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How does excessive volatility of consumption vary across countries?

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ABSTRACT

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 cross-country panel data. I find that the sensitivity of consumption on the income level appears differently by the country's commodity dependence. The sensitivity is higher in low-income groups for the commodity-dependent countries, whereas the opposite pattern is observed for non-commodity-dependent countries.

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, counter-cyclical current accounts, and dramatic reversal in capital flows, which typically are not observed in developed countries (see, e.g., Kaminsky et al., 2004; Aguiar and Gopinath, 2007; Garcia-Cícco et al., 2010; Naoussi and Tripier, 2013).[2] Moreover, the features in those countries are usually accompanied by pro-cyclical fiscal and monetary policies (Kaminsky et al., 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 one-time income.[3] The higher volatility of consumption, than that of output, is considered as 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 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

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

[2] Regarding the relationship between net exports and output, the relationship 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 based on the frequent policy regime changes observed in developing and emerging countries. These are considered to induce a volatile trend growth rate.

[5] Garcia-Cícco et al. (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 et al. (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).

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

	High		Upper-middle		Lower-middle		Low	
	mean	p50	mean	p50	mean	p50	mean	p50
st.d(C)/st.d(Y)	1.022	0.935	1.230	1.116	1.298	1.182	1.185	1.095
st.d(c)/st.d(y), per capita	1.012	0.948	1.226	1.118	1.294	1.219	1.186	1.091
Observations	54		47		39		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.

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 in order 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 commodity-dependent countries, the consumption sensitivity is higher in the low-income group compared to the high-income group, whereas, for non-commodity-dependent countries, the opposite pattern appears.

Are resource-rich countries distinguishable from those countries that 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 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 (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 the 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 return 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; Prichard et al., 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; 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]

A transmission channel of natural abundance to slow economic growth is also sought in a channel of human capital, although the consensus has not yet been reached in empirical studies.[13] Some empirical studies reveal the inverse relationship between a natural abundance and the development of human capital, regardless of the high revenue from the resource revenue, causing the economic slowdown in the countries (see, e.g., Gylfason, 2001; Birdsall, et al., 2004; Rahim, et al., 2021). The studies emphasize the need for efficient usage of natural resource rents in the education sector to boost economic growth. On the other hand, reverse evidence are provided on the relationship between resource abundance and human capital, so the transmission channel through human capital to economic growth is not yet crystal clear. Resource-rich countries are able to invest in the education sector like other countries and the resource abundance is found to be associated with higher human capital (Stijns, 2006; Blanco and Grier, 2012).[14]

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.[15] The empirical results have reached mixed conclusions and the LC/PIH is not always supported.[16] Shirvani and Wilbratte (2009) find supporting evidence in

[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 from 97 developing countries.

[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). Countries that get high revenue from natural resources are once again challenged to cope with commodity price fluctuations to which the contribution of common factors has been increasing. The common factors are mainly driven by global macroeconomic shocks and synchronized movement across volatile commodity prices becomes evident (World Bank, 2022). Furthermore, the commodity prices entail so-called super-cycles, over 30–40 years long with a large amplitude of 20–40% from long-run trend, in addition to its short-term volatility (Erten and Ocampo, 2012). This brings further risks and challenges in managing resource revenues for those countries.

[10] Empirical findings using the cross-countries data are reported. Brahmbhatt et al. (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 from 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] Badeeb et al. (2017) summarize the transmission channels, including human capital, of natural resource curse to slow economic growth.

[14] Stijns (2006) finds that resource-rich countries spend not less on education than other countries and resource abundance is found to be positively related to human capital when the human capital indicators are reviewed. Blanco and Grier (2012) find that resource abundance in terms of primary commodity exports is found to increase human capital in long run.

[15] 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).

[16] This study attempts to cover the studies that utilize the aggregate data, however, see for example Jung and Kim (2020) for a recent micro study. Jung and Kim (2020) document that households, those who are mostly constrained households, are able to smooth their consumption when income volatility increases using the Korean household survey data.

Table 2
The ratio of consumption volatility and output volatility 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.

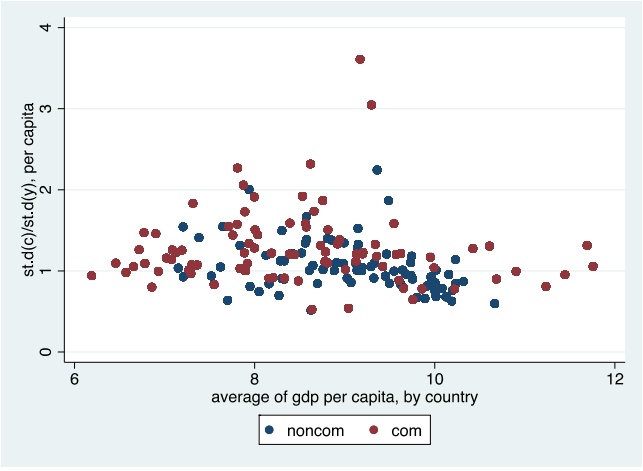

Fig. 1. The relation between the ratio of consumption to output volatility and output per capita by countries' commodity dependence. Note: Each dot indicates a country. For Fig. 1, the blue-colored dot indicates that a county is non-commodity-dependent, and the red-colored dot indicates that country is commodity-dependent. In Fig. 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.

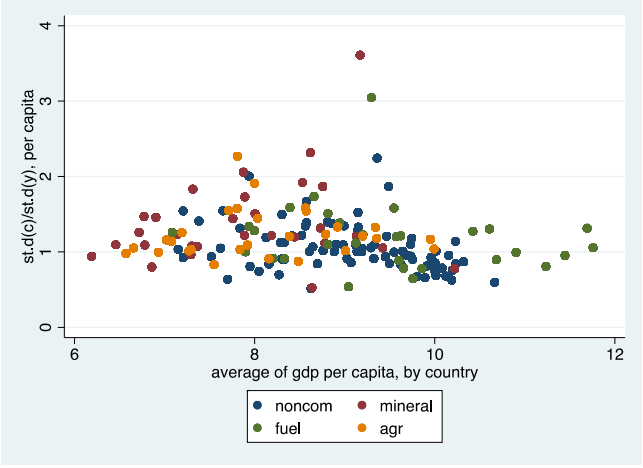

Fig. 2. The relation between the ratio of consumption to output volatility and output per capita by countries' commodity type. Note: Each dot indicates a country. For Fig. 1, the blue-colored dot indicates that a county is non-commodity-dependent, and the red-colored dot indicates that country is commodity-dependent. In Fig. 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.

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, 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; Wang, 2011; Kim et al., 2006; Pontines, 2020).[17]

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).[18] Financial liberalization is found to help with reducing liquidity constraints in the case of South Korea, Sri Lanka, and Taiwan (Habibullah et al., 2006).[19] 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).[20]

This study attempts to grasp the 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 make a link between natural resource wealth and why it leads to certain outcomes, it helps to understand how these countries are

[17] 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 et al. (2006), by Wang and Lee (2010), and Wang (2011). Kim et al. (2006) find the low degree of consumption risk sharing in ten East Asian countries and point out the limited role of capital markets. Pontines (2020) investigates how consumption risk is shared during the Global Financial Crisis and the European sovereign debt crisis using the provincial and metropolitan cities of Korea. The degree of consumption risk is found to be imperfect, yet the assets, such as net receipts of debt, equity, and FDI retained earnings play a substantial role in consumption risk sharing during the periods.

[18] Leading studies on liquidity constraints are Zeldes (1989) and Deaton (1991).

[19] Habibullah et al. (2006) estimate the fraction by error-correction model. They find that the liquidity-constrained consumers are estimated to be in the range of between 0.25 and 0.98 when a sample of ten Asian economies is used.

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

Table 3
Regression results from estimation of the model (1) Dependent variable is the change of consumption, per capita.

	(1) D.log(c), per capita	(2) D.log(c), per capita
D.log(y)	0.808***	0.803***
	(0.043)	(0.047)
IncomeBelow	0.003*	0.000
	(0.002)	(.)
IncomeBelow X D.log(y)	-0.130**	-0.122*
	(0.066)	(0.071)
ComDep	0.008***	0.000
	(0.002)	(.)
ComDep X D.log(y)	-0.396***	-0.403***
	(0.107)	(0.110)
IncomeBelow X ComDep	-0.013***	0.000
	(0.003)	(.)
IncomeBelow X ComDep X D.log(y)	0.503***	0.505***
	(0.124)	(0.129)
Constant	0.013**	0.016***
	(0.006)	(0.005)
Obs	9233	9233
Adj R2	0.309	0.303
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)
IncomeAbove # Noncom	0.808***
	(0.043)
IncomeAbove # ComDep	0.412***
	(0.099)
IncomeBelow # Noncom	0.678***
	(0.049)
IncomeBelow # ComDep	0.785***
	(0.038)
Obs	9233

Standard errors in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01
Note that "Noncom" refers to non-commodity-dependent countries and "ComDep" refers to commodity-dependent countries, respectively.

characterized in terms of the 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 two subsections. First, empirical analysis of the sensitivity of consumption to output on cross-country panel data is introduced. Next, the empirical results and discussions are presented. Lastly, Section 4 concludes.

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.[21] 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 its Gross National Income (GNI) per capita in current US dollars. These are high, upper-middle, lower-middle, and low-income groups.[22] 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 mean and median relative consumption volatility by income classification.[23] Aggregate and per-capita values of output and consumption are used for the first and second rows, respectively. The mean and median ratios are lowest for the high-income group, 1.022 and 0.935, respectively. Similarly, in terms of per capita, the mean and median ratios of the high-income group are the lowest, 1.012 and 0.948, 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 the upper-middle and lower-middle-income categories, still, they are higher than the high-income category.

Table 2 shows the mean and median relative consumption volatility

[21] The usage of real household consumption data is desirable for the purpose of the study, however, it is challenging to collect such data at the aggregate level. Penn World Table version 8 notes that country-specific definitions make it difficult to clearly distinguish between household and government consumptions and use the sum of the two consumptions. I follow the definition and refer to consumption terms, including both household and government if it is not indicated otherwise.

[22] In specific, a country is classified by the WB income classification of 2017.

[23] Table B1 and Table B2 show summary statistics of the output and consumption by income classification and commodity dependence, respectively. Note that the mean and median are calculated on the original series.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.

Table 5
Coefficient equality test on income level by commodity dependence.

	(1) Non-commodity-dependent group	(2) Commodity-dependent group
Difference of income level	-0.130	0.373
	(0.066)	(0.105)
Obs	4449	4784
p-values	0.049	0.001

Standard errors in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01
Note that the difference in income level is calculated by excess sensitivity of consumption of the below-lower-income group minus that of the above-upper-income group.

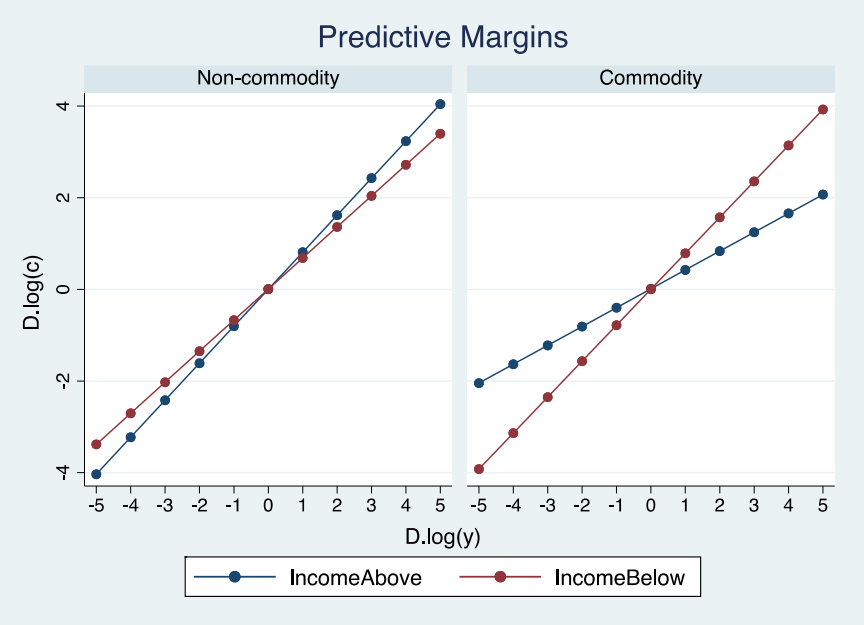

Fig. 3. Effect of the sensitivity of consumption to output between income groups by commodity dependence.

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 Fig. 1 and by commodity type in Fig. 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.

3. Empirical results

3.1. Empirical methodology

Regression analysis follows the empirical specification made in Ravallion and Chaudhuri (1997).[24] 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.

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

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 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

[24] 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.

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 countries is 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.

3.2. Empirical result and discussion

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 the 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 in the sensitivities between below-lower- and above-upper-income groups among non-commodity-dependent countries is − 0.13, statistically significant at 5%.[25] 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 0.412, significantly lower than the above-upper-income, non-commodity-dependent countries. The difference is − 0.396, significant at 1%. Moreover, the sensitivity of the below-lower-income, commodity-dependent countries is 0.785, statistically significant at 1%.[26]

Table 5 shows how the effect of excess sensitivity of consumption to output depends on income level by commodity dependence. The difference in excess sensitivity is derived from the excess sensitivity of lower-income countries minus that of higher-income countries. Column (1) shows the difference between the excess sensitivity of lower-income countries and that of higher-income countries for non-commodity-dependent countries. The excess sensitivities of the two income groups are 0.678 and 0.808 respectively and the difference between the income groups is − 0.13, significant at 5%. The sensitivity appears significantly lower for the below-lower-income group. Column (2) compares the commodity-dependent countries. The excess sensitivities are observed to be 0.785 and 0.412 for lower-income and higher-income groups, respectively. The difference between income levels is 0.373 significant at 1%, which indicates the sensitivity of the below-lower-income group is higher than that of the above-upper-income group for commodity-dependent countries.

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 appear unalike between commodity- and non-commodity-dependent countries.[27]

Fig. 3 illustrates how consumption changes to different scales of income change by income levels using the predicted margins. The blue lines and red lines show overall consumption change in response to income change for high-income and low-income countries, respectively. The difference in the income level is further depicted by countries' commodity dependence; the left panel shows the consumption change for non-commodity-dependent and the right panel shows that for the commodity-dependent countries. As for non-commodity countries, on the left panel, a 1% increase in income will result in an overall 0.811% increase in consumption for high-income countries, while the same increase in income will result in an overall 0.685% increase in consumption for low-income countries. Excess sensitivity of consumption, measured by the line slope, is higher for high-income countries, and the difference in the sensitivities between low- and high-income countries is − 0.13% as shown in Table 5.[28]

As for commodity-dependent countries in the right panel, a 1% increase in income will result in an overall 0.423% increase in consumption for high-income countries, while the same increase in income will result in an overall 0.787% increase in consumption for low-income countries. The slope of consumption change is steeper for low-income countries which is equivalent to saying that low-income countries entail higher excess sensitivity of consumption. The difference in excess sensitivities of consumption between the low- and high-income countries is 0.373% as shown in Table 5.[29]

[25] The estimate is significant at 10% when the country fixed effect is controlled.

[26] Since the interaction term of below-lower-income and commodity dependence, $IncomeBelow_i \times ComDep_i$, is controlled, the effect of sensitivity of consumption to output for the below-lower-income, commodity-dependent country is 0.785, which is obtained by subtracting 0.13 and 0.396 from 0.808 and adding 0.503.

[27] The empirical result is robust when the ratio of consumption volatility to output volatility is regarded as a dependent variable in the simple regression based on Uribe and Schmitt-Grohé (2017). Table B3 in the Appendix shows the result. The result indicates that the relative consumption volatility declines as output increases for countries besides the lower-income commodity-dependent countries. As for the lower-income commodity-dependent countries, in contrast with the other countries, the relative volatility of consumption increases as the output level increases. Besides directly considering the countries' export dependence on commodities, 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). A resource-rich country can be dependent on its resource, but if the country's export revenues are driven by different types of sectors or trading partners, then it will be considered more diversified. The index is publicly available on the official website of the International Monetary Fund (IMF). A similar result is obtained when the export diversification index is incorporated into the model by interacting with the change in output. The results are available upon request.

[28] The line slope is the excess sensitivity of consumption which is also the coefficient of the change in income. When there is no change in income, consumption for higher-income countries increases by a total of 0.003%, and therefore, a one percentage increase in income results in a 0.808% increase in consumption, subtracting 0.003% from 0.811%. In terms of low-income countries, consumption increases by 0.007% overall when there is no income change, and therefore, a one percentage increase in income will result in a 0.678% increase in consumption, subtracting 0.007% from 0.685%. The difference between the slopes of the two lines shows the difference in excess sensitivity of consumption between the low- and high-income countries and this is − 0.13%, 0.678% minus 0.808%. The figure also shows how consumption reduces with a negative change in income.

[29] When there is no change in income, consumption for higher-income countries increases by a total of 0.011%, while consumption for lower-income countries increases by a total of 0.002%. Hence, for higher-income countries, a one percentage increase in income will increase consumption by 0.412%, 0.423% minus 0.011%. As for lower-income countries, a one percentage income will increase consumption by 0.785%, 0.787% minus 0.002%. Similarly, the difference between excess sensitivities of consumption between lower- and higher-income countries is 0.373%, 0.785% minus 0.412%.

The result of the model estimation should be understood carefully when it is compared with the implication of excess volatility of consumption. The comparison of consumption volatility and output volatility is simply the ratio of the standard deviation of consumption and that of output (i.e., st.d(C)/st.d(Y)). When the ratio exceeds one it indicates the excess volatility of consumption, and as it is revisited earlier, the consumption volatility is higher than output in emerging and developing countries, whereas it is almost the same or lower in developed countries.

On the other hand, the model in the analysis estimates the elasticity of consumption with respect to output by the beta coefficients on change in output. If the coefficient is significantly different than zero, it indicates the existence of excess sensitivity of consumption and implies that LC/PIH is not achieved. As it is described previously, the countries from different categories exhibit heterogeneous excess sensitivities. If the liquidity constraint is the bottleneck of the excess sensitivity of consumption, the lower-income countries are expected to entail higher sensitivity than high-income countries, just as they have the excess volatility of consumption.

The implication is not crystal clear when countries are further compared by their commodity dependence. As for commodity-dependent countries, the lower income countries entail higher sensitivity of consumption just as they also have higher volatility of consumption. The results can be rationalized in the context of the liquidity constraint. The estimation result is consistent with Islamaj and Kose (2016) in which higher consumption sensitivity is estimated for low-income countries when full sample years are utilized.

While in non-commodity-dependent countries, the sensitivity is observed to be higher for the wealthy countries, as opposed to the implication of the liquidity constraint. The estimation result should be carefully interpreted as the analysis utilizes the aggregate data, which might induce aggregation bias and measurement error. Moreover, the inclusion of durable goods is often considered to cause excess sensitivity as it functions as a saving and yields utility for households' lifetime (Mankiw, 1982; and Souleles, 1999).[30] However, recent studies also find the excess sensitivity of consumption in wealthy countries or households. When excess sensitivity of consumption is estimated each year using the countries' panel data, Islamaj and Kose (2016) find higher sensitivity for rich countries for some years although the overall sensitivity is estimated as lower than developing countries.[31] Kueng (2018) finds that high-income households respond to large and predictable cash flow using Alaskan household data, which indicates that the wealthy do not suffer from not smoothing consumption. LC/PIH does not provide sufficient explanation for such behavior and, therefore, it urges this area to be studied further.

4. Conclusion

This chapter studies the excess volatility of 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 pattern of the sensitivity of consumption on income level appear different based on 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.

Why low-income commodity-dependent countries are exposed to larger excess volatility of consumption than the other types of countries can be explored in several theoretical frameworks. As previously raised, resource-rich countries are featured with both the economic and political resource curse, and the latter points to weak government institutions and political instability (Frankel, 2012; Ross, 2015). These properties may expose low income in particular to permanent productivity shocks that induce excessive consumption fluctuations (Aguiar and Gopinath, 2007). Another theoretical framework suggests that a larger ratio of consumption volatility could be induced by other shocks such as the world interest rate or country risk premium that these countries face in the international capital market (Neumeyer and Perri, 2005; Uribe and Yue, 2006). Furthermore, these countries might suffer from limited international borrowing if the collateral is mainly dependent on the commodity (Uribe and Schmitt-Grohé, 2017).

This study does not unmask a driving force of the excess volatility of consumption, however, the evidence of it in relatively 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. To shed light on the driving forces behind the excess volatility in consumption through a theoretical framework, it would be helpful to distinguish the role of shocks in each economy and 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 likely to occur and how to deal with them. Along with that, micro studies that pay close attention to categories of goods and services will further clear the way leads to volatility in consumption at the aggregate level, and bring policy suggestions to be implemented, particularly in those low-income commodity-dependent countries.

Appendix A. : Country classification by income level and export commodity dependence

Dependence on exports of minerals, ores, and metals.

[30] Souleles (1999) finds that expenditure on durables responds more than nondurables using the federal tax refunds as a predictable part of income using the micro-level data.

[31] Islamaj and Kose (2016) estimate excess sensitivity of consumption categorizing the countries by advanced and developing countries. Following similar categorization, when the consumption sensitivity of high-income countries is compared with low-income developing countries, sensitivity is significantly lower for high-income countries. The categorization of low-income developing countries is by the IMF Fiscal Monitor categorization. In addition, when the consumption sensitivity of OECD countries is compared to that of low-income developing countries, again sensitivity is lower for OECD countries, although the difference between the two groups is not significant.

Income category	Countries
High-income	Australia, Chile
Upper-middle-income	Armenia, Botswana, Jamaica, Montenegro, Namibia, Peru, Suriname
Lower-middle-income	Ghana, Kyrgyzstan, Lao People's Democratic Republic, Mauritania, Mongolia, Uzbekistan, Zambia
Low-middle-income	Burkina Faso, Burundi, Democratic Republic of the Congo, Guinea, 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, Russian Federation, Saint Lucia, Turkmenistan, Venezuela
Lower-middle-income	Angola, Bolivia, Cameroon, Congo, Nigeria, Sudan
Low-income	Chad, Yemen

Dependence on exports of agricultural products.

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

Appendix B

See Table B1,Table.B2,Table.B3.

The dependent variable is the ratio of consumption volatility to output volatility. Following the method described in descriptive analysis in Section 2, 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 each series. The relative consumption volatility is regressed on the logarithm of country *i*'s average output per capita over the available period and its interaction with country *i*'s income level and commodity dependence, and lastly, country *i*'s average openness ratio. The openness ratio, denoted by *Open*, is a sum of the share of merchandise exports and imports at current PPPs.

Table B1
Summary statistics of the output and consumption by income classification.

	High		Upper-middle		Lower-middle		Low	
	mean	p50	mean	p50	mean	p50	mean	p50
log(Y)	11.329	11.538	10.452	10.534	10.258	10.306	9.102	8.948
log(C)	10.980	11.220	10.177	10.451	10.057	10.142	8.991	8.957
log(y), per capita	9.953	9.954	8.952	8.944	8.062	8.033	7.218	7.206
log(c), per capita	9.603	9.675	8.677	8.687	7.861	7.802	7.107	7.013
Observations	54		47		39		29	

Note: The table is supplement to Table 1. The mean and median are calculated on the original series.

Table B2
Summary statistics of the output and consumption by countries' commodity dependence and commodity type.

	Non-commodity		Mineral		Fuel		Agriculture	
	mean	p50	mean	p50	mean	p50	mean	p50
log(Y)	10.952	11.174	9.547	9.191	11.153	11.165	9.260	9.628
log(C)	10.771	10.909	9.378	8.957	10.552	10.813	9.077	9.424
log(y), per capita	9.053	9.144	7.901	7.885	9.470	9.422	8.117	7.996
log(c), per capita	8.872	9.026	7.732	7.544	8.869	8.869	7.934	7.801
Observations	81		29		30		29	

Note: The table is supplement to Table 2. The mean and median are calculated on the original series.

Table B3
Regression result in which dependent variable is the ratio of consumption volatility to output volatility.

	(1)
	std(c)/std(y)
average log(y)	-0.170*
	(0.087)
IncomeBelow	-0.251
	(1.539)
IncomeBelow X average log(y)	0.015
	(0.183)
ComDep	-0.486
	(1.031)
ComDep X average log(y)	0.078
	(0.108)
IncomeBelow X ComDep	-2.692
	(1.804)
IncomeBelow X ComDep X average log(y)	0.359*
	(0.216)
openness	-0.216
	(0.201)
Constant	2.601***
	(0.833)
Obs	169
Adj R2	0.136

Standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Notes: The result is derived from the following regression:

$$\sigma_{c,i}/\sigma_{y,i} = \alpha_i + \beta_1 \log Y_i + \beta_2 IncomeBelow_i + \beta_3 \log Y_i \times IncomeBelow_i + \beta_4 ComDep_i + \beta_5 logY_i \times ComDep_i + \beta_6 IncomeBelow_i \times ComDep_i + \beta_7 logY_i \times IncomeBelow_i \times ComDep_i + \beta_8 Open_i + \varepsilon_i$$

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