# Trade and Real Wages of the Rich and Poor: Cross-Country Evidence

# 1 Introduction

Trade liberalization may impact an individual's real wage through her nominal wage and her consumer price index. The change in her nominal wage depends on changes in producer prices and the job in which she is employed, where the job of her employment is determined by her characteristics such as age, gender and educational attainment. On is consistent with standard factor proportions theory in which a reduction in trade costs raises the relative nominal wage of the abundant factor in every country, benefiting the unskilled (and poor) workers in skill-scarce countries that are low income and the skilled (and rich) workers in skill-abundant countries that are high income. Shutting down the income channel, I find that the expenditure channel benefits the poor more than the rich in every country and more so in high-income countries. Intuitively, lower trade costs increase real incomes and, therefore, decrease the relative demand for and the relative price of low-income elastic goods. Because low-income consumers spend more on these goods, they benefit relatively more. The expenditure channel benefits the poor relatively more in high-income countries because these countries are net importers of low-income elastic goods.

These two channels do not work in isolation. Studying either channel in the absence of

I parametrize the model for a sample of 40 countries (27 European countries and 13 other large countries) and 35 sectors using a range of datasets including the World Input-Output Database (WIOD) and the Integrated Public Use Microdata Series, International (IPUMS-I). WIOD provides information on bilateral trade flows and production data.[5] I derive a sectoral non-homothetic gravity equation that allows me to estimate the elasticity of substitution and the income elasticity of goods as follows.[6] First, I estimate the elasticity of substitution by projecting countries' sectoral expenditure shares on trade costs. Second, I estimate the income elasticity of each good using the following insight: if high-income or more unequal countries spend relatively more on a good, then I infer that this good is high-income elastic. IPUMS-I provides publicly available nationally representative survey data for 82 countries that are coded and documented consistently across countries and over time. It reports individual-level information including age, reduces gains by 0.1 percentage point: the bottom 10th percentile experiences a real wage gain that is larger than the top 10th percentile in every country, and the difference is 0.8 percentage points in the average country. These results highlight that the distributional effects of trade liberalization are large compared to its average effect. I obtain the result that the poor gain relative to the rich in spite of the fact that I find the opposite result for nominal wages. In the average country, the bottom 10th percentile see their nominal wages decrease by 0.2 percentage points relative to the top 10th percentile. Hence, the reduction in the poor's relative price index must fall substantially. In the average country, the bottom 10th percentile see their consumer price indices decrease by 1 percentage point more than the top 10th percentile.

My framework also allows me to re-examine the impact of a significant increase in U.S. manufacturing imports from China on U.S. real-wage inequality while accounting for both channels and their interaction.[8][9] I consider a uniform reduction in trade costs between the U.S. and China that would yield a $1000 per U.S. worker increase in Chinese manufacturing imports. I find that this reduction in trade costs decreases the consumer price index for a U.S. representative consumer by 0.85%. An individual whose nominal wage is at the 10th percentile of the initial distribution sees a further 0.35 percentage point reduction in her consumer price index compared to the representative consumer, while an individual whose nominal wage is at the 90th percentile sees her consumer price index decrease by 0.1 percentage point less than the representative consumer. This result arises because Chinese manufacturing goods are low-income elastic and, consequently, their lower prices benefit more the poor individuals who spend relatively more on these goods. Although the former sees a bigger decline in her nominal wage (0.13% vs. 0.11%) because she's more likely to work in manufacturing sectors that are in direct competition with cheaper Chinese imports, this income effect is more than offset by her much lower consumer price index. Rising Chinese import competition increases the real wage of the poor by 0.43 percentage points more than that of the rich in the U.S.

A vast body of research has examined the impact of trade on the distribution of earnings across workers. Most recently, Galle, et al. (2015) develop the notion of "risk-adjusted gains from trade" to evaluate the full distribution of welfare changes in one

[8] Autor et al. (2013), Autor et al. (2014) and Acemoglu et al. (2016) study the impact of increased Chinese import competition on employment and earnings of U.S. workers by comparing more affected industries and local labor markets to less affected ones but have no implications at the aggregate level.

[9] Another interesting counterfactual to consider is the Trans-Pacific Partnership (TPP). I can use my framework to simulate the aggregate and distributional effects of this trade agreement for each of the participating countries.

range of countries, I am able to identify general patterns across countries with different characteristics. I am also able to conduct model-based counterfactuals of different trade shocks which are important for policymakers. In addition, as critiqued in Goldberg and Pavcnik (2007), the predictions of these studies depend in a crucial way on estimates of the degree of pass-through from trade policy changes to product prices as well as the wage-price elasticities. These are difficult to estimate consistently with time-series data

$$\hat{u}_z = \sum_j \sum_n s^z_{(j,n)} \left( -\widehat{p^h_{(j,n)}} \right) + \hat{w}_z \tag{1}$$

Here, $s^z_{(j,n)}$

The AIDS allows consumption baskets of high-income and low-income individuals to differ so that price changes resulting from trade liberalization have a differential impact on their consumer price indices. It belongs to the family of Log Price-Independent Generalized Prefereces defined by the following indirect utility function:

$$v\left(w_z, \mathrm{p}^h\right) = F\left[\left(\frac{w_z}{a\left(\mathrm{p}^h\right)}\right)^{1/b\left(\mathrm{p}^h\right)}\right] \tag{3}$$

where $F[\cdot]$ is a continuous, differentiable, and strictly increasing function. The AIDS is the special case that satisfies:

$$\begin{aligned} a\left(\mathrm{p}^h\right) &= \exp\left[\underline{\alpha} + \sum_j \sum_n \alpha^h_{(j,n)} \ln p^h_{(j,n)} + \right. \\ &\left. \frac{1}{2} \sum_j \sum_n \sum_{j'} \sum_{n'} \gamma_{(j,n)(j',n')} \ln p^h_{(j,n)} \ln p^h_{(j',n')}\right] \end{aligned} \tag{4}$$

$$b\left(\mathrm{p}^h\right) = \exp\left[\sum_j \sum_n \beta_{(j,n)} \ln p^h_{(j,n)}\right] \tag{5}$$

where $a\left(\mathrm{p}^h\right)$ is a homothetic price aggregator which captures the cost of a subsistence

Applying Shephard's Lemma to the indirect utility function, I can derive the individual expenditure shares as follows:

$$\begin{aligned} s^{z}_{(j,n)} &= s_{(j,n)}\left(w_z, \mathbf{p}^h\right) \\ &= \alpha^h_{(j,n)} + \sum_{j'} \sum_{n'} \gamma_{(j,n)(j',n')} \ln p^h_{(j',n')} + \beta_{(j,n)} \ln \left( \frac{w_z}{a\left(\mathbf{p}^h\right)} \right) \end{aligned} \tag{10}$$

According to this equation, if a consumer has relatively low nominal wage, then she nominal wages as follows:

$$\hat{u}_z = \hat{E}^h - \ln\left(\frac{w_z}{\tilde{w}^h}\right)\hat{b}^h + \hat{w}_z \tag{13}$$

The global welfare change of individual $z$ under the AIDS between an initial scenario under trade and a counterfactual scenario can be derived by integrating each component of the equation above:[15]

$$\underbrace{u_z^{tr\rightarrow cf}}_{\text{total effect}} = \underbrace{\left(\frac{E^h_{cf}}{E^h_{tr}}\right)}_{\text{agg. exp. effect}} \underbrace{\left(\frac{w_z^{tr}}{\tilde{w}^h_{tr}}\right)^{-\ln(b^h_{cf}/b^h_{tr})}}_{\text{ind. exp. effect}} \underbrace{\left(\frac{w_z^{cf}}{w_z^{tr}}\right)}_{\text{income effect}} \tag{14}$$

$$\frac{E^h_{cf}}{E^h_{tr}} = \prod_{(j,n)}\left(\frac{p^{h,tr}_{(j,n)}}{p^{h,cf}_{(j,n)}}\right)^{S^h_{(j,n)}} \tag{15}$$

$$-\ln\left(\frac{b^h_{cf}}{b^h_{tr}}\right) = -\sum_j\sum_n \beta_{(j,n)} \ln\left(\frac{p^{h,cf}_{(j,n)}}{p}\right)$$

units across different sectors from a multivariate Fréchet distribution:[17]

$$
\begin{aligned}
G(\epsilon(z);\lambda) &= \Pr\left[e(z;j) \leq \epsilon(z;j) \quad \forall j\right] \\
&= \exp\left(-\sum_j \epsilon(z;j)^{-\theta(\lambda)}\right) \qquad (17)
\end{aligned}
$$

where $\theta(\lambda) > 1$ governs within-type dispersion of efficiency units. Worker $z$ inelastically supplies $\epsilon(z;j)$ efficiency units of labor if she chooses to work in sector $j$.

Production requires only one factor, labor.[18,19,20] The production function in country $h$, sector $j$, using $l$ efficiency units of labor type $\lambda$ is:

unit wage of labor type $\lambda$ across the sectors, along with the dispersion parameter, $\theta(\lambda)$.[22]

The average nominal wage, $\bar{w}^h$, and the Theil index, $\square^h$, in country $h$ can also be expressed in terms of $x^h(\lambda)$ and then the system stays in the neighborhood of that equilibrium. I find no quantitative evidence of multiple equilibria.[26]

# 3 Analytical Results

In this section, I study these two channels and their interaction analytically. I consider a simple case where there are two countries, two sectors and two labor groups to illustrate the intuition.

### Setup

Suppose that there are two countries, $h = 1, 2$, two sectors, $j = 1, 2$ and two labor groups, $\lambda = 1, 2$. The two labor groups di�er in their skill levels, which allows nominal wages to vary across workers within a country. I assume that $\lambda = 1$ is high skilled. Goods produced in each sector are homogeneous and not di�erentiated by country of origin. As a result, there are two goods in total, $j = 1, 2$, which simplifies the analysis that follows. These two goods, however, have di�erent income elasticity, which are $\beta > 0$ and $-\beta$, respectively.[27] That is, good 1 is high-income elastic relative to good 2. The implied non-homothetic preferences allow price indices to vary across consumers within a country. I further assume that good 1 is more skill intensive, based on the empirical finding that there is a positive correlation between the skill intensity of a good and its income elasticity. Allowing the two goods to di�er in their skill intensity also leads to comparative advantage of di�erent labor groups across sectors, which is necessary in generating the pattern of trade consistent with the Heckscher-Ohlin model. Finally, I assume perfect competition in all markets as before.

### Demand

Suppose that country $h$'s taste for good 1 independently from prices or income, $\alpha_1^h = \alpha$, and for good 2, $\alpha_2^h = 1 - \alpha$, $h = 1, 2$.[28] I further assume that the semi-elasticity of the

[26] I have tried multiple starting points and the system always converges to the same equilibrium. I have not proven either existence or uniqueness analytically. It is a complicated model with interactions and is not mapped neatly into the class of models considered in Alvarez and Lucas (2007).

[27] More precisely, $\beta$ is semi-elasticity since it relates expenditure shares to log of income, but I refer to it as elasticity to save notation.

[28] ,

expenditure share in one good with respect to the price of another, $\gamma_{12} = \gamma_{21} = \gamma$, and that with respect to its own price, $\gamma_{11} = \gamma_{22} = -\gamma$. Under these parametric restrictions, the budget shares equations in the Almost Ideal Demand System share the properties of a demand function. In addition, I assume that the outlay required for a minimal standard of living when prices are unity, $\underline{\alpha} = 0$, following the literature. The homothetic price aggregator becomes:

$$a(\mathbf{p}^h) = \exp\left[\alpha \ln p_1^h + (1-\alpha)\ln p_2^h + \gamma \ln p_1^h \ln p_2^h\right] = (p_1^h)^{\alpha}(p_2^h)^{1-\alpha}(p_2^h)^{\gamma \ln p_1^h} \quad (27)$$

The non-homothetic price aggregator becomes:

$$b(\mathbf{p}^h) = \exp\left[\beta \ln p_1^h - \beta \ln p_2^h\right] = \left(\frac{p_1^h}{p_2^h}\right)^{\beta} \quad (28)$$

The aggregate expenditure shares in country $h$ are:

$S_1^h = \alpha -$

A producer in country $h$, sector $j$, solves the following cost minimization problem:

$$\min w_H^h H_j^h +$$

Substitute $w_L^h$ using equation (40),

$$p_1^h = \frac{(1-\eta_2)^{1-\eta_1}\eta_2^{\frac{\eta_2(1-\eta_1)}{1-\eta_2}}}{(1-}$$

Case 2: $\eta_1 = \eta_2 = \frac{1}{2}$

Under this restriction, equation (40) implies that $w_L^h = \frac{1}{4w_H^h}$. Equation (45) then implies that:

$$\frac{1}{4w_H^h} = \frac{(1-\eta_2)}{L^h} N \left( \frac{H^h}{N} w_H^h + \frac{L^h}{N} \frac{1}{4w_H^h} \right) \tag{47}$$

Solve the equation,

$$w_H^h = \frac{1}{2} \sqrt{\frac{L^h}{H^h}} \tag{48}$$

## Free Trade Equilibrium

In the two country example, free trade implies that the price of each good is the same in both countries, that is, $p_1^1 = p_1^2 = p_1$ and $p_2^1 = p_2^2 = p_2$. I consider the case in which both countries produce both goods. The producer cost minimization problem implies, as in equation (34), that $\frac{\eta_j L_j^h}{1-\eta_j} \frac{w_L^h}{w_H^h} = H_j^h$. Combined with zero profits,

$$p_j = \frac{(w_L^h)^{1-\eta_j} (w_H^h)^{\eta_j}}{(1-\eta_j)^{1-\eta_j} \eta_j^{\eta_j}}, \; j, h = 1, 2 \tag{49}$$

Since technologies and prices are the same in the two countries, equation (49) implies that:

$$\begin{aligned} (w_L^1)^{1-\eta_1} (w_H^1)^{\eta_1} &= (w_L^2)^{1-\eta_1} (w_H^2)^{\eta_1} \\ (w_L^1)^{1-\eta_2} (w_H^1)^{\eta_2} &= (w_L^2)^{1-\eta_2} (w_H^2)^{\eta_2} \end{aligned} \tag{50}$$

Replace these two equations in one another: $w_H^1 = w_H^2 = w_H$ and $w_L^1 = w_L^2 = w_L$. That is, factor price equalization (FPE) holds in the free trade equilibrium.

From the cost minimization of the producer:

$$p_j y_j^h = \frac{w_H H_j^h}{\eta_j} \tag{51}$$

Sum up over $h$ and use FPE:

$$p_j (y_j^1 + y_j^2) = \frac{w_H}{\eta_j} (H_j^1 + H_j^2) \tag{52}$$

Use goods market clearing condition:

$$S_j^1(H^1 w_H + L^1 w_L) + S_j^2(H^2 w_H + L^2 w_L) \quad = p_j(y_j^1 + y_j^2) \quad = \frac{w_H}{\eta_j}(H_j^1 + H_j^2)$$

Compare the two cases in the autarky equilibrium with the free trade equilibrium, I find that suppose $\frac{H^1}{L^1} > \frac{H^2}{L^2}$,

$$\begin{cases} \begin{cases} w_H^{aut} < w_H^{ft} & for\, h = 1 \\ w_H^{aut} > w_H^{ft} & for\, h = 2 \end{cases} \\ \begin{cases} w_L^{aut} > w_L^{ft} & for\, h = 1 \\ w_L^{aut} < w_L^{ft} & for\, h = 2 \end{cases} \end{cases} \tag{68}$$

which is consistent with the prediction based on the Heckscher-Ohlin model, but inconsistent with my quantitative result in the next section that the relative nominal wage of the skilled workers in skill-scarce countries also goes up after trade liberalization.

Recall that the goods market clearing condition in the autarky equilibrium is:

$$w_L^h L^h = \bar{w}^h N \left[ 1 - \eta_2 + (\eta_2 - \eta_1) \left[ \alpha - (\gamma + \alpha\beta) \ln p_1^h + \beta \ln \tilde{w}^h \right] \right] \tag{69}$$

and the goods market clearing condition in the free trade equilibrium is:

$$\begin{aligned} w_H(H^1 + H^2) = & (w_H H^1 + w_L L^1) \left[ \eta_2 + (\eta_1 - \eta_2) \left[ \alpha - (\gamma + \alpha\beta) \ln p_1 + \beta \ln \tilde{w}^1 \right] \right] + \\ & (w_H H^2 + w_L L^2) \left[ \eta_2 + (\eta_1 - \eta_2) \left[ \alpha - (\gamma + \alpha\beta) \ln p_1 + \beta \ln \tilde{w}^2 \right] \right] \end{aligned} \tag{70}$$

Trade liberalization in the form of lower trade costs increases $\ln \tilde{w}^1$ and $\ln \tilde{w}^2$ exogenously. In both cases, it is only when $\beta = 0$ and $\eta_1 = \eta_2$ that this increase leads to a rise in the relative nominal wage of the skilled workers in both countries according to equations (69) and (70) since $\eta_1 > \eta_2$. I also solve the two equilibria numerically and find consistent result with my quantitative exercise for reasonable parameter values.

# 4 Data

For the demand-side estimation, I use mainly the World Input-Output Database (WIOD), which provides information on bilateral trade flows and production data for 40 countries (27 European countries and 13 other large countries) and 35 sectors in the economy. It also distinguishes between final consumption and intermediate uses.[29]

World Input-Output Table looks like the following:

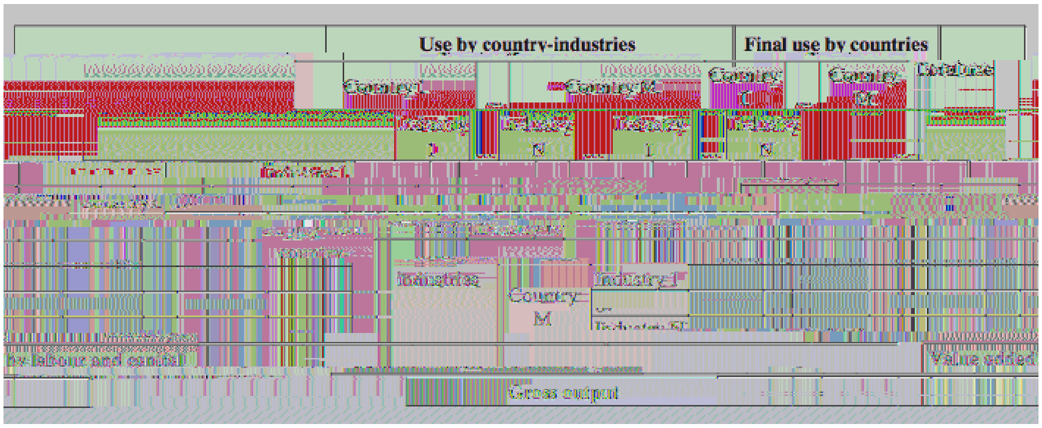



Figure 1: Schematic Outline of a World Input-Output Table (WIOT)

For the supply-side estimation, I use mainly the Integrated Public Use Microdata Series, International (IPUMS-I), which provides publicly available nationally representative survey data for 82 countries that are coded and documented consistently across countries and over time. It also provides individual-level data with labor incomes and worker characteristics. I divide the workers in IPUMS-I dataset into 18 disjoint groups, $\Lambda$, by age (15-24, 25-49 and 50-74), gender (male and female) and educational attainment (ED0-

$$\frac{VAR\left[w_z \mid z \in Z^h(\lambda)\right]}{\left(E\left[w_z \mid z \in Z^h(\lambda)\right]\right)^2} = \frac{\Gamma\left(1 - \frac{2}{\theta(\lambda)}\right)}{\left(\Gamma\left(1 - \frac{1}{\theta(\lambda)}\right)\right)^2} - 1 \tag{71}$$

I restrict my sample in the following way: I drop workers who are younger than 15 years old, are self-employed or work part-time (<30 hours per week), do not report positive labor earnings, or have missing information on age, sex or education. I also drop the top and bottom 1% of earners to remove potential outliers, and to minimize the impact of potential cross-country differences in top-coding procedures. All calculations in my analysis are weighted using the applicable sample weights. I measure $w_z$ as the annual labor earnings; $(z; j)$ captures both the hours worked and efficiency units of worker $z$ who chooses to work in sector $j$; $\theta(\lambda)$ reflects dispersion in both hours worked and eff in detail in the next section, I need to compute the inequality-adjusted average nominal wage of each country, which requires an estimate of its average nominal wage as well as its Theil index. Table 1 reports my estimates of the average labor earnings and the Theil index for the 40 countries based on equations (24) and (25). I estimate $\bar{w}^h$ and $\square^h$ for the years 2005, 2006 and 2007, and then take the average.

| Country | Theil | Avg Labor Earnings | Country | Theil | Avg Labor Earnings |
|---|---|---|---|---|---|
| AUS | 0.17 | 35871 | IRL | 0.18 | 45164 |
| AUT | 0.18 | 31585 | ITA | 0.17 | 25381 |
| BEL | 0.17 | 31446 | JPN | 0.17 | 30438 |
| BGR | 0.19 | 7196 | KOR | 0.18 | 23422 |
| BRA | 0.32 | 2835 | LTU | 0.17 | 11927 |
| CAN | 0.17 | 37134 | LUX | 0.17 | 60919 |
| CHN | 0.34 | 1661 | LVA | 0.18 | 9889 |
| CYP | 0.18 | 17773 | MEX | 0.23 | 3813 |
| CZE | 0.17 | 18342 | MLT | 0.20 | 13412 |
| DEU | 0.16 | 33901 | NLD | 0.17 | 39566 |
| DNK | 0.17 | 34748 | POL | 0.17 | 11096 |
| ESP | 0.19 | 25098 | PRT | 0.19 | 14326 |
| EST | 0.17 | 14544 | ROU | 0.19 | 6365 |
| FIN | 0.17 | 32274 | RUS | 0.18 | 11210 |
| FRA | 0.18 | 27794 | SVK | 0.17 | 12936 |
| GBR | 0.18 | 31318 | SVN | 0.17 | 19767 |
| GRC | 0.18 | 20335 | SWE | 0.17 | 33596 |
| HUN | 0.17 | [illegible] | TUR | [illegible] | 6884 |

In Figure 4, I plot my model-implied labor earnings per capita against output-side GDP per capita. My measure of income per capita tracks the data very well. These parameter implications provide evidence that my model assumptions on the supply side do well at matching the data.

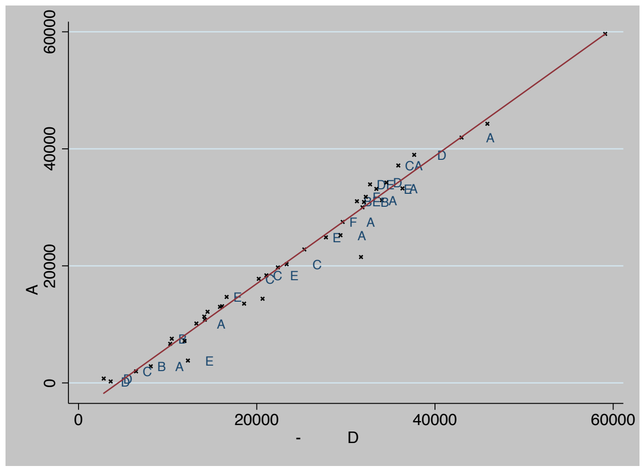
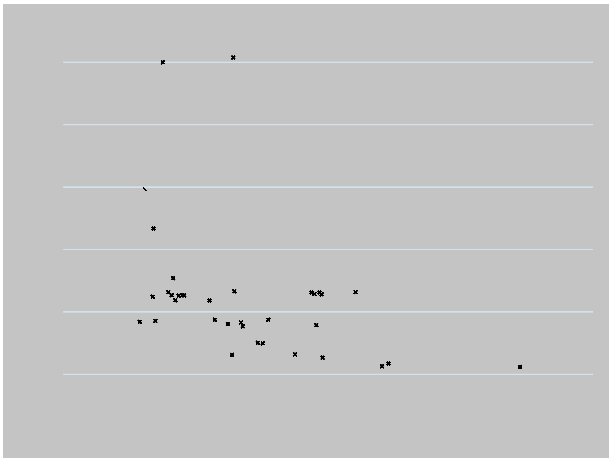



Figure 4: Average Labor Earnings

As discussed above, the worker sorting pattern can be used to parametrize $T(\lambda, j)$. I need $\Lambda + J - 1 = 52$ normalization. I pick $\lambda = 1$ such that $T(\lambda, j) = 1 \quad j$. I also pick $j = 1$ such that $T(\lambda, j) = 1 \quad \lambda$. Then I have $T(\lambda, j) = \left(\frac{\pi^h(\lambda, j)}{\pi^h(\lambda, j=1)}\right)^{\frac{1}{\theta(\lambda)}} / \left(\frac{\pi^h(\lambda=1, j)}{\pi^h(\lambda=1, j=1)}\right)^{\frac{1}{\theta(\lambda=1)}}$, $\lambda = 1 \quad j = 1$ where $\pi^h(\lambda, j) = L^h(\lambda, j)/L^h(\lambda)$ and $L^h(\lambda, j)$ is the headcount of type $\lambda$ workers in country $h$ that choose to work in sector $j$. Since there is no information on $L^h(\lambda, j)$ in Eurostat or UNdata, I use data on the countries that are available in IPUMS-I to compute $T(\lambda, j)$ and then use the average of the estimates for all of the countries.[33] Given the specified normalization,

$$\frac{\pi(\lambda, j)}{\pi(\lambda, j)} = \frac{T(\lambda, j)^{\theta(\lambda)}}{T(\lambda, j)^{\theta(\lambda)}} \tag{72}$$

I plot in Figure 5 this ratio aggregating the 18 labor groups into three broad categories tertiary degree in the U.S.[34][35] The correlation coe□cients are -0.41 and -0.52 respectively. These graphs illustrate that workers with less education are more likely to work in unskill-intensive sectors. This implies that a decline in the relative price of goods in unskill-intensive sectors decreases the relative nominal wage of unskilled workers.[36]



I assume that $A^h(\lambda = 1) = 1 \quad h$.

on the matrix Γ to reduce the number of parameters I estimate:

$$\gamma_{(j,n)(j\ ,n\ )} = \begin{cases} \frac{\gamma_j}{N} & j = j\ , n = n \\ -\left(1 - \frac{1}{N}\right)\gamma_j & j = j\ , n = n \\ 0 & j = j \end{cases} \tag{75}$$

In words, this implies that within the same sector, cross elasticities are the same between goods produced by different countries and across sectors, there is no substitution.[39]

Under these parametric restrictions, the sectoral non-homothetic gravity equation is:[40]

$$S^h_{(j,n)} \equiv \frac{Y^h_{(j,n)}}{Y^h} = \frac{Y_{(j,n)}}{Y^W} + K^h_{(j,n)} - \gamma_j M^h_{(j,n)} + \beta_{(j,n)}\Omega^h \tag{76}$$

where $\frac{Y_{(j,n)}}{Y^W}$ captures the size of the exporter $n$ in sector $j$ in the world economy; $K^h_{(}$

$$S_j^h = \sum_n S_{(j,n)}^h = \bar{\alpha}_j^h + \bar{\beta}_j y^h \qquad (79)$$

where $\bar{\alpha}_j^h = \sum_n$

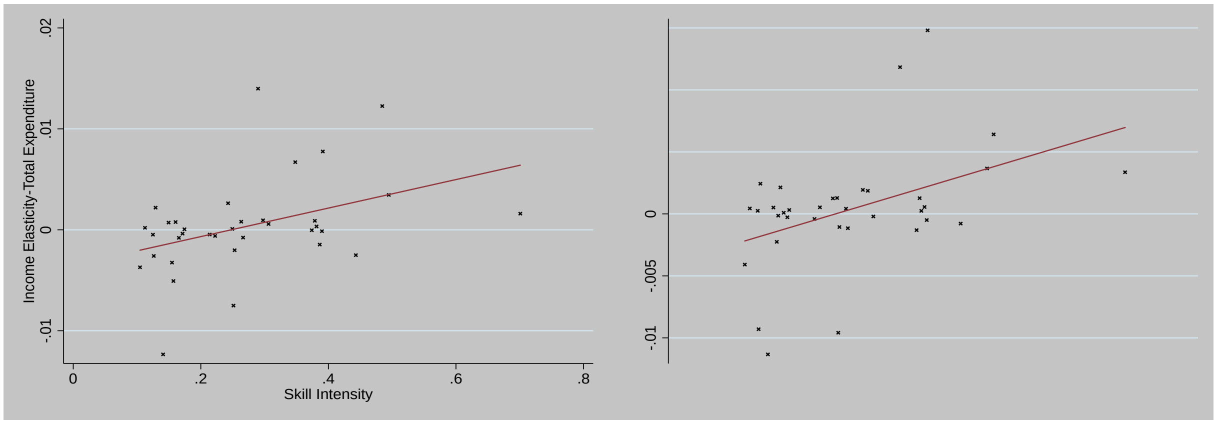
sectors is 0.24. It is very close to the estimate in Fajgelbaum and Khandelwal (2016). Estimating a translog gravity equation, Novy (2012) reports $\gamma = 0.167$ while Feenstra and Weinstein (2013) reports a median $\gamma$ of 0.19.

| sector | $\gamma_j$-total | $\gamma_j$-final | sector | $\gamma_j$-total | $\gamma_j$-final |
|---|---|---|---|---|---|
| Agriculture | 0.0060 | 0.0048 | Sales, Repair of Motor Vehicles | 0.0030 | 0.0030 |
| Mining | 0.0029 | 0.0008 | Wholesale Trade and Comission Trade | 0.0115 | 0.0121 |
| Food, Beverages and Tobacco | 0.0086 | 0.0102 | Retail Trade | 0.0104 | 0.0131 |
| Textiles | 0.0021 | 0.0017 | Hotels and Restaurants | 0.0074 | 0.0109 |
| Leather and Footwear | 0.0004 | 0.0004 | Inland Transport | 0.0046 | 0.0042 |
| Wood Products | 0.0013 | 0.0003 | Water Transport | 0.0006 | 0.0001 |
| Printing and Publishing | 0.0037 | 0.0017 | Air Transport | 0.0013 | 0.0012 |
| Coke, Refined Petroleum, Nuclear Fule | 0.0045 | 0.0023 | Other Auxilliary Transport Activities | 0.0025 | 0.0015 |
| Chemicals and Chemical Products | 0.0068 | 0.0022 | Post and Telecommunications | 0.0058 | 0.0051 |
| Rubber and Plastics | 0.0026 | 0.0006 | | | |

Table 3 reports my estimates of the sectoral income elasticities, $\beta_j = \sum_n \beta_{(j,n)}$. The corresponding elasticities for food, manufacturing and services are -0.022, -0.0051 and 0.0271, respectively. I find that the service sectors have a higher income elasticity as expected.

| sector | $\beta_j$-total | $\beta_j$-final | sector | $\beta_j$-total | $\beta_j$-final |
|---|---|---|---|---|---|
| Agriculture | -0.0128 | -0.0117 | Sales, Repair of Motor Vehicles | 0.0020 | 0.0022 |
| Mining | -0.0052 | -0.0002 | Wholesale Trade and Comission Trade | -0.0001 | -0.0008 |
| Food, Beverages and Tobacco | -0.0080 | -0.0103 | Retail Trade | -0.0011 | 0.0000 |
| Textiles | -0.0034 | -0.0024 | Hotels and Restaurants | 0.0004 | 0.0016 |
| Leather and Footwear | -0.0005 | -0.0004 | Inland Transport | -0.0041 | -0.0044 |
| Wood Products | -0.0006 | 0.0002 | Water Transport | -0.0008 | -0.0012 |
| Printing and Publishing | 0.0007 | 0.0012 | Air Transport | 0.0003 | 0.0002 |
| Coke, Refined Petroleum, Nuclear Fule | -0.0017 | 0.0004 | Other Auxilliary Transport Activities | 0.0024 | 0.0011 |
| Chemicals and Chemical Products | -0.0027 | -0.0009 | Post and Telecommunications | 0.0005 | 0.0002 |
| Rubber and Plastics | -0.0005 | -0.0003 | Financial Intermediation | 0.0117 | 0.0032 |

Figure 7 plots the sectoral income elasticity computed from total expenditure and



Income Elasticity-Total Expenditure
.02
.01
0
-.01
0
.2
.4
.6
.8
Skill Intensity
0
-.005
-.01

elastic goods makes her better off. $\frac{w_z^{cf}}{w_z^{tr}}$ is the income effect, and its change depends on the sector that individual $z$ works in. An increase in a sector's output price raises the

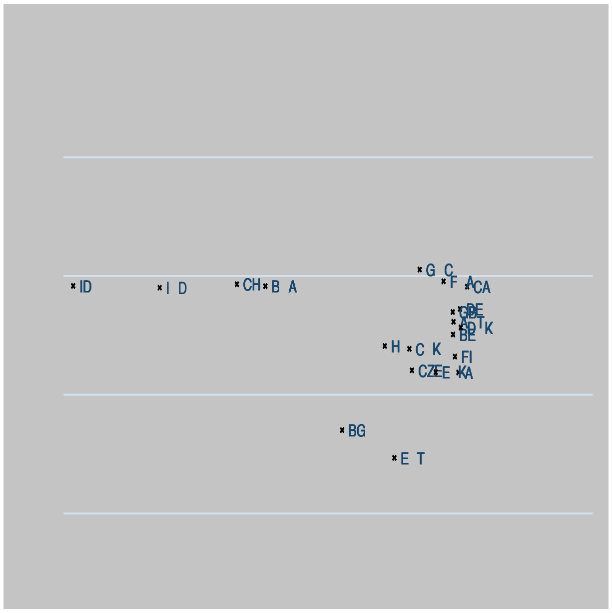
| Active channel(s) | Income | Expenditure | Both |
|---|---|---|---|
| diff. exp. effect | 0 | [0.43, 0.88] | [0.76, 1.36] |
| diff. inc. effect | [−0.01, 0.04] | 0 | [−0.72, −0.04] |
| diff. tot. effect | [−0.01, 0.04] | [0.43, 0.88] | [0.24, 1.29] |

Table 4: Distributional Effects through Income Channel

I find that in Estonia, the 10th percentile suffers a decrease in the nominal wage relative to the 90th percentile of 0.01 percentage points. On the other hand, in Portugal, the 10th percentile enjoys an increase in the relative nominal wage of 0.04 percentage points. The change in the relative nominal wage in the rest of the countries lies in between.

Panel A of Figure 9 plots diff. inc. effect against the log average income for each country based on a weighted least squares regression with weights equal to the output share of a country in the world economy. The correlation coefficient is -0.18. Panel B plots a country's skill abundance against its log average income. The correlation coefficient is 0.77.[47]

A. di . inc. e ect

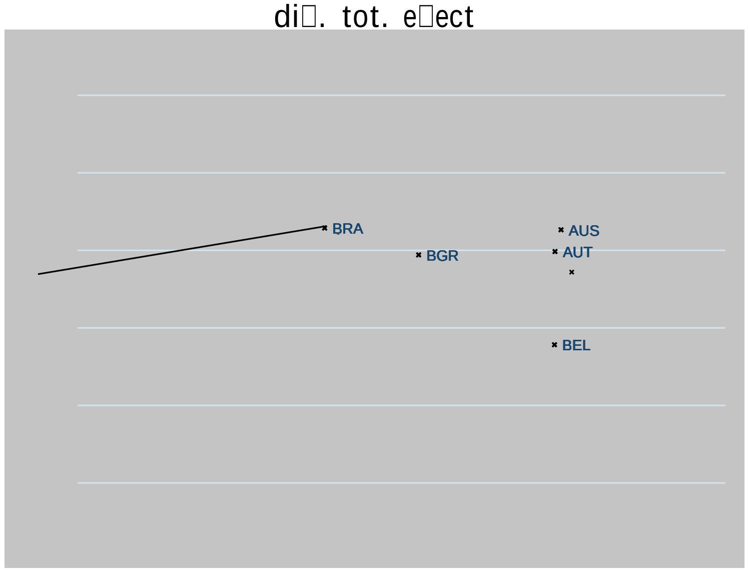


0.88 percentage points bigger than the 90th percentile. The poor's relative benefit from the expenditure channel in the rest of the countries lies in between.

sort into di

How does the poor's relative benefit from the combined effect of trade liberalization vary across countries? Figure 13 plots **diff. tot. effect** against the log average income for each country based on a weighted least squares regression with weights equal to the output share of a country in the world economy. The correlation coefficient is 0.19. Since the expenditure channel benefits more the poor individuals in rich countries and the rich individuals in poor countries, while the income channel benefits more the rich individuals in rich countries and the poor individuals in poor countries, allowing both channels to operate no longer makes income per capita a good predictor of the pro-poor bias of trade liberalization.[51]

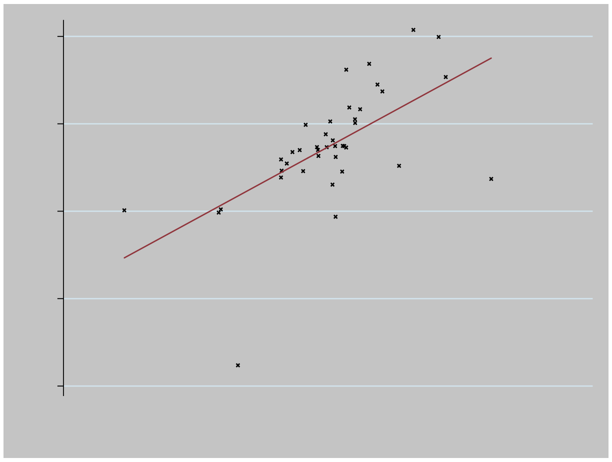
diff. tot. effect



| Country | Separate | Combined | Country | Separate | Combined |
|---|---|---|---|---|---|
| AUS | 0.75 | 0.85 | IRL | 0.66 | 0.80 |
| AUT | 0.66 | 0.80 | ITA | 0.68 | 0.91 |
| BEL | 0.55 | 0.56 | JPN | 0.76 | 1.06 |
| BGR | 0.64 | 0.79 | KOR | 0.76 | 1.18 |
| BRA | 0.66 | 0.86 | LTU | 0.63 | 0.78 |
| CAN | 0.63 | 0.74 | LUX | 0.60 | 0.24 |
| CHN | 0.71 | 0.90 | LVA | 0.63 | 0.78 |
| CYP | 0.74 | 1.01 | MEX | 0.70 | 0.77 |
| CZE | 0.59 | 0.73 | MLT | 0.68 | 0.76 |
| DEU | 0.65 | 0.76 | NLD | 0.67 | 0.82 |
| DNK | 0.68 | 0.81 | POL | 0.60 | 0.72 |
| ESP | 0.75 | 1.08 | PRT | | |

0.74 0.78 KOU EST

Panel A



or greater import competition in the foreign markets that U.S. regions serve. Their main measure of local labor market exposure to import competition is the change in Chinese import exposure per worker in a region, where imports are apportioned to the region according to its share of national industry employment. They also control for the start-of-period manufacturing share within commuting zones so as to focus on variation in exposure to Chinese imports stemming from differences in industry mix within local manufacturing sectors.

Instead of using the variation across local labor markets, I analyze the aggregate effect of a \$1K increase in U.S. manufacturing imports from China per worker.[55] At initial equilibrium, average per capita spending by the U.S. on Chinese manufacturing goods is $\sum_{j \in M} S^{us}_{(j,chn)} \bar{w}^{us} = 0.0187 \times 22.4128 = 0.42$.[56] To increase it by \$1K is equivalent to an increase in the total expenditure share on these goods of 4.46%.[57] I shut down the effects of greater U.S. exports to China or greater import competition in the foreign markets that the U.S. serves by holding the production prices, $p_{(j,h)}$ $\forall j \in J,\ h = US$, and trade costs, $\tau^{n}_{(j,h)}$ $\forall j \in J,\ h = CHN,\ n = US$, unchanged. To compute the reduction in trade costs in the manufacturing sectors that would lead to this increase in Chinese imports, I apply the expenditure share equation (32), and lesles(970117107.9701169.17438.25Tm/T8.01Tf

impact on consumer price indices. To my knowledge, there are only three case studies that have combined both channels to examine how real wages of different groups of people are affected in individual countries, Argentina, Mexico and India.

I build a model combining demand heterogeneity across consumers with productivity heterogeneity across workers to quantify the distributional effects of trade liberalization

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# 9 Appendix

$$\frac{b^h_{cf}}{b^h_{tr}} = \prod_{(j,n)} \left(\frac{p^{h,cf}_{(j,n)}}{p^{h,tr}_{(j,n)}}\right)^{\beta_{(j,n)}} \quad \rightarrow \quad -\ln\left(\frac{b^h_{cf}}{b^h_{tr}}\right) = -\sum_j \sum_n \beta_{(j,n)} \ln\left(\frac{p^{h,cf}_{(j,n)}}{p^{h,tr}_{(j,n)}}\right)$$

## 9.3 Specialization in Production

I construct an index of a country $n$ s relative supply of goods in skill-intensive sectors as the following: $\frac{\sum_{j=1}^{J} \alpha_j supply(j,n)}{\sum_{j=1}^{J} supply(j,n)}$ where $\alpha_j$ denotes the skill intensity of a sector. As expected, skill-abundant countries produce relatively more in skill-intensive sectors at equilibrium. In addition, I construct an index of a country $n$ s relative price increase in skill-intensive sectors as the following: $\sum_j ($

=

$$= A^h(\lambda) T(\lambda, j) \frac{1}{\pi^h(\lambda, j)} \int_0^\infty \exp$$

$\square \; \square_{j \;\; J} \; \square \; p^{h}_{(j\;,h}$

$$= \sum_{\lambda} \frac{L^n(\lambda)}{L^n} \Gamma(\lambda)\, x^n(\lambda) \left[ \sum_{j} \pi^n(\lambda, j) \hat{p}^n_{(j,n)} \right]$$

Alternatively, $\partial \bar{w}^n = \sum_{\lambda} \frac{L^n(\lambda)}{L^n} \Gamma(\lambda)\, \partial x^n$ where

$$\partial x^n = \frac{1}{\theta(\lambda)} \left[ \sum_{j} p^n_{(j,n)} A^n(\lambda) T(\lambda, j) \right]^{\theta(\lambda)}$$

function and $\Psi(\lambda) \equiv \Psi \left( 1 - \right.$

$\log \square x^h(\lambda)$

Substract the second equation from the first,

$$
\begin{aligned}
\frac{Y^h_{(j,n)}}{Y^h} - \frac{Y_{(j,n)}}{Y^W} = & \underbrace{\left( \alpha^h_{(j,n)} - \sum_n \frac{Y^n}{Y^W} \alpha^n_{(j,n)} \right)}_{\equiv K^h_{(j,n)}} \\
& \underbrace{-\gamma_j \left( \ln \left( \frac{\tau^h_{(j,n)}}{\bar{\tau}^h_j} \cdot \frac{p^n_{(j,n)}}{\bar{p}_j} \right) - \sum_n \frac{Y^n}{Y^W} \ln \left( \frac{\tau^n_{(j,n)}}{\bar{\tau}^n_j} \cdot \frac{p^n_{(j,n)}}{\bar{p}_j} \right) \right)}_{\equiv M^h_{(j,n)}} \\
& +\beta_{(j,n)} \underbrace{\left( y^h - \sum_n \frac{Y^n}{Y^W} y^n \right)}_{\equiv \Omega^h}
\end{aligned}
$$

## 9.10 The Differences in Tastes across Countries

Under the additional assumptions on $\Gamma$ and $\sum_n \alpha_n = 1$ combined with the equation $\alpha^h_{(j,n}$

I combine these reservation price equations with $J$ market clearing conditions in autarky, which equalize the total supply and the total demand.

The total supply of good $(j, h)$ is:

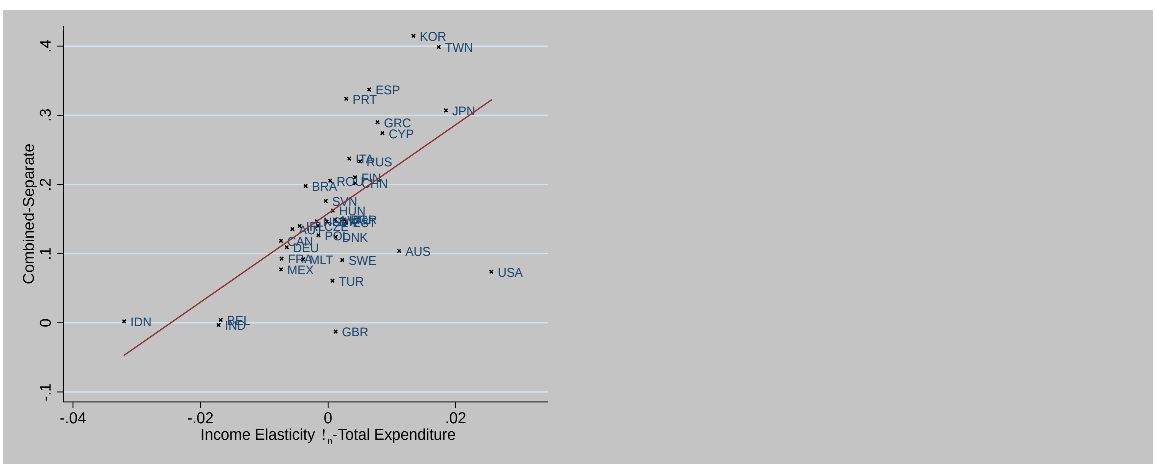
$$\sum_{\lambda} A^h(\lambda) T(\lambda, j) \Gamma$$

The autarky wage distribution is:

$$\begin{aligned} Pr(w_z \leq w) &= \sum_{\lambda} Pr\left(w_z \leq w | z \in Z^h(\lambda)\right) Pr\left(z \in Z^h(\lambda)\right) \\ &= \sum_{\lambda} \frac{L^h(\lambda)}{L^h} \exp\left(-x^h(\lambda)^{\theta(\lambda)} w^{-\theta(\lambda)}\right) = \sum_{\lambda} \exp\left(-x^h(\lambda)^{\theta(\lambda)} w^{-\theta(\lambda)} + \ln\left(\frac{L^h(\lambda)}{L^h}\right)\right) \end{aligned}$$

## 9.12 Bias and Income Elasticity

Figure 16 plots the difference in the poor's relative benefit from trade liberalization between estimating the two effects jointly and separately against the income elasticity of the country's production, $\bar{\beta}^h_{prod} = \sum_j \beta_{(j,h)}$. Panel A uses the income elasticity computed from total expenditure while Panel B is restricted to final consumption. The correlation between the bias and the income elasticity of a country's production remains positive and significant after excluding Luxembourg. This implies that the interaction of the two channels benefits more the countries that produce high-income elastic goods.




$Correlation = 0.6163$