Trade effects of income inequality within and between countries

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Abstract

In this paper I analyze the effect of between and within country inequality on trade patterns using a model of non-homothetic preferences and structural change. A (non-homothetic) price independent generalized linear (PIGL) utility function allows me to aggregate individual demand functions and include a parameter for the income inequality between individuals in a country in the aggregate demand function.

I assume that the individual demand for (tradable) manufacturing goods decreases relative to the individual demand for (non tradable) services if individual income increases. I find that for a given GDP per capita more equality is associated with a bigger market for manufacturing goods which leads to more concentrated production in countries with higher equality levels.

If two countries are similar in terms of equality, increasing equality in either country increases trade between both countries. I confirm

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my findings using an augmented gravity equation. I estimate the parameters of the model and use these results to calibrate a multi-country model of bilateral trade for 13 OECD countries. I show that more equality in a country increases exports of this country towards all other countries as well as its imports from all other countries, but it crowds out trade between all other countries.

JEL classification : E2, F12, F16, L11, L16

Key Words : Non-homothetic preferences, income inequality, structural change, international trade, trade flows

1 Introduction

Since the well-known Lindner hypothesis, Linder (1961), many economist investigated the effect of income inequality on trade patterns. While Lindner's research was more descriptive, models with non-homothetic preference became popular in the late 1980s. Especially, the work of Hunter et al. (1986), Markusen (1986) and Hunter (1991) draw attention to the importance of non-homothetic preferences for trade flows.[1] Most of the older literature focuses on between country income differences and trade flows, for example Bergstrand (1990) shows that greater similiarity of countries in terms of GDP, GDP per capita, captial-labor endowments and tariffs is linked to more intra-industry trade.

If income differences between countries have an effect on consumption and trade patterns, clearly within country income difference should have an effect as well. Many empirical studies confirm this intution, see Francois and Kaplan (1996) or Dalgin et al. (2007). Martínez-Zarzoso and Vollmer (2010) find that countries with greater overlaps of the income distribution trade more with each other, which extends the findings of Bergstrand (1990). Similarly Bernasconi (2013) finds that income similarity increases trade flows at the intensive and extenisve margin. Most of the empirical studies highlight the importance of non-homothetic preferences for their findings. On the theoretical side Mitra and Trindade (2005) develop a two country model Heckscher-Ohlin trade model with two types of individual that differ in their capital endowment and find that trade is driven by consumption specialization. Matsuyama (2000) shows strong effects of the income distribution on productivity in a Ricaridan trade model a la Dornbusch-Fischer-Samuelson. He finds that redistribution between rich and poor individuals changes the terms of trade. Most theoretical models only consider two income groups, rich and poor, to describe inequality and the arising trade patterns. The main reason for this is that most non-homothetic preferences become untractable if you aggregated over more

[1]See Markusen (2010) for a good summary of many applications of non-homothetic preferences in trade theory.

income groups.

I contribute to this literature by developing a tractable model with non-homothetic preferences that incoperates between and within country inequality in a monopolistic competition trade model a la Krugman (1979) and Krugman (1980). In a recent paper on growth and structural change Boppart (2011) used price independent generalized linearity (PIGL) utility function (Muellbauer (1975) and Deaton and Muellbauer (1980)) to aggregate the individual demands over all individuals and to directly relate the aggregated demand to the inequality in the economy. With these preferences we are able to consider an economy with a continuous income distribution without loosing tractability, as we can describe the income distribution by one parameter. Depending on the parameterization of PIGL preference can either be linear or non-linear Engel curves, which is a testable feature of the model. If Engel curves are non-linear the income inequalty will have an effect on the sectoral allocation of production and hence on bilateral trade patterns.

I assume that poorer individuals consume relatively more manufacturing goods and relatively less services than richer individuals. This implies that the relative demand for manufacturing goods against services decreases with income. In terms of the within country inequality this implies that for a given GDP per capita more equal countries consume more manufacturing goods than less equal countries.

The main channel in my model is the change of market size for manufacturing goods and services due to changes in the income and income inequality in the country and its trading partner. A bigger market for manufacturing leads production specialization in manufacturing, hence the model is in line with a recent strand of literature that explores the effects of inequality on structural change, see Foellmi and Zweimüller (2006), Foellmi and Zweimüller (2008), Matsuyama (2009), Boppart (2011) and Fajgelbaum et al. (2011). Consequently, trade patterns depend as well on income and income inequality. Exports of a country increase with equality (in both countries) as long as the country has a similar equality level as its trading partner. Thus, we see this as theoretical evidence of the importance of non-homothetic preference for the empirical findings of Francois and Kaplan (1996), Dalgin et al. (2007), Martínez-Zarzoso and Vollmer (2010) and Bernasconi (2013).

In contrast to previous theoretical models, I consider a more detailed income distribution.[2] Thus, I am able to directly estimate the parameters of the model, using decentile income shares from the World Income Inequality Database (WIID). I find clear evidence for the non-homotheticity of the utility function and confirm the impact of within country inequality on trade patterns, estimating an augmented gravity equation.
The model with bilateral trade is tractable and can be easily expand to multi-country trade. I simulate the model for 13 OECD countries, the correlation between the observed bilateral trade flows and the model prediction is 0.83, whereas predicitions from common gravity models have a correlation up to 0.79, see Bergstrand et al. (2013). Lastly, the model suggest that elasticity of trade with respect to equality in all countries is close to unity, which indicates the importance of within country inequality.

The remainder of the paper is structured as follow: Section 2 introduces the theoretical model in a closed and open economy. In section 3 we present some empirical evidence. In section 4 we show the results for a calibrated multi-country trade model. Finally, section 6 concludes.

[2]I use only 10 income classes to construct our income equality measure, but theoretically I could consider a continous income distribution.

2 Model

2.1 Preferences and Demand Side

There are N individuals in the economy, that differ in their labor endowment, $l_j > 0$, which is supplied inelastically.[3] The total labor supply of the economy is $L = \int_0^N l_j dj$. The wage rate, w, is the same for all individuals, but individual income, y_i, is heterogenous as the individual labor endowment is heterogenous.

Following Muellbauer (1975) all individuals have the following indirect utility function over a (composite) manufactured good, m, and services, s:

$$V(P_m, P_s, y_j) = \frac{1}{\epsilon}\left(\frac{y_j}{P_s}\right)^{\epsilon} - \frac{\tilde{\beta}}{\gamma}\left(\frac{P_m}{P_s}\right)^{\gamma}, \tag{1}$$

where $y_j = wl_j$ is the individual income, P_s is the price of services and P_m is the price index of the manufacturing good. The parameters are restricted to $0 \leq \gamma, \epsilon \leq 1$ and $\tilde{\beta} > 0$. We can interprete ϵ as the degree of non-homotheticity in the model, where $\epsilon = 0$ implies homothetic preferences. $1 - \epsilon$ gives the income elasticity of the manufacturing good.

Using Roy's identity the individual demand for each good is:

$$c_{jm} = -\frac{\frac{\partial V}{\partial P_m}}{\frac{\partial V}{\partial y_j}} = \tilde{\beta}\frac{y_j}{P_m}\left(\frac{P_s}{y_j}\right)^{\epsilon}\left(\frac{P_m}{P_s}\right)^{\gamma} = c_{jm} \tag{2}$$

$$c_{js} = -\frac{\frac{\partial V}{\partial P_s}}{\frac{\partial V}{\partial y_j}} = \frac{y_j}{P_s}\left[1 - \tilde{\beta}\left(\frac{P_s}{y_j}\right)^{\epsilon}\left(\frac{P_m}{P_s}\right)^{\gamma}\right] = c_{js}. \tag{3}$$

Figure 1 plots the (individual) Engel curves for manufacturing goods and services. Richer individuals consume more manufacturing goods and services than poor individuals. For $\epsilon > 0$ Engel curves are non-linear for both goods, indicating the non-homotheticity of the preferences. Note that the preferences are only well defined if the income is sufficiently high, such

[3]The interpretation of l_j as actual individual labor endowment might be to close. l_i should be interpreted as an equivalent labor endowment which considers as well the distribution of capital and different skills among individuals.

that positive amounts of both goods are consumed, which is the case if $Y \geq \frac{1-\epsilon}{1-\gamma}\tilde{\beta}P_m^{\gamma}P_s^{\epsilon-\gamma}$. If $\epsilon = \gamma = 0$ the demand functions collapse to Cobb-Douglas demand functions.

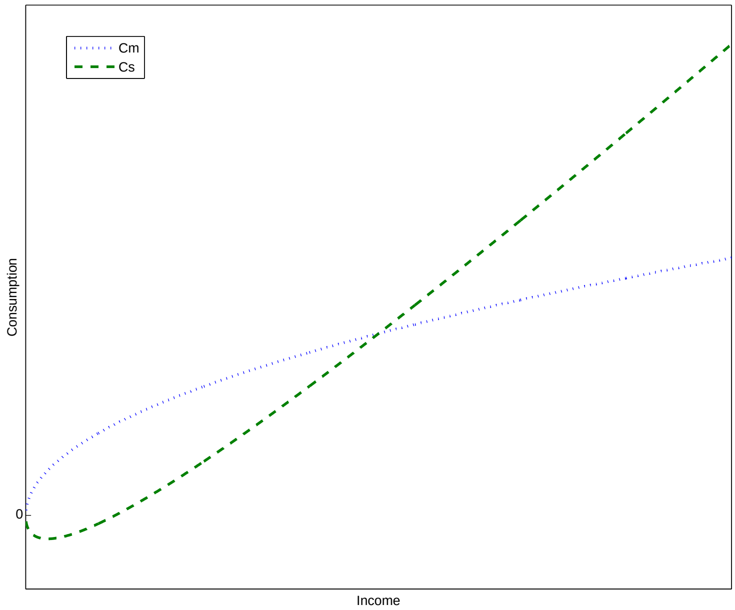

Figure 1: Individual consumption of manufactured goods and service: Engel curves. PIGL utility function. Prices are exogenous.[5]

I divide the population in $K \geq 1$ income classes of equal population size. I treat individuals within an income class as homogenous. This allows me to aggregate the total income as follows:

$$Y = \int_0^N y_j \; dj = \int_0^K \frac{N}{K} y_k \; dk, \tag{4}$$

where K gives the number of income classes and y_k is the (homogenous) income of all individuals in income class $k \in K$. I obtain the aggregated demand in the economy by taking the integral over all individuals in the economy.

[5]In the appendix I show some evidence that the Engel curves of the model are consistent with cross country consumption patterns of manufacturing and services.

$$c_m = \int_0^N c_{jm}\ dj = \beta P_m^{-1} P_s^{\epsilon} \left(\frac{P_m}{P_s}\right)^{\gamma} w^{-\epsilon} Y \phi \tag{5}$$

$$c_s = \int_0^N c_{js}\ dj = \frac{Y}{P_s} - \beta P_s^{\epsilon-1} \left(\frac{P_m}{P_s}\right)^{\gamma} w^{-\epsilon} Y \phi, \tag{6}$$

where $Y = \int_0^N y_j dj = wL$ is the aggregate income, $y = \frac{Y}{N}$ is the GDP per capita in the economy and $\beta = \frac{\tilde{\beta}}{K}$. I normalize the labor endowment of the average worker to one to interprete the wage rate in the model as GDP per capita, $w = y$. The inequality of the economy is given by

$$\phi = \int_0^K \left(\frac{wl_k}{wL}\right)^{1-\epsilon} dk, \tag{7}$$

where $\frac{wl_k}{wL} = \frac{y_k}{Y}$ is the share of income class k's income in total income. If the equality in the economy increases, ϕ increases. If I divide the economy in $K = 10$ income classes I can use decentile income shares to generate the parameter ϕ.[6]

As in Boppart (2011) ϕ fullfills the principle of transfers, scale invariance and decomposability and hence ϕ is good a indicator of income inequality. $\epsilon \in [0, 1)$ reflects the inequality aversion of the inequality indice ϕ, the higher is ϵ the more sensitive is ϕ for changes in the income shares. A completely unequal society would have $\phi = 1$, while complete equality would be $\phi = K^{\epsilon}$.

If $\epsilon \neq 0$, within country inequality has an impact on the aggreagated demands for manufacturing and services. For homothetic preferences and $\epsilon = 0$ inequality does not matter in the model as would be $\phi = 1$ and the aggreagte demands only depends on the aggregate income.

It is important to understand the implication of controlling for the income distribution. Increasing the total income, Y, without changing the income distribution can be seen as adding an individual to each income class. This

[6] As K goes to infinity the income classes get smaller until ϕ will reflect a completely continous income distribution.

will increase the demand for manufactured goods and services proportionally to the increase in total income. On the other hand, increasing the GDP per capita and holding the number of individuals and income distribution constant, raises the income of all individuals proportional to their income share. As all individuals are richer the relative consumption shifts for each individual towards services, which implies an increasing relative demand for services.

If income is redistributed from rich to poor households, holding the income constant, ϕ increases and the aggregated demand for manufacturing goods increases while it decreases for services.

It is straigth forward to derive the expenditure share for manufacture goods and services:

$$S_m = \frac{P_m c_m}{Y} = \beta P_s^{\epsilon} \left(\frac{P_m}{P_s}\right)^{\gamma} y^{-\epsilon} \phi \tag{8}$$

$$S_s = \frac{P_s c_s}{Y} = 1 - \beta P_s^{\epsilon} \left(\frac{P_m}{P_s}\right)^{\gamma} y^{-\epsilon} \phi. \tag{9}$$

In contrast to aggregate consumption the expenditure shares only depend on the GDP per capita and the income distribution.

2.2 Labor Market

Assume a closed economy. Each good is produced with labor as only input. a_s is the labor requirement in the service sector. We take the price P_s in the s sector as numeria, and the wage rate, w, is given by $a_s P_s = w$. Labor is completely mobile between the two sectors and hence the wage rate applies as well in the m sector.

Labor is supplied inelastically by all individuals and we denote the share of labor in the m sector by L_m. The total labor employed in manufacturing is $L_m L$.

Market clearing in the service sector implies that the production equals demand:

$$c_s = (1 - L_m)La_s. \tag{10}$$

By Walras law the market is cleared for the remaining m sector as well. I use equation (6) to express the share of labor allocated to manufacturing as a function of prices, income, total labor supply and inequality, see Appendix.[7]

$$L_m = \beta w^{-\gamma} a_s^{\gamma-\epsilon} P_m^{\gamma} \phi \tag{11}$$

For a given income per capita and price index of the manufacturing sector, increasing ϕ (equality), increases the labor share in manufacturing. This effect is driven by the demand side as more equality increases the demand for manufactured goods.

2.3 Production

The manufacturing good, x_m, is a composite of (intermediate) manufactured goods, c_i. x_m is created using a constant elasticty of substitution (CES) production function.

Maximize the function

$$x_m = \left(\int_\Omega c_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \tag{12}$$

$$\text{s.t.} \qquad \int_\Omega p_i c_i di = wLS_m$$

,

where $\sigma > 1$ is the constant elasticity of substitution and p_i is the price of the manufactured good i.

[7]Note that L_m has to be in the range of $[0, 1]$, which restricts the parameter values in the model.

I use a simple Krugman model in which the demand for each (intermediate) manufactured good, c_i, is given by:

$$c_i = \frac{p_i^{-\sigma}}{P_m^{1-\sigma}} S_m w L, \tag{13}$$

where the price index P_m is given by:

$$P_m = \left(\int_\Omega p_i^{1-\sigma} di \right)^{\frac{1}{1-\sigma}}. \tag{14}$$

Note that the demand for each variety depends on the overall income level of the society and the inequality parameter as the expenditure share of the (composite) manufactured good, S_m, is a function of w and ϕ.

Each (intermediate) manufactured good is produced by an individual firm under monopolistic competition. Each firm has to cover its fixed costs, f, in terms of labor units to produce. Marginal costs (in terms of labor) are $\frac{1}{\psi}$. The total costs of production in units of labor are $TC = f + \frac{1}{\psi} c_i$. Hence the constant optimal price is:

$$p = p_i = \frac{\sigma}{\sigma - 1} \frac{w}{\psi} \quad \forall i. \tag{15}$$

By symmetry the price index in the m sector is:

$$P_m = \left(n \left(\frac{\sigma}{\sigma - 1} \frac{w}{\psi} \right)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} = n^{\frac{1}{1-\sigma}} \frac{\sigma}{\sigma - 1} \frac{w}{\psi}, \tag{16}$$

where n gives the number of (intermediate) manufactured goods or number of firms.

The profits for each (intermediate) manfuctured good are given as:

$$\pi_i = p_i c_i - \left(f w + \frac{w}{\psi} c_i \right) = w \left(\frac{c_i}{(\sigma - 1)\psi} - f \right). \tag{17}$$

Free entry ensures that each firm in the market has zero profits.

$$\pi_i = 0 \Rightarrow c_i = (\sigma - 1)\psi f \qquad \forall i \tag{18}$$

The number of firms in the m sector is derived using the labor market clearing condition:

$$n\left(f + \frac{c_i}{\psi}\right) = L_m L \tag{19}$$

$$n = \frac{L_m L}{\sigma f}. \tag{20}$$

In equilibrium n firms produce and sell for price p. We express the employment share in the m sector in terms of the number of firms and the inequality by using (11) and (16):

$$L_m = \beta a_s^{\gamma-\epsilon}\left(\frac{\sigma}{\sigma-1}\right)^{\gamma}\psi^{-\gamma}n^{\frac{\gamma}{1-\sigma}}\phi. \tag{21}$$

Substitute this in (20) and solving for n yields:

$$n = \left(\frac{L}{\sigma f}\beta a_s^{\gamma-\epsilon}\left(\frac{\sigma}{\sigma-1}\right)^{\gamma}\psi^{-\gamma}\phi\right)^{\frac{1-\sigma}{1-\sigma-\gamma}}. \tag{22}$$

The optimal number of firms in autarky is a function of the inequality and the GDP per capita. As $\sigma > 1$ the exponent, $\frac{1-\sigma}{1-\sigma-\gamma}$, will be always positive and the number of firms in the m sector increases with ϕ and L.

I can express (11) in terms of the inequality parameter ϕ using (22) and (21):

$$\begin{aligned} L_m &= \left(\frac{L}{f\sigma}\right)^{\frac{\gamma}{1-\sigma-\gamma}}\left(\beta a_s^{\gamma-\epsilon-1}\left(\frac{\sigma}{\sigma-1}\right)^{\gamma}\psi^{-\gamma}\right)^{\frac{1-\sigma}{1-\sigma-\gamma}}(w\phi)^{\frac{1-\sigma}{1-\sigma-\gamma}} \\ &= \left(\frac{L}{f\sigma}\right)^{\frac{\gamma}{1-\sigma-\gamma}}\left(\beta\left(\frac{\sigma}{\sigma-1}\right)^{\gamma}\psi^{-\gamma}\right)^{\frac{1-\sigma}{1-\sigma-\gamma}}\phi^{\frac{1-\sigma}{1-\sigma-\gamma}}a_s^{\frac{(1-\sigma)(\gamma-\epsilon)}{1-\sigma-\gamma}} \\ &= \left(\frac{L}{f\sigma}\right)^{\frac{\gamma}{1-\sigma-\gamma}}\left(\beta\left(\frac{\sigma}{\sigma-1}\right)^{\gamma}\psi^{-\gamma}\right)^{\frac{1-\sigma}{1-\sigma-\gamma}}\phi^{\frac{1-\sigma}{1-\sigma-\gamma}}\left(\frac{w}{P_s}\right)^{\frac{(1-\sigma)(\gamma-\epsilon)}{1-\sigma-\gamma}} \end{aligned} \tag{23}$$

Taking the derivatives of equation (23) with respect to ϕ, L and as leads to the following proposition:

Proposition 1: *For non-homothetic preferences, $\epsilon, \gamma > 0$ and $\sigma > 1$, the share of labor in the manufacturing sector will be higher in a country with a more equal income distribution. A higher population, decreases the labor share of manufacturing. If $\gamma - \epsilon > 0$ a higher productivity in the service sector, a_s, increases the labor share in manufacturing, which implies that a higher GDP per capita leads to a lower labor share in manufacturing.*

2.4 Consumption Patterns

I analyse the aggregate consumption pattern in the context average income and income inequality. Assume that the technology in the service sector exogenously increases. For a given price level P_s this implies an increasing wage rate in the economy, i.e., a higher GDP per capita.

I express equation (5) in terms of n and a_s using equation (16):

$$c_m = \beta n^{\frac{\gamma-1}{\sigma-1}} \left(\frac{\sigma}{\sigma-1}\right)^{\gamma-1} \psi^{1-\gamma} a_s^{\gamma-1} L\phi. \tag{24}$$

As a better service technology, a_s, increases the number of varieties in the economy by equation (22) if $\gamma > \epsilon$, I substitute equation (22) to obtain an expression of consumption that depends only on the productivity parameters:

$$c_m = (\beta L\phi)^{\frac{2(1-\gamma)-\sigma}{1-\sigma-\gamma}} (\sigma f)^{\frac{\gamma-1}{1-\sigma-\gamma}} \left(\frac{\sigma}{\sigma-1}\right)^{\frac{(1-\gamma)(2\gamma-1+\sigma)}{1-\sigma-\gamma}} a_s^{\frac{(1-\gamma)(\gamma-\epsilon)+(\gamma-1)(1-\sigma-\gamma)}{1-\sigma-\gamma}}, \tag{25}$$

for $1 > \gamma > \epsilon$ and $\sigma > 1$ the exponent of a_s is always negative and hence an increase of average income decreases the aggregate consumption of the manufactured good. On the other hande a higher average income increases the aggregate consumption of services. Next notice that more equality (higher ϕ) and a bigger population (L) will increase the consumption of manufactured goods if $\frac{2-\sigma}{2} < \gamma$, which is always for $\sigma > 2$. The reverse applies to the service sector.

Richer and more unequal economies produce more services and less manufactured goods. Figure 2 shows the responses graphically. For a country in autarky more equality implies that more varieties are produced in this country, $\frac{\partial n}{\partial \phi} > 0$ and hence the price index P_m is lower. Manufactured goods are relatively cheaper in more equal countries and are more consumed in such countries.

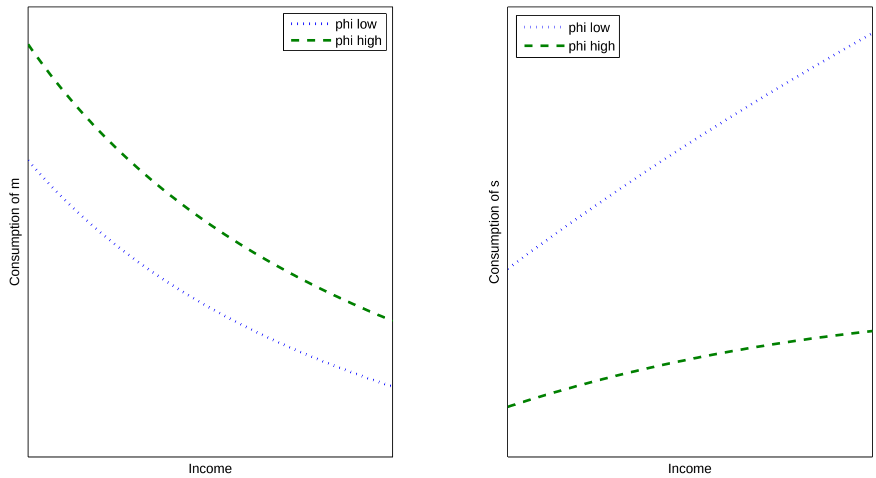

Figure 2: Increasing average income (GDP per capita) and its effects on consumption. A higher ϕ reflects more equality in the economy.

2.5 Bilateral Trade

I analyse the trade flows of manufactured goods between two countries which might differ in inequality and GDP per capita. Trade is subject to iceberg trade costs ($\tau \geq 1$). Foreign variables are denoted by an asterix.

The price of each (intermediate) manufactured good in a country is still given by (15) which will be the same in the two countries if the GDP per capita to productivity ratio and the elasticity of substition, σ, is the same in the two countries:

$$p = \frac{\sigma}{\sigma - 1}\frac{w}{\psi} \qquad\qquad p^* = \frac{\sigma}{\sigma - 1}\frac{w^*}{\psi^*}$$

.

The price index of the composite manufactured good depends on the prices in the two countries and iceberg trade costs:

$$P_m = \left(np^{1-\sigma} + n^*(\tau p^*)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} \qquad\qquad P_m^* = \left(n(\tau^* p)^{1-\sigma} + n^* p^{*1-\sigma}\right)^{\frac{1}{1-\sigma}}. \tag{26}$$

The production of an intermediate manfuctured good, c_i, in the domestic country is simply $c_{it} = c_i + \tau^* c_i^*$ and hence the profit function is $\pi = w\left(\frac{c_{it}}{(\sigma-1)\psi} - f\right)$. Free entry ensures that all firms produce the same output $c_{it} = (\sigma - 1)\psi f$.

The labor market clearing conditions follow from equation (19):

$$\begin{aligned} n\left(f + \frac{c_{it}}{\psi}\right) &= L_m L \quad \Rightarrow \quad n = \frac{L_m L}{\sigma f} \\ n^*\left(f + \frac{c_{it}^*}{\psi*}\right) &= L_m^* L^* \quad \Rightarrow \quad n^* = \frac{L_m^* L^*}{\sigma f}. \end{aligned} \tag{27}$$

The number of firms are derived as previously, but I use the price index from equation (26):

$$\begin{aligned} n &= \frac{L}{f\sigma}\beta a_s^{\gamma-\epsilon}\left(np^{1-\sigma} + n^*(\tau p^*)^{1-\sigma}\right)^{\frac{\gamma}{1-\sigma}}\phi \\ n^* &= \frac{L^*}{f\sigma}\beta a_s^{*\gamma-\epsilon}\left(n(\tau^* p)^{1-\sigma} + n^* p^{*1-\sigma}\right)^{\frac{\gamma}{1-\sigma}}\phi^*. \end{aligned} \tag{28}$$

I derive the slope by solving the implicit function for ϕ:

$$\frac{1}{\zeta}\left(n^{\frac{\sigma+\gamma-1}{\gamma}}p^{1-\sigma} + n^{\frac{\sigma-1}{\gamma}}n^*(\tau p^*)^{1-\sigma}\right)^{\frac{\gamma}{\sigma-1}} = \phi, \tag{29}$$

where $\zeta = \frac{L}{f\sigma}\beta a_s^{\gamma-\epsilon}$

Everything else equal, if n increases, then n^* have to decrease, so $\frac{\partial n^*}{\partial n} < 0$. By symmetry it follows that $\frac{\partial n}{\partial n^*} < 0$. More firms in the domestic country, imply more competition, which decreases the number of foreign firms.

Figure 3 plots this two equations. The functions can be interpreted as "best response functions" for the number of firms in each country. The intersection with the axis gives the optimal number of firms in autarky. Trade decreases the number of firms in each country, but increases the number of available varieties in both countries.
An increasing ϕ (more equality) will shift the functions to the north-east. An increase in ϕ reallocates firms from the foreign country to the domestic country. Equality has a spillover effect on the production of the foreign country.
The curvature of the functions depends (among others) on the trading costs, the lower the trading costs, the bigger is the reallocation of firms when the inequality changes.

In equilibrium the equations (28) hold simultaneously. For complete free trade, $\tau = 1$, between two identical countries in terms of prices, $p = p^*$, population, $L = L^*$, labor productivity in the service sector, fixed costs, elasticity of substitution, ϵ, β and γ, but different levels inequality, the equilibrium conditions can be combined and simplified:

$$\frac{n}{n^*} = \frac{\phi}{\phi^*}. \tag{30}$$

Substituting this equation into equation (28), I take the derivative of the number of firms with respect to equality in each country. The equilibrium number of manufacturing firms in a country depends positively on its own equality and negatively on the equality in the other country:

$$\frac{\partial n}{\partial \phi} > 0 \qquad \frac{\partial n^*}{\partial \phi^*} > 0 \qquad \frac{\partial n^*}{\partial \phi} < 0 \qquad \frac{\partial n}{\partial \phi^*} < 0, \tag{31}$$

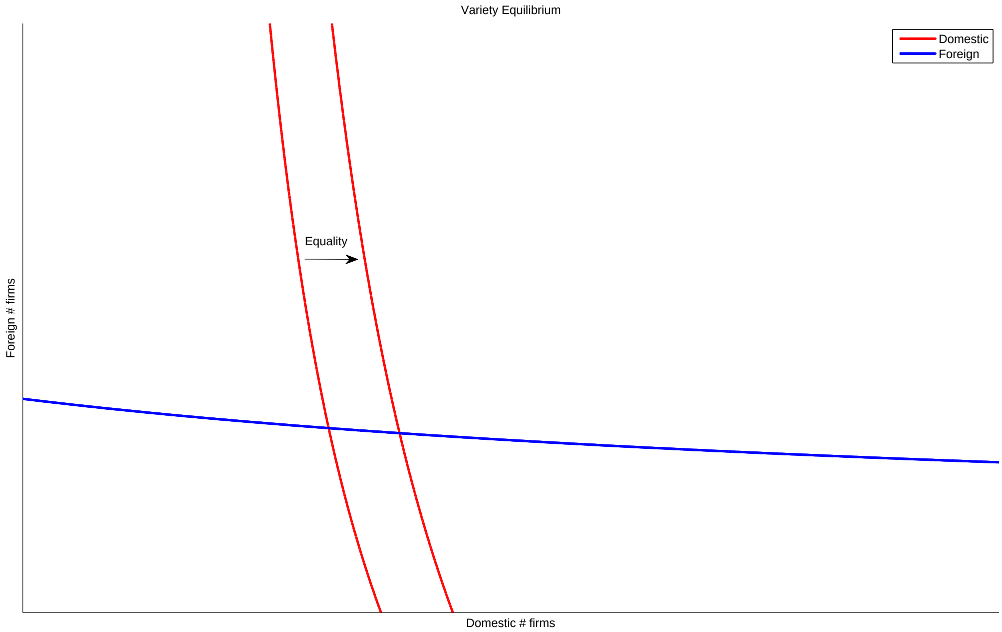

Figure 3: "Best responses" for number of (intermediate) manufacturing firms in two countries.

see appendix.

More equality in the domestic country increases the domestic demand for manufacturing goods, which leads to more domestic firms. More equality in the foreign country, implies that more firms produce and export in the foreign country; the increased foreign competition has a negative effect on domestic firms.

2.6 Trade Patterns

2.7 Two Countries Trade

The optimal number of firms is interdependent for the two countries. Within country and between country inequality are important to determine the structure of the economy and hence trade patterns. Without loss of generality we focus only on the trade patterns of the domestic country. I analyse only exports, but exports of the domestic country are the imports of the foreign country, hence I can easily transfer our results to an import perspective. For simplicity I assume that both countries are symmetric in all variables but inequality and the price of each variety is one in each country.

The value of exports from the domestic country is given by the multiplication of the equilibrium number of domestic (intermediate) manufactured goods, the foreign consumption of each variety in the foreign country and the price for (intermediate) manufacturing goods.

$$\text{Export value} = \hat{n}pc^* \tag{32}$$

where $c^* = \frac{(p\tau^*)^{-\sigma}}{P_m^{*1-\sigma}} w^* L^* S_m^*$ is the consumption in the foreign country of each variety produced in the domestic country. An increase in the equality in the domestic country (ϕ increases), increases the exports if

$$\frac{\partial X}{\partial \phi} > 0. \tag{33}$$

For free trade between two symmetric countries, that differ only in their equality level, this condition holds if $\frac{\gamma}{\sigma+\gamma-1}\phi < \phi^*$. If the domestic country has a high level of equality and the foreign country is very unequal, an increase of the domestic equality decreases exports. On the other hand, if the relative inequality is small, an increase of equality in the domestic country increases exports. Similarly, we find that if $\frac{\gamma}{\sigma+\gamma-1}\phi^* < \phi$, than more equality in the foreign country increases exports of the domestic country.

Proposition 2 *Consider free trade between two identical countries in terms of prices, $p = p^*$, population, $L = L^*$, labor productivity in the service sector, fixed costs, elasticity of substitution, ϵ, β and γ, but with possibily different equality levels. If $\frac{\gamma}{\sigma+\gamma-1}\phi < \phi^*$, the exports from the domestic country increase with the equality of the domestic country. If $\frac{\gamma}{\sigma+\gamma-1}\phi^* < \phi$, then exports from the domestic country increase with the equality of the* *foreign country.*

Proof see appendix.

corollary *If two trading countries are similar in their equality levels,* $\frac{\gamma}{\sigma+\gamma-1} < \frac{\phi^*}{\phi} < \frac{\sigma+\gamma-1}{\gamma}$*, exports increase with equality of each of the countries.*

The effect of an increasing technology in the service sector and hence increasing GDP per capita on the exports cannot be solved analytically.[8] I solve the model using the calibration as shown in Table 1. I will show later, that the values for γ, ϵ and ϕ are empirically consistent. The results are given graphically in Figure 4.

A higher domestic GDP per capita decreases the exports, as the domestic exports become more expensive and the foreign import demand decreases. On the other hand, an increasing GDP per capita in the foreign country increase the exports, as the foreign market becomes more attractive.

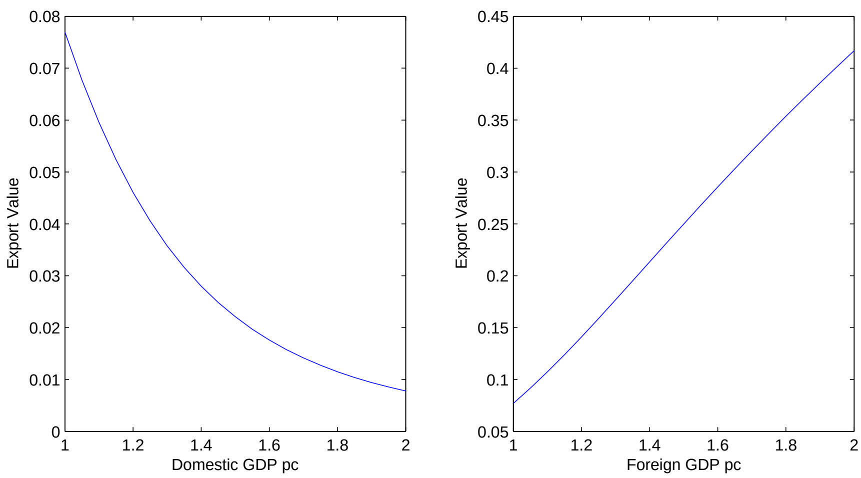

Figure 4: Domestic manufactured exports using the calibration in Table 1. Domestic and foreign GDP per capita increase due to an increasing labor productivity in the service sector. Prices are endogeous.

[8]The assumption about the price equality in the two countries will be violated, if $w^* \neq w$ then $p^* \neq p$.

Variable	L	L^*	f	f^*	σ	β	P_s	P_s^*	a_s	a_s^*
Value	1	1	0.01	0.01	5	2.1	1	1	[1,2]	[1,2]
Variable	w	w^*	γ	ϵ	ψ	ψ^*	τ	τ^*	ϕ	ϕ^*
Value	[1,2]	[1,2]	0.44	0.21	1.65	1.65	1.3	1.3	1.6	1.6

Table 1: Calibration for two country trade model.

3 Empirics

The individual demand functions can be aggregated without losing information about the equality in the economy, so I construct the equality measure ϕ and confirm the prediction of the theoretical model. In this section I show that the model is qualitatively consistent with the observed data, using mainly reduced form regressions. I establish a the link between equality and labor allocation and finally show that more equality leads to more aggregate manufacturing exports. Then, I estimate the parameter of the model in a closed economy. I use this estimates to solve for multi-country trade equilibrium.[9].

3.1 Data Description

The data for inequality is taken from the World Income Inequality Database 2 (WIID2). This database might be the most comprehensive for inequality, but still its coverage is limited. When possible we used income inequality and not consumption inequality. The inequality indices are always taken for the greatest coverage, i.e. country wide surveys were preferred to regional surveys. The parameter ϕ is constructed as in the theoretical model, using the decentil distribution of income from the WIID2 data set with $\epsilon = 0.21$. An increasing ϕ implies a more equal society. This index is negatively correlated with the GINI coefficient, corr $= -0.98$. Population, GDP, GPD per

[9]The estimated parameters were already used to calibrate the model for the numerical solution in Figure 4

capita, trade share (openness) and employment share in manufacturing are taken from the World Bank indicators. Productivity measures and number of firms (more than 20 employees) are from the OECD STAN. database. Average years of schooling is from the Barro and Lee.
We use aggregated manufacturing exports from the ComTrade data accessed through WITS. Manufacturing goods are defined by the two-digit HS classification 27 to 97. The final data set spans from 1990 to 2010 and includes 73 countries. For distance we use the CEPII values.
Table 2 shows the summary statistics for these variables.

Table 2: Summary statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Population in 1,000	2001	41036.14	145473.7	9.53	1311020
GDP in mil USD	1978	252798.6	979108.3	14.93581	1.33e+07
GDP pc in 1,000 USD	1978	8.560051	11.3552	.1110017	72.95976
Exports in 1,000 USD	9737	748095.3	4377642	0.007	1.53E+08
ϕ	382	1.552616	0.0463278	1.436936	1.64149
Gini	708	38.30725	10.67954	19.68706	63.7
90:50	382	2.358993	0.639408	1.548791	4.450881
50:10	382	3.922264	2.266311	1.786389	20.76633
90:10	384	10.20845	8.767507	2.852523	73.894
Distance	2028	5787.901	4440.541	162.1818	19054.85
Employment manufacturing	419	41.35	11.93	21	88.3
Trade share	485	77.45	42.49	14.93	278.99
Service productivity	195	0.682	1.087	0.309	7.111
Manufacturing productivity	197	41705.19	22783.13	282.7734	101192.7
Number of firms	118	14210	19199	175	111558
Freedom House Index	3498	4.368	2.012	1	7
Schooling (years)	3302	6.568	2.994	0.108	13.190

3.2 Employment share in Manufacturing

The theoretical model predicts that more equal countries have a bigger manufacturing sector in terms of number of firms and labor allocation. The same holds for countries with higher GDP per capita. On the other hand, a higher labor endowment reduces the allocation of labor in the manufacturing sector, see equation (23). Table 3 shows the results for a reduced form estimation of the log share of workers in manufacturing for a unbalanced panel of 65 countries between 1990 - 2010.

Table 3: Regression table. Employment share in manufacturing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ϕ	1.265	1.289	1.281	1.381	1.162	1.245	1.738
	(.654)*	(.575)**	(.570)**	(.627)**	(.544)**	(.594)**	(.776)**
GDP pc		.089	.082	.119	.083	.104	.134
		(.024)***	(.024)***	(.027)***	(.023)***	(.027)***	(.037)***
Population		-.150	-.133	-.072	-.178	-.097	.183
		(.132)	(.133)	(.131)	(.129)	(.131)	(.224)
Schooling					.260	.213	.249
					(.085)***	(.089)**	(.114)**
Openness				.108		.092	.119
				(.041)***		(.040)**	(.063)*
FHouse			.083			.078	.116
			(.039)**			(.037)**	(.057)**
N	419	419	418	415	414	409	367
R^2	.955	.957	.958	.959	.953	.955	.958

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
All variables in logs. 65 countries, 1990-2010. Country and year fixed effects.

All estimates show that more equality and higher GDP per capita have a positive impact on the labor share in manufacturing as suggested by the model. The estimations suggest that indeed $\gamma > \epsilon$. Equation (23) predicts that population size, L, has a negative influance on the labor allocation on manufacturing. The coefficients of L in columns (1) to (6) are negative, but not significant. This might be due to the fact that $\frac{\gamma}{1-\sigma-\gamma}$ should be small and close to zero. In column (7) we estimate the labor in manufacturing using the five year lagged inequality index, ϕ to control for possible endogeneity. The results are persistent, although population has now a positive sign, but is still insignificant.
Further controls, such as average years of schooling, openness (Trade volume / GDP) or the Freedom House index do not change the results of the estimations and only add very little explanatory power.

Table 4: Regression table. Employment share in manufacturing

	(1)	(2)	(3)	(4)
Gini	-.246			
	(.135)*			
90:10 ratio		-.062		
		(.025)**		
50:10 ratio			-.075	
			(.027)***	
90:50 ratio				-.062
				(.074)
GDP pc	.149	.106	.108	.102
	(.054)***	(.028)***	(.029)***	(.028)***
Population	.024	-.112	-.123	-.167
	(.378)	(.133)	(.132)	(.138)
Years of schooling	.259	.234	.248	.265
	(.140)*	(.096)**	(.094)***	(.099)***
Openness	.218	.092	.085	.081
	(.064)***	(.043)**	(.042)**	(.042)*
Freedom House	.112	.087	.084	.076
	(.047)**	(.036)**	(.036)**	(.037)**
N	450	402	400	400
R^2	.925	.957	.958	.956

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
All variables in logs. 65 countries, 1990-2010. Country and year fixed effects.

Table 4 checks the previous results for robustness using alternative inequality indicators. The Gini coefficient has a negative effect on the labor share, as a higher Gini implies more inequality and a higher ϕ indicates more equality. The coefficient is only marginally significant (p-value 0.069). It might be that the effects in the extremes of the distribution are captured incompletely by the Gini coefficient, see Francois and Kaplan (1996). A closer look shows that inequality in the lower tail (50:10 ratio) has strong effect on the labor share. Again this reconciles with the model intuition, redistribution towards the very poor should have stronger effects on the consumption of manufacturing goods than redistribution among relatively rich individuals who already consume relatively more services.

3.3 Trade Patterns

In this section I show that the trade patterns in our model reconcile with observed patterns. I show that for bilateral trade exports increase with domestic and foreign equality. I estimate an augmented gravity model to show that the model qualitively fits the data. The dependent variable is bilateral trade in aggreagated manufacturing, HS 27-97, and I control for equality, ϕ, GDP per capita, total GDP, population of the exporter and importer and distance between the exporter and importer. Table 5 shows the results of these estimations. All estimates included importer, exporter and time fixed effects.

Column (1) gives the most basic estimation, using GDP per capita, popualtion and the equality indices. Higher equality in the exporting country and the importing country increases the export value of manufacturing goods. The GDP per capita in the importing country has a positive effect, as the market becomes more attractive. A higher GDP per capita is insignificant and hence we cannot reject the model predictions. The second column shows the estimates including total GDP and population instead of GDP per capita. As I controll for population size the effect of equality is identical to the estimation in column (1).

In Column (3) I exclude the inequality variables from the estimation to

Table 5: Regression table. Aggregate manufacturing exports.

	(1)	(2)	(3)	(4)	(5) Rich	(6) Poor
ϕ Im	3.113*	3.113*			3.439**	2.928
	(1.667)	(1.667)			(1.670)	(6.397)
ϕ Ex	6.171**	6.171**			6.451**	8.215
	(2.595)	(2.595)			(3.021)	(7.011)
Gini Im				-0.287		
				(0.231)		
Gini Ex				-0.955***		
				(0.298)		
GDP pc Im	1.000***		0.991***	0.996***	1.028***	0.863**
	(0.0931)		(0.0930)	(0.0931)	(0.0951)	(0.347)
GDP pc Ex	0.0668		0.0741	0.0477	-0.0335	0.923**
	(0.0974)		(0.0971)	(0.0982)	(0.103)	(0.446)
GDP Im		1.000***				
		(0.0931)				
GDP Ex		0.0668				
		(0.0974)				
Pop. Im	-0.799	-1.799***	-0.830	-0.870	-1.032	1.174
	(0.632)	(0.632)	(0.633)	(0.637)	(0.637)	(2.468)
Pop. Ex	-0.845	-0.912	-0.833	-1.153	-1.073	5.807*
	(0.737)	(0.736)	(0.739)	(0.745)	(0.904)	(3.005)
Dist.	-1.966***	-1.966***	-1.966***	-1.967***	-1.966***	-2.151***
	(0.0337)	(0.0337)	(0.0337)	(0.0336)	(0.0360)	(0.0858)
N	9737	9737	9737	9737	8446	1291
R^2	0.849	0.849	0.849	0.849	0.856	0.756

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Aggregated exports in manufacturing, HS 28 - 97. 73 countries, 1990-2006. All variables in logs.

Importer, exporter and year fixed effects.

estimate a standard gravity equation splitting total GDP into GDP per capita and population. The coeffiecents are almost identical to the previous estimations.

Column (4) checks for robustness, using the Gini coefficient instead of ϕ for the same sample. The effect for the importers Gini coefficient is much weaker, the possible reasons for this have been discussed above. Columns (5) and (6) we split the sample into rich and poor exporting countries, where poor countries are in the lower 25% percentile in terms of GDP per capita. I find that the effect of equality is only significant positive for rich countries. An increase in the equality in poor countries are more likely to shift consumption and labor from manufacturing to agriculture, while in rich countries it would shift from services to manufacturing.[10] The coefficient for the GDP per capita of the exporter is negative, but not significant. Still this squares with the model prediction.

In Table 6 I split the sample such that the exporting country has either a higher or a lower inequality than the importing country. If $\phi_{\text{Ex}} < \phi_{\text{Im}}$ an increase of ϕ_{Ex} makes the two countries more equal and hence the condition from Proposition 2 is more likely to hold. In this case we expect that exports increase with ϕ_{Ex} and conversly stay constant or decrease with ϕ_{Im}, which is exactly the result of column (1). In column (2) we find the (weaker) oposite effect, which again squares with the Proposition 2. Last, I expect that as both equality levels get more equal, countries trade more, as shown in column (3).

3.4 Calibration Closed Economy

The reduced form estimation clearly shows the positive impact of inequality on the sectoral allocation of labor and trade patterns. We directly estimate

[10]To adapt the model to poor countries we would need to relabel manufacturing as agriculture and services as manufacturing.

Table 6: Regression table.

	(1)	(2)	(3)
	$\phi_{\text{Ex}} < \phi_{\text{Im}}$	$\phi_{\text{Ex}} > \phi_{\text{Im}}$	
ϕ Im	-1.335	3.627*	
	(3.963)	(2.040)	
ϕ Ex	12.78***	-3.266	
	(4.029)	(3.098)	
$\lvert\phi_{\text{Ex}} - \phi_{\text{Im}}\rvert$			-0.0310*
			(0.0179)
GDP pc Im	0.797***	1.131***	0.992***
	(0.166)	(0.121)	(0.0931)
GDP pc Ex	-0.141	0.144	0.0762
	(0.138)	(0.157)	(0.0970)
Pop. Im	-0.216	-1.747**	-0.848
	(1.131)	(0.780)	(0.632)
Pop. Ex	-5.955***	2.115*	-0.867
	(1.171)	(1.123)	(0.739)
Dist.	-2.008***	-1.914***	-1.944***
	(0.0740)	(0.0700)	(0.0369)
N	4523	5214	9737
R^2	0.859	0.868	0.849

Standard errors in parentheses. * $p < 0.10$,** $p < 0.05$, *** $p < 0.01$
Aggregated exports in manufacturing, HS 28 - 97. 73 countries, 1990-2006. All variables in logs. Importer, exporter and year fixed effects.

the parameters of the model. The labor share in the manufacturing sector is described by equation (11). We use $\tilde{P}_m = n\left(\frac{\sigma}{1-\sigma}\frac{w}{\psi}\right)$ to completly isolate the exponent of the price index and re-write equation (11) as:

$$L_m = \beta a_s^{\epsilon-\gamma} \tilde{P}_m^{\frac{\gamma}{1-\sigma}} w^{-\gamma} \phi, \tag{34}$$

and take logs:

$$log(L_{mit}) = log(\beta) + (\gamma-\epsilon) log(a_{sit}) + \frac{\gamma}{1-\sigma} log(\tilde{P}_{mit}) - \gamma log(w_{it}) + log(\phi_{it}) + \eta_{it}, \tag{35}$$

where the subscripts it indicates country i at time t and η is an iid error term.

I estimate the above equation for a panel of OECD countries. Unfortunately, only a limited number of observations can be used to estimate the equation due to data constraints, mainly in terms of the labor productivity in the service sector, a_s, the number of manufacturing firms, n, and the inequality measure ϕ. In total I estimate the above equation with 118 observations.[11] I take the share of workers in the non-service sector as dependent variable. ϕ is calculated by the WIID data set using $\epsilon = 0.21$. I use an iterative procedure to obtain an value for ϵ. First, I estimate the equation (35) starting with an arbitrary ϵ, then I obtain the estimates and check if the choosen ϵ is close to the estimate. If not I update the guess and estimate the equation again, until the estimation converges.
I use the OCED STAN database to obtain total domestic production of services (in monetary values) and employment in the service sector. Equation (10) is used to calculate a_s which is the labor productivity in the service sector. The price index $\tilde{P}_m$ was constracted for a closed economy, where I calculate the labor productivity in manufacturing in the same way as for service sector, again using OECD STAN data. From the same data base the number of firms is taken.

[11] A list of countries and years is in the appendix

Table 7: Structural estimation. Employment share in manufacturing.

	Coefficient	(1) OLS	(2) Constrained
$log(\phi)$		.799 (1.117)	1
log(GDP pc)	$-\gamma$	-.443 (.0349)***	-.441 (.0334)***
$log(a_s)$	$\gamma - \epsilon$	.230 (.0420)***	.228 (.0394)***
$log(P_m)$	$\frac{\gamma}{1-\sigma}$	-.030 (.009)***	-.029 (.009)***
constant	$log(\beta)$	.832 (.517)	.740 (.155)***

Robust standard errors in parentheses. * $p < 0.10$,** $p < 0.05$, *** $p < 0.01$
Unbalanced panel of 22 countries between 1991 - 2004. 118 Observations.
R^2 for the OLS regression is 0.73.

Table 7 presents the results of a OLS and a constraint OLS regression. All coefficients have the expected signs and are highly significant. The theoretical model suggests that the coefficient for ϕ is one, but the estimation underpredicts the coefficient. Still I cannot reject the hypothesis that the coefficient is different from one. This is due to the high standard error might which might arise from the limited sample and the fact that ϕ does not have a big variation.[12] If I constraint the coefficient for ϕ to be one, the estimates only change very slightly.

I calcuate the parameter ϵ using the coefficient of GDP per capita and labor productivity in ther service sector, a_s, which yields $\epsilon = 0.21$. ϵ is clearly smaller than γ, which is reflected in the coefficient of a_s. The results are very close to the estimates of Boppart (2011) who optained $\gamma = 0.4$ and $\epsilon = 0.22$ using data from the US consumption survey. The estimate for coefficient of P_m is rather low, using $\sigma = 5$ and $\gamma = 0.44$, the estimate should be -0.11, or the σ parameter should be much higher.[13] Lastly, I use the constant to calcualte the value for β as 2.1.

[12] $max(\phi) = 1.64$, $min(\phi) = 1.56$, $var(\phi) = 0.00026$.

[13] The results from the simulated trade flows do not change dramatically if I use for example $\sigma = 12$. The correlation between observed and predicit trade flows is about 0.77.

4 Multi-Country Trade

I generalize the model to trade between multiple countries by adapting the price index P_m to multiple countries. Hence equation (26) becomes:

$$P_{mi} = \left(\sum_j n_j (\tau_{ij} p_j)^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \tag{36}$$

where the subscript i indicates the exporter and j the importer. τ_{ij} are iceberg trade costs, with $\tau_{ii} = 1$ and $\tau_{ij} > 1$ if $i \neq j$. The equilibrium is defined by a system of non-linear implicit functions as in equation (28) using the price index equation (36). The number of firms in country i depends on the number of firms all countries.

I solve this system of equations for 13 OECD countries in the year 2000.[14] I use the calibration for γ and ϵ as given in the previous section. The data for ϕ is taken from the WIID dataset, productivity measures were calcualted using data from OECD STAN database. Population and GDP were taken from the Penn World Tables. The iceberg trade costs are asymmetric and taken from Egger and Nigai (2012).[15]
Using only OECD countries for the analytical solution has three advantages. First, these countries were already used to estimate the parameters of the model. Second, tariffs and trade costs between these countries are small, thus they reconcile best with the assumption of free trade. Last, there is no country pair that does not trade, thus we are not concerned about zeros in the trade matrix. Still trade among these 13 countries accounts for about 43% of all trade in manufacturing goods.

Figure 5 plots bilateral trade predicted by the theoretical model against the observed bilateral trade.The straight line in the graph is a linear regression of observable exports on predicted exports. The model can explain a

[14] Austria, Belgium, Czech Republic, Germany, Denmark, Finland, France, Greece, Italy, Korea, Luxembourg, Norway, Sweden, United States

[15] Where trade costs where missing, they were approximated by a neighbouring country's trade costs. The results are robust for reasonable changes in the trade costs.

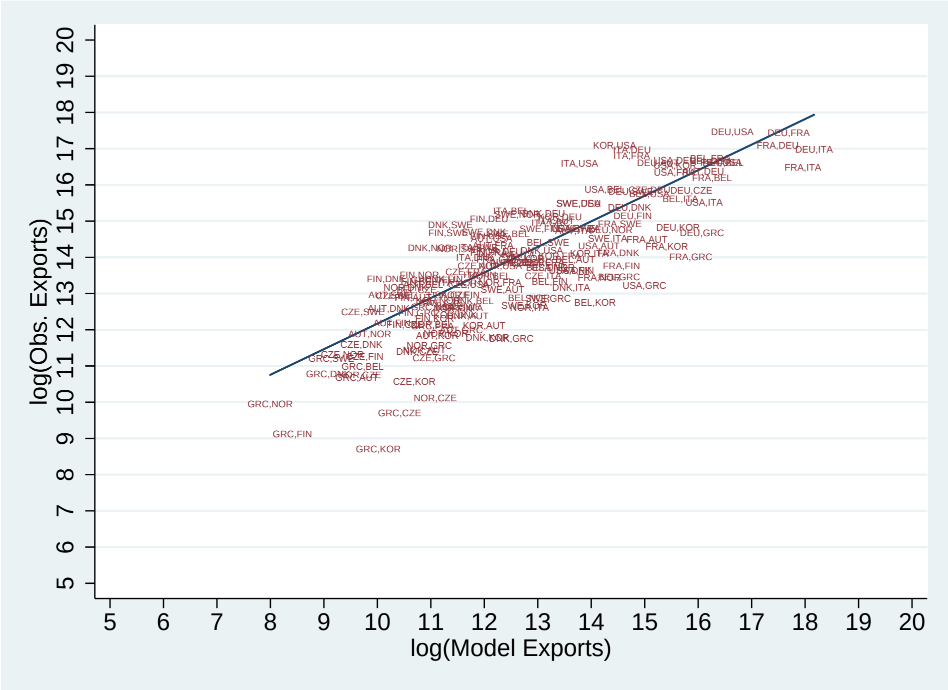

Figure 5: Model predicted bilateral trade vs. observed bilateral trade, aggregated manufacturing, SITC 5-9, 13 OECD countries, year 2000, UN Comtrade data. Corrlation between observed and predicted trade flows is 0.83.

significant part of bilateral trade in manufacturing. The corrlation between observed and predicted trade flows is 0.83.

5 Counterfactuals

As shown in the previous section, the model fits the observed data qualitatively and quantitivaly very well, which makes it highly suitable to look at counterfactuals.

5.1 Trade flows and Inequality

If the equality parameter ϕ increases in all countries by 1%, the bilateral trade increases in all countries on average by 0.97%. An increasing equality of 1% in the US increases the exports of the US to the remaining 12 country by roughly 0.9%, on the other hand each of the remaining 12 countries increase their exports to the US by about 0.05%. The export elasticity with respect to its own equality is close to one. But, there is a negative spillover effect on trade among the remaining 12 countries, which decreases trade between these 12 countries in average by 0.083%. The net effect for trade for the remaining 12 countries is negative, which implies that more equality in the US crowds out trade.

5.2 Welfare effects

Intuitively gains from trade, will not be equally distributed among income decentiles. More trade lead to a lower price index of manufacturing. As poorer individuals spend relatively more on manufacturing their decentile specific consumper price index decreases more than for richer individuals, which implies an relative welfare gain. 6 shows the gains from trade if trade costs τ would be one for all 13 OECD countries.

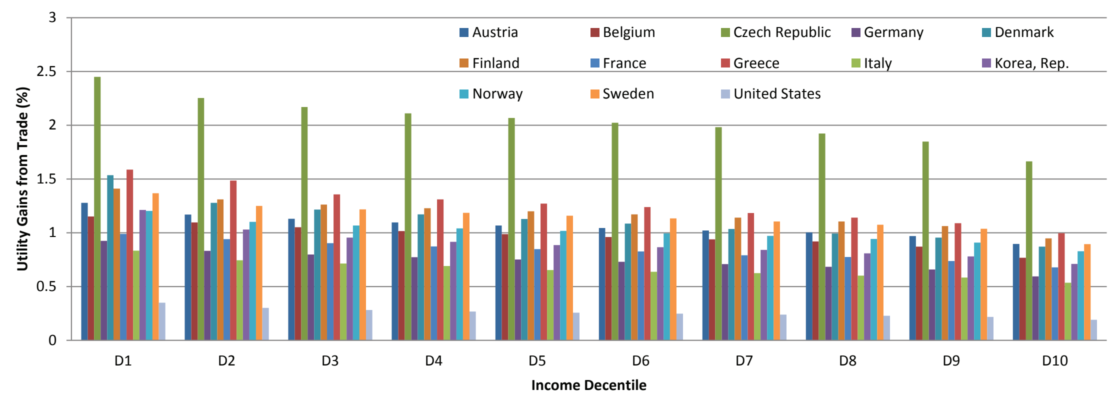

Figure 6: Percentage increase of utility by income decentile for 13 OCED countries under complete free trade, $\tau_{ij} = 1 \quad \forall i, j$.

Gains are the higest at the lowest decentiles and decrease with income, for example in France the lowest percentile gains roughly 1% more utility, while the highest decentile receives .67% additional utility. The Czech Republic gains most (2% on average), while the US gains least (.25% on average). The gains are very similar in the middle income decentiles, while relatively high in the lowest 2 decentiles. The correlation between average gains from trade and the equality parameter ϕ is 0.44, which indicates that more equal countries gain more from trade.

6 Conclusion

I provide an empirically testable framework of non-homothetic preferences, structural change and bilateral trade considering between and within country inequality.
I find evidence that preferences are non-homothetic and Engel curves for manufacturing and services are non-linear. I am able to consider analytically an income distribution with K different income classes, which allows us to relate the inequality measure in the model to decentile income shares.

Within country inequality and average income affect the sectoral allocation of labor into the service sector and the manufacturing sector. More equal economies will consume and produce relatively more manufactured goods, while economies with a higher per capita income will produce relatively more services. Trade in manufacturing goods depends on the sectoral structure of each economy and on the local demand and consequently on the income level and the income distribution in a country. For two trading countries with similar levels of income inequality, more equality in the domestic country increases the number of manufacturing goods produced in this country, which leads to higher exports. More equality in the foreign country increases the demand for manufacturing goods and hence makes this country more attractive for exports. This results might reverse if the two countries are very different in terms of inequality. Thus my model gives first theoretical foundations for the empirical findings of Martínez-Zarzoso and Vollmer (2010) and Bernasconi (2013).
An increasing GDP per capita in the exporting country decreases exports, as production shifts from manufacturing to services, while higher GDP per

capita in the importing country increases exports to this country.

I estimating an augmented gravity model to show that within and between country inequality has an important factor on trade. All estimates reconcile with the theoretical findings.

Lastly, I estimate the parameters of the model and use them to calibrate a multi-country bilateral trade model for 13 OECD countries in the year 2000. The simulated trade flows are highly correlated with the observed trade flows, corr = 0.83. This is considerably more than comparable gravity equations generate. I show that if the equality in all countries increases by 1%, trade volumes increase in average by 0.97%. On the other hand, increasing equality only in the US leads to more trade of the US, while it crowds out trade between the remaining countries.

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A Engel curves

I use data from the OECD STAN Database to calculate the domestic consumption of manufacturing and services. Therefore I use total production plus exports less imports for both variables. I estimate the per capita consumption as a quadratic function of GDP per capita using fixed effects. Table 8 gives the estimation results.

Table 8: Fixed effect regression. Per capita consumption

	Service	Manufacuring
GDP pc	.110	.660***
	(.159)	(.051)
(GDP pc)^2	1.51e-08***	-3.48e-09***
	(1.54e-09)	(5.19e-10)
Constant	9.193***	-2.146**
	(2.915)	(.9011)
N	512	519

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Per capital consumption of services and manufacturing in constant 2005 USD (1,000). Fixed effects 30 countries, 1990 - 2009.

Figure 7 shows the prediction of the above estimation, which reconciles with the model prediction of the PIGL preferences.

B Proof of equation (11)

$$\frac{Y}{P_s} - \beta P_s^{\epsilon-\gamma-1} P_m^{\gamma} w^{-\epsilon} Y \phi = (1 - L_m) L a_s \tag{37}$$

use that $P_s = \frac{w}{a_s}$ and $w = y$

$$La_s - \beta w^{\epsilon-1-\gamma} as^{1+\gamma-\epsilon} P_m^{\gamma} w^{-\epsilon} w L \phi = (1 - L_m) L a_s$$

$$1 - \beta w^{-\gamma} as^{\gamma-\epsilon} P_m^{\gamma} \phi = 1 - L_m \tag{38}$$

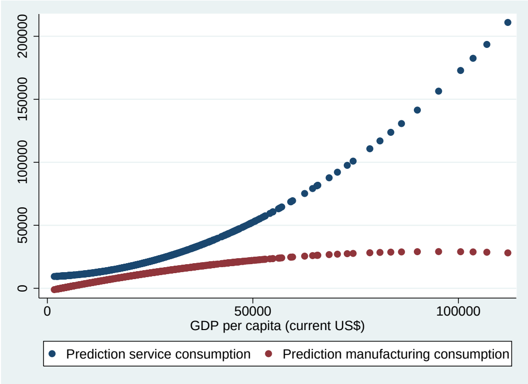

Figure 7: Prediction of service consumption and manufacturing consumption against GDP per capita constant 2005 USD. 30 countries, 1990 - 2009. OECD STAN Database.

$$L_m = \beta w^{-\gamma} a_s^{\gamma-\epsilon} P_m^{\gamma} \phi \tag{39}$$

C Number of firms and equality

Assume complete free trade, $\tau = 1$, and $p = p^* = 1$ to simplify notation. The equilibrum condition equatoin (28) for the number of firms simplifies to

$$n = \underbrace{\frac{L}{f\sigma} \beta a_s^{\gamma-\epsilon} L^{-\epsilon}}_{\zeta} (n + n^*)^{\frac{\gamma}{1-\gamma}} \phi \tag{40}$$

Substituting the equilibrium condition $n^* = \frac{\phi^*}{\phi} n$ into the equation and solving for n yields

$$n = \zeta^{\frac{1-\sigma}{1-\sigma-\gamma}} \left(\phi^{\frac{1-\sigma}{\gamma}} + \phi^* \phi^{\frac{1-\sigma-\gamma}{\gamma}} \right)^{\frac{\gamma}{1-\sigma-\gamma}} \tag{41}$$

with

$$\frac{\partial n}{\partial \phi} = \zeta^{\frac{1-\sigma}{1-\sigma-\gamma}} \frac{\gamma}{1-\sigma-\gamma} \left(\phi^{\frac{1-\sigma}{\gamma}} + \phi^* \phi^{\frac{1-\sigma-\gamma}{\gamma}} \right)^{\frac{\gamma}{1-\sigma-\gamma}-1} \left(\frac{1-\sigma}{\gamma} \phi^{\frac{1-\sigma-\gamma}{\gamma}} + \frac{1-\sigma-\gamma}{\gamma} \phi^{\frac{1-\sigma-\gamma}{\gamma}-1} \phi^* \right) > 0 \tag{42}$$

and

$$\frac{\partial n}{\partial \phi^*} = \zeta^{\frac{1-\sigma}{1-\sigma-\gamma}} \frac{\gamma}{1-\sigma-\gamma} \left(\phi^{\frac{1-\sigma}{\gamma}} + \phi^* \phi^{\frac{1-\sigma-\gamma}{\gamma}} \right)^{\frac{\gamma}{1-\sigma-\gamma}-1} \phi^{\frac{1-\sigma-\gamma}{\gamma}} < 0 \tag{43}$$

for $\sigma > 1$ and $0 < \gamma < 1$. By symmetry we find that $\frac{\partial n^*}{\partial \phi^*} > 0$ and $\frac{\partial n^*}{\partial \phi} < 0$.

It is easy to derive the elasticities of the number of firms with respect to equality in each country, $\epsilon_{n\phi} = \frac{\partial n}{\partial \phi} \frac{\phi}{n}$, using (42) and (41).

$$\begin{aligned}
\epsilon_{n\phi} &= \phi \frac{\gamma}{1-\sigma-\gamma} \left(\phi^{\frac{1-\sigma}{\gamma}} + \phi^* \phi^{\frac{1-\sigma-\gamma}{\gamma}} \right)^{-1} \left(\frac{1-\sigma}{\gamma} \phi^{\frac{1-\sigma-\gamma}{\gamma}} + \frac{1-\sigma-\gamma}{\gamma} \phi^{\frac{1-\sigma-\gamma}{\gamma}-1} \phi^* \right) \\
&= \frac{\gamma}{1-\sigma-\gamma} \left(1 + \frac{\phi^*}{\phi} \right)^{-1} \left(\frac{1-\sigma}{\gamma} + \frac{1-\sigma-\gamma}{\gamma} \frac{\phi^*}{\phi} \right) \\
&= \frac{\phi}{\phi+\phi^*} \left(\frac{1-\sigma}{1-\sigma-\gamma} + \frac{\phi^*}{\phi} \right)
\end{aligned} \tag{44}$$

In a similar way we derive $\epsilon_{n\phi^*} = \frac{\partial n}{\partial \phi^*} \frac{\phi^*}{n}$, using (43) and (41).

$$\begin{aligned}
\epsilon_{n\phi^*} &= \phi^* \frac{\gamma}{1-\sigma-\gamma} \left(\phi^{\frac{1-\sigma}{\gamma}} + \phi^* \phi^{\frac{1-\sigma-\gamma}{\gamma}} \right)^{-1} \phi^{\frac{1-\sigma-\gamma}{\gamma}} \phi^* \\
&= \phi^* \frac{\gamma}{1-\sigma-\gamma} \left(1 + \frac{\phi^*}{\phi} \right)^{-1} \frac{\phi^*}{\phi} \\
&= \phi^* \frac{\gamma}{1-\sigma-\gamma} \frac{\phi^*}{\phi+\phi^*}
\end{aligned} \tag{45}$$

D Proof of Export Condition - Equation (33)

I begin with the export equation.

$$X = npc^* \tag{46}$$

I re-write the consumption of each variety as a function of the number of firms in the two countries.

$$c^* = (p\tau^*)^{-\sigma} P_m^{*\sigma-1} w^* L^* S_m^* = \underbrace{(p\tau^*)^{-\sigma} Y^* \beta P_s^{*\epsilon-\gamma}}_{\kappa^*>0} \phi^* (n(p\tau^*)^{1-\sigma} + n^* p^{*1-\sigma})^{\frac{\sigma+\gamma-1}{1-\sigma}} \tag{47}$$

where for the second equality we use equation (8) and (26). We assume to complete symmetric countries, that differ only in their inequality, and trade is complete free, hence $\tau = \tau^* = 1$ the unit prices of each variety are the same in both countries, $p = p^* = 1$. Using this we write the exports as

$$X = \kappa^* n \phi^* (n + n^*)^{\frac{\sigma+\gamma-1}{1-\sigma}} \tag{48}$$

Now I use that in the equilibrium for two symmetric firms we have $n^* = \frac{\phi^*}{\phi} n$

$$X = \kappa^* n^{\frac{\gamma}{1-\gamma}} \phi^* \left(1 + \frac{\phi^*}{\phi}\right)^{\frac{\sigma+\gamma-1}{1-\sigma}} \tag{49}$$

To derive the condition for increasing exports, I take the derivative with respect to ϕ

$$\begin{aligned} \frac{\partial X}{\partial \phi} &= \phi^* \kappa^* n^{\frac{\gamma}{1-\sigma}-1} \frac{\partial n}{\partial \phi} \left(1 + \frac{\phi^*}{\phi}\right)^{\frac{\sigma+\gamma-1}{1-\sigma}} \\ &\quad + \phi^* \kappa^* n^{\frac{\gamma}{1-\sigma}} \frac{\sigma+\gamma-1}{1-\sigma} \left(1 + \frac{\phi^*}{\phi}\right)^{\frac{\sigma+\gamma-1}{1-\sigma}-1} \left(-\frac{\phi^*}{\phi^2}\right) > 0 \\ &= \frac{\gamma}{1-\gamma} \frac{\partial n}{\partial \phi} \frac{\phi}{n} - \frac{\sigma+\gamma-1}{1-\sigma} \left(1 + \frac{\phi^*}{\phi}\right)^{-1} \frac{\phi^*}{\phi} > 0 \\ &= \epsilon_{n\phi} - \frac{\phi^*}{\phi+\phi^*} \frac{\sigma+\gamma+1}{\gamma} < 0 \end{aligned} \tag{50}$$

hence the condition for increasing exports is

$$\epsilon_{n\phi} < \frac{\phi^*}{\phi+\phi^*} \frac{\sigma+\gamma+1}{\gamma} \tag{51}$$

Now I subsitute the elasticity from (44) into the above equation

$$\frac{\phi}{\phi+\phi^*}\left(\frac{1-\sigma}{1-\sigma-\gamma}+\frac{\phi^*}{\phi}\right)<\frac{\phi^*}{\phi+\phi^*}\frac{\sigma+\gamma+1}{\gamma}$$
$$\frac{1-\sigma}{1-\sigma-\gamma}\phi<\frac{\sigma+\gamma-1}{\gamma}\phi^*-\phi^*$$
$$\frac{1-\sigma}{1-\sigma-\gamma}\phi<\frac{\sigma-1}{\gamma}\phi^* \tag{52}$$
$$\frac{\gamma}{\sigma+\gamma-1}\phi<\phi^*$$

If the equality in the domestic country increases, the LHS increases and hence the inequality will be violated at some point. This means that if the domestic country has a much higher level of equality more, equality in the domestic country will decrease the exports of the domestic country to the foreign country.

In the same way I derive the export condition for equality in the foreign country.

$$\begin{aligned}\frac{\partial X}{\partial \phi^*} &= \phi^*\kappa n^{\frac{\gamma}{1-\sigma}-1}\frac{\partial n}{\partial \phi^*}\left(1+\frac{\phi^*}{\phi}\right)^{\frac{\sigma+\gamma-1}{1-\sigma}} \\ &+\kappa n^{\frac{\gamma}{1-\sigma}}\left(1+\frac{\phi^*}{\phi}\right)^{\frac{\sigma+\gamma-1}{1-\sigma}} \\ &+\phi^*\kappa n^{\frac{\gamma}{1-\sigma}}\frac{\sigma+\gamma-1}{1-\sigma}\left(1+\frac{\phi^*}{\phi}\right)^{\frac{\sigma+\gamma-1}{1-\sigma}-1}\frac{1}{\phi})>0 \\ &=\frac{\gamma}{1-\sigma}\frac{\partial n}{\partial \phi^*}\frac{\phi^*}{n}+1+\frac{\sigma+\gamma-1}{1-\sigma}\frac{\phi^*}{\phi+\phi^*}>0 \\ &=\epsilon_{n\phi^*}<\frac{\sigma-1}{\gamma}+\frac{1-\sigma-\gamma}{\gamma}\frac{\phi^*}{\phi+\phi^*}\end{aligned} \tag{53}$$

Now I subsitute the elasticity from (45) into the above equation

$$\begin{aligned}&\phi^*\frac{\gamma}{1-\sigma-\gamma}\frac{\phi^*}{\phi+\phi^*}<\frac{\sigma-1}{\gamma}+\frac{1-\sigma-\gamma}{\gamma}\frac{\phi^*}{\phi+\phi^*} \\ &\frac{\gamma}{\sigma+\gamma-1}\phi^*<\phi\end{aligned} \tag{54}$$

Which yields the symmetric condition for ϕ^*

This impliest that if either of the two countries is much more equal than the other country, exports of the domestic country to the foreign country will decrease.

E Tables

Country	Years
Austria	1995 - 2001
Belgium	1999 - 2001
Czech Republic	1996
Denmark	1997 - 2002
Estonia	1995,1996, 1999 - 2001
Finland	1996 - 1999, 2001,2002
France	1995 - 2001
Germany	2000,2002 - 2004
Greece	1997 - 2000
Hungary	1998 - 2003
Ireland	1995 - 2001, 2003
Italy	1995 - 2002
Luxembourg	1995, 1998
Netherlands	1995 - 2001
Poland	1996 - 2001, 2003
Portugal	1997 - 2001
Slovakia	1996 - 1998, 2000 - 2003
Slovenia	1995 - 1997, 1999
Spain	1995 - 1997, 2002,2003
Sweden	1996, 1997, 1999 - 2002
United Kingdom	1995 - 2002
United States	1991, 1992, 1997, 2000

Table 9: List of countries and years used to estimate the labor share in manufacturing sector.