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Revisiting the Gains from Trade in EMDEs

The Case of Selected East Asian and East African Economies

Enkhmaa Battogtvor
Socrates Kraido Majune
Angella Faith Montfaucon

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Abstract

Following the gains from variety literature, this paper estimates the welfare impact of growth of the variety of imported goods in 28 countries in East Africa and East Asia and compares the results. While estimating the gains from variety, the elasticities of substitution are estimated for each country at the Harmonized System six-digit level of disaggregation. More than 100,000 elasticities are estimated, and the paper constructs an exact price index to measure the welfare gains from variety growth. The findings show that from 1995 to 2021, African countries gained on average 5.47 percent of their gross domestic product (0.20 percent annually), and Asian countries excluding Bhutan gained 3.46 percent (0.13 percent annually). Bhutan, Mongolia, Rwanda, and Mozambique are among the countries with the highest gains over the sample period. The evidence indicates that the creation and extension of trade linkages can be a source of welfare, particularly for small and transitioning economies, a point that is occasionally overlooked in discussions about the positive effects of globalization and economic integration. The estimated elasticities may also be useful for other studies.

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Revisiting the Gains from Trade in EMDEs: The Case of Selected East Asian and East African Economies*

Enkhmaa Battogtvor[†], Socrates Kraido Majune[‡], and Angella Faith Montfaucon[§]

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†National University of Mongolia, enkhmaab@num.edu.mn

‡University of Nairobi, skmajune@uonbi.ac.ke

§World Bank, amontfaucon@worldbank.org Corresponding author

1 Introduction

In the core of the monopolistic competition model with differentiated goods pioneered by Dixit and Stiglitz (1977), consumers benefit from having more varieties of final goods. These benefits stem from lower unit costs of imports and these lower costs are the source of the welfare gains. However, most studies focus on the conventional sources of gains from trade, such as productivity improvement due to increasing returns to scale, trade-induced innovation, technology spillover, and improved market efficiency because of import competition (Chen and Ma, 2012). These studies often assume a constant set of products over time, and this leads to systematically understated welfare gain calculations.

This paper estimates the comprehensive gains from import variety in emerging markets and developing economies (EMDEs), particularly for each of 28 Asian (including one Pacific Island nation) and East African economies during 1995-2021, following the seminal works by Feenstra (1994) and Broda and Weinstein (2006). The gains from variety for the economies were estimated, using six-digit harmonized system (HS) product data. We estimated more than 100,000 elasticities in total and with the elasticities, we constructed an exact price index to measure the welfare gains from variety growth. This method is consistent with the theory of monopolistic competition and is robust in empirical applications (Feenstra, 1994), from which the quantitative analysis of gains from variety started.

Feenstra (1994) showed how to estimate the elasticity of substitution of individual products, and using these elasticities he offered the formula for an exact price index that can account for entry and exit of varieties. By doing so, Feenstra (1994) demonstrated that new product varieties lead to an increase in consumer utility. However, a comprehensive measure of the gains from import variety puts tremendous demands on data availability and was not realized until Broda and Weinstein (2006).

Applying Feenstra's estimation technique, Broda and Weinstein (2006) estimated the welfare gain that the United States enjoyed through trade liberalization over 30 years by computing the elasticities of substitutions of more than 30,000 products. Using the elasticities, they created the import price index adjusted for new and disappearing varieties and measured the value that consumers attached to these new product varieties. They found that the total gain from the introduction of new varieties in the United States was 2.6 percent of GDP between 1972 and 2001. This meant that to obtain the new set of varieties imported each year, consumers would be ready to pay on average 0.1 percent of their income.

Following Broda and Weinstein (2006), a body of country studies emerged, using the same methodology. [1] For instance, Chen and Ma (2012) found that the welfare gain in the Chinese economy as a result of new import variety amounts to 4.9 percent of GDP, or 0.4 percent annually between 1997 and 2008. Minondo and Requena (2010) investigated the welfare gains due to Spanish imports of new varieties over the period 1988-2006. They found that the total welfare gain is equal to 1.2 percent of GDP in 2006. In a comparative study of Switzerland and the United States, Mohler (2009) estimated a lower and an upper bound of the gains from variety. He found that during the period from 1990 to 2006, the gains from variety in Switzerland were between 0.3 and 4.98 percent of GDP and that in the United States the gains from variety were between 0.5 and 4.7 percent of GDP.

Mohler and Seitz (2012) applied the methodology to the 27 countries of the European Union for the period 1999 to 2008. Their results show that within the European Union, especially "newer" and smaller member states exhibit high gains from newly imported varieties. For instance, Estonia gained 2.80 percent of GDP (GDP of Estonia); the Slovak Republic, 2.37 percent; Latvia, 1.65 percent; and Bulgaria, 1.59 percent. They also found that interestingly, two of the largest economies in the group, France and Germany, both had negative gains from variety. They argue that the reason for this is that these larger economies were already heavily integrated in the European economy and therefore did not experience the increase in product varieties as did the "new", smaller economies.

Our analysis of 4,537 elasticities of substitution across 28 countries reveals that the

[1] As a reference, only a few papers are mentioned here. In addition to its welfare gain estimation, Broda and Weinstein's (2006) paper is often cited for the import demand elasticity estimation. Already estimated data of 73 countries using the dataset from 1994-2003 is available at the following Columbia University webpage:http://www.columbia.edu/~dew35/TradeElasticities/TradeElasticities.html

average elasticity is 13.0, while the median is 4.1. A lower elasticity indicates that goods are highly differentiated, suggesting a significant potential for gains from variety. The median lambda ratio for countries indicates significant variety growth in imported products. The average welfare gain owing to newly imported varieties from 1995 to 2021 amounts to 5.49 percent of GDP, or 0.20 percent annually. This average distorts significant heterogeneity among countries. African countries gained on average 5.47 percent of their GDP, however Asian countries excluding Bhutan gained less from import variety by 3.46 percent. Nevertheless, this is a significant result considering the moderate annual gains of 0.1 per cent (Broda and Weinstein, 2006) to 0.4 percent (Chen and Ma, 2012).

The evidence indicates that the creation and extension of trade linkages can be a source of welfare, particularly for small and transitioning economies, a point occasionally overlooked in discussions about the positive effects of globalization and economic integration. Gains from increased import varieties are not limited to consumers. Access to more imported varieties may enhance productivity growth, leading domestic firms to gain substantially. In fact, with the widely used constant elasticity of substitution (CES) structure, new varieties could be modeled either as consumption goods or as intermediate inputs (Romer, 1994). While we follow Broda and Weinstein (2006) and treat all imported goods as intended for final consumption, future research could expand on this work in this direction as well as potential losses such as fiscal costs (revenue losses) for specific groups and related policies to mitigate such costs.

We contribute to the growing literature by providing measures of East Asian and East African countries' welfare gain due to import variety from 1995 to 2021. To our knowledge, this is the first study that pursues these measures for the selected countries, thus we have two motivations in mind. First, as small open economies, most of the countries underwent significant trade liberalization after their accession to World Trade Organization (WTO). Thus, measuring their gains from import varieties provides supporting evidence favoring trade liberalization for developing countries. It may also provide informative implications to the countries' policymakers. Second, we obtain estimates for thousands of elasticities of substitution using highly disaggregated import data, which may be useful for other studies. For example, different elasticities may imply different responsiveness of imported products to demand shocks or exchange rate movements suggested by Chen and Ma (2012).

The rest of the paper is organized as follows. Section 2 describes the data and reviews import growth from 1995 to 2021. Section 3 reviews Broda and Weinstein's (2006) model. Section 4 explains the estimation strategy and gives a brief overview of the importance of elasticities of substitution. Section 5 reports the results of the analysis and presents the welfare gain. Section 6 concludes the study.

2 Data and Descriptive Analysis

We used trade data from BACI (Gaulier and Zignago, 2010).[2] We used the import data of the selected countries from 1995 to 2021, covering 27 continuous years. The data contains information on the total values, quantities, and exporters of registered products to the countries. Unspecified country data and products with data on their quantities are dropped. Furthermore, due to the insufficient numbers of observations, HS-6 products with fewer than 26 observations are dropped in the sample. This is due to the problem that many products were not imported to the countries constantly throughout the period. This left us with more than 40 million observations of 5,383 products.[3] Gross domestic product (GDP) data were taken from the World Bank's World Development Indicators (WDI) Database.

To study the welfare implications of the drastic increase in imports of the countries, we should consider the increase in value of each product (i.e., the intensive margin) and the increase in the number of products and varieties for each product (i.e., the extensive margin).

Figure 1 shows average annual imports as shares of GDP between 1995 and 2021. The imports share of GDP greatly varies among the countries. For instance, Japan has an import

[2]BACI relies on data from the United Nations Comtrade - International Trade Statistics database

[3]Note that not all 5,383 products were imported to each country. On average, 4,537 products were imported by one country.

share as low as 11% on average and Hong Kong SAR, China, has the highest share of imports in its GDP of 163%. The rest of the countries, during the 27 years on average, spend 35% of their GDP for the imported products. No matter what the annual imports-to-GDP ratio for an individual country is, the data shows a general upward trend, suggesting that international trade increased for the selected EMDEs.

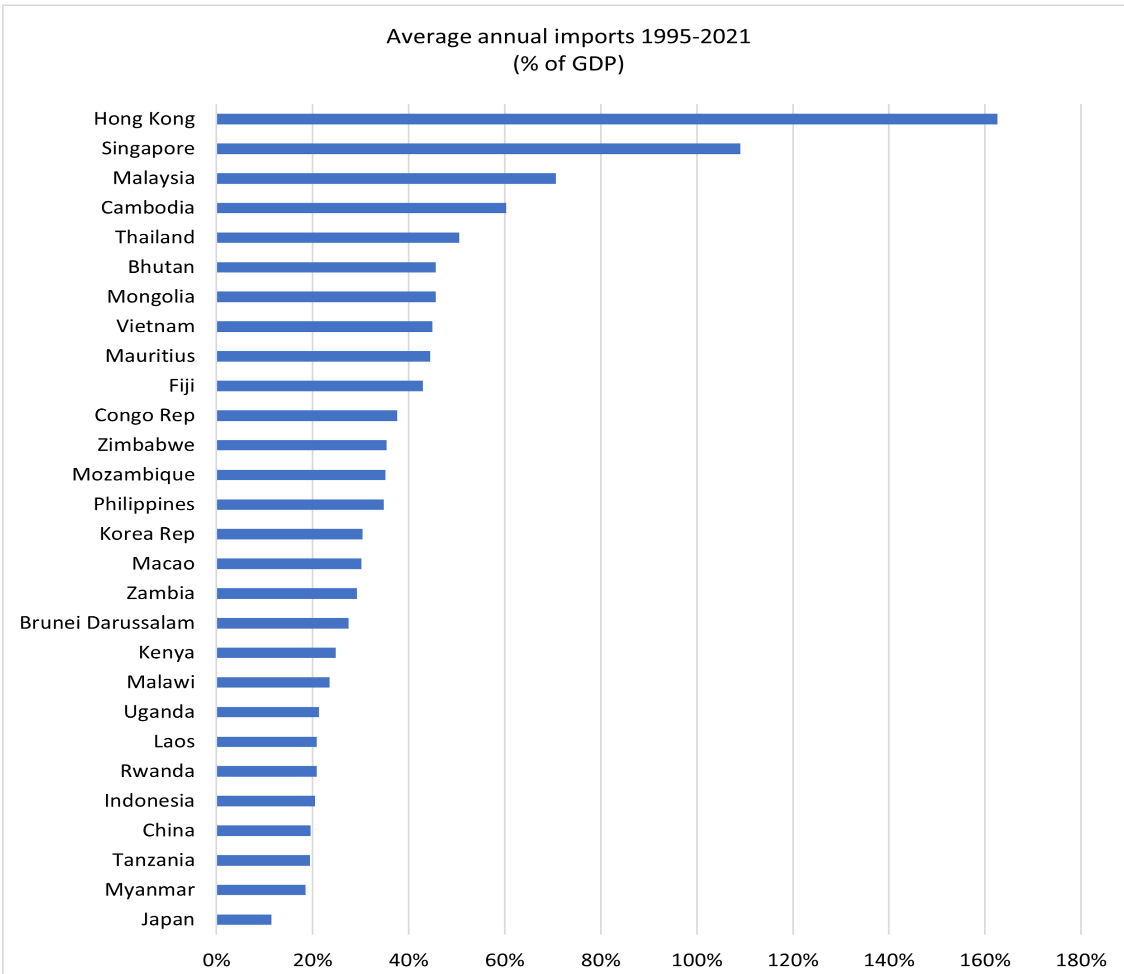

Figure 1: **Average annual imports 1995-2021 (% of GDP)**
Source: Authors' calculation based on United Nations Comtrade - International Trade Statistics database

Table 1 summarizes the count measure of imported varieties of the selected 28 countries in 1995 and 2021. The definition of variety used in this paper is same as the variety defined in Broda and Weinstein (2006), which is an Armington (1969) definition of a product variety. By this definition, a variety is a particular good produced in a particular country. To be more specific, a product in this paper is defined as a six-digit Harmonized System (HS) good. To give an example, in Mongolia a sparkling wine (with HS-6 product code 220410) was imported from only one country, Germany, in 1989. In contrast, the same wine was imported from 13 different countries, such as France, Spain, Italy and Chile, in 2015. This represents an increase from a single variety to 13 different varieties. Therefore, by the Armington (1969) assumption, an HS-6 product supplied by one country is regarded as different from the same product supplied by any other country.

The data reveals that behind the rapid growth in import value, the growth in import varieties is similarly dramatic. Columns (1) and (4) of Table 1 report the number of HS-6 products for the years 1995 and 2021 respectively. We can see that the number of HS-6 products increased by almost a factor of 3 in Bhutan during the period, growing from 519 in 1995 to 1,537 in 2021. Similarly imported HS-6 products more than doubled in Rwanda and almost doubled in Cambodia, Mongolia, and Mozambique. On average, the number of imported products increased by 31% for the sample countries. Moreover, columns (3) and (6) show the total number of imported product varieties in 1995 and 2021 respectively, which can be calculated as the number of HS-6 products multiplied by the average variety in columns (2) and (5) respectively.

Comparing columns (3) and (6), we can see that the total number of varieties increased more than 10 times in Rwanda, 8 times in Mongolia, 7 times in Cambodia, 6 times in Mozambique, 5 times in Bhutan, and 4 times in Brunei, Kenya, the Lao People's Democratic Republic and Viet Nam. The total number of varieties grew 3.5 times from 1995 to 2021 for an average country of the sample. However, we can say that African countries on average show more increase in their total import varieties with 3.65 times growth compared to 3.37 times for the average of Asian countries. Columns (2) and (5) show the average number of exporting countries, i.e., the number of varieties in 1995 and 2021 respectively. We can observe that the number of exporting countries increased over time in all 28 countries. For example in China, 16 varieties or source countries were available per good in 1995, but in

2021 on average 33 varieties were available. These dramatic changes in goods and varieties suggest that conventional measures using a fixed basket of goods or varieties could be largely biased. Consequently, these facts demonstrate that the gains from variety are not negligible.

Table 1: *Variety in Imports (1995-2021)*

		1995			*2021*		
	Country	*Number of HS-6 products*	*Average number of varieties*	*Total number of varieties*	*Number of HS-6 products*	*Average number of varieties*	*Total number of varieties*
		(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
1	Bhutan	519	1.7	883	1537	3.4	5152
2	Brunei Darussalam	3373	3.1	10505	4075	10.8	43892
3	Cambodia	2446	2.6	6299	4270	10.5	44776
4	China	5198	16.0	83360	5349	33.7	180519
5	Congo, Rep.	2880	3.9	11324	3703	10.1	37354
6	Fiji	3243	2.7	8917	4003	7.6	30372
7	Hong Kong SAR, China	5165	15.7	81260	5262	22.3	117246
8	Indonesia	5110	12.8	65576	5284	22.1	116905
9	Japan	5240	19.0	99689	5342	25.0	133629
10	Kenya	3940	4.7	18371	4786	16.5	78886
11	KoreaRep	5197	14.2	73880	5332	29.4	156867
12	Lao PDR	2357	2.1	5016	3369	6.5	21963

		1995			2021		
13	Macao SAR, China	3521	5.8	20446	3561	12.1	43042
14	Malawi	3023	3.8	11527	3583	4.3	15458
15	Malaysia	5143	12.8	65902	5292	21.5	113892
16	Mauritius	4369	7.6	33026	4652	13.7	63552
17	Mongolia	2074	2.5	5226	3639	12.3	44783
18	Mozambique	2442	3.2	7786	4408	11.1	48770
19	Myanmar	3313	3.2	10629	4395	8.9	39076
20	Philippines	4851	7.3	35177	5173	19.3	99606
21	Rwanda	1608	2.4	3876	3731	11.3	42112
22	Singapore	5150	16.5	84864	5247	27.9	146637
23	Tanzania	3801	6.7	25641	4609	14.8	68335
24	Thailand	5122	14.4	73973	5305	26.4	140160
25	Uganda	3523	5.8	20590	4062	7.3	29806
26	Viet Nam	4332	5.3	23033	5189	19.3	100091
27	Zambia	3656	4.5	16422	4409	10.4	45827
28	Zimbabwe	3982	6.0	23881	4438	8.6	37991

Source: Authors' calculation

3 Methodology: The Broda and Weinstein Method

Following Feenstra (1994) and Broda and Weinstein (2006), we start by deriving an exact price index for a constant elasticity of substitution (CES) utility function of a single good with a constant number of varieties. This index is then extended by allowing for new and disappearing varieties. Finally, we show how to construct an aggregate import price index and gains from variety formula. Let us start with a simple CES utility function with the following functional form for a single imported good. Assume that varieties of a good g are treated as differentiated across countries of supply, c:

$$M_{gt} = \left(\sum_{c \in C} d_{gct} m_{gct}^{1-\sigma_g} \right)^{\frac{1}{1-\sigma_g}} \quad ; \quad \sigma_g > 1 \tag{1}$$

where C denotes the set of all countries and hence of all potentially available varieties. In the equation, m_{gct} is the subutility derived from the consumption of imported variety c of good g in period t; $\lceil_{gct}$ is the corresponding taste or quality parameter. The elasticity of substitution among varieties of good g is given by σ_g and is assumed to be larger than one.

Let $I_{gt} \subset C$ be the subset of all varieties of good g imported in period t. Using standard cost minimization for the subutility function (1) gives us the minimum unit-cost function:

$$\phi_{gt} \left(I_{gt}, \overrightarrow{d}_{gt} \right) = \left(\sum_{c \in I_{gt}} d_{gct} \left(p_{gct} \right)^{1-\sigma_g} \right)^{\frac{1}{1-\sigma_g}} \tag{2}$$

where p_{gct} is the price of variety c of good g in period t and $\overrightarrow{d}_{gt}$ is the vector of taste or quality parameters for each country.

Suppose the sets of varieties I_g in periods t and $t-1$ are identical, the taste parameters $\overrightarrow{d}_g$ are also constant over time and $\overrightarrow{x}_{gt}$ and $\overrightarrow{x}_{gt-1}$ are the cost-minimizing consumption bundle vectors for the varieties of good g for given the price vectors. In this case, Diewert (1976) defines an exact price index as a ratio of the minimum cost functions:

$$P_g \left(\overrightarrow{p}_{gt}, \overrightarrow{p}_{gt-1}, \overrightarrow{x}_{gt}, \overrightarrow{x}_{gt-1}, I_g \right) = \frac{\phi_{gt} \left(I_g, \overrightarrow{d}_g \right)}{\phi_{gt-1} \left(I_g, \overrightarrow{d}_g \right)} \tag{3}$$

where the price index does not depend on the unknown taste or quality parameters d_{gc}. Sato (1976) and Vartia (1976) have derived the exact price index for the case of the CES unit-cost function. It can be written as the geometric mean of the individual variety price changes:

$$P_g\left(\overrightarrow{p}_{gt},\overrightarrow{p}_{gt-1},\overrightarrow{x}_{gt},\overrightarrow{x}_{gt-1},I_g\right)=\prod_{c\in I_g}\left(\frac{p_{gct}}{p_{gct-1}}\right)^{w_{gct}} \tag{4}$$

where the weights are calculated using the expenditure shares s_{gct}:

$$w_{gct}=\frac{\left(\frac{s_{gct}-s_{gct-1}}{\ln\ s_{gct}-\ln\ s_{gct-1}}\right)}{\sum_{c\in I_g}\left(\frac{s_{gct}-s_{gct-1}}{\ln\ s_{gct}-\ln\ s_{gct-1}}\right)} \tag{5}$$

$$s_{gct}=\frac{p_{gct}x_{gct}}{\sum_{c\in I_g}p_{gct}x_{gct}} \tag{6}$$

So far, it was assumed that all varieties of good g were available in both periods to calculate the exact price index. To include new and disappearing varieties into account, Feenstra (1994) showed how to modify this exact price index for the case of different, but overlapping, sets of varieties in the two periods. This contribution of Feensta is given by the following proposition.

Proposition: For every good g, if $d_{gct}=d_{gct-1}$ for $c\in I_g=(I_{gt}\cap I_{g-1})\,,\ I_g\neq\varnothing$, then the exact price index for good g with change in varieties is given by

$$\pi_g\left(\overrightarrow{p}_{gt},\overrightarrow{p}_{gt-1},\overrightarrow{x}_{gt},\overrightarrow{x}_{gt-1},I_g\right)=\frac{\phi_{gt}\left(I_{gt},\overrightarrow{d}_g\right)}{\phi_{gt-1}\left(I_{gt-1},\overrightarrow{d}_g\right)} \tag{7}$$

$$=P_g\left(\overrightarrow{p}_{gt},\overrightarrow{p}_{gt-1},\overrightarrow{x}_{gt},\overrightarrow{x}_{gt-1},I_g\right)\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g-1}} \tag{8}$$

where

$$\lambda_{gt}=\frac{\sum_{c\in I_g}p_{gct}x_{gct}}{\sum_{c\in I_{gt}}p_{gct}x_{gct}}\quad\text{and}\quad\lambda_{gt-1}=\frac{\sum_{c\in I_g}p_{gct-1}x_{gct-1}}{\sum_{c\in I_{gt-1}}p_{gct-1}x_{gct-1}} \tag{9}$$

Feenstra's theoretical contribution is correcting the conventional price index $P_g(I_g)$ by multiplying it with an additional term which captures the influence of new and disappearing varieties. This additional term is called the lambda ratio. The numerator of this term, λ_{gt}, captures the impact of newly available varieties. λ_{gt} is the ratio of expenditures on varieties available in both periods (i.e., $c \in I_g = (I_{gt} \cap I_{g-1})$) relative to the entire set of varieties available in period t (i.e., $c \in I_{gt}$). Hence, λ_{gt} decreases when expenditure share of new varieties increases and therefore, the exact price index decreases relative to the conventional price index. On the other hand, the denominator of the lambda ratio, λ_{gt-1}, captures the impact of disappearing varieties. λ_{gt-1} increases when there are only few disappearing varieties, and therefore the exact price index is relatively low when compared to the conventional price index.

The exact price index also depends on the elasticity of substitution between varieties, σ_g. If σ_g is high, $\frac{1}{\sigma_g - 1}$ is close to zero and the additional term $\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g - 1}}$ is close to unity. Hence the variety change has small influence on the price index. This is intuitive, when σ_g is high since new and disappearing products are close substitutes to existing varieties, they only have a minor influence on the price index.

The exact price index with changing variety for good g was derived in equation (6). Aggregating it for all imported goods G gives us the aggregate exact import price index:

$$\Pi\left(\overrightarrow{p}_t, \overrightarrow{p}_{t-1}, \overrightarrow{x}_t, \overrightarrow{x}_{t-1}, I\right) = \frac{\phi_t\left(I_t, \overrightarrow{d}\right)}{\phi_{t-1}\left(I_{t-1}, \overrightarrow{d}\right)} \tag{10}$$

$$CIPI(I) = \prod_{g \in G} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{w_{gt}}{\sigma_g - 1}} \tag{11}$$

where $CIPI(I) = \prod_{g \in G} P_g(I_g)^{w_{gt}}$ and the weights w_{gt} is defined in equation 5. Equation 11 shows that the aggregate exact import price index is the product of the aggregate conventional import price index, CIPI(I), and the aggregated lambda ratios which is referred as an “aggregate bias” of the import price in Broda and Weinstein (2006).

The aggregate import bias, or simply the bias measure, is thus an indicator of an upward bias of the aggregate conventional import price index compared to the aggregate exact import price index. The ratio between the aggregate exact price index including variety and the aggregate conventional price is as follows.

$$Bias = \frac{\Pi\,(I)}{CIPI(I)} = \prod_{g \in G} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{\frac{w_{gt}}{\sigma_g - 1}} \tag{12}$$

Using a simple Krugman et al. (1980) structure of the economy, the inverse of the bias can be weighted by the import expenditure share to get the gains from variety:

$$GFV = \left(\frac{1}{Bias} \right)^{w_t{}^M} - 1 = \left[\prod_{g \in G} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{-\frac{w_{gt}}{\sigma_g - 1}} \right]^{w_t{}^M} - 1 \tag{13}$$

where $w_t{}^M$ is the import expenditure share in t.[4]

4 Estimation Strategy

Equation 13 implies that to compute the exact import price index, we have to estimate the elasticity of substitution between varieties of each good. Therefore, in this section, we briefly review the estimator developed by Feenstra (1994) and improved by Broda and Weinstein (2006). After the review, using examples we explain the importance of the elasticities of substitution.

The estimation procedure allows for random changes in the taste parameters for imported varieties and is robust to measurement errors produced by using unit values. Given the utility function (1), the import demand equation for a specific variety using expenditure shares is as follows:

$$\Delta \ln s_{gct} = \varphi_{gt} - (\sigma_g - 1)\, \Delta \ln p_{gct} + \varepsilon_{gct} \tag{14}$$

where $\varphi_{gt} = (\sigma_g - 1) \ln \left[\frac{\phi_{gt}(d_t)}{\phi_{gt-1}(d_{t-1})} \right]$ is a random effect since d_t is random and $\varepsilon_{gct} =$

[4]The import expenditure share $w_t{}^M$ is calculated as the share of imports in GDP in t. This is the separation point of our work from Broda and Weinstein (2006). To estimate the *overall* welfare gain, they used the ideal import share for their whole sample period, however they do not provide an estimation annually. In contrast to that, we estimate the welfare gain for *each year* in our sample period and as an overall gain, we simply take the summation. Refer to section 2.5.3 for details.

$\Delta \ln d_{gct}$. The export supply equation is specified by:

$$\Delta \ln p_{gct} = \psi_{gt} + \frac{\omega_g}{1+\omega_g} \Delta \ln s_{gct} + \delta_{gct} \tag{15}$$

Where $\psi_{gt} = -\omega_g \frac{\Delta \ln E_{gt}}{(1+\omega_g)}$, $E_{gt} = \sum_{c \in C_{gt}} p_{gct} x_{gct}$ and $\omega_g \geq 0$ is the good specific inverse supply elasticity[5] (assumed to be constant between countries) and $\delta_{gct} = \frac{\Delta \ln v_{gct}}{(1+\omega_g)}$ is an error term that captures random changes in a technology factor v_{gct}.

To identify the elasticity of substitution we can assume that the error terms between the demand and supply curves ($\varepsilon_{gct},\ \delta_{gct}$) are uncorrelated after controlling for good and time specific effects. This means that demand and supply errors at the variety level are assumed to be uncorrelated, once good-time specific effects are controlled for. To take advantage of this assumption, we first eliminate the random terms φ_{gt} and ψ_{gt} from equations (14) and (15) by taking differences relative to a reference country k:

$$\Delta^k \ln s_{gct} = -\left(\sigma_g - 1\right) \Delta^k \ln p_{gct} + \varepsilon^k_{gct} \tag{16}$$

$$\Delta^k \ln p_{gct} = \frac{\omega_g}{1+\omega_g} \Delta^k \ln s_{gct} + \delta^k_{gct} \tag{17}$$

where $\Delta^k x_{gct} = \Delta x_{gct} - \Delta x_{gkt}$, $\varepsilon^k_{gct} = \varepsilon_{gct} - \varepsilon_{gkt}$ and $\delta^k_{gct} = \delta_{gct} - \delta_{gkt}$. Next, we multiply (16) and (17) and use the assumption of the independent error terms, i.e., $E\left(\varepsilon^k_{gct}\delta^k_{gct}\right) = 0$. As a result, we obtain the following:

$$\left(\Delta^k \ln p_{gct}\right)^2 = \theta_1 \left(\Delta^k \ln s_{gct}\right)^2 + \theta_2 \left(\Delta^k \ln p_{gct} \Delta^k \ln s_{gct}\right) + u_{gct} \tag{18}$$

where $\theta_1 = \frac{\omega_g}{(1+\omega_g)(\sigma_g-1)}$, $\theta_2 = \frac{1-\omega_g(\sigma_g-2)}{(1+\omega_g)(\sigma_g-1)}$ and $u_{gct} = \varepsilon^k_{gct}\delta^k_{gct}$. However, there is a correlation between u_{gct} and the explanatory variables. To make the error term u_{gct} independent of

[5] $\omega_g = 0$ is a special case of the export supply equation (15), where it is horizontal and there is no simultaneity bias, which is used for most of the empirical studies that use a gravity model to estimate the elasticity of substitution. However, stating $\omega_g \geq 0$, this study allows the equation for the export supply of variety c to vary with the amount of exports.

the explanatory variables, the average of all variables over t are taken and denoted by upper bar:

$$\left(\overline{\Delta^k \ln p_{gct}}\right)^2 = \theta_1 \left(\overline{\Delta^k \ln s_{gct}}\right)^2 + \theta_2 \left(\overline{\Delta^k \ln p_{gct} \Delta^k \ln s_{gct}}\right) + \overline{u_{gct}} \tag{19}$$

Using weighted least squares estimation, the estimates of θ_1 and θ_2 can now be consistent. For each good g, the following objective function is used to obtain Hansen's (1982) estimator:

$$\widehat{\beta}_g = \arg\min_{\beta \in B} G^* \left(\beta_g\right)' W G^* \left(\beta_g\right) \tag{20}$$

where $G^* \left(\beta_g\right)$ is the sample analog of $G\left(\beta_g\right)$, B is the set of economically feasible β such that $\sigma_g > 1$ and $\omega_g > 1$, and W is a positive definite weighting matrix. The optimal weights depend on the time span and import quantities (Broda and Weinstein, 2006). We estimate θ_1 and θ_2 and subsequently solve for σ_g. If the estimated σ_g is not economically reasonable, we use a grid search over the space defined by B. We follow Broda and Weinstein (2006) to compute the minimized GMM objective function over $\sigma_g \in [1.05, 131.5]$ at intervals which are 5 percent apart.[6]

Why Elasticities Are Important

An elasticity of substitution is a responsiveness (of the buyers) of a good to the price changes in its substitutes. Basically, it shows what happens to the relative demand when relative price changes between two goods. It is measured as the ratio of proportionate change in the relative demand for two goods to the proportionate change in their relative prices. In theory, to obtain estimates, we make a number of restrictive, simplifying assumptions. Similarly, to value varieties, let us assume that we have only one or at most two elasticities of substitution, an assumption often made when using a utility function. This will implicitly assume the following (Broda and Weinstein, 2006).

[6]For a more detailed explanation, refer to the working paper version of Broda and Weinstein (2006), which is Broda and Weinstein (2004).

First, elasticities of substitution among varieties of different goods are the same. However, same amount of increase in price of a variety of two different goods may be valued differently by consumers. For example, presumably consumers care more about varieties of computers than crude oil. So, all increases in imports do not give the same gains. Second, elasticities of substitution across goods equals that across varieties of a given good. However, presumably we care more about the different varieties of vegetables than about varieties of potatoes. Third, maybe the largest problem arises from assuming that all varieties enter into the utility function with a common elasticity.

For example, let us say Saudi Arabian oil prices went up. Then what will happen to a country's imports of Mexican oil? What will happen to a country's imports of automobiles? One should rise and the other should fall. The reason is that Mexican oil is almost the perfect substitute of the Saudi Arabian oil and cars are the complements. However, if we assume that the elasticities are equal, then it is very hard to interpret the meaning of the elasticity and there will be no intuition about its magnitude.

5 Results

In this section we discuss the results of our estimation of welfare gains from an increased import product variety from 1995 to 2021 for 28 countries from East Africa and Asia. The estimation has four steps, and we follow these steps for respective countries in our sample. First, following the estimation strategy in section 5, elasticities of substitution σ_g for each product are estimated. Second, we use equation 9 to calculate the lambda ratios λ_g for each imported product category. Third, with σ_g and λ_g, we obtain an estimate of the exact price index for each product after import variety change. Finally, using equation 11, we apply the log-change ideal weights to the price movements of each good to estimate the impact of variety growth on the aggregate import price index. Then with the knowledge of each year's aggregate import price index, using equation 13, we quantify the variety gains from trade with respect to GDP.

5.0.1 Elasticities of Substitution

We estimated equation 19 for each HS-6 product and obtained 4,537 elasticities of substitution (sigmas henceforth) on average for all the 28 countries. Although it is impossible to report all sigmas,[7] Table 2 presents the descriptive statistics of sigmas for each country. By examining the table, we can obtain a sense of the degree of substitutability among varieties. If sigma is high, say above 5 or 10, then this suggests that the potential for gains from variety are small. This is intuitive. When σ_g is high, since new and disappearing products are close substitutes to existing varieties, they will only have a minor influence on the price index and hence the gains from variety.[8] On the other hand, if sigma is low, then this suggests that goods are highly differentiated by country, meaning the potential for gains from variety is high.

Table 2 shows that the median elasticity is 4.1 with no country in the sample exceeding 5. The average elasticity of substitution is 13.0 for the 28-country sample.[9]Based on these results, we can expect the potential gains to be relatively high, especially for countries like Malawi, the Philippines, Fiji, among others, as both median and mean are relatively low.

5.0.2 Change in Varieties

The second step is to calculate the changes in variety over time (i.e., the lambda ratio). The calculation of lambdas requires the existence of common varieties in the beginning and at the end of the period.[10] This is one of the major obstacles we face when implementing the

[7]The estimated sigmas for each country are published by the World Bank Data Development Hub https://datacatalog.worldbank.org/data/dataset/0066672/elasticities_of_substitution_for_28_countries_.

[8]If we look at equations (8) and (11), it is clear that if σ_g is high, $\frac{1}{\sigma_g-1}$ is close to zero and the additional term $\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\frac{1}{\sigma_g-1}}$ is closer to unity. Hence the variety change has small influence on the price index when σ_g is high.

[9]As a reference, the results of Broda and Weinstein (2006) are as follows, mean is 17.3 in HS9, 7.5 in SITC-5, and median is 3.7 in HS9, 2.8 in SITC-5 in period 1972-1988 in the United States.

[10]The reason why we need common varieties is that we cannot value the creation and destruction of a variety without knowing something about how this affects the consumption of other varieties (Broda and Weinstein, 2006).

Table 2: Estimated Elasticities of Substitution

	Country	Statistics				Nobs of HS	Average
		Percentile 90	**Percentile 50**	**Percentile 10**	**Mean**	**products**	**variety**
1	Bhutan	20.7	3.7	1.8	21.6	1548	12.4
2	Brunei Darussalam	14.4	4.0	2.1	18.1	4213	17.3
3	Cambodia	12.3	4.1	2.1	8.5	4302	17.6
4	China	12.6	4.7	2.8	11.1	5368	23.7
5	Congo, Rep.	12.5	4.2	2.3	10.0	3829	16.4
6	Fiji	11.0	3.6	1.9	8.7	4228	18.5
7	Hong Kong SAR, China	12.9	4.4	2.4	10.6	5317	22.7
8	Indonesia	10.2	4.0	2.4	7.5	5327	22.9
9	Japan	15.2	4.7	2.5	23.1	5368	23.4
10	Kenya	15.2	4.5	2.4	13.6	4864	18.5
11	Korea, Rep.	12.5	4.6	2.7	11.9	5355	23.5
12	Lao PDR	15.0	3.7	1.9	10.9	3394	18.1
13	Macao SAR, China	12.9	4.2	2.2	9.6	3879	19.0
14	Malawi	13.0	3.8	1.9	8.5	3950	17.6
15	Malaysia	9.0	3.4	2.1	11.2	5334	23.4
16	Mauritius	11.8	4.1	2.3	13.3	4806	20.7
17	Mongolia	12.3	4.0	2.2	13.8	3708	17.2
18	Mozambique	11.9	3.4	1.9	26.4	4465	18.1
19	Myanmar	14.7	3.9	2.1	12.1	4470	18.5
20	Philippines	8.7	3.6	2.3	6.4	5234	22.6
21	Rwanda	17.0	4.8	2.4	16.8	3841	13.3
22	Singapore	15.6	4.7	2.5	12.3	5303	22.5
23	Tanzania	19.3	4.9	2.5	13.9	4754	15.2
24	Thailand	12.2	4.3	2.5	10.5	5333	22.7
25	Uganda	15.1	4.3	2.2	16.1	4502	16.4
26	Viet Nam	13.2	4.3	2.4	10.1	5240	21.3
27	Zambia	12.8	3.8	2.0	12.6	4503	19.9
28	Zimbabwe	14.7	3.9	2.0	14.9	4561	18.4
	Average		**4.1**		**13.0**		

Note: Authors' calculation. See text for explanation.

technique. As a result, there are fewer lambda ratios than product groups or sigmas. Some lambda ratios cannot be defined at the HS-6 level since there is no common variety. We then follow Broda and Weinstein (2006) and define the lambda ratio at the HS-4 level.

Table 3 shows the summary statistics for the lambda ratios for each country. The median lambda ratio of an average country is 0.99980146, expressing that the typical imported product category in the importing country experienced a positive variety growth of about 1 percent[11]. Using the lambda ratios as a measure of variety growth is more sophisticated than just counting new and disappearing varieties. Due to the large number of new varieties with small market shares, just counting the new varieties can be misleading. Thus, this

[11]Calculated as 1/0.9997837=1%.

underscores the importance of carefully measuring variety growth when making price and welfare calculations. The measure also accounts for the importance of different varieties to the consumer budget decision by using expenditure shares as weights. Lower lambda ratios mean there are more varieties, and more is spent on new varieties.

Table 3: *Descriptive Statistics of Lambda Ratios*

		Statistics		
	Country	*Percentile 5*	*Percentile 50 (Median)*	*Percentile 95*
1	Bhutan	0.180621	1	4.873188
2	Brunei Darussalam	0.2329797	0.9998763	3.409473
3	Cambodia	0.2241164	0.9998575	3.127603
4	China	0.753171	0.9998782	1.271071
5	Congo, Rep.	0.1689567	0.9998815	4.86562
6	Fiji	0.2912371	1	2.729448
7	Hong Kong SAR, China	0.73206	0.9999413	1.296693
8	Indonesia	0.6388264	0.9999301	1.502139
9	Japan	0.8844972	0.9999906	1.127803
10	Kenya	0.2560976	0.9989868	3.221963
11	Korea, Rep.	0.8347616	0.9999483	1.178565
12	Lao PDR	0.2689466	1	2.75684
13	Macao SAR, China	0.3357269	1	2.712074
14	Malawi	0.1913071	1	4.847844
15	Malaysia	0.6697937	0.9998229	1.391351
16	Mauritius	0.3905521	0.9999442	2.413027

17	Mongolia	0.2049434	0.9999985	3.777976
18	Mozambique	0.1939012	1	3.666995
19	Myanmar	0.255213	1	3.175392
20	Philippines	0.5128704	0.9996975	1.642905
21	Rwanda	0.110361	0.9976976	6.446118
22	Singapore	0.6877884	0.999858	1.384267
23	Tanzania	0.1978172	0.9996312	4.230312
24	Thailand	0.7119598	0.9999421	1.349686
25	Uganda	0.1801364	1	4.742794
26	Viet Nam	0.434588	0.9995584	1.739385
27	Zambia	0.258725	1	3.361022
28	Zimbabwe	0.2852985	1	3.50275
	Average		**0.99980146**	

Note: In here, due to the existence of outliers reaching high absolute values, median is preferable than mean.

5.0.3 Welfare Gain

Using the estimated elasticities of substitution and the lambda ratios, now we are ready to calculate the variety change effects on price. Following equation 11 and aggregating the lambda ratios gives the estimates of the impact of variety growth on the aggregate exact import price index. Tables 4 to 6 respectively report the results of this exercise for Bhutan, Mongolia and Rwanda, the countries with the highest gains from variety in our sample. Table 7 summarizes the results for all 28 countries in our sample.

Table 4: *Import Price Bias and the Gains from Variety in Bhutan*

Year	*Bias*	$(\frac{1}{bias} - 1) \times 100$	*Annual Import (% of GDP)*	*Gains from Variety (% of GDP)*
	(1)	*(2)*	*(3)*	*(4)*
1995	1.000	0.00	39%	0.00
1996	0.984	1.66	42%	0.70
1997	0.937	6.69	39%	2.55
1998	0.911	9.77	37%	3.50
1999	0.993	0.75	46%	0.34
2000	0.991	0.92	41%	0.38
2001	0.994	0.63	41%	0.26
2002	0.863	15.92	38%	5.75
2003	0.986	1.41	41%	0.58
2004	0.981	1.94	60%	1.16
2005	0.859	16.39	48%	7.63
2006	0.976	2.43	48%	1.16
2007	1.008	-0.78	45%	-0.35
2008	1.029	-2.84	44%	-1.27
2009	0.961	4.01	43%	1.70
2010	0.951	5.11	55%	2.79
2011	0.869	15.10	59%	8.60
2012	0.957	4.53	56%	2.49
2013	1.025	-2.43	52%	-1.26
2014	0.994	0.62	49%	0.30
2015	0.968	3.27	53%	1.72
2016	1.009	-0.86	46%	-0.40
2017	0.936	6.85	42%	2.82

Year	Bias	$(\frac{1}{bias} - 1) \times 100$	*Annual Import (% of GDP)*	*Gains from Variety (% of GDP)*
2018	1.024	-2.34	43%	-1.01
2019	1.000	-0.04	39%	-0.02
2020	0.995	0.52	39%	0.20
2021	1.002	-0.16	48%	-0.08
Average per-annum	**0.970**	**3.30**	**46%**	**1.49**
Total (1995-2021)		**89.08**		**40.25**

Note: Authors' calculation based on six-digit disaggregated data. See text for detailed explanation.

Table 5: *Import Price Bias and the Gains from Variety in Mongolia*

Year	*Bias* *(1)*	$(\frac{1}{bias} - 1) \times 100$ *(2)*	*Annual Import (% of GDP)* *(3)*	*Gains from Variety (% of GDP)* *(4)*
1995	1.000	0.00	29%	0.00
1996	0.679	47.34	34%	13.87
1997	0.997	0.32	40%	0.13
1998	1.004	-0.41	45%	-0.19
1999	0.996	0.43	49%	0.21
2000	0.979	2.18	54%	1.17
2001	0.998	0.17	50%	0.09
2002	1.028	-2.76	49%	-1.38
2003	0.961	4.01	50%	1.99
2004	0.992	0.81	51%	0.41

Year	Bias	$(\frac{1}{bias}-1)\ \times 100$	*Annual Import (% of GDP)*	*Gains from Variety (% of GDP)*
2005	1.007	-0.69	47%	-0.33
2006	0.998	0.21	44%	0.09
2007	1.007	-0.70	50%	-0.35
2008	1.011	-1.13	64%	-0.73
2009	0.986	1.41	46%	0.65
2010	1.012	-1.23	46%	-0.56
2011	0.998	0.23	63%	0.15
2012	0.997	0.35	55%	0.19
2013	0.979	2.14	51%	1.08
2014	1.004	-0.41	43%	-0.18
2015	1.001	-0.11	33%	-0.03
2016	0.999	0.13	30%	0.04
2017	0.995	0.50	38%	0.19
2018	0.999	0.09	45%	0.04
2019	1.001	-0.07	43%	-0.03
2020	1.001	-0.11	40%	-0.05
2021	1.000	-0.03	45%	-0.02
Average per-annum	**0.986**	**1.95**	**46%**	**0.61**
Total (1995-2021)		**52.66**		**16.47**

Note: Authors' calculation based on six-digit disaggregated data. See text for detailed explanation.

Table 6: *Import Price Bias and the Gains from Variety in Rwanda*

Year	*Bias* (1)	$(\frac{1}{bias} - 1) \times 100$ (2)	*Annual Import (% of GDP)* (3)	*Gains from Variety (% of GDP)* (4)
1995	1.000	0.00	18%	0.00
1996	0.810	23.52	19%	4.02
1997	1.005	-0.52	16%	-0.08
1998	0.991	0.93	14%	0.13
1999	1.001	-0.12	12%	-0.01
2000	1.051	-4.81	10%	-0.50
2001	0.518	93.04	14%	9.85
2002	1.000	-0.04	13%	0.00
2003	0.999	0.07	12%	0.01
2004	1.009	-0.88	12%	-0.10
2005	1.217	-17.83	16%	-3.10
2006	0.991	0.90	18%	0.16
2007	1.007	-0.74	19%	-0.14
2008	0.976	2.45	23%	0.55
2009	0.986	1.38	23%	0.32
2010	0.996	0.44	23%	0.10
2011	0.995	0.55	30%	0.16
2012	1.001	-0.10	30%	-0.03
2013	1.005	-0.54	29%	-0.16
2014	1.003	-0.27	30%	-0.08
2015	0.993	0.68	28%	0.19
2016	1.002	-0.19	26%	-0.05
2017	1.000	-0.01	24%	0.00

Year	*Bias*	$(\frac{1}{bias} - 1) \times 100$	*Annual Import (% of GDP)*	*Gains from Variety (% of GDP)*
2018	0.984	1.67	26%	0.42
2019	1.006	-0.55	26%	-0.14
2020	0.997	0.29	25%	0.07
2021	0.998	0.20	26%	0.05
Average per-annum	**0.983**	**3.69**	**21%**	**0.43**
Total (1995-2021)		**99.51**		**11.63**

Note: Authors' calculation based on six-digit disaggregated data. See text for detailed explanation.

In column 1 of Tables 4 to 6, the ratio of the aggregate exact price index including variety and the aggregate conventional price index is reported as the yearly *bias* measure as in equation (10). It is worth explaining the intuition behind this bias. If this fraction is lower than one, it means that the changing set of imported varieties has *lowered* the import price index. In that case, the consumers benefit from lower unit costs of imports. Thus, these lower costs are the source of the welfare gains. On the other hand, if the bias is larger than one, this means that the import price index is *increased* by the changing variety set. Thus, the disappearing varieties are more valuable to the consumers than the new varieties and it results in welfare loss.

Column 1 in Tables 4 to 6 shows that in most years, the bias is lower than one, meaning the variety change resulted in a lower import price index. On average, the bias measure is 0.970 in Bhutan, 0.986 in Mongolia and 0.983 in Rwanda, which means that ignoring new and disappearing product varieties in the conventional price index had led to an upward bias. We would like to show by how much this import price inflation is overstated yearly. To show that, we calculated $(\frac{1}{bias} - 1) \times 100$ for each year, showing the percentage change or percentage bias between the exact price index and the conventional price index in column (2) in Tables 4 to 6. We can see that import price inflation is overstated by 3.30 percent on average per year for Bhutan, 1.95 percent for Mongolia and 3.69 percent for Rwanda.

In Table 7, to save space, we summed up these yearly bias measures, thus showing the total percentage bias in column (4) for the period from 1995 to 2021 for each country. We see that total percentage bias is 89.1 in Bhutan, the highest among the selected Asian countries during the sample period. In Rwanda it is 99.5, the highest among the African sample countries. The total percentage biases are higher in African countries with 29.7 on average than Asian countries with 14.9, which means African countries' import price inflation is overstated almost twice on average compared to the Asian countries throughout the period.

Table 7: *The Gains from Variety*

	Country	*Increase in number of products*	*Increase in variety (%)*	*Average annual Import (% of GDP)*	*Total percentage bias in price indices*	*Gains from Variety (% of GDP)*
		(1)	*(2)*	*(3)*	*(4)*	*(5)*
1	Bhutan	196%	97%	46%	89.1	40.25%
2	Mongolia	75%	388%	46%	52.7	16.47%
3	Brunei Darussalam	21%	246%	27%	32.0	6.91%
4	Cambodia	75%	307%	60%	14.7	7.63%
5	China	3%	110%	20%	2.9	0.55%
6	Hong Kong SAR, China	2%	42%	163%	3.4	4.32%
7	Indonesia	3%	72%	21%	1.4	0.24%

	Country	*Increase in number of products*	*Increase in variety (%)*	*Average annual Import (% of GDP)*	*Total percentage bias in price indices*	*Gains from Variety (% of GDP)*
8	Japan	2%	31%	11%	0.0	0.01%
9	Korea, Rep.	3%	107%	30%	0.4	0.15%
10	Lao PDR	43%	206%	21%	9.6	1.79%
11	Macao SAR, China	1%	108%	30%	4.5	1.60%
12	Malaysia	3%	68%	71%	6.6	4.95%
13	Myanmar	33%	177%	19%	10.6	2.12%
14	Philippines	7%	166%	35%	13.2	4.55%
15	Singapore	2%	0.696	109%	1.4	1.38%
16	Thailand	4%	83%	50%	1.4	0.79%
17	Viet Nam	20%	263%	45%	10.2	1.88%
	Average (1-17)	**29%**	**150%**	**47%**	**14.9**	**5.62%**
	Average (2-17)		**153%**	**47%**	**10.3**	**3.46%**
18	Congo, Rep.	29%	157%	38%	11.8	2.62%
19	Kenya	21%	254%	25%	24.5	4.77%
20	Malawi	19%	13%	24%	24.2	5.75%
21	Mauritius	6%	81%	44%	6.7	2.75%
22	Mozambique	81%	247%	35%	51.3	9.80%
23	Rwanda	132%	368%	21%	99.5	11.63%
24	Tanzania	21%	120%	19%	8.8	1.64%
25	Uganda	15%	26%	21%	2.0	0.46%

	Country	*Increase in number of products*	*Increase in variety (%)*	*Average annual Import (% of GDP)*	*Total percentage bias in price indices*	*Gains from Variety (% of GDP)*
26	Zambia	21%	131%	29%	37.3	7.35%
27	Zimbabwe	11%	43%	35%	31.3	7.94%
	Average (18-27)	**36%**	**144%**	**29%**	**29.7**	**5.47%**
28	Fiji	23%	176%	43%	8.8	3.39%
	Average (1-28)	**39%**	**148%**	**41%**	**20.0**	**5.49%**

Note: Authors' calculation based on six-digit disaggregated data. See text for detailed explanation.

Now let us move on to the welfare effect of the fall in the exact import prices. It should be noted that the welfare gain from this price fall is based on the functional forms assuming the Dixit-Stiglitz structure and cannot be general. Although our estimate of the impact of imported varieties on import prices is correct for any domestic production structure (Broda and Weinstein, 2006), it is not possible to translate this into a welfare gain without making explicit assumptions about the structure of domestic production. Following Broda and Weinstein (2006), our choice is to assume the same structure of the selected countries' economies as in Krugman et al. (1980). There are two reasons for this. First, since Krugman's model is the dominant model of varieties, to understand the potential welfare gains, it provides a useful benchmark. The second reason is the lack of the necessary data and model of the economies' input-output linkages to estimate variants of the monopolistic competition model with more complex interactions between imported and domestic varieties.

Column (4) of Tables 4 to 6 presents the gains from variety for every year between

1995 and 2021 in Bhutan, Mongolia and Rwanda respectively. The results show that on a yearly basis, the welfare gain due to the increase in imported product varieties in Bhutan, Mongolia and Rwanda accounted for averages of 1.49, 0.61 and 0.43 percent of their respective GDP. This means that a representative consumer in Bhutan, Mongolia and Rwanda would be willing to give up 1.49. 0.61 and 0.43 percent of their income to access the new import varieties every year. The welfare gains for the whole sample period from 1995 to 2021 are approximately 40, 16 and 12 percent of their respective GDP and these are remarkable results considering the moderate gains that most studies show. Total welfare gains of all the sample countries are presented in column (5) of Table 7. Our results show that excluding Bhutan, Asian countries gained on average 3.46% of their respective GDPs as a gain from increasing import variety. Compared to this relatively high gain from trade in Asia, more interestingly, African countries gained more with an average of 5.4% of their GDPs from imported goods variety abundance.

Looking at column (5) of Table 7, we see that each country gained differently from trade, from the lowest in Japan with only 0.01% gain, to the highest in Bhutan with 40.25%. It is possible to find explanations for each of these countries, however, we are more interested in studying the common factors to explain the differences in gains from variety. The countries with the highest gains from variety increase are Bhutan, Mongolia, Rwanda, and Mozambique. Let us consider the following two reasons, among many, to be important.

First, as presented in section 3, the countries with the highest gains have a high import share of GDP as 46% in Bhutan and Mongolia compared to the countries with the least gains such as Japan (11%) and China (20%). These import shares in most gaining countries are also high compared to other countries in our sample in column (3) of Table 7 (as well as in Figure 1). They are also considerably high compared to similar studies. For instance, Broda and Weinstein (2006) found the ideal import share of the United States to be 6.7 percent for 1972-1988 and 10.3 percent for 1990-2001, respectively and Chen and Ma (2012) found the log-change ideal weight of China's imports in GDP to be 11.5 percent during 1997-2008.

Since we used the share of imports in GDP as a weight ${w_t}^M$ in equation 13, and most gaining countries' import share of GDP is relatively high, as a result the variety gain is consequently high.

Second and the main reason is that not only growth in number of varieties was drastic, but also growth in the number of products was significant in these countries. Columns (1) and (2) of Table 7 show the percentage increase in number of products and number of varieties from 1995 to 2021. For example, in Bhutan the number of varieties increased 97%, from 1.7 to 3.4[12], and on the other hand, the number of products increased 196%, from 519 to 1537[13]. This means that the numerator of the lambda ratios, λ_{gt}, which captures the impact of newly available varieties is low. Since λ_{gt} is the ratio of expenditures on varieties available in both periods (i.e., $c \in I_g = (I_{gt} \cap I_{g-1})$) relative to the entire set of varieties available in period t (i.e., $c \in I_{gt}$), evolving of the new variety decreases λ_{gt}. Hence, the exact price index is relatively low, and the welfare gain is relatively high. We can see from Table 7 that Bhutan, Mongolia, Rwanda, and Mozambique are the countries with the highest increases in both number of products and number of varieties. Compared to these countries China; Hong Kong SAR, China; Japan; and the Republic of Korea have moderate increase in their number of products during the period.

6 Conclusion

There is a considerable amount of literature attempting to quantify the welfare gain from growing import variety. Thus, the importance of importing new varieties has been long-established. Moreover, the literature confirms that gains from trade varieties are in general much higher in developing countries than in developed countries. In our study, we looked at 17 Asian countries, 10 East African countries (mostly EMDEs), and Fiji. Compared to their size, the economies import a great deal, spending on average 41 percent of the total

[12]See Table 1 columns (2) and (5).
[13]see Table 1 columns (2) and (5)

expenditure in a year from 1995 to 2021. At the same time, these economies have been gaining greatly from international trade. However, no comprehensive study exists on how much they have gained from import variety growth.

We use highly disaggregated import data from 1995 to 2021 to estimate the elasticities of substitution for 4,537 imported goods on average for all 28 countries. These elasticities allow us to construct a comprehensive measure of the welfare gain using the seminal works by Feenstra (1994) and Broda and Weinstein (2006). The welfare gain as a result of growth in import variety during the period amounts to an average of 5.49% of GDP. We found that African countries on average gained more than Asian countries excluding Bhutan during the period. This indeed confirms the finding in the literature that the welfare impact of import variety growth is greater in developing countries.

The evidence from this paper indicates that for small and transitioning economies, the establishment and expansion of trade linkages can be a significant source of welfare. This aspect is often overlooked in discussions about the effects of globalization and economic integration.

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