Who Bears Aggregate Fluctuations in Emerging Economies?*

Seungki Hong†

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Abstract

This paper assesses how rich and non-rich households share aggregate consumption and income fluctuations differently between a developed economy and an emerging economy. To this end, I apply the fluctuation decomposition method devised by Parker and Vissing-Jorgensen (2009) to the U.S. and Peruvian household surveys. The U.S. bottom 80% consumption group contributes to aggregate consumption fluctuations 0.8 times as much as it does to aggregate income fluctuations, while the Peruvian bottom 80% consumption group contributes to aggregate consumption fluctuations 1.7 times as much as it does to aggregate income fluctuations. This result suggests that non-rich households in emerging economies could be important contributors to the phenomenon of excess consumption volatility in emerging economies. The existing theories for this phenomenon do not square well with the empirical finding of this paper because these theories involve mechanisms that non-rich households in emerging economies are less able to accommodate.

***JEL classification*:** E21, E32, F41, O57

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†Department of Economics, Columbia University. E-mail: sh3454@columbia.edu

I Introduction

Emerging economies have distinct business cycle properties compared to developed economies. One of the most salient patterns is excess consumption volatility: consumption is more volatile than output in emerging economies, while it is not the case in developed economies. In the field of international macroeconomics, there has been a long tradition of explaining this phenomenon using representative-agent small open economy models. Partly due to this tradition, the question of 'who suffers the most from excess consumption volatility' has been overlooked in the literature.

This paper provides an empirical answer to this question in one important dimension of household heterogeneity: the heterogeneity between rich and non-rich households. Specifically, I assess how rich and non-rich households share aggregate consumption and income fluctuations differently between a developed economy and an emerging economy by applying the fluctuation decomposition method developed by Parker and Vissing-Jorgensen (2009) to the U.S. and Peruvian household surveys.

The result shows that rich and non-rich households share aggregate fluctuations quite differently in the two economies. The U.S. households in the bottom 80% consumption group (or, equivalently, the bottom 80% of households when sorted by consumption) bear 55% of aggregate income fluctuations and 43% of aggregate consumption fluctuations, contributing to aggregate consumption fluctuations 0.8 times as much as they do to aggregate income fluctuations. On the other hand, Peruvian households in the bottom 80% consumption group contribute to aggregate consumption fluctuations 1.7 times as much as they do to aggregate income fluctuations, as they bear 26% of aggregate income fluctuations and 43% of aggregate consumption fluctuations.

This fluctuation decomposition result suggests that non-rich households could be important contributors to excess consumption volatility in emerging economies. This finding is informative about which theory we should pursue in explaining emerging market business cycles.

In the literature of explaining emerging market business cycles through the lens of representative-agent models, two theories have been widely accepted as an explanation for excess consumption volatility. First, Aguiar and Gopinath (2007) explain excess consumption volatility in emerging economies using a strong consumption response of representative households to a trend shock (or, equivalently, a shock to the growth of production technology). Second, Neumeyer and Perri (2005) explain excess consumption volatility using representative households' intertemporal substitution of consumption in response to volatile interest rate variations that emerging economies face. However, these theories do not square well with the empirical finding of this paper because they involve mechanisms that non-rich households are less able to accommodate.

Under Aguiar and Gopinath (2007)'s mechanism, households bring their future resources to current consumption either by dissaving or borrowing when a positive trend shock hits the economy. Non-rich households are less able to implement this mechanism because they hold fewer assets to dissave than rich households and their access to credits is also more limited.[1] Under Neumeyer and Perri (2005)'s mechanism, households again bring their future resources to current consumption when they face a negative interest rate shock. For the same reason discussed above, non-rich households are less able to accommodate this mechanism.[2]

Instead, the empirical finding of this paper calls for an alternative theory in which non-rich households can make greater consumption adjustment than rich households. In searching for such theories, an important hint might come from a recently growing literature examining how household heterogeneity affects aggregate dynamics or the transmission mechanisms of macroeconomic policies in the context of developed economies, such as Kaplan, Moll, and Violante (2018), McKay, Nakamura, and Steinsson (2016), Krueger, Mitman, and Perri (2016), and Oh and Reis (2012). These studies emphasize the presence of liquidity-constrained people since their consumption responds excessively to a transitory income shock. Emerging economies might have a larger fraction of liquidity-poor households than developed economies as their financial markets tend to be less developed.[3] An alternative theory exploiting the presence of liquidity-poor households and their sensitive consumption behavior might provide an explanation for the excess consumption volatility of emerging economies in which non-rich households play an important role.

The rest of this paper is organized as follows. Section II discusses the fluctuation decomposition method developed by Parker and Vissing-Jorgensen (2009), the processing of the micro data used in the decomposition analysis, and an adaptation of the general regression framework to specific features of the micro data. Section III presents the result of the fluctuation decomposition analysis. Section IV concludes the paper.

II Empirical Analysis

How do rich and non-rich households share aggregate income and consumption fluctuations differently between a developed economy and an emerging economy? To answer this question, I apply Parker and Vissing-Jorgensen (2009)'s fluctuation decomposition method to the U.S. and Peruvian household surveys. This section explains the fluctuation decomposition method developed by Parker and Vissing-Jorgensen (2009), the processing of the micro data used in the analysis, and

[1]In response to a negative trend shock, non-rich households might be able to adjust their consumption as much as rich households because there is no restriction on their saving. Even in response to a negative trend shock, however, non-rich households cannot exhibit stronger consumption adjustment than rich households under this mechanism.

[2]Similarly to the explanation in footnote 1, non-rich households might be able to adjust their consumption as much as rich households in response to a positive interest rate shock, but even in this case, this mechanism cannot rationalize non-rich households' stronger consumption adjustment.

[3]For evidence on underdeveloped financial markets in emerging economies, see Demirguc-Kunt and Klapper (2012), Demirguc-Kunt, Klapper, Singer, and Van Oudheusden (2015), and Demirguc-Kunt, Klapper, Singer, Ansar, and Hess (2018).

an adaptation of the general method to specific features of the micro data.

A Parker and Vissing-Jorgensen (2009)'s Fluctuation Decomposition

The main regression equation of Parker and Vissing-Jorgensen (2009)'s fluctuation decomposition is as follows.

$$\frac{w^G(\bar{C}^G_{y+1,m} - \bar{C}^G_{y,m})}{\bar{C}^{agg}_{y,m}} = \alpha^G_m + \beta^G\left(\frac{\bar{C}^{agg}_{y+1,m} - \bar{C}^{agg}_{y,m}}{\bar{C}^{agg}_{y,m}}\right) + \epsilon^G_{y+1,m} \tag{1}$$

in which

$$\bar{C}^{agg}_{y+1,m} = \frac{\sum_{i\in \text{All}}(w^i_{y,y+1,m}C^i_{y+1,m})}{\sum_{i\in \text{All}}(w^i_{y,y+1,m})}, \quad \bar{C}^{agg}_{y,m} = \frac{\sum_{i\in \text{All}}(w^i_{y,y+1,m}C^i_{y,m})}{\sum_{i\in \text{All}}(w^i_{y,y+1,m})}$$
$$\bar{C}^{G}_{y+1,m} = \frac{\sum_{i\in G}(w^i_{y,y+1,m}C^i_{y+1,m})}{\sum_{i\in G}(w^i_{y,y+1,m})}, \quad \bar{C}^{G}_{y,m} = \frac{\sum_{i\in G}(w^i_{y,y+1,m}C^i_{y,m})}{\sum_{i\in G}(w^i_{y,y+1,m})},$$
$$w^G = \sum_{i\in G} w^i_{y,y+1,m}.$$

G is a group of households such as bottom 80% consumption group (*i.e.,* the bottom 80% of households when sorted by consumption) or top 20% income group (*i.e.,* the top 20% of households when sorted by income). $C^i_{y,m}$ is household i's nondurable consumption during the previous three months before month m, year y ((y,m), hereafter) in which the household is interviewed. Household i has to appear in both (y,m) and $(y+1,m)$ to be used in regression (1). $w^i_{y,y+1,m}$ is a weight given to the observation of household i in (y,m) and $(y+1,m)$. $\bar{C}^{agg}_{y,m}$ and $\bar{C}^{agg}_{y+1,m}$ are weighted averages of consumption during the previous three months before (y,m) and $(y+1,m)$, respectively, in the whole sample. $\bar{C}^G_{y,m}$ and $\bar{C}^G_{y+1,m}$ are the weighted averages of consumption for observations in group G. w^G is the sum of the weights assigned to observations in group G. [4] α^G_m on the right-hand side of equation (1) represents monthly dummies.

To better understand the regression equation (1), consider two groups G_1 and G_2 that partition the whole sample.[5] Then, the following equation holds.

$$w^{G_1}(\bar{C}^{G_1}_{y+1,m} - \bar{C}^{G_1}_{y,m}) + w^{G_2}(\bar{C}^{G_2}_{y+1,m} - \bar{C}^{G_2}_{y,m}) = \bar{C}^{agg}_{y+1,m} - \bar{C}^{agg}_{y,m}. \tag{2}$$

The right-hand side of equation (2) is a year-over-year change of quarterly aggregate consumption. The first and the second terms on the left-hand side of equation (2) are parts of the aggregate consumption change that come from group G_1 and group G_2, respectively. By dividing both sides

[4]For example, if group G represents the bottom 80% consumption group, w^G is equal to 0.8.

[5]For example, the bottom 80% and top 20% consumption groups can be the pair of G_1 and G_2.

of equation (2) with the aggregate consumption in the initial period $\bar{C}^{agg}_{y,m}$, we can obtain

$$\frac{w^{G_1}(\bar{C}^{G_1}_{y+1,m} - \bar{C}^{G_1}_{y,m})}{\bar{C}^{agg}_{y,m}} + \frac{w^{G_2}(\bar{C}^{G_2}_{y+1,m} - \bar{C}^{G_2}_{y,m})}{\bar{C}^{agg}_{y,m}} = \frac{\bar{C}^{agg}_{y+1,m} - \bar{C}^{agg}_{y,m}}{\bar{C}^{agg}_{y,m}}. \tag{3}$$

The right-hand side of equation (3) is the year-over-year growth of quarterly aggregate consumption. The first and second terms on the left-hand side of equation (3) are parts of the aggregate consumption growth that are generated from group G_1 and group G_2, respectively.

In the main regression equation (1), each term on the left-hand side of equation (3) is regressed on the right-hand side of equation (3) with monthly dummies. Therefore, coefficient β^G in equation (1) can be interpreted as 'the fraction of aggregate consumption fluctuations borne by group G'. Note that because G_1 and G_2 partition the whole sample, the sum of the estimates of β^{G_1} and β^{G_2} is always equal to one.

Parker and Vissing-Jorgensen (2009)'s fluctuation decomposition method can also be applied to income fluctuations. In this paper, I decompose both income and consumption fluctuations. Importantly, I use the same sample and grouping of observations for the decomposition of both consumption and income fluctuations.[6] To differentiate the income fluctuation share and the consumption fluctuation share of group G, I denote the former as β^G_y and the latter as β^G_c.

Equation (3) always holds. On the other hand, the regression regression (1) imposes an additional assumption that each term on the left-hand side of equation (3) is an affine function of the consumption growth on the right-hand side. In other words, the regression model (1) is a good description of the data only when we observe a strong linear relationship between the regressand and the regressor in the data.

Figure 1 confirms the linear relationship between the regressand and the regressor of regression (1). Panels in this figure present scatter plots between the regressor and the regressand of regression (1) after controlling both of them with an intercept and monthly dummies. Each panel represents each of the eight cases from $\{$US, Peru$\} \times \{$consumption fluctuations, income fluctuations$\} \times \{$bottom 80% consumption group, top 20% consumption group$\}$. The strong linear relationship in each of the eight panels in Figure 1 assures that the regression model (1) is indeed a good description of both the U.S. and Peruvian micro datasets under the grouping of the bottom 80% and top 20% consumption groups, which is the benchmark grouping strategy in the baseline analysis.[7]

[6] On the other hand, Parker and Vissing-Jorgensen (2009) use different micro datasets as well as different grouping strategies for the decomposition of consumption fluctuations and income fluctuations.

[7] See subsection II.C for details regarding how the consumption groups are constructed.

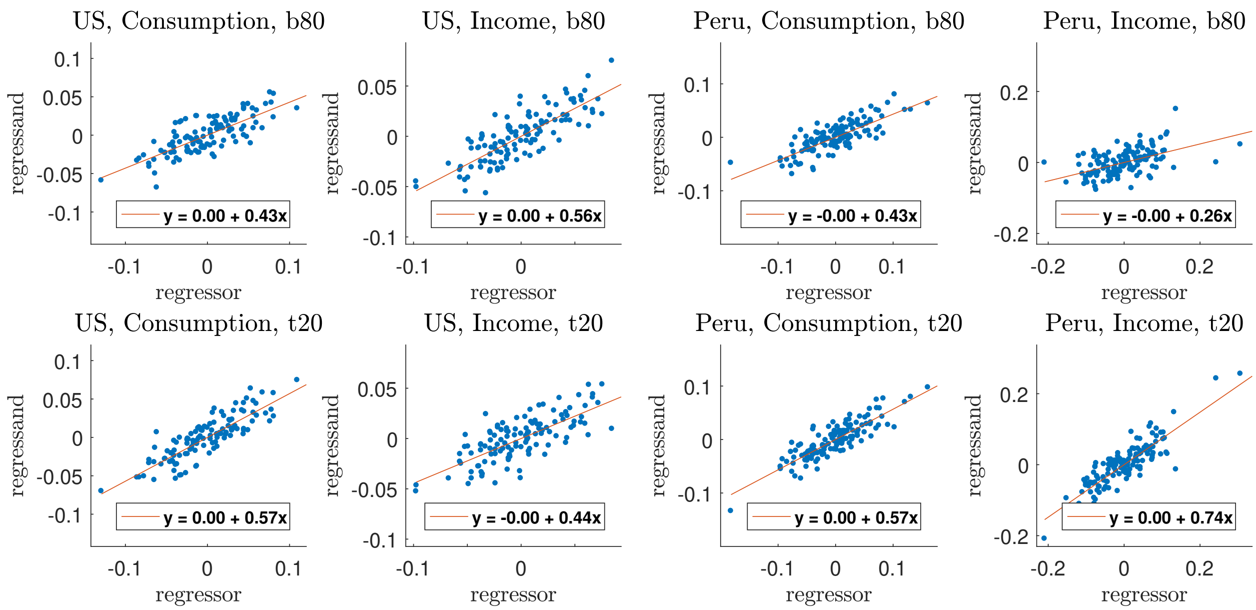

Figure 1: linearity between the regressor and the regressand in regression (1)

Notes. Each panel in this figure is a scatter plot between the regressor on the right-hand side of regression (1) and the regressand on its left-hand side after controlling both of them with an intercept and monthly dummies. Each panel represents each of the eight cases from {US, Peru} × {consumption fluctuations, income fluctuations} × {bottom 80% consumption group, top 20% consumption group}.

B Relative Bearing Raio

Assume groups G_1 and G_2 partition the whole sample. A statistic $\left[(\beta_c^{G_1}/\beta_y^{G_1})/(\beta_c^{G_2}/\beta_y^{G_2})\right]$ captures how much group G_1 contributes to aggregate consumption fluctuations more than group G_2 relative to their respective contributions to aggregate income fluctuations. I name this statistic 'relative bearing ratio'. In the next section, I use this relative bearing ratio to compare two different economies and see whether group G_1 in one economy contributes to aggregate consumption fluctuations more than the same group in the other economy relative to their respective contributions to aggregate income fluctuations. In this subsection, I examine whether the relative bearing ratio can have a theoretical ground for this comparison.

For tractability, let's assume in all models considered in this subsection that aggregate output y_t follows an exogenous process and is split into two groups G_1 and G_2 in an affine manner as follows.[8]

$$
\begin{aligned}
y_t &= y_t^{G_1} + y_t^{G_2}, \\
y_t^{G_1} &= \gamma^{G_1} + \rho^{G_1} y_t, \text{ and,} \\
y_t^{G_2} &= \gamma^{G_2} + \rho^{G_2} y_t
\end{aligned}
\tag{4}
$$

in which $\gamma^{G_1} + \gamma^{G_2} = 0$ and $\rho^{G_1} + \rho^{G_2} = 1$.

Let's first consider a simple model in which households' consumption is an affine function of their income in each group as follows.

$$c_t^{G_1} = \delta^{G_1} + \psi^{G_1} y_t^{G_1}, \text{ and}$$

$$c_t^{G_2} = \delta^{G_2} + \psi^{G_2} y_t^{G_2}.$$

Parameter ψ^{G_1} and ψ^{G_2} capture how much each group translates their income fluctuations into consumption fluctuations.[9] If we conduct the fluctuation decomposition regression in this economy, we obtain the following relationship.

$$\frac{\psi^{G_1}}{\psi^{G_2}} = \frac{\beta_c^{G_1}}{\beta_y^{G_1}} \left(\frac{\beta_c^{G_2}}{\beta_y^{G_2}} \right)^{-1}.$$

Therefore, comparing the relative bearing ratios between two different economies, A and B, is equivalent to comparing (ψ^{G_1}/ψ^{G_2}) between the two economies. This comparison is relevant for evaluating how much group G_1 in economy A translates income fluctuations into consumption fluctuations more than the same group in economy B relative to group G_2 in each economy.

In this simple model, current consumption depends solely on current income. When households optimize intertemporally, however, current consumption depends not only on current income, but also on the whole income path including past incomes, current income, and expected future incomes.

Next, I consider a model in which households optimize intertemporally, the aggregate income process y_t is subject to shocks with various degrees of persistence, and households' consumption behavior can be well captured by the first-order Taylor approximation. Assume that the aggregate income process is specified as follows.

$$y_t = \sum_{j=0}^{\infty} \phi_{1,j} \epsilon_{1,t-j} + \sum_{j=0}^{\infty} \phi_{2,j} \epsilon_{2,t-j} + \cdots + \sum_{j=0}^{\infty} \phi_{p,j} \epsilon_{p,t-j}$$

[8] This assumption is consistent with the linear patterns in the data presented in Figure 1.

[9] In this simple economy, ψ^{G_1} and ψ^{G_2} are the marginal propensity to consume out of an income shock regardless of its persistence.

where $\{\epsilon_{1,t}\}, \{\epsilon_{2,t}\}, \cdots, \{\epsilon_{p,t}\}$ are income shocks with different degrees of persistence. As in the previous simple model, I assume that the aggregate income is split into groups G_1 and G_2 according to equation (4). Under this assumption, we can obtain

$$y_t^{G_1} = \gamma^{G_1} + \sum_{k=1}^{p}\sum_{j=0}^{\infty}(\rho^{G_1}\phi_{k,j})\epsilon_{k,t-j}, \text{ and}$$

$$y_t^{G_2} = \gamma^{G_2} + \sum_{k=1}^{p}\sum_{j=0}^{\infty}(\rho^{G_2}\phi_{k,j})\epsilon_{k,t-j}.$$

Under the first-order approximation with respect to the income shocks, the consumption of each group can be described as follows.

$$c_t^{G_1} = \delta^{G_1} + \sum_{k=1}^{p}\sum_{j=0}^{\infty}\psi_{k,j}^{G_1}(\rho^{G_1}\phi_{k,j})\epsilon_{k,t-j}, \text{ and}$$

$$c_t^{G_2} = \delta^{G_2} + \sum_{k=1}^{p}\sum_{j=0}^{\infty}\psi_{k,j}^{G_2}(\rho^{G_2}\phi_{k,j})\epsilon_{k,t-j}.$$

The sets of parameters $\{\psi_{k,j}^{G_1}\}_{1\leq k\leq p,\ j\geq 0}$ and $\{\psi_{k,j}^{G_2}\}_{1\leq k\leq p,\ j\geq 0}$ capture the degree to which each group's consumption responds to income shocks. If groups G_1 and G_2 have the same consumption-optimizing strategy by having the same consumption response parameters (or, equivalently, $\psi_{k,j}^{G_1} = \psi_{k,j}^{G_2}$ for $1 \leq k \leq p,\ j \geq 0$), the coefficients of the fluctuation decomposition regression satisfy

$$\frac{\beta_c^{G_1}}{\beta_y^{G_1}}\left(\frac{\beta_c^{G_2}}{\beta_y^{G_2}}\right)^{-1} = 1.$$

If the regression yields

$$\frac{\beta_c^{G_1}}{\beta_y^{G_1}}\left(\frac{\beta_c^{G_2}}{\beta_y^{G_2}}\right)^{-1} > 1,$$

it means that this economy deviates from the homogeneity between group G_1 and group G_2 in their consumption optimization such that group G_1 contributes to aggregate consumption fluctuations more than group G_2 relative to their respective contribution to aggregate income fluctuations. When comparing two different economies, A and B, if we have

$$\left[\frac{\beta_c^{G_1}}{\beta_y^{G_1}}\left(\frac{\beta_c^{G_2}}{\beta_y^{G_2}}\right)^{-1}\right]_A > \left[\frac{\beta_c^{G_1}}{\beta_y^{G_1}}\left(\frac{\beta_c^{G_2}}{\beta_y^{G_2}}\right)^{-1}\right]_B,$$

it means that group G_1's consumption function deviates from that of group G_2 more significantly in economy A than in economy B toward having greater contribution to aggregate consumption fluctuations relative to its contribution to aggregate income fluctuations. In this sense, the relative bearing ratio is still a relevant statistic in a model with intertemporally optimizing households.

C Processing the Data

U.S. CEX and Peru ENAHO

In order to run the fluctuation decomposition regression (1), a household survey needs to satisfy four requirements. First, the data should include both the income and expense of households. Second, the data should have a panel structure of at least two consecutive periods. Third, the survey should be conducted at least as frequently as one time per year since the main interest of this paper is on business cycles. Fourth, the sample should be representative of a country.

Surveys satisfying all these requirements are rare. The Consumer Expenditure (CEX) Interview Survey for U.S. households[10] and Encuesta Nacional de Hogares sobre Condiciones de Vida y Pobreza (ENAHO) for Peruvian households are two of such surveys. Fortunately, one is for a developed economy and the other is for an emerging economy. In this sense, these two surveys provide a unique opportunity to compare how rich and non-rich households share aggregate fluctuations differently between a developed economy and an emerging economy.

Both the CEX and ENAHO are used by national statistical agencies to compute aggregate statistics. Naturally, both surveys are nationally representative and have detailed information on household expenditure. Although many other countries have their own expenditure surveys for similar purposes, the CEX and ENAHO are unique in that they are conducted as frequently as annually. In addition, both survey collect income data. In the CEX, income questionnaires are asked only in the first and fourth interviews among four interviews designated to each household. In ENAHO, income questionnaires are asked in every interview. Moreover, both the CEX and ENAHO have rotating panel structures. In the CEX, once a household enters, the household is interviewed four times in every three months, and then exits. In ENAHO, a subset of observations in the cross-sectional sample of a year are tracked in the following year and possibly more. These panel households are also nationally representative. If a household is selected as a panel household, the household is re-visited in the same month of the following year. Most panel households appear two or three times, while the maximum number of appearance is six in the data.

I use the 2004-2014 waves of the CEX and the 2004-2016 waves of ENAHO. My CEX sample starts from 2004 because the CEX began to allow households to report their income in a bracket form if they do not want to reveal the exact amount from 2004. Moreover, income imputation for

[10] The Consumer Expenditure includes two different types of surveys: Interview Survey and Diary Survey. This paper uses data from Interview Survey only. Throughout this paper, the acronym CEX indicates the Interview Survey only.

missing observations began to be implemented from 2004. Before 2004, neither reporting income in brackets nor imputations of missing income were available in the CEX. Naturally, there should be more missing incomes and even worse, it is difficult to evaluate how much fraction of incomes are missing before 2004. My CEX sample ends in 2014 because the CEX stopped including taxes reported by households ('reported tax' hereafter) since 2015 so that disposable income measure cannot be constructed consistently before and after 2015.[11] My ENAHO sample starts from 2004 because there was a major reform on the survey in May 2003, such as the survey being conducted continuously from then on.

sample selection

The CEX sample is selected as follows. First, households should report their monthly expenses in each of the previous three months. Any household that reports monthly expenses for more than or less than three months is dropped. Second, households who report non-positive consumption, food expenditure, or income are dropped. Third, households residing in student housing are dropped. Fourth, households are required to participate in both the first and fourth surveys, in which their incomes are reported. Fifth, households are dropped if the headship is not continued. Household heads' gender and age are used as criteria for determining whether the headship is continued. Sixth, households reporting too much value in the imputed or bracketed parts of income are dropped. (Subsection II.D provides more details on this.) Seventh, outliers on their log income change or log consumption change are dropped. Outliers are defined as those who deviate more than four standard deviations from the mean in each calendar year subsample. When (year, household appearing the first and the fourth interviews) is counted as one observation, I obtain 22,709 observations from the 2004-2014 waves of the CEX as a result of this sample selection.

The ENAHO sample is selected according to the following procedure. First, observations with non-positive consumption, food expenditure, or income are dropped. Second, observations are dropped if the survey response is categorized as 'incomplete' by pollsters. Third, observations on households appearing at least two consecutive interviews are selected. Fourth, observations are dropped if the interview months are not matched between the two consecutive interviews. Fifth, there are cases in which two different households might be wrongly connected as a panel household. Such panel households are defined as 'potentially fake panel households', detected, and dropped.[12] Sixth, observations are dropped if household headship is not continued. As in

[11] In a robustness check in Appendix B.2.a, I extend the sample period of the CEX from 2004-2014 to 2004-2016 by estimating taxes for the whole periods using the TAXSIM program developed by Feenberg and Coutts (1993) and maintained and updated by Feenberg (ndb) and Feenberg (nda).

[12] This problem exists because panel households are selected based on addresses. When an old household moves away and a new household moves into an address selected for a panel interview, there is a risk of connecting these two different households as a panel household. In Appendix B.3 of Hong (2020), I provide a detailed discussion on why

the CEX, the gender and age of household heads are used as criteria for determining whether headship is continued. Seventh, observations with too much value in the imputation for the missing incomes are dropped. Eighth, outliers on their log income change or log consumption change are dropped. Outliers are defined in the same way as in the CEX. When (year, household appearing two consecutive years) is counted as one observation, this sample selection yields 40,035 observations from the 2004-2016 waves of ENAHO.

constructing consumption and income

Attanasio and Weber (1995)'s consumption measure is a popular benchmark in the literature when constructing a measure of nondurable consumption from the CEX sample. Their consumption measure includes nondurable goods and part of services but excludes services inheriting a durable nature such as health expenses, education expenses, and certain housing expenses like mortgage expenses. Kocherlakota and Pistaferri (2009) follow the consumption definition of Attanasio and Weber (1995) and list the expense items included at the Universal Classification Code (UCC) level. I closely follow the consumption measure of Attanasio and Weber (1995) and Kocherlakota and Pistaferri (2009) by adopting an updated version of Kocherlakota and Pistaferri (2009)'s UCC sets.[13]

I make one notable deviation from Kocherlakota and Pistaferri (2009)'s UCC sets when constructing my consumption measure. Their consumption measure includes housing rents but does not include the rental equivalence of housing for homeowners. Since my analysis involves sorting households by their consumption, it is important to either include or exclude both the rental costs for renters and the rental equivalence of housing for homeowners. My baseline consumption measure includes both of them.[14]

I construct the consumption measure for the ENAHO sample similarly by including expenses on nondurable goods and part of services but exclude services with a durable nature. Consistently with the consumption definition for the CEX sample, the rental equivalence of housing for homeowners is also included.[15] Appendix A provides detailed lists of expense items included in the consumption measure for each of the surveys, ENAHO and the CEX, as well as the crosswalk between them.

The income concept used in this paper is disposable income. In both the CEX and ENAHO, the baseline measure of income includes labor income, capital income, and regular transfers (including both public and private transfers.) Irregular lump-sum transfers such as inheritance or gambling

this problem exists and how to detect the potentially fake panel households.

[13]Here, an 'updated version' means that new UCCs that have been introduced after Kocherlakota and Pistaferri (2009)'s sample period are included and categorized.

[14]I also conduct a robust check by excluding both of them in Appendix B.1.g and find that the results are robust.

[15]ENAHO also collects the rental equivalence of donated housing. This expense is also included.

prizes are excluded. Then I subtract taxes and deductions reported by households. Appendix A provides detailed lists on the income items included in the income measure for each of the surveys. For each income item, I split it into 'non-bracketed and non-imputed' part and 'bracketed or imputed' part. The baseline income measure is constructed by including only the non-bracketed and non-imputed parts.[16]

Both consumption and income are deflated with consumer price indexes (CPIs). For the CEX sample, CPI series for nondurable consumption are used. For the ENAHO sample, the headline CPI series are used because the CPI series for nondurable consumption are not available in Peru.[17]

constructing consumption and income groups

To construct consumption groups, I sort observations by their average quarterly consumption between the former and latter quarters in the consumption change.[18] Specifically, I sort observations within each calendar quarter subsample. When computing the quantile of each observation in the consumption distribution, observations' weights are taken into account. Consistently with the sorting criterion, observations' weights are constructed by averaging their survey weights in the former and the latter quarters of the consumption change.

I also conduct the fluctuation decomposition analysis under income grouping, and income groups are constructed similarly as follows. Observations are sorted by their average quarterly income between the former and latter quarters of the income change within each calendar quarter subsample. Households' weights are again taken into account in computing quantiles in the income distribution.

D Adaptation

Both the CEX and ENAHO have specific features that do not perfectly fit into the general framework of the fluctuation decomposition in equation (1). To accommodate these survey-specific features, I introduce some modifications to the regression equation or sample restrictions while trying to minimize the loss of comparability between the two surveys.

[16] Note that as discussed above, observations with too much value in imputed or bracketed part of income are dropped in the sample selection procedure.

[17] The ENAHO data set provides expenses and incomes in terms of both nominal values and the values at the price level of the survey year. For example, when a survey is conducted in April 2008 and the reference period of a certain expense item is 'previous three months', both the nominal values of the expenses and the values of the expenses in the 2008 price level are provided. Deflation over the sample periods of 2004-2016 is implemented by deflating the within-year-deflated values with annual CPIs.

[18] Parker and Vissing-Jorgensen (2009) sort observations by their consumption in the former period of the consumption change. This sorting based on one-period consumption might be less stable than a sorting based on average consumption over multiple periods because a large and infrequent expenditure can shift households from a non-rich group to a rich group more easily under the former sorting than the latter sorting. For this reason, I use the average consumption of the former and latter quarters of the consumption change.

Adaptation to CEX 1. rotating panel with the length of four quarters

In regression (1), a year-over-year growth of quarterly consumption is used. In the CEX, however, households are tracked over only four quarters. If a household has its first interview in January 2004, for example, this household is interviewed three more times in April 2004, July 2004, and October 2004, and then exits. Therefore, the CEX sample can provide up to three-quarter growth of consumption and inocme, but cannot provide four-quarter growth (or, equivalently, year-over-year growth). Given this feature of the data, when the decomposition regression is conducted using the CEX sample, I use three-quarter growth instead of year-over-year growth.[19] This modification does not cause a seasonality issue because monthly dummies are included in the regression.

Adaptation to CEX 2. reference period of income

In the CEX, the reference period for expenditure items is ‘previous three months’, which is consistent with the general regression framework in equation (1). However, the reference period for income items is ‘previous twelve months’ in the CEX. To deal with the issue of the inconsistent reference period of income, the following modification to the regression framework is introduced.

The three-quarter-growth version of regression (1) discussed above can be written as follows.

$$\frac{w^G(\bar{Y}^G_{y,m+9} - \bar{Y}^G_{y,m})}{\bar{Y}^{agg}_{y,m}} = \alpha^G_m + \beta^G \left(\frac{\bar{Y}^{agg}_{y,m+9} - \bar{Y}^{agg}_{y,m}}{\bar{Y}^{agg}_{y,m}} \right) + \epsilon^G_{y,m+9}. \tag{5}$$

Let $[\bar{Y}^G_{y,m}]_{1y}$ and $[\bar{Y}^{agg}_{y,m}]_{1y}$ be the average income in the previous 12 months of group G and the whole sample, respectively. In other words,

$$[\bar{Y}^G_{y,m}]_{1y} = \bar{Y}^G_{y,m} + \bar{Y}^G_{y,m-3} + \bar{Y}^G_{y,m-6} + \bar{Y}^G_{y,m-9}, \text{ and}$$

$$[\bar{Y}^{agg}_{y,m}]_{1y} = \bar{Y}^{agg}_{y,m} + \bar{Y}^{agg}_{y,m-3} + \bar{Y}^{agg}_{y,m-6} + \bar{Y}^{agg}_{y,m-9}.$$

By weight-averaging equation (5) over four consecutive quarters with weights

[19] Parker and Vissing-Jorgensen (2009) also use the CEX sample for the consumption fluctuation decomposition, but they take a different route in dealing with this issue. They compute the quarterly growth rates of consumption for each group in each quarter and add up four consecutive quarterly growth rates of the group to compute a year-over-year growth rate. I do not follow their approach because i) this approach cannot be used to compute income growth because income is collected only in the first and fourth interviews, and ii) even for the consumption growth, the set of households included in computing each quarterly growth rate are different across four consecutive quarters.

$(\bar{Y}^{agg}_{y,m}, \bar{Y}^{agg}_{y,m-3}, \bar{Y}^{agg}_{y,m-6}, \bar{Y}^{agg}_{y,m-9})$, we can obtain the following equation.

$$\begin{aligned}\frac{w^G([\bar{Y}^G_{y,m+9}]_{1y} - [\bar{Y}^G_{y,m}]_{1y})}{[\bar{Y}^{agg}_{y,m}]_{1y}} &= \frac{\bar{Y}^{agg}_{y,m}\alpha^G_m + \bar{Y}^{agg}_{y,m-3}\alpha^G_{m-3} + \bar{Y}^{agg}_{y,m-6}\alpha^G_{m-6} + \bar{Y}^{agg}_{y,m-9}\alpha^G_{m-9}}{[\bar{Y}^{agg}_{y,m}]_{1y}} \\ &+ \beta^G\left(\frac{[\bar{Y}^{agg}_{y,m+9}]_{1y} - [\bar{Y}^{agg}_{y,m}]_{1y}}{[\bar{Y}^{agg}_{y,m}]_{1y}}\right) \\ &+ \frac{\bar{Y}^{agg}_{y,m}\epsilon^G_{y,m} + \bar{Y}^{agg}_{y,m-3}\epsilon^G_{y,m-3} + \bar{Y}^{agg}_{y,m-6}\epsilon^G_{y,m-6} + \bar{Y}^{agg}_{y,m-9}\epsilon^G_{y,m-9}}{[\bar{Y}^{agg}_{y,m}]_{1y}}.\end{aligned}$$

The last term on the right-hand side of the equation can be treated as a heteroskedastic and autocorrelated error term, $\mathcal{E}^G_t$ defined as

$$\mathcal{E}^G_t := \frac{\bar{Y}^{agg}_{y,m}\epsilon^G_{y,m} + \bar{Y}^{agg}_{y,m-3}\epsilon^G_{y,m-3} + \bar{Y}^{agg}_{y,m-6}\epsilon^G_{y,m-6} + \bar{Y}^{agg}_{y,m-9}\epsilon^G_{y,m-9}}{[\bar{Y}^{agg}_{y,m}]_{1y}}.$$

In computing standard errors, the heteroskedasticity and autocorrelation of $\mathcal{E}^G_t$ are taken into account by using Newey-West standard errors.

The first term on the right-hand side of the equation above is not constant over each year's calendar month m because the weights $(\bar{Y}^{agg}_{y,m}/[\bar{Y}^{agg}_{y,m}]_{1y}, \bar{Y}^{agg}_{y,m-3}/[\bar{Y}^{agg}_{y,m}]_{1y}, \bar{Y}^{agg}_{y,m-6}/[\bar{Y}^{agg}_{y,m}]_{1y}, \bar{Y}^{agg}_{y,m-9}/[\bar{Y}^{agg}_{y,m}]_{1y})$ vary over time. However, given the overall stable and low quarterly income growths of the U.S. economy, these weights should be close to (0.25,0.25,0.25,0.25). Based on this reasoning, I approximate the first term with new monthly dummies $\mathcal{A}^G_m$.

Using the new monthly dummies $\mathcal{A}^G_m$ and error terms $\mathcal{E}^G_t$, the equation above is re-written as follows.

$$\frac{w^G([\bar{Y}^G_{y,m+9}]_{1y} - [\bar{Y}^G_{y,m}]_{1y})}{[\bar{Y}^{agg}_{y,m}]_{1y}} = \mathcal{A}^G_m + \beta^G\left(\frac{[\bar{Y}^{agg}_{y,m+9}]_{1y} - [\bar{Y}^{agg}_{y,m}]_{1y}}{[\bar{Y}^{agg}_{y,m}]_{1y}}\right) + \mathcal{E}^G_t. \quad (6)$$

For the fluctuation decomposition of the U.S. income, I use equation (6) instead of equation (1).

Adaptation to CEX 3. bracketed or imputed part of income

In the CEX, when households do not want to reveal the exact amount of certain incomes, they can choose to report brackets into which these incomes fall. The fraction of the incomes reported using brackets is called a 'bracketed part of income'. If households report that they earn certain income items but do not reveal both the exact amount and brackets, these income items are imputed based on other information of the households. This part of income is called an 'imputed part of income'.

The bracketed part of income can miss substantial income fluctuations. When individual income fluctuates within brackets, for example, these fluctuations are completely ignored. Imputation could also miss a nontrivial fraction of income fluctuations if the variables used for the income imputation do not vary along with their actual income.

To deal with this issue, I restrict the sample to observations of which bracketed or imputed part of income is smaller than 5% of their total income including both the non-imputed, non-bracketed part and the bracketed or imputed part.

This sample restriction might generate a selection bias if the proportion of the bracketed or imputed part of income is correlated with how rich households are. To resolve this concern, I conduct a robustness check in Appendix B.1.a in which observations dropped due to too much value in the bracketed or imputed part of income are temporarily included in computing the quantiles of selected observations.

Adaptation to ENAHO 1. reference periods varying over items

In ENAHO, reference periods vary over both expense and income items.[20] Importantly, the vast majority of the reported values in both expenses and incomes have reference periods no longer than the previous three months. Given this feature of the data, I set the reference period as previous three months. For expense and income items with reference periods shorter than three months, I normalize them into three-month values. For example, the reference period for cigarette expense is 'previous one month'. I multiply this monthly cigarette expense by three to get a three-month cigarette expense. In the same way, I also normalize expense and income items with reference periods longer than three months into three-month values. For example, the reference period for alimony income is 'previous 12 months'. This annual alimony income is divided by four to get three-month alimony income.

The practice of normalizing expense or income items with shorter reference periods to the values for longer reference periods is common.[21] However, it is less common to normalize expense or income items with longer reference periods to the values for shorter reference periods. Although the normalization for items with reference periods longer than three months to three-month values might seem less intuitive, it is a reasonable way to process the data for the following reasons. First, this treatment gives a better measure of how rich households are as it includes infrequent expense and income items. Second, what we use in regression (1) are group statistics. If expense and income items with reference periods longer than three months are purchased and received with a uniform frequency in each group throughout a year, the group statistics should not be affected

[20] Usually, frequently purchased expense items and frequently received income items such as cigarette expense and wage income have shorter reference periods than infrequent items such as legal expenses and alimony income. There are also some expense and income items for which households can choose the reference periods according to their convenience in reporting.

[21] For example, in the CEX data set, households are asked to report their 'usual weekly' cigarette expense over the last three months, and then this 'usual weekly' cigarette expense is normalized to a three-month expense.

much by this treatment.[22] Third, most importantly, excluding all expense and income items with reference period longer than three months do not change the result in any meaningful way, as checked in a robustness check in Appendix B.3.a.

Adaptation to ENAHO 2. imputed part of income

Like the CEX, ENAHO also contains imputed components of income, while it does not have a bracketed part of income. Regarding this issue, I apply the same treatment as in the CEX, *i.e.*, the sample is restricted to the observations that have the imputed part of income less than 5% of the total income including both the non-imputed and imputed parts of income.

Again, this treatment can create a selection bias if the fraction of the imputed income components is correlated with how rich households are. To resolve this concern, a robustness check is conducted in Appendix B.1.a in which observations dropped due to too much value in income imputation are temporarily included in computing the quantiles of selected observations.

III Results

Table 1 reports the result of the fluctuation decomposition under the grouping based on consumption. In the top line of the table, 'b60', 't40', 'b70', 't30', 'b80', 't20', 'b90', and 't10' represent the bottom 60%, top 40%, bottom 70%, top 30%, bottom 80%, top 20%, bottom 90 %, and top 10% consumption groups, respectively. The first two rows in the top and bottom panels report the level shares of consumption and income of each group in the U.S. and Peru, respectively. In both countries, the consumption level share is quite close to the income level share in each consumption group.[23]

The third, fourth, fifth, and sixth rows in each of the top and bottom panels of Table 1 report the consumption fluctuation share (β_c^G), income fluctuation share (β_y^G), and their heteroskedasticity-autocorrelation-consistent (HAC) standard errors.[24] As a benchmark distinction between rich and non-rich households, let's first examine how the bottom 80% and top 20% consumption groups

[22] This reason is not valid when an expense or income item involves seasonality, such as 'Christmas bonus'.

[23] This does not mean that consumption inequality and income inequality are similar in each economy because the groups are constructed by sorting households based on consumption in Table 1. To compare income inequality and consumption inequality in each economy, consumption share in consumption groups and income share in income groups should be compared.

[24] In both the CEX and ENAHO, there are missing observations in the time series of the group statistics used in the fluctuation decomposition. In the CEX, missing observations occur because of the sample design changes between 2004 and 2005 and between 2014 and 2015. In ENAHO, missing observations occur because no household is tracked between 2006 and 2007. Datta and Du (2012) show that when there are missing observations, the equal-spacing Newey-West standard errors (i.e., Newey and West (1987)'s standard errors computed by ignoring missing observations and treating data as equally spaced), which has been often considered as 'practical but ad hoc' circumvention of the problem, in fact, give consistent HAC estimates and are better than imputation in general. Following their suggestions, I compute and report the equal-spacing Newey-West standard errors in this paper.

Table 1: Fluctuation Decomposition by Consumption Groups: U.S. vs Peru

	b60	t40	b70	t30	b80	t20	b90	t10
U.S. CEX (2004-2014)								
C level share	0.39	0.61	0.50	0.50	0.62	0.38	0.77	0.23
Y level share	0.38	0.62	0.49	0.51	0.62	0.38	0.78	0.22
C fluc. share	0.24	0.76	0.31	0.69	0.43	0.57	0.58	0.42
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Y fluc. share	0.34	0.66	0.43	0.57	0.56	0.44	0.75	0.25
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ratio (β_c^G/β_y^G)	0.69	1.16	0.73	1.20	0.77	1.28	0.78	1.66
Peru ENAHO (2004-2016)								
C level share	0.36	0.64	0.47	0.53	0.60	0.40	0.76	0.24
Y level share	0.32	0.68	0.43	0.57	0.56	0.44	0.72	0.28
C fluc. share	0.23	0.77	0.32	0.68	0.43	0.57	0.54	0.46
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)	(0.05)
Y fluc. share	0.11	0.89	0.19	0.81	0.26	0.74	0.43	0.57
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)	(0.05)
ratio (β_c^G/β_y^G)	2.03	0.87	1.68	0.84	1.66	0.77	1.25	0.81

Notes: The equal-spacing Newey-West standard errors are reported in $(\cdot)$. (See footnote 24 for an explanation regarding the equal-spacing Newey-West standard errors.) Households are sorted by consumption when constructing quantile groups.

share aggregate fluctuations. Two interesting observations emerge from the comparison in the aggregate fluctuation shares of these groups between the U.S. and Peru. First, the Peruvian bottom 80% consumption group bears 26% of aggregate income fluctuations, which is substantially smaller than the share borne by the U.S. bottom 80% consumption group, 56%.[25] Second, the Peruvian bottom 80% consumption group bears 43% of aggregate consumption fluctuations, which is nearly identical to the share borne by the U.S. bottom 80% consumption group, despite the fact that the Peruvian bottom 80% consumption group bears a much smaller share of aggregate income fluctuations than the U.S. bottom 80% consumption group.

These two findings can be summarized by the ratio β_c^G/β_y^G reported in the seventh row in each of the top and bottom panels of Table 1. The U.S. bottom 80% consumption group contributes to aggregate consumption fluctuations 0.77 times as much as it does to aggregate income fluctuations, while the Peruvian bottom 80% consumption group contributes to aggregate consumption fluctuations 1.66 times as much as it does to aggregate income fluctuations. The ratio β_c^G/β_y^G of the Peruvian bottom 80% consumption group is substantially greater than that of the U.S. bottom 80%

[25] This finding is in line with Dercon (1996)'s empirical finding that poor households tend to choose lower-return and less risky activities in Tanzania, and Dercon (1998)'s model for a developing economy in which in the presence of subsistence constraints, poor households choose lower-return and less risky activities to the secure subsistence level of consumption, while rich households choose higher-return and riskier activities involving lumpy investment.

Table 2: Relative Bearing Ratios $\left[(\beta_c/\beta_y)^{bottom}/(\beta_c/\beta_y)^{top}\right]$ by Consumption Groups: U.S. vs Peru

	b60/t40	b70/t30	b80/t20	b90/t10
U.S.	0.60 [0.45,0.78]	0.60 [0.44,0.83]	0.60 [0.43,0.85]	0.47 [0.32,0.69]
Peru	2.33 [1.56,3.46]	1.99 [1.51,2.72]	2.16 [1.37,3.52]	1.55 [1.05,2.32]
p-value	0.0000	0.0000	0.0000	0.0000

Notes: Number in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The third row reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by consumption when constructing quantile groups.

consumption group. On the other hand, the ratio β_c^G/β_y^G of the Peruvian top 20% consumption group (0.77) is much smaller than that of the U.S. top 20% consumption group (1.28).

Columns other than the fifth and the sixth ones in Table 1 report the fluctuation decomposition results under alternative distinctions between rich and non-rich households, including the pairs of the bottom 60% and top 40%, the bottom 70% and top 30%, and the bottom 90% and top 10% consumption groups. The main patterns are robust under these alternative distinctions: the Peruvian bottom consumption group exhibits a higher value of the ratio β_c^G/β_y^G than the U.S. bottom consumption group, while the Peruvian top consumption group exhibits a lower value of the ratio than the U.S. top consumption group.

The first two rows of Table 2 report the relative bearing ratio $[(\beta_c^{G_1}/\beta_y^{G_1})/(\beta_c^{G_2}/\beta_y^{G_2})]$ in the U.S. and Peru. When G_1 and G_2 are the bottom 80% and top 20% consumption groups, respectively, the relative bearing ratio in Peru (2.16) is substantially greater than the ratio in the U.S. (0.60). In other words, the Peruvian bottom 80% consumption group contributes to aggregate consumption fluctuations substantially more than the U.S. bottom 80% consumption group relative to their respective contribution to aggregate income fluctuations.

For the standard errors of the relative bearing ratios and the statistical test on whether the relative bearing ratios of the two countries are significantly different, we need to know the distribution of $[(\beta_c^{G_1}/\beta_y^{G_1})/(\beta_c^{G_2}/\beta_y^{G_2})]$ in each country. Given that $\beta_c^{G_1} + \beta_c^{G_2} = 1$ and $\beta_y^{G_1} + \beta_y^{G_2} = 1$, the relative bearing ratio can be re-written as $\left[\frac{\beta_c^{G_1}(1-\beta_y^{G_1})}{(1-\beta_c^{G_1})\beta_y^{G_1}}\right]$, and its distribution can be simulated using the distribution of $(\beta_c^{G_1}, \beta_y^{G_1})$. The asymptotic distribution of $(\beta_c^{G_1}, \beta_y^{G_1})$ can be obtained by applying the generalized method of moments (GMM) to two moment conditions, each of which comes from the consumption and income fluctuation decomposition.[26] Once the asymptotic distribution of $(\beta_c^{G_1}, \beta_y^{G_1})$ is obtained for each country, I simulate the relative bearing ratios and construct 5% confidence intervals. For the test on whether the relative bearing ratios are equal between the two

[26]Both the estimates of $\beta_c^{G_1}$ and $\beta_y^{G_1}$ and their Newey-West standard errors obtained from the GMM are econometrically the same as those obtained from the two respective single-equation regressions. The only additional benefit of casting the two single-equation regressions into the GMM framework is that the covariance between $\beta_c^{G_1}$ and $\beta_y^{G_1}$ is obtained.

Table 3: Fluctuation Decomposition by Income Groups: U.S. vs Peru

	b60	t40	b70	t30	b80	t20	b90	t10
U.S. CEX (2004-2014)								
C level share	0.45	0.55	0.56	0.44	0.68	0.32	0.81	0.19
Y level share	0.30	0.70	0.41	0.59	0.54	0.46	0.71	0.29
C fluc. share	0.33	0.67	0.47	0.53	0.60	0.40	0.74	0.26
	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)	(0.03)	(0.03)
Y fluc. share	0.23	0.77	0.31	0.69	0.39	0.61	0.54	0.46
	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)
ratio (β_c^G/β_y^G)	1.42	0.87	1.54	0.76	1.53	0.66	1.39	0.56
Peru ENAHO (2004-2016)								
C level share	0.39	0.61	0.50	0.50	0.63	0.37	0.78	0.22
Y level share	0.29	0.71	0.39	0.61	0.52	0.48	0.69	0.31
C fluc. share	0.30	0.70	0.40	0.60	0.55	0.45	0.67	0.33
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Y fluc. share	0.10	0.90	0.16	0.84	0.23	0.77	0.28	0.72
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ratio (β_c^G/β_y^G)	3.10	0.77	2.48	0.72	2.39	0.58	2.42	0.45

Notes: The equal-spacing Newey-West standard errors are reported in $(\cdot)$. (See footnote 24 for an explanation regarding the equal-spacing Newey-West standard errors.) Households are sorted by income when constructing quantile groups.

countries, I assume that the two countries' relative bearing ratios are independent.

The third row of Table 2 reports the p-values for the two-sided test on the null hypothesis that the two economies have the same relative bearing ratio. The reported p-value in the third column shows that the relative bearing ratio between the bottom 80% and the top 20% in Peru is statistically significantly different from the relative bearing ratio in the U.S. at 1% significance level.

The first, second, and fourth columns of Table 2 report the results under alternative distinctions between rich and non-rich households, including the bottom 60% and top 40%, the bottom 70% and top 30%, and the bottom 90% and top 10% consumption groups. In all these alternative distinctions, the relative bearing ratio is substantially greater in Peru than in the U.S., and their difference is statistically significant at 1% significance level.

Table 3 and Table 4 conduct the same analysis as Table 1 and Table 2 but under income grouping instead of consumption grouping. One important difference between the top panel of Table 3 and that of Table 1 is that unlike the U.S. bottom consumption groups, the U.S. bottom income groups contribute to consumption fluctuations more than they do to income fluctuations. For example, the U.S. bottom 80% income group bears 39% of income fluctuations and contributes to 60% of consumption fluctuations, yielding the ratio β_c^G/β_y^G (1.53) greater than 1. On the other hand, the ratio for the U.S. bottom 80% consumption group (0.77) is smaller than 1. On the flip

Table 4: relative bearing ratios $\left[(\beta_c/\beta_y)^{bottom}/(\beta_c/\beta_y)^{top}\right]$ by Income Groups: U.S. vs Peru

	b60/t40	b70/t30	b80/t20	b90/t10
U.S.	1.62 [1.10,2.44]	2.02 [1.47,2.88]	2.34 [1.66,3.38]	2.49 [1.72,3.74]
Peru	4.01 [2.59,7.43]	3.46 [2.43,5.33]	4.09 [3.07,5.72]	5.33 [3.63,8.18]
p-value	0.0029	0.0360	0.0190	0.0078

Notes: Numbers in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The third row reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by income when constructing quantile groups.

side, the U.S. top 20% income group exhibits the ratio β_c^G/β_y^G (0.66) less than one, while the U.S. top 20% consumption group exhibits the ratio (1.28) greater than one.

This change occurs because consumption and income are not perfectly correlated. When households are sorted by consumption, households who enjoy a high level of consumption but earn very little income such as rich retirees belong to top groups, contributing to the increase in $(\beta_c/\beta_y)^{top}$. When households are sorted by income, however, these households belong to bottom groups, and as a result, $(\beta_c/\beta_y)^{bottom}$ increases.

A change in the same direction takes place in Peru. Compared to the bottom panel of Table 1 in which households are sorted by consumption, $(\beta_c/\beta_y)^{bottom}$ increases while $(\beta_c/\beta_y)^{top}$ decreases in the bottom panel of Table 3 where households are sorted by income.

Regardless of these changes due to the choice of sorting variables, the main pattern that the relative bearing ratio between bottom and top groups is substantially greater in Peru than in the U.S. robustly appears. Table 4 reports the relative bearing ratios, simulated confidence intervals, and p-values for the two-sided test on the hypothesis that the two countries have the same relative bearing ratio under income grouping. This table verifies that the relative bearing ratios between bottom and top groups are higher in Peru than in the U.S., and the differences are statistically significant under 5% significance level. Moreover, this pattern is robust to various distinctions for rich and non-rich households, including the bottom 60% and top 40%, the bottom 70% and top 30%, the bottom 80% and top 20%, and the bottom 90% and top 10% income groups.

In short, the relative bearing ratio between the bottom and top groups is substantially greater in Peru than in the U.S., and the difference is statistically significant. Economically, it means that non-rich households in Peru contribute to aggregate consumption fluctuations more than non-rich households in the U.S. relative to their respective contribution to aggregate income fluctuations. This finding is robust to i) the choice of grouping strategies between consumption grouping and income grouping and ii) the choice of distinction between rich and non-rich households. Appendix B provides robustness checks in a number of other dimensions.

IV Concluding Remark

The dominant modeling framework in the literature of emerging market business cycles is representative-agent models. Naturally, the question of who bears excess consumption volatility in emerging economies has been ignored in the literature. This paper addresses this question in one important dimension of household heterogeneity: the heterogeneity between rich and non-rich households. Specifically, this question is addressed by decomposing aggregate consumption and income fluctuations into the shares borne by rich and non-rich households in Peru and the U.S. according to the method developed by Parker and Vissing-Jorgensen (2009) and then comparing the shares between the two countries. I find that Peruvian non-rich households contribute to aggregate consumption fluctuations disproportionately more than U.S. non-rich households relative to their respective contribution to aggregate income fluctuations.

This finding is important because it has an implication on which theories should be pursued in explaining the phenomenon of excess consumption volatility in emerging economies. The conventional theories for excess consumption volatility in emerging economies do not square well with the empirical finding of this paper because these theories require mechanisms that should be facilitated far better by rich households than non-rich households, while the finding of this paper suggests that non-rich households could be important contributors to the phenomenon.

A question that is cast outside the representative-agent realm leads to an empirical answer that does not fit well with theories in the realm. It might be time to extend our theoretical boundary of emerging market business cycle models in the literature.

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[Online Appendix]

Who Bears Aggregate Fluctuations
in Emerging Economies?

Seungki Hong

A Construction of Consumption and Income from the CEX and ENAHO

Table A.1 presents expense item codes included in the baseline consumption measures in the CEX and ENAHO and the crosswalk between the two surveys. Expense categories 1 $\sim$ 29 are the same as those used in Kocherlakota and Pistaferi(2009). Expenditure categories 30 and 31 are newly added to their set of expenditure categories. Category 30 represents rental equivalence of homeowners or donated housing. Category 31 includes expense items that are surveyed in ENAHO but not in the CEX Interview Survey. They are non-durable goods for daily use, such as laundry items, bathroom items, housing maintenance items, and personal care items (lotion, shampoo, toothpaste, and so on).[27] Five-digit numbers appearing in this table are expense item codes ('pcode' hereafter) that I create in order to represent expense items surveyed in ENAHO. The first three digits in each pcode are the corresponding questionnaire number. For example, pcode 60301 represents an expense item which is collected in questionnaire 603. An excel file 'expenditure and income classification.xlsx' in supplementary materials contain detailed information on which expense each pcode represents.

Table A.1: crosswalk between the CEX and ENAHO on expense items included in the baseline consumption

[1. food at home]	
CEX	190904 790220 790230 790240*
ENAHO	60101 60102 60103 60104 60105 60106 60107 60108 60109 60110 60111 60112 60113 60114 60115 60116 60117 60118 60119 60120 60121 60122 60123 60124 60125 60126 60127 60128 60129 60130 60131 60132 60133 60134 60135 60136 60137 60138 60139 60140 60141 60142 60143 60145 60146 60148 60149
[2. food away from home]	
CEX	190901 190902 190903 790410 790430 800700
ENAHO	60147 60150 60201 60202 60203 60204 60205 60206 60207 60208 60211 60212 60213 60214 60215 60216 55901 55902 55903

[27] These items are surveyed in the Diary Survey of the CEX.

[3. alcohol]	
CEX	200900 790310 790320 790330* 790420
ENAHO	60144 55904
[4. apparel and footwear]	
CEX	360110 360120 360210 360311 360312 360320 360330 360340 360350 360410 360420* 360511 360512 360513* 360901 360902 370110 370120 370125* 370130 370211 370212 370213 370220 370311 370312 370313 370314* 370901 370902 370903 370904 380110 380210 380311 380312 380313 380315* 380320 380331 380332 380333* 380340 380410 380420 380430 380510 380901 380902 380903 390110 390120 390210 390221 390222 390223* 390230 390310 390321 390322 390901 390902 400110 400210 400220 400310 410110 410111 410112 410120 410121 410122 410130 410131 410132 410140 410141 410142 410901 410902 410903 410904 420110 420115* 420120
ENAHO	60701 60702 60703 60704 60705 61106 31101 31102
[5. clothing services]	
CEX	440110 440120 440130 440140 440210 440900
ENAHO	60706 60707
[6. tobacco]	
CEX	630110 630210
ENAHO	61111
[7. heating]	
CEX	250111 250112 250113 250114 250211 250212 250213 250214 250221 250222 250223 250224 250901 250902 250903 250904 250911* 250912* 250913* 250914*
ENAHO	11703 11705 11706 11707 11708 11709 11714
[8. utilities: gas]	
CEX	260211 260212 260213 260214
ENAHO	11704
[9. utilities: electricity]	
CEX	260111 260112 260113 260114
ENAHO	11702
[10. utilities: water and sewerage]	
CEX	270211 270212 270213 270214 270411 270412 270413 270414 270901 270902 270903 270904
ENAHO	60507 11701
[11. public transportation]	
CEX	530110 530210 530311 530312 530411 530412 530510 530901 530902
ENAHO	60404 60405 60406 60407 60408 60409 56001
[12. vehicle expenses]	

CEX	520110 520111 520112 520310 520410 520511 520512 520516* 520517* 520521 520522 520530 520531 520532 520541 520542 520550 520901 520902 520903 520904 520905 520906 520907
ENAHO	..
[13. gasoline and oil]	
CEX	470111 470112 470113 470114 470211 470212
ENAHO	60401 60402
[14. vehicle maintenance and repairs]	
CEX	470220 480110 480211 480212 480213 480214 480215* 480216* 490000 490110 490211 490212 490220 490221 490231 490232 490300* 490311 490312 490313 490314 490315 490316 490317 490318 490319 490411 490412 490413 490500 490501 490502 490900
ENAHO	60403
[15. parking fees]	
CEX	220901 220902
ENAHO	60501 61110
[16. newspapers and magazines]	
CEX	590110 590111 590112 590210 590211 590212 590310* 590410*
ENAHO	60601
[17. books]	
CEX	590220 590230
ENAHO	..
[18. club membership fees]	
CEX	520560* 620110 620111 620112 620113 620114* 620115 680904* 680905*
ENAHO	60603 60604
[19. ticket admissions]	
CEX	620121 620122 620211 620212 620213* 620214* 620221 620222 620310
ENAHO	60602
[20. miscellaneous entertainment expenses]	
CEX	310240* 310350* 610900 620330 620410 620420 620902 620903 620904 620905 620906 620907 620908 620909 620912 620918* 620919 620921 620922 620926 620930* 680310* 680320*
ENAHO	60608 61104
[21. home rent]	
CEX	210110 210210 210310 210901 210902 350110 800710
ENAHO	61108 10501 10602
[22. home insurance]	
CEX	220111 220112 220121 220122
ENAHO	..

[23. home maintenance and repairs]	
CEX	230111 230112 230113 230114 230115 230116 230117 230118 230119 230121 230122 230123 230131 230132 230133 230134 230141 230142 230150 230151 230152 230901 230902 330511 340914 790600
ENAHO	60506
[24. telephone and cable]	
CEX	270000 270101 270102 270103 270104 270105* 270106* 270310 270311*
ENAHO	60410 60411 60412 60413 11710 11711 11712 11713 31401 56002 56003 56004
[25. babysitting]	
CEX	340210 340211 340212
ENAHO	..
[26. domestic services]	
CEX	340310 340410 340420
ENAHO	60503
[27. other home services]	
CEX	340510 340520 340530 340906 340911 340912 340915
ENAHO	60313 60502 60504 60505 60508
[28. personal care]	
CEX	650110 650210 650310 650900
ENAHO	60620 60621
[29. miscellaneous rentals and repair]	
CEX	340610 340620 340630 340901 340902 340903 340904 340905 340907 340908 440150 620916* 620917*
ENAHO	61001 61002
[30. rental equivalence of owned or donated housing]	
CEX	910050*
ENAHO	10601 10603
[31. daily non-durable goods]	
CEX	..
ENAHO	60301 60302 60303 60304 60305 60306 60307 60308 60309 60310 60311 60312 60315 60607 60611 60612 60613 60614 60615 60616 60617 60618 60619

Notes. The asterisk (*) next to a 6-digit UCC code means that the UCC is newly added to Kocherlakota and Pistaferi(2009)'s UCC sets either because the CEX sample period is extended to 2016 or because new expense categories (30,31) are introduced.

Table A.2 presents income sources included in the baseline income from the CEX and ENAHO. In the 'note' column for the CEX survey, I specify the names of the CEX variables and the data sets containing the variables. MEMI contains income from major income sources for each household member, and FMLI contains income from both major income sources and other income sources at a household level. Notation 'YYQ5' is used to indicate data on the first quarter of the following year (YY+1) included in the data set of year YY. (For example, 2016Q5 is the data on 2017Q1 included in CEX 2016 data.) In the 'note' column for ENAHO, I specify the questionnaire number in which each income source is collected and the income codes that I create to differentiate them. STATA codes constructing these income variables from corresponding questionnaires are available in supplementary materials.

Table A.2: income sources included in income measure

survey	income source	note
CEX	· wage and salary	'salaryxm' (MEMI 04Q1-16Q5)
	· self-employment income (net of expenses)	'farmincm','nonfarmm' (MEMI 04Q1-13Q1) 'sempfrmm' (MEMI 13Q2-16Q5)
	· social security and railroad retirement income	'socrrxm' (MEMI 04Q1-16Q5)
	· supplemental security income	'ssixm' (MEMI 04Q1-16Q5)
	· financial income from interest, dividend, royalties, estates, or trusts	'finincxm','intearnm' (FMLI 04Q1-13Q1) 'intrdvxm','royestxm'(FMLI 13Q2-16Q5)
	· retirement, survivor, or disability pensions	'pensionm'(FMLI 04Q1-13Q1), 'retsurvm'(FMLI 13Q2-16Q5)
	· net income from rental units	'inclosam','inclosbm' (FMLI 04Q1-13Q1), 'netrentm' (FMLI 13Q2-16Q5),
	· regular income from unemployment compensation, veterans' benefits, alimony, and child support	'unemplxm','compensm','aliothxm','chdothxm' (FMLI 04Q1-13Q1) 'othregxm' (FMLI 13Q2-16Q5)
	· other money income such as scholarships, stipends (not based on working), or from the care of foster children	'othrincm' (FMLI 04Q1-16Q5)
	· food stamps	'foodsmpm' (FMLI 04Q1-13Q1) 'jfs_amtm' (FMLI 13Q2-16Q5)
	· (-) federal income tax on wage and salary	'anfedtxm' (MEMI 04Q1-14Q5)
	· (-) state& local income tax on wage and salary	'ansltxm' (MEMI 04Q1-14Q5)
	· (-) other taxes	'fedtaxx','sloctaxx','misctaxx' (FMLI 04Q1-14Q5)
	· (+) tax refunds	'fedrfndx', 'slrfndx' (FMLI 04Q1-14Q5) 'othrfndx' (FMLI 04Q1-13Q1)

	· (-) deductions including Gov't Retirement, Railroad Retirement, Social Security	'angovrtm','anrrdedm','jssdedxm','slfempsm' (MEMI 04Q1-16Q5)
ENA-HO	· monetary labor income from primary dependent work after tax and deductions	income code 'inc1' constructed from Q524
	· in-kind labor income from primary dependent work including food, clothes, health, transportation, etc (but not housing)	income code 'inc2' constructed from Q529 (housing excluded to avoid double counting with 'rent as pay' in 'inc14')
	· net income (both monetary and in-kind) from primary independent work	income code 'inc3' constructed from Q530
	· income from self-consumption or self-supply from primary independent work	income code 'inc4' constructed from Q536
	· monetary labor income from secondary dependent work after tax and deductions	income code 'inc5' constructed from Q538
	· in-kind labor income from secondary dependent work including food, clothes, health, transportation, etc (but not housing)	income code 'inc6' constructed from Q540 (housing excluded to avoid double counting with 'rent as pay' in 'inc14')
	· net income (both monetary and in-kind) from secondary independent work	income code 'inc7' constructed from Q541
	· income from self-consumption or self-supply from secondary independent work	income code 'inc8' constructed from Q543
	· extra labor income from (both primary and secondary) dependent work such as bonuses	income code 'inc9' constructed from Q544
	· transfers within the country including alimony, feeding pension, remittances, retirement pension, unemployment pension, pension for widows, orphanage, or survival, transfer from JUNTOS, Pension 65, other public and private transfers	income code 'inc10' constructed from Q556
	· transfers from abroad	income code 'inc11' constructed from Q556
	· capital income from properties including business profits, interests, dividends, rent (houses, machines, lands), patents, etc	income code 'inc12' constructed from Q557
	· rental equivalence of housing, including housing from owned house(s), housing provided by work (*i.e.,* rent as pay), and donated housing	income code 'inc14' constructed from Q106

B Robustness

This section conducts various robustness checks for the main findings of this paper presented in section III. In Appendix B.1, robustness checks regarding changes applicable to both the CEX and ENAHO are conducted. Appendix B.2 and B.3 conduct robustness checks regarding CEX-specific and ENAHO-specific changes, respectively.

B.1 Robustness to Changes applicable to both the CEX and ENAHO

Nine robustness checks are conducted regarding changes applicable to both the CEX and ENAHO. All the robustness checks are conducted under both consumption grouping and income grouping. The results under the consumption grouping are reported in Table B.1, and the results under the income grouping are reported in Table B.2. Throughout all these robustness checks, the point estimates of the relative bearing ratios between the bottom and top groups are robustly greater in Peru than in the U.S. by substantial margins. Moreover, the two economies' relative bearing ratios are significantly different at 5% significance level in most cases under consumption grouping and with 10% significance level in most cases under income grouping.

B.1.a *Including Observations with Too Much Value in Imputed or Bracketed Part of Income in Defining Quantiles*

In the baseline analysis, the sample is restricted to observations of which imputed or bracketed part of income is small enough. If the fraction of the imputed or bracketed part of income is correlated with how rich households are, this sample restriction can generate a selection bias.

Each household's income and consumption play two roles in the fluctuation decomposition analysis. First, they enter into group statistics in computing changes of group income and consumption. Second, they are used in determining households' quantiles in the income distribution and consumption distribution. Regarding the second role, one household's income and consumption are also used in computing other households' quantiles.

The imputed or bracketed part of income is bad for serving the first role as it ignores substantial income fluctuations. However, it can still serve the second role well. In the baseline analysis, I drop observations with too much value in the imputed or bracketed part of income because they are bad for the first purpose, but the selection bias emerges because the dropped observations are also not used for the second role.

To resolve the concern regarding the selection bias, in this robustness check, I include observations dropped due to too much value in the imputed or bracketed part of income when determining the quantiles of selected observations. When the selected and dropped observations are sorted together by income (*i.e.,* under income grouping), a comprehensive income measure including both

Table B.1: Robustness: relative bearing ratios $\left[(\beta_c/\beta_y)^{bottom}/(\beta_c/\beta_y)^{top}\right]$ by Consumption Groups under Changes Applicable to both the CEX and ENAHO

	b60/t40	b70/t30	b80/t20	b90/t10
Robustness B.1.a				
U.S.	0.58 [0.45,0.75]	0.67 [0.51,0.86]	0.64 [0.46,0.88]	0.47 [0.33,0.65]
Peru	2.25 [1.39,3.70]	2.41 [1.70,3.63]	2.29 [1.36,4.13]	1.55 [0.99,2.49]
p-value	0.0000	0.0000	0.0000	0.0000
Robustness B.1.b				
U.S.	0.80 [0.62,1.04]	0.90 [0.69,1.18]	0.80 [0.65,1.00]	0.89 [0.63,1.24]
Peru	2.27 [1.37,4.92]	1.63 [0.98,3.16]	1.71 [1.09,2.88]	1.24 [0.72,2.20]
p-value	0.0007	0.0441	0.0029	0.2989
Robustness B.1.c				
U.S.	0.71 [0.54,0.94]	0.90 [0.71,1.15]	0.81 [0.64,1.02]	0.80 [0.56,1.13]
Peru	1.75 [1.14,2.72]	1.85 [1.20,3.03]	1.68 [1.02,2.91]	1.09 [0.68,1.76]
p-value	0.0007	0.0044	0.0092	0.2971
Robustness B.1.d				
U.S.	0.58 [0.44,0.75]	0.57 [0.41,0.78]	0.60 [0.42,0.84]	0.48 [0.33,0.67]
Peru	1.38 [0.75,2.37]	1.56 [0.98,2.59]	1.60 [0.97,2.79]	1.60 [1.05,2.49]
p-value	0.0135	0.0005	0.0016	0.0000
Robustness B.1.e				
U.S.	0.54 [0.38,0.70]	0.63 [0.47,0.81]	0.52 [0.37,0.74]	0.48 [0.33,0.67]
Peru	1.45 [0.85,2.35]	1.63 [0.87,2.88]	1.53 [0.87,2.92]	1.74 [1.06,2.92]
p-value	0.0024	0.0081	0.0013	0.0000
Robustness B.1.f				
U.S.	0.67 [0.47,0.94]	0.66 [0.49,0.88]	0.67 [0.48,0.91]	0.58 [0.38,0.86]
Peru	2.34 [1.40,3.95]	1.86 [1.28,2.83]	1.86 [1.01,3.56]	1.33 [0.79,2.26]
p-value	0.0001	0.0000	0.0033	0.0130
Robustness B.1.g				
U.S.	0.74 [0.53,1.00]	0.65 [0.48,0.87]	0.63 [0.44,0.88]	0.53 [0.36,0.78]
Peru	2.25 [0.99,4.93]	2.28 [1.34,4.09]	2.06 [1.14,3.86]	1.82 [1.13,2.98]
p-value	0.0168	0.0001	0.0007	0.0001
Robustness B.1.h				
U.S.	0.65 [0.49,0.87]	0.60 [0.44,0.80]	0.63 [0.43,0.93]	0.54 [0.35,0.81]
Peru	2.22 [1.05,4.07]	1.92 [1.15,3.02]	1.93 [1.19,3.06]	1.49 [0.94,2.37]
p-value	0.0066	0.0004	0.0006	0.0015
Robustness B.1.i - stricter				
U.S.	0.79 [0.61,1.03]	0.90 [0.63,1.28]	0.93 [0.67,1.27]	0.80 [0.59,1.12]
Peru	2.38 [1.43,4.04]	2.07 [1.42,3.20]	2.24 [1.28,4.15]	1.58 [1.00,2.56]
p-value	0.0005	0.0017	0.0071	0.0184
Robustness B.1.i - less strict				
U.S.	0.61 [0.45,0.80]	0.60 [0.41,0.86]	0.60 [0.39,0.90]	0.43 [0.28,0.65]
Peru	1.84 [1.10,3.05]	1.68 [1.16,2.52]	1.86 [1.15,3.08]	1.44 [0.96,2.19]
p-value	0.0004	0.0001	0.0004	0.0001

Notes: Numbers in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The third row in each panel reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by consumption when constructing quantile groups.

Table B.2: Robustness: relative bearing ratios $\left[(\beta_c/\beta_y)^{bottom}/(\beta_c/\beta_y)^{top}\right]$ by Income Groups under Changes Applicable to both the CEX and ENAHO

	b60/t40	b70/t30	b80/t20	b90/t10
Robustness B.1.a				
U.S.	2.09 [1.41,3.23]	2.39 [1.65,3.62]	2.21 [1.38,3.63]	2.55 [1.48,4.57]
Peru	3.45 [2.34,5.34]	3.81 [2.63,6.08]	3.71 [2.67,5.41]	5.43 [3.55,8.78]
p-value	0.0924	0.1010	0.0859	0.0397
Robustness B.1.b				
U.S.	2.13 [1.43,3.36]	2.57 [1.74,4.04]	2.24 [1.59,3.22]	3.25 [2.05,5.29]
Peru	3.95 [3.13,5.09]	4.61 [3.18,7.81]	4.33 [3.16,6.14]	5.27 [3.31,8.94]
p-value	0.0189	0.0501	0.0072	0.1566
Robustness B.1.c				
U.S.	2.39 [1.52,3.93]	2.30 [1.52,3.60]	2.78 [1.85,4.34]	2.92 [1.89,4.60]
Peru	4.27 [3.14,6.18]	4.08 [3.16,5.26]	3.83 [2.77,5.44]	5.10 [3.40,8.03]
p-value	0.0513	0.0286	0.2511	0.0722
Robustness B.1.d				
U.S.	1.59 [1.09,2.40]	2.04 [1.48,2.92]	2.28 [1.62,3.30]	2.64 [1.89,3.85]
Peru	3.38 [2.09,6.01]	3.25 [2.13,5.41]	3.96 [2.89,5.50]	5.81 [4.13,8.48]
p-value	0.0192	0.1014	0.0261	0.0025
Robustness B.1.e				
U.S.	1.75 [1.28,2.35]	1.81 [1.19,2.75]	2.04 [1.50,2.80]	2.15 [1.29,3.76]
Peru	4.67 [2.97,7.18]	3.51 [2.09,6.00]	3.76 [2.44,6.02]	3.79 [2.15,7.37]
p-value	0.0008	0.0515	0.0254	0.1626
Robustness B.1.f				
U.S.	1.86 [1.26,2.81]	2.03 [1.45,2.93]	2.27 [1.71,3.08]	2.56 [1.70,3.97]
Peru	3.44 [2.13,5.79]	3.37 [2.47,4.72]	3.52 [2.37,5.48]	5.46 [3.69,8.47]
p-value	0.0564	0.0394	0.0858	0.0118
Robustness B.1.g				
U.S.	1.72 [1.16,2.63]	2.00 [1.43,2.88]	2.35 [1.65,3.43]	2.54 [1.76,3.78]
Peru	4.01 [2.35,7.89]	3.72 [2.42,6.20]	4.46 [3.18,6.60]	6.47 [4.69,9.27]
p-value	0.0148	0.0312	0.0132	0.0005
Robustness B.1.h				
U.S.	1.68 [1.24,2.31]	2.20 [1.67,2.99]	2.46 [1.75,3.56]	2.65 [1.76,4.19]
Peru	4.04 [2.16,8.83]	3.64 [2.19,6.49]	4.23 [2.69,7.13]	4.80 [3.00,8.12]
p-value	0.0145	0.0994	0.0700	0.0751
Robustness B.1.i - stricter				
U.S.	2.15 [1.50,3.25]	2.43 [1.69,3.63]	2.37 [1.54,3.81]	3.41 [2.11,6.29]
Peru	4.21 [2.54,8.46]	3.54 [2.29,6.01]	4.42 [3.14,6.65]	6.45 [4.42,9.86]
p-value	0.0443	0.2151	0.0360	0.0772
Robustness B.1.i - less strict				
U.S.	1.95 [1.32,3.01]	2.45 [1.62,3.92]	2.97 [2.03,4.53]	3.10 [2.18,4.60]
Peru	4.08 [2.82,6.56]	3.51 [2.54,5.19]	3.90 [2.98,5.30]	5.11 [3.58,7.58]
p-value	0.0118	0.2077	0.2794	0.0646

Notes: Numbers in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The third row in each panel reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by income when constructing quantile groups.

the baseline income and the bracketed or imputed part is used as a sorting variable. Once grouping is complete, households with too much value in the imputed or bracketed part of income are dropped when computing group statistics. After dropping them, weights of the selected observations are re-scaled such that the total weight of each group equals what the group is supposed to represent. When computing group statistics, the baseline measures of income and consumption are used as before. Note that in this robustness check, households with too much value in the imputed or bracketed part of income are not used in serving the first role (computing changes in group income and consumption), but they are used in serving the second role (determining the quantiles of the selected observations) so that the concern regarding the selection bias is removed.

B.1.b *Restricting Missing Expense Imputation*

In the baseline analysis, the sample selection procedure only deals with the concern regarding the imputation on missing income. However, imputation for the missing expense is also implemented in both surveys. Although missing expense imputation might cause less concern than missing income imputation because households often have only one or two income sources, while they usually spend on a variety of expense items. In principle, however, missing expense imputation can generate the same problem as missing income imputation. To deal with the concern regarding the missing expense imputation, in this robustness check, I further restrict the sample by dropping observations with missing expense imputation greater than 5% of the total consumption including both imputed and non-imputed components.[28] I also exclude missing expense imputation from the measure of consumption in this robustness check.

B.1.c *Robustness B.1.a + Robustness B.1.b*

In robustness check B.1.b, by further restricting the sample due to the missing expense imputation, the selection bias discussed in robustness check B.1.a might become more serious. To remove the selection bias concern from robustness check B.1.b, I repeat the analysis with one change that groups are defined before dropping observations with too much value in bracketed or imputed part of income and consumption as in robustness check B.1.a.

[28]The questionnaires in ENAHO ask both expenses and quantities for purchased food items. When it comes to non-purchased food items such as donated food or food received as an in-kind payment, however, there is no actual expense spent, and the questionnaires only ask quantities. Then, the local prices of food items are estimated using quantities and expenses of purchased cases, and the estimated prices are used to estimate the monetary value of non-purchased food consumption. These values are also categorized as imputation but are not involved with missing data. I do not include the imputation for the monetary values of non-purchased food items as missing expense imputation in this robustness check.

B.1.d *Excluding Non-Purchased Consumption*

Non-purchased consumption includes donations from public/private institutions, in-kind income, and self-production. Both the CEX and ENAHO include non-purchased consumption. In the baseline analysis, non-purchased consumption is included in both consumption and income. In this robustness check, I instead exclude non-purchased consumption from both consumption and income.

B.1.e *Equivalence Scale*

The unit of analysis in the baseline analysis is a household. In this robustness check, I use an equivalence scale suggested by the World Bank instead of a household as a unit of analysis. Specifically, I divide each household's income and consumption by the square root of the household size. Weights are re-scaled accordingly, *i.e.,* multiplied by the square root of the household size.

B.1.f *Sorting in each monthly subsample*

In the baseline analysis, observations are sorted in each calendar-quarter subsample when computing quantiles and constructing groups. In this robustness check, I sort observations in each monthly subsample instead of the quarterly subsample.

B.1.g *Excluding Housing Rents and Rental Equivalence of Housing from Consumption*

As discussed in subsection II.C, I construct the baseline consumption by closely following Kocherlakota and Pistaferri (2009) but with one deviation that the rental equivalence of housing is also included in consumption. This deviation is made in order to be fair in ranking consumption between renters and homeowners. An alternative way to be fair in sorting their consumption is to exclude both rents and rental equivalence of housing from consumption. In this robustness check, I take this alternative route.

B.1.h *Including Households with Discontinued Headship*

In the baseline analysis, I drop observations when the headships change between the former and the latter interviews. This sample selection might be overly restrictive if households' income and consumption are generally not affected much by the change of the headship. In this robustness check, I include observations with discontinued headship in the sample.

B.1.i *Adjusting the Cutoff for Outliers in Consumption Growth and Income Growth*

When a household's consumption growth or an income growth or both are too high or too low, this observation is categorized as an outlier and dropped from the sample. In the baseline analysis, I set the cutoff for the outliers at the four standard deviations greater or smaller than the mean of each annual subsample. To see whether adjusting this cutoff changes the main results in any meaningful way, in this robustness check, I adjust the cutoff to i) the three standard deviations greater or smaller than the mean (stricter cutoff) or ii) the five standard deviations greater or smaller than the mean (less strict cutoff).

B.2 Robustness to Changes Specific to the CEX

Regarding the CEX-specific changes, four robustness checks are conducted under both consumption grouping and income grouping, and one additional robustness check is conducted under consumption grouping only. Since the changes are specific to the CEX, in each robustness check, the newly estimated U.S. relative bearing ratios are compared with Peru's baseline estimates. Results under consumption grouping are reported in Table B.3, while results under income grouping and reported in Table B.4. Throughout all these robustness checks, the point estimates of the U.S. relative bearing ratios between the bottom and top groups are robustly lower than Peru's baseline estimates. Moreover, the U.S. estimates are significantly different from Peru's baseline estimates at 1% significance level in all cases under consumption grouping and at 10% significance level in most cases under income grouping.

B.2.a *Extending the U.S. Sample Period to 2004-2016 Using TAXSIM-Estimated Taxes instead of Reported Taxes*

As discussed in subsection II.C, the sample period of the U.S. ends in 2014 because I use taxes reported by households when computing disposable income, and the reported taxes have been replaced by TAXSIM-estimated taxes since 2015 in the CEX. If taxes are estimated using TAXSIM back to 2004 and disposable income is computed based on TAXSIM-estimated taxes, however, the sample period does not have to end in 2014. In this robustness check, I extend the U.S. sample period to 2004-2016 by replacing reported taxes with TAXSIM-estimated taxes when computing disposable income. When estimating taxes for the whole period of 2004-2016 using the TAXSIM program, I closely follow Curtin (2017), Fisher, Johnson, and Smeeding (2015), and Lorenz Kueng's code posted on Feenberg (nda).

B.2.b *Back to the U.S. Sample Period of 2004-2014 using TAXSIM-Estimated Taxes instead of Reported Taxes*

As reported in Table B.3 and Table B.4, the U.S. relative bearing ratios between the bottom and top groups are lower in robustness check B.2.a than in the baseline analysis, and thus the gap between the U.S. and Peru becomes larger. To see whether it is because of the extended sample period or because of the reported taxes being replaced by the TAXSIM-estimated taxes, in this robustness check, I repeat the analysis of robustness check B.2.a but with the sample period of 2004-2014. The results in this robustness check are very close to those in robustness check B.2.a, indicating that the difference between the results in robustness check B.2.a and those in the baseline analysis are due to the substitution of reported taxes with TAXSIM-estimated taxes.[29]

B.2.c *Excluding Quarterly Components from Annual Income*

In the CEX, the common reference period in income questionnaires is 'previous twelve months'. However, in addition to income items collected from the income questionnaires, my baseline income measure also includes the rental equivalence of homeowners and non-purchased consumption, which are collected in expenditure questionnaires and thus have the reference period of 'previous three months'.[30] These expense items are annualized by being multiplied by four in order to be added to other annual income items. In principle, however, households' actual expenses on these items in the previous twelve months could be different from these expenses in the last quarter times four. This issue will not cause any problem if these expense items have a negligible effect on the results. To see whether that is the case, in this robustness check, I exclude these expense items from income.

B.2.d *Dropping Observations with 'Incomplete Income Respondents'*

Prior to 2004, income reporting using brackets and imputation for missing income were both unavailable in the CEX. When the CEX sample prior to 2004 are used, in order to restrict the

[29] There is a mechanical reason why the difference between the two countries get larger when TAXSIM-estimated taxes are used in computing disposable income instead or reported taxes. Reported taxes in the CEX generally underreport the actual amount of taxes. (That is why the Bureau of Labor Statistics (BLS) replaced it with TAXSIM-estimated taxes.) Because the U.S. tax system is progressive, once TAXSIM-estimated taxes replace reported taxes in computing disposable income, the disposable income of rich households decreases substantially more than that of non-rich households, and it leads to a decrease in the income fluctuation share of rich households and an increase in the income fluctuation share of non-rich households. If a similar tax-under-reporting problem exists in ENAHO, robustness checks B.2.a and B.2.b fix the problem only for one country and not the other, biasing the results in favor of my argument (*i.e.*, widening the gap in relative bearing ratios between the U.S. and Peru). This is the reason why my preferred specification in the baseline analysis is to keep the tax-under-reporting problem unfixed by using reported taxes in both surveys.

[30] Specifically, the expense items added to my baseline income measure are UCC 910050(homeowner's rental equivalence), 800700 (meals as pay), and 800710 (rent as pay).

Table B.3: Robustness: relative bearing ratios $\left[(\beta_c^{bottom}/\beta_y^{bottom})/(\beta_c^{top}/\beta_y^{top})\right]$ by Consumption Groups under Changes Specific to the CEX

	b60/t40	b70/t30	b80/t20	b90/t10
Baseline Peru				
Peru	2.33 [1.56,3.46]	1.99 [1.51,2.72]	2.16 [1.37,3.52]	1.55 [1.05,2.32]
Robustness B.2.a				
U.S.	0.51 [0.38,0.67]	0.57 [0.43,0.74]	0.54 [0.41,0.72]	0.52 [0.38,0.72]
p-value	0.0000	0.0000	0.0000	0.0000
Robustness B.2.b				
U.S.	0.52 [0.39,0.67]	0.58 [0.42,0.78]	0.57 [0.40,0.80]	0.51 [0.35,0.74]
p-value	0.0000	0.0000	0.0000	0.0001
Robustness B.2.c				
U.S.	0.60 [0.44,0.81]	0.59 [0.41,0.84]	0.61 [0.40,0.91]	0.49 [0.34,0.71]
p-value	0.0000	0.0000	0.0000	0.0000
Robustness B.2.d				
U.S.	0.58 [0.44,0.75]	0.61 [0.44,0.85]	0.59 [0.42,0.82]	0.46 [0.32,0.67]
p-value	0.0000	0.0000	0.0000	0.0000
Robustness B.2.e				
U.S.	0.67 [0.50,0.88]	0.69 [0.52,0.91]	0.82 [0.58,1.15]	0.56 [0.38,0.83]
p-value	0.0000	0.0000	0.0007	0.0003

Notes: Numbers in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The second row in each panel reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by consumption when constructing quantile groups.

sample to those with an acceptable quality of income information, researchers often resort to BLS's categorization of 'complete/incomplete income respondents'. Except for some special cases, a household is categorized as a 'complete income respondent' if its reference person reports a non-zero amount from one of the major income sources such as wage and salary, self-employment, and Social Security benefits. Otherwise, the household is categorized as an 'incomplete income respondent'.

'Complete income respondents' are far from being complete in reporting income information, however: it is possible that complete income reporters miss a substantial amount of income from both the reference person or other members. Bracketing and imputation are better at capturing missing income, and BLS introduced them in 2004. My sample restriction method takes into account how much fraction of income is bracketed or imputed, and thus better than just restricting the sample to 'complete income respondents'.

By changing from the traditional restriction method (restricting to complete income respondents) to a more sophisticated one (restricting to those who do not have too much value in the bracketed or imputed part of income), some incomplete income respondents are included in my sample. To see whether including them distorts the result in any meaningful way, in this robust-

Table B.4: Robustness: relative bearing ratios $\left[(\beta_c^{bottom}/\beta_y^{bottom})/(\beta_c^{top}/\beta_y^{top})\right]$ by Income Groups under Changes Specific to the CEX

	b60/t40	b70/t30	b80/t20	b90/t10
Baseline Peru				
Peru	4.01 [2.59,7.43]	3.46 [2.43,5.33]	4.09 [3.07,5.72]	5.33 [3.63,8.18]
Robustness B.2.a				
U.S.	1.34 [0.98,1.85]	1.53 [1.09,2.18]	1.39 [1.06,1.83]	1.26 [0.91,1.82]
p-value	0.0001	0.0015	0.0000	0.0000
Robustness B.2.b				
U.S.	1.29 [0.89,1.88]	1.43 [0.98,2.14]	1.41 [1.05,1.90]	1.44 [1.05,2.04]
p-value	0.0001	0.0013	0.0000	0.0000
Robustness B.2.c				
U.S.	1.83 [1.14,3.22]	2.20 [1.47,3.58]	2.53 [1.82,3.60]	2.86 [1.96,4.30]
p-value	0.0316	0.1365	0.0386	0.0291
Robustness B.2.d				
U.S.	1.64 [1.09,2.53]	2.09 [1.48,3.06]	2.28 [1.62,3.31]	2.44 [1.71,3.61]
p-value	0.0044	0.0582	0.0152	0.0054

Notes: Numbers in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The second row in each panel reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by income when constructing quantile groups.

ness check, I drop observations categorized as incomplete income respondents from the baseline sample.[31]

B.2.e *Using Annual Consumption as a Sorting Variable*

In the baseline analysis, the sum of consumption in the former and the latter periods of consumption change is used as a sorting variable. In the CEX, it is the sum of the quarterly consumption in the first and last interviews. In the CEX, however, households' quarterly consumption is collected in each of four consecutive quarters, and thus we also have information on the quarterly consumption in the second and third interviews. Using the information on consumption for all four interviews can provide a more stable measure of how rich households are. In this robustness check, I use the sum of the quarterly consumption in all four interviews when sorting observations. Accordingly, households weights are computed by summing the weights in all four interviews. Note that this robustness is not available under income grouping because the CEX collects income data only in the first and fourth interviews.

[31] BLS itself stops including the variable that categorizes households into complete and incomplete income respondents since 2014. I create the variable for the CEX sample in 2014-2016 according to BLS's criteria described in Fisher (2006) after confirming that the variable in 2004-2013 can be exactly replicated by following these criteria.

B.3 Robustness to Changes specific to ENAHO

Regarding ENAHO-specific changes, six robustness checks are conducted under both consumption grouping and income grouping. Peru's relative bearing ratios under each robustness check are compared with the U.S. baseline estimates. Results under consumption grouping are reported in Table B.5, and results under income grouping are reported in Table B.6. Table B.5 and Table B.6 show that the relative bearing ratios between the bottom and top groups in Peru are robustly greater than the U.S. baseline estimates throughout all these robustness checks. Moreover, the relative bearing ratios are significantly different between two economies at 1% significance level in all cases under consumption grouping and at 10% significance level in most cases under income grouping.

B.3.a *Excluding Items with Reference Periods Longer Than Previous Three Months from both Income and Consumption*

In ENAHO, reference periods vary over both expense and income items. As discussed in subsection II.C, any income and expense items with reference periods longer than previous three months are normalized into three-month values in the baseline analysis. To see if this practice has any nontrivial influence on the relative bearing ratios, in this robustness check, I exclude all expenses and incomes with reference periods longer than previous three months from income and consumption measures.

B.3.b *Repeating Robustness Check B.3.a after Correcting Quantiles of Households - 1*

Income and consumption after excluding those reported with reference periods longer than previous three months could be better in measuring income and consumption changes, but not necessarily in determining how rich households are. For example, a household whose usual spending pattern exhibits a modest amount of food consumption and a large amount of of expenses on legal services can be moved from a rich group in the baseline analysis to a non-rich group under robustness check B.3.a because the reference period of legal services is previous twelve months, which are longer than the previous three months.

To reduce this concern, in this robustness check, I sort observations by the baseline measures of income and consumption in determining their quantiles, while income and consumption after excluding expense and income items with reference periods longer than previous three months are used in computing changes in group consumption and income.

Table B.5: Robustness: relative bearing ratios $\left[(\beta_c^{bottom}/\beta_y^{bottom})/(\beta_c^{top}/\beta_y^{top})\right]$ by Consumption Groups under Changes Specific to ENAHO

	b60/t40	b70/t30	b80/t20	b90/t10
Baseline U.S.				
U.S.	0.60 [0.45,0.78]	0.60 [0.44,0.83]	0.60 [0.43,0.85]	0.47 [0.32,0.69]
Robustness B.3.a				
Peru	2.16 [1.49,3.11]	1.95 [1.41,2.79]	2.01 [1.21,3.46]	1.48 [0.99,2.23]
p-value	0.0000	0.0000	0.0001	0.0000
Robustness B.3.b				
Peru	2.09 [1.43,3.03]	1.84 [1.35,2.62]	1.99 [1.23,3.32]	1.44 [0.97,2.16]
p-value	0.0000	0.0000	0.0001	0.0001
Robustness B.3.c				
Peru	2.03 [1.22,3.36]	2.22 [1.54,3.36]	2.08 [1.21,3.79]	1.40 [0.90,2.22]
p-value	0.0001	0.0000	0.0001	0.0003
Robustness B.3.d				
Peru	2.16 [1.35,3.40]	1.89 [1.46,2.45]	1.99 [1.29,3.09]	1.49 [1.00,2.25]
p-value	0.0000	0.0000	0.0000	0.0001
Robustness B.3.e				
Peru	2.42 [1.71,3.49]	1.89 [1.42,2.54]	2.07 [1.38,3.14]	1.48 [0.97,2.28]
p-value	0.0000	0.0000	0.0000	0.0001
Robustness B.3.f				
Peru	2.48 [1.67,3.67]	1.96 [1.40,2.79]	2.13 [1.40,3.33]	1.30 [0.88,1.95]
p-value	0.0000	0.0000	0.0000	0.0003

Notes: Numbers in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The second row in each panel reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by consumption when constructing quantile groups.

B.3.c *Repeating Robustness Check B.3.a after Correcting Quantiles of Households - 2*

Regarding the concern discussed in robustness check B.3.b, including observations dropped due to too much value in bracketed or imputed part of income when determining the quantiles of selected observations , as discussed in robustness check B.1.a, might be even better in resolving the concern. In this robustness check, I include them in determining the quantiles of selected observations, as in robustness check B.1.a. When sorting selected observations together with observations dropped due to too much value in bracketed or imputed part of income, a comprehensive measure of income including both the baseline measure of income and the bracketed or imputed part of income is used as a sorting variable. Observations with too much value in the bracketed or imputed part of income are dropped when computing group statistics. As in robustness check B.1.a, weights are re-scaled. Income and consumption after subtracting those with reference periods longer than three months are used as income and consumption measures when computing group statistics.

Table B.6: Robustness: relative bearing ratios $\left[(\beta_c^{bottom}/\beta_y^{bottom})/(\beta_c^{top}/\beta_y^{top})\right]$ by Income Groups under Changes Specific to ENAHO

	b60/t40	b70/t30	b80/t20	b90/t10
Baseline U.S.				
U.S.	1.62 [1.10,2.44]	2.02 [1.47,2.88]	2.34 [1.66,3.38]	2.49 [1.72,3.74]
Robustness B.3.a				
Peru	3.90 [2.65,6.26]	3.24 [2.36,4.71]	4.31 [3.16,6.14]	4.85 [3.55,6.84]
p-value	0.0024	0.0522	0.0129	0.0112
Robustness B.3.b				
Peru	3.81 [2.44,7.08]	3.37 [2.38,5.11]	3.96 [3.00,5.42]	4.99 [3.49,7.43]
p-value	0.0056	0.0435	0.0252	0.0125
Robustness B.3.c				
Peru	3.21 [2.15,5.06]	3.64 [2.50,5.82]	3.59 [2.62,5.13]	5.13 [3.41,8.13]
p-value	0.0197	0.0259	0.0815	0.0141
Robustness B.3.d				
Peru	3.60 [2.35,6.32]	2.96 [2.09,4.42]	4.04 [3.04,5.55]	5.09 [3.80,7.03]
p-value	0.0085	0.1327	0.0214	0.0056
Robustness B.3.e				
Peru	4.00 [2.61,7.33]	3.48 [2.48,5.30]	4.09 [3.05,5.74]	5.36 [3.60,8.38]
p-value	0.0028	0.0301	0.0203	0.0085
Robustness B.3.f				
Peru	3.86 [2.57,6.89]	3.37 [2.45,5.02]	4.02 [3.01,5.59]	5.26 [3.51,8.28]
p-value	0.0032	0.0357	0.0237	0.0108

Notes: Numbers in $[\cdot,\cdot]$ report a 5% confidence interval based on one-million simulated draws of $(\beta_c^G, \beta_y^G)'$. The second row in each panel reports p-values for a two-sided test on 'H_0 : The U.S. and Peru have the same relative bearing ratios.' Households are sorted by income when constructing quantile groups.

B.3.d *Replacing Non-Purchased Expense Items from Income Questionnaires with Those from Expenditure Questionnaires in Constructing Income*

Non-purchased consumption is included in both income and consumption in the baseline analysis. In the CEX, all the non-purchased consumption items are collected in expenditure questionnaires. In ENAHO, on the other hand, some non-purchased consumption items are collected twice: one in expenditure questionnaires (by asking how much a household acquired without payment) and the other in income questionnaires (by asking how much a household earned in the form of direct consumption). In the baseline analysis, non-purchased consumption collected in income questionnaires are included in the baseline measures of income and non-purchased consumption collected in expenditure questionnaires are included in the baseline measure of consumption (with an exception that rental equivalence of owned, donated, or provided housing collected from expenditure questionnaires is included in both the baseline measures of income and consumption).

However, expenditure questionnaires cover a wider range of non-purchased consumption than income questionnaires. Expenditure questionnaires cover i) self-consumption, ii) self-supply, iii) in-kind payment, iv) public donation, v) private donation, vi) other, and vii) not knowing how to obtain, while income questionnaires only cover i) self-consumption, ii) self-supply, and iii) in-kind payment. Therefore, the baseline measure of income misses non-purchased consumption in the form of iv) public donation, v) private donation, vi) other, and vii) not knowing how to obtain. Moreover, it is not certain whether income questionnaires and consumption questionnaires yield similar values for the commonly covered parts of non-purchased consumption. To see whether this issue affects the main results in any meaningful way, in this robustness check, income definition is modified by replacing the non-purchased consumption included in the baseline measure of income with the non-purchased consumption included in the baseline measure of consumption.[32]

B.3.e *Alternative Measure of Expenses on Questionnaire 559 and 560 - 1*

In general, ENAHO's expenditure questionnaires ask expenses at a household level. Unlike other expense questionnaires, however, questionnaire 559 (food away from home) and 560 (other expenses at an individual level) collect expenses at the level of household members. In these two questionnaires, each member can report whether the member acquires an item by purchasing it or without purchasing it. If the member purchases the item, the member also has to answer whether it is only for the use of the member itself or for the use of multiple people. If it is a purchase for multiple people, the member should also report how many people consume the purchased item, and how many of them are members of the household.

For example, if a household member X acquires an item by purchasing it and this purchased item is consumed by five people, ENAHO records 'the purchased value divided five' as X's consumption. This is the correct accounting if all household members correctly report what they consume including both items purchased by themselves and items purchased by others. For example, assume a situation in which a father purchases five hamburgers at 50 Sols, which are consumed by himself, his three sons and his friend. His friend is not a member of his household. If each of the four household members (the father and three sons) correctly report what they consume, the father reports that he spends 50 Sols for five people, and each of the three kids reports that s/he acquires a hamburger without purchasing it. The consumption of the father is recorded as 10 Sol (50 Sols divided by five). The three kids' non-purchased consumption will be imputed. If the imputation is precise, each kid's consumption on a 10-Sol hamburger will be correctly recorded. At the household level, 40 Sols of hamburger consumption is correctly captured in this accounting. In the baseline analysis, expenses from questionnaire 559 and 560 are measured this way.

[32] There are income items in which monetary income and in-kind income are not distinguishable, such as net income from primary independent work (questionnaire 530) and net income from secondary independent work (questionnaire 541). I keep including these items in the definition of income in this robustness check, assuming that most of the values reported in these questionnaires are in the form of monetary income.

If the kids do not correctly report their non-purchased consumption of the hamburgers either because they do not remember or because they do not actively participate in the survey, this accounting can substantially underestimate expenses in questionnaire 559 and 560. To deal with this concern, in this robustness check, I multiply the consumption of a purchasing household member by the number of household members who consume it together. Back to the example of one father and three kids, this alternative way of accounting assigns 40 Sols as the father's hamburger consumption. If all the three kids forget to report their hamburger consumption, this accounting correctly captures the household's hamburger consumption, 40 Sols. If one or more of the kids do not forget to report his/her hamburger consumption, this accounting overestimates the household's hamburger consumption.

B.3.f *Alternative Measure of Expenses on Questionnaire 559 and 560 - 2*

To fix the possible overestimation of the expenses in robustness check B.3.e, I categorize a household into two types, one that has a member who purchases at least one expense item for other members of the household, and the other that has no such member. The household of one father and three kids in the former example belongs to the first category. In this robustness check, any non-purchased consumption from questionnaire 559 and 560 by the members of households falling into the first category is nullified. In the example of one father and three kids, the father's hamburger consumption is again evaluated as 40 Sols, while the kids' reporting on their hamburger consumption is nullified under the accounting of this robustness check.

However, this robustness check has its own problem: non-purchased consumption provided by people outside a household can be neglected. Back to the example of one father and three kids, assume that the three kids' mother is another member of the household, and she receives food from her workplace. Her food consumption from the workplace is ignored in the accounting of this robustness check.

Although none of the baseline analysis, robustness checks B.3.e, and B.3.f are free from mismeasuring households' consumption on the expense items from questionnaire 559 and 560, one of them (robustness check B.3.e) overestimates the expenses, while the other two (the baseline analysis and the robustness check B.3.f) underestimate them. The fact that all these three cases give similar estimates demonstrate that the mismeasurement problem discussed above is immaterial to the main finding of this paper.