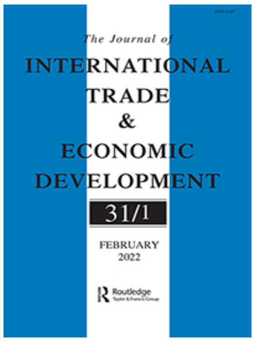

The Journal of International Trade & Economic Development

An International and Comparative Review

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rjte20

Import demand elasticities revisited

Julia Grübler, Mahdi Ghodsi & Robert Stehrer

THE JOURNAL OF INTERNATIONAL TRADE & ECONOMIC DEVELOPMENT
2022, VOL. 31, NO. 1, 46–74
https://doi.org/10.1080/09638199.2021.1951820

Routledge
Taylor & Francis Group

Check for updates

Import demand elasticities revisited

Julia Grübler *, Mahdi Ghodsi and Robert Stehrer

The Vienna Institute for International Economic Studies (wiiw), Vienna, Austria

ABSTRACT
Import demand elasticities are regularly used to compute trade restrictiveness indices, to transform estimated effects of trade policies into ad-valorem equivalents, or to judge on the prohibitive level of various tariff and non-tariff policy instruments. The fast rising number of negotiations of free trade agreements and the fact that non-tariff measures are at the core of these strongly motivates for an update of the import demand elasticity estimates provided by Kee, Nicita, and Olarreaga in 2008 which are based on trade data for the period 1988–2001. Following their GDP function approach, we present import demand elasticities for more than 150 countries and over 5000 products over the period 1996–2014. Countries exhibiting the highest average elasticities belong to the economically biggest countries in their respective regions, while countries with the lowest import demand elasticities are typically small island states. Import-weighted results suggest that especially countries rich in natural resources are facing an inelastic import demand, with the agri-food sector being more price-responsive than the manufacturing sector. Finally, import demand for intermediate goods seems to be more elastic than demand for products destined for final consumption.

KEYWORDS International trade; import demand; price elasticity

JEL CLASSIFICATIONS D12, F14

ARTICLE HISTORY Received 20 October 2020; Accepted 29 June 2021

1. Introduction

The global trade order is in turmoil. The stalemate in plurilateral negotiations at the level of the World Trade Organisation (WTO) led to a surge in the number of bilateral and multilateral trade agreements and an expansion in their geographical scope and policy depth. The set of applied trade policy instruments is constantly increasing, with non-tariff measures such as technical barriers to trade or antidumping practices ousting traditional trade policy tools such as tariffs or quotas in ongoing trade negotiations. A rise in new generation trade agreements paired with a weakening position of the WTO bears the potential of exerting a substantial impact on quantities and prices of traded products.

In order to compare the impact of different trade policies, economists often make use of so-called import demand elasticities (e.g. Kee, Nicita, and Olarreaga 2009; Nizovtsev and Skiba 2016; Ghodsi, Grübler, and Stehrer 2016; Gasiorek, Serwicka, and Smith 2019)

CONTACT Julia Grübler grublerj@ceu.edu

*Present address: Central European University (CEU), Vienna, Austria JuliaGruebler

as these answer the central question of how imports respond to price changes: *What would be the percentage change in import quantities if the price of the imported good increased by 1%*?

Trade policy is typically operational at the tariff line level. However, data on import elasticities for a broad set of products at a disaggregated product level[1] is scarce. Most available studies have a strong focus on either selected products and/or particular importers (e.g. Feenstra 1994; Panagariya, Shah, and Mishra 2001; Broda and Weinstein 2006; Altinay 2007; Soderbery 2015; Mukherjee, Mukherjee, and Das 2017; Sun and Niquidet 2017). Recently, Amiti, Redding, and Weinstein (2019) estimated US trade elasticities of goods with respect to tariffs to calculate the deadweight loss attributable to new tariffs and analyse the welfare implications of the 'trade war' initiated by the Trump administration for the US economy. Similarly, Fajgelbaum et al. (2020) estimate the US trade elasticities with respect to tariffs at the HS 8-digit level and use them in a general equilibrium model to evaluate the pass-through effects of hiked tariffs on the US economy.

Applying a single methodology and dataset for a wide range of countries and products has the inherent advantage of rendering them comparable. Broda, Greenfield, and Weinstein (2006) derived elasticities of substitution at the three-digit level of the Harmonised System (HS) for 73 countries over the period 1994–2003. Feenstra and Romalis (2014) estimated elasticities of substitution at the four-digit level of the Standard International Trade Classification (SITC) for the period 1984–2011 for 185 countries. Soderbery (2018) derived elasticities of substitution at the HS 4-digit level for 192 countries over the period 1991–2007.

Some recent literature exploits the information on variable trade costs, such as tariffs, to explore trade elasticities (Romalis 2007; Chaney 2008; Simonovska and Waugh 2014; Caliendo and Parro 2015; Giri, Yi, and Yilmazkuday 2021). For instance, Fontagné, Guimbard, and Orefice (2020) estimate trade elasticities using tariffs in a gravity framework. The average of their elasticities is around −5.5 while the median is around −4. Results by Kee and Nicita (2016) suggest that the exclusion of non-tariff measures in trade flow regressions results in seriously downward-biased estimates: the estimated trade elasticity of tariffs ranges between −2.7 and −3, while the trade elasticity of trade policy including non-tariff measures could be as high as −6.

While these studies build on observable variable trade costs, such as tariffs, the approach proposed by Kee, Nicita, and Olarreaga (2008) does not rely on trade policy data. The contribution by Kee, Nicita, and Olarreaga (2008) is the seminal work that evaluated price elasticities of import demand[2] for a wide range of countries and products[3] by exploiting information on the variation of shares of imported goods in GDP, factor endowments and relative prices of imported goods. Overall, they estimated more than 300,000 import demand elasticities across 117 countries for about 4900 products at the HS 6-digit level (HS revision 1988) for the period 1988–2001. Their estimates are still frequently used in various trade policy analyses (e.g. Kee, Nicita, and Olarreaga 2009; Maoz 2009; Peterson and Thies 2014; Beghin, Disdier, and Marette 2015; Bratt 2017; Devadoss, Luckstead, and Ridley 2019).

However, the structure of trade between countries and regions has changed significantly since the mid-1990s, for example, with the establishment of the WTO, the transition of Eastern European economies to market economies, major EU enlargements, the economic rise of China (which joined the WTO in 2001), the development of global value chains, and the evolution of non-tariff trade policies and deep trade agreements. Therefore, more recent data on import demand elasticities is needed to analyse the welfare implications of trade policies.

Following the approach proposed by Kee, Nicita, and Olarreaga (2008), we compute price elasticities of import demand for the more recent period 1996–2014 (HS revision 1996) and present differences across countries, regions and income levels, as well as by product groups and sectors. Improved data availability and the inclusion of products not considered in HS revision 1988 allow us to estimate about twice as many import demand elasticities for 167 importing countries and more than 5000 products. Furthermore, looking at the more recent period allows us to distinguish the period before and after the financial crisis in 2007–2008.

The remainder of this paper is structured as follows. Section 2 introduces the theoretical framework. Section 3 describes the data used and the empirical strategy. Section 4 presents the empirical results and Section 5 discusses the robustness of the findings. The final section concludes.

2. Deriving import demand elasticities from products' shares in GDP

For the estimation of price elasticities of import demand, we follow the methodology proposed by Kee, Nicita, and Olarreaga (2008), which is based on Kohli's (1991) GDP-maximisation approach. In an economy with N products and M factors of production, perfect competition results in the optimal net output vector q_t of an economy (i.e. output including exports, reduced by inputs including imports). The optimal output maximises the economy's gross domestic product (GDP) $G_t(\tilde{p}_t \mathrm{A_t}, v_t)$, taking the country's Hicks-neutral productivity $\mathrm{A_t}$ and factor endowments v_t, as well as world prices $\tilde{p}_t$ as exogenously given:

$$G_t(p_t, v_t) \equiv \max_{q_t}\{p_t q_t : (p_t, v_t)\} \tag{1}$$

Following Harrigan (1997), p_t is the productivity-inclusive and therefore country-specific price vector ($p_t \equiv \tilde{p}_t \mathrm{A_t}$). Positive numbers for the net output vector q_t refer to output destined to meet domestic or foreign demand (i.e. including exports), while negative numbers refer to inputs including imported goods. If good n is an imported good then the derivative of the GDP function with respect to the good's price gives the GDP-maximising import demand function[4] of good n, which does not depend on a specific function of income or utility,[5] but on a country's factor endowments.

$$\frac{\partial G_t(p_t, v_t)}{\partial p_{nt}} = q_{nt}(p_t, v_t), \forall n = 1, \ldots, N \tag{2}$$

In order to evaluate the GDP function empirically, Kee, Nicita, and Olarreaga (2008) employed a flexible translog GDP function[6] with indices n and k indicating goods and m and l representing factors of production:

$$\begin{aligned} \ln G_t(p_t, v_t) = {} & a_{0t} + \sum_{n=1}^{N} a_{nt} \ln p_{nt} + \frac{1}{2}\sum_{n=1}^{N}\sum_{k=1}^{N} a_{nkt} \ln p_{nt} \ln p_{kt} + \sum_{m=1}^{M} b_{mt} \ln v_{mt} \\ & + \frac{1}{2}\sum_{m=1}^{M}\sum_{l=1}^{M} b_{mlt} \ln v_{mt} \ln v_{lt} + \sum_{n=1}^{N}\sum_{m=1}^{M} c_{nmt} \ln p_{nt} \ln v_{mt} \end{aligned} \tag{3}$$

The derivative of $\ln G_t(p_t, v_t)$ with respect to $\ln p_{nt}$ yields the equilibrium share of good n in GDP at time t:

$$\frac{\partial \ln G_t}{\partial \ln p_{nt}} = \frac{1}{G_t(p_t, v_t)} q_{nt}(p_t, v_t) p_{nt} \equiv s_{nt}(p_t, v_t) \tag{4}$$

After imposing restrictions on the functional form of the translog GDP function to ensure that it is homogeneous of degree one with respect to prices and factor endowments[7] and satisfies the symmetry property,[8] equations (3) and (4) result in:

$$s_{nt}(p_t, v_t) = a_{0nt} + \sum_{k=1}^{N} a_{nkt} \ln p_{kt} + \sum_{m=1}^{M} c_{nmt} \ln v_{mt}, \forall n = 1, \ldots, N \tag{5a}$$

$$s_{nt}(p_t, v_t) = a_{0nt} + a_{nnt} \ln p_{nt} + \sum_{k \neq n}^{N} a_{nkt} \ln p_{kt} + \sum_{m=1}^{M} c_{nmt} \ln v_{mt}, \forall n = 1, \ldots, N \tag{5b}$$

s_{nt} corresponds to the share of good n in GDP. By construction, negative values are assigned to inputs including imports, while positive values are associated with output including exports. Henceforth, we only consider imports for the estimation of price elasticities of import demand.[9] The derivative of the imported product's share s_{nt} in equations (4) and (5b) with respect to its price p_{nt} is given as

$$\frac{\partial s_{nt}}{\partial p_{nt}} = \underbrace{\frac{q_{nt}}{G_t} + p_{nt} \frac{\frac{\partial q_{nt}}{\partial p_{nt}}}{G_t} - \frac{q_{nt} p_{nt}}{(G_t)^2} \frac{\partial G_t}{\partial p_{nt}}}_{see\, eq.(4)} = \underbrace{a_{nnt} \frac{1}{p_{nt}}}_{see\, eq.(5b)} \tag{6}$$

where a_{nnt} is the parameter stemming from the translog GDP function that captures the change in the share of imported good n in GDP when its price increases by 1%. The multiplication of both sides by p_{nt} and rearranging terms[10] results in the following expression for the price elasticity of import demand for good n, which depends on a_{nnt} as well as the product share s_{nt}:

$$\varepsilon_{nnt} \equiv \frac{\partial q_{nt}(p_t, v_t)}{\partial p_{nt}} \frac{p_{nt}}{q_{nt}} = \frac{a_{nnt}}{s_{nt}} + s_{nt} - 1 \tag{7}$$

If $a_{nnt} > 0$, the share of the imported good n in GDP decreases (i.e.s_{nt} becomes less negative), implying that demand is elastic: an increase in the price of good n reduces imported quantities more than proportionally. However, if $a_{nnt} < 0$, the share of imported good n in GDP increases (i.e. s_{nt} becomes more negative), indicating that import demand must be relatively inelastic, as quantities respond less than proportionally to a change in prices. Thus, for goods in accordance with the law of demand[11] it holds that the price elasticity of import demand ranges between minus infinity (as theoretically import quantities might drop by 100% as a response to an infinitesimally small increase in prices) and zero:

$$\varepsilon_{nnt} = \begin{cases} (-\infty; s_{nt} - 1] \; if \; a_{nnt} \geq 0 \\ (s_{nt} - 1; 0] \; if \; a_{nnt} < 0 \end{cases} \tag{8}$$

3. Empirical implementation and data

Empirically, Kee, Nicita, and Olarreaga (2008) implemented this strategy by using a parameterisation from a fully flexible translog function (equation [5b]) to a semi-flexible version following Diewert and Wales (1988) and by restricting all translog parameters to be time invariant[12] in order to handle the large number of goods at the HS 6-digit level.[13] The resulting share equation is specified as:

$$s_{nt}(p_t, v_t) = a_{0n} + a_{nn} \ln \frac{p_{nt}}{\overline{p_{kt}}} + \sum_{m=1, m \neq l}^{M} c_{nm} \ln \frac{v_{mt}}{v_{lt}}, \forall n = 1, \ \ldots \ , N \tag{9}$$

where p_{nt} is measured using unit values of imports, k refers to all non-n goods and thus $\overline{p_{kt}}$ is the average of the log prices of all non-n goods. Hence, the share of good n in GDP is a linear function of factor endowments and the price of good n relative to an average price of all non-n goods k. Factors of production used in this analysis comprise labour, capital and agricultural land. Following Caves et al. (1982), $\overline{\ln p_{kt}}$ is approximated with the observed Törnqvist price index of all non-n goods using the GDP deflator p_t:

$$\overline{\ln p_{kt}} \approx \frac{(\ln p_t - \overline{s_{nt}} \ln p_{nt})}{(1 - \overline{s_{nt}})}, \text{with } \overline{s_{nt}} = \frac{(s_{nt} + s_{nt_{-1}})}{2} \tag{10}$$

The final share equation is estimated across importing countries i and years t, but for each good n separately (and therefore more than 5000 times), taking the following form:

$$\begin{aligned} s_{nit}(p_{nit}, p_{kit}, v_{it}) = a_{0n} + a_{ni} + a_{nt} + a_{nn} \ln \frac{p_{nit}}{p_{kit}} \\ + \sum_{m=1, m \neq l}^{M} c_{nm} \ln \frac{v_{mit}}{v_{lit}} + u_{nit}, \forall n = 1, \ldots, N \end{aligned} \tag{11}$$

where k refers to all non-n goods, a_{ni} and a_{nt} denote country and time fixed effects respectively, with error terms u_{nit} being clustered at the importing country level. It is assumed that the structural parameters of the semi-flexible translog GDP function are common across countries up to a constant. Equation (11) can be estimated with data on importer-specific product shares in GDP, the GDP deflator, unit values of imports[14] and information on factor endowments. Final modifications allow (i) for the correction of a possible endogeneity bias by using instruments for unit values and (ii) for the correction of a selection bias by following a two-step procedure.[15]

3.1. Tackling endogeneity

The price elasticity of import demand should reflect how imported quantities respond to price changes. Conversely, however, a change in demand for a good might affect the product's price as well. For example, if an economy experiences a positive demand shock, prices might react to demand and in fact increase, resulting in reversed causality and a simultaneity bias. Similar to the approach used by Kee, Nicita, and Olarreaga (2008), we instrument the unit values of good n by two measures:

First, we use the simple average of the Törnqvist price index for product n computed over all importing countries except country i, i.e. over the rest of the world j. We expect world price indices of good n to be positively correlated with the importing country's price index for the same product. However, while a domestic demand shock might affect an economy's domestic and import prices, we do not assume that domestic demand for imported products is shaping price indices of the rest of the world.[16]

Remembering from equation (10) that the price of non-n goods can be expressed as the GDP deflator adjusted for the share and price of good n, the price index over all non-i importing countries (indexed j) can be computed in a similar fashion:

$$z_1 = \ln \frac{\overline{p_{njt}}}{\overline{p_{kjt}}} \underbrace{\ln \left(\sum_j w\, p_{njt} \right)}_{\ln(\overline{p_{njt}})} - \underbrace{\left(\frac{\ln \left(\sum_j w\, p_{jt} \right) - \left(\sum_j w\, \overline{s_{njt}} \right) \ln \left(\sum_j w\, p_{njt} \right)}{\left(1 - \sum_j w\, \overline{s_{njt}} \right)} \right)}_{\ln(\overline{p_{kjt}})} \tag{12}$$

with k referring to all non-n goods and j corresponding to all non-i importers. For the simple average of the Törnqvist price index, the employed weight is simply $w = 1/J$, with J referring to the total number non-i importers.

A second instrument we use is the trade-weighted average distance of importing country i to its trading partners j. The price of imported products is expected to be higher for products that have to be transported over greater distances, while distance itself should not drive domestic demand for good n.

$$z_2 = \sum_j x_{jt}\ \text{distance}_{ij} \tag{13}$$

where $distance_{ij}$ is the physical distance between importer i and exporter j and x_{jt} is the share of an exporter j in total exports of good n in period t.

3.2. Accounting for selection

Results using these instruments might, however, still suffer from a selection bias as unit values entering our analysis are calculated based on positive import flows. Country and year fixed effects can reduce the bias resulting from unobserved variables. Yet, due to the possibility that zero trade flows in our data are the result of countries' selection not to import, we follow an amended form of the Heckman two-stage estimation procedure.

In the first step, the selection equation (14a) evaluates the probability of non-zero trade flows. The dependent variable is equal to 1 if the share of good n in country i's GDP is smaller than zero (i.e. imports are greater than zero). It is regressed on a product-specific term γ_{0n}, time fixed effects γ_{nt}, country fixed effects γ_{ni}, as well as the previously introduced instruments and factor endowments, captured in z_{nit}. ϵ_{nit} is an error term. From this first step, the inverse Mills ratio (ϕ_{nit}) is obtained, which enters the outcome equation (15) in the second step as an explanatory variable, which should solve the omitted variable bias in the presence of sample selection.

A drawback of this procedure is that probit model estimations with country fixed effects suffer from the incidental parameters problem. It means that as we are using a big panel data set incorporating many fixed effects, probit models are more likely to render inconsistent estimates as they do not converge to their true value as the number of parameters (i.e. fixed effects) increases with sample size. In line with Kee, Nicita, and

Olarreaga (2008) we, therefore, substitute country fixed effects with time averages of the exogenous variables and instruments $\overline{z_{ni}}$ in the first stage (equation [14b]).

$$\mathrm{Prob}[s_{nit} < 0] = \gamma_{0n} + \gamma_{nt} + \gamma_{ni} + \delta_{1n} z_{nit} + \epsilon_{nit}, \forall n = 1, \ldots, N \tag{14a}$$

$$\mathrm{Prob}[s_{nit} < 0] = \gamma_{0n} + \gamma_{nt} + \delta_{1n} z_{nit} + \delta_{2n} \overline{z_{ni}} + \epsilon_{nit}, \forall n = 1, \ldots, N \tag{14b}$$

$$(s_{nit} | s_{nit} < 0) = a_{0n} + a_{nt} + a_{nn} \ln \frac{p_{nit}}{p_{kit}} + \sum_{m=1, m \neq l}^{M} c_{nm} \ln \frac{v_{mit}}{v_{lit}} + d_n \overline{z_{ni}} + h_n \hat{\phi}_{nit} + u_{nit}, \forall n = 1, \ldots, N \tag{15}$$

Finally, using the average import shares of each importing country i and estimates of a_{nn}, the resulting import demand elasticity of country i for good n is computed as

$$\hat{\varepsilon}_{nni} \equiv \frac{\partial q_{ni}(p_i, v_i)}{\partial p_{ni}} \frac{p_{ni}}{q_{ni}} = \frac{\widehat{a_{nn}}}{\overline{s_{ni}}} + \overline{s_{ni}} - 1 \tag{16}$$

3.3. Abundant data sources

The data necessary for estimation were compiled from different sources. Import values and quantities were taken from the Commodity Trade Statistics Database (COMTRADE) for the period 1995–2014. It covers 5221 products at the HS 6-digit level (HS revision 1996). Data on agricultural land in square kilometres was retrieved from the World Development Indicators (WDI) database of the World Bank and complemented by data provided by the Food and Agriculture Organization of the United Nations (FAO). Data on GDP, physical capital and labour was collected from the Penn World Tables 9.0 (Feenstra, Inklaar, and Timmer 2015).

We dropped observations for which bilateral quantities were missing (even though bilateral import values were reported) to avoid a bias of unit values entering our estimation procedure. For our preferred specification, we additionally dropped observations where import values of one importer for one specific product never exceeded 10,000 USD per year during the period 1995–2014.[17]

On average, each HS 6-digit product in our sample was imported by 155 countries, with a minimum of 17 importers for petroleum oil obtained from bituminous minerals (HS 271094) and a maximum of 167 importers for 378 different products at the HS 6-digit level. Countries in the sample imported 4790 products on average, ranging from a minimum of 1593 products for Djibouti to 5121 products for France.

4. Empirical results

Following the methodology presented in Section 3, we performed three estimations: First, we employed simple fixed effects (FE), resulting in 687,927 estimates for the price elasticity of import demand. Second, we introduced instrument variables (FEIV), amending our data in 96,695 cases. Finally, substituting the fixed effects approach by a two-step procedure to account for a possible sample selection bias (SSB) adjusts 18,636 estimates.[18]

Price elasticities of import demand derived from the FE approach were replaced by FEIV results, based on instruments introduced in equations (12) and (13), whenever the Hansen J-statistic was greater than 0.1 and the Anderson–Rubin F–statistic was smaller than 0.1: (i) The Hansen J-statistic reports the validity of instruments with the null hypothesis that instruments are exogenous. (ii) The Anderson–Rubin F-statistic shows whether instruments have an impact on the endogenous variable with the null hypothesis that the endogenous regressors in the structural equation are jointly equal to zero. Furthermore, when the coefficient of the inverse mills ratio (h_n) in equation (15), indicating whether our results might suffer from sample selection bias, was found to be statistically significantly different from zero at the 10% level, FEIV estimates were replaced by SSB results.

Extreme values and potential outliers were dealt with in two steps: First, we dropped the tails (0.5% from either side) of the distribution. Second, we dropped positive elasticities as we are not concerned with products that violate the law of demand, such as Giffen goods. These steps reduce the number of estimated price elasticities of import demand to 548,625, out of which roughly 80% show to be significantly different from zero at the 10% level. We will henceforth refer to the latter as *significant* elasticities.

The distribution of our estimates is shown in Figure 1 with the left panel depicting all elasticities and the right panel presenting only the significant ones. It is characterised by a big spike around unitary elasticities and a quick flattening out. The mean computed over all observations is −1.20, yet, more than half of the observations are found to be less than unitary elastic with the median found to be around −0.94.

The shape of the distribution of elasticities presented by Kee, Nicita, and Olarreaga (2008) resembles ours. Yet, the average elasticity reported by Kee, Nicita, and Olarreaga (2008) is −3.12. Our results suggest that the most elastic product is facing an elasticity of −25.03. However, the maximum elasticity in the data provided by Kee, Nicita, and Olarreaga (2008) is −372.25 with 91 products attributable to 45 importing countries (primarily Japan and the United States) showing elasticities equal or greater than −300.

While Figure 1 shows the distribution of our estimated import demand elasticities over all HS 6-digit products and importers, the following sections discuss geographical and sectoral patterns of this distribution. We start by presenting elasticity aggregates by countries and by income groups and proceed by illustrating elasticities across product classifications.

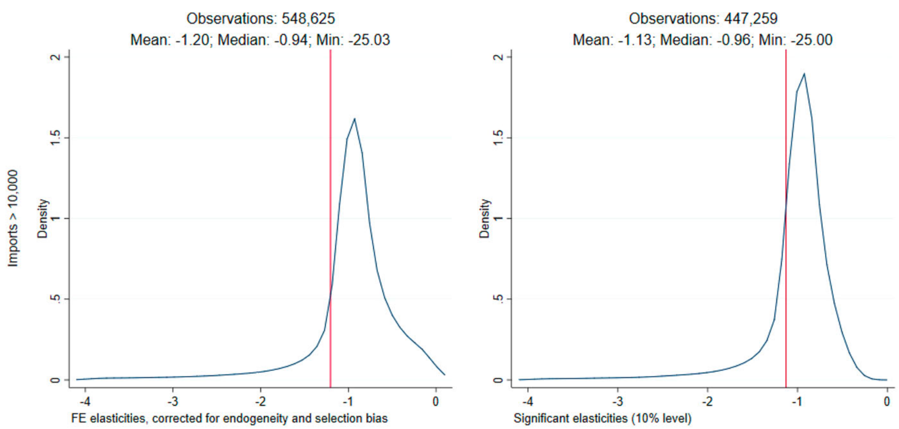

Figure 1. Distribution of elasticity estimates at the HS 6-digit level

4.1. Elasticities by importer

Our results by importing country are summarised in Table 1. The first two columns report our findings as simple average (s.a.) elasticities. Results shown in the second and subsequent columns are restricted to products for which elasticities were found to be statistically significantly different from zero at the 10% level (sign.). The third column of Table 1 shows results of significant elasticities when import-weights are applied. Columns four and five split up these import-weighted results into the agri-food and the manufacturing sectors. We illustrate simple average significant elasticities with a world map (Figure 2) with darker colour shadings indicating more elastic import demand and lighter shadings pointing towards less elastic or inelastic demand.

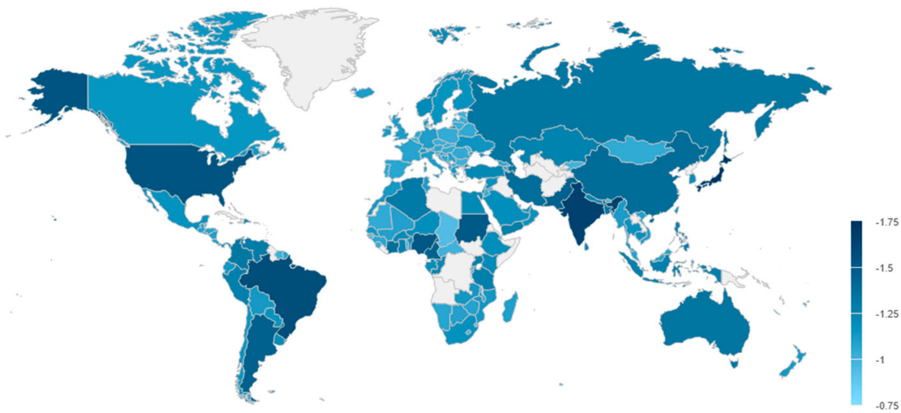

Figure 2. World map of simple average significant elasticities per country.

The United States and Brazil show the most elastic average import demand in North and South America respectively. Europe is shaded in light blue throughout with particularly inelastic demand found for Eastern Europe and the Iberian Peninsula. In Asia, India and Japan appear particularly price-sensitive. To the south of the equator, African countries' imports seem to respond relatively little to price changes. To the north of the equator, however, the picture is very diverse. Grey areas indicate missing data which are mainly found in Africa and Central Asia.

Intuitively, both physically larger and economically more developed countries are more likely to be able to substitute imported products by domestically produced goods whereas small (island) states and poor countries lack the capacities of developing and maintaining a diverse set of domestic industries and are more dependent on imports.

Country differences in average import demand elasticities along GDP and GDP per capita at purchasing power parities (PPP) are plotted in Figure 3. Note that we opted for showing GDP and GDP per capita in log scales such that the difference between two ticks on the x-axis indicates a quintupling of GDP and a doubling of income per capita at PPP respectively.

Countries with the highest simple average elasticities in absolute terms – Japan, India, Brazil, the United States, Nigeria – belong to the most populous countries in their respective regions with the exception of Japan. They are associated with the economically

Table 1. Elasticities by importer.

		s.a. $\hat{\varepsilon}_{nni}$	Sign. s.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	
ISO2	Country name	Total	Total	Total	Agri-food	Manufacturing	GDP *p.c.*
AL	Albania	−1.045	−1.049	−0.961	−0.967	−0.959	6.7
DZ	Algeria	−1.472	−1.310	−0.951	−0.978	−0.944	10.5
AG	Antigua and Barbuda	−0.958	−0.987	−0.984	−0.980	−0.986	17.6
AR	Argentina	−1.757	−1.457	−0.975	−1.040	−0.973	15.9
AM	Armenia	−1.047	−1.063	−0.968	−0.966	−0.969	5.2
AW	Aruba	−0.969	−0.986	−0.974	−0.991	−0.966	42.1
AU	Australia	−1.494	−1.339	−0.931	−0.945	−0.930	38.6
AT	Austria	−1.106	−1.053	−0.957	−0.951	−0.958	39.1
AZ	Azerbaijan	−1.431	−1.332	−0.949	−0.964	−0.947	7.5
BS	Bahamas	−1.238	−1.155	−0.979	−0.969	−0.981	25.5
BH	Bahrain	−1.203	−1.133	−1.006	−0.956	−1.011	31.3
BD	Bangladesh	−1.635	−1.336	−0.985	−0.992	−0.983	1.8
BB	Barbados	−1.049	−1.051	−0.969	−0.963	−0.970	19.6
BY	Belarus	−1.079	−1.050	−1.005	−0.957	−1.010	11.9
BE	Belgium	−0.990	−0.992	−0.984	−0.959	−0.987	36.8
BZ	Belize	−0.964	−0.972	−0.989	−0.972	−0.992	7.4
BJ	Benin	−1.162	−1.173	−0.974	−0.982	−0.970	1.6
BM	Bermuda	−1.100	−1.100	−0.963	−0.950	−0.966	48.7
BT	Bhutan	−0.942	−0.969	−0.993	−0.993	−0.993	5.2
BO	Bolivia	−1.151	−1.127	−0.962	−0.951	−0.963	4.1
BA	Bosnia and Herzegovina	−1.086	−1.058	−0.973	−0.976	−0.972	6.8
BW	Botswana	−1.140	−1.089	−0.982	−0.951	−0.986	11.4
BR	Brazil	−1.903	−1.572	−1.002	−1.017	−1.002	10.7
BN	Brunei Darussalam	−1.262	−1.212	−0.957	−0.952	−0.958	61.0
BG	Bulgaria	−1.022	−1.009	−0.979	−0.952	−0.981	11.9
BF	Burkina Faso	−1.276	−1.206	−0.969	−0.970	−0.968	1.2
BI	Burundi	−0.967	−0.994	−0.982	−0.999	−0.977	0.6
CV	Cabo Verde	−0.954	−0.977	−0.974	−0.981	−0.972	4.4
KH	Cambodia	−1.194	−1.173	−0.984	−0.994	−0.983	1.9
CM	Cameroon	−1.536	−1.446	−0.960	−0.980	−0.955	2.3
CA	Canada	−1.228	−1.145	−0.951	−0.953	−0.950	38.6
CF	Central African Republic	−0.919	−1.003	−0.956	−0.968	−0.952	0.9
TD	Chad	−0.865	−0.941	−0.965	−0.968	−0.964	1.5
CL	Chile	−1.286	−1.157	−0.963	−0.979	−0.961	14.8
CN	China	−1.621	−1.389	−0.966	−1.049	−0.963	6.8
HK	China, Hong Kong SAR	−1.240	−1.129	−1.023	−0.972	−1.025	41.8
MO	China, Macao SAR	−1.289	−1.265	−0.978	−0.968	−0.979	58.1
CO	Colombia	−1.524	−1.326	−0.956	−0.995	−0.951	8.8
KM	Comoros	−0.884	−0.949	−0.981	−0.994	−0.973	1.6
CG	Congo	−1.289	−1.224	−1.037	−0.969	−1.043	2.9
CR	Costa Rica	−1.148	−1.110	−0.967	−0.963	−0.968	11.0
CI	Côte d'Ivoire	−1.475	−1.368	−0.984	−0.976	−0.986	2.5
HR	Croatia	−1.096	−1.064	−0.963	−0.954	−0.964	17.0
CY	Cyprus	−1.169	−1.114	−0.974	−0.966	−0.975	29.2
CZ	Czech Republic	−1.048	−1.023	−0.967	−0.948	−0.968	24.8
DK	Denmark	−1.219	−1.120	−0.948	−0.969	−0.945	38.2
DJ	Djibouti	−0.938	−0.955	−0.987	−0.991	−0.986	2.6
DM	Dominica	−0.922	−0.947	−0.980	−0.980	−0.980	9.1

(*continued*).

Table 1. Continued.

		s.a. $\hat{\varepsilon}_{nni}$	Sign. s.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	
ISO2	Country name	Total	Total	Total	Agri-food	Manu-facturing	GDP *p.c.*
DO	Dominican Republic	−1.340	−1.224	−0.964	−0.958	−0.965	9.0
EC	Ecuador	−1.248	−1.134	−0.957	−0.955	−0.957	7.2
EG	Egypt	−1.360	−1.220	−0.971	−0.983	−0.967	6.4
SV	El Salvador	−1.124	−1.080	−0.969	−0.967	−0.970	4.1
EE	Estonia	−1.017	−1.003	−0.975	−0.979	−0.975	17.8
ET	Ethiopia	−1.227	−1.191	−0.974	−0.994	−0.972	0.8
FJ	Fiji	−1.010	−1.040	−1.005	−0.974	−1.011	6.6
FI	Finland	−1.274	−1.166	−0.963	−0.971	−0.962	35.1
FR	France	−1.089	−1.075	−0.966	−0.978	−0.964	33.8
GA	Gabon	−1.184	−1.184	−0.949	−0.949	−0.949	12.2
GM	Gambia	−0.945	−0.981	−1.004	−0.993	−1.010	1.6
GE	Georgia	−1.116	−1.061	−0.963	−0.963	−0.963	5.1
DE	Germany	−1.168	−1.103	−0.950	−0.980	−0.947	37.0
GH	Ghana	−1.360	−1.264	−0.959	−0.968	−0.958	2.6
EL	Greece	−1.223	−1.128	−0.979	−0.969	−0.980	26.2
GD	Grenada	−0.921	−0.944	−0.980	−0.972	−0.982	9.0
GT	Guatemala	−1.152	−1.084	−0.975	−0.961	−0.977	5.4
GN	Guinea	−1.076	−1.061	−0.985	−0.987	−0.985	1.4
GW	Guinea-Bissau	−0.936	−0.992	−0.997	−1.006	−0.988	1.4
HN	Honduras	−1.100	−1.075	−0.986	−0.968	−0.990	3.7
HU	Hungary	−1.061	−1.041	−0.966	−0.952	−0.967	19.2
IS	Iceland	−1.177	−1.105	−0.974	−0.953	−0.976	39.3
IN	India	−1.990	−1.649	−0.983	−0.978	−0.983	3.0
ID	Indonesia	−1.443	−1.277	−0.979	−0.981	−0.979	5.6
IR	Iran (Islamic Republic of)	−1.632	−1.384	−0.969	−0.998	−0.963	11.9
IE	Ireland	−1.211	−1.113	−0.965	−0.961	−0.966	39.6
IL	Israel	−1.326	−1.194	−0.943	−0.958	−0.941	30.9
IT	Italy	−1.138	−1.099	−0.958	−0.969	−0.957	33.7
JM	Jamaica	−1.124	−1.114	−1.001	−0.972	−1.006	6.6
JP	Japan	−1.986	−1.733	−0.977	−0.990	−0.975	34.0
JO	Jordan	−1.070	−1.041	−0.989	−0.977	−0.992	6.4
KZ	Kazakhstan	−1.444	−1.267	−0.946	−0.927	−0.948	12.1
KE	Kenya	−1.275	−1.209	−0.965	−0.986	−0.963	2.2
KW	Kuwait	−1.429	−1.244	−0.934	−0.942	−0.933	56.3
KG	Kyrgyzstan	−0.988	−0.998	−0.985	−0.977	−0.986	2.6
LV	Latvia	−1.038	−1.025	−0.966	−0.972	−0.965	15.1
LB	Lebanon	−1.168	−1.123	−0.983	−0.968	−0.986	11.0
LS	Lesotho	−0.952	−0.985	−0.992	−0.986	−0.994	1.9
LT	Lithuania	−1.056	−1.023	−0.991	−0.971	−0.994	16.6
LU	Luxembourg	−1.301	−1.155	−0.973	−0.969	−0.974	75.4
MG	Madagascar	−1.099	−1.092	−0.964	−0.994	−0.959	0.9
MW	Malawi	−1.049	−1.061	−0.961	−0.969	−0.960	1.0
MY	Malaysia	−1.090	−1.069	−0.989	−0.959	−0.991	16.4
MV	Maldives	−0.976	−0.973	−0.999	−0.980	−1.003	10.2
ML	Mali	−1.114	−1.088	−0.982	−0.968	−0.985	1.2
MT	Malta	−1.099	−1.067	−1.024	−0.968	−1.029	25.2
MR	Mauritania	−1.009	−1.042	−1.000	−0.989	−1.002	2.5
MU	Mauritius	−1.053	−1.051	−0.980	−0.974	−0.981	14.4
MX	Mexico	−1.301	−1.169	−0.952	−0.983	−0.950	13.1
MN	Mongolia	−1.044	−1.045	−0.979	−0.963	−0.981	5.4
ME	Montenegro	−1.026	−1.023	−0.977	−0.982	−0.976	10.2
MS	Montserrat	−0.934	−0.948	−1.012	−0.982	−1.019	17.5
MA	Morocco	−1.252	−1.126	−0.966	−0.990	−0.962	5.3
MZ	Mozambique	−1.183	−1.136	−0.959	−0.972	−0.957	0.8
MM	Myanmar	−1.120	−1.114	−0.986	−0.971	−0.988	2.3
NA	Namibia	−1.079	−1.071	−0.968	−0.963	−0.969	7.0

(*continued*).

Table 1. Continued.

		s.a. $\hat{\varepsilon}_{nni}$	Sign. s.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	Sign. w.a. $\hat{\varepsilon}_{nni}$	
ISO2	Country name	Total	Total	Total	Agri-food	Manu-facturing	GDP *p.c.*
NP	Nepal	−1.263	−1.226	−0.976	−0.978	−0.976	1.5
NL	Netherlands	−1.068	−1.061	−0.969	−0.957	−0.970	41.1
NZ	New Zealand	−1.217	−1.128	−0.944	−0.929	−0.945	29.2
NI	Nicaragua	−1.082	−1.086	−0.979	−0.969	−0.981	3.6
NE	Niger	−1.243	−1.186	−0.961	−0.986	−0.954	0.8
NG	Nigeria	−1.805	−1.513	−0.954	−0.975	−0.949	2.8
NO	Norway	−1.385	−1.210	−0.949	−0.968	−0.947	49.3
OM	Oman	−1.283	−1.166	−0.970	−0.964	−0.971	28.5
PK	Pakistan	−1.745	−1.452	−0.985	−0.990	−0.985	3.4
PA	Panama	−1.219	−1.152	−0.966	−0.962	−0.967	12.0
PY	Paraguay	−1.224	−1.160	−0.975	−0.962	−0.976	5.3
PE	Peru	−1.458	−1.276	−0.954	−0.958	−0.954	7.1
PH	Philippines	−1.389	−1.276	−0.986	−0.962	−0.988	4.8
PL	Poland	−1.050	−1.035	−0.952	−0.961	−0.952	16.8
PT	Portugal	−1.090	−1.044	−0.955	−0.965	−0.954	24.0
QA	Qatar	−1.390	−1.202	−0.953	−0.950	−0.954	88.7
KR	Republic of Korea	−1.307	−1.186	−0.981	−1.002	−0.980	27.0
MD	Republic of Moldova	−0.991	−0.998	−0.982	−0.973	−0.984	2.9
RO	Romania	−1.075	−1.048	−0.951	−0.961	−0.950	12.0
RU	Russian Federation	−1.544	−1.334	−0.915	−0.959	−0.907	15.2
RW	Rwanda	−1.099	−1.087	−0.945	−0.967	−0.940	1.0
KN	Saint Kitts and Nevis	−0.928	−0.947	−0.968	−0.977	−0.966	17.2
LC	Saint Lucia	−0.942	−0.965	−0.994	−0.980	−0.998	8.9
ST	Sao Tome and Principe	−0.897	−0.930	−1.001	−0.996	−1.002	2.2
SA	Saudi Arabia	−1.343	−1.186	−0.935	−0.943	−0.934	29.7
SN	Senegal	−1.140	−1.133	−0.981	−0.988	−0.978	2.0
RS	Serbia	−1.114	−1.078	−0.960	−0.947	−0.961	9.4
SC	Seychelles	−0.931	−0.957	−1.055	−1.017	−1.063	20.0
SL	Sierra Leone	−1.003	−1.021	−1.044	−0.977	−1.052	1.3
SG	Singapore	−1.085	−1.044	−1.045	−0.960	−1.048	51.5
SK	Slovakia	−1.029	−1.027	−0.975	−0.951	−0.976	19.7
SI	Slovenia	−1.051	−1.026	−0.968	−0.957	−0.969	25.6
ZA	South Africa	−1.275	−1.175	−0.952	−0.985	−0.950	10.2
ES	Spain	−1.093	−1.064	−0.954	−0.960	−0.954	29.6
LK	Sri Lanka	−1.287	−1.225	−0.972	−0.983	−0.970	5.9
VC	St. Vincent and the Grenadines	−0.918	−0.949	−0.984	−0.978	−0.986	8.2
PS	State of Palestine	−1.153	−1.137	−1.003	−0.981	−1.010	3.7
SD	Sudan (Former)	−1.719	−1.503	−0.948	−0.966	−0.945	2.5
SR	Suriname	−1.001	−1.005	−0.979	−0.966	−0.981	10.1
SZ	Swaziland	−0.971	−0.988	−0.986	−0.973	−0.988	7.6
SE	Sweden	−1.243	−1.158	−0.963	−0.960	−0.964	38.3
CH	Switzerland	−1.234	−1.122	−1.027	−0.953	−1.030	46.6
SY	Syrian Arab Republic	−1.273	−1.169	−0.994	−0.974	−0.998	3.3
TW	Taiwan	−1.277	−1.168	−0.985	−0.967	−0.985	35.3
MK	TFYR of Macedonia	−0.996	−1.019	−0.977	−0.964	−0.978	9.3
TH	Thailand	−1.229	−1.160	−0.978	−0.959	−0.979	10.1

(*continued*).

Table 1. Continued.

ISO2	Country name	s.a. $\hat{\varepsilon}_{nni}$ Total	Sign. s.a. $\hat{\varepsilon}_{nni}$ Total	Sign. w.a. $\hat{\varepsilon}_{nni}$ Total	Sign. w.a. $\hat{\varepsilon}_{nni}$ Agri-food	Sign. w.a. $\hat{\varepsilon}_{nni}$ Manu-facturing	GDP *p.c.*
TG	Togo	−0.972	−0.998	−0.984	−0.970	−0.986	1.2
TT	Trinidad and Tobago	−1.195	−1.108	−0.999	−0.964	−1.002	20.5
TN	Tunisia	−1.148	−1.102	−0.969	−0.976	−0.968	9.0
TR	Turkey	−1.338	−1.224	−0.956	−0.988	−0.955	13.6
TC	Turks and Caicos Islands	−0.902	−0.941	−1.005	−0.983	−1.012	20.2
TZ	U.R. of Tanzania: Mainland	−1.327	−1.278	−0.991	−0.986	−0.992	1.5
UG	Uganda	−1.388	−1.287	−0.965	−0.992	−0.961	1.4
UA	Ukraine	−1.251	−1.148	−0.979	−0.951	−0.981	7.2
AE	United Arab Emirates	−1.269	−1.158	−0.963	−0.950	−0.964	79.0
UK	United Kingdom	−1.150	−1.107	−0.961	−0.973	−0.959	36.1
US	United States	−1.717	−1.534	−0.997	−1.043	−0.995	47.8
UY	Uruguay	−1.260	−1.199	−0.975	−0.953	−0.977	13.3
VE	Venezuela	−1.419	−1.297	−0.930	−0.971	−0.923	10.6
VN	Viet Nam	−1.152	−1.091	−0.974	−0.971	−0.974	3.1
YE	Yemen	−1.394	−1.287	−0.980	−0.985	−0.977	2.4
ZM	Zambia	−1.161	−1.133	−0.960	−0.948	−0.961	2.0
ZW	Zimbabwe	−1.082	−1.082	−0.984	−0.973	−0.986	2.3

Notes: s.a. refers to the simple average over all HS 6-digit products per country: $\sum_h \hat{\varepsilon}_{nni}/H$. w.a. refers to the import-weighted average per country: $\sum_h(\hat{\varepsilon}_{nni} x Imports_{ih}/Imports_i)$. Sign. elasticities refer to estimates statistically significantly different from zero at the 10% level. GDP *p.c.* refers to the average expenditure-side real GDP per capita measured at chained PPPs in thousand 2011 USD for the period 1995–2014.

biggest countries in the region, but the difference in GDP per capita between these countries is huge (upper panel of Figure 3). At the other end of the spectrum, the ten countries associated with the lowest import demand elasticities are small island states, with the exception of landlocked and poverty-stricken and violence-ridden Chad.

The picture reverses when focusing on the most important traded commodities in terms of trade volumes by attaching import weights to every HS 6-digit product within a country (bottom panel of Figure 3). Employing import weights puts more emphasis on products for which countries are more dependent on imports. We find that bigger economies are associated with lower trade-weighted average import demand elasticities [and on average lower import shares in GDP] which would be in line with the assumption that larger economies have better means to substitute imports by domestic production.

In contrast, Figure 3 does not reveal that richer countries (in terms of GDP per capita) are associated with more or less elastic demand. However, focusing on the sub-sample of Member States of the European Union, some trend towards more elastic demand for richer countries is visible and which is not only a matter of the absolute size of the economies.

Country characteristics potentially explaining the variation of price elasticities of import demand across importers in our sample are summarised in Table 2. We consider the share of product n in GDP, measures of the economic size and three indicators as approximations of countries' status of development: real GDP per capita, the Human Development Index (HDI) and the Economic Complexity Index (ECI). In addition to

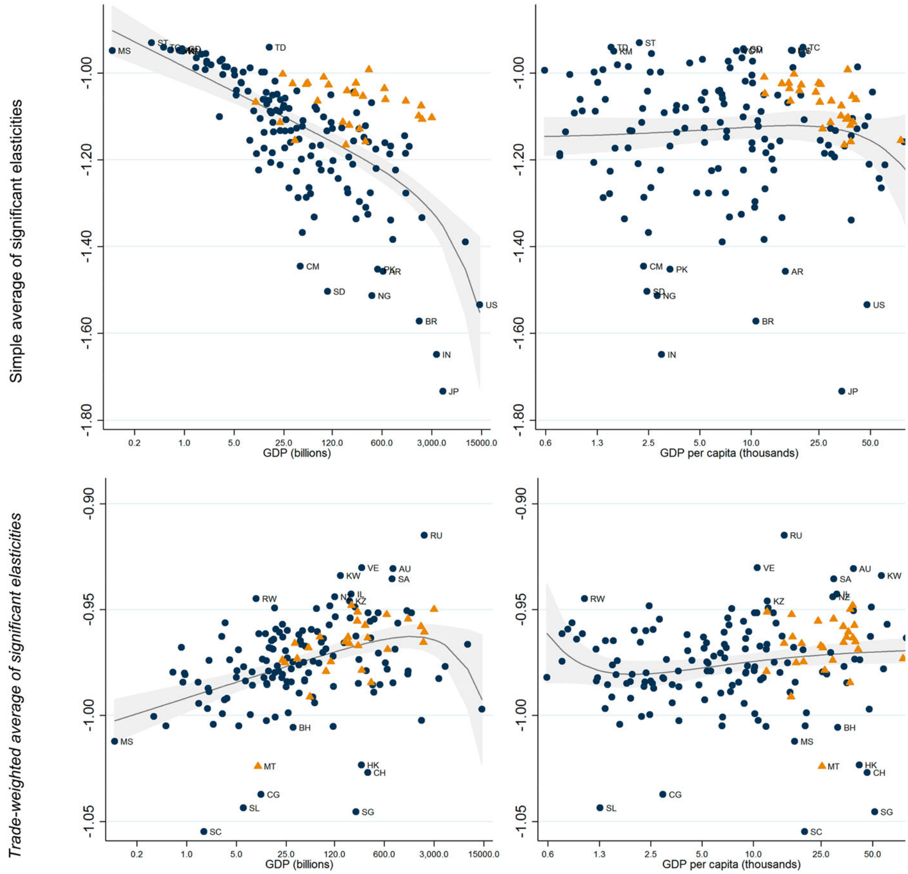

Figure 3. Significant elasticities over income.

Notes: Simple average per country computed over all HS 6-digit products: $\sum_n \hat{\varepsilon}_{nni}/N$; the weighted average refers to the import-weighted average per country: $\sum_h (\hat{\varepsilon}_{nni} x Imports_{ih}/Imports_i)$. Significant elasticities are estimates statistically significantly different from zero at the 10% level. GDP p.c. refers to the average expenditure-side real GDP per capita per country measured at chained PPPs in thousand 2011 USD for the period 1995–2014. EU Member States highlighted as orange triangles. The fitted line stems from a second order fractional polynomial estimation of significant elasticities on GDP and GDP per capita respectively.

GDP per capita, the HDI published by the United Nations accounts for the dimensions of health and education. The ECI provided by the Centre for International Development at Harvard University captures how diversified an economy is with respect to the level of complexity of products and the number of products it exports and can be considered as an alternative measure for development (Hausmann et al. 2011). These three measures are closely related but grasp different dimensions of development. As the estimated price elasticity of import demand has a country-product dimension, we additionally incorporate product fixed effects.

Indeed, we find a higher share of the imported good n in GDP to be associated with a less elastic import demand.[19] Moreover, economically and physically bigger economies, according to their GDP and surface area, show higher (i.e. more negative) import demand elasticities on average.[20]

Table 2. Regression of significant import demand elasticities on country characteristics.

Dependent variable: ε_{ni}	(1)	(2)	(3)	(4)
Product's share in GDP	9.047***	5.687***	5.878***	4.615**
	[1.237]	[1.335]	[1.363]	[1.855]
GDP (real, at PPP, in trillion 2011 USD)	−0.078***	−0.045***	−0.046***	−0.046***
	[0.004]	[0.003]	[0.003]	[0.004]
$(GDP)^2$	0.004***	0.002***	0.002***	0.002***
	[0.000]	[0.000]	[0.000]	[0.000]
GDP *p*.c. (real, at PPP, in ten thousand 2011 USD)	0.009***	0.017***		
	[0.003]	[0.003]		
$(GDP\ p.c.)^2$	−0.002***	−0.003***		
	[0.000]	[0.000]		
HDI (average 1995–2014)			0.418***	
			[0.084]	
$(HDI)^2$			−0.259***	
			[0.066]	
ECI (average 1995–2014)				0.038***
				[0.003]
$(ECI)^2$				−0.023***
				[0.002]
Area (in million square kilometres)	−0.009***	−0.007***	−0.006***	−0.007***
	[0.001]	[0.001]	[0.001]	[0.001]
Landlocked	0.033***	0.0173***	0.022***	0.025***
	[0.005]	[0.004]	[0.004]	[0.005]
Small Island Developing State	0.121***	0.0414***	0.038***	0.018**
	[0.006]	[0.005]	[0.005]	[0.009]
EU membership (dummy)	0.101***	0.0822***	0.082***	0.079***
	[0.005]	[0.005]	[0.005]	[0.006]
WTO membership (dummy)	0.017***	0.0223***	0.026***	0.029***
	[0.006]	[0.005]	[0.005]	[0.006]
Exports of fuels, in % of GDP	−0.031***	−0.0278***	−0.035***	−0.017***
	[0.006]	[0.005]	[0.005]	[0.006]
Constant	−1.158***	−1.167***	−1.316***	−1.159***
	[0.007]	[0.006]	[0.027]	[0.006]
Observations	442281	442281	431369	343471
R^2	0.006	0.306	0.308	0.317
Economic Development Indicator	*GDP p.c.*	*GDP p.c.*	*HDI*	*ECI*
Product fixed effects	No	Yes	Yes	Yes

Standard errors in brackets; $*p < .10$, $**p < .05$, $***p < .01$.

Furthermore, import demand becomes less price-sensitive with a higher level of development. This effect, however, is diminishing. Positive coefficients on the dummy variables for landlocked countries and small island developing states are in line with our expectation that countries that are more dependent on imports exhibit a less elastic import demand. Finally, membership of the EU or the WTO is associated with lower price responsiveness[21] whereas a higher share of fuel exports in GDP (and therefore higher volatility of income) points towards more elastic demand.

4.2. *Elasticities by product categories*

In this section we seek to further elaborate differences and commonalities along different product groups. We start off by illustrating how elasticities vary between the agri-food and the manufacturing sectors. Considering simple averages first, we find that for 158 out of 167 countries in our sample, the agri-food sector appears to face a more elastic demand than the manufacturing sector. However, when imposing product-specific

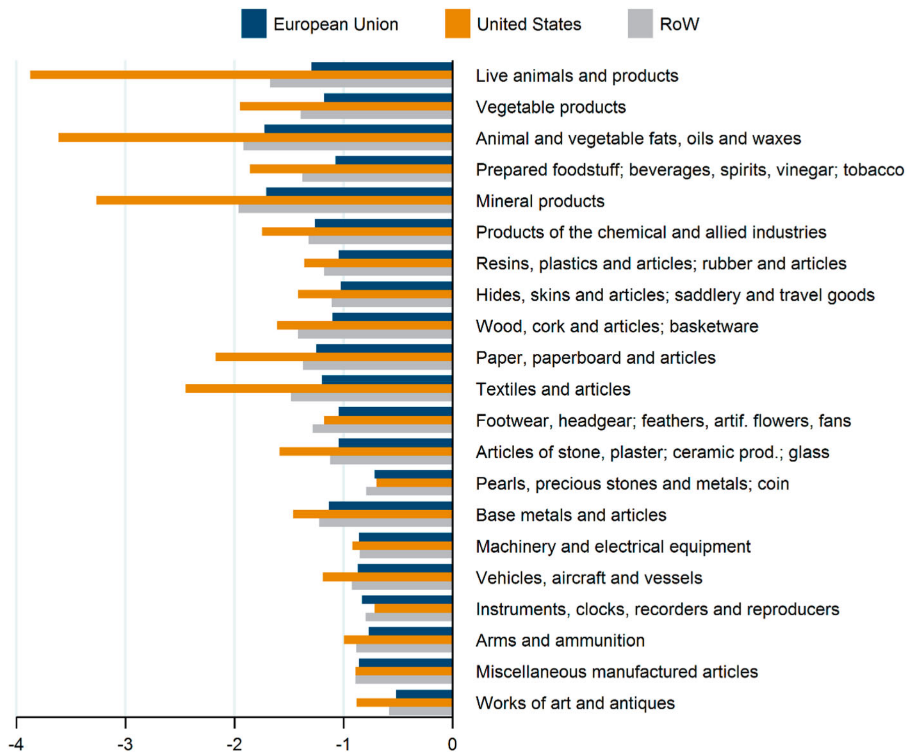

Figure 4. Significant simple average elasticities per HS Section.
Note: Significant elasticities refer to estimates statistically significantly different from zero at the 10% level.

import weights – separately for each sector – the import demand for products of the manufacturing sector is shown to be more elastic for 91 countries.

Focusing on import weighted results as reported in columns four and five of Table 1, it is observable that the manufacturing sector tends to be more elastic than the agri-food sector for countries exhibiting an overall elastic demand. In contrast, for countries for which we estimated an overall inelastic demand, imports of the agri-food sector seem to be more price-responsive. The bottom 5 countries, for which the least elastic total import demand was estimated, represent countries rich in natural resources – particularly fossil fuels – led by Russia and followed by Venezuela, Australia, Kuwait and Saudi Arabia.

As regressions were run separately for every product at the HS 6-digit level, a natural second step is to look at aggregates for the 21 HS sections, with the first four sections representing the agricultural sector. Figure 4 illustrates significant simple average elasticities per section for the European Union, the United States and the rest of the countries in our sample (RoW).

The graph shows, first, that highest import demand elasticities for all three importer groups can be attributed to animals, meat and fats, as well as mineral and paper products. Vegetable products and prepared foodstuff show more modest elasticity estimates, comparable with textiles or products of the chemical industry. Second, with very few exceptions, import demand of the United States is more elastic than import demand of the European Union. This could be due to the relative remoteness of the United States from other economies in the world compared to the members of the European Union.

According to the international trade literature, the further away and more remote a country is from other economies, the larger should be the trade elasiticity of that country with any other trading partner (Baier and Bergstrand 2009; and Yotov et al. 2016). It has to be noted, however, that figures for the EU represent average elasticities over Member States without differentiating between extra-EU and intra-EU trade. As we do not cover trade among US states but trade among EU Member States in our analysis, the difference between the EU and the US has to be interpreted with a grain of salt. Third, product categories for which import demand is relatively inelastic, i.e. smaller than −1 for every country group, belong to the luxury segment (such as works of art, pearls and precious metals), or concern machinery and electrical equipment, or arms and ammunition.

Technology seems to be a promising candidate for partly explaining this pattern. Using a correspondence from HS 6-digit products to ISIC (International Standard Industrial Classification) 4-digit industries, we can differentiate our import demand elasticity results for the manufacturing industries with respect to the OECD technology intensity definition as proposed by Hatzichronoglou (1997). Indeed, simple t-tests reveal that distributions of elasticities are significantly different between various technology intensity groups, with more R&D content being associated with lower mean and median elasticities in absolute terms. Unfortunately, some manufactured products, as well as products belonging to the agricultural sector, were not assigned to any technology intensity class (low, medium-low, medium-high or high technology intensity). However, median elasticities of these products were found to be not significantly different from median import demand elasticities for low-tech manufacturing products.

A different product classification is adopted for input-output tables as used by the World Input-Output Database (WIOD[22]) project (Timmer et al. 2015). Our data covers seventeen out of 35 sectors included in the WIOD database as our analysis is restricted to trade in goods and does not include trade in services. Table 3 presents our estimates aggregated by these sectors.

Independently of the weights employed and whether we consider all estimates or only significant elasticities, the energy sectors, i.e. 'Electricity, Gas and Water Supply' and 'Coke, Refined Petroleum and Nuclear Fuel', surprisingly always appear as the most price-elastic. Restricting our analysis to HS27 (Mineral fuels, mineral oils and products of their distillation) and considering the pre-crisis and the post-crisis periods separately, we do find that demand was particularly elastic prior to the onset of the global economic crisis whereas it appears to have been price-inelastic between 2009 and 2014.

Note, however, that the energy sectors are covered to a great extent by statistics on trade in services which are not covered by our analysis. The results for 'Electricity, Gas and Water Supply' are based on only 118 estimates for two HS 6-digit products for which commodity trade data is available.[23] The sector 'Coke, Refined Petroleum and Nuclear Fuel' is covered by 39 HS 6-digit products and 3,884 estimates. Other WIOD sectors represent averages of 378 HS 6-digit products and 47,389 elasticity estimates.

Simple average elasticities are also high for food, beverages and tobacco but the sector shifts half-way down the ranking when making use of import weights. The sectors for electrical and optical equipment, other machinery and transport equipment feature as the most demand-inelastic sectors.

In addition to sectoral classifications, one might expect differences in import demand elasticities with respect to the way they are used in the economy. Imports might be used as (i) final consumption goods, (ii) intermediate goods in the production process of final goods or (iii) in the form of stocks or gross fixed capital formation (GFCF). This analysis

Table 3. Elasticities by WIOD sector.

Sector	All elasticities			Significant elasticities		
	Simple avg.	Country w.a.	Sector w.a.	Simple avg.	Country w.a.	Sector w.a.
c1 Agriculture, Hunting, Forestry and Fishing	−1.376	−0.946	−0.934	−1.246	−0.959	−0.959
c2 Mining and Quarrying	−1.695	−1.008	−1.011	−1.413	−1.008	−1.012
c3 Food, Beverages and Tobacco	−1.529	−0.953	−0.959	−1.335	−0.970	−0.989
c4 Textiles and Textile Products	−1.411	−0.986	−1.004	−1.310	−0.997	−1.017
c5 Leather, Leather and Footwear	−1.324	−1.000	−0.972	−1.318	−1.042	−0.991
c6 Wood and Products of Wood and Cork	−1.333	−1.005	−0.981	−1.306	−1.025	−0.992
c7 Pulp, Paper, Printing and Publishing	−1.319	−0.942	−0.956	−1.297	−0.956	−0.976
c8 Coke, Refined Petroleum and Nuclear Fuel	−2.347	−1.178	−1.306	−1.876	−1.167	−1.305
c9 Chemicals and Chemical Products	−1.316	−0.929	−0.924	−1.231	−0.947	−0.952
c10 Rubber and Plastics	−0.991	−0.944	−0.944	−1.034	−0.963	−0.967
c11 Other Non-Metallic Mineral	−1.138	−0.967	−0.952	−1.160	−0.980	−0.983
c12 Basic Metals and Fabricated Metal	−1.189	−0.938	−0.953	−1.148	−0.958	−0.987
c13 Machinery, Nec	−0.864	−0.882	−0.862	−0.917	−0.906	−0.895
c14 Electrical and Optical Equipment	−0.817	−0.840	−0.884	−0.851	−0.874	−0.911
c15 Transport Equipment	−0.932	−0.924	−0.928	−0.972	−0.940	−0.945
c16 Manufacturing, Nec; Recycling	−1.054	−0.906	−0.887	−1.032	−0.919	−0.902
c17 Electricity, Gas and Water Supply	−2.649	−2.636	−1.868	−2.035	−2.051	−1.868

Note: Simple avg. refers to the simple average computed over all country-averages per WIOD sector. Country w.a. refers to the simple average over country specific import-weighted elasticities per WIOD sector. Sector w.a. refers to the import-weighted average over country specific import-weighted elasticities. Significant elasticities refer to estimates statistically significantly different from zero at the 10% level.

Table 4. Elasticities by product use.

Weights	All elasticities			Significant Elasticities		
	Intermediates	Final consumption	GFCF	Intermediates	Final consumption	GFCF
Simple avg.	−1.265	−1.175	−0.819	−1.181	−1.135	−0.885
Country w.a.	−0.959	−0.928	−0.858	−0.942	−0.909	−0.844
Product w.a.	−0.942	−0.904	−0.828	−0.922	−0.878	−0.813

Note: Simple avg. refers to the simple average computed over all country-averages per product category. Country w.a. refers to the simple average over country specific import-weighted elasticities per product category. Product w.a. refers to the import-weighted average over country specific import-weighted elasticities. Significant elasticities refer to estimates statistically significantly different from zero at the 10% level. GFCF refers to Gross Fixed Capital Formation.

is interesting in the context of the global trade slowdown, or 'trade plateau' (Evenett and Fritz 2016) and negotiations of 'new generation' trade deals in which non-tariff measures play a prominent role. Imports of intermediates represented more than 52% of global imports in every year during the period 1995-2014. The importance of global value chains, as exemplified by intermediate goods trade, is increasing over time with only three major setbacks: in 1998, in 2009 following the global economic and financial crisis[24] and again in 2014.

We borrow a correspondence table that links HS 6-digit products (rev. 1996) to the UN Broad Economic Categories (BEC rev. 3) and further to the three broader categories as defined by the OECD.[25] Results summarised in Table 4 indicate that intermediate goods face the most elastic demand, followed by final consumption goods, while demand for GFCF goods appears quite price-inelastic.[26]

Our discussion on cross-product differences in import demand elasticities is summarised in Table 5. Again, we find a positive coefficient on a product's share in GDP,

Table 5. Regression of significant import demand elasticities on product characteristics.

	(1)	(2)	(3)	(4)
Dependent variable: ε_{ni}		*Incl. importer FE*	*Excl. fuels*[a]	*Excl. non-classified products*
Product's share in GDP	2.722**	0.957	1.360	−0.265
	[1.211]	[1.206]	[1.839]	[1.815]
Sector dummy (base = agri-food)	−0.063***	−0.068***	−0.084***	−0.087***
	[0.006]	[0.006]	[0.006]	[0.007]
Number of exporters per product	0.003***	0.003***	0.003***	0.002***
	[0.000]	[0.000]	[0.000]	[0.000]
Number of importers per product	0.005***	0.005***	0.005***	0.005***
	[0.000]	[0.000]	[0.000]	[0.000]
Low tech	−0.056***	−0.058***	−0.090***	0
	[0.008]	[0.008]	[0.008]	[.]
Medium low tech	0.001	0.006	−0.027***	0.047***
	[0.009]	[0.009]	[0.009]	[0.005]
Medium high tech	0.035***	0.046***	0.011	0.085***
	[0.008]	[0.008]	[0.008]	[0.005]
High tech	0.221***	0.225***	0.190***	0.270***
	[0.010]	[0.010]	[0.010]	[0.007]
Final consumption good	−0.093***	−0.095***	−0.095***	−0.119***
	[0.007]	[0.007]	[0.007]	[0.007]
Intermediate good	−0.154***	−0.149***	−0.150***	−0.144***
	[0.006]	[0.006]	[0.006]	[0.005]
Constant	−1.884***	−1.872***	−1.822***	−1.974***
	[0.015]	[0.015]	[0.015]	[0.016]
Observations	*447,259*	*447,259*	*443,596*	*412,607*
R^2	0.033	0.044	0.043	0.046
Importer fixed effects	No	Yes	Yes	Yes
Fuels excluded	No	No	Yes	Yes
Baseline technology	non-classified	non-classified	non-classified	low

Standard errors in brackets; $*p < .10$, $**p < .05$, $***p < .01$

[a]Fuels referring to HS 2-digit product 27: Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes.

however, it becomes non-significant when accounting for importer fixed effects. Other factors that potentially decrease the price elasticity of demand are (i) the technological intensity of a product, (ii) the number of countries exporting a specific product and (iii) the number of importers of a specific product.

One argument would be that technology-intensive products cannot easily be substituted by domestic production. The number of exporting countries per product is a proxy for the possibility to substitute between different exporters. The greater the number of suppliers of a specific product, the easier it is for the importing country to substitute imports between different source countries, leaving the share of a product in per cent of GDP unchanged. The number of importers per product might be an indication of the market power of the exporting country. The greater the number of importers of one specific product per exporter, the smaller an importer's bargaining power and its import demand elasticity.

Negative coefficients are found for the sector dummy, indicating that agri-food products on average face a more elastic import demand. The regression table once more highlights that, on average, goods contributing to gross fixed capital formation (base line) face the most inelastic demand followed by final consumption goods and intermediate goods. These findings persist even when fuels (Column 3) and products without an assigned technology intensity measure (Column 4) are excluded from the regression. Differences in import demand elasticities across all these variables are statistically significant. Note, however, that the predictive power of these product characteristics is very limited.

5. Robustness

In the robustness section we challenge our findings[27] by (i) using unconstrained import data, (ii) performing separate regressions for the pre-crisis and the post-crisis periods, and finally, by (iii) running separate regressions for four income groups as classified by the World Bank.

5.1. Thresholds for import data

Our benchmark specification does not consider observations for products that never exceeded an import value of 10,000 USD for an importer during 1995 and 2014. The reason is that we do not want to bias our results with economically unimportant trade flows. However, the threshold of 10,000 USD is arguably somewhat arbitrary. We therefore perform our robustness analysis for all reported import data without any restrictions but bearing the risk of greater outlier values in mind (Figure 5).

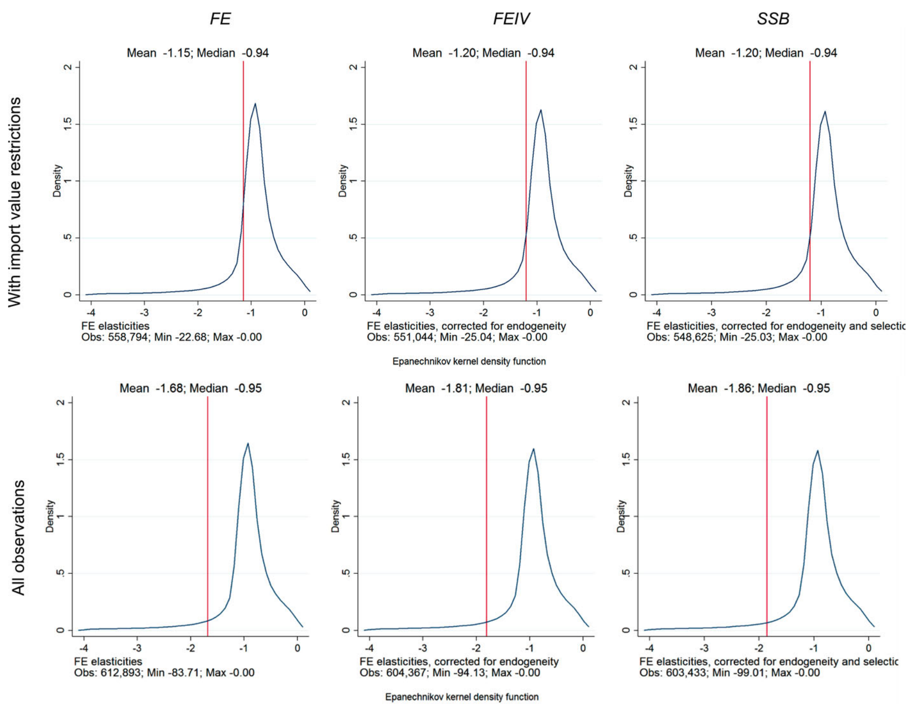

Figure 5. Distribution of elasticity estimates: FE, FEIV, SSB.

Using all reported data without dropping observations with economically seemingly low import values, the number of initial fixed effects estimates would increase from 687,927 to 785,290 (by 14%). After correcting estimates for endogeneity and a possible selection bias as well as dropping the tails of the distribution and positive elasticity estimates, the final number of import demand elasticity estimates increases from 548,625 to 603,433 estimates (by roughly 10%). This means that not employing any restrictions on import values leaves us with a greater proportion of positive import demand elasticities to be excluded from our analysis. 79% of the final estimates are found to be statistically significant at the 10% level which is slightly less than in our preferred specification. Although median values are very similar, mean values do differ. Using all import data, the minimum value, i.e. for the most elastic product, is found at −99. This means that a 1% increase in the price of the imported good leads to a 99% decrease in import quantities. Excluding import values below 10,000 USD reduces this minimum value to −25. The scaling up of import demand elasticities when including smaller import values is what we expect; recalling from equation (16) that the share of an imported product in GDP enters our elasticity formula in a multiplicative way: $\hat{\varepsilon}_{nni} = \widehat{a_{nn}}/\overline{s_{ni}} + \overline{s_{ni}} - 1$.

5.2. The difference between pre-crisis and post-crisis estimates

Our investigation encompasses data from 1995 to 2014. This period notably includes the global financial and economic crisis which might have had a significant impact on the price elasticity of demand for imported products. Therefore, we split our sample into a pre-crisis period covering the years 1995–2007 and a post-crisis period covering 2009–2014 and estimated elasticities separately for both time spans.

Comparing results for the pre-crisis with the post-crisis periods, we still find a rather inelastic median elasticity of −0.95 for both subsamples. However, while the mean elasticity for the pre-crisis period is found at around −1.7, the post-2008 period shows a higher mean elasticity of −2.4. We find that the discrepancy in mean elasticities between the pre-crisis and post-crisis periods is particularly strong for intermediate products. Looking at simple average significant elasticities, we find demand for imports of intermediate goods to be 13% more elastic in the post-2008 period compared to the period in the run-up to the financial crisis. Demand for goods attributable to GFCF also appears slightly more elastic for the post-crisis period but remains rather inelastic with an average elasticity around −0.87. It is only the demand for final consumption goods which shows a 1.7% lower average elasticity after the crisis.

A higher import demand elasticity for intermediate and capital goods after the crisis is an interesting result. Greater price sensitivity for imported goods used in production processes suggests that the global economic and financial crisis has not had a lasting impact on global value chains; rather they are even more intertwined than during the pre-crisis period.

Producers can more easily substitute tradeable goods with cheaper ones along their supply chains. While this structural change at the global level might not be necessarily related to the crisis itself – as it is also a result of trade liberalisation, in particular, of emerging economies – the role of crisis in sourcing cheaper products to boost the economy cannot be easily neglected.

5.3. Differentiation by the level of economic development

The approach proposed by Kee, Nicita, and Olarreaga (2008) assumes that the GDP function is common across all countries up to a country-specific term. This implies that $\widehat{a_{nn}}$, which captures the change in the share of good n in GDP resulting from a price increase of good n, is equal across countries. However, assuming that it might substantially vary by the level of economic development of the importing country, we re-run our estimations for four different income groups as classified in the World Bank list of economies (version July 2015): (i) low-income, (ii) lower-middle-income, (iii) upper-middle-income and (iv) high-income groups.[28] This specification improves the fit for trade-weighted significant elasticity estimates plotted against GDP per capita, resulting in a U-shape: The poorest countries in our sample seem to face the most price-inelastic import demand with middle-income countries being centred around unitary elasticities[29] and high-income countries again showing less elastic demand.

6. Conclusion

In this paper, we present price elasticities of import demand estimated for more than 150 importing countries and more than 5000 products at the six-digit level of the Harmonised System (HS, revision 1996). Following the semi-flexible translog GDP function approach proposed by Kee, Nicita, and Olarreaga (2008; based on HS revision 1988 trade data for the period 1988–2001), we provide updated estimates of unilateral import demand elasticities for a wider range of countries and products and for the more recent period 1996–2014.

Countries exhibiting the highest average elasticities belong to the economically most important countries in their respective regions while countries with the lowest import demand elasticities are small island states with the exception of landlocked and poverty-ridden Chad. Import-weighted results suggest that especially countries rich in natural resources – particularly fossil fuels – are facing an inelastic import demand, with the agri-food sector for these states being more price-responsive than the manufacturing sector. Europe, too, is characterised by a rather inelastic import demand, particularly for Eastern European countries and the Iberian Peninsula.

Both the European Union and the United States show the highest elasticities for live animals, animal and vegetable fats and mineral products, yet, with the United States' import demand being about twice as elastic. Relatively inelastic demand is found for luxury goods such as pearls or works of art, machinery and electrical equipment, arms and ammunition and – in the case of the EU, but not the US – for vehicles and aircrafts. Applying the product classification according to industries used in the WIOD, the energy sectors again feature as the most elastic while imports of electrical equipment and machinery are found to be price-inelastic. Distinguishing between the use of products, it is evident that intermediate goods face the highest elasticities which appears particularly noteworthy in the context of an increasing importance of global value chains and production fragmentation, the global trade slowdown since 2011 and negotiations of mega-regional trade deals.

Our preferred specification does not include importer-product observations where imports of a particular product to one specific importer never exceeded 10,000 USD for the period 1995–2014. Using all data provided by UN Comtrade without any import threshold has no impact on the median of the distribution but results in higher mean elasticities with the minimum elasticity shifting from about −25 to –99. Splitting the period 1995–2014 into pre-crisis and post-crisis periods indicates that import demand became more elastic after 2008, particularly for intermediate goods. A final specification suggests that allowing the effect of prices on the product composition of GDP to vary by the economic development of countries along the income group classification of the World Bank, suggesting that import demand elasticity is U-shaped. The poorest countries seem to be the least price-responsive with respect to imports while the majority of middle-income countries is centred around unitary elasticity with richer countries again being less sensitive to price changes.

Notes

1. Imbs and Mejean (2015) showed how macroeconomic models relying on elasticity estimates based on aggregate data can have predictions at odds with multi-sector models due to a heterogeneity bias.
2. The elasticity of substitution, often used in trade and macroeconomic models, shows how the ratio of two inputs (such as imported goods) would change if their prices changed, with different responses in the short and the long run (see e.g. Crucini and Davis 2016).
   Kee, Nicita, and Olarreaga (2008) refer to Blackorby and Russell (1989), who showed that the elasticity of substitution is only equal to the price elasticity when cross price elasticities are equal to zero. Recent research on the income elasticity of import demand include e.g. Hummels and Lee (2018). Hillberry and Hummels (2013) review various types of trade elasticities and discuss how they can be used to analyse welfare implications of trade policies.
3. Building on Kee, Nicita, and Olarreaga (2008), Nicita, Olarreaga, and Silva (2018) estimated export supply elasticities, subsequently used to empirically test for cooperation of WTO members in setting tariffs.
4. The Envelope Theorem is applied, which implies that when we differentiate GDP with respect to the exogenous price of good n, we can ignore changes in the endogenous variables $q_t : (p_t, v_t)$.
5. Import demand derived with a GDP-maximisation approach is not directly comparable to a utility-maximising Marshallian import demand subject to a given income or to an expenditure-minimising Hicksian import demand with a fixed utility level. In particular, income in the GDP-maximisation problem is endogenous to prices and factor endowments. However, being subject to factor endowments, GDP-maximising import demand is more similar to Hicksian import demand.
6. Feenstra (2016) gives an overview of applications of the translog GDP function, including Kohli (1991) and Harrigan (1997).
7. Homogeneity of degree 1 in prices $\sum_{n=1}^{N} a_n = 1, \sum_{k=1}^{N} a_{nk} = 0, \sum_{n=1}^{N} c_{nm} = 0$ and factor endowments $\sum_{m=1}^{M} b_m = 1, \sum_{l=1}^{M} b_{ml} = 0, \sum_{m=1}^{M} c_{nm} = 0$.
8. Symmetry implies $a_{nk} = a_{kn}$ and $b_{ml} = b_{lm}$.
9. The dependent variable (product shares in GDP) does not sum up to one as only shares of imports in GDP are considered, but no domestic production or exports.
10. The multiplication of both sides of equation (6) with p_{nt} and remembering that, (i) $\frac{\partial G_t}{\partial p_{nt}} = q_{nt}$, (ii) $\partial s_{nt}^t \equiv q_{nt}p_{nt}/G_t$ and (iii) $\varepsilon_{nnt} \equiv \frac{\partial q_{nt}(p_t, v_t)}{\partial p_{nt}} \frac{p_{nt}}{q_{nt}}$ results in $s_{nt} + s_{nt}\varepsilon_{nnt} - (s_{nt})^2 = a_{nnt}$.
11. For goods not in line with the law of demand (e.g. Giffen goods) the import demand elasticity could be positive. From equation (7), it follows that this may be true whenever $a_{nnt} < s_{nt}(1 - s_{nt})$, where the right hand side is by construction always negative for imported goods.
12. The empirical estimation procedure, however, controls for time-fixed effects.
13. The parameterisation from a fully flexible to a semi-flexible translog function reduces the number of parameters to be estimated from N(N−1)/2+N to N diagonal elements of the substitution matrix.
14. As other prices than import prices are only indirectly accounted for via the GDP deflator, it is not possible to calculate the elasticity of substitution between imported and domestically produced products.
15. Making use of the Stata package xtivreg2 by Schaffer (2010)
16. The underlying assumption is that countries are “small” in international trade. There is abundant evidence of market power on the supply side, particularly related to primary commodities (e.g. Igami (2015), on coffee markets), extractive industries (e.g. Hansen and Lindholt (2008), on OPEC),

or services (e.g. Hummels, Lugovskyy, and Skiba (2009), on international shipping). Much less research is concerned with market power exerted by the demand side. Magee and Magee (2008) argued that even the United States is to be considered a "small" importing country in international trade, with negligible influence on world prices. However, Broda, Limão, and Weinstein (2008) found empirical evidence for market power of importers, significantly affecting trade policies not constrained by the WTO.

17. Section 5 on the robustness of our findings also discusses results when no import threshold is imposed. Kee, Nicita, and Olarreaga (2008) excluded tariff lines with import volumes below 50,000 USD at the HS 6-digit level.
18. The Vienna Institute for International Economic Studies (wiiw) provides all elasticity estimates freely available for download in its Open Data section: https://wiiw.ac.at/ds-3.html.
19. Computationally, it is evident from equation (16) that smaller shares have a bigger effect on the multiplicative component and a smaller impact on the additive component of our elasticities.
20. The size of economies is also negatively correlated with the importance of imported products. The correlation between a country's GDP and the average share of imported products in terms of GDP is −0.2108. Considering the sum of all shares as a proxy for the exposure to imports, the correlation coefficient is −0.2231.
21. See for example Jakubik and Piermartini (2019) on the effects of WTO commitments on lowering uncertainty or Broda, Limão, and Weinstein (2008) on WTO constraints on importers' exertion of market power.
22. See www.wiod.org.
23. 270500 – Coal Gas, Water Gas, Producer Gas, Similar Gases (Other than Petroleum Gas); 271600 – Electrical Energy.
24. Trade in intermediates has important implications for the transmission of demand shocks. E.g. Bems, Johnson, and Yi (2010) found that 20%–30% of the decline in demand by the United States and the EU during the global recession 2008–2009 were borne by foreign countries through cross-border intermediate goods linkages.

    Bussière et al. (2013) followed the methodology of Kee, Nicita, and Olarreaga (2008) to derive the import intensity of demand components to explain trade dynamics, particularly during the 2008–2009 crisis, highlighting the import content in exports and investments.
25. About 15% of products were reclassified for the WIOD project to account for the fact that some products qualify for more than one category (e.g. HS 940540 electric lamps and lighting fittings).
26. This result remains unchanged when excluding the energy sector: WIOD sector c18: Coke, Refined Petroleum and Nuclear Fuel.
27. Based on FE estimation before correction for endogeneity and self-selection.
28. For the determination of income group thresholds and data on their evolution over time please consult: https://datahelpdesk.worldbank.org/knowledgebase/articles/378833-how-are-the-income-group-thresholds-determined.
29. The only middle-income countries showing elasticities greater than −1.1 comprise Syria, Kenya, Sudan, Bolivia, Nicaragua, Senegal and Morocco.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Seventh Framework Programme of the European Commission as part of the PRONTO (Productivity, Non-Tariff Measures and Openness) project [grant number: 613504].

Data availability statement

Import demand elasticity estimates are available for download: wiiw Import Demand Elasticities, Version: March 2017, https://wiiw.ac.at/ds-3.html.

ORCID

Julia Grübler http://orcid.org/0000-0002-2098-6319
Mahdi Ghodsi http://orcid.org/0000-0002-0991-7873
Robert Stehrer http://orcid.org/0000-0002-4120-4953

References

Altinay, G. 2007. "Short-run and Long-run Elasticities of Import Demand for Crude Oil in Turkey." *Energy Policy* 35: 5829–5835.

Amiti, M., S. J. Redding, and D. E. Weinstein. 2019. "The Impact of the 2018 Tariffs on Prices and Welfare." *Journal of Economic Perspectives* 33 (4): 187–210.

Baier, S. L., and J. H. Bergstrand. 2009. "Estimating the Effects of Free Trade Agreements on International Trade Flows Using Matching Econometrics." *Journal of International Economics* 77 (1): 63–76.

Beghin, J., A.-C. Disdier, and S. Marette. 2015. "Trade Restrictiveness Indices in Presence of Externalities: An Application to Non-Tariff Measures." *Canadian Journal of Economics* 48 (4): 1513–1536.

Bems, R., R. C. Johnson, and K.-M. Yi. 2010. "Demand Spillovers and the Collapse of Trade in the Global Recession." *IMF Economic Review* 58 (2): 295–326.

Blackorby, C., and R. Russell. 1989. "Will the Real Elasticity of Substitution Please Stand Up? (A Comparison of the Allen/Uzawa and Morishima Elasticities)." *American Economic Review* 79: 882–888.

Bratt, M. 2017. "Estimating the Bilateral Impact of Nontariff Measures on Trade." *Review of International Economics* 25 (5): 1105–1129.

Broda, C., J. Greenfield, and D. E. Weinstein. 2006. "From Groundnuts to Globalization: A Structural Estimate of Trade and Growth." NBER Working Papers no. 12512, September. Cambridge.

Broda, C., N. Limão, and D. E. Weinstein. 2008. "Optimal Tariffs and Market Power: The Evidence." *American Economic Review* 98 (5): 2032–2065.

Broda, C., and D. E. Weinstein. 2006. "Globalization and the Gains from Variety." *The Quarterly Journal of Economics* 121 (2): 541–585.

Bussière, M., G. Callegari, F. Ghironi, G. Sestieri, and N. Yamano. 2013. "Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008–2009." *American Economic Journal: Macroeconomics* 5 (3): 118–151.

Caliendo, L., and F. Parro. 2015. "Estimates of the Trade and Welfare Effects of NAFTA." *The Review of Economic Studies* 82 (1): 1–44.

Caves D.W., L.R. Christensen and W.E. Diewert (1982), 'Multilateral Comparisons of Output, Input, and Productivity Using Superlative Index numbers', The Economic Journal, Vol. 92, No. 365, pp. 73-86.

Chaney, T. 2008. "Distorted Gravity: The Intensive and Extensive Margins of International Trade." *American Economic Review* 98 (4): 1707–1721.

Crucini, M. J., and J. S. Davis. 2016. "Distribution Capital and the Short- and Long-run Import Demand Elasticity." *Journal of International Economics* 100: 203–219.

Devadoss, S., J. Luckstead, and W. Ridley. 2019. "A Dynamic Analysis of the Impacts of Export Taxes: The Case of Argentinean soy and Beef Markets." *The World Economy* 42 (8): 2427–2451.

Diewert, W. E., and T. J. Wales. 1988. "A Normalized Quadratic Semiflexible Functional Form." *Journal of Econometrics* 37 (3): 327–342.

Evenett, S. J., and J. Fritz. 2016. *Global Trade Plateaus. The 19th Global Trade Alert Report*. London: CEPR Press.

Fajgelbaum, P. D., P. K. Goldberg, P. J. Kennedy, and A. K. Khandelwal. 2020. "The Return to Protectionism." *The Quarterly Journal of Economics* 135 (1): 1–55.

Feenstra, R. C. 1994. "New Product Varieties and the Measurement of International Prices." *The American Economic Review* 84 (1): 157–177.

Feenstra, R. C. 2016. *Advanced International Trade. Theory and Evidence*. Princeton: Princeton University Press.

Feenstra, R. C., R. Inklaar, and M. P. Timmer. 2015. "The Next Generation of the Penn World Table." *American Economic Review* 105 (10): 3150–3182.

Feenstra, R. C., and J. Romalis. 2014. "International Prices and Endogenous Quality." *The Quarterly Journal of Economics* 129 (2): 477–527.

Fontagné, L. G., H. Guimbard, and G. Orefice. 2020. "Product-Level Trade Elasticities: Worth Weighting For." CESifo Working Papers no. 8491, August.

Gasiorek, M., I. Serwicka, and A. Smith. 2019. "Which Manufacturing Industries and Sectors are Most Vulnerable to Brexit?" *The World Economy* 42 (1): 21–56.

Ghodsi, M., J. Grübler, and R. Stehrer. 2016. "Estimating Importer-Specific Ad Valorem Equivalents of Non-tariff Measures." wiiw Working Papers no. 129, September. The Vienna Institute for International Economic Studies.

Giri, R., K. M. Yi, and H. Yilmazkuday. 2021. "Gains from Trade: Does Sectoral Heterogeneity Matter?" *Journal of International Economics* 129: 1–27. Article No. 103429.

Hansen, P. V., and L. Lindholt. 2008. "The Market Power of OPEC 1973–2002." *Applied Economics* 40 (22): 2939–2959.

Harrigan, J. 1997. "Technology, Factor Supplies, and International Specialization: Estimating the Neoclassical Model." *American Economic Review* 87: 475–494.

Hatzichronoglou, T. 1997. "Revision of the High-Technology Sector and Product Classification." OECD Science, Technology and Industry Working Papers no. 1997/02.

Hausmann, R., C. A. Hidalgo, S. Bustos, M. Coscia, S. Chung, J. Jimenez, A. Simoes, and M. Yildirim. 2011. *The Atlas of Economic Complexity*. Cambridge MA: Puritan Press.

Hillberry, R., and D. Hummels. 2013. 'Trade Elasticity Parameters for a Computable General Equilibrium Model'. In *Handbook of Computable General Equilibrium Modeling*, Vol. 1, 1213–1269. Oxford, UK: Elsevier.

Hummels, D., and K. Y. Lee. 2018. "The Income Elasticity of Import Demand: Micro Evidence and an Application." *Journal of International Economics* 113: 20–34.

Hummels, D., V. Lugovskyy, and A. Skiba. 2009. "The Trade Reducing Effects of Market Power in International Shipping." *Journal of Development Economics* 89 (1): 84–97.

Igami, M. 2015. "Market Power in International Commodity Trade: The Case of Coffee." *The Journal of Industrial Economics* 63 (2): 225–248.

Imbs, J., and I. Mejean. 2015. "Elasticity Optimism." *American Economic Journal: Macroeconomics* 7 (3): 43–83.

Jakubik, A., and R. Piermartini. 2019. "How WTO Commitments Tame Uncertainty." WTO Staff Working Papers no. ERSD-2019-06. Geneva: World Trade Organization (WTO).

Kee, H. L., and A. Nicita. 2016. *'Trade Frauds, Trade Elasticities and non-Tariff Measures'*. Washington, DC/Geneva: mimeo, The World Bank/UNCTAD.

Kee, H. L., A. Nicita, and M. Olarreaga. 2008. "Import Demand Elasticities and Trade Distortions." *Review of Economics and Statistics* 90 (4): 666–682.

Kee, H. L., A. Nicita, and M. Olarreaga. 2009. "Estimating Trade Restrictiveness Indices." *The Economic Journal* 119: 172–199.

Kohli, U. 1991. *Technology, Duality, and Foreign Trade: The GNP Function Approach to Modeling Imports and Exports*. Ann Arbor: The University of Michigan Press.

Magee, C. S. P., and S. P. Magee. 2008. "The United States Is a Small Country in World Trade." *Review of International Economics* 16 (5): 990–1004.

Maoz, Z. 2009. "The Effects of Strategic and Economic Interdependence on International Conflict Across Levels of Analysis." *American Journal of Political Science* 53 (1): 223–240.

Mukherjee, P., V. Mukherjee, and D. Das. 2017. "Estimating Elasticity of Import Demand for Gold in India." *Resources Policy* 51: 183–193.

Nicita, A., M. Olarreaga, and P. Silva. 2018. "Cooperation in WTO's Tariff Waters?" *Journal of Policital Economy* 126 (3): 1302–1338.

Nizovtsev, D., and A. Skiba. 2016. "Import Demand Elasticity and Exporter Response to Anti-dumping Duties." *The International Trade Journal* 30 (2): 83–114.

Panagariya, A., S. Shah, and D. Mishra. 2001. "Demand Elasticities in International Trade: Are They Really low?" *Journal of Development Economics* 64: 313–342.

Peterson, T. M., and C. G. Thies. 2014. "The Demand for Protectionism: Democracy, Import Elasticity, and Trade Barriers." *International Interactions* 40: 103–126.

Romalis, J. 2007. "NAFTA's and CUSFTA's Impact on International Trade." *Review of Economics and Statistics* 89 (3): 416–435.

Schaffer, M. E. 2010. "xtivreg2: Stata Module to Perform Extended IV/2SLS, GMM and AC/HAC, LIML and K–class Regression for Panel Data Models." http://ideas.repec.org/c/boc/bocode/s456501.html.

Simonovska, I., and M. E. Waugh. 2014. "The Elasticity of Trade: Estimates and Evidence." *Journal of International Economics* 92 (1): 34–50.

Soderbery, A. 2015. "Estimating Import Supply and Demand Elasticities: Analysis and Implications." *Journal of International Economics* 96: 1–17.

Soderbery, A. 2018. "Trade Elasticities, Heterogeneity, and Optimal Tariffs." *Journal of International Economics* 114: 44–62.

Sun, L., and K. Niquidet. 2017. "Elasticity of Import Demand for Wood Pellets by the European Union." *Forest Policy and Economics* 81: 83–87.

Timmer, M. P., E. Dietzenbacher, B. Los, R. Stehrer, and G. J. de Vries. 2015. "An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production." *Review of International Economics* 23 (3): 575–605.

Yotov, Y. V., R. Piermartini, J. A. Monteiro, and M. Larch. 2016. An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model. Geneva: World Trade Organization. https://vi.unctad.org/tpa/web/vol2/vol2home.html.

Appendix 1. Income classification of countries.

Low income			Lower middle income (ctd.)			High income		
1	BJ	Benin	52	ST	Sao Tome and Principe	107	AG	Antigua and Barbuda
2	BF	Burkina Faso	53	SN	Senegal	108	AR	Argentina
3	BI	Burundi	54	LK	Sri Lanka	109	AW	Aruba
4	KH	Cambodia	55	PS	State of Palestine	110	AU	Australia
5	CF	Central African Republic	56	SD	Sudan (Former)	111	AT	Austria
6	TD	Chad	57	SZ	Swaziland	112	BS	Bahamas
7	KM	Comoros	58	SY	Syrian Arab Republic	113	BH	Bahrain
8	ET	Ethiopia	59	UA	Ukraine	114	BB	Barbados
9	GM	Gambia	60	VN	Viet Nam	115	BE	Belgium
10	GN	Guinea	61	YE	Yemen	116	BM	Bermuda
11	GW	Guinea-Bissau	62	ZM	Zambia	117	BN	Brunei Darussalam
12	MG	Madagascar				118	CA	Canada
13	MW	Malawi	Upper middle income			119	CL	Chile
14	ML	Mali	63	AL	Albania	120	HK	China, Hong Kong SAR
15	MZ	Mozambique	64	DZ	Algeria	121	MO	China, Macao SAR
16	NP	Nepal	65	AZ	Azerbaijan	122	HR	Croatia
17	NE	Niger	66	BY	Belarus	123	CY	Cyprus
18	RW	Rwanda	67	BZ	Belize	124	CZ	Czech Republic
19	SL	Sierra Leone	68	BA	Bosnia and Herzegovina	125	DK	Denmark
20	TG	Togo	69	BW	Botswana	126	EE	Estonia
21	TZ	Tanzania	70	BR	Brazil	127	FI	Finland
22	UG	Uganda	71	BG	Bulgaria	128	FR	France
23	ZW	Zimbabwe	72	CN	China	129	DE	Germany
			73	CO	Colombia	130	EL	Greece
Lower middle income			74	CR	Costa Rica	131	HU	Hungary
24	AM	Armenia	75	DM	Dominica	132	IS	Iceland
25	BD	Bangladesh	76	DO	Dominican Republic	133	IE	Ireland
26	BT	Bhutan	77	EC	Ecuador	134	IL	Israel
27	BO	Bolivia	78	FJ	Fiji	135	IT	Italy
28	CV	Cabo Verde	79	GA	Gabon	136	JP	Japan
29	CM	Cameroon	80	GD	Grenada	137	KW	Kuwait
30	CG	Congo	81	IR	Iran	138	LV	Latvia
31	CI	Côte d'Ivoire	82	JM	Jamaica	139	LT	Lithuania
32	DJ	Djibouti	83	JO	Jordan	140	LU	Luxembourg
33	EG	Egypt	84	KZ	Kazakhstan	141	MT	Malta
34	SV	El Salvador	85	LB	Lebanon	142	NL	Netherlands
35	GE	Georgia	86	MY	Malaysia	143	NZ	New Zealand
36	GH	Ghana	87	MV	Maldives	144	NO	Norway
37	GT	Guatemala	88	MU	Mauritius	145	OM	Oman
38	HN	Honduras	89	MX	Mexico	146	PL	Poland
39	IN	India	90	MN	Mongolia	147	PT	Portugal
40	ID	Indonesia	91	ME	Montenegro	148	QA	Qatar
41	KE	Kenya	92	MS	Montserrat	149	KR	Republic of Korea
42	KG	Kyrgyzstan	93	NA	Namibia	150	RU	Russian Federation

(*continued*).

Table A1. Continued.

Low income			Upper middle income			High income		
43	LS	Lesotho	94	PA	Panama	151	KN	Saint Kitts and Nevis
44	MR	Mauritania	95	PY	Paraguay	152	SA	Saudi Arabia
45	MA	Morocco	96	PE	Peru	153	SC	Seychelles
46	MM	Myanmar	97	RO	Romania	154	SG	Singapore
47	NI	Nicaragua	98	LC	Saint Lucia	155	SK	Slovakia
48	NG	Nigeria	99	RS	Serbia	156	SI	Slovenia
49	PK	Pakistan	100	ZA	South Africa	157	ES	Spain
50	PH	Philippines	101	VC	St. Vincent and the Grenadines	158	SE	Sweden
51	MD	Republic of Moldova				159	CH	Switzerland
			102	SR	Suriname	160	TW	Taiwan
			103	MK	TFYR of Macedonia	161	TT	Trinidad and Tobago
			104	TH	Thailand	162	TC	Turks and Caicos Islands
			105	TN	Tunisia	163	AE	United Arab Emirates
			106	TR	Turkey	164	UK	United Kingdom
						165	US	United States
						166	UY	Uruguay
						167	VE	Venezuela

Note: World Bank list of economies (July 2015), Montserrat classified according to information provided by the United Nations. Information on West Bank and Gaza used for Palestine.