Income distribution and vertical comparative advantage *

Hélène Latzer[†] Florian Mayneris[‡]

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Abstract

In this paper, we investigate the relationship between a country's income distribution and the quality of its exports. Using bilateral export flows at a very disaggregated level for EU25 countries, we show that a country's average income is positively related to the unit value of its exports. Moreover, we show that income inequality is also positively related to the quality of exports in rich enough countries only. These results are robust to the inclusion of controls for supply-side determinants of the quality of exports, and to an IV strategy to address reverse causality. They are consistent with recent theoretical research emphasizing the role of the composition of local demand in determining the comparative advantage of countries in terms of quality. A quantification exercise reveals that the positive effect of inequality becomes sizable only if coupled with an increase of average income. This suggests that a growing middle class is decisive for internal demand to drive quality upgrading of production and exports.

Keywords: Income distribution, Product quality, Trade, Economies of scale, Home market effect.

JEL classification: F12, L15, O15.

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[†]IRES, Université Catholique de Louvain. E-mail: helene.latzer@uclouvain.be.

[‡]IRES,CORE, Université Catholique de Louvain. E-mail: florian.mayneris@uclouvain.be.

1 Introduction

Climbing up the quality ladder is an objective for many developed and developing countries engaged in international trade. Indeed, while in classical models of trade, welfare gains from openness do not depend on the specialization of countries, recent contributions show that what countries produce and export does matter. Hausmann et al. (2007) show for example that countries exporting more sophisticated products grow faster; producing high-quality varieties has also been emphasized as a way to increase differentiation and escape competition (see, for example Aghion et al., 2005; Amiti and Khandelwal, 2011); finally, firms producing high-quality varieties might generate more technological spillovers and be less likely to delocate.

In this context, understanding what drives a country's vertical comparative advantage (i.e. comparative advantage in terms of quality) has been under intense scrutiny over the last few decades. Differences across countries in technology and/or relative abundance of factors have been proposed as potential explanationss (see, among others, Schott, 2004; Verhoogen, 2008; Fieler, 2011a,b). More recently, along with a conjecture first formulated by Linder (1961), the impact of the composition of aggregate demand on vertical trade patterns has been emphasized by the theoretical literature (Fajgelbaum et al., 2011), which demonstrates the existence of a "vertical home market effect". Similarly to what had been identified by the economic geography literature in the case of intra-industrial horizontal trade patterns, production is expected to follow demand in presence of economies of scale and positive trade costs: when preferences are non-homothetic, income distribution, by affecting the relative size of domestic demand for high- and low-quality varieties, should then influence the specialization of countries in terms of quality.

This paper documents the relationship between a country's income distribution and the quality of its exports in the case of an integrated market. More precisely, we investigate trade flows within the enlarged EU25, which is a free trade area whose member countries exhibit massive differences both in terms of average income and inequality. For a given product and a given importing country, controlling for supply-side determinants of quality, we find that unit values increase significantly with the average income of the exporter. Inequality alone is either not significantly or weakly negatively related to export unit values. However, the interaction term between average income and inequality in the exporting country is positively and very significantly correlated with export unit values: in other words, the average quality of a country's exports is positively linked to inequality for rich enough exporting countries only.

We carefully address endogeneity issues. In particular, we control in our regressions for country-level Balassa index and endowment in scientific skills as a proxy for supply-side determinants of vertical comparative advantage, and for bilateral distance between countries to control for potential quality-sorting or pricing-to-market. We also propose an IV strategy to tackle the possible reverse causality between income distribution and the quality of exports: based on the literature in economic geography and in political economy of redistribution, we use geographic centrality and political "color" of governments (left- and right- wing) as instruments for average income and inequality. Our results are also robust to several robustness checks. In particular, they hold when we introduce controls for skill dispersion and quality of governance, and when we restrict the analysis to alternative subsamples of countries and products.

The ambiguous role of inequality we highlight can be rationalized in a model where the composition of domestic demand drives the specialization of countries in terms of quality. Indeed, for a given average income, an increase in inequality means both more rich and more poor consumers; the net effect on the overall demand for quality is then undetermined and depends on how demand for high-quality varieties evolves along income. We provide such a model of vertical intra-industrial trade featuring non-homothetic preferences and love-for-variety at the consumer's level in Appendix A. We show that only when demand for high-quality is increasing and convex with income does the quality content of production and exports increase unambiguously with income inequality: in this case, it can also be shown that the positive effect of inequality on the quality content of exports is stronger for richer exporting countries.[1]

We hence interpret our empirical findings as pointing in the direction of a relationship between the aggregate demand structure and the average quality of a country's exports. Based on our empirical results, we provide a quantification of the relative impact of average income and inequality on the quality content of exports. We show that the positive effect of inequality can be substantial only when coupled with an increase of average income. Overall, this suggests that for poor countries, upgrading the quality of production and exports through the stimulation of internal demand is possible; however, in this purpose, favoring first the emergence of strong middle classes is preferable to favoring income growth of top incomes at the expense of poor consumers.

Our paper is related to several strands of the literature. First, it provides an empirical investigation of the demand-based determinants of vertical comparative advantage that had been only theoretically discussed so far (Fajgelbaum et al., 2011).

Also, several recent papers have focused on demand-based determinants of the quality content of *imports*. Hallak (2006) shows that richer countries tend to import higher-quality goods, while Choi et al. (2009) show that countries displaying similar income distributions tend to exhibit similar distributions of import prices. Bekkers et al. (2012) find that more unequal countries import lower quality varieties. In this paper, we instead deal with the quality of *exports*.

Some other papers have focused on comparative advantage in terms of *goods*: in particular, Fieler (2011a) and Caron et al. (2012) study how non-homothetic preferences interact with technology/relative endowment in production factors to explain specialization of countries in high income-elasticity goods. Jaimovich and Merella (2012) propose another

[1] It can be shown that such a result is reminiscent of the predictions obtained by Fajgelbaum et al. (2011) regarding the impact of inequality on the quality content of exports in a unit consumption framework - for a more detailed analogy, cf. Appendix A.

perspective: they assume that goods are vertically differentiated, but the scope for vertical differentiation differs across goods. Combining non-homothetic preferences with Ricardian comparative advantage, they show that countries that are initially similar in terms of income and productivity might still diverge in terms of income along the development path. Our focus is clearly different: we study how income distribution shapes the specialization of countries in terms of *average quality for a given good.*

Finally, some papers investigate the geography of exports: Hallak (2010) shows that the Linder hypothesis (countries with similar domestic demand structure trade more together) is verified at the sectoral level, i.e. countries with similar average income trade more intensively; at the firm-level, Crino and Epifani (2012) show that highly productive firms produce higher quality varieties and thus concentrate their exports on high-income countries. Fieler (2011b) combines non-homothetic preferences and Ricardian comparative advantage to derive the conditions under which rich countries trade more with other rich countries, and uses this framework to study the effect of different types of technical progress. In this paper, we do not discuss the issue of "who trades with whom", but rather focus on the question of "who trades what".

The rest of the paper is structured as follows. Our data and empirical results are presented in sections 2 and 3. We then provide a quantification of the effects at play in section 4 while section 5 concludes.

2 Data and empirical strategy

We present in this section the data we use and the empirical strategy we follow to try and isolate the relationship between income distribution in the exporting country and the quality of the goods being exported .

We focus on EU25 countries for the period 2005-2007.[2] Three main reasons motivate this choice. First, trade policy and the quality content of production and exports have been conjectured to be closely related in the literature (Zhou et al., 2002; Vandenbussche and Wauthy, 2001). Since May 2004, the EU25 is an integrated market where goods can circulate freely, without any trade restrictions: focusing on trade flows within such an area allows us to ignore interferences between trade policy and the quality of exports/imports. Second, to conduct our empirical analysis, we need reliable data on both average income and inequality within countries. However, information on inequality (Gini index or interquintile ratio) is rather scarce.[3] The World Income Inequality Database, collected by the United Nations, provides some data, but information is missing for many years and countries. The Luxemburg Income Survey database used by Choi et al. (2009) has the advantage to provide information allowing to compute different moments of the income distribution.

[2]Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Great-Britain, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.

[3]See Fieler (2011a).

However, many countries are absent from the database. On the opposite, Eurostat, the statistical office of the European Union, provides harmonized and reliable information on average income, Gini index and interquantile ratios within EU countries. Finally, since the enlargement to Eastern European countries in 2004, the EU displays important variations across countries in terms of both average income and inequality. Therefore, the enlarged EU looks like a perfect ground to investigate empirically how income distribution and the quality of country-level exports are related.

2.1 Data

For trade data, we use the BACI database. BACI has been developed by CEPII, based on COMTRADE data.[4] It records all bilateral trade flows at the hs6-product level, in value (dollars) and in volume (tons).

We keep in the sample bilateral export flows involving EU25 countries only, both as exporters and importers. As commonly done in the literature (see for example Choi et al., 2009), we clean the data and consider trade flows for which the quantity shipped is at least equal to one kilogram. We drop the flows whose unit value is lower than 0.1 time and higher than 10 times the median unit-value observed for that commodity within EU25. This amounts to dropping 5-6% of non-missing observations per year. We restrict our analysis to manufacturing products.[5]

For each year, we also need information on exporter characteristics. Eurostat provides data for all EU25 members from 2005 to 2007. Average income and income by quantiles, in purchasing power parity (PPP) and in nominal value, Gini index of income inequality, total population, level of wages and statistics on educational attainment are directly available.[6]

Finally, data on distance between countries are taken from the CEPII.[7]

2.2 Measuring quality

In this paper, for a given product p, we decide to use unit values, measured by fob prices, as a proxy for the quality of varieties exported by country x to country m. Within a given product category (defined at the 6-digit level of the Harmonized Commodity System), more expensive varieties are thus assumed to be higher quality varieties. Country x might export both low- and high- quality varieties of product p to country m: the higher the unit value of the export flow uv_{xmpt}, the higher the share of high-quality varieties.

The 6-digit level is the most disaggregated level of the product nomenclature to be harmonized across countries. For some products, hs6 is the finest entry,[8] while some other

[4] See Gaulier and Zignago (2010).

[5] They correspond in our dataset to hs6 products nested into 2-digit industries HS28 to HS97.

[6] In BACI, Belgium and Luxembourg are a single entity. We calculate the population of Belgium-Luxembourg as the sum of the population of both countries. All the other characteristics of Belgium-Luxembourg are calculated as the weighted average of these characteristics for Belgium and Luxembourg, using population shares of each country as weights (around 96% for Belgium and 4% for Luxembourg).

[7] "dist_cepii" database, available online at `http://www.cepii.fr/francgraph/bdd/distances.htm`.

[8] "Footwear with outer soles of leather, and uppers which consist of leather straps across the instep and around the big toe" for example, coded as product 640320.

product lines can be further disaggregated in varieties for which codification is country-specific. Sometimes, these varieties are clearly vertically differentiated.[9] In this case, variations in unit values at the hs6 level will mirror both variations in prices and differences in the composition of exports in terms of the 8 or 10-digit vertically differentiated varieties which are nested within the considered hs6 product line.

The recent empirical trade literature has discussed the relevance of unit values as a proxy for quality. In particular, Hallak and Schott (2011) and Khandelwal (2010) point at the fact that differences in unit values might capture other elements than quality. For example, exogenous differences in factor prices or exchange rate misalignments might have an impact on unit values of exports, without being directly linked to the quality of exported products. They develop alternative measures of quality, using information on both the value and the volume of exports. The intuition in both papers is the same: for a given product and a given price, countries that sell more export higher quality varieties.

However, both indices are derived from models featuring homothetic preferences. They are consequently not suited to investigate the role of income distribution, since only in case of non-homothetic preferences income inequality will also matter for the determination of the quality of production and exports. We thus prefer to rely on unit values, as other papers like Schott (2004), Hummels and Klenow (2005), Hallak (2006), Fontagné et al. (2008), Fieler (2011b) or Bekkers et al. (2012). Note that Amiti and Khandelwal (2011) show that their results on quality upgrading and import competition are qualitatively unchanged when they use unit values, instead of the Khandelwal (2010) index, as a proxy for quality. Moreover, in our empirical analysis, we propose different robustness checks to ensure that unit values actually proxy for quality. First, Khandelwal (2010) shows that prices are a correct approximation for quality when products are characterized by a long quality ladder. We actually show that all our results not only hold but are also magnified when we restrict the sample to the most vertically differentiated products.[10] Second, we also directly control in he regressions for the level of wages in the exporting country.

2.3 Estimated equation

We want to relate the unit value of exports to income distribution in the *exporting* country, controlling for supply-side determinants of export quality. This focus is different from papers relating unit values to importer characteristics (see, among others Choi et al., 2009; Bekkers et al., 2012; Simonovska, 2011).

First, controlling for product-level comparative advantage is important since specific ability of country x for product p might translate into lower prices. In particular, Bernard et al. (2007) develop a model featuring firms with heterogeneous productivities, countries with different relative factor abundance and industries with different factor intensity. In this

[9] "Watch straps, watch bands and watch bracelets, and parts thereof of precious metal or of metal clad with precious metal", coded as product 911310, which can be decomposed into finer 8-digit varieties such as "Watch straps, watch bands and watch bracelets, and parts thereof of precious metal" and "Watch straps, watch bands and watch bracelets, and parts thereof of metal clad with precious metal".

[10] Those are the products whose unit values exhibit a higher coefficient of variation within EU25.

framework, they show that trade liberalization induces tougher selection in the comparative advantage industry, and consequently magnifies *ex ante* comparative advantage. Since, for a given level of quality, higher productivity firms charge lower prices, we should observe a negative relationship between unit value and comparative advantage. We do not have direct information on product-level comparative advantages of countries. This is why we introduce, for each exporter x and product p, a Balassa index of revealed comparative advantage, defined as follows:

$$\mathrm{B}_{xpt} = \frac{\mathrm{X}_{xpt}/\mathrm{X}_{xt}}{\mathrm{X}_{EU25pt}/\mathrm{X}_{EU25t}} \quad (1)$$

where X denotes exports in volume. This index measures the share of product p in exports of country x, as compared to the share of product p in total exports of EU25 countries. The higher is B_{xpt}, the higher the comparative advantage of country x for product p, as compared to its EU25 competitors. We compute the Balassa index using the BACI database and focusing on trade flows among EU25 members. We expect the coefficient on the Balassa index to be negative.

However, the Balassa index does not control for specific ability in a given quality range. Schott (2004) for example interprets the positive correlation between unit values and GDP per capita as reflecting better endowments in terms of capital to labor ratio or in terms of skills. Technology might also matter, the production of high-quality varieties necessitating certainly more advanced technologies. If high-income countries are better endowed in the skills or technologies necessary to produce high-quality varieties, the coefficient on average income will also capture the effect of supply-side determinants of comparative advantage. There exists however an extended literature emphasizing the complementarity between advanced technologies and skills: as a consequence, controlling for skill endowments also controls for differences in technologies. This is why we control for the number of graduates in mathematics, sciences and technology per thousand inhabitants, obtained from Eurostat. We take this variable as a proxy for the ability of the workforce and the availability of technologies necessary to conceive and produce high-quality goods, which are intensive in scientific skills. In robustness checks, we will also control for skill dispersion.

We further control for two additional variables. First, we add the distance between the exporting and the importing country; indeed, several recent papers show, with aggregate or firm-level data, that bilateral distance is positively correlated with export unit values, either due to strategic pricing-to-market or to spatial sorting of exported qualities along distance (see Martin, 2012; Bastos and Silva, 2010; Baldwin and Harrigan, 2011). Second, we also introduce population in the exporting country: Fajgelbaum et al. (2011) show that an increase in population increases disproportionately the number of varieties that are more horizontally differentiated. Since we can reasonably think that high-quality varieties are more differentiated than low-quality ones, this argument points at a possible positive correlation between unit value of exports and population size. On the other hand, Desmet and Parente (2010) show that bigger markets exhibit lower markups and consequently bigger firms, which favors process innovation. This could lead, all else equal, to lower prices in bigger countries. Given these conflicting theoretical insights, we have no prior on the empirical correlation between unit values and population.

In the end, the estimated equation is the following:

$$\text{uv}_{xmpt} = \alpha \text{avg\_inc}_{xt} + \beta \text{ineq}_{xt} + \delta \text{avg\_inc}_{xt} \times \text{ineq}_{xt} + \gamma \text{bal}_{xpt} + \eta \text{skills}_{xt} + \mu \text{dist}_{xm} + \nu \text{pop}_{xt} + \mu_{mpt} + \epsilon_{xmpt}$$

where, after log-linearization, uv_{xmpt} is the unit value of exports of product p by country x to country m at time t, avg_inc_{xt} is the average PPP income of country x at time t, in euros, and ineq_{xt} is the Gini index of income inequality in country x at time t. bal_{xpt} denotes the Balassa index for country x and product p at time t, skills_{xt} the number of graduates in maths, sciences and technology per thousand inhabitants in country x at time t, dist_{xm} the distance between countries x and m and finally pop_{xt} the size of the population in country x at time t. μ_{mpt} is an importer/product/year fixed effect, so that all importer-side determinants of unit values are absorbed by the fixed effect. δ measures the potential heterogeneous impact of inequality along average income. Due to the presence of importer-product-year fixed effects, the impact of each variable is measured by exploiting, for a given importer-product-year, variations across the source countries. Actually, the within variations of average income and inequality over the three years are too small to exploit them for our estimations. However, since the gaps between EU25 countries in terms of average income and inequality vary over the period, we still use the three years at our disposal as repeated cross-sections. However, we show that our results hold when using only one year of observations, instead of repeated cross-sections.

Several remarks are in order. We use PPP income rather than nominal income. The reason for this is that the cost of living varies a lot across European countries. This is particularly true for necessity products, that are cheaper on average in Eastern countries. This means that once average income is controlled for, the income share a consumer can allocate to luxury products/varieties might depend on the average cost of necessity goods/varieties. We thus prefer using PPP income, but we show that our results remain qualitatively unchanged when using nominal income in current euros. Also, we use the Gini index as a measure for income inequality, while other measures of inequality exist; we show that our results hold when using the interquintile ratio.

Finally, our dependent variable is exporter-importer-product-year specific, while our variables of interest are exporter-year specific. According to Moulton (1990), standard-errors of the coefficients on exporter-year characteristics might consequently be downward-biased. To correct for this, we cluster all the regressions at the exporter-year level, i.e. at the level of aggregation of our variable of interest.

2.4 Reverse causality

We want to provide an empirical perspective on the theoretical literature investigating demand-based determinants of vertical comparative advantage. We thus aim at capturing the effect of average income and inequality on the quality content of exports, controlling as much as possible for supply-side determinants. However, as suggested by quality-ladder models, one can also think that quality upgrading favors average income growth (Grossman and Helpmann, 1991). Moreover, recent papers have emphasized the role of trade and quality upgrading on income distribution. Verhoogen (2008), for example, shows on Mexican data that quality upgrading in manufacturing industries has generated an increase in wage inequality within sectors. Indeed, following the peso devaluation in the 1990's, more productive firms increased their quality so as to export to the US market; since high productivity/high-quality firms pay higher wages, this increased wage inequality.

In spite of all the additional controls and fixed effects we introduce, the estimated equation presented above might thus suffer from reverse causality. We take the issue seriously and propose an instrumentation strategy.

To instrument average income, we refer to the empirical literature in economic geography. It is now a well-established fact that in the presence of economies of scale and of positive transport costs, locations with a high market potential offer a better access to demand and thus attract more economic activities, increasing the level of average income (Head and Mayer, 2004). To tackle the possible reverse causality between market potential and income per capita, papers interested in the causal impact of market potential on average income have proposed to instrument market potential by geographic centrality. The more central a country is from a "physical" geography viewpoint, the higher its market potential, "physical" geography being exogenous to other country characteristics that could potentially affect income per capita. In their study of income inequality between countries, Redding and Venables (2004) use as instruments for market potential distance to New-York, Brussels and Tokyo, while Head and Mayer (2011) use the sum of the inverse of distance between a country and all its trading partners.

Here, we use geographic centrality as an instrument for income per capita: geographic centrality should be positively related to the income per capita of countries through its effect on market potential. However, geographic centrality should not affect directly the quality of a country's exports, proxies for other supply-side determinants of comparative advantages such as the Balassa index and the level of skills being also controlled for. Since the years 2000, Germany is the most central and biggest market within EU25. We thus use the inverse of distance to Germany as a proxy for geographic centrality within EU25.

To instrument the Gini index of income inequality, we use the number of years during which a country has been run by a left-wing government from 1973 to 2000. The rationale for this is that left-wing governments should be more inclined to implementing redistributive policies in order to smooth income inequality, which sounds reasonable and has been both assumed and demonstrated in the literature (Piketty, 1995; Alesina and Glaeser, 2005). We expect our instrument to be negatively correlated with the level of inequality in 2005-2007. Obviously, electing left-wing rather than right-wing governments is correlated to many things. However, it seems implausible that left-wing governments have different preferences from right-wing governments regarding technology or quality choice, and thus implement different policies in this respect. Should it be the case, this should also be reflected in the level of skills. We thus expect the number of years with left-wing governments from 1973 to 2000 not to be directly related to unit values of exports, other variables such as average income, Balassa index and the level of skills being already controlled for in the regression. We obtain information on the political color of governments in European countries from information available on the Guardian website.[11]

Finally, we will provide several robustness checks, controlling for non-linearities in average income and income inequality themselves (introducing quadratic terms), for labor costs, for skill dispersion and for the quality of governance. We will also show that our results hold for different subsamples of products and countries.

Hence, controlling for many supply-side determinants and addressing reverse causality issues thanks to our instrumentation strategy, we argue that the remaining relationship we capture between income distribution and unit values can be interpreted in light of recent theories emphasizing the role of national demand for the determination of the vertical comparative advantage of countries.

3 Results

In this section, we first present some descriptive statistics on average income and income inequality within EU25 countries. We then detail our baseline results and provide several additional robustness checks.

3.1 Descriptive statistics

We distinguish "rich" and "poor" countries, rich countries having an average income higher than 16,000 euros over the period. This threshold splits countries of the enlarged EU into two equal-sized samples.[12]

Table 1 shows that rich countries are almost twice as rich as poor countries in terms of average PPP income, whatever the income quintile we consider. In 2005, rich countries also seem to be slightly less unequal than poor countries: the Gini index is equal to 28 on average in rich countries, *vs* 31.3 in poor countries. However, Figure 1 shows that both average income and inequality vary strongly across countries of the enlarged EU, whatever the sample of countries we consider. We observe rich and unequal countries (Great-Britain, Germany), rich and equal countries (Sweden, Denmark), but also poor and unequal countries (Latvia, Lithuania) and poor and equal countries (Hungary, Slovakia).

[11] `http://www.guardian.co.uk/world/interactive/2011/jul/28/europe-politics-interactive-map-left-right`

[12] Rich countries are Austria, Belgium-Luxembourg, Cyprus, Denmark, Finland, France, Germany, Great-Britain, Ireland, Italy, Netherlands and Sweden. Poor countries are Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia, Slovenia and Spain.

No significant correlation exists between average income and inequality in the different samples of countries.[13] This confirms that the enlarged EU is very well suited to investigate the role of income distribution as a determinant of the quality of exports. Moreover, in robustness checks, we verify that our key result, the heterogeneous effect of inequality along average income, holds when we control for a potential non-linear relationship between unit values and average income or inequality (thanks to the introduction of quadratic terms): hence, the heterogeneous relationship along average income between the quality of exports and income inequality cannot be attributed to a specific correlation in the data between average income and inequality.

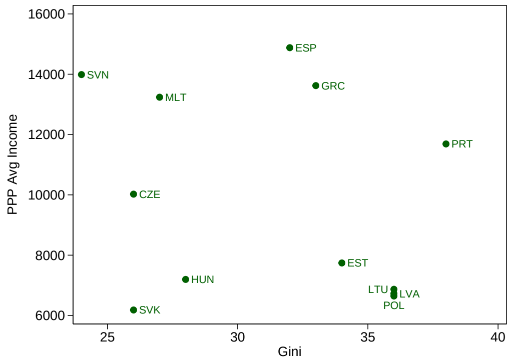
Table 1: Average income and inequality in the enlarged EU in 2005 - PPP

	Mean	Sd	Min	Max
	All countries			
Average income	14435	5348	6182	21966
1st quintile Average income	6197	2507	2220	9479
5th quintile Average income	27119	10053	10695	44372
Gini	29.7	4.5	23	38
	Poor countries			
Average income	9900	3376	6182	14880
1st quintile Average income	4084	1593	2220	7064
5th quintile Average income	19005	6489	10695	28718
Gini	31.3	4.9	24	38
	Rich countries			
Average income	18970	1883	16544	21966
1st quintile Average income	8311	923	5956	9479
5th quintile Average income	35233	5059	28445	44372
Gini	28	3.5	23	34

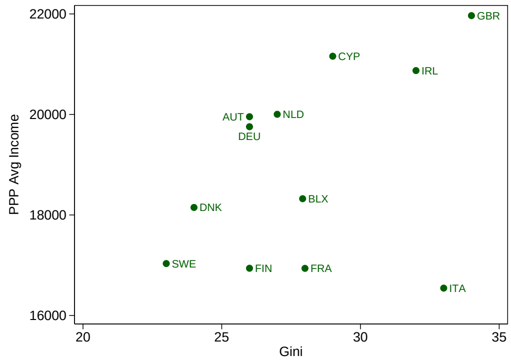
3.2 Bilateral export prices and income distribution within the exporting country

Table 2 displays our baseline results. We first provide evidence based on OLS regressions with importer-product-year fixed effects. As expected, column (1) shows that export unit values and average PPP income are positively correlated, with a coefficient equal to 0.216 and significant at the 1% level. Moreover, when average income is controlled for, income inequality is on average not significantly related to unit value: indeed, the coefficient associated to the Gini index is non significant and very close to zero. In column (2), we further control for the Balassa index of revealed comparative advantage. It is affected by a negative and significant coefficient: countries that are relatively more specialized in a given product exhibit lower export unit values for that product, pointing at a cost advantage for these product-exporter pairs. We introduce in column (3) the log of the number of people graduated in maths, sciences and technology per thousand inhabitants, as a proxy for the level of skills, and thus for supply-side determinants of the quality content of

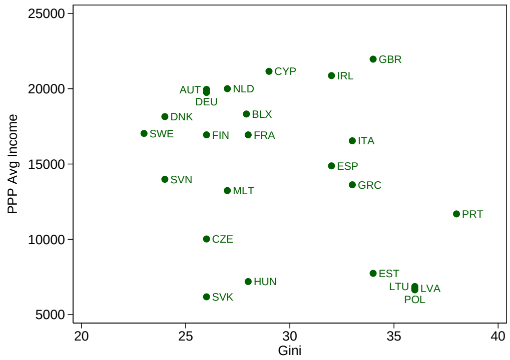
[13] For year 2005, the correlation between the Gini index and the average PPP income is equal to -0.36 on the whole sample, -0.25 on the sample of poor countries and 0.39 on the sample of rich countries, never significant at the 5% level.



Poor countries



Rich countries



All countries

Figure 1: Average income and inequalities in 2005

exports. This variable is positively and very significantly correlated to export unit values: countries that are better endowed in workers with scientific skills export higher quality varieties. Controlling for skills tends to reduce the coefficient on average PPP income, pointing at a positive correlation between average income and skills (but the difference is not significant). However, even after controlling for supply-side determinants of the quality content of exports, average income and export unit values are positively correlated, with a coefficient roughly equal to 0.2. This is in line with a demand-side explanation of vertical comparative advantage. On the other hand, the coefficient on the Gini index is still very close to zero.

In column (4), we check that these results are not driven by omitted variables such as distance and population. In line with results obtained, among others, by Bastos and Silva (2010), Martin (2012) and Baldwin and Harrigan (2011), we find a positive correlation between unit values and distance: for a given product, the most expensive varieties imported by a country are those coming from further away. This is coherent with both Alchian-Allen selection effects and/or price discrimination based on bilateral distance. Also, big countries seem to export, all else equal, cheaper varieties than smaller ones, in line with scale effects or innovation mechanisms such as the one developed in Desmet and Parente (2010). However, the coefficient on population is rather small as compared to the elasticity of export unit values with respect to average income and scientific skills. When distance and population are taken into account, the Gini index attracts a negative and significant coefficient; this coefficient is however very close to zero.

In column (5), we test for a potential heterogeneous relationship between inequality and unit values along average income. We thus introduce an interaction term between average PPP income and the Gini index. Note that in presence of an interaction term, the coefficient on PPP income and the Gini index alone cannot be directly interpreted anymore. We find a positive and significant coefficient on this interaction term. The effect of income inequality on the quality content of countries' exports is hence heterogeneous: it becomes positive only when countries are rich enough.[14] This heterogeneous relationship between inequality and unit values along average income is actually consistent with a demand-based explanation of the quality content of exports, as we demonstrate in the theoretical model provided in Appendix A. Indeed, we show that the relationship between aggregate demand for high-quality and inequality is *a priori* undetermined, except when consumers' demand for high-quality varieties is increasing and convex along income. In this particular case, (i) a higher inequality level has an unambiguously positive impact on the average quality of the consumption bundle; (ii) its marginal effect on the demand for high-quality varieties is stronger for richer countries. Translated in an open economy context and applied to the relationship between the quality content of exports and income distribution in the exporting country, it means that we should observe a stronger positive association between income inequality and export unit values in richer countries. Hence, these theoretical insights help understand the fact that unit values are not significantly or at most weakly negatively related to the Gini index when the latter is introduced alone, while this relationship becomes positive for rich countries.

We investigate in column (6) whether this peculiar relationship between unit values and inequality in the exporting country resists to our instrumentation strategy, implemented to tackle the potential reverse causality between unit values and income distribution. In this regression, average income and Gini index are both considered as potentially endogenous. As explained in section 2.4, we use geographic centrality and the number of years during which a country was run by a left-wing government from 1973 to 2000 as instruments for average income and income inequality. The interaction between the Gini index and average income is instrumented by the interaction between our two instruments. As shown by first-stage regressions in Table 1 in Appendix E and by the Kleinbergen-Paap test for weak identification at the bottom of Table 2, our instruments are good predictors of average income, Gini index in the exporting country and their interaction. The F-test for excluded instruments is well above 10 and the Kleinbergen-Paap statistic for under-identification allows to reject the null hypothesis that our equation is underidentified. In accordance with the intuition, geographic centrality is positively related to average PPP income, while the number of years with a left-wing government from 1973 to 2000 is negatively correlated with income inequality (see Table 1 in Appendix E). The results of the regression also show that correcting for reverse causality does not affect much our estimated coefficients.

[14] According to the coefficients obtained, an increase in the Gini index by one point has a positive impact for countries with a PPP average income above $\exp(0.134/0.0137) \approx$ 17,700 euros.

Table 2: Bilateral export prices and exporter characteristics

	Dependent Variable: Ln uv_{xmpt}						
Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln Avg PPP Income	0.216^{a}	0.242^{a}	0.222^{a}	0.208^{a}	-0.198	-1.759^{a}	-0.233^{c}
	(0.0206)	(0.0204)	(0.0218)	(0.0246)	(0.121)	(0.677)	(0.136)
Gini	-0.00334	-0.00163	-0.00297^{c}	-0.00559^{a}	-0.134^{a}	-0.583^{a}	-0.160^{a}
	(0.00213)	(0.00172)	(0.00149)	(0.00188)	(0.0359)	(0.205)	(0.0409)
Ln Avg PPP Income × Gini					0.0137^{a}	0.0597^{a}	0.0162^{a}
					(0.00384)	(0.0209)	(0.00441)
Ln Balassa ind. vol.		-0.0790^{a}	-0.0781^{a}	-0.0828^{a}	-0.0841^{a}	-0.0881^{a}	-0.103^{a}
		(0.00289)	(0.00272)	(0.00281)	(0.00275)	(0.00333)	(0.00294)
Ln Skills			0.0831^{a}	0.0824^{a}	0.0842^{a}	0.142^{a}	0.0954^{a}
			(0.0302)	(0.0290)	(0.0274)	(0.0329)	(0.0300)
Ln Distance				0.125^{a}	0.125^{a}	0.140^{a}	0.143^{a}
				(0.00744)	(0.00747)	(0.00745)	(0.00831)
Ln Pop				-0.0161^{b}	-0.0205^{b}	-0.00787	-0.0259^{b}
				(0.00773)	(0.00819)	(0.0129)	(0.0102)
	FE	FE	FE	FE	FE	IV	FE
N	2421908	2421908	2405704	2405704	2405704	2405704	1033474
Importer-Product-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kleinbergen-Paap test						7.11^{a}	
Endog. test (p-value)						0.12	
	All manuf. prod.						Vert. diff. prod.

Note: Standard errors in parentheses [a], [b] and [c] respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are clustered at the exporter-year level. The proxy for skills is the number of graduated people in maths, sciences and technologies per thousand inhabitants.

Actually, a formal test of endogeneity of average income and Gini index[15] shows that we cannot reject the null hypothesis that average income, the Gini index and their interaction are exogenous.

There are several reasons why the fact that our estimations are not plagued by reverse causality should not be surprising. First, the theoretical and empirical literature that emphasized the effect of globalization and quality upgrading on inequality considers wage inequality. However, in our data, income is defined as "the total disposable income of a household, calculated by adding together the personal income received by all of household members plus income received at household level". It encompasses earnings from work, but also private income from investment and property, transfers between households and all social transfers received in cash including old-age and pensions. Therefore, our measure of income and income inequality goes beyond wage and wage inequality.

Moreover, as emphasized by Atkinson et al. (2011), "aggregate economic growth per capita and Gini inequality indexes are sensitive to excluding or including top incomes". They show that top incomes play a key role in the evolution of inequality in the past decades, the evolution of top incomes themselves being mainly driven by top managers' and CEOs' wages in some countries, and by capital income in other countries (in Scandinavia in particular). In addition, Philippon and Reshef (2013) point at the role of the financial sector in the evolution of wages and inequality. Consequently, in our data, wages and wage inequality between high- and low- skilled workers in vertically differentiated manufacturing industries are probably not the main determinants of our measures of income distribution.

Finally, the studies emphasizing the effect of quality upgrading on inequality, such as Verhoogen (2008), generally focus on short- or medium- run evolutions, when skill supply is fixed; in the long-run, intergenerational mobility operating through educational choices has been shown to compensate, at least partly, for the short-run increase in inequality generated by globalization and/or quality upgrading (Galor and Tsiddon, 1997). Since our empirical analysis is based on cross-sectional variations between EU25 countries, we capture the long-run relationship between income distribution and quality content of exports, rather than short-run movements. We thus suspect reverse causality issues to be less probable in this case.

Consequently, in the rest of the paper, fixed-effects estimations will be our preferred specification.

In column (7), we run the same analysis, but we focus on the products that are more vertically differentiated. We rank products according to the coefficient of variation of their export unit values within EU25, and conserve the top 50% of products in terms of observed unit-value dispersion. This is an important test; indeed, Khandelwal (2010) shows that the correlation between unit value and the quality index he develops is very high for products with long quality ladders. Results remain qualitatively the same, and if anything, the magnitude of the coefficient on the interaction term slightly increases.

Overall, our baseline results show that even when we control for supply-side determi-

[15] Directly implemented with the command ivreg2 in Stata and equivalent to a Hausman test.

nants of vertical comparative advantage and for reverse causality, export unit values are still correlated with income distribution in the exporting country. This is in line with the predictions obtained in recent theoretical papers featuring non-homothetic preferences and home-market effect to explain the comparative advantage of countries in terms of quality. In particular, we obtain that higher income inequality is associated with higher export unit values in rich enough countries only, a feature that can be rationalized in a model of vertical intra-industrial trade featuring non-homothetic preferences and love-for-variety such as the one we provide in Appendix A.

3.3 Robustness checks: Additional controls

We provide in this section several robustness checks, by introducing additional controls to our baseline regression (column (5) of Table 2).

First, we check that the effects we have measured so far are not driven by labor costs. Indeed, unit values are often criticized on the ground that they would capture other elements than quality, in particular the level of production costs (see Khandelwal, 2010; Hallak and Schott, 2011). However, results in the first column of Table 3 show that once individual earnings (taken from Eurostat) are taken into account, the coefficient on the interaction term between average PPP income and inequality remains unaffected.

Even though descriptive statistics were rather reassuring in this respect (see section 3.1), one might also fear that some correlation exists between average income and inequality; in this case, our interaction term between average PPP income and the Gini index could capture non linearities in the relationship between the quality content of exports and average income or income inequality alone. In column (2) of Table 3, we thus introduce the square of log average PPP income. The coefficient on this variable is positive and significant, but the interaction between average income and inequality remains positive and significant. In column (3), we do the same with income inequality. We do not find any non-linear relationship between export unit values and income inequality; moreover, the introduction of the square of the Gini index does not affect our baseline results.

In columns (4) to (6), we check further that the non-linear relationship between inequality and unit values along average income does not capture a non-linear relationship between income and supply side determinants of quality. In column (4), we thus control for the interaction between the level of skills and average income. The coefficient on this interaction term is positive and significant, suggesting that a better endowment in workers with scientific skills increases the quality content of exports disproportionately more for richer countries. However, the interaction term between average income and inequality remains positive and significant.

Recent papers show that not only the average level of skills available in the population, but also the diversity of these skills, might have an impact on comparative advantages of countries. More specifically, Grossman and Maggi (2000) and Bombardini et al. (2012) show that observed and unobserved skill dispersion might confer countries a comparative advantage in industries where complementarity between tasks is low. Those industries are industries where individual talent is more important. The same kind of reasoning could apply to vertical specialization within sectors; we can imagine that producing high-quality varieties requires more ingeniousness, so that countries with more diverse skills tend to specialize in high-quality products. Consequently, if income inequality reflects skill dispersion, one might worry that the heterogeneous relationship between the Gini index and export unit values does not capture demand-side effects, but also supply-side determinants of vertical comparative advantage. In columns (5) and (6), we control for skill dispersion in the population and its interaction with average income.

We measure skill diversity thanks to the inverse of a Herfindahl index, calculated as follows:

$$\text{Skill diversity} = \ln[(\text{share\_sec\_educ}^2 + \text{share\_post\_sec\_educ}^2 + \text{share\_tert\_educ}^2)^{-1}]$$

It accounts for the dispersion of skills in the population, as measured by the share of population with up to secondary education, the share of population with post secondary education and the share of population with tertiary education (the information is available on the Eurostat website). The higher the index, the more dispersed the skills.

Results in column (6) show that skill diversity is positively correlated to the average quality content of exports in poorest countries only. Regarding our results on the role of income distribution on the quality content of exports, our conclusions remain unchanged: when skill dispersion and its interaction with average income are controlled for, the quality content of exports remains positively and significantly related to the interaction between average income and inequality.

Finally, one might think that the quality of governance in a country might affect both average income and the the quality of production and exports, through specific investments or a more favorable environment. We use the ICRG index to proxy for the quality of governance in a country.[16] All else equal, no significant relationship is detected between the ICRG index and unit values, as shown in column (7), and the coefficient on the interaction between the Gini index and average income remains unaffected.

We introduce in column (8) all these additional controls altogether, and again, this does not change our results on the relationship between export unit values and income distribution.

Overall, Table 3 shows that a robust heterogeneous relationship exists between the quality content of exports and income inequality, beyond many supply-side additional controls. This points further at income distribution as a determinant of the quality of exports through demand-side (home market) effects.

[16] Country-level rating established by the PRS group. Economic, financial and political risks are assessed, and a composite index based on these three dimensions is also available. We take the composite index as a proxy for the quality of governance in a country.

Table 3: Bilateral export prices and exporter characteristics - Additional controls

	Dependent Variable: Ln uv_{xmpt}							
Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln Avg PPP Income	-0.184	-2.378^a	-2.318^a	-0.466^a	-0.0860	0.230	-0.271^b	-5.711^a
	(0.162)	(0.805)	(0.837)	(0.148)	(0.137)	(0.177)	(0.119)	(0.638)
Gini	-0.133^a	-0.131^a	-0.119^b	-0.0747^b	-0.113^a	-0.201^a	-0.148^a	-0.0366
	(0.0396)	(0.0340)	(0.0491)	(0.0371)	(0.0392)	(0.0485)	(0.0346)	(0.0460)
Ln Avg PPP Income × Gini	0.0135^a	0.0133^a	0.0130^a	0.00736^c	0.0115^a	0.0207^a	0.0153^a	0.0104^b
	(0.00429)	(0.00364)	(0.00371)	(0.00398)	(0.00413)	(0.00512)	(0.00371)	(0.00405)
Ln Balassa ind. vol.	-0.0841^a	-0.0831^a	-0.0831^a	-0.0835^a	-0.0859^a	-0.0873^a	-0.0832^a	-0.0874^a
	(0.00274)	(0.00268)	(0.00267)	(0.00264)	(0.00253)	(0.00239)	(0.00260)	(0.00213)
Ln Skills	0.0847^a	0.0759^b	0.0774^b	-1.693^a	0.106^a	0.127^a	0.0813^a	-2.614^a
	(0.0279)	(0.0300)	(0.0301)	(0.398)	(0.0314)	(0.0266)	(0.0284)	(0.384)
Ln Distance	0.125^a	0.130^a	0.130^a	0.126^a	0.124^a	0.120^a	0.125^a	0.133^a
	(0.00741)	(0.00710)	(0.00706)	(0.00761)	(0.00709)	(0.00686)	(0.00735)	(0.00609)
Ln Pop	-0.0201^b	-0.0207^a	-0.0215^b	-0.0202^b	-0.0210^a	-0.0200^a	-0.0182^b	-0.0314^a
	(0.00861)	(0.00780)	(0.00873)	(0.00859)	(0.00735)	(0.00690)	(0.00845)	(0.00694)
Ln Individual earnings	-0.00524							0.0684^a
	(0.0321)							(0.0211)
Ln^2 Avg PPP Income		0.118^b	0.115^b					0.312^a
		(0.0460)	(0.0474)					(0.0350)
$Gini^2$			-0.000152					-0.00111^a
			(0.000460)					(0.000332)
Ln Avg PPP Income × Ln Skills				0.186^a				0.289^a
				(0.0426)				(0.0409)
Ln Skill diversity					-0.117^b	3.411^a		4.856^a
					(0.0553)	(1.200)		(0.872)
Ln Avg PPP Income × Ln Skill diversity						-0.368^a		-0.538^a
						(0.125)		(0.0908)
Quality of government (ICRG)							0.110	-0.0361
							(0.0792)	(0.0583)
Observations	2405704	2405704	2405704	2405704	2405704	2405704	2405704	2405704
Importer-Product-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are clustered at the exporter-year level. The proxy for skills is the number of graduated people in maths, sciences and technologies per thousand inhabitants. The proxy for skill diversity is the inverse of a Herfindahl index calculated thanks to the share of population with up to secondary education, the share of population with post secondary education and the share of population with tertiary education.

3.4 Robustness checks: Alternative samples

In this section, we show that the heterogeneous relationship between unit values and Gini index along average income is robust to several alternative subsamples.

We first limit the sample to final products.[17] Results obtained in column (1) of Table 4 are similar to those obtained on the whole sample. The role of income distribution as a determinant of the quality content of exports is consequently not limited to final products. This is not so surprising, since high-quality inputs are generally needed to produce high-quality final products (see Kugler and Verhoogen, 2012, for example).

In column (2), we get rid of small trade flows, for which the measure of unit value could be spurious. We drop trade flows smaller than 10,000 euros, and again, results are pretty much the same.

In column (3), we drop the smallest countries, i.e. the islands Cyprus and Malta, and in column (4), we drop from the pool of exporters both the poorest and the richest countries in terms of average PPP income over the period, i.e. Slovakia, Lithuania, Great-Britain and Austria. In column (5) we do the same with the Gini index and drop Portugal, Latvia, Slovenia and Sweden. In all cases, results remain qualitatively unchanged, showing that our results are not driven by some outlier countries.

Finally, in column (6), we limit the sample to year 2005 and in column (7), we use average unit value of exports of product p by country x at time t as a dependent variable, instead of bilateral prices (using shares of flows $xmpt$ in the total volume of exports of product p by country x at time t as weights). Again, we find qualitatively and quantitatively very similar results.

In Tables 2 and 3 in Appendix F, we also show that our results hold when we consider current average income and not PPP income, and when we use the interquintile ratio as a measure of inequality instead of the Gini index.

Our results are thus remarkably robust to alternative subsamples of products or countries. Moreover, they are not driven by the repeated cross-sections approach of our baseline analysis, and remain similar when we consider the average unit value of exports for a given product and a given exporting country, rather than the unit value of bilateral flows.

4 Quantitative assessment of the effects

Now that we have shown that average income is positively related the quality content of exports, beyond supply-side determinants of country-level comparative advantage in terms of quality, and that the relationship between inequality and export unit values is heterogeneous along average income, we provide a quantitative assessment of the effects at play.

[17] Antras et al. (2012) develop an index of industries upstreamness, based on I-O tables. Their method gives a measure of the number of production stages between a given industry and final consumers. We use a conversion of their index, available for US industries, into the HS6 product classification. Final products are defined as products for which the index is below 1.41 (first quartile of the value of the index, final products having an index equal to 1). We thank Julien Martin for providing us the data.

Table 4: Bilateral export prices and exporter characteristics - Alternative subsamples

Dependent Variable:	Ln uv_{xmpt}						Ln uv_{xpt}
Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Final goods	w/o flows <10,000$	w/o CYP and MLT	w/o GBR, AUT SVK and LTU	w/o PRT, LVA SVN and SWE	Year 2005	Avg unit val.
Ln Avg PPP Income	-0.179	-0.141	-0.192	-0.261	-0.231^{c}	-0.192	-0.0716
	(0.129)	(0.133)	(0.121)	(0.203)	(0.131)	(0.219)	(0.125)
Gini	-0.109^{a}	-0.122^{a}	-0.132^{a}	-0.143^{b}	-0.146^{a}	-0.142^{b}	-0.0977^{b}
	(0.0385)	(0.0392)	(0.0358)	(0.0609)	(0.0387)	(0.0593)	(0.0371)
Ln Avg PPP Income × Gini	0.0113^{a}	0.0123^{a}	0.0134^{a}	0.0145^{b}	0.0148^{a}	0.0140^{b}	0.0102^{b}
	(0.00415)	(0.00417)	(0.00383)	(0.00650)	(0.00415)	(0.00623)	(0.00400)
Ln Balassa ind. vol.	-0.0559^{a}	-0.0946^{a}	-0.0842^{a}	-0.0840^{a}	-0.0856^{a}	-0.0866^{a}	-0.0979^{a}
	(0.00393)	(0.00303)	(0.00280)	(0.00260)	(0.00304)	(0.00485)	(0.00248)
Ln Skills	0.0595^{b}	0.0827^{a}	0.0866^{a}	0.0970^{a}	0.0913^{a}	0.0919^{b}	0.0134
	(0.0297)	(0.0290)	(0.0295)	(0.0305)	(0.0279)	(0.0420)	(0.0260)
Ln Distance	0.104^{a}	0.124^{a}	0.125^{a}	0.134^{a}	0.124^{a}	0.132^{a}	n.a
	(0.00977)	(0.00785)	(0.00750)	(0.00854)	(0.00850)	(0.0133)	n.a
Ln Pop	-0.0203^{b}	-0.0193^{b}	-0.0193^{b}	-0.0183^{c}	-0.0224^{b}	-0.0125	-0.00480
	(0.00831)	(0.00865)	(0.00872)	(0.00924)	(0.00918)	(0.0117)	(0.00695)
Observations	649385	1882401	2387286	1992203	2132695	801666	234436
Importer-Product-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No
Product-Year fixed effects	No	No	No	No	No	No	Yes

Note: Standard errors in parentheses ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are clustered at the exporter-year level. The proxy for skills is the number of graduated people in maths, sciences and technologies per thousand inhabitants.

We first consider a country with an average income and a Gini index equal to the average within EU25, i.e. 14,435 euros and 29.7 (see Table 1). Given the results obtained in column (6) of Table 2, a one standard deviation increase in the average income of that country (i.e. an increase by 5,348 euros) will generate an average increase of its export unit values by 6.8%.[18] On the other hand, an increase in income inequality by one standard deviation (i.e. by 4.5), keeping average PPP income constant, would increase export unit values by 1.8%.[19] This is not negligible, but far less important than the effect of average income. Finally, an increase in both average income and inequality would raise export unit values by 10.6%.[20]

Assume now that we want to match the income distribution of a poor and egalitarian Eastern European country in 2005, Czech Republic, with the income distribution of a rich and more unequal Western European country, France. In the long run, increasing Czech average PPP income (equal to 10,023 euros) to the level of French average PPP income (equal to 16,938 euros) would raise unit values of Czech exports by 8.6%. Doing the same for inequality (i.e. increasing the Gini index from 26 to 28) would slightly decrease Czech export unit values by 0.2%.[21] Finally, matching both average PPP income and income

[18] The figure is obtained thanks to the following calculation: $-0.2\times[\ln(14435+5348)-\ln(14435)]+0.014\times[\ln(14435+5348)-\ln(14435)]\times 29.7\approx 6.8\%$

[19] The figure is obtained thanks to the following calculation: $-0.13\times 4.5+0.014\times[\ln(14435)]\times 4.5\approx 1.8\%$

[20] The figure is obtained thanks to the following calculation: $-0.2\times[\ln(14435+5348)-\ln(14435)]-0.13\times 4.5+0.014\times[(29.7+4.5)\times\ln(14435+5348)-29.7\times\ln(14435)]\approx 10.6\%$

[21] This slightly negative effect is due to the negative sign affecting inequality in the regression with the interaction term. Theoretically, a negative impact of inequality on the quality content of exports is not possible when demand for high-quality varieties is increasing and convex along income. Still, according to the coefficients obtained in our benchmark regression (column (5) of Table 2), an increase in the Gini index by one point has a positive impact for countries with a PPP average income above $\exp(0.134/0.0137)\approx$ 17,700 euros. However, we would not interpret too much this negative coefficient; indeed, it is calculated so as to fit best the data given the presence of the interactive term, and has no economic significance *per se*.

inequality would raise the unit value of Czech exports by 9.9%.

These simple thought experiments show that inequality does impact on the average quality content of exports, but that it has alone a low impact as compared to average income. However, due to the heterogeneous relationship between inequality and unit values, the effect of inequality on export unit values is magnified when coupled with an increase in average income.

5 Conclusion

Our empirical results on EU25 countries tend to support the recent literature emphasizing demand-side determinants of the comparative advantage of countries in terms of quality. The quantification of the effects at play suggests that a poor country seeking to climb the quality ladder should not immediately favor the formation of a rich class through an increase in inequality. The intuition for this is that for low levels of average income, demand for high-quality varieties increase very slowly with income; a small and relatively wealthy group of consumers does not represent a sufficient market for high-quality firms to produce in the country, since a vast, poor majority of consumers still cannot afford high-quality goods. An increase in inequality then has no significant impact on the quality mix being produced and exported.

The influence of the demand structure on vertical specialization clearly points in the direction of a sequential development path: a poor country should first implement policies increasing the income of the whole population, so that average income reaches a level that is high enough for a sizable domestic market for high-quality varieties to develop. Only once average income has increased to a certain point does an increase in inequality start having a sizable positive effect on the quality mix being produced. Favoring first the emergence of strong middle classes is thus crucial.

We furthermore believe that our results have several interesting implications. In particular, in a more dynamic view, we can conjecture that high-quality varieties are more likely to generate externalities or to induce technology adoption. Some interesting new results could thus certainly be obtained on the link between income distribution and growth through this quality channel. These could be interesting avenues for future research.

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Appendix A: Non-homothetic preferences and quality of exports - a theoretical framework

We here present a model able to replicate the main empirical properties identified, and in particular able to rationalize the heterogenous impact along income of the inequality level on the average quality exported by a country.

We model international trade between a domestic (D) and a foreign (F) country. Each country features a two-class society with N_r $(r = D, F)$ consumers differing in their effective labor endowment, and hence belonging either to a poor (P) or a rich (R) class. The extent of inequality within each economy is determined by the share β_r of poor consumers within the population, as well as by the distribution of the aggregate amount of effective labor supply L available in the economy.[22] $\theta_r \in (0, 1)$ is defined as the ratio of a poor consumer's labor supply l_{Pr} *relative* to the average per-capita labor supply L/N_r: $\theta_r = \frac{l_{Pr}}{L/N_r}$. As θ_r gets closer to 1, the level of inequality within the economy r diminishes. Given θ_r, it is possible to compute the labor supply of respectively a poor and a rich consumer in country r as $l_{Pr} = \theta_r \frac{L}{N_r}$ and $l_{Rr} = \frac{1-\beta_r\theta_r}{1-\beta_r} \frac{L}{N_r}$. In this framework, a mean-preserving increase in the level of inequality corresponds to a decrease in θ_r, while an increase in the average income, leaving the level of inequality unchanged, corresponds to a decrease in N_r.

The utility of a type i $(i = P, R)$ consumer living in country r is assumed to be of the form:

$$U_{ir} = M_{ir}^{\mu} A_{ir}^{1-\mu} \tag{2}$$

with M_{ir} being an index of consumption of the varieties of a both vertically- and horizontally differentiated good, and A_{ir} being the consumed quantity of a homogenous good. The homogenous good is priced competitively, freely traded, and produced with unit efficient labor requirement, therefore implying that wages equalize across countries and can be normalized to 1. With $n = n_D + n_F$ being the total number of varieties being produced (i.e. both domestic and foreign), we define M_{ir} as:

$$M_{ir} = \left[\int_0^n \left(\gamma_k^{\phi_i} c_{ir}(k) \right)^{\frac{\sigma-1}{\sigma}} dk \right]^{\frac{\sigma}{\sigma-1}}, \ \sigma \in (1, +\infty) \tag{3}$$

where γ_k and $c_{ir}(k)$ are respectively the quality and the quantity of a variety k consumed by a type i consumer living in country r, σ is the elasticity of substitution between any two varieties, and ϕ_i is a type-specific taste parameter that determines the intensity of preferences for product quality. Along Hallak (2006), we assume that ϕ_i is a positive function of individual income l_i, i.e. that richer households value quality more.

Consumers use two-stage budgeting. A type i consumer living in country r will devote a share μ of its overall income l_{ir} to the consumption of the differentiated good; he will then spend the following amount of those expenses μl_{ir} on a given variety k:

$$p_r(k) c_{ir}(k) = \left(\frac{\left(\frac{p_r(k)}{\gamma_k^{\phi_i}} \right)^{1-\sigma}}{\int_0^n \left(\frac{p_r(k)}{\gamma_k^{\phi_i}} \right)^{1-\sigma} dk} \right) \mu l_{ir} \tag{4}$$

[22] Since we want to neutralize any supply-based variation of the quality mix being produced and exported, we assume that both countries have the same fixed amount of overall labor supply L.

with $p_r(k)$ being the price charged for the variety k in country r. Assuming there exists only two possible qualities for each variety, i.e. high quality γ_H and low quality γ_L ($\gamma_H > \gamma_L$), using (4) and introducing specific consumption indices C_{ir}^L and C_{ir}^H for low- and high-quality variety bundles,[23] the share $s_j(l_{ir})$ of those expenses μl_{ir} devoted to varieties of quality j is:

$$s_j(l_{ir}) = \frac{P_{rj}C_{ir}^j}{\mu l_{ir}} = \frac{\left(\frac{P_{rj}}{\gamma_j^{\phi_i}}\right)^{1-\sigma}}{\left(\frac{P_{rL}}{\gamma_L^{\phi_i}}\right)^{1-\sigma} + \left(\frac{P_{rH}}{\gamma_H^{\phi_i}}\right)^{1-\sigma}} \tag{5}$$

with $P_{rj} = \left[\int_0^{n_{rj}} p_{rj}(k)^{1-\sigma}dk + \int_0^{n_{sj}} p_{rj}^s(k)^{1-\sigma}dk\right]^{\frac{1}{1-\sigma}}$ $(r, s = D, F,\ r \neq s)$ being a quality and country-specific price index, and p_{rj}^s being the price of a good of quality j produced in country r and sold in country s (p_{rj} being the mill price). Focusing on the share devoted to high-quality goods, we unambiguously have $\frac{\partial s_H(l_{ir})}{\partial l_{ir}} > 0$ (P1) and, for levels of income l_{ir} for which we have $s_H(l_{ir}) < s_L(l_{ir})$, we also have $\frac{\partial^2 s_H(l_{ir})}{\partial l_{ir}^2} > 0$ (P2). Hence, **high-quality varieties are goods whose share in a given consumer's consumption basket increases with individual income**.

Firms compete monopolistically. In the quality segment j, producing a quantity $x_j(k)$ of variety k requires $f_j + a_j x_j(k)$ units of labor, with f_j and a_j being respectively the fixed and marginal labor requirements for quality j.[24] We impose $a_H > a_L$, in line with the idea that high-quality varieties are more expensive to produce (see, for example Kugler and Verhoogen, 2012), and assume free entry in each segment of the market.[25] Our model features "iceberg" trade costs: in order to export to country r ($r \in \{D, F\}$) one unit of quality j's output manufactured in country s, a firm must ship $\tau_j \geq 1$ units. Finally, firms fully pass on their shipping costs to their foreign costumers: one unit of variety k of quality j manufactured in country s is sold to consumers of country r at price $p_{sj}^r(k) = \tau p_{sj}$, where p_{sj} is the mill price. Denoting by $D_{rj} = \beta_r N_r C_{Pr}^j + (1-\beta)N_r C_{Rr}^j$ the total demand in country r for all varieties of quality j (both domestically- and foreign produced), (4) yields the following expression for the demand d_{rj} devoted to a variety of quality j produced in country r: $d_{rj} = p_{rj}^{-\sigma}(P_{rj}^\sigma D_{rj} + \tau^{1-\sigma}P_{sj}^\sigma D_{sj})$. The resolution of the firm's profit maximization problem within each country and quality segment is similar to the benchmark monopolistic competition model, and yields the following standard mill price and break-even output:

$$p_{rj} = \frac{\sigma}{\sigma-1}a_j, \quad d_{rj} = \frac{f_j(\sigma-1)}{a_j} \tag{6}$$

The price index in country r for quality j can then be re-expressed as:

$$P_{rj} = (n_{rj} + \tau^{1-\sigma}n_{sj})^{\frac{1}{1-\sigma}}\frac{\sigma}{\sigma-1}a_j \tag{7}$$

[23] $C_{ir}^j = \left(n_{Dj}(\gamma_j^{\phi_i}c_{ijr}^D)^{\frac{\sigma-1}{\sigma}} + n_{Fj}(\gamma_j^{\phi_i}c_{ijr}^F)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$ with c_{ijr}^r and n_{rj} denoting respectively the consumption for a variety of quality j produced in country r by a type ir consumer and the number of firms producing quality j within country r.

[24] Since we want to neutralize any supply-side determinant of a country's vertical specialization, we assume that those costs are similar across countries.

[25] We assume that firms are mono-variety in our set-up: a single firm cannot enter both quality segments of the market.

It is then convenient to introduce along Fajgelbaum et al. (2011) the notion of "effective competitors" of quality j present on the domestic market r: $\tilde{n}_{rj} = n_{rj} + \tau^{1-\sigma} n_{sj}$. The intuition behind the concept is straightforward: while love for variety guarantees that for each quality j, each consumer in each country will devote a non-null part of its overall expenses to every available variety (both domestic and foreign), the market penetration of foreign varieties is discounted by a factor $\tau^{1-\sigma}$, capturing the fact that the price charged for foreign varieties bears the burden of shipping costs. Substituting for (7) in d_{rj}, we then get:

$$d_{rj} = \tilde{n}_{rj}^{\frac{\sigma}{1-\sigma}} D_{rj} + \tau^{1-\sigma} \tilde{n}_{sj}^{\frac{\sigma}{1-\sigma}} D_{sj} \tag{8}$$

Equating demand and supply within each country and quality segment and using the fact that $d_{Dj} = d_{Fj} = d_j$ (i.e. domestic demand faced by a producer of a quality j variety is the same in both countries), equations (5), (6) and (8) yield the following four equilibrium conditions:

$$\frac{f_j \sigma}{\mu L} = \frac{(1+\tau^{1-\sigma})(\beta_r \theta_r s_j(l_{Pr}) + (1-\beta_r\theta_r) s_j(l_{Rr}))}{\tilde{n}_{rj}}, \qquad j = H, L, \ r = D, F \tag{9}$$

Proposition 1 (Existence and uniqueness of the equilibrium with trade): *For given income distribution parameters β_r, N_r, L_r and θ_r ($r = D, F$), there exists a unique positive solution to the system of four equations defined by (9), determining the distribution of effective firms across country and sectors ($\tilde{n}_{DL}, \tilde{n}_{DH}, \tilde{n}_{FL}, \tilde{n}_{FH}$).*

Proof. See Appendix B.

This result concerning the number of *effective* firms within each country does however not guarantee that we will observe trade of the differentiated good at the equilibrium. Indeed, we have the following expression for n_{rj}, i.e. the number of local firms producing varieties of quality j within country r:

$$n_{rj} = \frac{\tilde{n}_{rj} - \tau^{1-\sigma}\tilde{n}_{sj}}{1 - \tau^{2(1-\sigma)}}, \qquad r \neq s, \ j = H, L, \ r, s = D, F \tag{10}$$

which entails the following condition for n_{rj} to be positive, i.e. to have partial specialization of both countries:

$$\tau^{1-\sigma} < \frac{\tilde{n}_{rj}}{\tilde{n}_{sj}} < \frac{1}{\tau^{1-\sigma}}, \qquad r \neq s, \ j = H, L, \ r, s = D, F \tag{11}$$

Condition (11) is scarcely respected for low levels of transport costs, i.e. τ very close to 1, but always met for high enough values of τ.[26] From now on, we hence assume the transport costs τ are sufficiently high to guarantee that both countries produce and export the two qualities, i.e. that $n_{rj} > 0$ for $j = H, L$ and $r = D, F$.

Proposition 2 (Impact of the average income and the level of inequality on the average quality of the export bundle):
For given income distribution parameters θ_D, N_D, N_F and θ_F, for high enough transport costs τ and provided we have $\frac{\partial^2 s_H(l_{iD})}{\partial (l_{Di})^2} > 0$ for both $i = P, R$, we have the following comparative statics along N_D and θ_D:
(i) An increase in average income within country D (i.e. a decrease in N_D) generates an increase in the average quality of country D's export bundle: $\frac{\partial n_{DH}}{\partial N_D} < 0$, $\frac{\partial n_{DL}}{\partial N_D} > 0$.

[26] For low values of τ, condition (11) is respected when countries D and F are relatively similar in terms of average income $\frac{L_r}{N_r}$ and efficient labor size L_r.

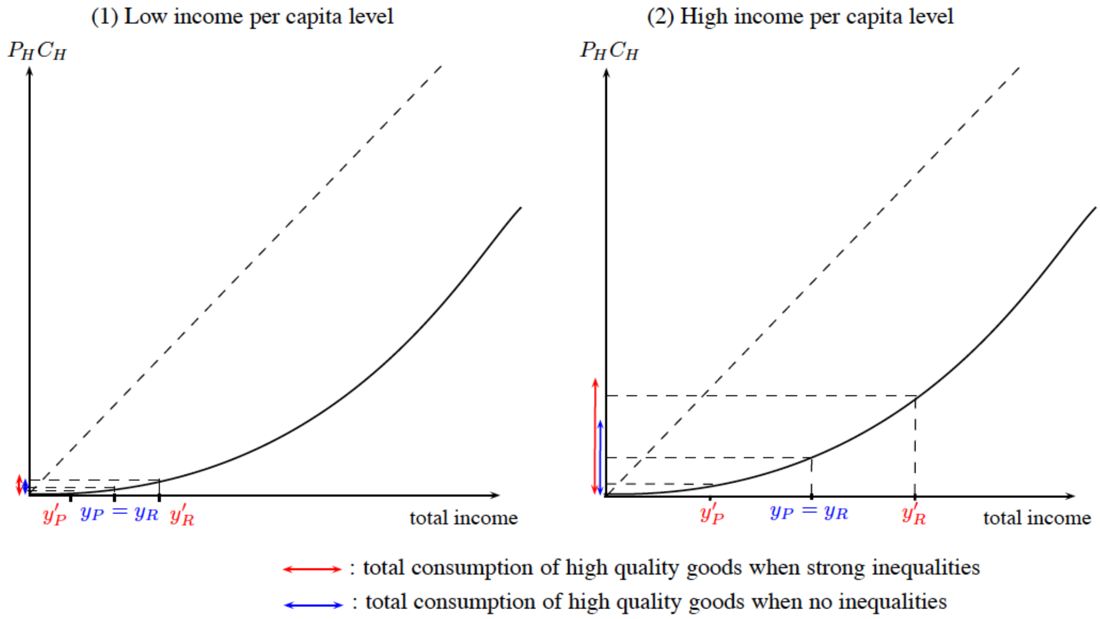

Figure 1: Heterogenous impact of inequality along the average income dimension

(ii) An mean-preserving spread of income within country D (i.e. a decrease in θ_D) generates an increase in the average quality of country D's export bundle: $\frac{\partial n_{DH}}{\partial \theta_D} < 0$, $\frac{\partial n_{DL}}{\partial \theta_D} > 0$
(iii) The impact of a higher level of inequality within country D on average unit values of country D's exports is all the more positive that average income in country D is high: $\frac{\partial^2 n_{DH}}{\partial \theta_D \partial N_D} > 0$, $\frac{\partial^2 n_{DL}}{\partial \theta_D \partial N_D} < 0$.

Proof. See Appendix B.

Proposition 2 implies that domestic income distribution has an impact on the quality mix being exported to trading partners. This result is the vertical translation of the classic horizontal "home-market effect" identified by Krugman (1980): a bigger market for varieties of a given quality j ensures the possibility to serve more consumers with sales that do not bear shipping costs, generating the entry of a greater number of producers of quality j and resulting in a shift in the quality level of exports.

Part (i) of Proposition 2 states that the average quality of the export bundle increases along the average income of consumers. This result is straightforward: since the share of overall consumption devoted to high-quality goods increases along income, an increase of average income leads to an increase in the size of the market for high-quality varieties. Such a demand shift raises the relative profitability of high-quality varieties, leaving the possibility for a higher number of firms to enter the market: $\tilde{n}_{DH}$ increases, leading to an increase (resp. decrease) in n_{DH} (resp. n_{DL}) and driving the exported quality mix upwards.

Parts (ii) and (iii) of Proposition 2 state that inequality has a positive *and* increasing impact on the exported quality mix along the average income dimension provided both l_{PD} and l_{RD} are below the income threshold for which $s_H(l_{iD})$ becomes greater than $s_L(l_{iD})$, i.e. if the evolution of the income share devoted to high-quality varieties is convex for both rich and poor consumers. This result is intuitively less straightforward, since mean-preserving variations in the spread of income impact in opposite ways the consumption of high-quality varieties of the poor and the rich: $\frac{\partial s_H(l_{PD})}{\partial \theta_D} > 0$, $\frac{\partial s_H(l_{RD})}{\partial \theta_D} < 0$. However, when the income share devoted to high-quality varieties increases in a convex way, the marginal increase of rich consumers' demand for high-quality varieties following an increase in inequality is more important than the marginal decrease of poor consumers' demand. Moreover, an increase in inequality gives more weight to rich consumers in total income. This leads to an overall increase in aggregate demand for high-quality varieties. Furthermore, since the amplitude of the variations in the consumption bundle increases along income, a shock on the level of inequality will be **magnified** for higher levels of average income (iii), as illustrated in Figure 1.

Our results on the effect of income and inequality are in line with those obtained by Fajgelbaum et al. (2011).[27] The nature of the adjustment of aggregate demand for high- and low- quality varieties is however different in the two models. In our model featuring love-for-variety at the individual level, it derives from changes in the quantity of each quality consumed at the individual level; in their model featuring heterogeneous consumers and unit consumption, it stems from changes in the number of people choosing a variety of a given quality.[28] This alternative framework also enables us to exemplify and rationalize the empirically identified heterogenous relationship between the second moment of a country's income distribution and the average quality of its exports, i.e. a stronger impact of inequality on the quality content of production for higher levels of income.

Quality content and unit value of exports

Unit value at the product-exporter level can be computed as $q^e = \frac{n_{rH}d_{rH}p_{rH}+n_{rL}d_{rL}p_{rL}}{n_{rL}d_{rL}+n_{rH}d_{rH}}$. It is possible to demonstrate that in our model, q^e can be reformulated in the following way:

$$q^e = \frac{La_La_H}{(\sigma-1)\left(\frac{La_H}{\sigma} + n_{Hr}f_H(a_L - a_H)\right)} \tag{12}$$

It is then straightforward to see that $\frac{\partial q^e}{\partial n_{Hr}} > 0$ under the condition that $a_L < a_H$, which is equivalent to $p_{Lr} < p_{Hr}$. Hence, an increase in n_{Hr} at fixed L_r can unambiguously be interpreted as a shift of the production mix towards high quality at equilibrium, which translates into higher average price of exports. Moreover, q^e being a convex function of n_{Hr}, we can easily show that our results regarding a stronger impact of inequality on n_{Hr} for higher levels of income also hold for unit values.[29]

Hence, predictions of the model relating income distribution and the number of exporters of each quality type translate into predictions relating income distribution and

[27] Indeed, the convexity property of the evolution of the income share devoted to high-quality varieties (needed so as to guarantee a positive impact of the inequality level on the average quality of the export bundle) is similar in the two models. In Fajgelbaum et al. (2011)'s unit consumption model though, it implies that a majority of any income class purchases low-quality goods: they hence interpret this property as pertaining to poor enough countries. In our model featuring love-for-variety at the individual level, this property is simply verified for countries in which both rich and poor consumers devote a greater share of their income to low-quality varieties. *Among* this group of countries however, both models predict that the impact of inequality will be stronger along the average income dimension; this prediction is simply not emphasized in the Fajgelbaum et al. (2011) paper.

[28] Such an equivalence between a framework featuring heterogeneous consumers and unit consumption and models with love-for-variety at the individual level is reminiscent of the the one demonstrated by Anderson et al. (1992) in a horizontal framework.

[29] Indeed, when the expenditure share of high-quality varieties is increasing and convex along income, we have $\frac{\partial^2 q^e}{\partial N \partial d} = \underbrace{\frac{\partial n_{Hr}}{\partial d}}_{<0}\underbrace{\frac{\partial n_{Hr}}{\partial N}}_{<0}\underbrace{\frac{\partial^2 q^e}{\partial n_{Hr}^2}}_{>0} + \underbrace{\frac{\partial^2 n_{Hr}}{\partial N \partial d}}_{>0}\underbrace{\frac{\partial q^e}{\partial n_{Hr}}}_{>0} > 0.$

average unit value of exports.

Appendix B: Proofs of the theoretical model

Proof of Proposition 1

Using (5) and (6), it is possible to reformulate the share $s_j(l_{ir})$ devoted to the consumption of varieties of quality j of a type i consumer living in country r as:

$$s_j(l_{ir}) = \frac{a_j^{1-\sigma}\tilde{n}_{rj}\gamma_j^{\phi_i(\sigma-1)}}{a_H^{1-\sigma}\tilde{n}_{rH}\gamma_H^{\phi_i(\sigma-1)} + a_L^{1-\sigma}\tilde{n}_{rL}\gamma_L^{\phi_i(\sigma-1)}}$$

The equilibrium conditions featured in (9) represent the possible combinations for numbers of low- and high-quality effective producers consistent with market clearing and zero profits in the two market segments in both countries. More precisely, for a given country r we have:

$$\frac{f_L\sigma}{\mu L_r} = \frac{(1+\tau^{1-\sigma})(\beta_r\theta_r s_L(l_{Pr}) + (1-\beta_r\theta_r)s_L(l_{Rr}))}{\tilde{n}_{rL}} \tag{13}$$

$$\frac{f_H\sigma}{\mu L_r} = \frac{(1+\tau^{1-\sigma})(\beta_r\theta_r s_H(l_{Pr}) + (1-\beta_r\theta_r)s_H(l_{Rr}))}{\tilde{n}_{rH}} \tag{14}$$

(13) and (14) yield two implicit functions $\tilde{n}_{rH} = \psi^L(\tilde{n}_{rL})$ and $\tilde{n}_{rH} = \psi^H(\tilde{n}_{rL})$. ψ^L and ψ^H are implicitly defined by writing (13) and (14) as $L(\tilde{n}_{rH}, \tilde{n}_{rL}) = 0$ and $H(\tilde{n}_{rH}, \tilde{n}_{rL}) = 0$ with:

$$L(.) = -\frac{f_L\sigma}{(1+\tau^{1-\sigma})\mu L_r} + \frac{\beta_r\theta_r s_L(l_{Pr})}{\tilde{n}_{rL}} + \frac{(1-\beta\theta_r)s_L(l_{Rr})}{\tilde{n}_{rL}}$$

$$H(.) = -\frac{f_H\sigma}{(1+\tau^{1-\sigma})\mu L_r} + \frac{\beta_r\theta_r s_H(l_{Pr})}{\tilde{n}_{rH}} + \frac{(1-\beta\theta_r)s_H(l_{Rr})}{\tilde{n}_{rH}}$$

ψ_L and ψ_H can be represented as downward-sloping curves in the $(\tilde{n}_{rH}, \tilde{n}_{rL})$ plane (respectively LL and HH in figure 2), since an increase in the number of competitors in one quality segment necessarily leads to a decrease in the number of competitors in the other segment in order to preserve profitability. More precisely, we have $\tilde{n}_{rL} \rightarrow \frac{f_L\sigma}{(1+\tau^{1-\sigma})\mu L}$ as $\tilde{n}_{rH} \rightarrow 0$ and $\tilde{n}_{rL} \rightarrow 0$ as $\tilde{n}_{rH} \rightarrow \infty$ in (13), while we have $\tilde{n}_{rH} \rightarrow \frac{f_H\sigma}{(1+\tau^{1-\sigma})\mu L}$ as $\tilde{n}_{rL} \rightarrow 0$ and $\tilde{n}_{rH} \rightarrow 0$ as $\tilde{n}_{rL} \rightarrow \infty$ in (14). The two curves hence necessarily intersect in the positive quadrant, i.e. there exists a positive equilibrium with $\tilde{n}_{rH} > 0$ and $\tilde{n}_{rL} > 0$.

Such an equilibrium is unique if LL is always steeper than HH, i.e. if $\frac{\partial\psi_L}{\partial\tilde{n}_{rL}} < \frac{\partial\psi_H}{\partial\tilde{n}_{rL}}$ $\forall\tilde{n}_{rL} > 0$. Using the implicit function theorem, this amounts to showing that we have $\frac{\partial L}{\partial\tilde{n}_{rL}}\frac{\partial H}{\partial\tilde{n}_{rH}} - \frac{\partial H}{\partial\tilde{n}_{rL}}\frac{\partial L}{\partial\tilde{n}_{rH}} > 0$. We note that $\frac{\partial s_j(l_i)}{\partial\tilde{n}_{rj}} = \frac{1}{\tilde{n}_{rj}}s_j(l_i)s_{-j}(l_i)$, and use the following notations to simplify the demonstration:

$$\begin{aligned} E[s_j] &= \beta_r\theta_r s_j(l_{Pr}) + (1-\beta_r\theta_r)s_j(l_{Rr}) \\ E[s_Hs_L] &= \beta_r\theta_r s_L(l_{Pr})s_H(l_{Pr}) + (1-\beta_r\theta_r)s_L(l_{Rr})s_H(l_{Rr}) \end{aligned}$$

We then have:

$$\begin{aligned} \frac{\partial L}{\partial\tilde{n}_{rL}}\frac{\partial H}{\partial\tilde{n}_{rH}} - \frac{\partial H}{\partial\tilde{n}_{rL}}\frac{\partial L}{\partial\tilde{n}_{rH}} &= \left(1/\tilde{n}_{rL}^2\right)\left(1/\tilde{n}_{rH}^2\right)E[s_L]E[s_H]\left(\left(\frac{E[s_Hs_L]}{E[s_L]} - 1\right)\left(\frac{E[s_Hs_L]}{E[s_H]} - 1\right) - \frac{E[s_Hs_L]^2}{E[s_H]E[s_L]}\right) \\ &= \left(1/\tilde{n}_{rL}^2\right)\left(1/\tilde{n}_{rH}^2\right)E[s_L]E[s_H]\left(1 - \frac{E[s_Ls_H]}{E[s_L]E[s_H]}\right) \end{aligned}$$

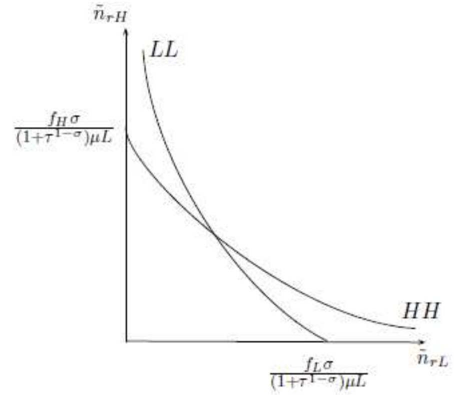

Figure 2: HH and LL in the $(\tilde{n}_{rH}, \tilde{n}_{rL})$ plane

Using the fact that $s_L(l_{ir}) = 1 - s_H(l_{ir})$, we have $E[s_L]E[s_H] = E[s_H] - E[s_H]^2$, while $E[s_H s_L] = E[s_H] - E[s_H^2]$: we hence have $\frac{E[s_L s_H]}{E[s_L]E[s_H]} < 1$, and $\frac{\partial L}{\partial \tilde{n}_{rL}}\frac{\partial H}{\partial \tilde{n}_{rH}} - \frac{\partial H}{\partial \tilde{n}_{rL}}\frac{\partial L}{\partial \tilde{n}_{rH}} > 0$. This ends the proof. □

Proof of Proposition 2

Using the implicit function theorem, the comparative statics of $\tilde{n}_{DH}$ and $\tilde{n}_{DL}$ with respect to a parameter η ($\eta = N_D, \theta_D$) can be obtained with the formula:

$$\begin{pmatrix} \frac{\partial \tilde{n}_{DH}}{\partial \eta} \\ \\ \frac{\partial \tilde{n}_{DL}}{\partial \eta} \end{pmatrix} = - \begin{pmatrix} \frac{\partial H}{\partial \tilde{n}_{DH}} & \frac{\partial H}{\partial \tilde{n}_{DL}} \\ \\ \frac{\partial L}{\partial \tilde{n}_{DH}} & \frac{\partial L}{\partial \tilde{n}_{DL}} \end{pmatrix}^{-1} \begin{pmatrix} \frac{\partial H}{\partial \eta} \\ \\ \frac{\partial L}{\partial \eta} \end{pmatrix}$$

which yields:

$$\begin{pmatrix} \frac{\partial \tilde{n}_{DH}}{\partial \eta} \\ \\ \frac{\partial \tilde{n}_{DL}}{\partial \eta} \end{pmatrix} = - \frac{1}{\frac{\partial H}{\partial \tilde{n}_{DH}}\frac{\partial L}{\partial \tilde{n}_{DL}} - \frac{\partial H}{\partial \tilde{n}_{DL}}\frac{\partial L}{\partial \tilde{n}_{DH}}} \begin{pmatrix} \frac{\partial H}{\partial \eta}\frac{\partial L}{\partial \tilde{n}_{DL}} - \frac{\partial H}{\partial \tilde{n}_{DL}}\frac{\partial L}{\partial \eta} \\ \\ -\frac{\partial L}{\partial \tilde{n}_{DH}}\frac{\partial H}{\partial \eta} + \frac{\partial H}{\partial \tilde{n}_{DH}}\frac{\partial L}{\partial \eta} \end{pmatrix}$$

The sign of the fraction is straightforward: considering demonstration of proposition 1, we have $-\frac{1}{\frac{\partial H}{\partial \tilde{n}_{rH}}\frac{\partial L}{\partial \tilde{n}_{DL}} - \frac{\partial H}{\partial \tilde{n}_{DL}}\frac{\partial L}{\partial \tilde{n}_{DH}}} < 0$. We are left to determine the signs of the derivatives of H and L with respect to θ_D and N_D:

$$\begin{aligned} \frac{\partial L}{\partial N_D} &= \frac{\beta_D\theta_D}{\tilde{n}_{DL}}\left(\frac{\partial s_L}{\partial l_{PD}}\frac{\partial l_{PD}}{\partial N}\right) + \frac{(1-\beta_D\theta_D)}{\tilde{n}_{DL}}\left(\frac{\partial s_L}{\partial l_{RD}}\frac{\partial l_{RD}}{\partial N}\right) \\ \frac{\partial H}{\partial N_D} &= -\frac{\beta_D\theta_D}{\tilde{n}_{rH}}\left(\frac{\partial s_H}{\partial l_{PD}}\frac{\partial l_{PD}}{\partial N}\right) + \frac{(1-\beta_D\theta_D)}{\tilde{n}_{rH}}\left(\frac{\partial s_H}{\partial l_{RD}}\frac{\partial l_{RD}}{\partial N}\right) \\ \frac{\partial L}{\partial \theta_D} &= \frac{\beta_D}{\tilde{n}_{DL}}\left(s_L(l_{PD}) - s_L(l_{RD})\right) + \frac{\beta_D L_D}{N_D\tilde{n}_{DL}}\left[\theta_D\frac{\partial s_L}{\partial l_{PD}} - \frac{1-\beta_D\theta_D}{1-\beta_D}\frac{\partial s_L}{\partial l_{RD}}\right] \\ \frac{\partial H}{\partial \theta_D} &= \frac{\beta_D}{\tilde{n}_{rH}}\left(s_H(l_{PD}) - s_H(l_{RD})\right) + \frac{\beta_D L_D}{N_D\tilde{n}_{rH}}\left[\theta_D\frac{\partial s_H}{\partial l_{PD}} - \frac{1-\beta_D\theta_D}{1-\beta_D}\frac{\partial s_H}{\partial l_{RD}}\right] \end{aligned}$$

(i) We have $\frac{\partial l_{PD}}{\partial N_D} = -\theta_D\frac{L}{N_D^2} < 0$ and $\frac{\partial l_{RD}}{\partial N_D} = \frac{1-\beta_D\theta_D}{1-\beta_D}\frac{L}{N_D^2} < 0$. Along P1, we are further able to state that $\frac{\partial s_H(l_{iD})}{\partial l_{iD}} > 0$ and $\frac{\partial s_L(l_{iD})}{\partial l_{iD}} < 0$. We hence obtain unambiguously that $\frac{\partial L}{\partial N_D} > 0$ and $\frac{\partial H}{\partial N_D} < 0$. The implicit function theorem then entails that $\frac{\partial \tilde{n}_{rH}}{\partial N_D} < 0$ and $\frac{\partial \tilde{n}_{DL}}{\partial N_D} > 0$.

An alternative and more intuitive demonstration of part (i) of Proposition 2 can be obtained by considering a slightly modified version of the equilibrium condition (14):

$$\frac{f_H \sigma \tilde{n}_{DH}}{\mu L_D(1+\tau^{1-\sigma})} = \beta_D \theta_D s_H(l_{PD}) + (1-\beta_D\theta_D) s_H(l_{RD}) \qquad (15)$$

As already said, an increase in N_D decreases both l_{PD} and l_{RD}, and hence generates a decrease of both $s_H(l_{PD})$ and $s_H(l_{RD})$ (cf property P1). The RHS of condition (15) hence unambiguously decreases. Considering the concavity of $s_H(l_{iD})$ along $\tilde{n}_{DH}$ ($\frac{\partial^2 s_H(l_{iD})}{\partial \tilde{n}_{DH}^2} < 0$, cf demonstration of Proposition 1) and the fact that the LHS is linear in $\tilde{n}_{DH}$, such a decrease of the RHS cannot be compensated by an increase in $\tilde{n}_{DH}$. The LHS necessarily needs to decrease for the equality to be respected again, leading to a decrease in $\tilde{n}_{DH}$ following an increase in N_D.

(ii)-(iii) As stated in Proposition 2, we place ourselves in the case where both l_{RD} and l_{PD} are under the income threshold l^T beyond which we have $s_H(l^T) > s_L(l^T)$. Along P1 and since $l_{RD} > l_{PD}$, we have that $s_H(l_{PD}) - s_H(l_{RD}) < 0$ and $s_L(l_{PD}) - s_L(l_{RD}) > 0$. Along (P2), we have that $\frac{\partial s_H}{\partial l_{RD}} > \frac{\partial s_H}{\partial l_{PD}}$ and $\frac{\partial s_L}{\partial l_{RD}} < \frac{\partial s_L}{\partial l_{PD}}$. Using those properties, we can deduce $\frac{\partial L}{\partial \theta_D} > 0$ and $\frac{\partial H}{\partial \theta_D} < 0$. Considering the formula obtained with the implicit function theorem, we then obtain unambiguously that $\frac{\partial \tilde{n}_{DH}}{\partial \theta_D} < 0$ and $\frac{\partial \tilde{n}_{DL}}{\partial \theta_D} > 0$.

Alternatively, considering (15) and under (P2), the RHS decreases following an increase in θ_D. The LHS hence needs to decrease for the equality to be respected again: $\tilde{n}_{DH}$ decreases. Demonstration of (iii) then folds out naturally: for higher levels of N_D (i.e. lower levels of average income) and because of the convexity of s_H along income levels under the income threshold l^T (P2), the sign of $\frac{\partial RHS}{\partial \theta_D}$ is left unchanged, but the *amplitude* of the variation is smaller. Hence, the smaller the income, the smaller is the decrease in $\tilde{n}_{DH}$ following an increase in θ_D: $\frac{\partial^2 \tilde{n}_{DH}}{\partial N_D \partial \theta_D} > 0$. In other words, the impact on the quality mix of a variation in the inequality level is more important for higher levels of income.

Adding up the equilibrium conditions in both quality segments for country D yields the following condition that needs to be met at the equilibrium:

$$f_L \sigma \tilde{n}_{DL} + f_H \sigma \tilde{n}_{DH} = \mu L_D(1+\tau^{1-\sigma}) \qquad (16)$$

Hence, at fixed overall labor supply L_D, condition (16) guarantees that an increase in $\tilde{n}_{DH}$ is only possible through a decrease in $\tilde{n}_{DL}$. Furthermore, we have that:

$$\frac{\partial n_{rj}}{\partial \tilde{n}_{rj}} > 0 \qquad j = H, L,\ r = D, F \qquad (17)$$

Those comparative statics imply that, provided that we are in an equilibrium with partial trade specialization (i.e. for high enough values of τ), an increase in the number $\tilde{n}_{rj}$ of "effective" producers of a given quality j in country r increases the number n_{rj} of domestic producers of this quality. We can hence directly interpret an increase in $\tilde{n}_{DH}$ as an increase in n_{DH}, and a decrease in $\tilde{n}_{DL}$ as a decrease in n_{DL}. In other words, an increase in $\tilde{n}_{DH}$ leads to a shift of the export mix of the domestic country D towards high a higher average quality at the equilibrium. This ends the proof. □

Appendix E: First stage regressions

We present here the first-stage regressions of columns (5) and (7) in Table 1.

Table 1: First-stage regressions

Dependent Variable:	Column (6) - Table 2		
	Ln Avg PPP Inc.$_{xt}$	Gini$_{xt}$	Ln Avg PPP Inc.$_{xt}\times$ Gini$_{xt}$
Model :	(1)	(2)	(3)
Ln $\frac{1}{\text{Distance to Germany}}$ (Geographic centrality)	0.165^{a}	-3.619^{a}	-29.530^{a}
	(0.0380)	(0.448)	(3.948)
Nb years left-wing gvt 1973-2000	-0.0218^{b}	-0.167^{a}	-2.306^{a}
	(0.00836)	(0.0492)	(0.404)
Ln $\frac{1}{\text{Distance to Germany}}\times$Nb years left-wing gvt 1973-2000	0.010^{c}	-0.125^{c}	-0.781
	(0.0060)	(0.0682)	(0.547)
Importer-Product-Year fixed effects	Yes	Yes	Yes
F-test excluded instruments	26.98	26.70	27.15

Note: Standard errors in parentheses ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are clustered at the exporter-year level. Exogenous regressors used to explain unit values are also included in the first stage, but we do not report the coefficients.

Appendix F: Robustness checks

Table 2: Bilateral export prices and exporter characteristics - Current income

	Dependent Variable: Ln uv$_{xmpt}$						
Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln Avg Income	0.146^{a}	0.159^{a}	0.148^{a}	0.135^{a}	-0.148^{b}	-1.029^{b}	-0.196^{b}
	(0.0119)	(0.0116)	(0.0133)	(0.0146)	(0.0674)	(0.432)	(0.0826)
Gini	-0.00243	-0.000845	-0.00193	-0.00499^{b}	-0.0939^{a}	-0.344^{a}	-0.118^{a}
	(0.00199)	(0.00169)	(0.00150)	(0.00195)	(0.0200)	(0.131)	(0.0248)
Ln Avg Income × Gini					0.00956^{a}	0.0350^{a}	0.0119^{a}
					(0.00219)	(0.0132)	(0.00274)
Ln Balassa ind. vol.		-0.0780^{a}	-0.0774^{a}	-0.0824^{a}	-0.0841^{a}	-0.0886^{a}	-0.103^{a}
		(0.00267)	(0.00261)	(0.00280)	(0.00275)	(0.00333)	(0.00298)
Ln Skills			0.0581^{c}	0.0599^{b}	0.0676^{b}	0.161^{a}	0.0784^{b}
			(0.0301)	(0.0291)	(0.0282)	(0.0430)	(0.0310)
Ln Distance				0.124^{a}	0.123^{a}	0.140^{a}	0.141^{a}
				(0.00741)	(0.00740)	(0.00776)	(0.00831)
Ln Pop				-0.0132^{c}	-0.0187^{b}	-0.00960	-0.0233^{b}
				(0.00743)	(0.00796)	(0.0120)	(0.0100)
	FE	FE	FE	FE	FE	IV	FE
N	2421908	2421908	2405704	2405704	2405704	2405704	1033474
Importer-Product-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kleinbergen-Paap test						6.050^{b}	
Endog. test (p-value)						0.08	
	All manuf. prod.						Vert. diff. prod.

Note: Standard errors in parentheses ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are clustered at the exporter-year level. The proxy for skills is the number of graduated people in maths, sciences and technologies per thousand inhabitants.

Table 3: Bilateral export prices and exporter characteristics - Interquintile ratio

	Dependent Variable: Ln uv$_{xmpt}$						
Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln Avg PPP Income	0.215^a	0.243^a	0.222^a	0.207^a	0.0179	-0.911^b	0.0184
	(0.0209)	(0.0205)	(0.0226)	(0.0263)	(0.0829)	(0.417)	(0.0907)
Interquintile ratio	-0.0120	-0.00495	-0.0102^c	-0.0212^a	-0.388^a	-1.888^b	-0.468^a
	(0.00820)	(0.00626)	(0.00532)	(0.00700)	(0.143)	(0.743)	(0.163)
Ln Avg PPP Income × Interquintile ratio					0.0393^b	0.193^b	0.0468^b
					(0.0154)	(0.0761)	(0.0177)
Ln Balassa ind. vol.		-0.0791^a	-0.0781^a	-0.0828^a	-0.0837^a	-0.0874^a	-0.103^a
		(0.00287)	(0.00271)	(0.00280)	(0.00271)	(0.00335)	(0.00290)
Ln Skills			0.0825^a	0.0824^a	0.0881^a	0.163^a	0.101^a
			(0.0301)	(0.0292)	(0.0284)	(0.0364)	(0.0314)
Ln Distance				0.126^a	0.124^a	0.138^a	0.142^a
				(0.00749)	(0.00741)	(0.00704)	(0.00831)
Ln Pop				-0.0161^b	-0.0208^b	-0.00993	-0.0258^b
				(0.00774)	(0.00837)	(0.0140)	(0.0100)
	FE	FE	FE	FE	FE	IV	FE
N	2421908	2421908	2405704	2405704	2405704	2405704	1033474
Importer-Product-Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kleinbergen-Paap test						7.92^a	
Endog. test (p-value)						0.12	
	All manuf. prod.						Vert. diff. prod.

Note: Standard errors in parentheses ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Standard errors are clustered at the exporter-year level. The proxy for skills is the number of graduated people in maths, sciences and technologies per thousand inhabitants.