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CHARACTERIZING MANUFACTURING ENGEL CURVES AROUND THE WORLD

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Characterizing manufacturing Engel curves around the world

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Abstract

Using the World Bank Global Consumption Dataset 2010, we study the spending data of over 90 countries. We estimate the cross-country average income elasticity of demand for different manufacturing products. Income elasticities are derived from non-parametrically estimated Engel curves, which is possible due to the high level of data disaggregation. We find a high correlation between product's elasticity and the tendency of demand for this product to satiate. We also find that the participation rate in the consumption of a product and the diversity of consumption patterns increase with GDP.

1 Introduction

According to OECD estimates, the size of the “global middle class” will reach 3.2 billion people by 2020 and 4.9 billion people by 2030¹. This will have a fundamental impact on global consumption and production. This paper explores global changes in consumption patterns of manufactured products as income increases.

According to World Bank estimates for 2015, household final consumption expenditure accounts, on average, for 61 per cent of GDP in OECD countries. It thus represents the core driving force of the economy. Consequently, estimates of household demand patterns play a crucial role in evaluating the economic effects of most government policies. This paper contributes to improving the way economists think about—and analyse—household expenditure patterns. A new approach is applied to identify important facts about how household spending patterns systematically change with rising income. Due to the release of detailed consumption data by the World Bank, this paper covers 90 countries and more than 100 goods and services. The data’s global scope discloses global consumption trends, comprising both different countries and products (cf. Clements and Chen, 1996, and references therein).

The traditional approach to investigate how income influences household expenditure is the study of Engel curves, which trace the dependence of specific categories of consumption on income across households. In this study, we emphasize the importance of identifying satiation levels (or tendencies to satiate) in Engel curves. One key notion in many models of post-Keynesian consumer theory and demand-driven structural change is that household expenditure on *any* particular good has an upper limit referred to as the *satiation* (or *saturation*) level; once this is reached, household expenditure will cease to rise in response to increasing income (Pasinetti, 1981). Satiation thus plays a crucial role in driving structural change from the demand side, implying that the growth in demand for an industry’s products will eventually slow down as more households reach the level of income at which satiation occurs. As a result of the slowdown in demand growth, resources shift away from industries supplying goods for which demand has been satisfied towards other newly emerged industries that produce goods for which demand has not yet been satiated. We assess how prevalent the tendency for Engel curves to flatten out, i.e. to *satiating*, is across a wide range of manufactured products. We find differences between countries with respect to the composition of manufactured products that tend to satiate demand.

¹ http://oecdobserver.org/news/fullstory.php/aid/3681/An_emerging_middle_class.html

The paper is organized as follows. In the following section, we provide details on the conceptual framework and elaborate on the significance of demand changes in driving structural change. The importance of Engel curves in describing this process and the main characteristics to be considered (shape of the curves, satiation points, etc.) are discussed. In Section 3, we introduce data sources used for the analysis and the methodological procedure to build an Engel curve and identify its tendency to satiate demand. The results in the main sectors of the economy (primary sector, manufacturing and services) as well as within manufacturing industries are presented in Section 4. Moreover, we provide a typology of manufacturing industries based on the characteristics of their Engel curves.

2 Background literature and evidence

2.1 Theoretical framework

Economists have long been concerned with the link between the manner in which demand expands and the industrial composition of the economy. Since the latter influences economic growth, which in turn (via income and price effects) influences the expansion of demand, the bi-directional causal relationship implicit in that link has also long been emphasized.

Adam Smith (1776), for example, highlighted the fact that the size and characteristics of an industry are influenced by the scope of demand. Around 150 years later, Alfred Marshall (1919) underlined the central role of demand in determining returns to scale. Explicit emphasis on the link between the growth rate of demand and the size of different industries was given by Solomon Fabricant (1942), who recognized that while an industry can only grow as much as the size of the market allows, this constraint itself is influenced by the growth rate of per capita income. The popularity of these ideas grew as new data emerged about the development trajectories of different industries (Kuznets, 1973). In this context, Colin Clark (1950) noted that consumption expenditure does not expand in a uniform manner across all goods and services as income rises. This unevenness has natural implications for an economy's industrial composition (cf. also Fisher, 1935).

The premise that the expansion pattern of consumption is able to influence the industrial composition of the economy and ultimately, economic growth, can be found in the work of Luigi Pasinetti (see in particular Pasinetti, 1981). Pasinetti argues that there is an upper limit as to how much an individual consumer is willing to spend on any good or service as income rises. In his words, "there is no commodity for which any individual's consumption can be increased indefinitely. An upper saturation level exists for all types of goods and services although at different

levels of real income” (Pasinetti 1981: 77). Since saturation (or satiation²) of demand occurs at very different levels of income (possibly also “out of sample”) and the paths leading to these levels may be of very different shapes and slopes, increases in consumption expenditure at any level of income tend to be concentrated in particular goods and services. Pasinetti (1981: 73) hypothesizes that goods and services possess one of three types of Engel curves (see Figure 1). Thus, there are significant differences in the productivity and growth rates between those industries whose products attract increases in consumption expenditure and those whose products do not. Note that satiation is a property of the growth rate—not of the level—of demand with respect to a given sector.

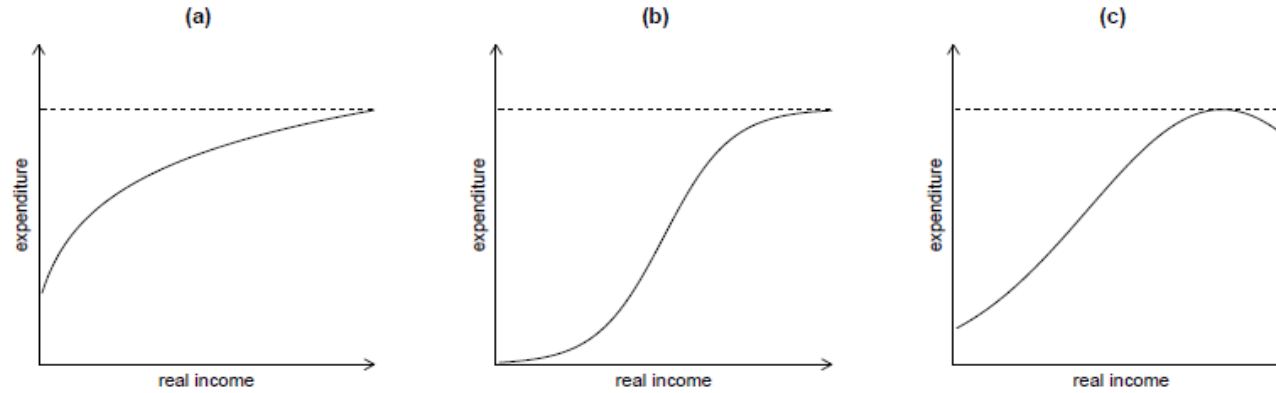
More recently, several scholars have followed Pasinetti’s idea of ascribing the cause of structural change to demand satiation, see e.g. Andersen (2001); Saviotti (2001); Aoki and Yoshikawa (2002); Metcalfe et al. (2006). Lewbel (2008) notes that Engel curves for certain goods (e.g. food) are close to a log-linear fit, while those for other goods and services are highly nonlinear, even in log formulation. Structural change is possible even if one observes a “slowdown” rather than a “satiation” of household spending on a good. Satiation implies that no matter how much household income increases, household expenditure on a good remains below a certain (good-specific) level. By contrast, a slowdown (also called “tendency to satiate”) simply means that as income increases, the growth rate of expenditure declines: in other words, the income elasticity of a good declines with increasing income. A slowdown is a necessary but insufficient condition to observe satiation in household expenditure.

Implicit in Pasinetti’s hypothesis regarding the shape of Engel curves (see Figure 1) on which his argument about structural change is based, is that observations about how expenditure changes as household income increases can be interpreted as an expansion path for expenditure over time. In other words, the hypothesized shapes of Engel curves are used to predict what will happen in the future, provided that income rises over time. This inference assumes that the underlying Engel curve is stable and will not change over time. In other words, given a rise in household income from x at time t to $x+h$ at time $t+1$, the household at time $t+1$ with income $x+h$ will display a consumption behaviour similar or identical to the household that possessed income $x+h$ already at time t .

² We use the two terms interchangeably in this paper, although in the literature, saturation generally refers to markets and satiation to individuals.

Figure 1 Engel curve types

Chart {a} is the hypothesized Engel curve for goods “necessary for physiological reasons (e.g. food)”, Chart {b} is the hypothesized Engel curve for almost all other cases, while Chart {c} is the hypothesized Engel curve for inferior goods.



5 Source: Pasinetti (1981:73).

2.2 Background evidence based on UK and German data

Chai and Moneta (2009), Chai and Moneta (2014) and Moneta and Chai (2014) use the UK Family Expenditure Survey and Expenditure and Food Survey conducted between 1968 and 2006 to explore several hypotheses about saturation or satiation in Engel curves. Specifically, having defined “weak saturation” as a decreasing slope of an Engel curve at a given range of income and “strong saturation” as a decreasing slope of an Engel curve jointly with its confidence bands, Moneta and Chai (2014) find that between 1968 and 2006, weak saturation occurs more than 80 per cent of the time for most subcategories of food expenditure (and tobacco), while it occurs for 51 per cent of the time for household goods. Strong saturation is recorded more than half of the time for most subcategories of food expenditure (and tobacco), while for household goods, clothing and footwear, motoring, leisure goods and services, strong saturation occurs far less than half of the time. The same work also studies the evolution of real Engel curves over time and reveals that while food consumption tends to exhibit a stable Engel curve over time (in terms of shape and position), other categories of expenditure such as clothing and footwear, household goods, motoring, leisure goods and leisure services are far more unstable. This phenomenon has been interpreted as suggesting an “escaping satiation dynamics” (Witt, 2001), which is much stronger for (manufacturing) durable goods and services than for food. Similar conclusions derived from an analysis of Engel curve derivatives are found in Chai and Moneta (2014).

Bruns and Moneta (2016) analyse Engel curves using German household data for different time intervals (1978-1983, 1983-1988 and 1988-1993). They find concave shapes of Engel curves for food, alcohol and tobacco as well as clothing and footwear. In the other categories (household goods and services, leisure goods and services, personal goods and services), they find a mixture of S-shaped and convex Engel curves. The intertemporal analysis shows that the propensity to consume under higher levels of income is lower for food than for durable goods.

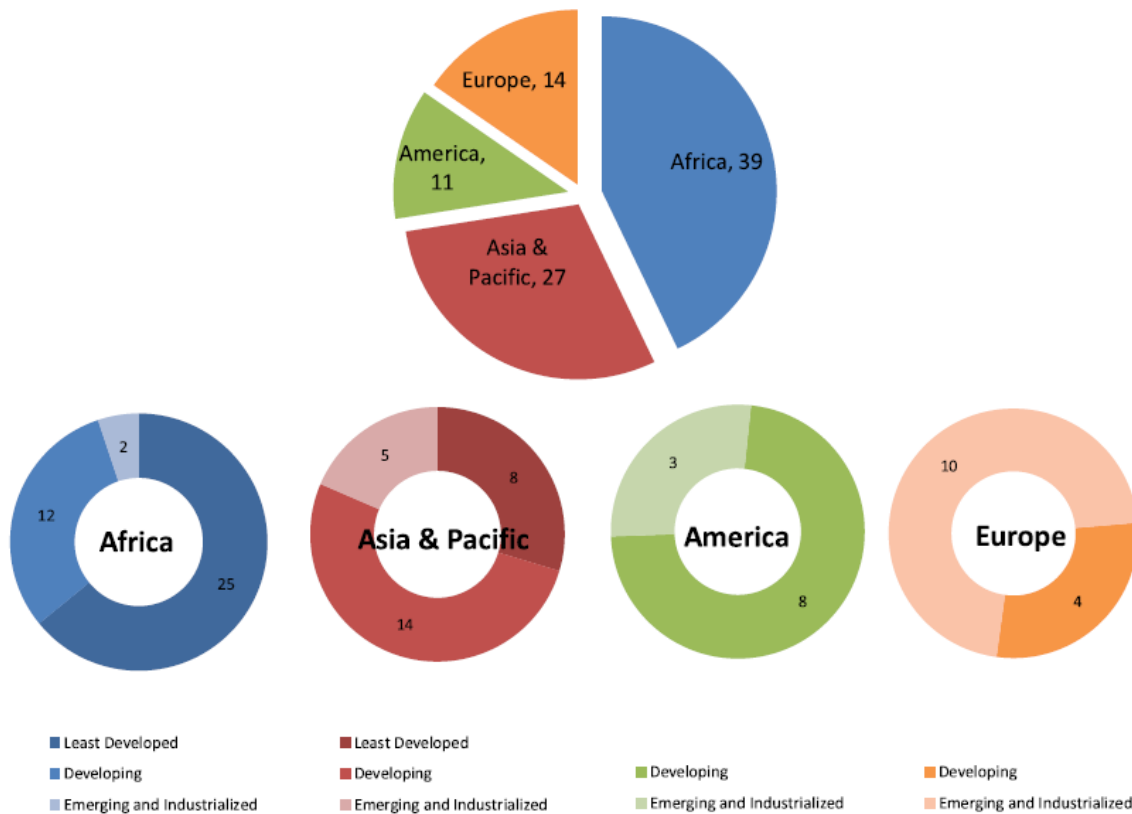
3 Data description and methodology

3.1. Data description

The data used for the present analysis was obtained from the World Bank’s Global Consumption Database (GCD) and are based on the national household consumption or expenditure survey datasets conducted by the World Bank. All data presented in the GCD refers to 2010. The data covers 91 countries, including least developed (36 per cent), developing (42 per cent), emerging and industrialized countries (22 per cent). Figure 2 presents the distribution of countries by geographical and economic criteria. The data cover 106 product/service consumption

categories, 32 of which are products from the primary sector (i.e. food and beverages), 35 are service categories and the remaining 44 are manufacturing goods. Out of the 44 manufacturing goods, only 15 can be mapped one-to-one to manufacturing industries³. The description of these 15 consumption categories and their corresponding manufacturing industry is provided in the Appendix.

Figure 2 Distribution of countries in the dataset by geo-economic groups



Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

The GCD presents four levels of income, proxied by total consumption expenditure, which segment the population in each country: lowest, low, middle and higher. These income segments are based on global income distribution data, which rank the global population by income per capita. The lowest consumption segment corresponds to the bottom half of the global distribution, or the 50th percentile and below; the low consumption segment to the 51st-75th percentiles; the middle consumption segment to the 76th-90th percentiles; and the higher consumption segment corresponds to the 91st percentile and above⁴.

³ We use the International Standard Industrial Classification (ISIC) rev. 3 here.

⁴ Cf. <http://datatopics.worldbank.org/consumption/detail>

The thresholds of the four income segments are as follows:

Lowest: below \$ PPP 1084.05 per capita total annual expenditure;

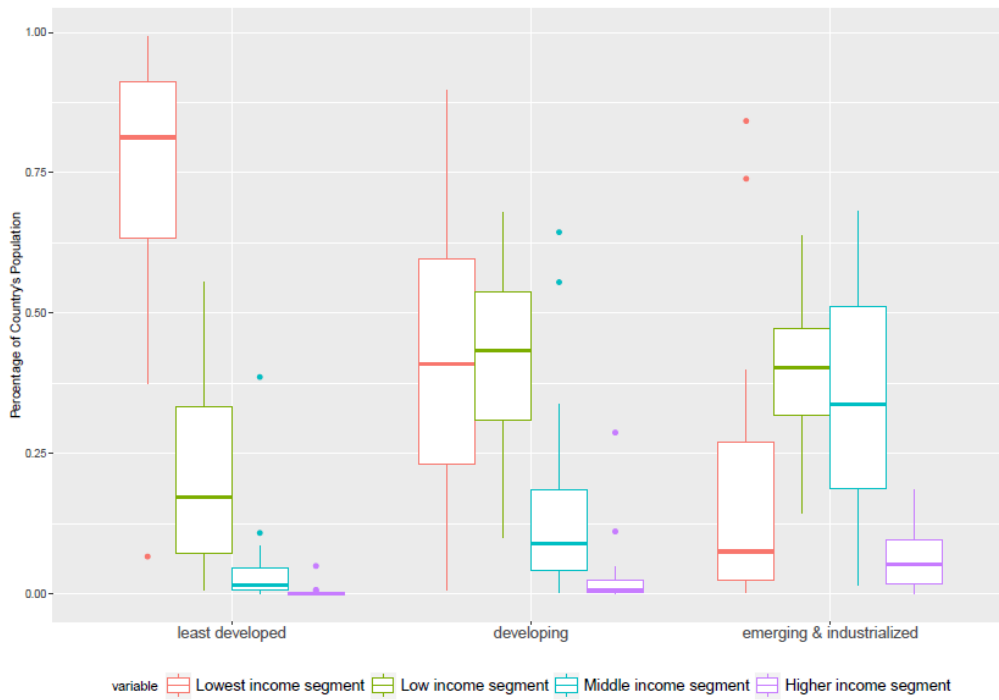
Low: between \$ PPP 1084.05 and \$ PPP 3080.6 per capita total annual expenditure;

Middle: between \$ PPP 3080.6 and \$ PPP 8405.95 per capita total annual expenditure;

Higher: above \$ PPP 8405.95 per capita total annual expenditure.

The distribution of population among these four income segments varies drastically between the countries, reflecting the world's income inequality. In some countries, a household that is considered wealthy at the country level may actually belong to the lowest segment at the global level. This fact is taken into account in our analysis. Figure 3 illustrates the population's distribution across global income segments (as defined above) in the least developed, developing and emerging and industrialized world. The figure displays four boxes that correspond to the four income segments. In the least developed world, 80 per cent of the country's population on average belong to the *lowest* income segment and the *higher* income segment is represented by less than 0.01 per cent of the population, while in the emerging and industrialized countries, 5 per cent of country's population on average belong to the global *higher* income segment. Table 1 classifies the countries under investigation considering the 5 per cent wealthiest population: if the 5 per cent wealthiest population of a country belongs to the *higher* income segment, the country belongs to the global "higher" income group (fourth column); if the 5 per cent wealthiest population of a country belongs to the *middle* income segment, the country belongs to the global "middle" income group (third column), and so on. Note that the sample of countries under investigation is not a representative sample of the world's countries: the only two industrialized countries included here are Russia and Lithuania, and the only two OECD countries are Latvia and Turkey. Thus, our sample over-represents countries with a low income. This bias is mitigated by the fact that the global distribution of income is highly skewed (with the peak at low income level), as shown by Chotikapanich et al. (1997).

Figure 3 Distribution of country's population across income segments in least developed, developing and emerging and industrialized countries



Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Table 1 Classification of countries into global income groups

Classification criteria: at least 5 per cent of the country's wealthiest population belong to the income segment (higher, middle, low, lowest)

Global Income Groups Economic group of a country	Lowest	Low	Middle	Higher
Least developed	Congo, Democratic Republic Madagascar	Afghanistan Mauritania Bangladesh Mozambique Burkina Faso Nepal Chad Niger Ethiopia Rwanda The Gambia Sierra Leone Lao PDR Tanzania Malawi Timor Leste Uganda Zambia	Bhutan Cambodia Djibouti Lesotho Sao Tome and Principe Yemen	
Developing		Armenia Cameroon Congo, Rep.of Egypt Kenya Kyrgyz Republic Mongolia Nigeria Pakistan Philippines Swaziland Viet Nam	Albania Jamaica Azerbaijan Jordan Bolivia Maldives Côte d'Ivoire Moldova El Salvador Morocco Fiji Namibia Gabon Papua New Guinea Ghana Peru Guatemala Republic of Cabo Verde Honduras Sri Lanka	Bosnia and Herzegovina Montenegro
Emerging, industrialized		India Indonesia	China Kazakhstan Mauritius Mexico Romania Thailand Ukraine	Belarus Russia Brazil Serbia Bulgaria South Africa Colombia Turkey Latvia Lithuania Macedonia (FYRO)

Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

For each country and in each income segment, the World Bank dataset provides the average annual expenditure, quantified in \$ PPP, for the 106 products/services mentioned above. Thus, for each category of products/services, we obtain four points on the basis of which we estimate an Engel curve.

a. Engel curves and tendency to satiate

An Engel curve can be written in the following way:

$$Exp_i^j = m_j (x_i) + \varepsilon_i, \quad (1)$$

where Exp_i^j denotes the expenditure of household i on category j , x_i is total expenditure (proxy for income) allocated by household i , $m_j (x) = E(Exp_i^j | x_i)$ and ε_i is the (household-specific) error term such that $E(\varepsilon_i | x_i) = 0$. Equation (1) is usually estimated using a cross-section of household data by linear or nonlinear least squares, if one assumes a functional form for $m_j (x)$ or, alternatively, by nonparametric methods.

Since we do not possess household expenditure data, but only the average expenditure for each of the four income segments mentioned above, a good approximation of an Engel curve is one that connects the four income/expenditure points. Therefore, our Engel curve is a smooth function f_j such that:

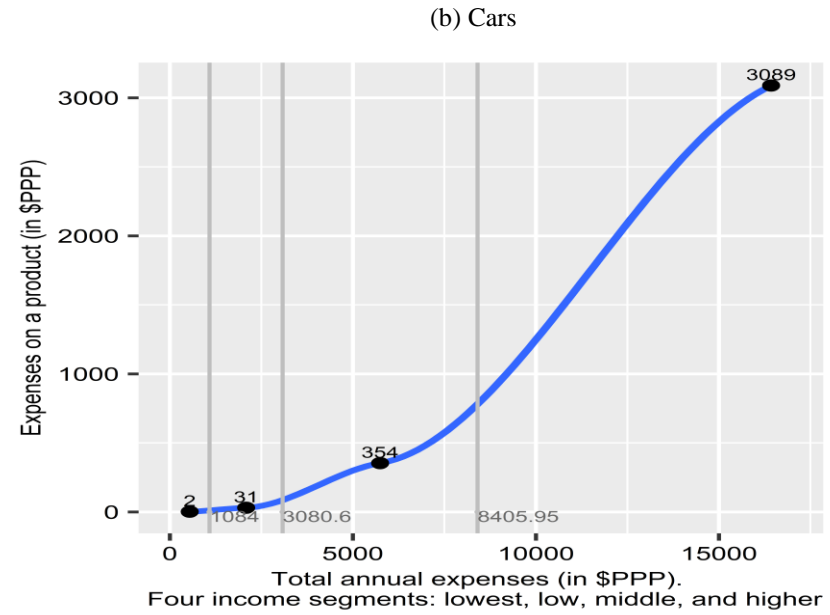
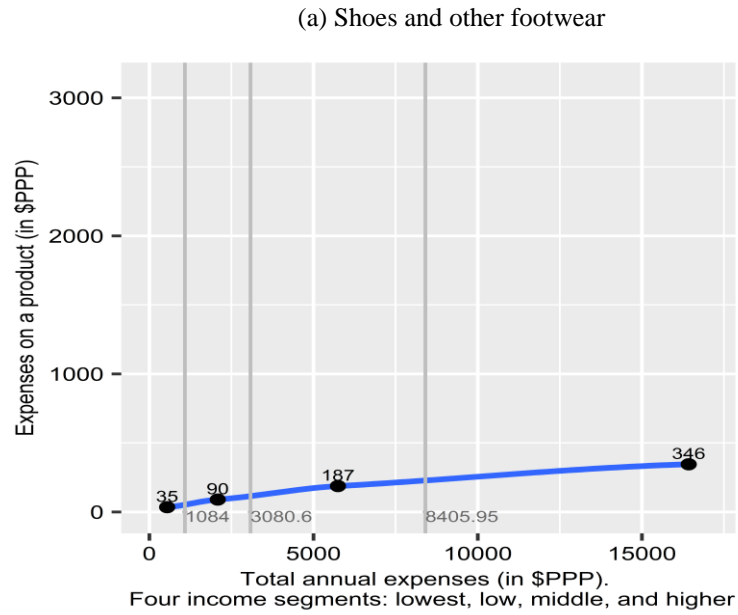
$$\overline{Exp}_b^j = f_j (\bar{x}_b), \quad (2)$$

where \bar{x}_b is the average income in income segment b and \overline{Exp}_b^j is the average expenditure on product j in income segment b . The function f_j is estimated using a local polynomial fitting procedure⁵. We claim that f_j (Equation (2)) is a good approximation of m_j because any regression function estimated through ordinary least squares in a given bin b will pass through the average point $(\bar{x}_b, \overline{Exp}_b^j)$.

Our procedure to estimate Engel curves as formalized in Equation (2) is illustrated in Figures 4a, 4b, which show the expenditures on shoes and cars in Brazil as a function of total expenditures. Vertical grey lines indicate the borders of the four income segments, which are the same for all countries in the GCD. Black points correspond to $(\bar{x}_b, \overline{Exp}_b^j)$ for $b = 1, \dots, 4$. While \overline{Exp}_b^j is given by GCD, \bar{x}_b is calculated as the middle point of each income segment, which, for the purpose of our analysis, is a sufficient approximation of average total expenditure within b .

⁵ We apply the *LOESS* curve fitting procedure in *R* with tri-cube weight function, bandwidth 0.75 and degree 2.

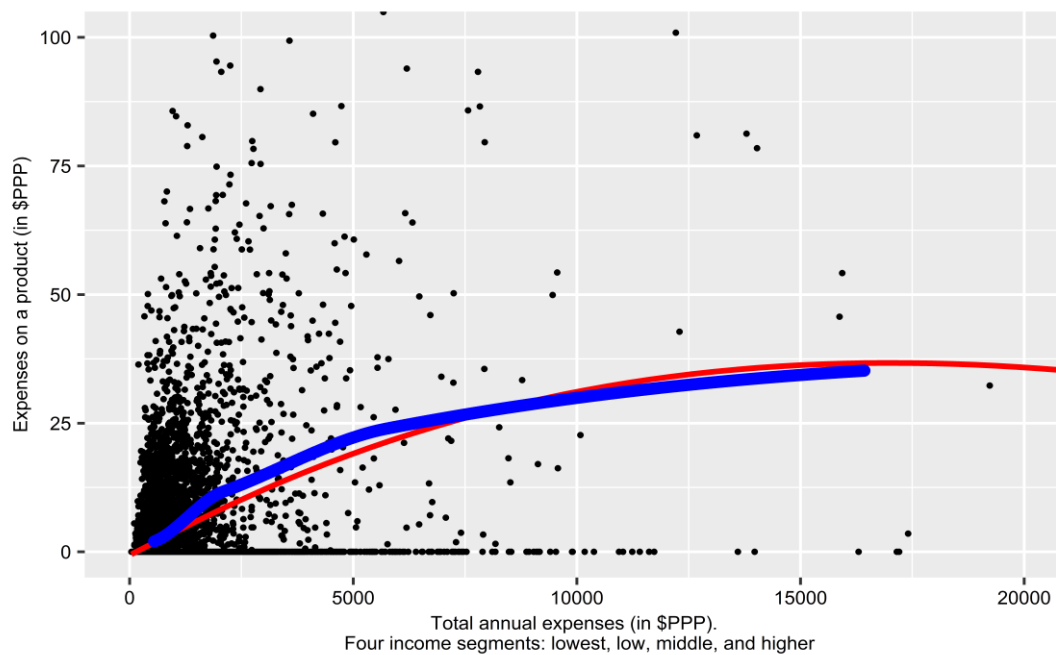
Figure 4 Estimation of Engel curves. The example of Brazil



Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

To justify our approach, we verify the Engel curve estimated using aggregate data from the GCD (as formalized in Equation (2)), with the Engel curve estimated using household level data (as formalized in Equation (1)). This comparison is possible for Malawi because both data at the household level as well as GCD data are available. Equation (1) is also estimated using a local polynomial regression. Figure 5 reveals that the two Engel curves are very similar.

Figure 5 Malawi, consumption of household textiles, Engel curve



Note: Red line: LOESS (Local Polynomial Regression of degree 2) on household data; blue line: LOESS on aggregated data from the World Bank dataset.

Source: Authors’ elaboration based on the Global Consumption Database (World Bank, 2014).

Next, we address the question on the identification of satiation tendencies in consumption. Chai and Moneta (2014) claim that an Engel curve exhibits satiation (or saturation) if it possesses a zero slope at a certain range of income. A zero slope indicates that expenditure is perfectly inelastic to incremental change in income. For example, Figure 5 shows that the Engel curve estimated from household data (red line) has a zero slope or even negative slope at a high level of income. This is evidence for satiation. However, the same figure also indicates that the Engel curve estimated from GCD data (blue line) does not show the same property, especially because it cannot (by construction) provide a reliable description of the consumption pattern at high levels of income, as it stops at the middle point of the higher income segment. Since satiation usually occurs at high levels of income, we must rely on a different approach. In the same figure, we see that the blue line shows a tendency to flatten out. We thus refer to the “tendency to satiate” as the tendency of expenditure growth to slow down as income rises. Operationally, we test

it by calculating the average values' ratio of the Engel curve derivative in the wealthy income segment over the average values of the Engel curve derivative in the less wealthy income segment and checking whether this ratio is less than 1. Formally,

$$R_j = \frac{\bar{f}'_j(x_b)}{\bar{f}'_j(x_{b-1})}. \quad (3)$$

If $R_j < 1$, there is a tendency to satiate.

Continuing our example of Brazil (Figures 4a, 4b), we calculate R for shoes and motor cars. In Brazil, $R_{shoes} = 0.73$ and $R_{motor\ cars} = 1.96$. Thus, we can assert that there is a tendency for shoes to satiate, but not motor cars.

In general, the income level at which an Engel curve displays satiation depends on the local income distribution within each country. Therefore, the method for measuring satiation needs to be tailored to suit the income distribution observed in each country. We would be led astray if we examined expenditures at the same income levels across all countries in order to measure satiation, since considerable differences in income distribution exist across countries.

Thus, our choice of income level to measure the slowdown in the Engel curve derivative depends on the percentage of population in the highest income segment. If more than 5 per cent of the country's wealthiest population belong to the higher income segment, i.e. if the country belongs to the global higher income group (cf. Table 1, fourth column), we calculate R as

$$R_j = \frac{\bar{f}'_j(x_{b_4})}{\bar{f}'_j(x_{b_3})},$$

where b_4 is the higher segment of income and b_3 represents the middle segment of income. If less than 5 per cent of the country's wealthiest population belong to the higher income segment and more than 5 per cent of the country's wealthiest population belong to the middle segment, i.e. if the country belongs to the global middle income group (cf. Table 1, third column), we calculate R as

$$R_j = \frac{\bar{f}'_j(x_{b_3})}{\bar{f}'_j(x_{b_2})},$$

where b_3 is the middle segment of income and b_2 represents the low segment of income. If less than 5 per cent of the country's wealthiest population belong to the higher or middle income segment and more than 5 per cent of the country's wealthiest population belong to the low seg-

ment, i.e. if the country belongs to the global low income group (cf. Table 1, second column), we calculate R as

$$R_j = \frac{\bar{f}_j'(x_{b_2})}{\bar{f}_j'(x_{b_1})},$$

where b_2 is the low segment of income and b_1 represents the lowest segment of income⁶.

The average income elasticity for good j corresponds to

$$\frac{1}{N} \sum_{n=1}^N \frac{d \text{Exp}_n^j}{d x_n} \frac{x_n}{\text{Exp}_n^j}, \quad (4)$$

where x_1, \dots, x_N is a sequence of income points, coupled with expenditure points $\text{Exp}_1, \dots, \text{Exp}_N$ and $\frac{d \text{Exp}_n^j}{d x_n}$ is the derivative of the Engel curve for product j estimated at x_n .

Analogously to our definition of R , if a country belongs to the global low income group, x_1, \dots, x_N is a sequence of income points in the first two income segments b only if a country belongs to the global middle income group, the sequence of income points refers to the first three income segments; if a country belongs to the global higher income group, the sequence of income points refers to all four income segments.

4 Empirical results

4.1 Results for broad sectors of the economy

4.1.1 Diversity of spending patterns

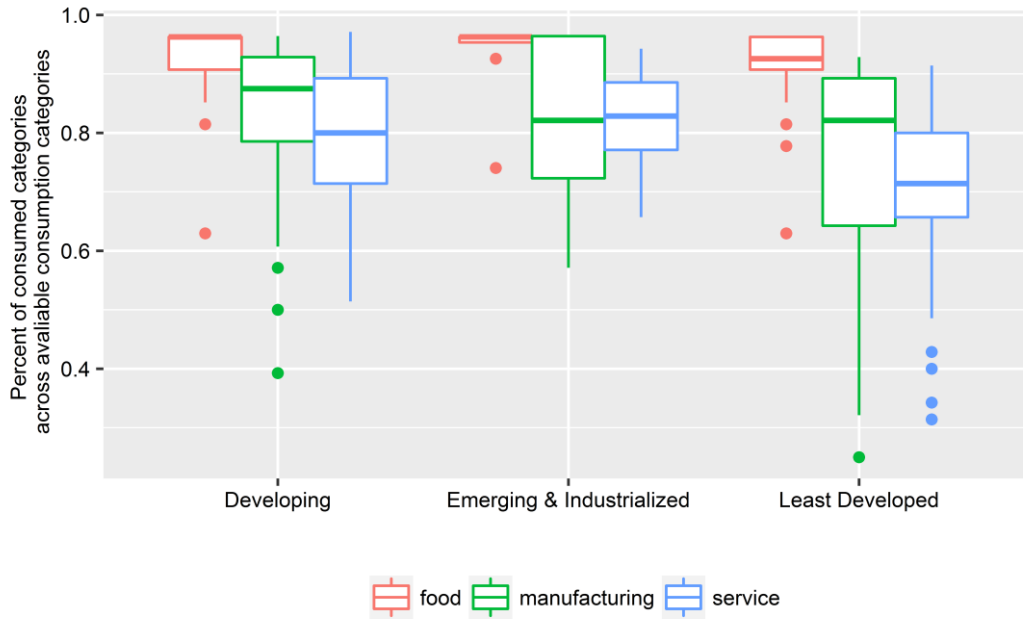
Consumption bundles differ across countries. Not all products in the list of products in the dataset are consumed by all countries. As Figure 6 shows, consumption bundles are larger in countries with higher GDP levels. Least developed countries consume, on average, 92 per cent of available food categories, 72 per cent of available service categories compared to the 95 per cent of food categories and 83 per cent of service categories consumed by emerging and industrialized countries. Countries differ not only in terms of number of consumed categories but also in terms of shares allocated to the same categories. We use the diversity index to characterize allocation differences. The average diversity of spending patterns for each country is defined as

$$\sum_{k=1}^{K=106} s_k (1 - s_k), \quad (5)$$

⁶ The reference level of 5 per cent is chosen *ad hoc* to ensure that the numerosity of the income segment is sufficient to derive reliable Engel curve estimates.

where s_k is the share of total expenditure allocated to consumption category k and K is the total number of consumption categories (106 in our dataset). This is the most popular diversity index (see Gini, 1912; Simpson, 1949), also known as the Gini-Simpson index. Figure 7 confirms the stylized fact that in least developed countries, spending diversity is low as food expenditure dominates spending. Spending diversity increases for developed and emerging countries via reductions in the budget share of food spending and increases in non-food expenditure.

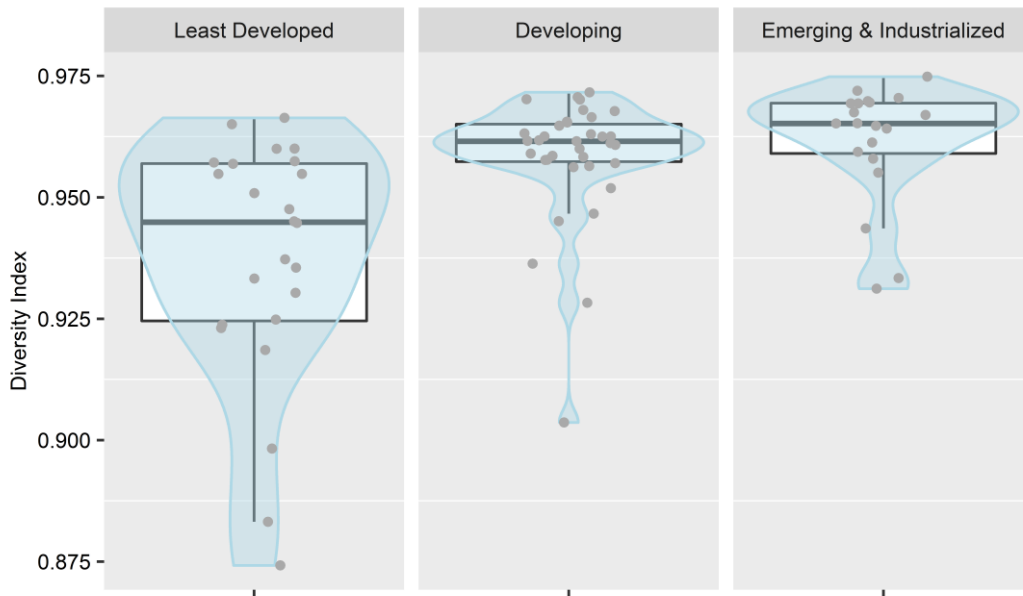
Figure 6 Percentage of consumption categories in food, manufacturing and services across countries



Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

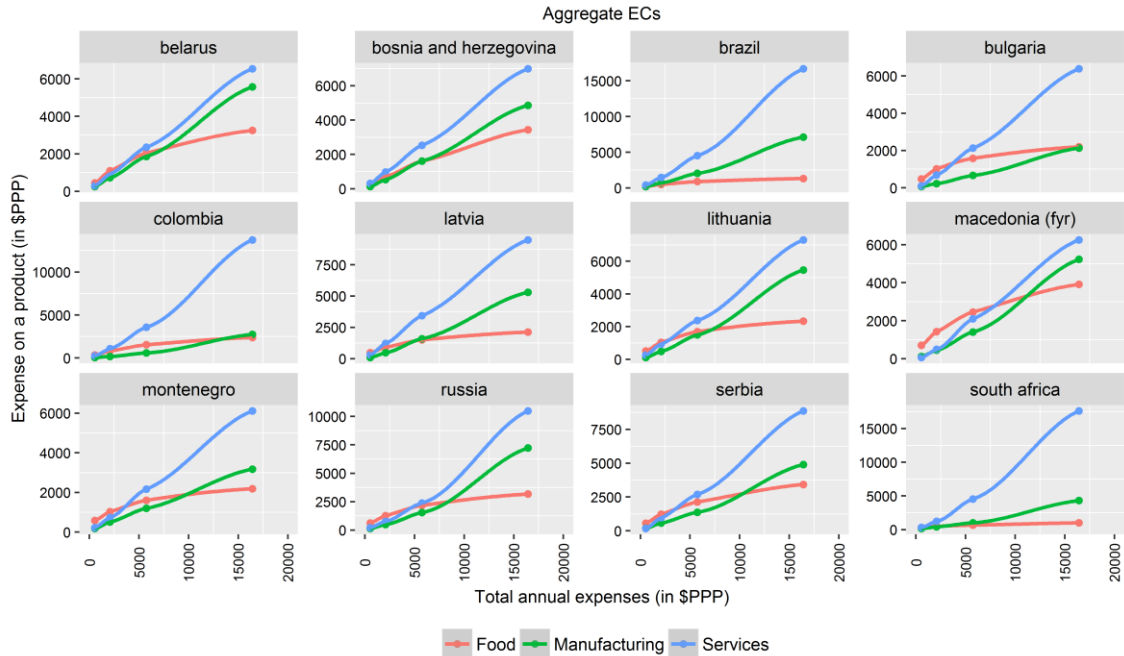
In Figure 8 we plot Engel curves for the manufacturing, services and food sectors for countries belonging to the global higher income group (see fourth column of Table 1). The categories of expenditure referred to as the manufacturing, services and food sectors are obtained by aggregating all respective products covered by the dataset. We observe that in the higher income segment, the highest expenditure is for services, followed by manufactured products and food. In the middle income segment, expenditure on food represents a large share of the household budget and is higher than the expenditure on manufactured products. Services appear to display the highest income elasticity, as suggested by the high slope of Engel curves, followed by manufacturing and food.

Figure 7 Distribution of the consumption diversity index across countries



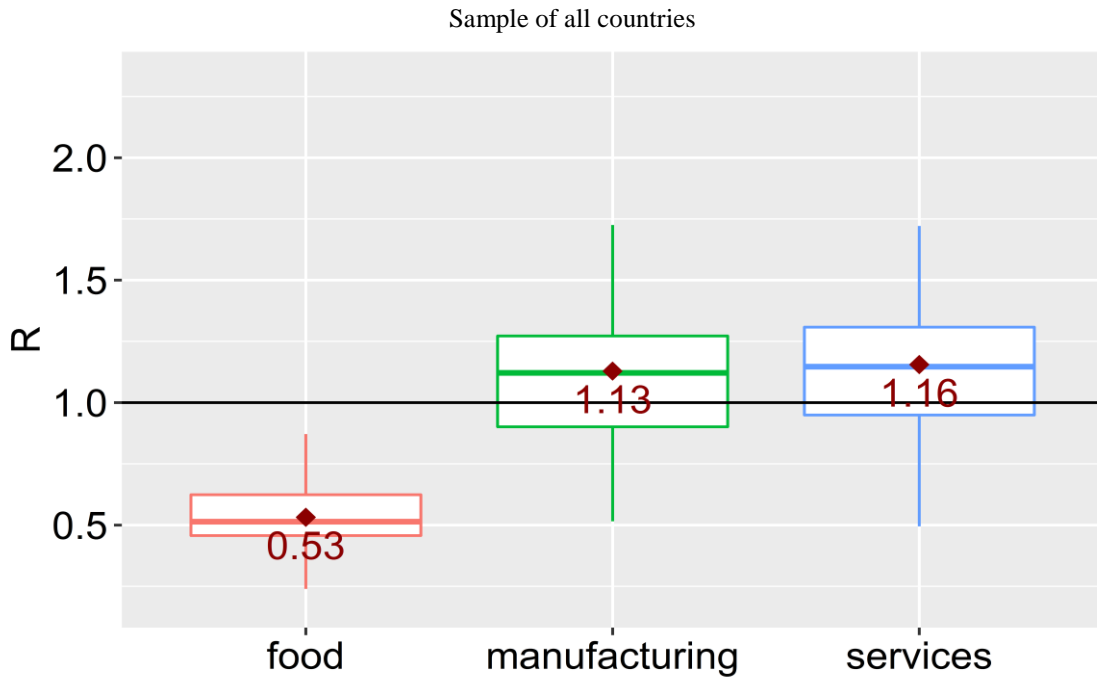
Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Figure 8 Aggregate Engel curves for manufacturing, services and food for countries belonging to global higher income group

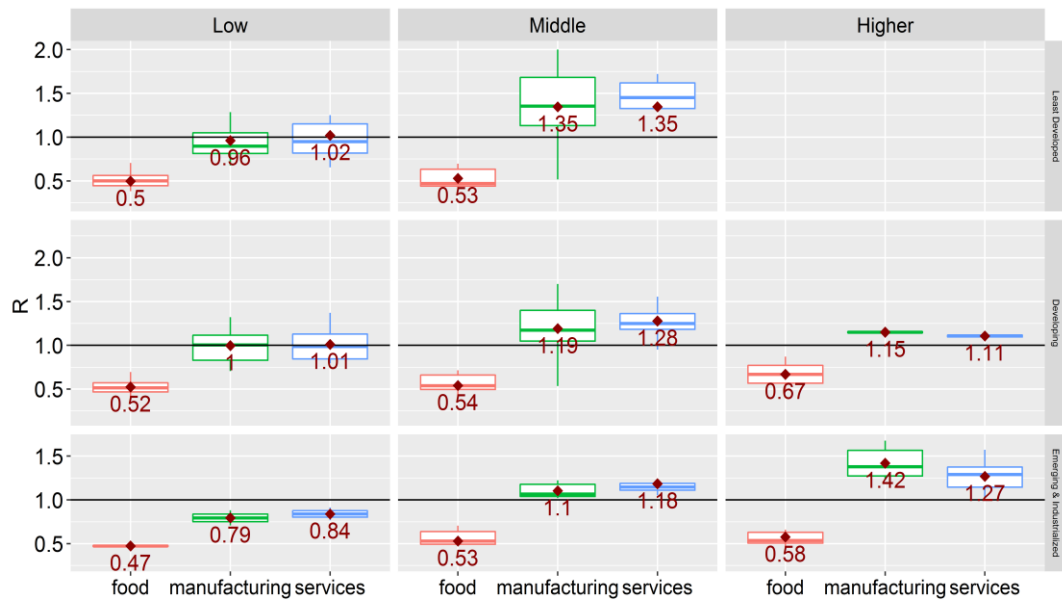


Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Figure 9 Tendency of Engel curves to satiate



Countries belonging to different economic groups and global income groups



Note: A black horizontal line is drawn at $R = 1$, below which there is a tendency to satiate.

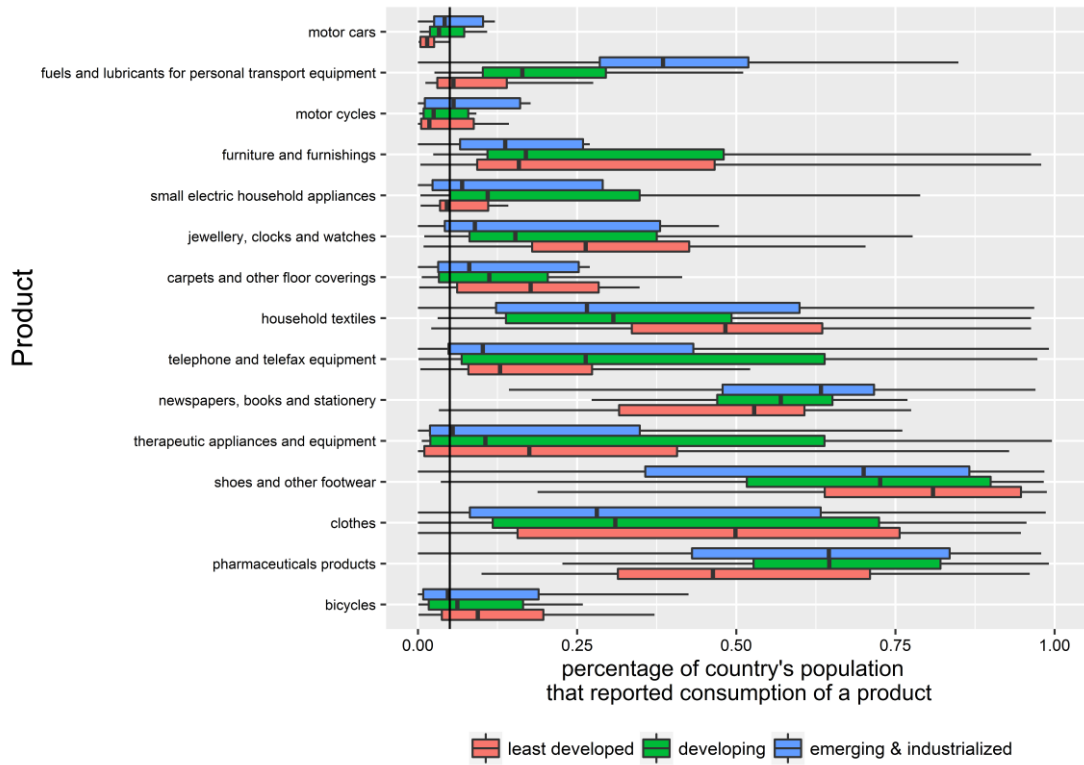
Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

In Figure 9, we plot the distribution of R across countries for each sector of the economy. In the bottom panel of the same figure, we provide a breakdown of the same distribution by global income group and economic group. The figure shows that there is a robust tendency for food to satiate, as in all countries $R_{food} < 1$. On the other hand, manufactured products and services do not, on average, satiate across countries. There is satiation of manufactured products and services in countries belonging to the global low income group (cf. first column of the bottom panel in Figure 9). This phenomenon can in part be explained by the fact that the distribution across income segments (on the basis of which R is calculated) differs considerably between countries belonging to the global low income group and the global higher income group. For example, in Afghanistan, 98 per cent of the population belongs to the lowest and low income segments, while in Bosnia Herzegovina, 16 per cent of the population belongs to the lowest and low income segments and 84 per cent of the population belongs to the middle and higher income segments. Although we try to control for this fact in how we define R , the differences in distribution may still play a role in determining the different satiation patterns. However, other factors are worthy of being investigated in future research.

a. Results for different manufacturing industries

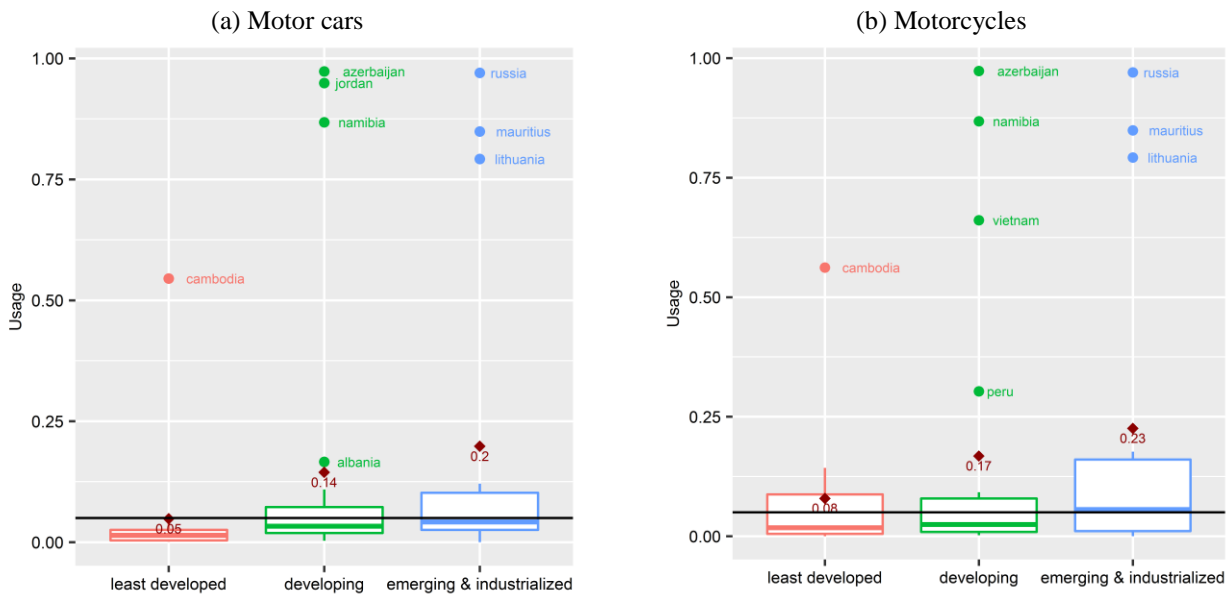
In this section, we discuss 15 manufactured products that have a one-to-one mapping to manufacturing industries (a description is provided in the Appendix). The first issue we discuss here is the participation rate (i.e. the percentage of the population purchasing a specific product) of different countries in the consumption of goods. The consumption of high-tech goods is correlated with the economic development of a country. High-tech goods show a skewed distribution of countries' participation rates (Figure 10). Figure 11 illustrates the example of cars: in all countries belonging to the least developed country group (with the exception of Cambodia), less than 5 per cent of the population purchases a car, while in emerging and industrialized countries, 20 per cent of the population purchases cars. In the further analysis, we do not consider cases in which the participation rate for a specific good in a particular country is less than 5 per cent.

Figure 10 Participation rate of countries in the consumption of manufactured products



Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Figure 11 Percentage of population reporting consumption of a product (boxplot)



Note: The black horizontal line indicates the reference 5 per cent level (i.e. 5 per cent of the population reported consumption of a product). Red dots indicate averages of consumption levels in economic groups of countries (least developed, developing, emerging and industrialized).

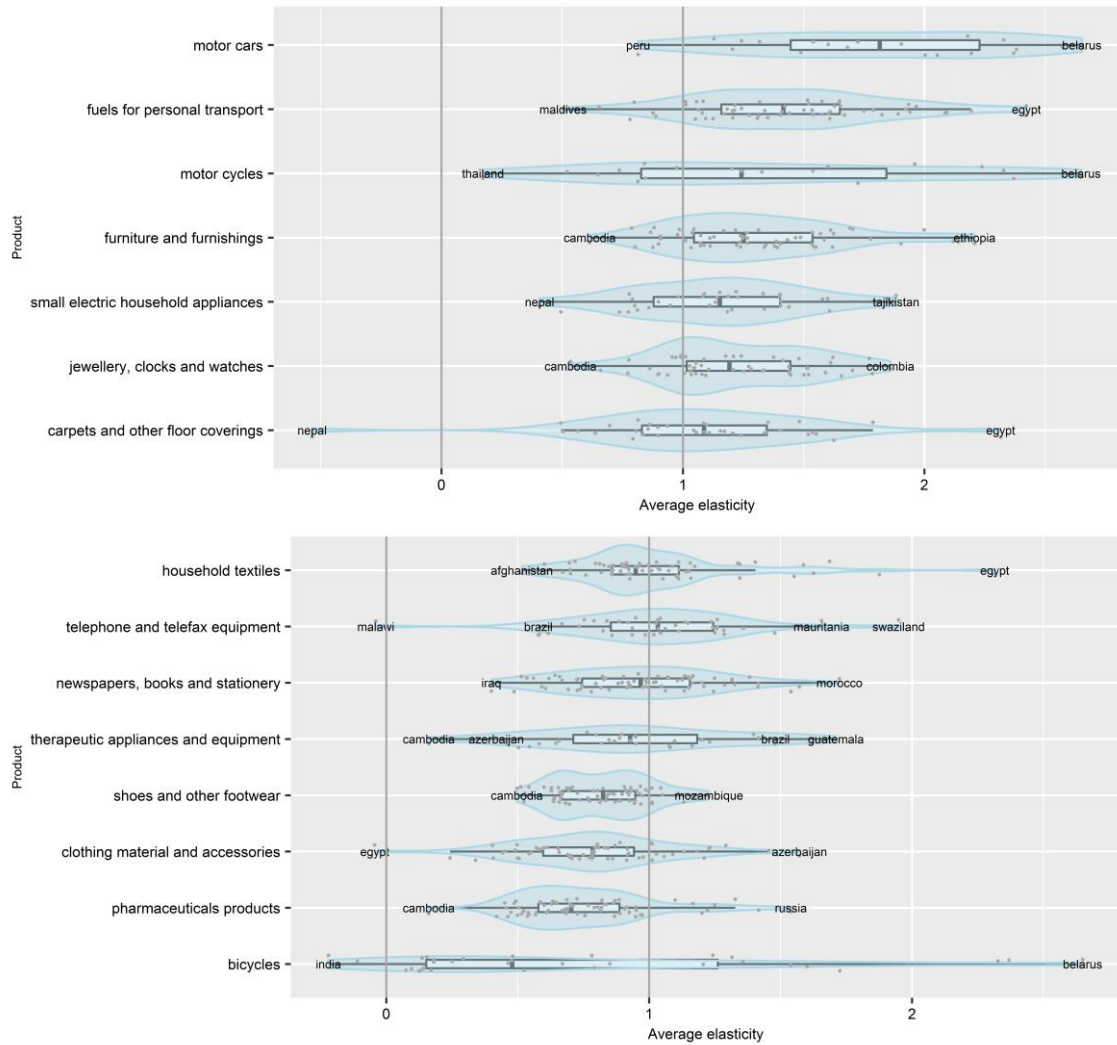
Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

We estimate the average income elasticities of the 15 manufactured products for each country. The distribution of average elasticities for different products across countries is plotted in Figure 12. Products are categorized by their average value of elasticity across all countries. Pharmaceutical products are found on at the bottom of the list and motor cars at the top of it. It is possible to classify products according to standard classifications: *inferior* goods (negative elasticity), *necessities* (elasticity between 0 and 1) and *superior* goods (elasticity higher than 1). Grey vertical lines in Figure 12 indicate 0 and borderlines 1. Pharmaceutical products, clothing and footwear are typical necessities in the majority of countries. Cars, motorcycles and transport fuels are typical superior goods in most of the countries. In the breakdown by economic group, we find that in emerging and industrialized countries nearly all products are superior goods. This is a consequence of the already mentioned unequal income distribution across countries. The breakdown by geographical region is provided in Figure 17 in the Appendix. We do not observe any clear pattern by sectioning data into geographical regions due to the fact that in each region, one finds countries from different economic groups.

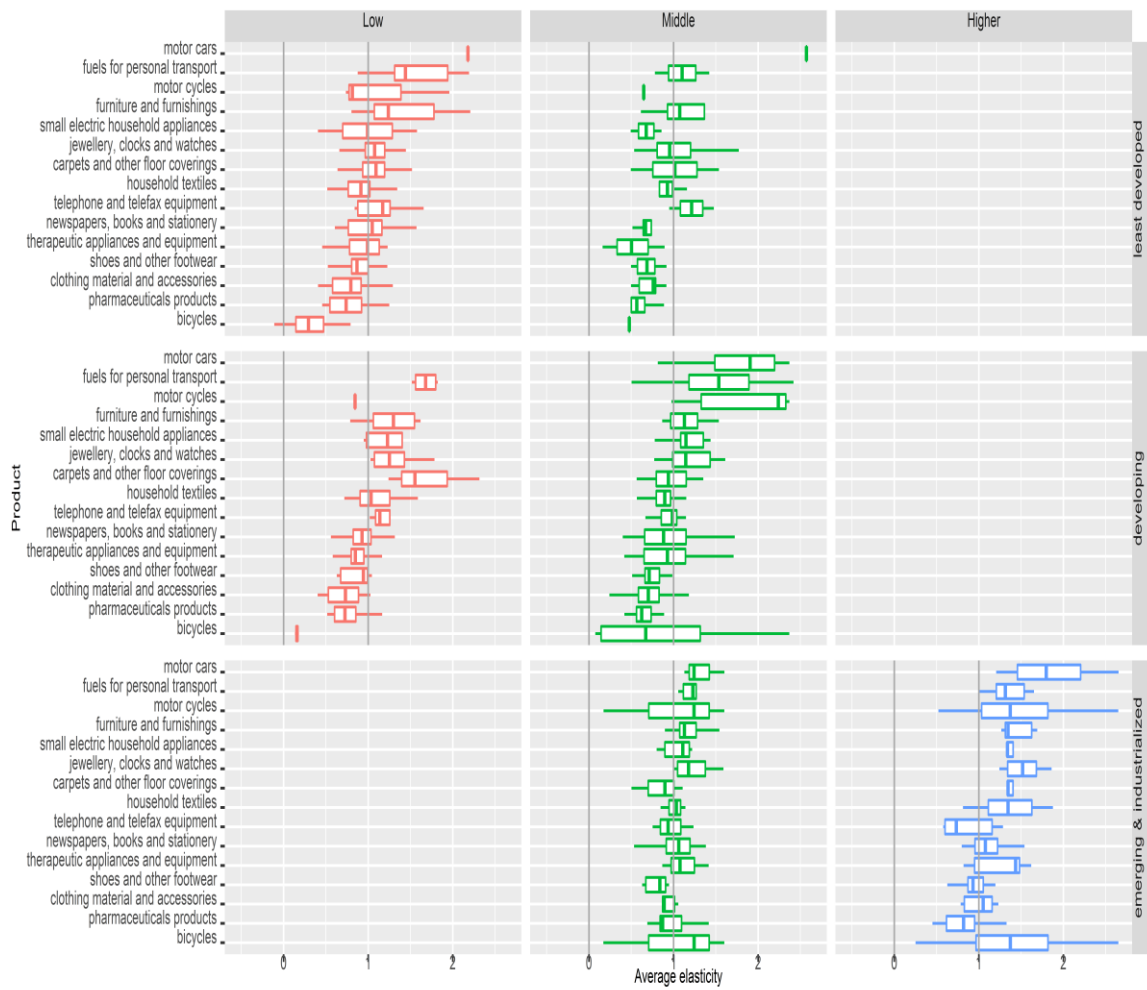
Comparing average elasticities in different income groups (cf. Figure 13), we witness how a product moves from being a luxury item for persons in the lowest income segment to becoming a necessity for those in the higher income segment. This is particularly obvious in the least developed country group (column 1 in Figure 13) and in the developing country group (column 2 in Figure 13). This pattern is not seen in the emerging and industrialized country group, because a considerable percentage of the population belongs to the higher income segment, so that we cannot separately observe the behaviour of the wealthiest groups in these countries.

Figure 12 Average elasticity - distribution across countries

(A) Sample of all countries



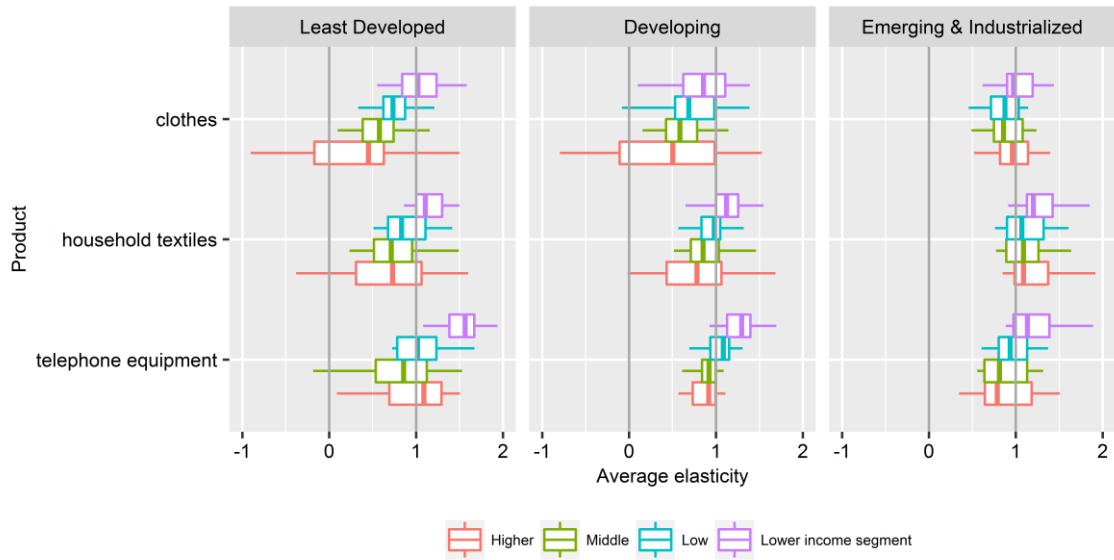
(B) Countries belonging to different economic groups and global income categories



Note: Grey vertical lines are drawn at 0 and 1. The product is classified as a necessity if the elasticity is between 0 and 1.

Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Figure 13 Average elasticity - distribution across different income segments



Note: The figure for all manufactured products is provided in the Appendix (Figure 16).

Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

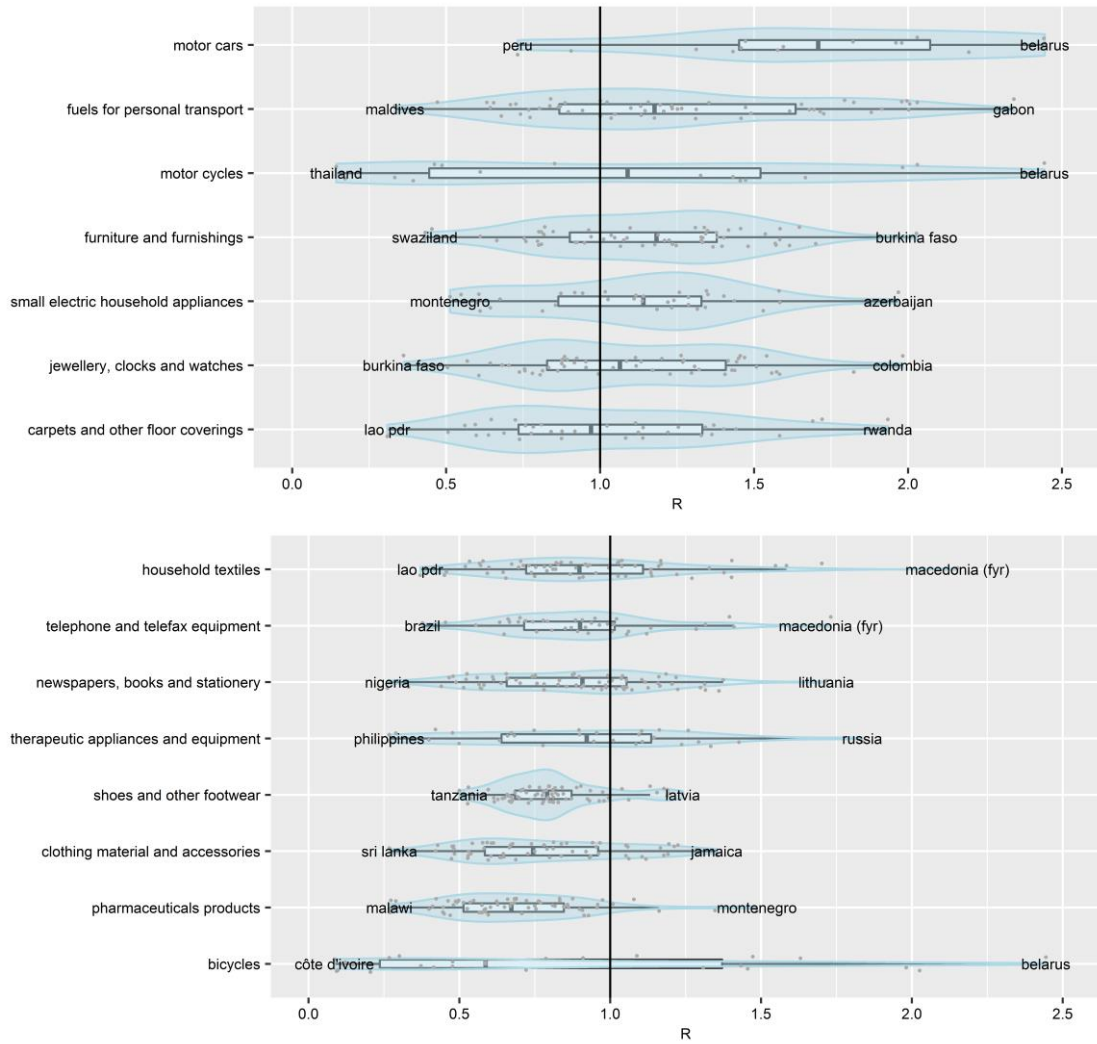
We present the results on tendencies to satiate, as measured by R as regards the 15 manufactured products. Figure 14 illustrates the distribution of R across countries for those products (the breakdown by geographical region is provided in Figure 18 in the Appendix). The black vertical line represents the threshold level of 1 above which a product does not satiate and below which a product tends to satiate. The resulting hierarchy of products is in line with the hierarchy that emerges from the analysis of income elasticities. In fact, there is a high correlation between the two measures.

To confirm this, we regressed R on average elasticity, controlling for different economic groups and global income groups. As shown in Table 2, there is significant dependence of the tendency to satiate at average elasticity (with a R^2 of 0.629); belonging to a specific economic group does not have a significant effect, while belonging to a particular global income group does. This is probably a consequence of unequal income distribution across countries.

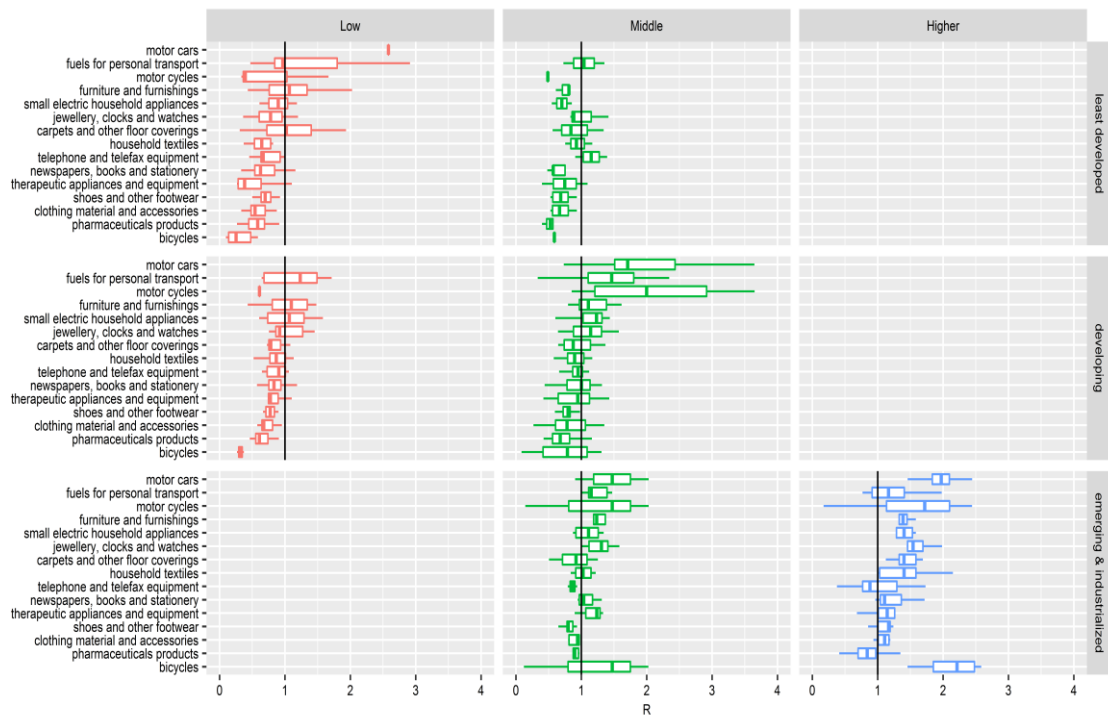
The dependence between the two measures is graphically depicted in Figure 15, with the bottom panel providing a breakdown of the results by economic group and global income group.

Figure 14 **Tendency to satiate - distribution across countries**

(A) Sample of all countries



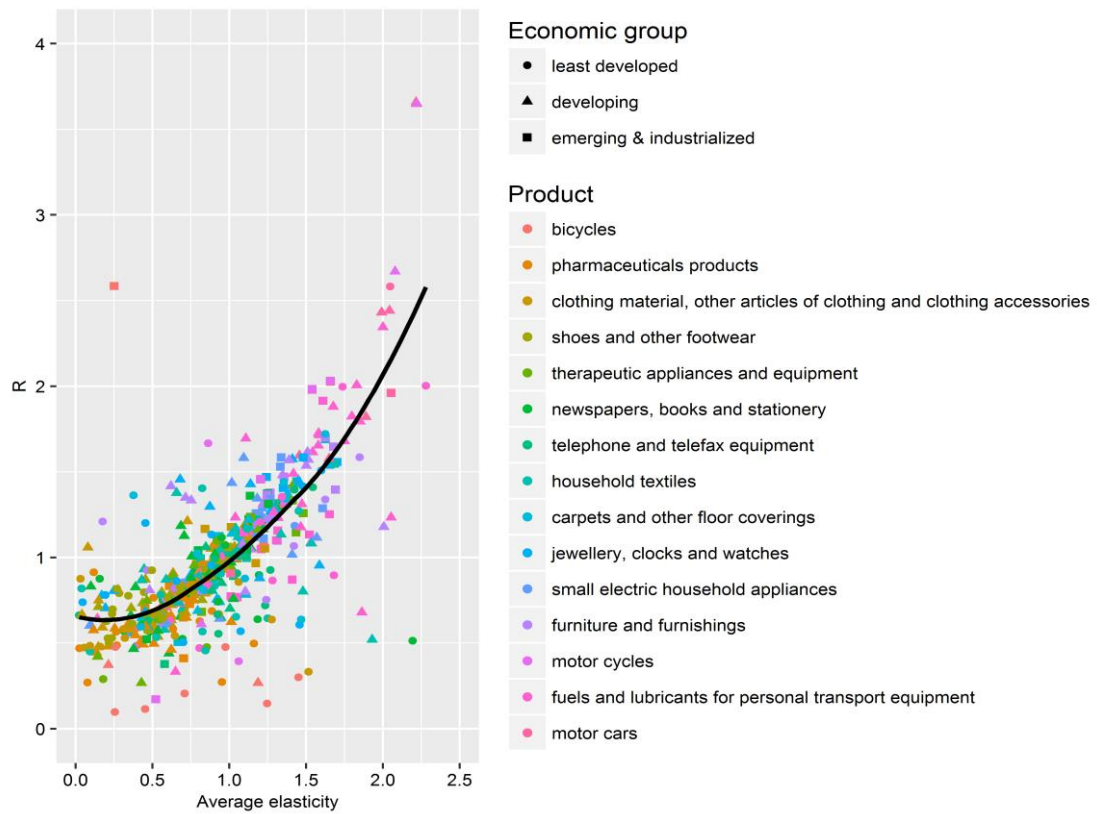
(B) Countries belonging to different economic groups and global income categories



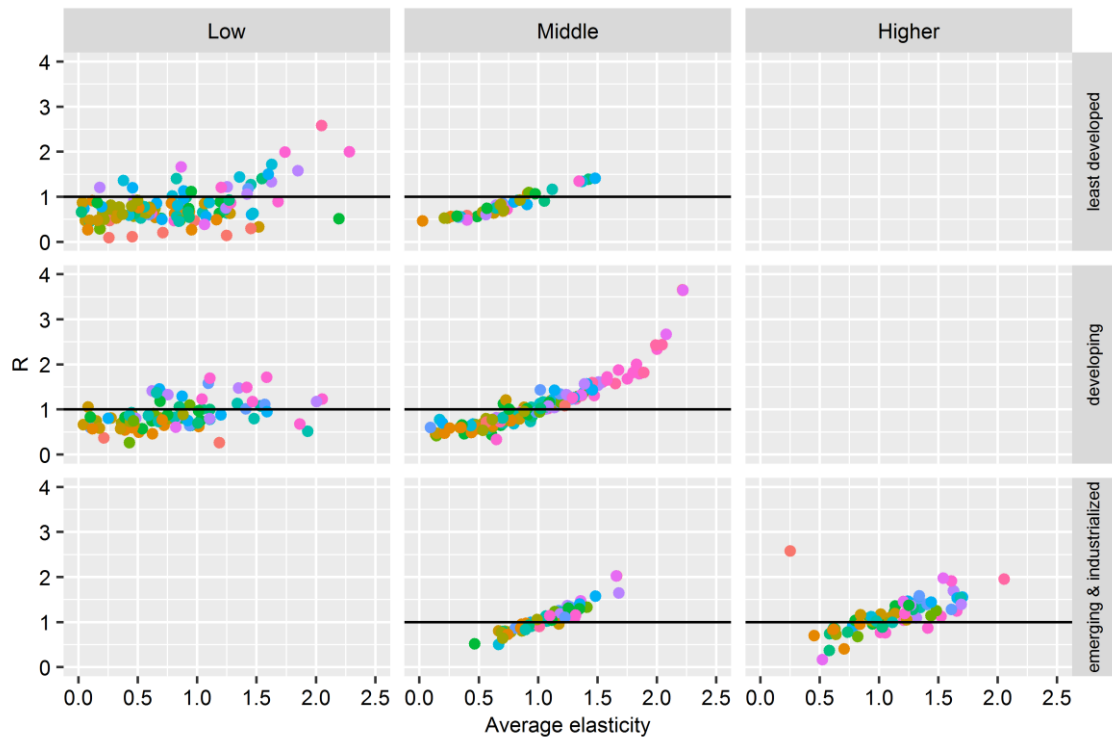
Note: A black vertical line is drawn at $R = 1$, on the left of which there is a tendency to satiate.

Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Figure 15 Tendency to satiate and elasticity of a product



Countries belonging to different economic groups and global income categories



Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Table 2 Regression output

<i>Dependent variable: R</i>	
Average elasticity	0.962 ^{***} (0.030)
Economic group of the country	
Least developed	(omitted)
Developing	0.056 [*] (0.032)
Emerging and industrialized	0.071 (0.049)
Global income group of the country	
Global income group of the country	(omitted)
Global middle income group	-0.009 (0.049)
Global low income group	-0.196 ^{***} (0.058)
Constant	0.040 (0.067)
Observations	653
Adjusted R ²	0.646

Note: *p<0.1; **p<0.05; ***p<0.01

5 Conclusion

We have analysed consumption patterns in sectors of the economy and of specific manufactured products. We find that demand for food and beverages tends to satiate, while demand for manufactured products and services does not, on average, tend to satiate across countries.

The composition of manufactured products consumed across countries differs drastically. The percentage of the population consuming high-tech goods depends on the country's economic development. For example, in the least developed countries, less than 5 per cent of the population consumes cars and motorcycles. We have built a hierarchy of manufactured products based on their elasticities. Pharmaceutical products, therapeutic equipment, clothing and footwear are at the bottom of the list displaying small elasticities (i.e. they can be classified as necessity goods), while motor cars, motorcycles and fuels for personal transport equipment are at the top of the list displaying high elasticities (i.e. they can be classified as superior goods). The hierarchy is quite stable across countries while the values of elasticities change from country to country depending on the level of income inequality and the country's economic development. We find high correlation between a product's elasticity and the tendency of demand for this product to satiate. Consequently, if the product is a necessity in a given country, it will have a high tendency to satiate.

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Appendix

Table 3 Correspondence between manufacturing industry and consumption product

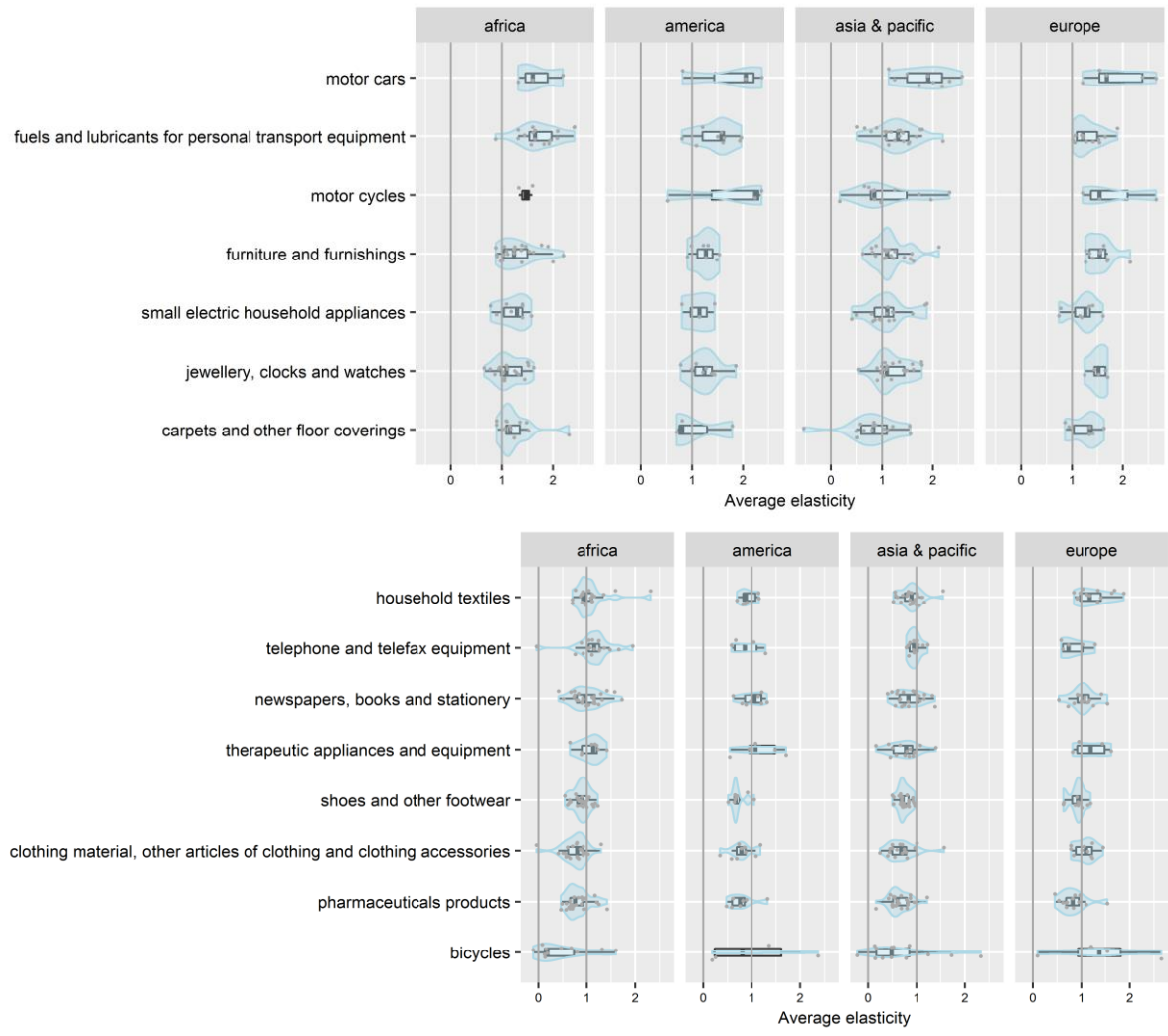
ISIC code	Industry	GCD consumption category
13	Manufacture of textiles	Household textiles
1393	Manufacture of carpets and rugs	Carpets and other floor coverings
14	Manufacture of wearing apparel	Clothing material, other articles of clothing and clothing accessories
152	Manufacture of footwear	Shoes and other footwear
1811	Printing	Newspapers, books and stationery
192	Manufacture of refined petroleum products	Fuels and lubricants for personal transport equipment
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	Pharmaceuticals products
263	Manufacture of communication equipment	Telephone and telefax equipment
2652	Manufacture of watches and clocks	Jewellery, clocks and watches
321	Manufacture of jewellery, bijouterie and related articles	Jewellery, clocks and watches
266	Manufacture of irradiation, electromedical and electrotherapeutic equipment	Therapeutic appliances and equipment
275	Manufacture of domestic appliances	Small electric household appliances
291	Manufacture of motor vehicles	Motor cars
3091	Manufacture of motorcycles	Motor cycles
3092	Manufacture of bicycles and invalid carriages	Bicycles
31	Manufacture of furniture	Furniture and furnishings

Figure 16 Average elasticity - distribution across different income segments



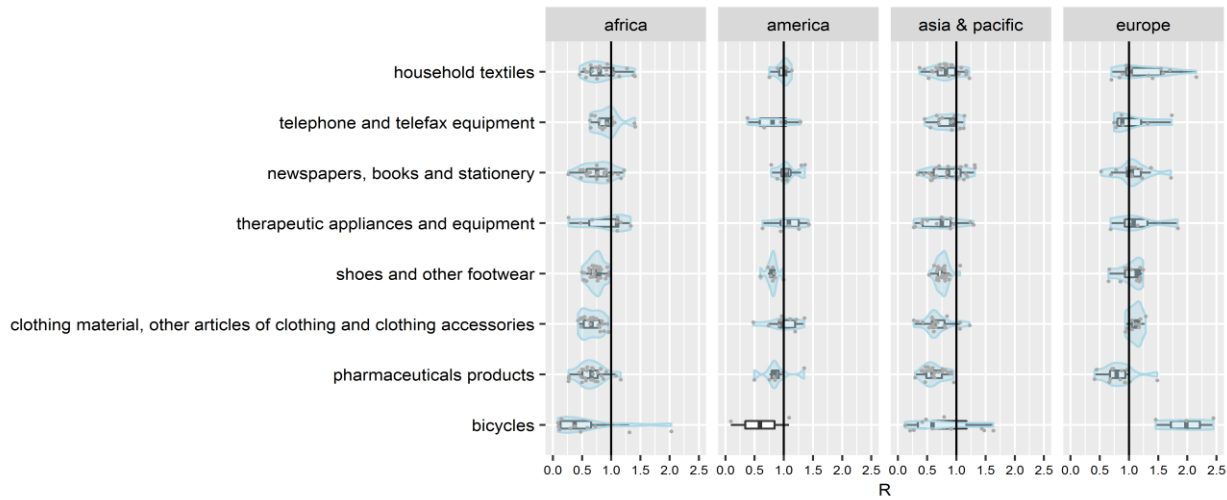
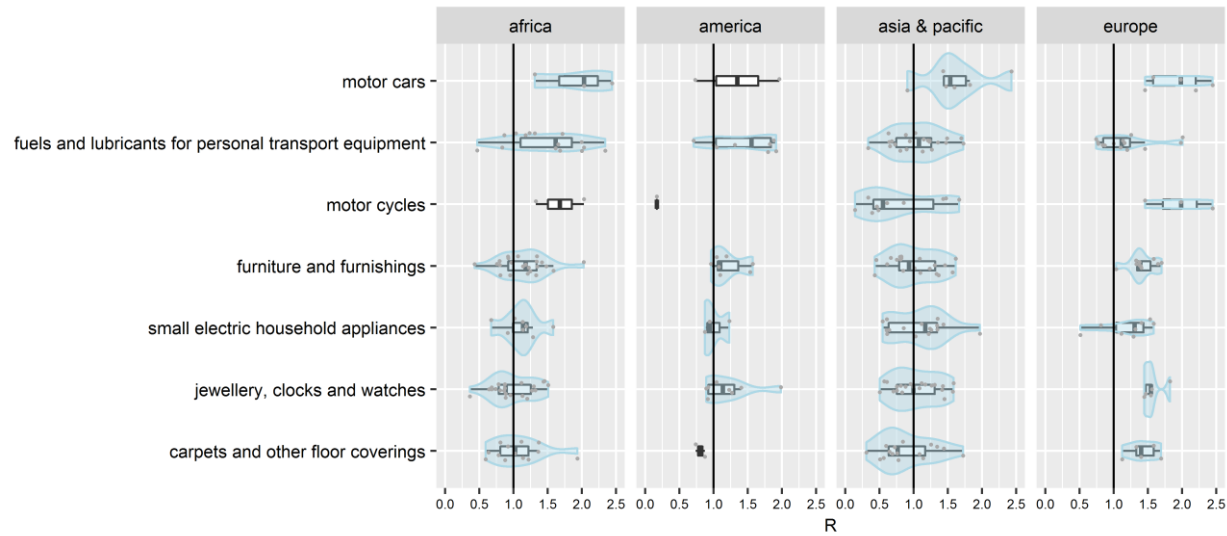
Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).

Figure 17 Average elasticity - distribution across countries of different geographical regions



Source: Authors' elaboration based on the Global Consumption Database (World Bank 2014).

Figure 18 Tendency to satiate - distribution across countries of different geographical regions



Source: Authors' elaboration based on the Global Consumption Database (World Bank, 2014).



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