging countries. These are considered to induce a volatile trend growth rate.

rate shocks to reflect limited international borrowing and emphasizes the role of financial imperfection (Neumeyer and Perri, 2005; Uribe and Yue, 2006). The dominance of temporary productivity shocks, attributed to financial friction, generates and amplifies aggregate fluctuations.⁵

This study revisits the context of excess volatility of consumption and attempts to clarify how it varies across countries, when it is translated into the sensitivity of the consumption to output. Specifically, I take into account the country's income level, commodity dependence, and their interrelation. Cross-country panel regression is run to grasp systematic differences of excess sensitivity of consumption to output, by classifying the countries by their income level and commodity-dependence. I find heterogeneous excess sensitivity of consumption to output across countries, when the countries' characteristics are taken into account. A pattern of the sensitivity of consumption on income level appears differently by the country's commodity dependence. For the commodity-dependent countries, the consumption sensitivity is higher in the low-income group compared to the high-income group, whereas for the non-commodity-dependent countries, the opposite pattern appears.

How do we ascertain whether the resource-rich countries are different from those are not? Developing and low-income countries are characterized by their commodity dependence. UNCTAD (2019) summarizes that resource-rich countries are exclusively a developing country phenomenon.⁶ For more than 90% of the low-income countries, exports are dependent on a certain type of commodity, while exports are dependent on commodities for around 30% of the high-income countries.⁷ Studies show that those resource-rich countries have a slower economic growth, on average, than resource-poor countries (Sachs and Warner, 1995).⁸ Several channels are raised to explain why resource wealth leads to slower growth (Frankel, 2012). Volatile commodity price matters due to the low demand and/or supply elasticities

⁵ Garcia-Cícco, Pancrazi, and Uribe (2010) and Chang and Fernandez (2013) are in favor of the role of financial frictions, when the two frameworks are compared to explain the business cycles in developing countries. Garcia-Cícco, Pancrazi, and Uribe (2010) find that the role of trend shocks is limited in the business cycle, when the financial shock is incorporated into the model. Chang and Fernandez (2013) find a similar result, when they introduce specifications of financial friction on the same data as Aguiar and Gopinath (2007).

⁶ According to UNCTAD (2019), a country is considered commodity-dependent if 60% of the country's export is dependent on commodities, such as minerals, oils, and agricultural products.

⁷ Income classification is based on the World Bank definition.

⁸ Sachs and Warner (1995) identify the negative relationship between output growth and exports on resources using the data of 97 developing countries.

(Hausmann and Rigobon, 2003).⁹ Another possibility is the so-called “Dutch disease,” where an increase in resource-based revenues results in the appreciation of real exchange rate and a decline in the manufacturing sector (Corden and Neary, 1982; Corden, 1984). This leads to lower economic growth in the long run, under a certain condition in which there is an increasing returns to scale in the manufacturing sector but not in the resource sector (Matsuyama, 1992).¹⁰

Not only are rich natural resources associated with lower economic performance, they also adversely affect a country’s governance, known as the “political” resource curse. Those arguments raised in the context of political science are given as explanations for the lower economic performance of those countries with rich natural resources, therefore, they are studied empirically. The rich natural resource is highly associated with autocratic governments and transiting to democracy is often inhibited (see, e.g., Ahmadov, 2014; and Prichard, Salardi, and Segal, 2018).¹¹ They are inversely related to institutional quality and can sometimes trigger conflict and civil war, particularly for the low-income countries (see, e.g., Sala-i-Martin and Subramanian, 2013; Andersen, et al., 2017; and Collier and Hoeffler, 1998). Ross (2015) indicates that those countries rich in fuel tend to have autocratic regimes and a lower quality of government institutions, however, civil war is associated with all commodity types.¹²

Excess sensitivity of consumption using the aggregate level data, starting with Campbell and Mankiw (1991), has been analyzed by different strategies at the cross-country level.¹³ The empirical results have reached mixed conclusions and the LC/PIH is not always supported. Shirvani and Wilbratte (2009) find supporting evidence in industrial countries, when they separate the permanent and transitory components in income by using a stochastic detrending approach. Dreger and Reimers (2006) find that the LC/PIH is supported once the financial wealth is taken care of by panel cointegration techniques for EU countries. On the other hand,

⁹ A certain amount of capital stock of raw materials is often needed, therefore, the demand elasticities become lower in the short run. Similarly, it is often difficult to adjust output in the short run and supply elasticities become lower (Frankel, 2012).

¹⁰ Empirical findings using the cross-countries data are reported. Brahmabhatt, Canuto, and Vostroknutova (2010) find that those countries with rich natural resources tend to have less non-resource tradable sectors. Moreover, the increase in oil revenue is found to be associated with a fall in the manufacturing sector (Ismail, 2010).

¹¹ The rent-seeking effect is given as one of the mechanisms. McGuirk (2013) finds a robust, negative relationship between natural resource rents and enforcement of taxation using the data of 15 sub-Saharan countries. In addition, those are related to a decline in the demand for democratic governance.

¹² Ross (2015) further reports the literature that studies the effect of rich natural resources, such as on the status of women, demographic trends, and HIV/AIDs.

¹³ As it is indicated by Attanasio and Weber (1993), using aggregate data might induce aggregation bias, however, employing micro-data has its limitation (Altonji and Siow, 1987).

there is evidence of the failure of the LC/PIH across countries. Bacchetta and Gerlach (1997) and Sarantis and Stewart (2003) find that it is not supported for OECD countries. Further evidence is found in Asian and developing countries (see, e.g., Speight and White, 1995; Chyi and Huang, 1997; Wang and Lee, 2010; and Wang, 2011).¹⁴

Failure of the LC/PIH, the finding of the excess sensitivity of consumption, is often attributed to liquidity constraints. People are more affected by liquidity constraints in countries with less developed credit markets (Jappelli and Pagano, 1989).¹⁵ Financial liberalization is found to help with reducing liquidity constraints in the case of South Korea, Sri Lanka, and Taiwan (Habibullah, Smith, and Azman-Saini, 2006).¹⁶ Furthermore, Islamaj and Kose (2016) find that consumption sensitivity declines as financial integration increases. This is particularly more noticeable for developed countries than for developing countries, yet, there is empirical evidence of other channels to explain the failure of the hypothesis. Madsen and McAleer (2001) find no evidence of liquidity constraints when they use 22 OECD countries' panel data and the failure of the PIH is attributed to the behavioral life-cycle hypothesis. Alternative hypotheses, such as habit persistence or non-separability in preference over consumption and leisure are raised on the aggregate data (Kiley, 2010).¹⁷

This study attempts to grasp excess sensitivity of consumption by comprehensively capturing the income level and commodity-dependence, based on countries' cross-sectional panel data. Therefore, firstly, the study is expected to contribute to the empirical literature by clarifying how the sensitivity depends on the countries' characteristics of income and commodity dependence. Secondly, this study is expected to shed light on how the excess volatility of consumption is translated into the sensitivity of consumption to output. Thirdly, although this study does not link between natural resource wealth and why it leads to certain outcomes, it

¹⁴ Sarantis and Stewart (2003) attribute the failure of the LC/PIH to liquidity constraints, when they study 20 OECD countries. Speight and White (1995) study ten developing economies over the period from 1950 to 1988 and they find that liquidity constraints are a feature for those economies. Chyi and Huang (1997) study five East Asian countries, Japan, South Korea, the Philippines, Thailand, and Taiwan. They find a higher fraction of "rule of thumb" consumers in those countries than in OECD countries. Liquidity constraints are confirmed again for the ten developing countries used in Habibullah, Smith, and Azman-Saini (2006), by Wang and Lee (2010), and Wang (2011).

¹⁵ Leading studies on the liquidity constraints are Zeldes (1989) and Deaton (1991).

¹⁶ Habibullah, Smith, and Azman-Saini (2006) estimate the fraction by error-correction model. They find that the liquidity constrained consumers are estimated to be in the range between 0.25 and 0.98, when a sample of ten Asian economies are used.

¹⁷ Household data is limited with a data range of income and consumption to test such an alternative hypothesis (Kiley 2010).

helps to understand how these countries are characterized in terms of volatility of their consumption to output.

The rest of the chapter is organized as follows. Section 2 shows the data and descriptive analysis on the excess volatility of consumption. Section 3 consists of three subsections. First, empirical analysis of the sensitivity of consumption to output on cross-country panel data is introduced. Next, the empirical results are presented, followed by the results of the robustness check using the export diversification index. Lastly, Section 4 concludes.

1.2 Data and Descriptive Analysis

In the study, annual data of real output and real consumption at constant national prices from the Penn Table are used. For real consumption, it is the sum of household and government consumption.¹⁸ Both values are in millions of 2005 US dollars. Per capita values are earned by dividing by the country's population. The earliest data is available from 1960.

The income classification is based on the World Bank (WB) income categories. A country is classified into one of the four income groups by their Gross National Income (GNI) per capita in current US dollars. These are high, upper-middle, lower-middle, and low-income groups. Regarding the country's commodity dependence, classification is based on the definition of the United Nations Conference on Trade and Development, the so-called UNCTAD. A country is accounted as commodity-dependent if 60% of its export is composed of commodities of fuel, minerals, and agricultural products. The country is considered as non-commodity dependent if the share does not exceed 60% (UNCTAD, 2019). Countries lists, according to their income level and commodity-dependence, are summarized in Appendix A.

Regarding the excess volatility of consumption by income classification, relatively consistent results are obtained with the previous studies. Table 1 shows the mean and median ratios of volatility between consumption and output by income classification.¹⁹ Aggregate and per capita values of output and consumption are used for the first and second rows, respectively. The

¹⁸ I refer to consumption terms, including both household and government, if it is not indicated otherwise.

¹⁹ The volatilities of real output and consumption are calculated on the cyclical components of the series, which are extracted from the Hodrick-Prescott filter setting the smoothing parameter to 100. The same procedure is applied for the series of output and consumption per capita.

mean and median ratios are lowest for the high-income group, 1.019 and 0.927, respectively. Similarly, in terms of per capita, the mean and median ratios of the high-income group are the lowest, 1.01 and 0.944, respectively. Values lower than 1 indicate that volatility of consumption is rather smooth in those high-income countries. Moreover, the mean and median are increasing as the income category becomes lower, the volatility of consumption is higher for lower-income categories. As for the low-income category, the mean and median are lower than upper-middle and lower-middle-income categories, still, they are higher than the high-income category.

Table 1. The ratio of volatility between consumption and output by income classification

	High		Upper-middle		Lower-middle		Low	
	mean	p50	mean	p50	mean	p50	mean	p50
st.d(C)/st.d(Y)	1.019	0.927	1.230	1.116	1.298	1.182	1.196	1.099
st.d(c)/st.d(y), per capita	1.010	0.944	1.226	1.118	1.294	1.219	1.196	1.092
Observations	55		47		39		28	

Note: Cyclical components of the real output and consumption are extracted from the Hodrick-Prescott filter setting the smoothing parameter to 100. Then, the volatilities are calculated by taking the standard deviation of the series. Aggregate and per capita values are used for the first and second rows, respectively.

Table 2 shows the mean and median ratio of volatility between consumption and output by export commodity dependence. The relation between the ratio of consumption to output volatility and output per capita by countries' commodity dependence is depicted in Figure 1 and by commodity type in Figure 2. The mean and median ratios are lowest for non-commodity dependent countries, 1.051 and 1.002, respectively. They are also lowest for non-commodity dependent countries in terms of per capita values, 1.051 and 1.004, respectively. For commodity-dependent countries, the mean and median ratios are above 1 and higher than non-commodity dependent countries. Moreover, there are heterogeneities across commodity types, the mean and median ratios are higher for mineral-dependent countries, 1.398 and 1.225, respectively. The same applies to values in terms of per capita, the mean and median ratios are higher for those countries, 1.392 and 1.222, respectively.

Table 2. The ratio of volatility between consumption and output by export commodity dependence

	Non-commodity		Mineral		Fuel		Agriculture	
	mean	p50	mean	p50	mean	p50	mean	p50
st.d(C)/st.d(Y)	1.051	1.002	1.398	1.225	1.200	1.175	1.250	1.163
st.d(c)/st.d(y), per capita	1.051	1.004	1.392	1.222	1.188	1.160	1.240	1.169
Observations	81		29		30		29	

Note: Cyclical components of the real output and consumption are extracted from the Hodrick-Prescott filter setting the smoothing parameter to 100. Then, the volatilities are calculated by taking the standard deviation of the series. Aggregate and per capita values are used for the first and second rows, respectively.

1.3 Empirical Results

A. Empirical Methodology

Regression analysis follows the empirical specification made in Ravallion and Chaudhuri (1997).²⁰ The model specification allows the separation of the aggregate worldwide shocks and idiosyncratic country shocks. I estimate the following fixed effect model (1), to assess the countries' excess sensitivity of the consumption to output incorporating the country characteristics.

$$\begin{aligned}
 \Delta \log C_{i,t} = & \alpha_i + \alpha_t + \beta_1 \Delta \log Y_{i,t} + \beta_2 \text{IncomeBelow} \\
 & + \beta_3 \Delta \log Y_{i,t} \times \text{IncomeBelow} + \beta_4 \text{ComDep} \\
 & + \beta_5 \Delta \log Y_{i,t} \times \text{ComDep} + \beta_6 \text{IncomeBelow} \times \text{ComDep} \\
 & + \beta_7 \Delta \log Y_{i,t} \times \text{IncomeBelow} \times \text{ComDep} + \Delta \varepsilon_{i,t}
 \end{aligned} \tag{1}$$

The subscript i indicates a country and t indicates the year. A dependent variable is a change of log of consumption per capita. The first and second terms on the right-hand side are the country and year fixed effects. $\Delta \log Y_{i,t}$ is a change of log of output per capita and, controlling the aggregate shock, coefficient β_1 measures the sensitivity of consumption to idiosyncratic

²⁰ The model specification in Ravallion and Chaudhuri (1997) is a modified version of Townsend (1994) and used in Deaton (1990) and Cochrane (1991) first. Although the village-time fixed effect is controlled in Ravallion and Chaudhuri (1997), a worldwide shock is controlled by the year fixed effect in this model.

output shock; it is an estimation of “excess sensitivity.” When the hypothesis of full consumption insurance holds, a country is able to diversify its risk completely, so that parameter is expected to be zero. Otherwise, it indicates that the country is not insured against idiosyncratic risks. The consistent estimates are expected to be provided by the model even under such circumstances of the hypothesis of full consumption insurance does not hold (Ravallion and Chaudhuri, 1997).

In order to comprehensively capture how sensitivity depends on the countries’ income classification and commodity dependence, the variable change in the log of output per capita is interacted with dummy variables *IncomeBelow* and *ComDep*. *IncomeBelow* is a dummy variable, takes 1 if a country is either of the lower-middle or low-income group following the income classification. Otherwise, it takes 0. Income categories are merged for high- and upper-middle-income, for lower-middle and low-income groups, respectively, as the number of the countries are few in some of the income categories. *ComDep* is a dummy variable, takes 1 if a country is categorized as commodity-dependent following UNCTAD classification. Otherwise, it takes 0. The estimates from the interaction terms serve to find out any systematic difference across and within the classification of income and commodity dependence.

I estimate the parameters based on the specified model, utilizing the cross-country panel data. Although the first differencing of the variables eliminates country-level fixed effects, I estimate the model both with and without country fixed effects. Table 6 and Table 7 show summary statistics of the output and consumption by income classification and commodity dependence, respectively.

B. Empirical Result

Table 3 shows the regression result of the estimation of the model (1) considering the country characteristics, such as income classification and commodity dependence. Results without and with controlling country fixed effects are given in columns 1 and 2, respectively. I mainly report the results without country fixed effect, as there is not much difference between them. Excess sensitivity of consumption to output is estimated by the coefficient on the change of output. Estimates of the four groups are obtainable. Those are above-upper-income non-commodity, below-lower-income non-commodity, above-upper-income commodity, and

below-lower-income commodity-dependent groups. The sensitivity of the consumption to the output of the above-upper-income non-commodity group is set as a base and the sensitivities of the other groups are statistically compared with it. Table 4 shows the estimated coefficients of overall effects of the sensitivity of consumption to output for each group based on the obtained result.

The sensitivity of the above-upper-income non-commodity group, keeping everything else constant, is 0.808 significant at 1%. A difference of the sensitivities between below-lower- and above-upper-income groups among non-commodity dependent countries is -0.13 , statistically significant at 5%.²¹ This indicates that among the non-commodity dependent countries, the excess sensitivity is statistically lower for lower-income countries. As for the above-upper-income commodity-dependent countries, the excess sensitivity of the consumption is 0.428, significantly lower than above-upper-income, non-commodity dependent countries. The difference is -0.381 , significant at 1%. Moreover, the sensitivity of the below-lower-income, commodity-dependent countries is 0.786, statistically significant at 1%.²²

The results suggest that, not only are there heterogeneities of the excess sensitivity across groups, when groups are compared to the above-upper-income non-commodity group, but the sensitivities dependent on the income level also appears unlike between commodity and non-commodity dependent countries. Table 5 shows how the effect of excess sensitivity of consumption to output depends on income level by commodity-dependence. As for commodity-dependent countries, the difference between income level is 0.358 significant at 1%, that indicates the sensitivity of the below-lower-income group is higher than that of the above-upper-income group. On the other hand, as with the non-commodity dependent group, sensitivity is lower for the below-lower-income group, and the difference between the income groups is -0.13 , significant at 5%. Figure 3 shows the effect of the sensitivity of consumption to output between above-upper and below-lower-income groups by commodity dependence.

²¹ The estimate is significant at 10%, when the country fixed effect is controlled.

²² Since the interaction term of below-lower-income and commodity dependence, $IncomeBelow \times ComDep$, is controlled, the overall effect of the below-lower-income, commodity-dependent country is 0.786, which is obtained by subtracting 0.13 and 0.381 from 0.808 and adding 0.488.

Table 3. Regression results from estimation of the model (1)

Dependent variable is the change of consumption, per capita

	(1) D.log(c)	(2) D.log(c)
D.log(y)	0.808*** (0.043)	0.803*** (0.047)
IncomeBelow	0.003* (0.002)	0.000 (.)
IncomeBelow X D.log(y)	-0.130** (0.066)	-0.122* (0.071)
ComDep	0.008*** (0.002)	0.000 (.)
ComDep X D.log(y)	-0.381*** (0.106)	-0.386*** (0.110)
ComDep X IncomeBelow	-0.013*** (0.003)	0.000 (.)
ComDep X IncomeBelow X D.log(y)	0.488*** (0.124)	0.488*** (0.129)
Constant	0.013** (0.006)	0.016*** (0.005)
Obs	9233	9233
Adj R2	0.308	0.302
Date FE	YES	YES
Country FE	NO	YES

Standard errors in parentheses.

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

Note: Standard errors are in parentheses and are robust to heteroscedasticity of unknown form and to arbitrary serial correlation of disturbances within a country.

Table 4. Estimated coefficients of excess sensitivity of consumption to output for each group

	Coefficients on D.log(y)
above upper # non-commodity dependent	0.808*** (0.043)
above upper # commodity dependent	0.428*** (0.097)
below lower # non-commodity dependent	0.678*** (0.049)
below lower # commodity dependent	0.786*** (0.040)
Obs	9233
p-values	0.002

Standard errors in parentheses.

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

Table 5. Coefficient equality test for non-commodity and commodity dependent group

	(1) non-commodity	(2) commodity
Difference of income level	-0.130 (0.066)	0.358 (0.105)
Obs	4449	4784
p-values	0.049	0.001

C. Robustness check with the export diversification index

Besides directly considering the countries' export dependence on commodity, I test the model (1) incorporating the export diversification index which considers the country's export diversification in terms of the product lines and trading partners (Papageorgiou, et al., 2014).²³ The export diversification index is comprised of an extensive and intensive margin, depending on the diversification type. While the extensive margin depends on the number of additional products, the intensive margin depends on the share of existing product lines. If a country introduces new product lines, this is reflected in the extensive margin and if the country has a more balanced mix of existing products, this is reflected in the intensive margin. A lower value

²³ The index is publicly available on the official website of the International Monetary Fund (IMF).

of the diversification index indicates higher export diversification. Similarly, diversification in trading countries is also reflected in each margin. Table 6 and Table 7 show summary statistics of the three indexes by income classification and commodity dependence, respectively. General summary statistics of the indexes are given in the Appendix (Table 8).

The category of high-income is associated with greater export diversification, which is reflected in lower diversification values (Table 6). This is reflected in Figure 4 which shows the relation between output per capita and the export diversification index by commodity type. Interestingly, not only is the high-income country associated with a lower diversification index, the relation between output per capita and the export diversification index is likely to be hump-shaped. Fuel dependent countries are associated with high income and the high diversification index, and the latter indicates that their exports are less diversified. Table 7 confirms this. Across the commodity-dependent countries, the diversification index and its extensive and intensive margins are observed to be highest for fuel-dependent countries. Mineral- and agricultural-dependent countries then follow. The indexes are observed to be lowest for non-commodity dependent countries.

Table 6. Summary statistics for the export diversification index and its extensive and intensive margins by income classification

	High		Upper-middle		Lower-middle		Low	
	mean	p50	mean	p50	mean	p50	mean	p50
log(Y)	10.747	11.062	10.195	10.482	9.867	9.558	9.142	9.047
log(C)	10.509	10.832	9.947	10.045	9.710	9.283	8.884	8.807
log(y), per capita	8.945	8.972	8.218	8.192	7.585	7.547	6.753	6.852
log(c), per capita	8.707	8.738	7.970	8.068	7.428	7.440	6.494	6.783
Diversification index	2.725	2.295	3.635	3.598	3.811	3.848	4.321	4.385
Extensive margin	0.440	0.187	0.546	0.411	0.543	0.576	0.966	0.816
Intensive margin	2.290	2.040	3.092	2.956	3.269	3.072	3.356	3.237
Observations	54		44		36		28	

Note: The numbers of the countries are slightly different from Table 1, due to the availability of the diversification index.

Table 7. Summary statistics for the export diversification index and its extensive and intensive margins by countries' commodity dependence and commodity type

	Non-commodity		Mineral		Fuel		Agriculture	
	mean	p50	mean	p50	mean	p50	mean	p50
log(Y)	10.569	10.736	10.613	10.298	10.136	10.761	9.597	9.363
log(C)	10.402	10.598	10.250	10.105	9.620	10.023	9.385	9.218
log(y), per capita	8.416	8.418	8.382	8.254	8.569	8.394	8.082	8.096
log(c), per capita	8.249	8.235	8.019	8.062	8.053	8.034	7.871	7.895
Diversification index	2.694	2.589	4.197	4.269	4.627	4.898	3.855	4.034
Extensive margin	0.325	0.200	0.763	0.633	0.970	0.772	0.721	0.689
Intensive margin	2.374	2.234	3.435	3.237	3.657	3.643	3.135	3.078
Observations	78		26		29		29	

Note: The numbers of the countries are slightly different from Table 2, due to the availability of the diversification index.

Although the fuel-dependent countries are associated with less export diversification and high income, heterogeneity is observed for the ratio of consumption to output volatility across commodity-dependent countries (Figure 5).²⁴ Non-commodity-dependent countries are diversified in terms of export and are associated with a lower ratio of consumption to output volatility. This is consistent with previous descriptive analysis. The export diversification index is incorporated into the model by interacting with the change of output. To get robust specifications with interaction terms, country-specific means are subtracted from the variable in order not to spuriously capture country-varying slopes (Balli and Sorensen, 2013; Giesselmann and Schmidt-Catran, 2018).

Based on model (1), the following model (2) is specified.

$$\begin{aligned}
\Delta \log C_{i,t} = & \alpha_i + \alpha_t + \beta_1 \Delta \log Y_{i,t} + \beta_2 \text{IncomeBelow} \\
& + \beta_3 \Delta \log Y_{i,t} \times \text{IncomeBelow} + \beta_4 \text{ComDep} \\
& + \beta_5 \Delta \log Y_{i,t} \times \text{ComDep} + \beta_6 \text{IncomeBelow} \times \text{ComDep} \\
& + \beta_7 \Delta \log Y_{i,t} \times \text{IncomeBelow} \times \text{ComDep} + \beta_8 \text{Div}_{i,t} \\
& + \beta_9 (\Delta \log Y_{i,t} - \overline{\Delta Y_i}) \times (\text{Div}_{i,t} - \overline{\text{Div}_i}) + \beta_{10} \text{Div}_{i,t} \times \text{IncomeBelow} \\
& + \beta_{11} (\Delta \log Y_{i,t} - \overline{\Delta Y_i}) \times (\text{Div}_{i,t} - \overline{\text{Div}_i}) \times \text{IncomeBelow} \\
& + \beta_{12} \text{Div}_{i,t} \times \text{ComDep} + \beta_{13} (\Delta \log Y_{i,t} - \overline{\Delta Y_i}) \times (\text{Div}_{i,t} - \overline{\text{Div}_i}) \times \text{ComDep} \\
& + \beta_{14} \text{Div}_{i,t} \times \text{ComDep} \times \text{IncomeBelow} \\
& + \beta_{15} (\Delta \log Y_{i,t} - \overline{\Delta Y_i}) \times (\text{Div}_{i,t} - \overline{\text{Div}_i}) \times \text{ComDep} \times \text{IncomeBelow} + \Delta \varepsilon_{i,t}
\end{aligned} \tag{2}$$

A variable *Div* indicates the export diversification index and it is a continuous variable. The diversification index and its extensive and intensive margins are used for the analysis. Table 9 shows the results of the estimation of the model (2). Columns (1) and (2) are the results of the baseline regression model (1). Columns (3) and (4) are the results of the estimation of the model (2) in which country-specific means are subtracted for the interaction terms of change of output and diversification index. In addition, columns (5) and (6) check the robustness of the estimates by subtracting country-specific means from the diversification index. Results with and without country-fixed effects are showed for each case.

²⁴ Commodity exporters, used in this context, are defined as those countries with more than 50% of their total exports consisting of fuels and other commodities. The difference between commodity and non-commodity exporters is less for the diversification indexes, based on output and employment (Papageorgiou, et al., 2014).

Relatively consistent results with the baseline estimation are obtained, except that the coefficient on the interaction term between the change of output and below lower-income countries is now statistically insignificant. The coefficient on the interaction term between the change of output and commodity dependence is -0.452 , statistically significant at 1%. The coefficient on the interaction term between the change of output and two dummy variables, that are a commodity-dependent and below-lower-income group, is 0.503 , remaining statistically significant at 1%. Except for lower-income countries, the effects of change in output do not depend on the export diversification index. Even for lower-income countries, the coefficient on interaction term between the diversification index and change on the output is -0.249 , significant at 10%.²⁵

The result indicates that the difference in the income level is less and statistically insignificant for non-commodity-dependent countries, while the difference in income level is greater for the commodity-dependent countries. For commodity-dependent countries, the sensitivity of the consumption of the lower-income group is higher than the higher-income group, confirming the baseline result. Similar results to the export diversification index are obtained when its extensive and intensive margins are used instead.²⁶

1.4 Conclusion

This chapter studies the excess volatility of the consumption in the context of excess sensitivity of consumption to output using cross-country panel data. I find heterogeneous sensitivity of consumption across a classification of countries when countries' characteristics, such as their commodity dependence and income level, are incorporated. The volatility of consumption is observed to be lowest for the high-income countries, however, I do not get the same result when it is translated into the sensitivity of consumption to output. Furthermore, the patterns of the sensitivity of consumption on income level appear differently by the country's commodity dependence. For the commodity-dependent countries, the sensitivity is higher for the lower-income groups, whereas the opposite pattern is observed for the non-commodity dependent countries. A consistent result is obtained when the export diversification index is controlled.

²⁵ The coefficients on the *ComDep* and *IncomeBelow* \times *ComDep* are insignificant.

²⁶ The results of the extensive and intensive margins are not included in this chapter, but are available upon request.

The evidence of excess volatility of consumption in rather low-income commodity-dependent countries indicates that the country's resource wealth should be taken into account, in addition to the income level, to implement policy tools to mitigate such volatility. Those countries are vulnerable to external shocks, such as commodity price movement and demand of the natural resource or weak government institutions and political instability (Jeffrey, 2012; Ross, 2015). While these factors may be responsible for the inducement, understanding why low-income, resource-rich countries are associated with excess volatility provides room for further research. One way to answer this question, although empirically challenging, is to distinguish the role of the shocks in each economy and to examine the mechanisms that lead to excess volatility. Such country studies and their comparisons are expected to help clear the conditions under which excess volatility is most likely to occur and how to deal with them.

1.5 Appendix

A. Country classification by income level and export commodity dependence

Dependence on exports of minerals, ores, and metals

Income category	Countries
High-income	Australia, Chile
Upper-middle-income	Armenia, Botswana, Jamaica, Montenegro, Namibia, Nauru, Peru, Suriname
Lower-middle-income	Ghana, Kyrgyzstan, Lao People's Democratic Republic, Mauritania, Mongolia, Papua New Guinea, Uzbekistan, Zambia
Low-middle-income	Burkina Faso, Burundi, Democratic Republic of the Congo, Eritrea, Guinea, Guyana, Liberia, Mali, Mozambique, Nigeria, Rwanda, Sierra Leone, Tajikistan, Togo, United Republic of Tanzania

Dependence on exports of fuel

Income category	Countries
High-income	Bahrain, Brunei Darussalam, Greece, Kuwait, Norway, Oman, Qatar, Saudi Arabia, Trinidad and Tobago, United Arab Emirates
Upper-middle-income	Algeria, Azerbaijan, Colombia, Equatorial Guinea, Gabon, Iran, Iraq, Kazakhstan, Libya, Russian Federation, Saint Lucia, Turkmenistan, Venezuela
Lower-middle-income	Angola, Bolivia, Cameroon, Congo, Nigeria, Sudan, Timor-Leste
Low-income	Chad, Yemen

Dependence on exports of agricultural products

Income category	Countries
High-income	Argentina, Iceland, New Zealand, Palau, Seychelles, Syrian Arab Republic, Uruguay
Upper-middle-income	Belize, Brazil, Ecuador, Fiji, Guatemala, Maldives, Paraguay, Tonga
Lower-middle-income	Cote d'Ivoire, Djibouti, Kenya, Kiribati, Micronesia, Myanmar, Sao, Tome and Principe, Solomon Islands, Vanuatu
Low-income	Afghanistan, Benin, Central African Republic, Comoros, Ethiopia, Gambia, Guinea-Bissau, Madagascar, Malawi, Senegal, Somalia, Uganda, Zimbabwe

B. Tables and Figures

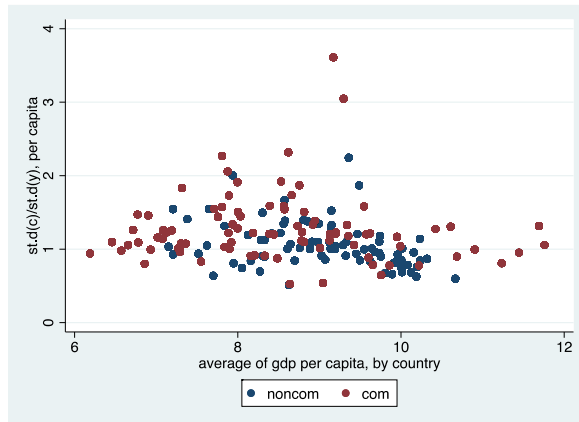


Figure 1. The relation between the ratio of consumption to output volatility and output per capita by countries' commodity dependence

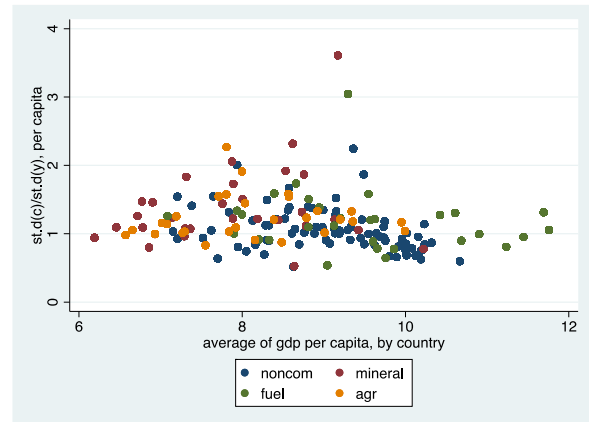


Figure 2. The relation between the ratio of consumption to output volatility and output per capita by countries' commodity type

Note: Each dot indicates a country. For Figure 1, the blue-colored dot indicates that a county is non-commodity dependent, and the red-colored dot indicates that country is commodity-dependent. In Figure 2, the countries are depicted by commodity type. Mineral-, fuel-, and agricultural products dependent countries are depicted in red-, green-, and yellow-colored dots, respectively.

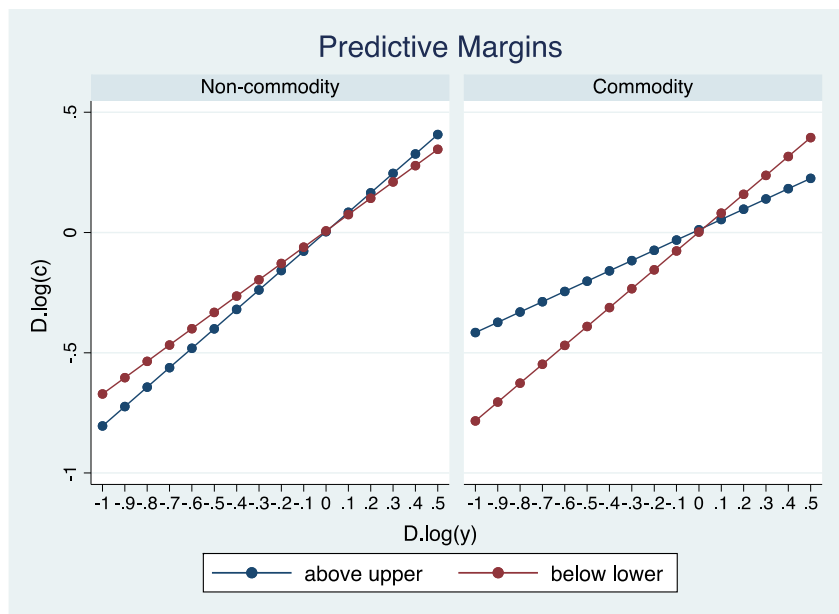


Figure 3. Effect of the sensitivity of consumption to output between income groups by commodity dependence

Table 8. Summary statistics of the export diversification index, its extensive and intensive margins

	mean	p50	min	max
Diversification index	3.545	3.603	0.961	6.438
Extensive margin	0.647	0.370	-0.064	6.438
Intensive margin	2.909	2.848	0.000	6.425
Observations	9626			

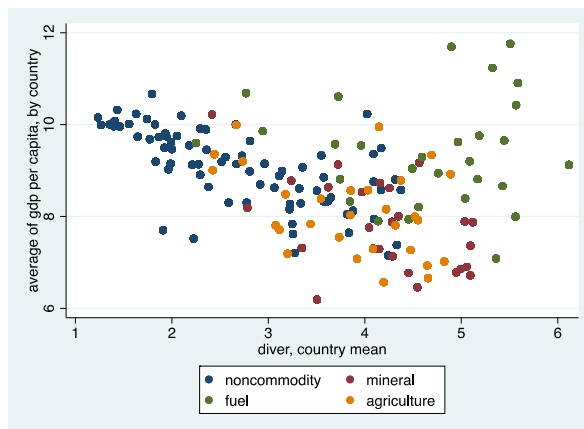


Figure 4. The relation between output per capita and export diversification index by commodity type

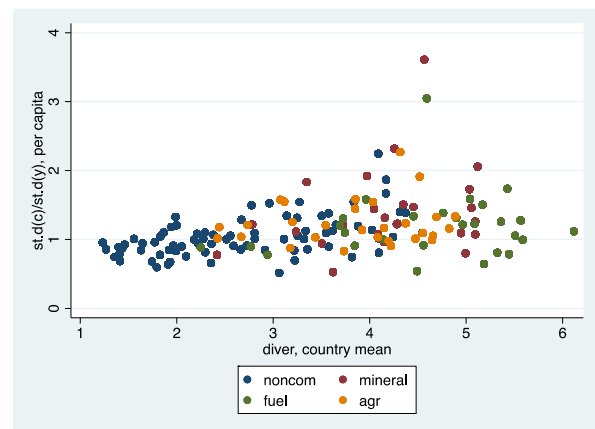


Figure 5. The relation between the ratio of consumption to output volatility and export diversification index by commodity type

Note: The horizontal axis is the export diversification index. A lower value indicates that a country is export diversified. Each dot indicates a country and the country is depicted by its commodity type. Mineral-, fuel-, and agricultural products dependent countries are depicted in red-, green-, and yellow-colored dots, respectively.

Table 9. Dependent variable: Change of consumption, per capita

	(1) D.log(c), per capita	(2) D.log(c), per capita	(3) D.log(c), per capita	(4) D.log(c), per capita	(5) D.log(c), per capita	(6) D.log(c), per capita
D.log(y)	0.808*** (0.043)	0.803*** (0.047)	0.822*** (0.041)	0.817*** (0.044)	0.822*** (0.042)	0.817*** (0.044)
IncomeBelow	0.003* (0.002)	0.000 (.)	0.009 (0.007)	0.000 (.)	0.001 (0.009)	0.000 (.)
IncomeBelow X D.log(y)	-0.130** (0.066)	-0.122* (0.071)	-0.051 (0.052)	-0.033 (0.058)	-0.055 (0.053)	-0.034 (0.058)
ComDep	0.008*** (0.002)	0.000 (.)	0.009* (0.006)	0.000 (.)	0.010 (0.006)	0.000 (.)
ComDep X D.log(y)	-0.381*** (0.106)	-0.386*** (0.110)	-0.452*** (0.110)	-0.459*** (0.114)	-0.453*** (0.110)	-0.460*** (0.114)
IncomeBelow X ComDep	-0.013*** (0.003)	0.000 (.)	-0.021* (0.011)	0.000 (.)	-0.013 (0.013)	0.000 (.)
IncomeBelow X ComDep X D.log(y)	0.488*** (0.124)	0.488*** (0.129)	0.503*** (0.121)	0.498*** (0.127)	0.509*** (0.121)	0.501*** (0.127)
Div			0.001 (0.001)	0.002 (0.002)	0.001 (0.001)	0.003 (0.002)
D.logy-mean(D.logy) X Div- mean(Div)			-0.055 (0.052)	-0.065 (0.053)		
ComDep X D.logy- mean(D.logy) X Div- mean(Div)			0.031 (0.106)	0.015 (0.110)		
IncomeBelow X D.logy- mean(D.logy) X Div- mean(Div)			-0.249* (0.147)	-0.254 (0.166)		
IncomeBelow X ComDep X D.logy-mean(D.logy) X Div- mean(Div)			0.200 (0.190)	0.212 (0.209)		
D.log(y) X Div-mean(Div)					-0.045 (0.047)	-0.063 (0.051)
ComDep X D.log(y) X Div- mean(Div)					0.014 (0.103)	0.009 (0.112)
IncomeBelow X D.log(y) X Div-mean(Div)					-0.216 (0.143)	-0.237 (0.153)
IncomeBelow X ComDep X D.log(y) X Div-mean(Div)					0.173 (0.188)	0.198 (0.203)
Constant	0.013** (0.006)	0.016*** (0.005)	0.011** (0.005)	0.014 (0.009)	0.011** (0.005)	0.008 (0.009)
Obs	9233	9233	6802	6802	6802	6802
Adj R2	0.308	0.302	0.314	0.307	0.314	0.307
Date FE	YES	YES	YES	YES	YES	YES
Country FE	NO	YES	NO	YES	NO	YES

Standard errors in parentheses.

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

(1) and (2) are the results from base line regression model (1).

(3) and (4) are the results from model in which diversification index is incorporated. Country-specific means are subtracted from change of output and diversification index, $(\Delta \log Y_{i,t} - \overline{\Delta \log Y_i}) \times (Div_{i,t} - \overline{Div_i})$.(5) and (6) are the results from the model in which diversification index is incorporated. Country-specific means are subtracted from diversification index, $\Delta \log Y_{i,t} \times (Div_{i,t} - \overline{Div_i})$.

2 Are There Any Heterogeneities of Excess Sensitivity of Consumption at the Micro-Level? If So, Why?

2.1 Introduction

How is the excess sensitivity of consumption to income observed at the household level? If excess sensitivity exists, are there any heterogeneities across income groups? There are explanations, such as liquidity constraints or trend income changes, to explain the excess sensitivity of the consumption. If the former holds, then households with low-income or low wealth exhibit an excess sensitivity more so than households with high-income or high wealth. If the latter holds, then consumption is expected to be sensitive for all the households. Using the household survey data in Mongolia, I find heterogeneous sensitivity of consumption across income groups, and this finding is attributed to the latter reason, that is, the change of the income trend. Furthermore, I find higher sensitivity for rather high-income groups.

A driving force of excess sensitivity for income groups is rationalized in the context of the stochastic trend hypothesis when the country's economic development since the 2000s is taken into account (Aguiar and Gopinath, 2007).²⁷ The country's output trend growth rate is a changing volatile; it increases until 2012 and then declines thereafter (Figure 6). According to the hypothesis, the output trend growth rate is affected by the permanent shocks that hit the economy. The timeline of output trend growth rate is associated with the discovery of one of the largest mines in the world in the early 2000s and policy changes towards the development of the mining sector. Particularly, a decline in the output trend growth rate is associated with the suspension of the largest financial undertaking in the mining sector. Furthermore, the economy goes through the boom-bust cycle accompanied by a significant change in key

²⁷ The theoretical approach of Aguiar and Gopinath (2007) is developed on the modern business cycle framework. It differentiates between transitory and permanent shocks to an economy and it is the latter that affects the output trend growth rate. The theory is raised to explain the business cycle characteristics in developing and emerging economies that have been known for their distinct characteristics from that of developed countries. They are featured with volatile output, consumption, and the volatility of consumption often exceeds that of output (see, e.g., Kaminsky, Reinhart, and Végh, 2004). Such volatile business cycle characteristics are indeed observed at the aggregate level in Mongolia. Table 12 shows the volatile output and consumption, and the ratio of volatility between consumption and output.

The other approach to explain the aggregate volatility in developing and emerging economies emphasizes the financial frictions reflected by country risk spread or foreign interest rate shocks (see, e.g., Uribe and Yue, 2006).

macroeconomic indicators (D. Gan-Ochir, et al., 2017; and Dovchinsuren, 2020).²⁸ It expands after the Global Financial Crisis in 2009 until around 2013, followed by a recession and then a financial crisis in 2016.

When an economy is hit by a permanent shock, agents' expectations of further economic growth change, and their consumption behavior are adjusted accordingly. Figure 7 shows changes in the household income trend for the lowest-, mid-, and highest-income groups from the representative household survey data in Mongolia, conducted from 2009 to 2018. Similar to the output trend growth rate, the household's income trend growth for each income group is increasing until 2012, and then it is in decline until 2016. Using the survey data, which covers the period of volatile change in output trend growth rate, I estimate the households' sensitivity of consumption to income and I find heterogeneous sensitivity across income groups. Furthermore, the sensitivity is observed to be higher for rather high-income groups, which is partially explained by the regional differences.

Consumption behavior at the household level has been studied intensively based on the well-known life-cycle/permanent income hypothesis (LC/PIH) hypothesis in which households successfully undertake consumption smoothing.²⁹ As some specific episodes, where income changes for households are observable, have revealed, consumption responds to income, particularly anticipated income (Jappelli and Pistaferri, 2010).³⁰ One of the major reasons for the failure of the theory is attributed to liquidity constraints. Zeldes (1989) reveals the sensitivity of the consumption to income arises for the low-asset group when U.S. households are separated, based on their asset. Excess sensitivity of the households' consumption is attributed to the liquidity constraints when fiscal experiments, such as tax rebates, tax change, or transfer programs, are employed. Johnson, Parker, and Souleles (2006) find that consumption responds to the tax rebate and also that the sensitivity is higher for low-income households.³¹

²⁸ D. Gan-Ochir et al. (2017) report that there have been two business cycles accompanied by economic expansion and contraction since 2000 in the country.

²⁹ Modigliani and Brumberg (1954) and Friedman (1957) build a foundation on the idea.

³⁰ Jappelli and Pistaferri (2010) organize the approaches and strategies employed in the empirical studies of consumption behavior.

³¹ Agarwal, Liu, and Souleles (2007) analyze the consumption response to the tax rebate and corroborate the finding of Johnson, Parker, and Souleles (2006).

On the other hand, the excess sensitivity is not always explained by the liquidity constraints of low-income households, and the reason is not consistent through the empirical findings. Parker (1999) and Souleles (1999, 2002) find the excess sensitivity from expected tax changes, refunds, and reductions, however, the failure of the theory is not necessarily credited to liquidity constraints. Shapiro and Slemrod (1995, 2003, 2009) analyze the subjective consumption responses of the individuals to tax policies and do not find any evidence of liquidity constraints or myopia.³² Furthermore, the magnitude of the anticipated income might influence the response, a small quantity of the income change might be too minor to influence the consumption (Browning and Collado, 2001).³³

Based on advancement in theoretical modeling and econometric analysis of household behavior with risk assessment, the excess sensitivity of the consumption has been started studying at the household-level in such regards. This is parallel to the excess sensitivity tests of the LC/PIH found in the studies of consumption at the aggregate level (Cox and Fafchamps, 2007). If sufficient risk-sharing holds among households, then the fluctuation in consumption comes from aggregate income fluctuations and not from an individual one. Although not to the extent of perfect risk-sharing, Townsend (1994) finds evidence of risk-sharing that comes close, when he studies the panel data of agricultural households at the village-level in rural India.

The strategy of separating aggregate income shocks from idiosyncratic shocks has been employed to study the extent of risk insurance in different groups and countries. Later studies, including Townsend's work, find evidence against complete risk-sharing and only partial risk-sharing holds. Ravallion and Chaudhuri (1997) use the same data as Townsend (1994) and find higher estimates of excess sensitivity than the original estimates by modifying the methods.³⁴ Weerdt and Dercon (2006) and Conning and Udry (2007) cover such empirical studies on risk insurance to some extent.³⁵ In each case, the full risk-sharing hypothesis among the relevant

³² Shapiro and Slemrod (1995, 2003, 2009) measure individual responses to different tax policies, such as a cut in the tax withholding and tax rebate. The results might be biased due to the subjective responses of the survey data (Jappelli and Pistaferri, 2010).

³³ Scholnick (2009) finds results consistent with the magnitude hypothesis, by examining how consumption responds to the amount of expected mortgage payments.

³⁴ Assumptions made in the utility function are common rates of time preference, separability of consumption and leisure, and additively separable preferences over time.

³⁵ For example, Deaton (1997) and Grimard (1997) use the data in Cote d'Ivoire, Townsend (1995) studies the different areas in Thailand. Jalan and Ravallion (1999) look into China, Dercon and Krishnan (2000) study in Ethiopia, Fafchamps and Lund (2003) look into rural Phillippines, Kazianga, and Udry (2006) investigate in Burkina Faso, and Weerdt and Dercon (2006) test in Tanzania.

groups is rejected, however, evidence of partial risk-sharing is often found. Such empirical studies indicate that risk-sharing among certain groups, such as villages and subgroups, can provide effective risk insurance (Conning and Udry, 2007).

This study contributes as further evidence from Mongolian households to the existing literature of the empirical studies on excess sensitivity of consumption.³⁶ I estimate the sensitivity of household's consumption for five income groups using the representative household survey data in Mongolia and employing the empirical strategy applied in the context of risk-assurance. The rest of the chapter is organized as follows. Section 2 describes the economic development and policy changes associated with the mining sector in Mongolia. Section 3 presents the household survey data. Section 4 consists of three subsections. First, empirical analysis to estimate the sensitivity of consumption to income is introduced. Next, the empirical results are presented, followed by the results of the regional difference. Lastly, Section 5 concludes.

2.2 Background in Mongolia

The Mongolian economy has been growing rapidly since its transition from a centrally-planned to a market-oriented economy in the early 1990s and, furthermore, the mining sector has been increasing its influence on the economy since the 2000s. Figure 8 shows the share of the agricultural and mining sector in nominal output. Although the share of the agricultural sector is declining steadily, the share of the mining sector increases sharply in the early 2000s and is stable thereafter. Raw minerals consist of more than 90% of the export and account for almost half of the fiscal revenue (Tserendorj and Purevjav, 2012).

The boom in the share of the mining sector in the early 2000s was derived from the discovery of the so-called Oyu Tolgoi (OT) mine, abundant in copper and gold, in Omnogovi province. Concluding the investment agreement between the Mongolian Government and Ivanhoe Mines in 2009, the OT project has been developed as the largest financial undertaking within the country.³⁷ The project is comprised of two phases of the extraction process, considering the

³⁶ Although micro-level analysis holds its limitations, it is worth investigating as excess sensitivity arising at the aggregate level might be due to the aggregation bias (Altonji and Siow, 1987).

³⁷ Ivanhoe Mines' name was changed to Turquoise Hill Resources in 2012. The OT project has been developed as a joint venture between the Mongolian government and Turquoise Hill Resources, in which Rio Tinto holds a majority stake and project financing is being obtained from both stakeholders.

mine's large scale. The first phase starts with open-pit mining techniques, then it gradually goes into the second phase of an underground project where 80% of the total mineral is stored (Ergo Strategy Group, 2018). The first phase was implemented between October 2010 and June 2013 and the second phase was scheduled to start immediately after the completion of the first phase (Ergo Strategy Group, 2018), however, it did not go as planned.

Development of the mining sector, led by the OT project and associated policy towards the sector, has been accompanied by the country's boom-bust cycle with key macroeconomic indicators. Associated with the start of the OT project, large Foreign Direct Investment (FDI) flowed from 2009 and 2012 during the first phase of the construction process (Figure 9). The amount of more than 6 billion dollars accounts for nearly 50% of the country's output at that time (IMF, 2015).³⁸ With a relatively stable macroeconomic condition and an expected increase in the export and optimistic revenue projection, the government issued the first sovereign bond to the international capital market in 2012 (Figure 10).³⁹ Supported by such external borrowing, international reserves reached an all-time high of 4.1 billion dollars at the end of 2012. Besides, the mining sector had been facilitated by the increase in the volume of the geological exploration based on the exploration expenditure until 2012 (Mineral Resources and Petroleum Authority, 2017). FDI standards were enacted to establish an environment to support investment and to protect the legitimate rights of investors in 2013.

Furthermore, the economy was enhanced by the expansionary fiscal policy implemented by the sizable source from external finance.⁴⁰ The domestic capital market is limited in its capacity to finance large and long-term projects, aimed to promote infrastructure and further development (Danaasuren, 2015). Such finance is provided by the government as off-budget

³⁸ 5.1 billion dollars of investment for the first-phase construction was contracted in the initial investment agreement. However, the cost exceeded the contract amount, and it led to a dispute between the shareholders as is documented later.

³⁹ The IMF (2012) documents that the country's macroeconomic stability and soundness are characterized by improved financial indicators, such as increasing capital adequacy and declining non-performing loans, at that time. The Mongolian government issued the government-guaranteed bonds, in addition to the sovereign bond, to the International Capital Market in 2012. With the successful issuance of a low bond yield at that time, both types of bonds were acclaimed by prestigious publications and captured the attention of foreign investors. The first sovereign bond, the so-called Chinggis Bond, was awarded "Best Sovereign Bond and Best Mongolia Deal" by the Finance Asia group, Hong Kong-based publication. The detailed issuance of the bonds is described in Table 13.

⁴⁰ As opposed to expansionary fiscal policy, countercyclical monetary policy was taking place to counteract the inflationary pressures arising from the fiscal policy. Inflation was around 15%, due to rapid government spending. However, in addition to the fiscal policy, monetary policy was eased from 2013 to recover the economic slowdown in mining development and coal exports. This is documented later.

spending and, therefore, it increased by 70% in real terms from 2010 to 2012 (IMF, 2014).⁴¹ For example, more than half of the first sovereign bond is directed towards projects that support the economic and social development of urban and rural areas (Figure 11). Among the category of urban development, nearly 40% is directed to the projects constructing modern public transport infrastructures, such as highway networks, new roads, and intersections in the streets, to alleviate the heavy traffic congestion and smoke (Figure 12) (Development Bank of Mongolia, 2014). Despite not being long after the Global Financial Crisis, the country experienced a relatively high output growth rate, 12.4% in 2012 and 11.7% in 2013 (Figure 13).

However, it was after the short economic expansion, that the economy had started slowing down, accompanied by the sudden discontinuation of the second phase of OT mine and its vulnerability had been unmasked. The Mongolian government announced their suspension of the first phase of the OT project before it moved onto the second phase, as the cost exceeded the contract amount.⁴² The government and related stakeholders held several meetings on the reason for the increase in the investment costs of the first phase and revision of the feasibility study of underground mining. Due to the disagreement over the construction and further development issues, the underground extraction work had been suspended from the initial schedule. It was late 2016 when the second phase of the construction was restarted, after the investment agreement on the revised terms between stakeholders was finally re-signed (Ergo Strategy Group, 2018). Mining activities were also generally restricted during this period: the issuance of new exploration licenses was suspended from 2010 to 2015 and 106 exploration licenses were revoked in 2013 (Mineral Resources and Petroleum Authority, 2017; and B. Dulamkhorloo, 2013).⁴³

Similar to the economic boom period, the recession period was accompanied by featured movements in key indicators. More than 50% depreciation in the nominal exchange rate from January 2012 to December 2016 and 20% depreciation were recorded over the 6 months in

⁴¹ The finance for large and long-term projects has been provided by the Development Bank of Mongolia (DBM) which was established by the Government in 2010. This is regarded as the off-budget spending of the Government.

⁴² As previously mentioned, the 5.1 billion dollars of investment was contracted in the initial investment agreement. The cost reached nearly 7 billion dollars at the end of the construction. Furthermore, the total investment costs on the first and second phases were increased from 14.6 to 24.4 billion dollars (E. Urantsetseg, 2013).

⁴³ The issuance of a new exploration license was suspended due to a law adopted in 2010. The law was revised in 2014 and the exploration license has been re-issued since 2015. The revoked 106 licenses were also reclaimed in 2015 (Mineral Resources and Petroleum Authority, 2017).

2016 (IMF, 2015). The Bank of Mongolia's international reserves declined considerably, contrary to large accumulation during the first phase of the OT project. The accumulated Debt-to-GDP ratio reached 87.6% of output in 2016, from an average of 37.3% between 2006 and 2014, with external Debt-to-GDP amounted to 67.8% since the country's first issuance in 2012.⁴⁴ Off-budget spending of the Government increased considerably with the primary deficit reaching 13.1% of output in 2016 from an average of 2.8% between 2006 and 2014 (IMF, 2017a).

Highly-vulnerable macroeconomic conditions and fragile stability were revealed, as in the rapid increase in fiscal deficit and accumulated debt, and the sharp decline in the exchange rate, and international reserves. Furthermore, the commodity prices started declining and China's demand for raw minerals was slowing down in the world market (Batdelger, et al., 2018; and IMF, 2015). In late 2016, an IMF bailout package was implemented, addressing the high degree of risk of a debt crisis and exposure to global commodity demand.

Figure 14 shows the share of the investment by sectors at the country level since 2009. Investment in the mining sector expands substantially, it reaches more than 60% in 2011, and then it steadily shrinks until 2016. This is associated with the evolution of the sector in the provinces that sector contributes to the regional output. Table 14 shows the share of the mining sector in nominal output by regions since 2010.⁴⁵ For eight regions (Dornod, Dornogovi, Omnogovi, Orkhon, Selenge, Sukhbaatar, Ulaanbaatar, and Govisumber), the share exceeds 10% in 2010. More than half of the output is comprised of the mining sector in Orkhon and Omnogovi. Other than Selenge province, the share of the mining sector for those provinces is already high in 2010, or is increasing during the economic expansion period. For three of the provinces (Dornod, Dornogovi, and Ulaanbaatar), the share of the mining sector increases during the expansionary period and then it shrinks during the contractionary period. For four of the provinces (Omnogovi, Orkhon, Sukhbaatar, and Govisumber), the share is already high in 2010, it declines during the recession, and then it increases again in 2017.⁴⁶ Furthermore, the share of the mining sector increases over time in provinces that have not engaged much in the sector in the early years. This is considered to be driven due to the mining boom in the early

⁴⁴ According to the IMF definition of general government debt, it "excludes SOEs debt and central bank's liabilities from PBOC swap line" (IMF, 2017a, 22).

⁴⁵ Data of the structure of output by province is available publicly after 2010.

⁴⁶ For Selenge province, the share of the mining sector declines over time.

2000s and the enhanced extraction process.⁴⁷

2.3 Data and Descriptive Analysis

The household data used in the analysis is based on the Household Socio-Economic Survey (HSES), a national representative survey conducted by the National Statistical Office of Mongolia (NSO). The survey is primarily used to evaluate households' income and expenditure, and further utilized in the poverty analysis, CPI update, and the input of the national account.⁴⁸ It was first conducted in 2002 and 2003 and the next survey covered 2007 and 2008. The successive data is collected from 2009, covering 12 months for each year and, therefore, I utilize the data from 2009 to 2018. Over 10,000 households are interviewed in each survey and the survey years which end with even numbers are rich with sample size. The number of households in each year is as follows: 11,126 in 2009, 11,117 in 2010, 11,166 in 2011, 12,709 in 2012, 11,162 in 2013, 16,072 in 2014, 11,156 in 2015, 16,400 in 2016, 11,151 in 2017, and 16,349 in 2018.⁴⁹ The design of the HSES is described in the Appendix.

My general procedure is to follow income groups, which are quintiles, through time by utilizing successive years of cross-sectional household survey data. The survey data is not panel data, so the same individuals or households are not followed over time and, therefore, I cannot obtain individuals' or households' histories. However, repeated cross-sectional data takes a different sample of a population over time, they are suitable for analyzing population or group changes. This aggregate change over time can be analyzed with a fixed-effects model, which is based on grouping "similar" individuals in groups and "group-averages" are treated as the observation from pseudo-panel data.⁵⁰

The first-level stratification, comprised of 20 provinces and a capital city, from the sample

⁴⁷ Table 15 shows an average of the real province output growth rate from 2010 to 2016. Provinces are divided into mining and non-mining groups. Those eight provinces in which the share of the mining sector exceeds 10% in 2010 are categorized into mining group and other provinces are categorized into non-mining group. For both groups, the average real output growth rate is more than 10% during the expansionary period and then substantially decreases to -6.96% in 2015 for the mining group and -5.84% for the non-mining group. Recovery of the output growth rate after the GFC is faster for the mining group than the non-mining group.

⁴⁸ The terminology of consumption and expenditure is used interchangeably throughout the chapter.

⁴⁹ These are the number of households after the outliers are subtracted. The households that fall outside of the three standard deviations from the mean are dropped.

⁵⁰ Please refer to Deaton (1985) and Moffitt (1993) for the earlier studies using the repeated cross-sectional data.

design of the HSES, is used to construct the quintiles. These are referred to as stratum, hereafter. Dataset of Govisumber province is excluded as the sample is a collected scattering, available only in the survey years of 2014 and 2016. Households in each stratum are divided into five equal parts, quintiles, based on their total income. The lowest income group corresponds to the first quintile, the second-lowest income group corresponds to the second quintile and, therefore, the highest income group corresponds to the fifth quintile. I apply the same procedure to each stratum, each year and track stratum-specific income quintiles over time. This procedure gives me pseudo-panel data, in which 105 constructed income groups (five quintiles for each of 21 strata) are tracked. For example, the first quintile of the capital city, which is the lowest income group, is tracked over time, then the second quintile of the capital city, the second-lowest income group, is tracked over time.

Figure 15 to Figure 19 show the average of real monthly, total income and expenditure each year by quintiles, respectively. Overall, all quintiles show an increasing and then stagnating trend of income and expenditure. Expenditure exceeds the income for the first quintile, whereas income and expenditure are mostly overlapped for the other quintiles, indicating income approximately equals expenditure. For the fifth quintile, the highest income group, income exceeds expenditure until 2015. Table 16 shows the average households' total income, expenditure, household head's age, and household size by quintiles. The household's total expenditure is the lowest for the first quintile and increases as the quintile rises. There is no distinguishable difference for average household head's age and household size across quintiles. Figure 20 shows the change of the trend component of the consumption by income quintiles. Similar to the income trend growth, the changes of the consumption trend growth are associated with the output trend growth for all quintiles.

2.4 Empirical Results

A. *Model Specification*

Excess sensitivities of the income groups are captured by following the specification made in Townsend (1994) and Ravallion and Chaudhuri (1997). As previously mentioned, the model specification allows testing excess sensitivity of the consumption to idiosyncratic income shock while separating the aggregate income shock. Townsend's original work and later

empirical studies employ the strategy at the village-level or relevant social groups, such as ethnic groups or neighbors. The sensitivity of the consumption is expected to arise from aggregate shock once the complete risk pooling is available at such a group, so that idiosyncratic shock is insured. With the nature of the data that I have, the repeated cross-sectional survey, I attempt to grasp the excess sensitivity of the consumption to income for income groups, while separating the aggregate country-level shock.⁵¹

Following empirical model is estimated for each of the quintiles.

$$\Delta \log c_{i,t} = \alpha_i + \alpha_t + \beta \Delta \log y_{i,t} + \Delta \varepsilon_{i,t} \quad (1)$$

The subscript i indicates a stratum-quintile, and t indicates the monthly date. A dependent variable is a change of log of real monthly household total expenditure. The first and second terms on the right-hand side are the stratum-quintile and time fixed effects. $\Delta \log y_{i,t}$ is a change of log of real monthly household total income, and coefficient β measures the sensitivity of consumption to income. Under the assumption of full-risk, the estimate of β is expected to be zero. The estimates of the beta will be consistent under the failure of the hypothesis of complete risk-sharing, so that excess sensitivity is observed from the idiosyncratic shocks when the coefficient β is above zero. To comprehensively capture how the sensitivity appears among income groups, the specified model is estimated for each quintile. That is, model (1) is estimated for each income group from one to five, and obtained estimates of the sensitivity are compared across quintiles. The standard errors are in parentheses and are robust to heteroscedasticity of unknown form and to an arbitrary serial correlation of disturbances within income stratum-quintiles. In addition, I use the lagged household income, following Zeldes (1989), instead of the change in income.

B. Empirical Results

Table 10 shows the empirical results of the model (1) by quintiles. Estimates on excess sensitivity of consumption to income are estimated to be 0.617 for the first quintile, 0.806 for

⁵¹ This is based on the approach employed in a well-known study by Zeldes (1989). He finds that excess sensitivity of consumption on households with a low asset when households are separated on their assets and, therefore, the excess sensitivity is attributed to liquidity constraints.

the second quintile, 0.837 for the third quintile, 0.846 for the fourth quintile, and lastly, 0.704 for the fifth quintile. Excess sensitivity is observed to be quite high for all the quintiles, statistically significant at 1% and, therefore, complete risk-sharing in the country is rejected. The sensitivity is getting higher as the quintile rises except for the fifth quintile. That is, other than the richest group, the richer the group higher the sensitivity of the consumption. For the richest income group, the sensitivity is higher than the lowest income group, however, it is lower than the other income groups. I get a robust result using the lagged household income, following the approach of Zeldes (1989), instead of the change in household income (Table 17).

Table 10. Empirical result of the model (1)

Dependent variable is change of consumption

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
D.log(y)	0.617*** (0.055)	0.806*** (0.028)	0.837*** (0.026)	0.846*** (0.025)	0.704*** (0.028)
Constant	0.078 (0.057)	0.142 (0.085)	0.076 (0.058)	-0.025 (0.070)	-0.063 (0.088)
Obs	2499	2499	2499	2499	2499
Adj R2	0.286	0.426	0.432	0.466	0.439
Time FE	YES	YES	YES	YES	YES
Stratum-Quintile FE	YES	YES	YES	YES	YES

Note: Standard errors are in parentheses and are robust to heteroscedasticity of unknown form and to arbitrary serial correlation of disturbances within income stratum-quintiles.

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

C. Can regional differences explain why the excess sensitivity of the consumption to income is higher for the rich groups?

The empirical model (1) is estimated with an additional dummy variable to capture how much the regional difference can explain the higher sensitivity of the consumption to income for the richer groups. The dummy variable takes one if the province is engaged in the mining sector and zero otherwise. As previously described, seven provinces, including the capital city, are regarded as the provinces engaged in the mining sector, based on the contribution of the mining sector to their output. Govisumber province is dropped due to scatter data availability of household survey data. The sensitivity of the consumption of the fourth quintile in the province engaged in the mining sector is significantly higher than those provinces not heavily engaged in the mining sector. The difference is 0.092, statistically significant at 5% (Table 11). For the other income quintiles, the difference between the regions is not confirmed.

Table 11. Empirical result of the model (2)

Dependent variable is change of consumption

	(1) Quintile 1	(2) Quintile 2	(3) Quintile 3	(4) Quintile 4	(5) Quintile 5
D.log(y)	0.569*** (0.073)	0.798*** (0.040)	0.812*** (0.020)	0.813*** (0.028)	0.687*** (0.033)
mine=1 X D.log(y)	0.133 (0.089)	0.020 (0.053)	0.073 (0.073)	0.092** (0.037)	0.053 (0.057)
Constant	0.074 (0.059)	0.141 (0.085)	0.072 (0.058)	-0.030 (0.071)	-0.066 (0.087)
Obs	2499	2499	2499	2499	2499
Adj R2	0.289	0.426	0.432	0.467	0.439
Time FE	YES	YES	YES	YES	YES
Stratum-Quintile FE	YES	YES	YES	YES	YES

Note: Standard errors are in parentheses and are robust to heteroscedasticity of unknown form and to arbitrary serial correlation of disturbances within income stratum-quintiles.

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

2.5 Conclusion

Excess sensitivity of household consumption to income is studied at the micro-level using the household survey data in Mongolia. Not only is heterogeneous excess sensitivity found among income groups, but also the sensitivity is found to be higher for the relatively richer groups, other than the richest group. If the liquidity constraints are the bottleneck, then it is expected that the relatively low-income group reveals higher excess sensitivity than the higher income groups.

Such behavior is rationalized within the scope of the stochastic trend hypothesis, considering the country's volatile economic development since the 2000s. The sudden boom of the mining sector, led by the OT project, the largest financial undertaking in the country, and associated government policy changes towards the sector have been considered to be influencing the economic and business activity. If such factors work as the "permanent shocks" which affect the output trend growth rate, agents' expectation and consumption behavior are optimally adjusted and, therefore, the excess sensitivity of the consumption across income groups are induced.

However, the framework explains to an extent that excess sensitivity does occur across income groups, it does not necessarily explain why relatively richer groups hold more sensitivity of consumption to income. The regional difference provides a partial explanation for the higher sensitivity of the rather richer groups. As previously described, associated with the increasing investment in the mining sector, the share of the mining sector to the output is increasing for those provinces heavily engaged in the sector. Similarly, when the investment is decreasing, the contribution of the sector to the output is declining. This suggests that those relatively high-income households located in those provinces are likely to be influenced by the mining-related boom-bust cycle. Although the regional difference provides a partial explanation, further research is needed to understand whether there is any systematic difference between the income groups. One way to tackle this question would be to investigate the nature of income shocks across households.

2.6 Appendix

A. Tables and Figures

Table 12. The volatility of output, consumption, ratio of volatility of consumption to output, and correlation of consumption and output

	Hodrick- Prescott	Baxter-King	Christiano- Fitzgerald	Butterworth
$\sigma(Y)$	5.91	3.76	5.17	5.49
$\sigma(C)$	7.52	6.84	6.62	7.1
$\sigma(C)/\sigma(Y)$	1.27	1.82	1.28	1.29
$\rho(C,Y)$	0.566*	0.634*	0.727*	0.556*

Note: The values are robust across Baxter-King, Christiano-Fitzgerald, and Butterworth filters. The ratio of the volatility of consumption to output exceeds one and it appears relatively high for the Baxter-King filter. Quarterly data of output and consumption, available from 2000, are used. The series is deseasonalized then the log is taken. Standard deviations of the series are computed on the cyclical components of the series which are extracted by different filters, such as Hodrick-Prescott, Baxter-King, Christiano-Fitzgerald, and Butterworth filters. The third row shows the ratio of the volatility of consumption to output. The fourth row shows the correlation coefficient between output and consumption. Star (*) notes significance level at 5%.⁵²

⁵² The Hodrick-Prescott (HP) filter is a data-smoothing technique, often used to extract out short-run fluctuations and reveal long-run trend component. Yet, the filtered series might contain spurious dynamic relations (Hamilton, 2018). The band-pass filters pass periodic components that lie within a pre-specified frequency band suppress fluctuations that are too long or too short (Cogley, 2008). Three types of band-pass filters, Baxter-King (BK), Christiano-Fitzgerald (CF), and Butterworth, are considered. BK and CF filters are very similar in design. Although they have the same ideal band-pass filter, they are different from three different perspectives: “in the approximation with respect to the length of the cycles considered, in the amount of calculable data points towards the ends of the data series, as well as in the removal of the trend of the original time series” (Everts, 2006, 1). Butterworth filter is a generalization of HP filter. Relatively smooth cycles are extracted from the series. Moreover, it adapts to the end of the sample and, therefore, it possesses a considerable degree of flexibility (Harvey and Trimbur, 2003).

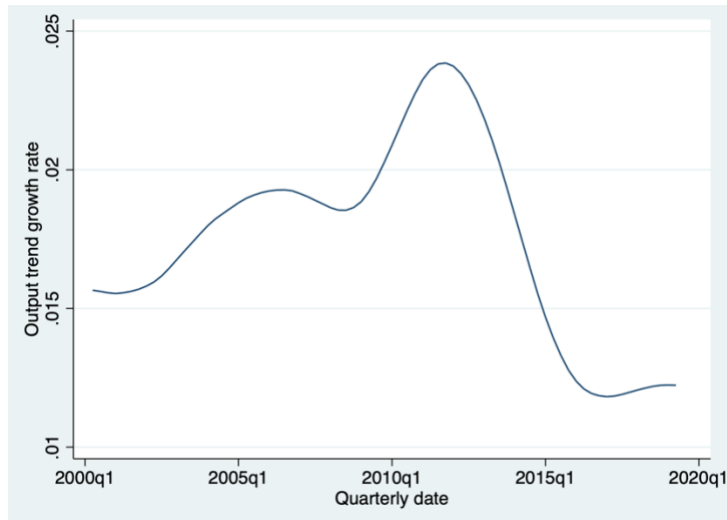


Figure 6. Output trend growth rate

Note: The unit of the horizontal axis is the percentage multiplying the values by 100. The trend component of the output is extracted by HP filter setting the smoothing parameter 1,600. The series is deseasonalized and then the log is taken before the trend component is extracted.

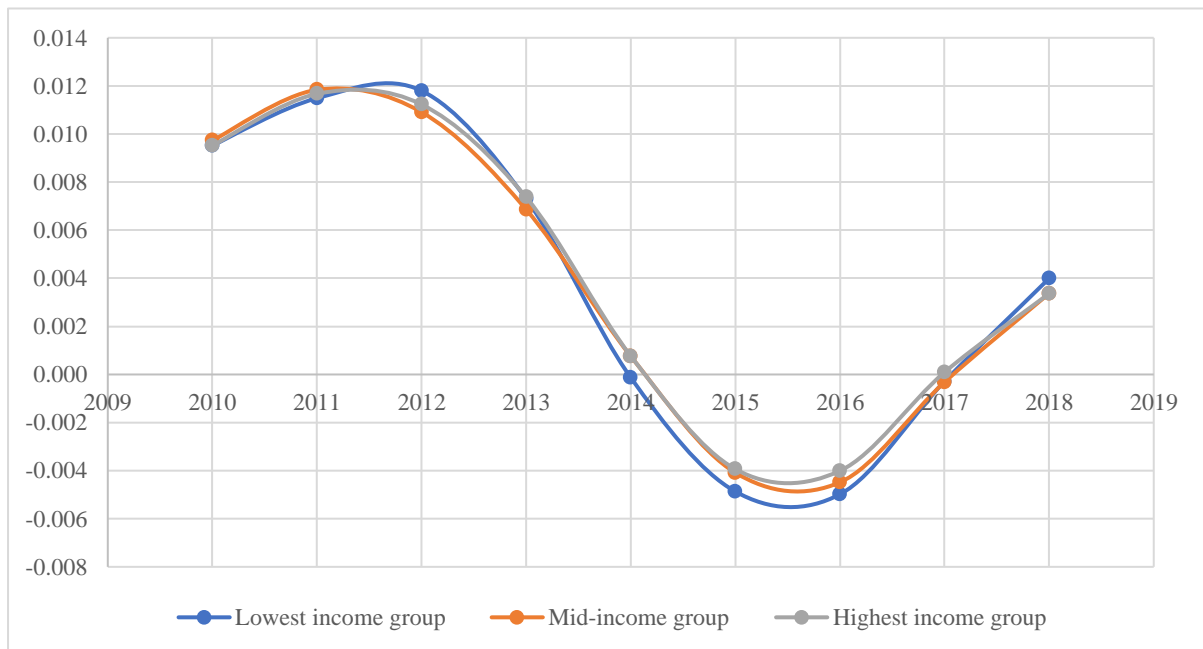


Figure 7. Change of the trend component of household's income of the lowest-, mid-, and the highest income groups

Note: The unit of the horizontal axis is the percentage multiplying the values by 100. Households are divided into quintile based on their total income. The trend component of the income is extracted by the HP filter.

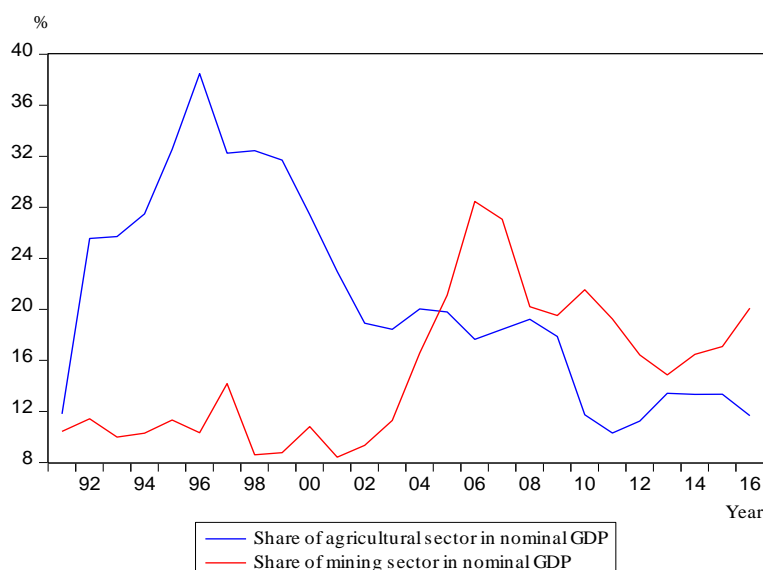


Figure 8. Share of agricultural and mining sector in nominal output

Table 13. Issuance of bonds in international capital market

(1)	(2)	(3)	(4)	(6)	(7)	(8)
Issued Year	Type of Bond (Name of bond)	Issued Institution	Amount	Yield Rate	Length (Year)	Return of Year
Mar. 2012	Government guaranteed bond	DBM	580 million dollars	5.75%	5	2017
Nov. 2012	Government bond (Chinggis)	GM	500 million dollars	4.13%	5	2018
Nov. 2012	Government bond (Chinggis)	GM	1 billion dollars	5.13%	10	2022
Dec. 2013	Government guaranteed bond (Samurai)	DBM	30 billion yen	1.25%	10	2023
Jun. 2014	Government guaranteed bond (Dim Sum)	DBM	1 billion yuan	7.50%	3	2018
Mar. 2016	Government bond (Mazaalai)	GM	500 million dollars	10.88%	5	2021
Mar. 2017	Government bond (Huraldai)	GM	476 million dollars	8.75%	7	2024
Mar. 2017	Government bond (Huraldai)	GM	124 million dollars	7.63%	7	2024
Jan. 2018	Government bond (Gerege)	GM	650 million dollars	-	-	-

Note: Information is collected from a yearly budget report provided by Ministry of Finance, Mongolia. Explanation of the abbreviation is mentioned below.

Column (2): Samurai bond refers to a yen-denominated bond issued in Japan to finance operation outside of Japan. Dim Sum bond refers to a renminbi-denominated bond issued outside of China.

Column (3): DBM refers to Development Bank of Mongolia, GM refers to Government of Mongolia.

Detailed information of Gerege bond is not yet provided at the time of December 2017.

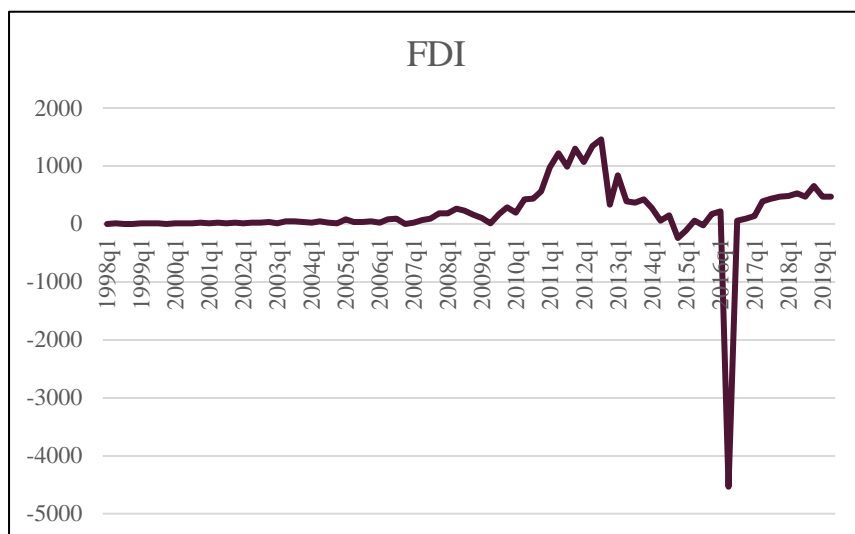


Figure 9. Foreign Direct Investment (FDI)

Note: The value in the horizontal axis is in million dollars. Since the end of the first phase of the Oyu Tolgoi project was accompanied by the delay of the second phase, FDI shrank and became almost zero in 2015. The large drop in 2016 reflects an accounting change related to Oyu Tolgoi's phase two (IMF, 2017a).

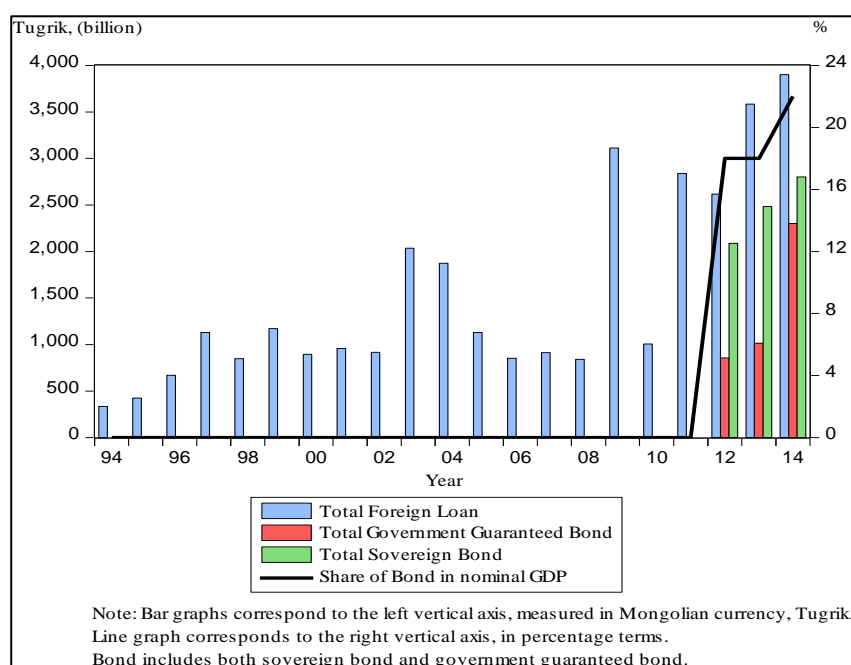


Figure 10. The total foreign debt and its components

Note: The figure shows the amount of the total foreign loan, government-guaranteed bond, and sovereign bond, measured in Mongolian currency, Tugrik. The sum of these are considered as total foreign debt. Until 2011, there had been only a foreign loan, which comprised of loans from other countries and international organizations. Black line represents the share of the bonds in nominal output. The amount of the bond is nearly 20 percent of nominal output.

Table 14. Share of the mining sector in output by provinces, %

	Provinces	2010	2011	2012	2013	2014	2015	2016	2017
1	Arkhangai	0.	0.1	0.	0.	0.3	0.5	0.7	0.6
2	Bayan-Olgii	1.	1.1	1.2	1.6	3.4	2.6	2.4	2.3
3	Bayankhongor	1.	2.6	2.2	0.9	7.2	12.7	14.8	12.7
4	Bulgan	0.4	0.8	0.7	0.5	0.9	1.8	1.9	1.9
5	Darkhan-Uul	6.6	7.7	12.4	8.7	5.4	8.7	16.8	12.2
6	Dornod	34.8	43.3	38.2	48.6	64.2	53.	59.1	63.5
7	Dornogovi	11.8	24.9	33.5	20.9	15.8	-2.8	4.8	5.3
8	Dundgovi	0.5	0.4	0.9	0.5	0.6	1.4	1.1	0.8
9	Govi-Altai	0.2	1.1	0.4	0.	5.8	10.8	11.1	10.3
10	Khentii	0.4	0.8	1.	0.7	0.4	0.1	0.2	0.3
11	Khovd	0.7	1.1	0.2	0.1	2.2	3.9	4.6	4.1
12	Khovsgol	0.4	1.3	0.6	0.3	7.1	12.5	14.4	13.6
13	Omnogovi	69.5	64.	38.9	47.	13.6	7.7	37.2	52.1
14	Orkhon	85.1	82.8	81.2	77.9	74.2	69.3	62.9	72.4
15	Ovorkhangai	3.7	0.9	0.8	0.9	3.	4.2	4.7	4.9
16	Selenge	49.2	37.3	36.	30.5	20.4	17.1	15.5	19.3
17	Sukhbaatar	45.3	35.	34.	25.	29.1	20.6	28.6	42.2
18	Tov	0.5	1.6	0.9	0.3	7.2	12.1	14.2	18.7
19	Ulaanbaatar	14.9	16.3	12.9	11.3	13.5	16.7	19.8	21.6
20	Uvs	0.4	1.3	0.7	0.9	5.7	9.3	11.8	11.3
21	Zavkhan	0.2	0.3	0.4	1.6	4.7	1.2	3.2	0.9
22	Govisumber	35.7	24.7	21.4	22.	24.	23.2	29.7	27.6

Table 15. Average of the real output growth rate by mining and non-mining engaged provinces, %

	2010	2011	2012	2013	2014	2015	2016
mining	18.93%	14.99%	7.10%	19.38%	10.17%	-6.96%	6.21%
non-mining	-12.44%	14.52%	17.37%	29.97%	12.62%	7.10%	-5.84%

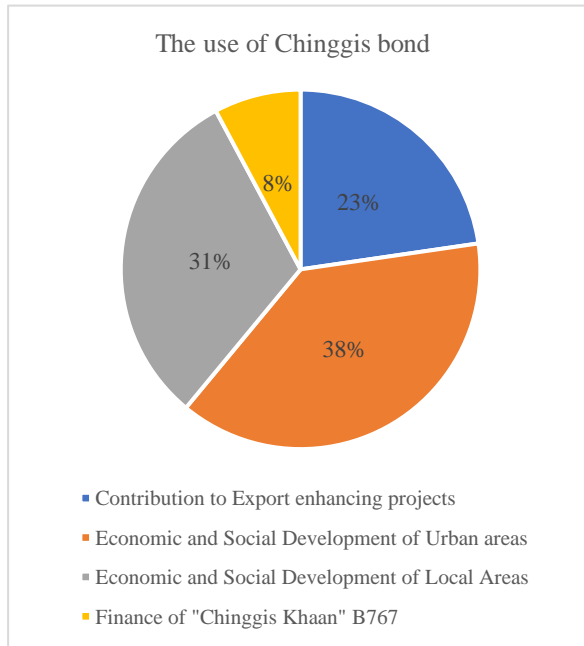


Figure 11. The use of external finance from Chinggis bond

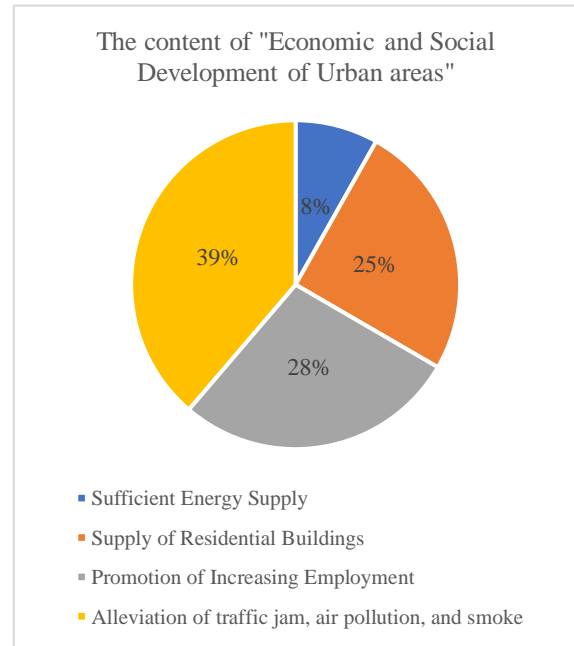


Figure 12. The content of "Economic and Social Development of Urban areas"

Note: The figures are created from the report of Development Bank of Mongolia (2014). The total amount of Chinggis bond is 2,502.7 billion tugrik and that amounts to 1.5 billion US dollar. The left figure shows the use of 2,203.5 billion Tugrik of Chinggis bond.

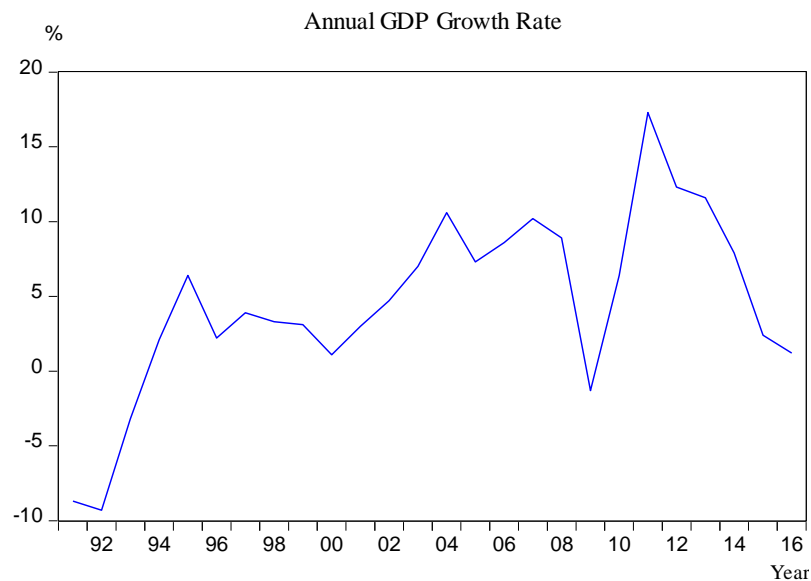


Figure 13. Annual real output growth rate

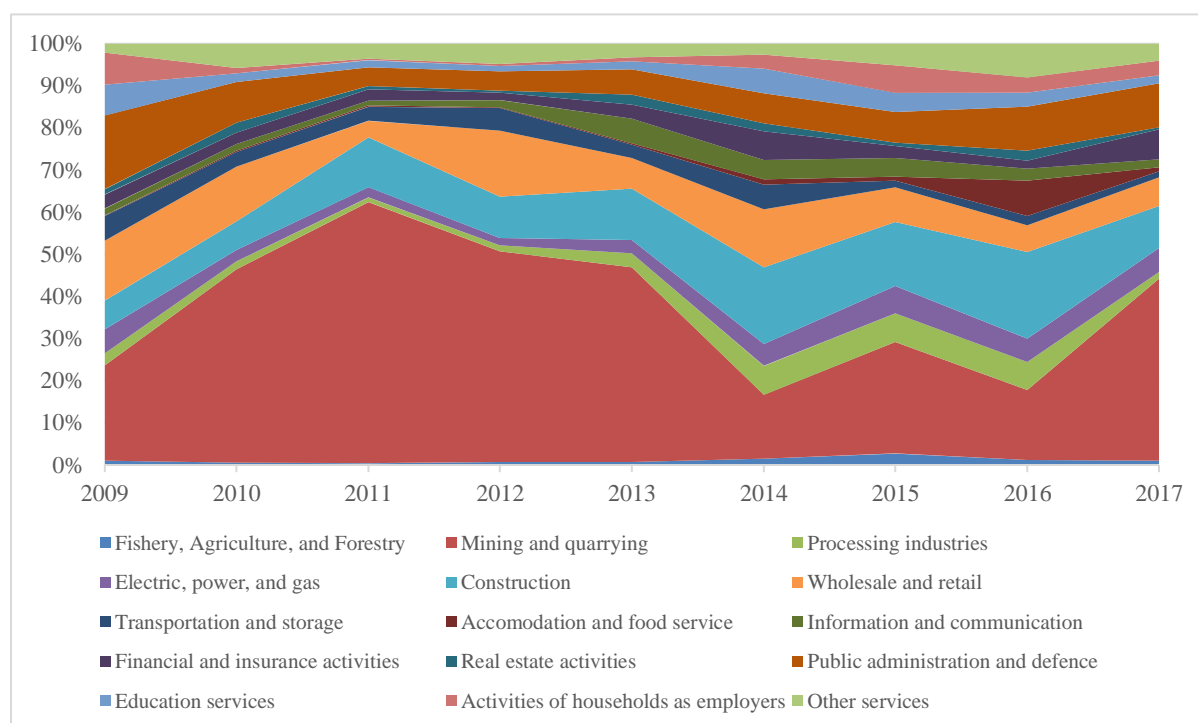


Figure 14. Share of the investment by sectors

Table 16. Description of income quintiles

	Quintile 1		Quintile 2		Quintile 3		Quintile 4		Quintile 5	
	mean	p50	mean	p50	mean	p50	mean	p50	mean	p50
Age of household head	46.69	45.00	46.02	44.00	45.35	44.00	44.61	43.00	44.40	44.00
Size of household	2.68	2.00	3.37	3.00	3.77	4.00	4.04	4.00	4.23	4.00
Real monthly total income	159761.66	152848.20	279902.99	270258.69	402390.01	386063.62	578951.05	557993.75	1051665.61	910658.06
Real monthly total expenditure	219874.92	187106.05	323233.45	289430.27	432948.70	384071.98	578863.74	519586.41	915959.01	792998.34
Observations	2520		2520		2520		2520		2520	

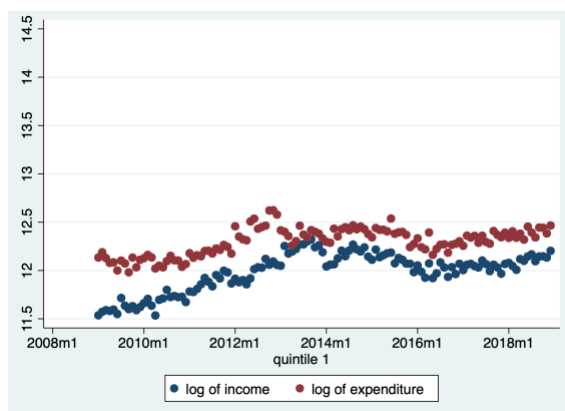


Figure 15. Quintile 1

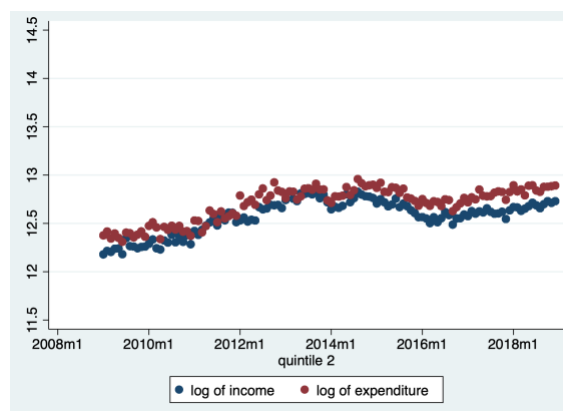


Figure 16. Quintile 2

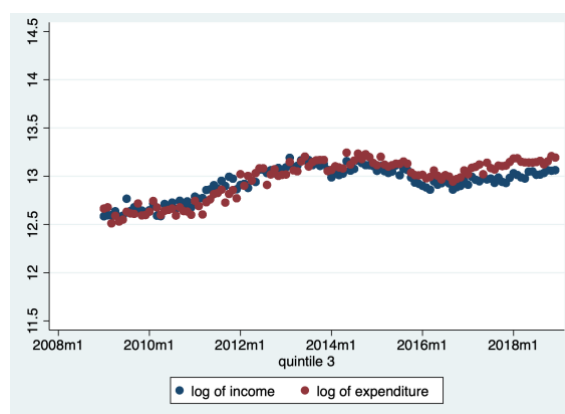


Figure 17. Quintile 3

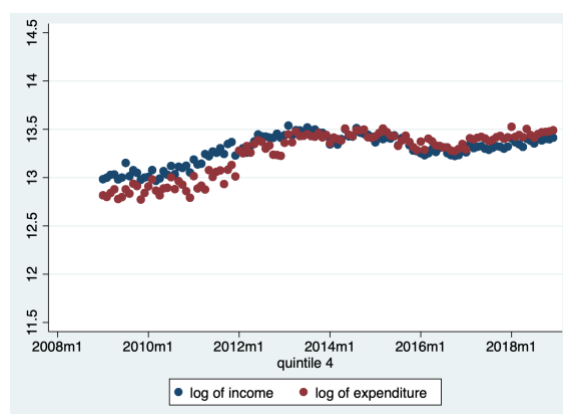


Figure 18. Quintile 4

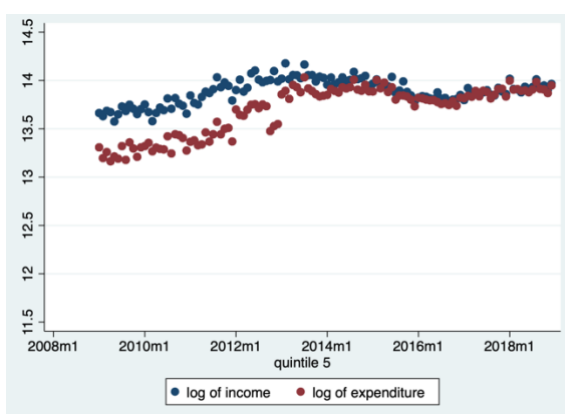


Figure 19. Quintile 5

Figure 15–Figure 19: Average log of real monthly total income and expenditure by income quintiles

Note: Average of the series is taken each year.

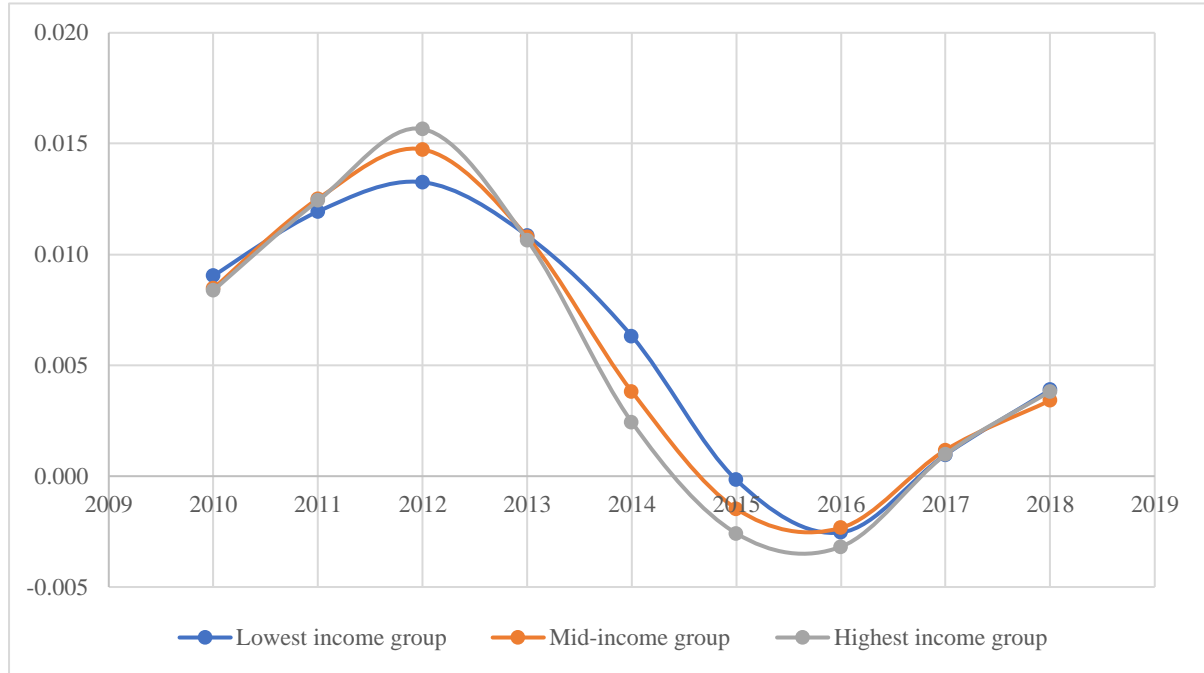


Figure 20. Change of the trend component of consumption by income quintiles

Note: The unit of the horizontal axis is the percentage multiplying the values by 100. The trend component of the consumption is extracted by the HP filter.

Table 17. Empirical result of the model (1)

Dependent variable is change of consumption

	(1)	(2)	(3)	(4)	(5)
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
L.log(y)	-0.415*** (0.054)	-0.561*** (0.042)	-0.589*** (0.036)	-0.609*** (0.050)	-0.557*** (0.045)
Constant	4.687*** (0.656)	6.776*** (0.524)	7.416*** (0.454)	7.903*** (0.630)	7.638*** (0.618)
Obs	2499	2499	2499	2499	2499
Adj R2	0.092	0.152	0.154	0.168	0.178
Time FE	YES	YES	YES	YES	YES
Stratum-Quintile FE	YES	YES	YES	YES	YES

Note: Standard errors are in parentheses and are robust to heteroscedasticity of unknown form and to arbitrary serial correlation of disturbances within income stratum-quintiles.

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

B. Design of HSES

In the HSES, a household refers to the people those who live together. Household members refer to “members of the household who usually live in the household, which may include people who did not sleep in the household previous night, but does not include visitors who slept in the household the previous night but do not usually live in the household” (Mongolia, NSO, *Statistical Microdata*).

The household survey is sampled by a “stratified, two-stage sample design.” Mongolia consists of 22 provinces, including the capital city Ulaanbaatar (Figure 21).⁵³ The “primary sampling units (PSUs),” refers to the clusters (bags in Mongolian), are sampled within each province. For the capital city these are referred to “enumeration areas (EAs).” According to the NSO, the PSUs, and EAs are sampled “systematically with probability proportional to size, where the measure of size is based on the total number of households in the cluster from the administrative frame,” and the administrative frame indicates each province (Mongolia, NSO, *Statistical Microdata*). Then, households are sampled with equal probability from the PSUs and EAs each month.



Figure 21. Description of first-level administrative division in Mongolia

⁵³ PL, Bogomolog, 2007. Aimags of Mongolia. Photograph. Wikipedia. https://commons.wikimedia.org/wiki/File:Mongolia_aimags_2007.png. Accessed December 12, 2017

C. Construction of household's monthly total income and expenditure

The survey asks for labor income during the past one-month period and during the past 12 months, for each individual in the household. I focus on the income obtained over the past month, since the individual is more likely to remember their monthly income compared to their annual income. Then, for individuals where their two incomes do not match, the value of the larger income is used in order to compensate. Similarly, income during the past one-month period is requested for those who have double work. Moreover, the survey also asks for bonuses obtained in the past 12 months. Since my focus is on the household level rather than at an individual level, I sum all individual's labor income to construct the household's total income. Related questions regarding labor income are as follows:⁵⁴

1. How much did you earn from your main job in the past month?
2. How much did you receive as a bonus from your main job in the past 12 months?
3. How much did you earn from your double job in the past month?
4. How much did you receive as a bonus from your double job in the past 12 months?

As for earning and expenditure related to pastoral farming, agricultural, and non-agricultural jobs, the survey asks at a household level. These three divisions will now be called sectors. The incomes are constructed from a difference between earning and expenditure, for each sector respectively. Questions related to the agricultural and non-agricultural sectors are following:

5. How much did you earn from selling crops in the past 12 months?
6. How much did you spend on expenditures related to these crops in the past 12 months?
7. How much did you earn from the enterprise business in the past 12 months? In this case, enterprise business refers to the non-agricultural sector.
8. How much did you spend on expenditures related to the enterprise business in the past 12 months?

Regarding pastoral farming, it might be important to mention the income of households who have a traditional nomadic lifestyle. Mongolia has a long tradition of raising livestock and some

⁵⁴ The translation is made by myself.

households are still engaged in traditional, nomadic-lifestyle, spending most of the time in the countryside. Their lifestyle is based on a system of pastoral herding, consisting of five kinds of livestock. The main products of the livestock sector are meat, milk, wool, cashmere, and rides. These products become the main sources of earnings from the nomadic lifestyle. Related questions to pastoral farming are following:

9. How much did you earn from selling your livestock over the past 12 months?
10. How much did you earn from selling raw products obtained from your livestock over the past 12 months?
11. How much did you earn from sales of produced goods from your livestock over the past 12 months? The difference from the previous question is that raw products are processed through some stages before they are finally sold.
12. How much did you spend on the expenditures related to the herding activity over the past 12 months?

Any other income, such as social benefits and private transfers, given to each individual is included in household income. There are several categories in other income, however, the list of these categories is subtracted in this research.⁵⁵ The total other income is constructed by adding together all of the categories. The following question is asked for each category of the additional income.

13. Has anybody received the following additional income in the past 12 months? The type of the income is given.

The yearly income from labor and each sector (agricultural, non-agricultural sector, and pastoral farming), as well as the total other income, are added together and then divided by 12 in order to construct a household monthly income.

Total expenditure is constructed from two categories: food and non-food expenditures. Regarding food expenditure, the survey differentiates the context of the question for urban and rural areas. For an urban area, the total consumed amount for the first ten days, second ten

⁵⁵ I omitted the list of the additional income. Please refer to the website of NSO.

days, and third ten days are asked for each category. The total consumed amount is generated by adding the entire consumed amount for the first, second, and third ten days. Then, monthly expenditure on food is constructed by multiplying the total consumed amount for each category by its average unit price. For a rural area, the survey asks the total consumed amount of each category for the past seven days. Hence, expenditure on food for seven days is constructed first, and then, multiplied by four in order to construct a monthly expenditure on food.

Non-food expenditure is a broad category, which includes expenditures spent on durable, semi-durable, and other expenditures, such as tuition, medical service, energy, and payment service. The survey asks directly for the amount purchased on non-food expenditures during the past month. In addition, a monthly amount spent on the likes of loan repayments, energy, and payment services is requested. Energy and payment services are related to housing expenditures. Monthly household expenditure is then calculated by adding the food and non-food expenditures.

3 Evidence on the Nature of Income Shocks: Are There Any Heterogeneities Across Income Groups?

3.1 Introduction

Income groups in Mongolia exhibit heterogeneous excess sensitivity of consumption to income. In addition, the sensitivity of the consumption increases, as the group becomes richer. To the extent of the consideration of the country's relatively volatile economic development associated with the mining sector, the excess sensitivity across income groups is rationalized in the context of the stochastic trend hypothesis. However, why relatively richer groups impose higher sensitivity of the consumption remains to be solved. If the liquidity constraints are the bottleneck, it is the lower-income group that poses higher sensitivity of the consumption. I provide a partial answer from the evidence on the joint analysis of households' income and consumption dispersion, using the Household Socio-Economic Survey (HSES) in Mongolia.

Changes in the variance of income shocks of different natures are identified using the successive years of the cross-sectional distribution of income and consumption. From the cohort-based analysis, I find the increases in income dispersion in 2012 and 2017 are driven by the increase in permanent shock variances. These periods are associated with the peak of the economic expansion and contraction. Furthermore, I find that the nature of the income shocks appears differently across income groups. While changes in the transitory shock variances appear in all income groups, changes in the permanent shock variances appear dominantly in the high-income group.

The joint analysis of income and consumption dispersion is useful to identify to what extent income shocks can be composed of temporary or permanent shocks.⁵⁶ It is informative to identify how consumption responds to different types of shocks, as it helps in understanding

⁵⁶ Aguiar and Bils (2015) document three types of literature on income and consumption dispersion. The first part focuses on the consumption dispersion in terms of mismeasurement of the Consumer Expenditure Survey led by Battistin (2003) and Attanasio, Battistin, and Ichimura (2007). The second part focuses on how the consumption dispersion mirrors the income dispersion. This is first pointed by Slesnick (2001) and Krueger and Perri (2006). The third part of the studies targets income and consumption dispersion over an individual's life cycle and is led by Deaton and Paxson (1994).

the mechanism for consumption smoothing (Attanasio and Pistaferri, 2016). According to the life-cycle/permanent income hypothesis (LC/PIH), changes in consumption are driven by unanticipated permanent income shocks, while it is not affected by expected or temporary income shocks. If individuals or households can borrow and save smoothly, the temporary income shocks are easier to insure against than permanent income shocks. Two approaches are employed dominantly to decompose the income shocks into their permanent and transitory components.

One methodology to identify the nature of the income shocks is to utilize the households' subjective income expectations and their realizations (Pistaferri, 2001). Within this framework, changes in income expectations reflect the permanent shocks, and once predictable components of the income are removed, the difference between income expectations and their realizations reflect the transitory shocks. Kuk, Kulikov, and Staehr (2016) use the Estonian household survey which asks for self-reported income and find that consumption responds differently depending on the persistence of income shocks. Kovacs, Rondinelli, and Trucchi (2019) investigate how consumption dynamics are shaped by the different income shocks, using subjective income expectations from Dutch household data.

The other approach to identifying the nature of income shocks is to consider the variance of income and consumption together and to utilize the statistical decomposition of income shocks (Jappelli and Pistaferri, 2010).⁵⁷ “This approach requires an econometrician to make specific statistical assumptions about the income process, treats deviations from observable income determinants as unanticipated income shocks, and then uses covariance restrictions on income and consumption growth” (Cashin and Unayama, 2016, 3). Generalizing the simple approximation, the model is expanded by introducing income persistence, insurance against permanent income shocks, and the heterogeneities across households to the extent of degree of insurance (Blundell, Low, and Preston, 2013). Blundell, Pistaferri, and Preston (2008) find insurance against both transitory and permanent income shocks for US households. Further,

⁵⁷ Jappelli and Pistaferri (2010) describe the three methodologies in the context of how consumption responds to unanticipated income shocks. Besides the approaches introduced here, they describe the methodology of the quasi-experimental approach.

Identification of shocks is a methodological challenge as a household's or individual's expected income process is private information from the view of an econometrician (Cashin and Unayama, 2016). The empirical studies based on individuals' subjective income expectations attempt to overcome this problem, however, the method is subject to its rare availability and even it is available, there is a concern about the credibility of the survey questions.

they find that the insurance for the transitory income shocks is complete while it is partial for the permanent income shocks.

Empirical studies on income and consumption dispersion primarily focus on developed and a few emerging economies. The United States, Canada, Germany, Spain, Sweden, Russia, and Mexico are covered.⁵⁸ Other empirical evidence is found in the United Kingdom, Italy, France, and Estonia.⁵⁹ Although income and consumption dispersion are increasing in most of the countries, Spain has decreasing trends in labor earnings dispersion, in contrast to the other countries, during the period of 1985 and 2000 driven by the decline in the college premium (Pijoan-Mas and Sánchez-Marcos, 2010). Moreover, the dispersion in consumption is decreasing to a lesser extent than dispersion in income. This is attributed to the decrease in permanent sources of income dispersion between households.

However, Pijoan-Mas and Sánchez-Marcos (2010) identify the permanent and transitory components of the income shocks with the evolution of cross-sectional income data alone. They indicate the need for further research on why the decline in consumption dispersion is smaller than income dispersion. Pistolesi (2014) studies the composition of income shocks in France, using the growth in the dispersion of income and consumption as in Blundell and Preston (1998). The decomposition makes clear that increasing consumption dispersion is partly due to the increase in permanent shocks. Yet, relatively smooth income dispersion in France is explained by the negative transitory shocks that mitigate the effect of increasing permanent shocks. In Mongolia, as in Spain, there is a substantial decline in income dispersion and drop in consumption dispersion to a lesser extent than income dispersion. I identify how different types of income shocks explain such trends, using the methodology used in Blundell and Preston (1998) that is endorsed by Pistolesi (2014).

In this regard, this study makes a contribution to the literature on income and consumption dispersion from the perspective of developing countries. The patterns of income shocks and their evolution over time might differ across countries. Aguiar and Bils (2015, 2729) indicate

⁵⁸ Several country-studies are compiled in Violante, Gianluca. ed., 2010. Special issue: Cross-Sectional Facts for Macroeconomists. *Review of Economic Dynamics* 13(1).

⁵⁹ Jappelli and Pistaferri (2010) document that the increase in income dispersion in Italy is most likely driven by the transitory idiosyncratic income shocks. As previously mentioned, Kuk, Kulikov, and Staehr (2016) investigate the income shocks using the Estonian household data.

“there is no a priori reason that the underlying income dynamics are the same in all countries” and they mention that Italy’s income dispersion is explained differently than that of the US. For Italy, it is the transitory income shocks that derive the increase in income dispersion (Jappelli and Pistaferri, 2010). Furthermore, as developing countries often lack panel data that covers sufficient periods, it is worth investigating how the evolution of cross-sectional income and consumption dispersion in those economies is informative on identifying different income shocks. Additional evidence is provided using the cross-sectional Mongolian household survey data and the nature of the income shocks is identified for the cohorts and income groups. This study does not necessarily attempt to make comparisons with other developed countries; however, the obtained findings are interpreted in the context of the country’s volatile economic development.

The rest of the chapter is organized as follows. Section 2 describes the cross-sectional data and evolution of the income and consumption dispersion. Section 3 is comprised of empirical methodology and its results. Lastly, Section 4 concludes.

3.2 Data and Descriptive Analysis

I use the Household Social Economic Survey (HSES) of Mongolia for the analysis. The first survey was taken from mid-2002 to mid-2003, and the next was taken between mid-2007 and mid-2008. For the first two years’ surveys, sample coverage is limited, survey questions are not consistent, therefore, I use the ten-year data from 2009 to 2018. Over 10,000 households are interviewed in each survey, with the survey years that end with even numbers being rich in sample size. The number of households in each year is as follows: 11,126 in 2009, 11,117 in 2010, 11,166 in 2011, 12,709 in 2012, 11,162 in 2013, 16,072 in 2014, 11,156 in 2015, 16,400 in 2016, 11,151 in 2017, 16,349 in 2018. Data is limited to household heads whose ages are between 25 and 60. In the analysis, I regard the oldest member of the household as the household head.

Adult equivalent income and consumption are used for the analysis as income and expenditure may vary by family types in terms of household size and composition (Deaton and Paxson, 1994). They are adjusted onto a comparable basis using OECD equivalence scale and a log is

taken respectively (OECD, 1982).⁶⁰ A value of 1 is assigned to the first household member, a value of 0.7 is assigned to each additional adult member of the household, and a value of 0.5 is assigned to each child who is under 14 years old. Six cohorts are created each year based on a ten-year band as follows: 1940–49, 1950–59, 1960–69, 1970–79, and 1980–89. The first cohort those who are born between 1940 and 1949 appear only in 2009, the cohort is excluded from the cohort-based analysis. Furthermore, five quintiles are created each year based on the adult equivalent income. Table 22 and Table 23 show the sample size of the cohorts and quintiles by year, respectively.⁶¹

Figure 22 shows the variances of adult equivalent income and consumption year-by-year. Overall, the variance of income is declining, except for the increases in 2012 and 2017. A sharp decline is observed in 2013. The variance of consumption increases in 2012 and 2013, similar to income, and it declines relatively gradual than that of income. Similar patterns are observed for cohorts who have the same birth year (Figure 23 and Figure 24). For all the cohorts, the variances of income are declining beside that they increase in 2012 and 2017. Other than cohorts born in the 1990s, the variances of consumption gradually decline after 2013 and they increase in 2017.⁶² For the youngest cohort, the variance of consumption is increasing. This might be due to the relatively small sample size of the youngest cohort. Furthermore, each year the variance is lower the older the cohort is. Patterns are similar when the Theil Index and Coefficients of Variation are used.

When variances of adult equivalent income and expenditure are computed by income quintiles, distinguished patterns are revealed (Figure 25 and Figure 26). As the quintiles are created based on the adult equivalent income, it is natural to see stable variances of income year-by-year. Interestingly, the variance of adult equivalent income of the first quintile that entails the lowest income hits the highest. Then, the variance of the fifth quintile, those with the highest income, follows. On the other hand, there is almost no difference in the variances of the income for the other three quintiles. The pattern of consumption variance by income quintile is similar to that of the overall and cohort patterns. After the increase until 2012, the variances are

⁶⁰ Atkinson, Rainwater, and Smeeding (1995) review many of the equivalence scales. The scale is useful for those countries that do not have their own equivalence scale (OECD, 1982).

⁶¹ Individuals whose adult equivalent income fall outside of the three standard deviations from the mean are dropped each year.

⁶² The variance of consumption is declining after 2012 for cohorts born in the 1980s.

declining for all quintiles and then they slightly increase in 2016.⁶³ Similar to the variance of income, the variance of consumption is highest for the lowest quintile and then followed by the highest quintile. Likewise, there is little difference among the other three quintiles.

3.3 Empirical Results

A. Empirical Methodology

Empirical methodology on identifying changes in the variance of transitory and permanent shocks follows Blundell and Preston (1998) and Pistolesi (2014). Income is decomposed into its permanent and transitory component, and income of individual i who belongs in cohort k in period t becomes as follows:

$$y_{i,t} = y_{i,t}^p + u_{i,t}, i \in k. \quad (1)$$

$y_{i,t}^p$ refers to the permanent component of income in period t , and $u_{i,t}$ refers to the transitory shock in period t . Transitory shock follows the white noise process (Pistolesi, 2014). The permanent component of income is assumed to follow a random walk as follows:

$$y_{i,t}^p = y_{i,t-1}^p + v_{i,t} \quad (2)$$

where $v_{i,t}$ is permanent shock assumed orthogonal to $u_{i,t}$. In any period, individuals are assumed to entail the same variances of shocks. The variances can change over time; however, it is assumed that there are no cross-sectional covariances between the shocks and income of previous periods. Moreover, shocks are independently distributed across individuals.

Substituting (2) into (1) and then subtracting $y_{i,t-1}$ from $y_{i,t}$, the income process for the individual can be written as follows:

$$y_{i,t} = y_{i,t-1} + v_{i,t} + u_{i,t} - u_{i,t-1}. \quad (3)$$

⁶³ The variance of consumption increases after 2017 for the lowest quintile.

The variances of the adult equivalent income and consumption for cohort k at time t are denoted by $var_{k,t}(y)$ and $var_{k,t}(c)$, respectively. The variances are calculated conditional on cohort k and time t . Corresponding variances of the permanent and transitory shocks for cohort k at time t are defined by the $var_{k,t}(v)$ and $var_{k,t}(u)$, respectively. Moreover, change of the cross-sectional variance of income is measured by $\Delta var_{k,t}(y)$, the difference between cross-sectional variance of income for cohort k at time t and time $t - 1$, that is $var_{k,t}(y) - var_{k,t-1}(y)$.

Then the variances are taken from the right- and left-hand sides of the income process (3). The change in the cross-sectional variance of income becomes the sum of the change in cross-sectional variance of transitory shocks and cross-sectional variance of permanent shocks,

$$\Delta var_{k,t}(y) = \Delta var_{k,t}(u) + var_{k,t}(v). \quad (4)$$

As in (4), the cross-sectional variance of income itself cannot identify the variance of permanent shocks and change in the variance of transitory shocks. Therefore, the cross-sectional variances of consumption and covariance of income and consumption are considered in addition to the variance of income to identify each of the changes in the variance of permanent and transitory shocks.

While income is affected by both permanent and transitory shocks, consumption is affected by only permanent shocks. It indicates that households cannot insure against permanent shocks, as they are not able to fully predict them. On the other hand, they are able to insure against transitory shocks. Therefore, consumption is affected by permanent shocks to income and assumed to follow random walk as follows:⁶⁴

$$c_{i,t} = c_{i,t-1} + v_{i,t}. \quad (5)$$

Computing the variance of the consumption from (5), the change in the cross-sectional variance of consumption for cohort k at time t becomes equal to the variance of the corresponding permanent shocks,

⁶⁴ Quadratic preferences and equal discount rate to the real interest rate are assumed (Blundell and Preston, 1998).

$$\Delta var_{k,t}(c) = var_{k,t}(v). \quad (6)$$

Lastly, additional information from covariance between income and consumption for cohort k at time t is considered. It is denoted by $cov_{k,t}(y, c)$. The change in the covariance between income and consumption for cohort k at time t becomes equal to the cross-sectional variance of permanent shocks, same as the change in the cross-sectional consumption,

$$\Delta cov_{k,t}(y, c) = var_{k,t}(v). \quad (7)$$

The permanent shock variances and changes in the transitory shock variances are derived from equations (4), (6), and (7). The detailed derivation of the equations is given in the Appendix. As previously stated, change in the variance of income is measured by the variance of permanent shocks and the change in the variance of transitory shocks. Since the variance of the permanent shocks is reflected in the change in the variance of consumption, the change in the variance of transitory shocks is measured by the difference in the growth of income dispersion and that of consumption dispersion. This is reflected in equation (8). Differences in growths in variances of income and consumption eliminate the variance of the permanent shocks. This indicates that individuals cannot insure against permanent shocks, whereas they can insure against transitory shocks by consumption smoothing.

Furthermore, the variance of permanent shocks is defined by both changes in the variance of consumption and covariance of income and consumption. Therefore, acceleration in the change of the consumption variance and covariance between income and consumption reflects the change in the variance of permanent shocks. These are reflected in equations (9) and (10) by modifying equations (6) and (7) into their first difference. Equations (9) and (10) provide one overidentifying restriction per period, data on the variance of consumption and covariance of income and consumption help improving the precision of estimates.

$$\Delta var_{k,t}(y) - \Delta var_{k,t}(c) = \Delta var_{k,t}(u). \quad (8)$$

$$var_{k,t}(c) - 2var_{k,t-1}(c) + var_{k,t-2}(c) = \Delta var_{k,t}(v). \quad (9)$$

$$cov_{k,t}(y, c) - 2cov_{k,t-1}(y, c) + cov_{k,t-2}(y, c) = \Delta var_{k,t}(v). \quad (10)$$

In sum, I estimate the parameters of changes in the variance of permanent and transitory shocks by (8), (9), and (10). In Blundell and Preston (1998), the parameters are estimated for each cohort, and analysis by cohort is compared with the overall changes in dispersion. Using the methodology, I estimate the parameters for cohorts and income quintiles, respectively. I use the econometric framework of GMM estimation for cohorts- and quintiles-based analysis. In each cohort except for the first and the sixth cohorts, 16 parameters are estimated based on the 24 moment conditions. The oldest cohort is excluded due to the limited sample. For the youngest cohort, that is the sixth cohort, four parameters are estimated based on the six moment conditions due to its sample availability. Similarly, for the quintile-based analysis, 16 parameters based on the 24 moment conditions are estimated for each quintile.

B. Empirical Results

Using the information on the dispersion of adult equivalent income and consumption, I estimate changes in the variance of transitory and permanent shocks by cohorts and quintiles. Table 18 and Table 19 show the results by cohorts and Table 20 and Table 21 by quintiles, respectively. Figure 27 and Figure 28 show the graphical presentations of the results for cohorts and Figure 29 and Figure 30 show them for quintiles.⁶⁵

Transitory shock variances significantly decline for all the cohorts in 2013 (Table 18). Estimates are statistically significant at 5% for the second and third cohorts, and significant at 1% for the fourth and the fifth cohorts, respectively. The decline of the transitory shock variance is already observed for the third cohort in 2012. Then, for the third and fourth cohorts, the transitory shock variances decline significantly in 2018. The permanent shock variance declines significantly for the oldest cohort in 2011 (Table 19). Other than the oldest cohort, the permanent shock variances increase significantly in 2012 and they decline in 2013. Furthermore, the variances increase significantly for the fourth and fifth cohorts in 2016 and the second cohort in 2017. The youngest and the oldest cohort experience decline in permanent shock variances in 2018.

⁶⁵ I omit the detailed explanation for the youngest cohort, those born in the 1990s, as their estimated parameters are limited.

While the permanent shock variances increase for most of the cohorts in 2012, both the permanent and transitory shock variances decline significantly in 2013. In later years, the changes in the variance of income shocks appear differently across cohorts. Figure 27 and Figure 28 show the graphical presentations of changes in the variance of transitory and permanent shocks for cohorts. All cohorts entail volatile changes in transitory and permanent shock variances.

From the identification of the changes in the variance of the income shock components from the cohort-analysis, the increase in the variance of income in 2012 is mostly driven by the increase in permanent shock variances, which significantly appear for most of the cohorts. Therefore, it is accompanied by the increase in consumption variance around the same period. The sharp decline of income variance in 2013 is now explained by the significant decline in both variances of permanent and transitory shocks. The decline in the variance of permanent shocks is reflected in the decline in consumption variance. The increase in income variance in 2017 is explained by the increase in permanent shock variances. Specifically, the increases in permanent shock variances are significant for the fourth and fifth cohorts in 2016; and the second cohort in 2017.

The overall evolution of cross-sectional income and consumption variances can be explained by the variances of permanent and transitory shocks. A substantial part of the income dispersion in the early years is explained by the transitory shocks, as the permanent shocks are highlighted by the consumption dispersion. Therefore, the decrease in income dispersion is most likely to be driven by the decrease in transitory shock variances. The estimation results show the decline in changes in the transitory shock variances for most of the cohorts, yet the decline in 2011 is ambiguous as the estimates are not statistically significant. On the other hand, as previously mentioned, a substantial drop in income variance after 2013 is driven by decreases in both permanent and transitory shock variances. The periods of the increases in the variance of permanent shocks observed across the cohorts are associated with the period of economic expansion and contraction in Mongolia. Particularly, the increase in 2012 is associated with the peak of the economic expansion, while the increase in 2017 and, for some cohorts, 2016 is associated with the economic recession.

How do the changes in the transitory and permanent shock variances appear across income quintiles? The transitory shock variances decline in 2012 and increase significantly in 2013

across quintiles (Table 20). Then the second to fourth quintiles experience an increase in the transitory shock variances in 2015. The third quintile already experiences an increase in 2014. In later years, in 2017 and 2018, the variances change significantly in the lowest quintile, there is an increase in 2017 and a decline in 2018. On the other hand, there are no significant changes in the variance of permanent shocks in the lowest quintile (Table 21). The permanent shock variances increase significantly for the fourth and fifth quintiles in 2011 and the second quintile in 2012. Then the variances decrease significantly for the second and fifth quintiles in 2013. The highest quintile experiences significant changes in permanent shock variances in 2017 and 2018. They increase in 2017 and decline in 2018. A significant decline is also observed for the fourth quintile in 2018.

Figure 29 and Figure 30 show the graphical presentations of the changes in the variance of transitory and permanent income shocks for income quintiles. The patterns of changes in the variance appear differently by the type of income shocks. While all quintiles entail volatile changes in transitory shock variances, changes in permanent shock variances are volatile for the lowest and the highest income groups. Furthermore, the significant volatile changes in permanent shock variances are particularly dominant for the richest quintile. Changes in the variance of permanent shocks are not statistically significant for the first quintile.⁶⁶ This implies that income quintiles are affected by the type of income shocks and that the high-income group, in particular, is subject to volatile changes in the permanent income shocks.

⁶⁶ Although the changes in the permanent shock variances are not significant for the third quintile, the volatility of the changes is larger for the first quintile.

Table 18. Estimates of the changes in transitory shock variances by cohort

Year	Cohort 2	Cohort 3	Cohort 4	Cohort 5	Cohort 6
2011	0.003 (0.031)	0.011 (0.021)	0.002 (0.023)	0.000 (0.035)	
2012	0.028 (0.033)	-0.060*** (0.022)	-0.004 (0.024)	-0.025 (0.034)	
2013	-0.061** (0.028)	-0.044** (0.020)	-0.069*** (0.022)	-0.119*** (0.025)	
2014	0.027 (0.020)	0.010 (0.017)	-0.005 (0.017)	0.038* (0.020)	
2015	-0.017 (0.021)	0.023 (0.017)	0.011 (0.015)	0.018 (0.017)	
2016	0.006 (0.020)	-0.023 (0.015)	0.014 (0.014)	-0.003 (0.016)	
2017	0.012 (0.022)	0.021 (0.014)	0.020 (0.014)	0.013 (0.015)	-0.041 (0.039)
2018	-0.036 (0.024)	-0.032** (0.015)	-0.033** (0.015)	-0.017 (0.015)	-0.081** (0.038)

Table 19. Estimates of the changes in permanent shock variances by cohort

Year	Cohort 2	Cohort 3	Cohort 4	Cohort 5	Cohort 6
2011	-0.109*** (0.029)	0.002 (0.021)	-0.032 (0.023)	-0.008 (0.042)	
2012	0.040 (0.032)	0.092*** (0.021)	0.060** (0.024)	0.118*** (0.036)	
2013	0.026 (0.032)	-0.057** (0.023)	-0.040* (0.024)	-0.116*** (0.036)	
2014	-0.050* (0.030)	-0.029 (0.023)	-0.008 (0.024)	0.026 (0.027)	
2015	0.026 (0.034)	0.025 (0.023)	-0.036 (0.023)	-0.031 (0.027)	
2016	-0.020 (0.032)	-0.003 (0.022)	0.056*** (0.021)	0.063*** (0.024)	
2017	0.091*** (0.034)	0.011 (0.022)	-0.010 (0.021)	0.004 (0.023)	0.021 (0.081)
2018	-0.078** (0.038)	-0.012 (0.022)	0.026 (0.020)	-0.050** (0.022)	-0.027 (0.056)

Note: Standard errors are shown in parentheses.

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

Table 20. Estimates of the changes in transitory shock variances by income quintile

Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
2011	0.034 (0.028)	0.030*** (0.012)	0.008 (0.013)	-0.028** (0.012)	-0.051*** (0.016)
2012	-0.024 (0.028)	-0.048*** (0.013)	-0.045*** (0.013)	-0.040*** (0.013)	-0.033** (0.017)
2013	0.048** (0.019)	0.094*** (0.012)	0.089*** (0.012)	0.110*** (0.011)	0.094*** (0.015)
2014	0.008 (0.015)	0.001 (0.011)	0.028*** (0.009)	0.007 (0.009)	0.022* (0.012)
2015	0.005 (0.015)	0.024** (0.011)	0.020** (0.009)	0.029*** (0.008)	0.017 (0.011)
2016	0.015 (0.014)	-0.008 (0.009)	-0.005 (0.008)	0.002 (0.008)	0.015 (0.01)
2017	0.024* (0.012)	0.008 (0.009)	-0.003 (0.008)	-0.003 (0.008)	-0.006 (0.01)
2018	-0.043*** (0.014)	-0.012 (0.008)	-0.006 (0.008)	-0.012 (0.008)	-0.017 (0.011)

Table 21. Estimates of the changes in permanent shock variances by income quintile

Year	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
2011	-0.016 (0.014)	-0.004 (0.004)	-0.005 (0.003)	0.009*** (0.003)	0.021* (0.012)
2012	0.012 (0.014)	0.008** (0.004)	0.003 (0.003)	-0.005 (0.003)	0.004 (0.013)
2013	0.002 (0.014)	-0.009** (0.004)	-0.004 (0.003)	0.001 (0.003)	-0.039*** (0.013)
2014	-0.015 (0.013)	0.003 (0.003)	0.002 (0.002)	-0.001 (0.003)	0.021* (0.011)
2015	-0.000 (0.012)	-0.001 (0.003)	-0.000 (0.002)	-0.002 (0.002)	-0.008 (0.011)
2016	0.010 (0.012)	0.002 (0.002)	0.001 (0.002)	0.003 (0.002)	-0.003 (0.010)
2017	-0.010 (0.011)	-0.002 (0.003)	-0.000 (0.002)	0.003 (0.002)	0.040*** (0.009)
2018	0.016 (0.011)	0.003 (0.003)	0.002 (0.002)	-0.004* (0.002)	-0.037*** (0.010)

Note: Standard errors are shown in parentheses.

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

3.4 Conclusion

Evolution in the cross-sectional income and consumption dispersion are studied to identify the nature of income shocks. As the dispersion of permanent shocks is highlighted by the consumption dispersion, using the joint distribution of income and consumption, it is helpful to identify the variance of type of income shocks. Overall, other than the increase in 2012 and 2017, income dispersion is declining. The increase in income dispersion is driven by the increase in permanent shock variances and, therefore, it is accompanied by the increase in consumption dispersion. Furthermore, I find that income groups are affected differently by the type of income shocks. While all income groups entail the volatile changes in the variance of the transitory shocks, the highest-income group entails the volatile changes in the permanent shock variances.

The increases in permanent shock variances are associated with Mongolia's economic expansion and contraction periods, dependent on the development of the mining sector. The country experiences an economic boom after the Global Financial Crisis and it peaks in 2012. Yet, the country falls into recession after a relatively short economic expansion and soon the financial crisis is unmasked. This led to the IMF bailout package in late 2016. Development of the mining sector, led by the Oyu Tolgoi project—the largest underlying mining project in the country—and accompanied government policy changes towards the sector are considered to drive such boom-bust cycle in a relatively short period.⁶⁷

Such driving forces are considered to affect the economy as country-wide shocks, not only affecting the regions that engaged in the mining sector. I do not find a significant difference between regions that are relatively engaged in the mining sector and those that are not, when changes in the variance of permanent shocks are compared across regions.⁶⁸ Rather, as revealed in the income group analysis, households are found to be exposed differently to the shock types.

⁶⁷ Further, external factors are also pointed (Batdelger, et al., 2018; IMF, 2015).

⁶⁸ I study the changes in the permanent and transitory shock variances by regions and the estimates are compared by the regression analysis. The analysis is made by regressing the changes in the variance of shocks on the interaction of year dummies and a dummy variable that indicates whether the region is engaged in the mining sector or not. The seven regions are considered as the regions engaged in the mining sector based on their share of the sector in the nominal GDP. Those regions are Dornod, Dornogovi, Omnogovi, Orkhon, Selenge, Sukhabaatar, and Ulaanbaatar. Though there is no significant difference for the changes in the permanent shock variances across regions, I find a difference for changes in the transitory shock variances across the regions. The changes in the variance of transitory shocks in regions engaged in the mining sector are statistically higher in 2013, 2014, and 2017 than in other regions. The estimates are statistically significant at 10%, 1%, and 10%.

Particularly, those high-income households are exposed to the changes in the permanent income shocks, which explains their high excess sensitivity of the consumption to income.

One conjecture of why relatively high-income households are subject to permanent shocks is the benefit from the mining sector is most likely shared among the rich groups. Natural resource-rich countries are often characterized by autocratic governments and low-quality institutions (see, e.g., Ahmadov, 2014; and Sala-i-Martin and Subramanian, 2013).⁶⁹ The political system in the country is featured by political finance in policy decisions, for example, private funding from the corporations to political parties are allowed with government contract (Burcher and Bértoa, 2018). Furthermore, frequent policy shifts and reversals are often observed when a new government is inaugurated, which seriously affects the country's political instability (Dalaibuyan and Dierkes, 2020). Associated with the features, gains from the undertaking are likely to be distributed among the wealthy hierarchy. As mentioned below, this gives space for further research in addition to revealing factors that contributed to the decline in income dispersion.

Although the increases in income dispersion in 2012 and 2017 are associated with the permanent shock increase that affects cohorts, further analysis is needed to identify the factors that drive the overall fall in income dispersion. For example, the fall of labor earning dispersion in Spain in the period from 1985 to 2000 is explained by the decrease in college premium (Pijoan-Mas and Sánchez-Marcos, 2010). Revealing such underlying factors is considered helpful in understanding the difference between income groups and why they are exposed differently to the type of income shocks. Furthermore, this is expected to improve the understanding of whether the difference in income quintiles is dependent on the mining that drives the boom-bust cycle in the country and, if it is, to what extent. Often the developing countries lack the panel data and the repeated cross-sectional data is the only source available to conduct research. Identifying the underlying factors remains a challenge, as data are only available for a relatively short period.

⁶⁹ The rent-seeking effect is given as one of the mechanisms (see, e.g., McGuirk, 2013). Tserendorj and S. Unur (2018) find that the rent-seeking in political parties increase since the parliament election in 2008 which causes the limitation in the government budget constraint and increases the future tax burdens.

3.5 Appendix

A. Tables and Figures

Table 22. The sample size of the cohorts based on year of birth by years

Year	1940s	1950s	1960s	1970s	1980s	1990s	Total
2009	122	2,037	2,972	2,642	903	0	8,676
2010	0	1,966	2,888	2,672	1,090	0	8,616
2011	0	1,823	2,846	2,834	1,270	0	8,773
2012	0	1,769	3,314	3,095	1,914	0	10,092
2013	0	1,389	2,823	2,759	1,814	0	8,785
2014	0	1,779	3,914	3,944	3,090	0	12,727
2015	0	958	2,645	2,770	2,212	128	8,713
2016	0	1,203	3,742	3,993	3,569	436	12,943
2017	0	619	2,485	2,618	2,501	426	8,649
2018	0	647	3,681	3,893	3,580	866	12,667
Total	122	14,190	31,310	31,220	21,943	1,856	100,641

Table 23. The sample size of the income quintiles by years

Year	1	2	3	4	5	Total
2009	1,736	1,735	1,735	1,735	1,735	8,676
2010	1,725	1,722	1,723	1,723	1,723	8,616
2011	1,755	1,755	1,754	1,755	1,754	8,773
2012	2,019	2,018	2,019	2,018	2,018	10,092
2013	1,757	1,757	1,757	1,757	1,757	8,785
2014	2,546	2,545	2,546	2,569	2,521	12,727
2015	1,743	1,746	1,739	1,743	1,742	8,713
2016	2,589	2,589	2,588	2,589	2,588	12,943
2017	1,730	1,730	1,730	1,730	1,729	8,649
2018	2,534	2,533	2,534	2,533	2,533	12,667
Total	20,134	20,130	20,125	20,152	20,100	100,641

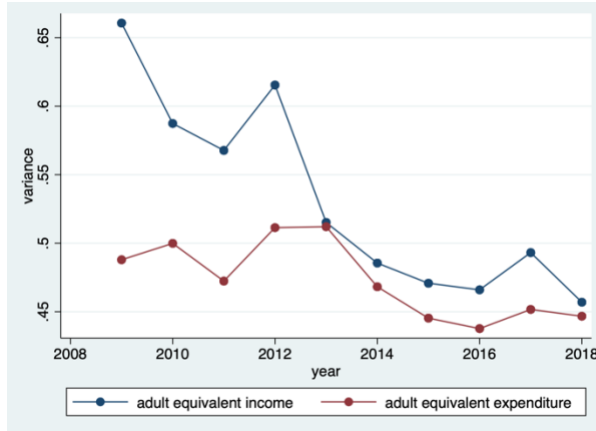


Figure 22. Variances of adult equivalent income and expenditure year-by-year

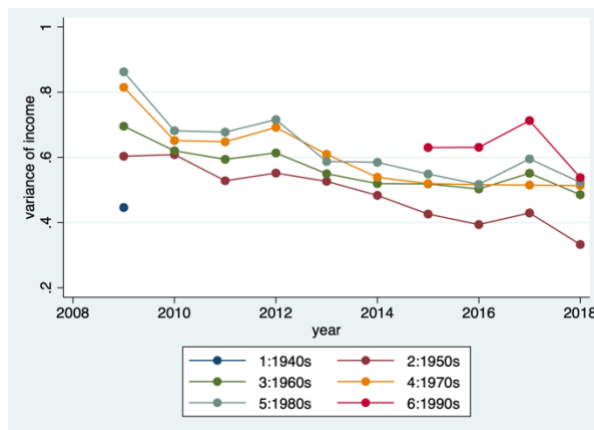


Figure 23. Variances of adult equivalent income for each year by cohort

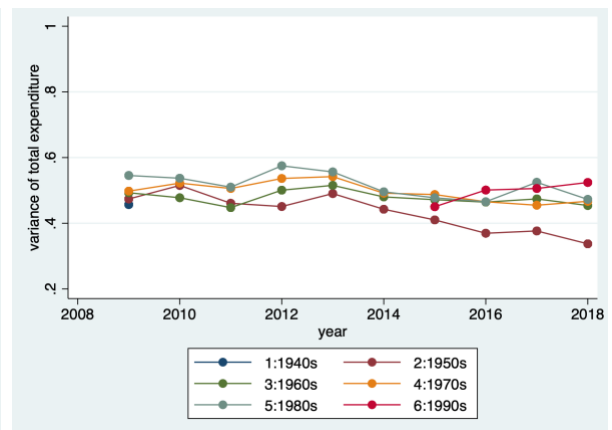


Figure 24. Variances of adult equivalent expenditure for each year by cohort

Note: Different color belongs to each cohort who share the same birth year.

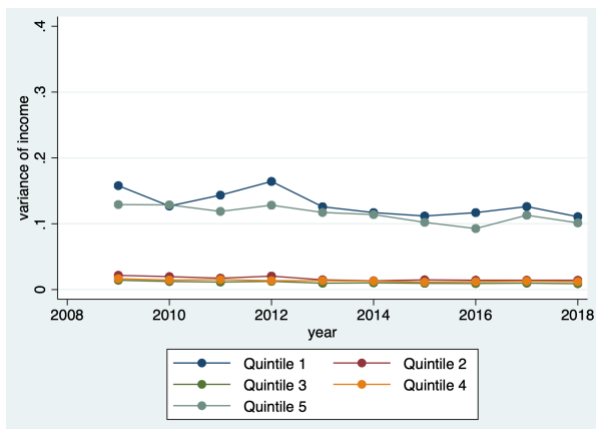


Figure 25. Variances of adult equivalent income for each year by income quintiles

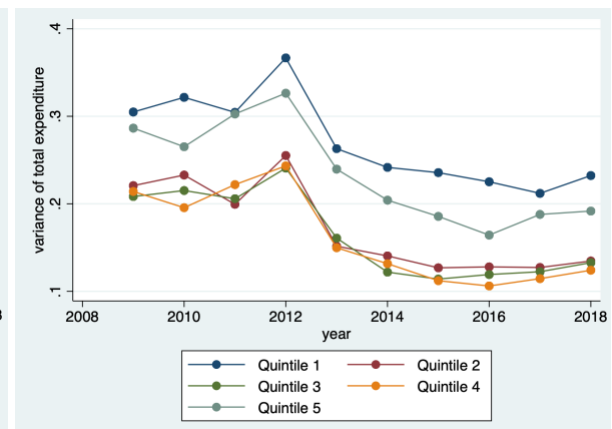


Figure 26. Variances of adult equivalent expenditure for each year by income quintiles

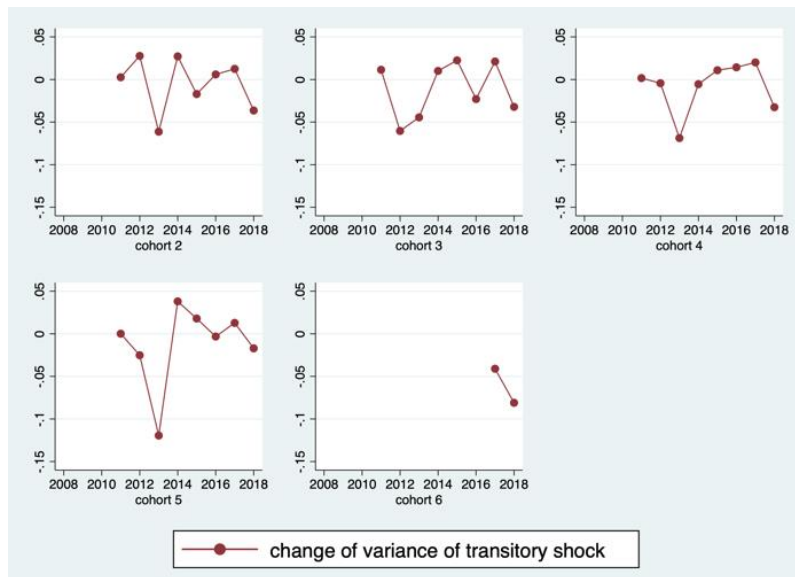


Figure 27. Estimates of the changes in the transitory shock variances by cohort

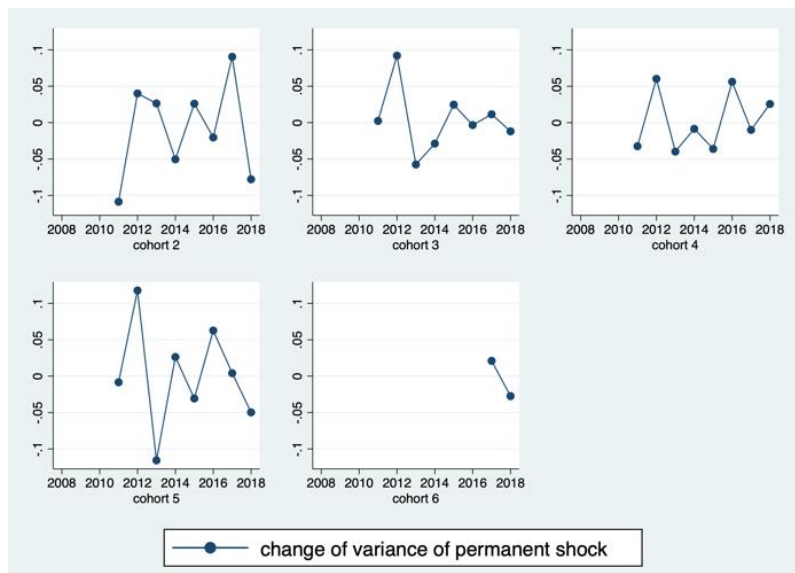


Figure 28. Estimates of the changes in the permanent shock variances by cohort

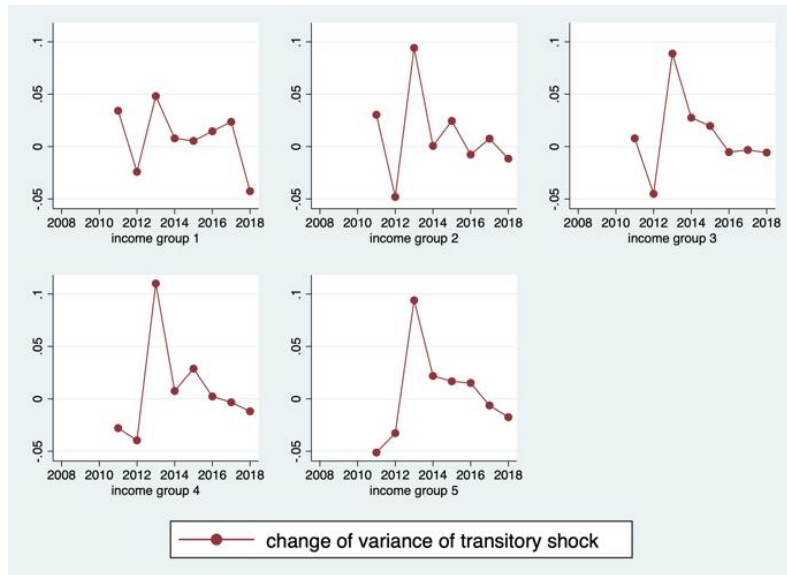


Figure 29. Estimates of the changes in the transitory shock variances by income quintile

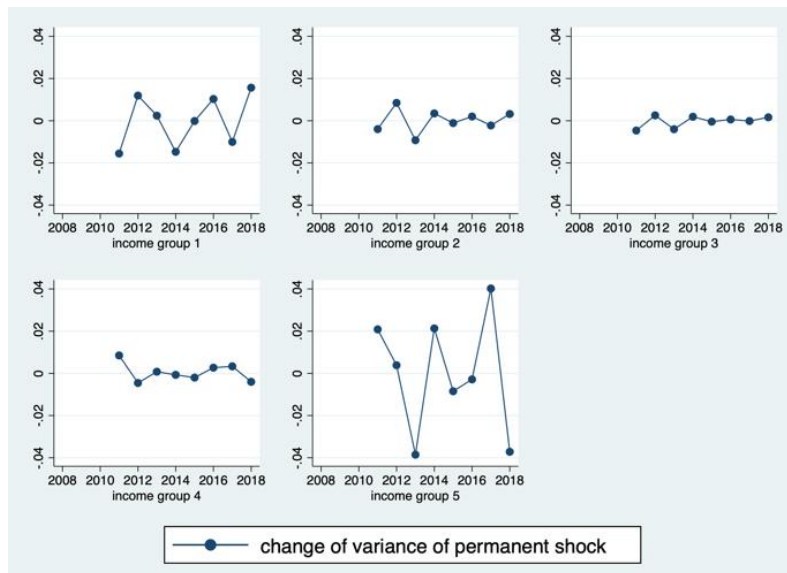


Figure 30. Estimates of the changes in the permanent shock variances by income quintile

B. Mathematical Procedure

Substituting (2) into (1), income process (1) can be written as follows:

$$y_{i,t} = y_{i,t}^p + u_{i,t} = y_{i,t-1}^p + v_{i,t} + u_{i,t}.$$

Following (1), the income process at $t - 1$ is written as follows:

$$y_{i,t-1} = y_{i,t-1}^p + u_{i,t-1}.$$

Subtracting $y_{i,t-1}$ from $y_{i,t}$, the difference is written as the sum of permanent and change in the transitory shocks.

$$y_{i,t} - y_{i,t-1} = v_{i,t} + u_{i,t} - u_{i,t-1}.$$

Then, modifying the above equation, equation (3) is derived.

$$y_{i,t} = y_{i,t-1} + v_{i,t} + u_{i,t} - u_{i,t-1}. \quad (3)$$

Taking variance from right- and left-hand sides, the equation (3) is written as follows:

$$\begin{aligned} var_{k,t}(y_{i,t}) &= var_{k,t}(y_{i,t-1} + v_{i,t} + u_{i,t} - u_{i,t-1}) \\ &= var_{k,t}(y_{i,t-1} + v_{i,t}) + 2cov_{k,t}[(y_{i,t-1} + v_{i,t}), (u_{i,t} - u_{i,t-1})] \\ &\quad + var_{k,t}(u_{i,t} - u_{i,t-1}). \end{aligned}$$

The first term of the right-hand side is organized as follows:

$$\begin{aligned} var_{k,t}(y_{i,t-1} + v_{i,t}) &= var_{k,t}(y_{i,t-1} + v_{i,t}) \\ &= var_{k,t-1}(y_{i,t-1}) + 2cov_{k,t}(y_{i,t-1}, v_{i,t}) + var_{k,t}(v_{i,t}) \\ &= var_{k,t-1}(y_{i,t-1}) + var_{k,t}(v_{i,t}). \end{aligned}$$

It is assumed that there are no cross-sectional covariances of the shocks with the previous period's incomes.

The second term of the right-hand side is organized as follows:

$$\begin{aligned}
& cov_{k,t}[(y_{i,t-1} + v_{i,t}), (u_{i,t} - u_{i,t-1})] \\
&= cov_{k,t}(y_{i,t-1}, u_{i,t}) - cov_{k,t-1}(y_{i,t-1}, u_{i,t-1}) + cov_{k,t}(v_{i,t}, u_{i,t}) \\
&\quad - cov_{k,t}(v_{i,t}, u_{i,t-1}) \\
&= -cov_{k,t-1}(y_{i,t-1}, u_{i,t-1}) \\
&= -cov_{k,t-1}(y_{i,t-1}^p + u_{i,t-1}, u_{i,t-1}) \\
&= -cov_{k,t-1}(y_{i,t-1}^p, u_{i,t-1}) - cov_{k,t-1}(u_{i,t-1}, u_{i,t-1}) \\
&= -cov_{k,t-1}(u_{i,t-1}, u_{i,t-1}) \\
&= -var_{k,t-1}(u_{i,t-1}).
\end{aligned}$$

As previously stated, there are no cross-sectional covariances of the shocks with the previous period's incomes.

The third term of right-hand side is organized as follows:

$$\begin{aligned}
var_{k,t}(u_{i,t} - u_{i,t-1}) &= var_{k,t}(u_{i,t}) - 2cov_{k,t}(u_{i,t}, u_{i,t-1}) + var_{k,t-1}(u_{i,t-1}) \\
&= var_{k,t}(u_{i,t}) + var_{k,t-1}(u_{i,t-1}).
\end{aligned}$$

Therefore, $var_{k,t}(y_{i,t})$ is written as follows:

$$\begin{aligned}
var_{k,t}(y_{i,t}) &= var_{k,t-1}(y_{i,t-1}) + var_{k,t}(v_{i,t}) - 2var_{k,t-1}(u_{i,t-1}) \\
&\quad + var_{k,t}(u_{i,t}) + var_{k,t-1}(u_{i,t-1}) \\
&= var_{k,t-1}(y_{i,t-1}) + var_{k,t}(v_{i,t}) + var_{k,t}(u_{i,t}) - var_{k,t-1}(u_{i,t-1}).
\end{aligned}$$

As $\Delta var_{k,t}(y) = var_{k,t}(y) - var_{k,t-1}(y)$ and $\Delta var_{k,t}(u) = var_{k,t}(u) - var_{k,t-1}(u)$ respectively, the change in the cross-sectional variance of income is decomposed as equation (4).

$$\Delta var_{k,t}(y) = \Delta var_{k,t}(u) + var_{k,t}(v). \quad (4)$$

Taking variance from right- and left-hand sides of the equation (5), the variance of consumption is written as follows:

$$\begin{aligned} var_{k,t}(c_{i,t}) &= var_{k,t}(c_{i,t-1} + v_{i,t}) \\ &= var_{k,t-1}(c_{i,t-1}) + 2cov_{k,t}(c_{i,t-1}, v_{i,t}) + var_{k,t}(v_{i,t}) \\ &= var_{k,t-1}(c_{i,t-1}) + var_{k,t}(v_{i,t}). \end{aligned}$$

Similarly, the assumption of no correlation between shocks with previous period income is applied. Then the change in the cross-sectional variance of consumption for cohort k at time t is written as equation (6).

$$\Delta var_{k,t}(c) = var_{k,t}(v). \quad (6)$$

The covariance of income and consumption is written as follows:

$$\begin{aligned} cov_{k,t}(y_{i,t}, c_{i,t}) &= cov_{k,t}(y_{i,t-1} + v_{i,t} + \Delta u_{i,t}, c_{i,t-1} + v_{i,t}) \\ &= cov_{k,t}(y_{i,t-1} + v_{i,t}, c_{i,t-1}) + cov_{k,t}(y_{i,t-1} + v_{i,t}, v_{i,t}) \\ &\quad + cov_{k,t}(\Delta u_{i,t}, c_{i,t-1}) + cov_{k,t}(\Delta u_{i,t}, v_{i,t}). \end{aligned}$$

The first term of the right-hand side is organized as follows:

$$\begin{aligned} cov_{k,t}(y_{i,t-1} + v_{i,t}, c_{i,t-1}) &= cov_{k,t-1}(y_{i,t-1}, c_{i,t-1}) + cov_{k,t}(v_{i,t}, c_{i,t-1}) \\ &= cov_{k,t-1}(y_{i,t-1}, c_{i,t-1}). \end{aligned}$$

The second term of the right-hand side is organized as follows:

$$\begin{aligned} cov_{k,t}(y_{i,t-1} + v_{i,t}, v_{i,t}) &= cov_{k,t}(y_{i,t-1}, v_{i,t}) + cov_{k,t}(v_{i,t}, v_{i,t}) \\ &= var_{k,t}(v_{i,t}). \end{aligned}$$

Similarly, applying the assumption, the third and fourth terms are eliminated. Then the covariance of income and consumption is simplified as follows:

$$cov_{k,t}(y_{i,t}, c_{i,t}) = cov_{k,t-1}(y_{i,t-1}, c_{i,t-1}) + var_{k,t}(v_{i,t}).$$

The change of the covariance of income and consumption for cohort k at time t is written as equation (7).

$$\Delta cov_{k,t}(y, c) = var_{k,t}(v). \quad (7)$$

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