HOW DOES INDUSTRY COMPARATIVE ADVANTAGE AFFECT ESTABLISHMENTS

Serge Shikher

ECONOMICS WORKING PAPER SERIES

Working Paper 2017–05–E

U.S. INTERNATIONAL TRADE COMMISSION
500 E Street SW
Washington, DC 20436
May 2017

How does industry comparative advantage affect establishments?
Serge Shikher
Office of Economics Working Paper 2017-05-E
May 2017

Abstract

Using a large multi-country dataset, this paper investigates how establishments in industries with a comparative advantage are different from establishments in industries with a comparative disadvantage. The paper finds that establishments in industries with a comparative advantage have a greater propensity to export and send a greater fraction of their output abroad. The paper also shows the industries estimated by the Eaton-Kortum methodology and industry-level data to have comparative advantages do indeed have more productive establishments than other industries.

Serge Shikher
Research Division
Office of Economics
U.S. International Trade Commission
serge.shikher@usitc.gov

1 Introduction

Recent literature has described heterogeneity across establishments in productivity, exporter status, and other variables. Another literature, going back decades, focuses on industry as a unit of analysis in international trade. It points to significant differences across industries that help explain the pattern of trade. The goal of this paper is to connect empirical facts at industry and establishment levels.

It seems plausible that the probability of success or failure of a particular establishment is affected by the characteristics of an industry and country it operates in. Consider, for example, a U.S. entrepreneur establishing a food manufacturing facility. The United States does not have a comparative advantage in food manufacturing and this entrepreneur would not have a high probability of being more productive than her competitors in other countries. If she does end up with a productivity advantage, it would be offset by high labor costs. As the result, her establishment is unlikely to be successful in exporting.

Similarly, consider an entrepreneur establishing production of medical equipment in a low-income country. Poorer countries have comparative disadvantage in medical equipment manufacturing relative to richer countries. This entrepreneur would likely be hampered by low productivity and low availability of skilled labor. As the result, his establishment would have a low probability of being successful. If it manages to stay in business, it is unlikely to be a exporter. It would concentrate on selling on the domestic market instead. In general, the industry and country of production provide the soil in which individual entrepreneurs grow their businesses. Some soil is more fertile than another and different soils are best suited for different purposes.

Despite this general idea of how industry characteristics can affect success or failure of an establishment, it is not clear exactly how industries with comparative advantages differ from those with comparative disadvantages in terms of establishments that populate them.

Do they have more exporters or more exports by the same number of establishments? Are establishments in the industries with comparative advantages indeed more productive than those in the industries with comparative disadvantages? These are the questions addressed by this paper.

To address these questions, this paper uses a rich dataset. Data on establishments comes from the World Bank Enterprise Surveys which provides consistent data for many countries by using the same questionnaire in all countries and performing consistency checks. Data on establishments is combined with industry-level productivity estimated from trade, output, and factor price data using methodology of Eaton and Kortum (2002).

The paper finds that the share of exporters increases with country income. The paper also finds that establishments in the industries with comparative advantage compared to establishments in the industries with comparative disadvantage have a greater propensity to export, export a greater share of their output, and have higher labor productivity. The first two findings tells us that industries with comparative advantage are successful because more establishments export in those industries and each exporter sends a greater portion of its output abroad. The last finding confirms that the Eaton-Kortum methodology and industry-level data tell the same story about productivity and comparative advantages as the establishment-level data.

This paper is related to the previous literature that documented key establishment-level facts.[1] From this literature, we know that exporters are a minority of firms. They are more productive and larger than non-exporters. In some countries exporters use more physical and human capital than non-exporters.

This paper is also related to the literature that studies trade at the industry-level (Harrigan, 1997). This literature finds that some countries are better at exporting certain

[1] See for example Section 2 in Melitz and Redding (2014) and Bernard, Jensen, Redding and Schott (2007).

types of products. Differences in industry competitiveness across countries have been explained by technological differences and differences in factor use across industries and factor endowments across countries.

The relationship between industry and establishment level facts has not been studied much in the literature. Bernard, Redding and Schott (2007) (BRS) embed a heterogeneous firm model of Melitz (2003) within a Heckscher-Ohlin-type model of comparative advantage. Their model predicts that with trade liberalization, productivity growth is stronger in the comparative advantage industry. These theoretical conclusions are supposed by data from U.S. manufactures in Bernard, Jensen, Redding and Schott (2007) (BJRS). BJRS show that in the U.S. exporting is more likely and export intensity is higher in more skill-intensive sectors, which is consistent with the model of BRS since the U.S. is skill abundant.[2] The limitations of BJRS are that they use data from only one country and do not estimate U.S. comparative advantages at the industry level.

2 Data

The paper combines establishment-level data from a number of countries with industry-level measures of productivity, which are obtained using various industry and country level data.

2.1 Establishment data

The main source of establishment-level data is the World Bank Enterprise Surveys (WBES). The surveys were conducted in two waves. The first wave was between 2002 and 2005 while the second started in 2006 and continues today. There are several differences between the two waves that are relevant to this study. The first wave covered countries at different income

[2]They measure skill as the fraction of non-production in total employment.

levels while the second wave concentrated on developing countries.[3] The first wave collected 71,789 observations from 104 countries of which 7 are high income while the rest are classified as upper-middle, lower-middle, and low income countries according to the World Bank.[4] The second wave collected 124,939 observations (as of July 2016) from 140 countries of which 2 are high income.[5] The first wave also collected more detailed data on the educational attainment of workers.[6]

The surveys collected data on the industry of the enterprise. All sectors of the economy were covered, with focus on manufacturing and services. In the first wave, industry classification was done in two ways. In one question, enterprises were asked to pick their industry using WBES's own classification system. In another question, enterprises were asked to record the ISIC code of their main activity. More firms responded with their industry using the WBES' classification than ISIC, which means that more observations are available when using WBES' industrial classification. In the second wave of surveys, industry classification is exclusively ISIC.

The relevant questions included in the surveys asked about the exporter status, total sales, sales to domestic market and for export, age of the establishment, and total employment. These questions had high response rates. Other relevant questions asked about sources of intermediate goods (foreign and/or domestic) and use of foreign licensed technology.

The results presented in this paper use data only from the first wave of WBES. The data from the first wave is more balanced across country income levels than the data from the second wave.

[3]Israel and Sweden are the only two high income countries in the second wave.

[4]The sampling unit is an establishment, which is defined as a physical location where operations are conducted. An establishment may be smaller than a firm but it must be able to make its own financial decisions and have its own separate financial statements.

[5]Many countries were surveyed several times (usually two) during different years.

[6]The first wave collected information on the share of workers with four different levels of educational attainment while the second wave only asked about the average educational attainment of workers.

2.2 Industry productivities

In addition to the establishment-level data, this paper uses industry-level data. The key industry characteristic for this paper is its productivity relative to other countries, which measures comparative advantage. Country-industry-specific measures of productivity are estimated using the methodology of Eaton and Kortum (2002) applied at the industry level, as in Shikher (2012). This measure of productivity is called "fundamental productivity" in the literature. Theoretically, it measures the productivity of all producers in autarky. It is the mean of the distribution of productivities of producers within an industry, including those that do not operate when there is trade. The estimated industry productivities used in this paper are taken from Shikher (2015). The details of the methodology are reproduced for convenience in Appendix A.

Productivities are estimated for 53 countries and 14 industries using 2005 data, which includes bilateral trade from COMTRADE, industry output from IndStat, and gravity variables from CEPII. Wages and labor shares for three types of labor distinguished by education level are from OWW and WBES. Physical capital shares are from OECD while the rates of return to capital are calculated in two different ways using two different assumptions. Under the first assumption, rates of return are assumed to be equal in all countries (meaning that capital is assumed to be internationally mobile, subject to transport costs, and economy is in a long-run equilibrium). Under the second assumption, rates of return are given by $r = \alpha Y/K$, where α is the capital share in the economy, equal to 0.3, Y is GDP, and K is capital stock, obtained from Penn World Tables 8 (Feenstra, Inklaar and Timmer, 2013). The choice of the rate of return measure has little effect on the results and conclusions of this paper. Results presented in the rest of the paper are obtained using the first assumption.

Even though industry productivities are estimated for 53 countries, the econometric analysis below uses only a subset of 28 of these countries for which establishment-level data is available in WBES. The estimated productivities for the 28 countries are presented in Tables A1 and A2 in the appendix. Productivities in these tables are measured relative to the United States. For example, Ecuador's productivity relative to the U.S. is 0.61 in the food industry, but only 0.35 in the electrical and communications machinery. Relative to the U.S., Ecuador's comparative advantage is in the food industry, not in the electrical and communications machinery industry.

In general, rich countries have higher productivities than the poor countries in all industries. There is also a pattern in comparative advantages across countries and industries, which was documented in Shikher (2015). Countries with high average productivity across all industries typically have comparative advantages in a certain set of industries (such as medical equipment). Countries with low average productivity across all industries have comparative advantages in a different set of industries (such as food manufacturing).

3 Methodology and results

The first wave of the WBES surveys includes 71,789 observations. Of those, 70,350 show exporter status. Of these enterprises, 80.22% are non-exporters and 19.78% are exporters. In manufacturing, 26% of enterprises are exporters, while in services 8.6% of enterprises are exporters.

Table 1 shows how the share of exporters changes with country income. Following the World Bank classification, WBES classifies countries into one of 4 income groups, based on GDP per capita. Table 1 shows the statistics for all enterprises and for manufacturing enterprises only. In general, the percentage of exporters grows with income group. The only exception is the decline in percentage of exporters when moving from upper-middle income to high income group for all enterprises. In manufacturing, there is a steady increase in the share of exporters with country income group.

Table 1: Percentages of enterprises that are exporters and non-exporters, by income group

	low	lower-mid	upper-mid	high	all
			all sectors		
Exporter	15.7%	20.8%	23.2%	17.3%	19.8%
Non-exporter	84.3%	79.2%	76.8%	82.7%	80.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
			manufacturing		
Exporter	20.9%	26.1%	31.1%	41.9%	26.1%
Non-exporter	79.1%	73.9%	68.9%	58.1%	73.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2: Percentages of enterprises that are exporters, by income group and industry

Industry name	low	lower-mid	upper-mid	high	all
food	23.0%	21.1%	23.0%	29.7%	22.2%
textile	37.6%	35.2%	24.0%	51.7%	33.3%
wood	31.0%	27.8%	32.2%	25.5%	29.7%
paper	7.3%	20.6%	21.4%	16.5%	17.4%
chemicals	14.7%	22.4%	27.5%	58.2%	24.4%
rubber	23.4%	33.3%	27.6%	68.2%	31.7%
nonmetals	15.8%	13.8%	17.2%	42.1%	16.5%
metals	12.5%	37.7%	40.0%	40.5%	33.3%
metal products	9.4%	23.6%	23.7%	39.5%	22.0%
other machinery	30.8%	31.8%	34.2%	60.3%	34.9%
e&c machinery	27.7%	48.8%	42.8%	65.7%	46.9%
medical	0.0%	45.7%	52.0%	53.8%	46.1%
transport	21.5%	35.8%	44.9%	61.9%	36.9%
other	15.9%	21.1%	26.8%	27.6%	21.0%

There are also interesting variations in the share of exporters across industries. For example, in Table 2 we can see that the percentage of exporters in the food industry does not vary much across country income groups. Food industry is one of the industries in which poor countries typically have comparative advantages. On the other hand, the percentage of exporters in the medical (equipment) industry or the metal products industry is much lower in the poor countries than in the rich countries. Medical and metal products industries are two of the industries in which rich countries typically have comparative advantages. Table 2 shows that rich countries have a greater proportion of exporters in all industries, but the difference in the proportion of exporters between rich and poor countries is much greater in some industries (like medical) than others (like food).

To perform a formal analysis of the relationship between establishment and industry characteristics, the following model is used:

$$\mathrm{EP}_{ijk} = \mu_0 + \mu_1 A_{ij} + \mu_2 \mathrm{C}_i + \mu_3 \mathrm{I}_j + \varepsilon_{ijk} \tag{1}$$

where EP is some measure of performance (such as exporter status) of establishment k in industry j of country i, A_{ij} is the productivity in industry j of country i relative to the U.S. (a measure of comparative advantage), C_i is the country fixed effect, I_j is the industry fixed effect, and ε is the error term. Measures of establishment performance include exporter status, share of exports in total sales, and sales per worker.

This analysis uses a subset of countries in WBES for which there are estimates of industry productivities. This subset includes 28 countries. There are 14 industries in this analysis. Countries and industries included in the analysis can be seen in tables in the appendix.

Table 3 shows the results of estimating (1) when EP_{ijk} is the exporter status (a binary variable). This regression and most the following ones use ISIC industrial classification with 14 industries. The four columns show the results with no fixed effects, only country fixed effects, only industry fixed effects, and both country and industry fixed effects, which is the full specification. Estimates are obtained using probit regression. The estimates of the fixed effects coefficients are not shown in order to conserve space.

Regardless of specification, industry productivity has a positive and significant effect on the exporter status of establishments. This means that establishments in industries with comparative advantage are more likely to be exporters than establishments in industries with comparative disadvantage. Note that the country fixed effect accounts for absolute advantages.

As a robustness check, Table 4 shows the results of estimating (1) when EP_{ijk} is the exporter status using OLS, probit, and logit, all without fixed effects. Again, regardless of the estimation procedure industry productivity has a positive and statistically significant effect on the exporter status of establishments.

As another robustness check, Table 5 shows the same estimation as Table 4, but using WBES industrial classification (with 7 industries) instead of ISIC. The estimated coefficients $\hat{\mu}_1$ are somewhat higher than with ISIC industries and still statistically significant.

Table 3: Regressions of exporter status on industry productivity (probit)

	(1)	(2)	(3)	(4)
Industry productivity	0.610***	1.603***	0.730***	3.355***
	(0.0891)	(0.163)	(0.0970)	(0.245)
Constant	-0.985***	-2.034***	-1.219***	-3.651***
	(0.0513)	(0.112)	(0.0666)	(0.186)
Fixed effects	None	Country only	Industry only	Country and industry
Observations	12160	12160	12160	12160

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6 shows the results of estimating (1) when EP_{ijk} is the percentage of sales that is exported. The four columns show the results with no fixed effects, only country fixed

Table 4: Regressions of exporter status on industry productivity, 14 industries

	(1) OLS	(2) Probit	(3) Logit
Industry productivity	0.200***	0.610***	1.038***
	(0.0290)	(0.0891)	(0.151)
Constant	0.149***	-0.985***	-1.628***
	(0.0165)	(0.0513)	(0.0872)
Fixed effects	None	None	None
Observations	12160	12160	12160
R^2	0.004		

Note: using ISIC industrial classification with 14 industries
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Regressions of exporter status on industry productivity, 7 industries

	(1) OLS	(2) Probit	(3) Logit
Industry productivity	0.304***	0.939***	1.592***
	(0.0228)	(0.0711)	(0.120)
Constant	0.0896***	-1.174***	-1.949***
	(0.0129)	(0.0409)	(0.0698)
Fixed effects	None	None	None
Observations	24287	24287	24287
R^2	0.007		

Note: using WBES industrial classification with 7 industries
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Regressions of shares of sales for export

	(1)	(2)	(3)	(4)
Industry productivity	9.745***	60.68***	5.477**	100.4***
	(1.949)	(3.218)	(2.106)	(4.709)
Constant	10.51***	-31.18***	10.97***	-70.73***
	(1.111)	(2.178)	(1.425)	(3.552)
Fixed effects	None	Country only	Industry only	Country and industry
Observations	12159	12159	12159	12159
R^2	0.002	0.124	0.019	0.160

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Regressions of sales per worker

	(1)	(2)	(3)	(4)
Industry productivity	321.3***	111.3***	364.6***	94.61*
	(22.04)	(29.44)	(23.74)	(43.47)
Constant	-82.30***	-31.48	-110.4***	-0.519
	(13.05)	(19.64)	(16.50)	(32.80)
Fixed effects	None	Country only	Industry only	Country and industry
Observations	8533	8533	8533	8533
R^2	0.024	0.415	0.055	0.429

Outliers have been dropped (0.4% of observations)

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

effects, only industry fixed effects, and both country and industry fixed effects. Estimates are obtained using OLS. In all specifications industry productivity has a positive and statistically significant effect on the percentage sales exported. This means that establishments in industries with comparative advantage tend to send a higher portion of their output for export than establishments in industries with comparative disadvantage.

Table 7 shows the results of estimating (1) when EP_{ijk} is the establishment sales per worker, measured in USD. Sales per worker is a simple measure of labor productivity at an establishment. Estimates are obtained using OLS. A few observations (about 0.4% of total number) are outliers. These establishments report extremely high values of sales per worker, which do not seem realistic. Most likely, these numbers represent recording errors. Keeping these outliers in the data affects estimation results, so they were dropped. Again, in all specifications industry productivity has a positive and statistically significant effect on sales per worker of an establishment. This means that establishment data confirms what the Eaton and Kortum's Ricardian model and industry-level data suggest. The industries with comparative advantage, as estimated by the Eaton-Kortum methodology, do indeed have more productive establishments than the industries with comparative disadvantage.

4 Conclusion

There are industry characteristics that influence the probability of success of establishments operating in that industry. For example, transfer of technology from rich to poor countries may be harder in some industries than in others. These industry characteristics determine countries' comparative advantage at the industry level. Therefore, one would expect to find systematic differences in establishment-level facts across countries and industries depending on the industry's productivity in a country relative to other countries. In other words, comparative advantage.

The goal of this paper is to study the relationship between empirical facts at the industry and establishment levels. How do the key establishment-level facts vary across countries and industries? Do they vary systematically, according to comparative advantage? It is a question has been largely unanswered in the literature.

Since the paper makes a connection between micro and macro facts, it needs both micro and macro data. It combines large multi-country establishment dataset with estimates of industry productivities obtained using Eaton-Kortum methodology together with industry and country level data.

It finds that industry comparative advantage has a positive and statistically significant relationship with establishment performance, which is measured as exporter status, share of output exported, and sales per worker. Specifically, it finds that the fraction of exporters and the share of output of an establishment destined for export are both higher in industries with a comparative advantage. It also finds that establishment productivity, measured by sales per worker, is higher in industries with comparative advantages.

Therefore, the superior performance of the industries estimated by the Eaton-Kortum methodology to have a comparative advantage comes from more productive enterprises, which results in more enterprises exporting. It also comes from stronger performance of exporters in those industries relative to exporters in other industries.

Appendix A Estimation of industry productivity

Estimation of country- and industry-specific productivities follows an extension of Eaton and Kortum (2002) to many industries and factors, as in Shikher (2012), Levchenko and Zhang (2016), and others. Each industry j in country i is populated with a continuum of producers. Each producer has its own productivity, drawn at random from a Fréchet distribution with parameters T and θ. The production function is

$$c_{ij} = r_i^{\alpha_j} \left(\prod\nolimits_e w_{ei}^{\lambda_{ej}}\right) P_{ij}^{1-\alpha_j-\beta_j}, \qquad (2)$$

where r is the cost of capital, α is the share of capital, w_e is the cost of labor with level of education e (primary, secondary, and tertiary), λ_e is the share of that type of labor, $\beta = \sum_e \lambda_e$ is total labor share, and P is the cost of the intermediate goods bundle. The cost of the intermediate goods bundle is

$$P_{ij} = \prod_m p_{im}^{\eta_{jm}}, \tag{3}$$

where p_{im} is the price index in industry m of country i and η_{jm} is the share of industry m in industry j intermediate goods bundle.

Following the standard Eaton-Kortum approach we can derive the share of country n imports of industry j goods that come from country i, X_{nij}, in total spending by country n on industry j goods, X_{nj}

$$\frac{X_{nij}}{X_{nj}} = \frac{T_{ij} c_{ij}^{-\theta} d_{nij}^{-\theta}}{\sum_m T_{mj} c_{mj}^{-\theta} d_{nmj}^{-\theta}} \tag{4}$$

If we divide import shares above by their domestic counterpart, we obtain

$$\frac{X_{nij}}{X_{nnj}} = \frac{T_{ij} c_{ij}^{-\theta}}{T_{nj} c_{nj}^{-\theta}} d_{nij}^{-\theta} \tag{5}$$

The mean productivity is industry j of country i is $A_{ij} \equiv T_{ij}^{1/\theta}$. This is an average productivity of all producers in an industry, not just those currently producing. This productivity can be called "fundamental" (Costinot, Donaldson and Komunjer, 2012) This is the productivity in autarky, so it is the appropriate productivity to consider when measuring comparative advantage.

Taking logs of (5) and using the definition of A_{ij} we obtain

$$\log \frac{X_{nij}}{X_{nnj}} = \theta \log (A_{ij}/c_{ij}) - \theta \log (A_{nj}/c_{nj}) - \theta \log d_{nij}, \tag{6}$$

Industry-specific bilateral trade cost d_{nij} is represented by the a trade cost function, following Eaton and Kortum:

$$\log d_{nij} = \text{DIST}_{kj} + \text{BORDER}_j + \text{LANG}_j + \text{FTA}_j + \text{DEST}_{nj} + \delta_{nij} \tag{7}$$

where DIST_{kj} $(k = 1, ..., 6)$ is the effect of distance lying in the kth interval, BORDER_j is the effect of common border, LANG_j is the effect of common language, FTA_j is the effect of belonging to the same free trade area, DEST_{nj} is the overall destination effect, and δ_{nij} is the sum of geographic barriers that are due to all other factors. International trade cost is measured relative to domestic trade cost so $\log d_{iij} \equiv 0$.

Plugging (7) into (6) we obtain

$$\begin{aligned} \log \frac{X_{nij}}{X_{nnj}} &= -\theta \text{DIST}_{kj} - \theta \text{BORDER}_j - \theta \text{LANG}_j - \theta \text{FTA}_j - \theta \text{DEST}_{nj} - \\ &\quad -\theta \delta_{nij} + \theta \log (A_{ij}/c_{ij}) - \theta \log (A_{nj}/c_{nj}) \end{aligned}$$

Collecting country-specific variables, we get a gravity equation, which is applied to data to estimate industry productivities:

$$\log \frac{X_{nij}}{X_{nnj}} = -\theta \text{DIST}_{kj} - \theta \text{BORDER}_j - \theta \text{LANG}_j - \theta \text{FTA}_j + D_{ij}^{exp} + D_{nj}^{imp} + \varepsilon_{nij}, \qquad (8)$$

where $D_{ij}^{exp} = \theta \log (A_{ij}/c_{ij})$ is the exporter fixed effect and $D_{nj}^{imp} = -\theta \text{DEST}_{nj} - \theta \log (A_{nj}/c_{nj})$ is the importer fixed effect. The error term is $\varepsilon_{nij} = -\theta \delta_{nij}$.

Trade flows X_{nij} are taken from data while domestic trade X_{nnj} is calculated as total output minus total exports of industry j in country n. When estimating fixed effects in (8) the U.S. is used as base country: $D_{us,j}^{exp} = D_{us,j}^{imp} = 0$. Consequently, we estimate "fundamental" productivities relative to the U.S., $A_{ij}/A_{us,j}$.

Productivities are calculated using the definition of the exporter fixed effects, cost function (2), and data on factor shares and prices:

$$\log\left(\frac{A_{ij}}{A_{us,j}}\right) = \frac{1}{\theta}D_{ij}^{exp} + \log\left(\frac{c_{ij}}{c_{us,j}}\right) = \tag{9}$$

$$= \frac{1}{\theta}D_{ij}^{exp} + \alpha_j \log\frac{r_i}{r_{us}} + \sum\nolimits_e \lambda_{ej} \log\frac{w_{ei}}{w_{e,us}} + \left(1 - \alpha_j - \beta_j\right)\log\frac{P_{ij}}{P_{us,j}}, \tag{10}$$

where price of the intermediate goods bundle in each country and industry is calculated using the Eaton-Kortum model following Shikher (2012):

$$\log\frac{P_{ij}}{P_{us,j}} = \frac{1}{\theta}\sum\nolimits_m \eta_{jm}\left(\log\frac{X_{iim}/X_{im}}{X_{us,us,m}/X_{us,m}} - D_{im}^{exp}\right). \tag{11}$$

Estimated productivities are shown in Tables A1 and A2 below. All productivities are measured relative to the United States. The estimated productivities for the United States are not shown because WBES does not include data for the U.S., so the U.S. is not included in the econometric analysis of this paper.

Table A1: Mean productivity relative to the U.S., $A_{ij}/A_{us,j}$, part 1

Country	Food	Textile	Wood	Paper	Chemicals	Rubber	Nonmetals
Brazil	0.795	0.665	0.691	0.572	0.654	0.608	0.631
Bulgaria	0.432	0.430	0.387	0.316	0.439	0.324	0.330
Chile	0.735	0.533	0.725	0.522	0.634	0.499	0.422
Colombia	0.610	0.531	0.407	0.434	0.474	0.443	0.444
Costa Rica	0.605	0.457	0.446	0.362	0.442	0.415	0.358
Czech Republic	0.518	0.538	0.537	0.530	0.550	0.532	0.609
Ecuador	0.607	0.420	0.480	0.344	0.414	0.394	0.353
Germany	0.874	0.948	0.972	0.946	0.915	0.932	1.001
Greece	0.675	0.715	0.541	0.588	0.608	0.588	0.605
Hungary	0.532	0.568	0.524	0.483	0.574	0.519	0.510
Ireland	0.812	0.639	0.632	0.699	0.873	0.629	0.605
Jordan	0.321	0.381	0.282	0.303	0.498	0.289	0.289
Kazakhstan	0.404	0.352	0.244	0.254	0.419	0.246	0.242
Korea	0.633	0.956	0.640	0.781	0.770	0.989	0.815
Mauritius	0.435	0.516	0.386	0.332	0.337	0.363	0.322
Mexico	0.569	0.572	0.464	0.491	0.621	0.511	0.523
Peru	0.514	0.461	0.349	0.288	0.466	0.313	0.334
Poland	0.581	0.562	0.596	0.529	0.581	0.515	0.566
Portugal	0.571	0.699	0.776	0.577	0.573	0.569	0.606
Russia	0.522	0.454	0.555	0.466	0.596	0.415	0.418
Slovakia	0.407	0.520	0.504	0.470	0.471	0.466	0.471
Slovenia	0.431	0.646	0.620	0.551	0.584	0.600	0.574
South Africa	0.707	0.676	0.612	0.580	0.663	0.586	0.597
Spain	0.815	0.872	0.850	0.770	0.793	0.797	0.893
Turkey	0.654	0.738	0.518	0.477	0.586	0.585	0.637
Ukraine	0.463	0.395	0.389	0.311	0.461	0.320	0.317
Uruguay	0.594	0.539	0.452	0.367	0.449	0.418	0.368
Vietnam	0.543	0.510	0.439	0.328	0.376	0.393	0.389

Table A2: Mean productivity relative to the U.S., $A_{ij}/A_{us,j}$, part 2

Country	Metals	Metal prod.	Mach., other	Mach., e&c	Medical	Transport	Other
Brazil	0.808	0.509	0.560	0.584	0.441	0.631	0.459
Bulgaria	0.487	0.309	0.351	0.364	0.284	0.314	0.581
Chile	0.794	0.428	0.429	0.419	0.360	0.446	0.399
Colombia	0.615	0.345	0.352	0.390	0.288	0.370	0.840
Costa Rica	0.440	0.382	0.442	0.564	0.356	0.351	0.895
Czech Republic	0.649	0.542	0.533	0.558	0.443	0.585	0.613
Ecuador	0.462	0.354	0.339	0.350	0.271	0.374	0.448
Germany	0.975	0.967	0.959	0.960	0.938	0.974	0.940
Greece	0.708	0.607	0.549	0.596	0.466	0.515	0.808
Hungary	0.578	0.514	0.545	0.645	0.468	0.556	0.621
Ireland	0.603	0.725	0.826	0.777	0.756	0.556	0.562
Jordan	0.458	0.279	0.289	0.313	0.237	0.311	0.738
Kazakhstan	0.618	0.228	0.261	0.285	0.213	0.290	0.566
Korea	0.933	0.807	0.799	0.932	0.708	0.936	1.000
Mauritius	0.400	0.335	0.303	0.385	0.314	0.346	0.771
Mexico	0.619	0.523	0.529	0.573	0.458	0.543	0.332
Peru	0.618	0.278	0.280	0.302	0.232	0.293	0.212
Poland	0.648	0.512	0.506	0.558	0.426	0.532	0.546
Portugal	0.549	0.609	0.547	0.592	0.419	0.532	0.632
Russia	0.769	0.356	0.389	0.412	0.336	0.482	0.399
Slovakia	0.592	0.431	0.435	0.517	0.384	0.478	0.305
Slovenia	0.619	0.568	0.513	0.547	0.494	0.508	0.242
South Africa	0.854	0.541	0.577	0.566	0.427	0.618	0.289
Spain	0.854	0.786	0.736	0.772	0.648	0.787	0.360
Turkey	0.676	0.561	0.516	0.578	0.392	0.612	0.452
Ukraine	0.670	0.290	0.323	0.355	0.237	0.392	0.253
Uruguay	0.479	0.337	0.319	0.356	0.300	0.371	0.386
Vietnam	0.421	0.345	0.302	0.373	0.232	0.392	0.365

References

Bernard, A. B., Jensen, J. B., Redding, S. J. and Schott, P. K. (2007). Firms in international trade, *Journal of Economic Perspectives* **21**(3): 105–130.

Bernard, A. B., Redding, S. J. and Schott, P. K. (2007). Comparative advantage and heterogeneous firms, *Review of Economic Studies* **74**: 31–36.

Costinot, A., Donaldson, D. and Komunjer, I. (2012). What goods do countries trade? A quantitative exploration of Ricardo's ideas, *Review of Economic Studies* **79**: 581–608.

Eaton, J. and Kortum, S. (2002). Technology, geography, and trade, *Econometrica* **70**(5): 1741–1779.

Feenstra, R. C., Inklaar, R. and Timmer, M. P. (2013). The next generation of the Penn World Table, *Available for download at www.ggdc.net/pwt* .

Harrigan, J. (1997). Technology, factor supplies, and international specialization: Estimating the neoclassical model, *The American Economic Review* **87**(4): 475–494.

Levchenko, A. A. and Zhang, J. (2016). The evolution of comparative advantage: Measurement and welfare implications, *Journal of Monetary Economics (forthcoming)* .

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica* **71**(6): 1695–1725.

Melitz, M. J. and Redding, S. J. (2014). Heterogeneous firms and trade, *in* G. Gopinath, E. Helpman and K. Rogoff (eds), *Handbook of International Economics*, Vol. 4, Elsevier, pp. 1–53.
URL: *http://www.sciencedirect.com/science/handbooks/15734404*

Shikher, S. (2012). Putting industries into the Eaton-Kortum model, *Journal of International Trade and Economic Development* **21**(6): 807–837.

Shikher, S. (2015). The impact of educated labor on technology adoption and comparative advantage, *USITC Working Paper No. 2015-08A* .