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Love for quality, comparative advantage, and trade☆

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ABSTRACT

We propose a Ricardian trade model with horizontal and vertical differentiation, where willingness to pay for quality rises with income, and productivity differentials across countries are stronger for high-quality varieties of goods. Our theory predicts that the scope for trade widens and international specialisation intensifies as incomes grow and wealthier consumers raise the quality of their consumption baskets. This implies that comparative advantages strengthen gradually over the path of development as a by-product of the process of quality upgrading. The evolution of comparative advantages leads to specific trade patterns that change over the growth path, by linking richer importers to more specialised exporters. We provide empirical support for this prediction, showing that the share of imports originating from exporters exhibiting a comparative advantage in a specific product correlates positively with the importer's GDP per head.

1. Introduction

Income is a key determinant of consumer choice. A crucial dimension through which purchasing power influences this choice is the quality of consumption. People with very different incomes tend to consume commodities within the same category of goods, such as clothes, cars, wines, etc. However, the actual quality of the consumed commodities differs substantially when comparing poorer to richer households. The same reasoning naturally extends to countries with different levels of income per capita. In this case, the quality dimension of consumption entails important implications on the evolution of trade flows.

Several recent studies have investigated the links between quality of consumption and international trade. One strand of literature has centred their attention on the demand side, finding a strong positive correlation between quality of imports and the importer's income per head [Hallak (2006), Fieler (2012)].[1] Another set of papers has focused instead on whether exporters adjust the quality of their production to serve markets with different income levels. The evidence here also points towards the presence of nonhomothetic preferences along the quality dimension, showing that producers sell higher quality versions of their output to richer importers.[2]

These empirical findings have motivated a number of models that yield trade patterns where richer importers buy high-quality versions of goods, while exporters differentiate the quality of their output by income at destination [Hallak (2010), Fajgelbaum et al. (2011), Jaimovich and Merella (2012)]. Yet, this literature has approached the determinants of countries' sectoral specialisation as a phenomenon that is independent of the process of quality upgrading resulting from higher consumer incomes. In this paper, we propose a theory where quality upgrading becomes the central driving force behind a general process of sectoral specialisation and comparative advantage intensification. The crucial novel feature of our theory is that quality upgrading by consumers leads to a strengthening in countries' specialisation in the

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[1] See also related evidence in Choi et al. (2009), Francois and Kaplan (1996) and Dalgin et al. (2008).

[2] For example, Verhoogen (2008) and Iacovone and Javorcik (2008) provide evidence of Mexican manufacturing plants selling higher qualities in the US than in their local markets. Brooks (2006) establishes the same results for Colombian manufacturing plants, and Manova and Zhang (2012) show that Chinese firms ship higher qualities of their exports to richer importers. Analogous evidence is provided by Bastos and Silva (2010) for Portuguese firms, and by Crino and Epifani (2012) for Italian ones.

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sectors where they exhibit a relative cost advantage. Therefore, the quality of the goods consumed and exchanged in world markets becomes a first-order determinant of the evolution of countries' sectoral specialisation, and of the intensity of the trade links that importers establish with different exporters.

Our theory is grounded on the hypothesis that productivity differentials are stronger for higher-quality goods, combined with willingness to pay for quality that rises with income. Within this framework, we show that international specialisation and sectoral trade intensify over the growth path. The evolution of trade flows presents novel specificities that stem from the interaction between nonhomothetic preferences and the deepening of sectoral productivity differentials at higher levels of quality. In particular, the process of quality upgrading with rising incomes sets in motion a simultaneous increase in specialisation by importers and exporters. Import and export specialisation arise as intertwined phenomena because, as countries become richer, consumers shift their spending towards high-quality goods, which are exactly those that tend to display greater scope for international trade.

We model a world economy with a continuum of horizontally differentiated goods, each of them available in a continuum of vertically ordered quality levels. The production technology differs both across countries and sectors. We assume that some countries are intrinsically better than others in producing certain types of goods. In addition, these intrinsic productivity differentials on the horizontal dimension tend to become increasingly pronounced along the vertical dimension. These assumptions lead to an intensifying process of sectoral specialisation as production moves up on the quality ladders of each good. For example, a country may have a cost advantage in producing wine, while another country may have it in whisky. This would naturally lead them to exchange these two goods. Yet, in our model, productivity differences in the wine and whisky industries do not remain constant along the quality space, but become more intense as production moves up towards higher quality versions of these goods. As a result, the scope for international trade turns out to be wider for high-quality wines and whiskies than for low-quality ones.

A key feature of our model is the embedded link between nonhomotheticities in quality and international trade at the sectoral level. More precisely, as richer individuals upgrade the quality of their consumption baskets, sectoral productivity differentials across countries become stronger, leading to the intensification of some trading partnerships and the weakening of others. In that respect, our model suggests that the study of the evolution of trade links may require a more flexible concept of comparative advantage than the one traditionally used, so as to encompass quality upgrading as an inherent part of it. In the literature of Ricardian trade, the comparative advantage is univocally determined by exporters' technologies. This paper instead sustains that both the importers' incomes and the exporters' sectoral productivities must be jointly taken into account in order to establish a rank of comparative advantage. This is because the degree of comparative advantage between any two countries is crucially affected by the quality of consumption. As a consequence, richer and poorer importers may end up establishing trade links of substantially different intensity with the *same* set of exporters, simply because the gaps between their willingness-to-pay for quality may translate into unequal degrees of comparative advantage across their trade partners.

The conditionality of comparative advantage on importers incomes entails novel testable predictions on the evolution of sectoral trade flows. In particular, our model predicts that the share of imports originating from exporters exhibiting a cost advantage must grow with the income per head of the importer. This is the result of richer importers buying high-quality versions of goods, which are those for which cost differentials across countries are relatively more pronounced. Using bilateral trade data at the sectoral level, we provide evidence consistent with the prediction that richer economies are more likely to buy their imports from producers who display a comparative advantage in the imported goods.

Finally, our theory also has implications in terms of policy, particularly with regard to stimulating the growth of a specific industry through import tariffs or subsidies to local producers. Using simple comparative statics, we show that the gains from free trade are stronger for more developed economies, as their consumers suffer a greater welfare loss when the tariff is imposed on more efficient producers. In addition, our results suggest that subsidies have a larger impact at fostering local production when introduced in developing countries.

1.1. Related literature

Nonhomothetic preferences are by now a widespread modelling choice in the trade literature. However, most of the past trade literature with nonhomotheticities has focused either on vertical differentiation [e.g., Flam and Helpman (1987), Stokey (1991) and Murphy and Shleifer (1997)] or horizontal differentiation in consumption [e.g., Markusen (1986), Bergstrand (1990) and Matsuyama (2000)].[3] Two recent articles have combined vertical and horizontal differentiation with preferences featuring income-dependent willingness to pay for quality: Fajgelbaum et al. (2011) and Jaimovich and Merella (2012).

Fajgelbaum et al. (2011) analyse how differences in income distributions between economies with access to the *same* technologies determine trade flows in the presence of increasing returns and trade costs. Like ours, their paper leads to an endogenous emergence of comparative advantages. In their case, this could be either due to trade costs being too high to allow trade, or countries' income distributions being too similar to induce specialisation via a home-market effect. Our paper, instead, sticks to the Ricardian tradition where trade and specialisation stem from cross-country *differences* in sectoral technologies featuring constant returns to scale. Comparative advantages and trade emerge gradually in our model, not because trade costs initially hinder the scope for exchange in the presence of increasing returns to scale, but because the demand for commodities displaying wider heterogeneity in cost of production (the high-quality goods) expands as incomes rise.[4]

Jaimovich and Merella (2012) also propose a nonhomothetic preference specification where budget reallocations take place both within and across horizontally differentiated goods. That paper, however, remained within a standard Ricardian framework where absolute and comparative advantages are determined from the outset, and purely by technological conditions. Hence, nonhomothetic preferences play no essential role there in determining export and import specialisation at different levels of development. By contrast, it is the interaction between rising differences in productivity at higher quality levels and nonhomotheticities in quality that generates our novel results in terms of co-evolution of export and import specialisation.

A key assumption in our theory is the widening in productivity differentials at higher levels of quality. To the best of our knowledge, Alcala (2012) is the only other paper that has explicitly introduced a similar feature into a Ricardian model of trade. An important difference between the two papers is that Alcala's keeps the homothetic demand structure presented in Dornbusch et al. (1977) essentially intact. Nonhomotheticities in demand are indeed crucial to our story. In

[3] For some recent contributions with horizontal differentiation and nonhomothetic preferences see: Foellmi et al. (2012) and Tarasov (2012), where consumers are subject to a discrete consumption choice; Fieler (2011) who ties the income elasticity of consumption goods across different industries to the elasticity of substitution of goods within the same industry; Simonovska (forthcoming) who fixes a bounded level of utility for each differentiated good; Breinlich and Cuñat (2013) who combine a Stone-Geary representation with Armington aggregators of country-specific varieties; and Melitz and Ottaviano (2008), Zhelobodko et al. (2012) and Dhingra and Morrow (2012), who adopt nonhomothetic specifications of preferences delivering linear demand systems.

[4] In this regard, an important feature present in our model is that high-quality versions of goods are inherently more tradable than low-quality ones, while this is not necessarily the case in Fajgelbaum et al. (2011) unless they specifically assume quality-specific trade costs that are restricted to be relatively lower for high-quality varieties.

particular, they underlie our predictions regarding the evolution of trade flows and specialisation at different levels of income.

Finally, Fieler (2011) also studies the interplay between non-homothetic demand and Ricardian technological disparities. She shows that, when productivity differences are stronger for goods with high income elasticity, her model matches quite closely key features of North–North and North–South trade. While her model exhibits horizontal differentiation, it does not display vertical differentiation, which is a crucial dimension exploited by our model. Our mechanism differs from hers in that the effects of demand on trade flows stem from the (vertical) reallocation of consumer spending *within* categories of goods rather than (horizontally) *across* them. It is in fact this within-good substitution process that leads to our main predictions where spending shares across different exporters of the same good change with the income of the importer.

The rest of the paper is organised as follows. Section 2 studies a world economy with a continuum of countries where all economies have the same level of income per head in equilibrium. Section 3 generalises the main results to a world economy where some countries are richer than others. Section 4 presents some empirical results consistent with the main predictions of our model. Section 5 provides some further discussion in terms of policy implications. Section 6 concludes. All relevant proofs can be found in the Appendices.

2. A world economy with equally rich countries

We study a world economy with a unit continuum of countries indexed by υ. In each country there is a continuum of individuals with unit mass. Each individual is endowed with one unit of labour time. We assume labour is immobile across countries. In addition, we assume all countries are open to international trade, and there are no trading costs of any sort.

All countries share a common commodity space defined along three distinct dimensions: a *horizontal*, a *varietal*, and a *vertical* dimension. Concerning the horizontal dimension, there exists a unit continuum of differentiated goods, indexed by z. In terms of the varietal dimension, we assume that each country υ produces a specific variety υ of each good z. Finally, our vertical dimension refers to the intrinsic quality of the commodity: we assume that a continuum of different qualities $q \geq 1$ are potentially available for each good z.[5]

Our model will display two main distinctive features. First, productivity differentials across countries will rise with the quality level of the commodities being produced. Second, richer individuals will choose to consume higher-quality commodities than poorer ones. The next two subections specify the functional forms of production technologies and consumer utility that we adopt to generate these two features.

2.1. Production technologies

In each country υ there exists a continuum of firms that may transform local labour into a variety υ of good z. Production technologies are idiosyncratic both to the sector z and to the country υ. In order to produce one unit of commodity z at the quality level q, a firm from country υ needs to use $\Gamma_{z,\upsilon}(q)$ units of labour, where:

$$\Gamma_{z,\upsilon}(q) = \frac{A}{1+\kappa} q^{\eta_{z,\upsilon}}. \tag{1}$$

Unit labour requirements contain two key technological parameters. The first is $\kappa > 0$, which applies identically to all sectors and countries, and we interpret it as the worldwide total factor productivity level. As such, in our model, increases in κ will capture the effects of aggregate growth and rising real incomes. The second is $\eta_{z,\upsilon}$, which may differ both across z and υ, and governs the elasticity of the labour requirements with respect to quality upgrading. In what follows, we assume that each parameter $\eta_{z,\upsilon}$ is *independently* drawn from a probability density function with uniform distribution over the interval $[\underline{\eta}, \overline{\eta}]$. In addition, we assume that $\underline{\eta} > 1$. Hence, $\Gamma_{z,\upsilon}(q)$ are always strictly increasing and convex in q. The term $A \equiv e^{-\underline{\eta}(\overline{\eta}-1)/(\underline{\eta}-1)}$ is simply a scale factor between labour input units and quality units, introduced for mathematical convenience.

An important feature implicit in the functional form of Eq. (1) is that cross-country sectoral productivity differentials will widen with the level of quality of production. This feature will in turn imply that the cost advantage of countries with better sectoral productivity draws will expand at higher levels of quality of production.

Let w_υ denote henceforth the wage per unit of labour time in country υ. We assume that, in all countries and all sectors, firms face no entry costs. In equilibrium, all commodities will then be priced exactly at their unit cost. Hence, the variety of good z in quality q produced by country υ will be sold (internationally) at price:

$$p_{z,\upsilon}(q) = \frac{A\, w_\upsilon}{1+\kappa} q^{\eta_{z,\upsilon}}. \tag{2}$$

Notice from Eq. (2) that changes in κ leave all relative prices unaltered. In this regard, we may consider a rise in total factor productivity κ as resulting in a *pure* increase in real income, entailing no substitution effect across the different commodities.

2.2. Utility function and budget constraint

To simplify the analysis, we introduce the following assumption concerning consumer choice:

Assumption 1. **(Selection of quality)** *Individuals consume a strictly positive amount of (at most) one quality version of each good z produced by country υ.*

Assumption 1 is analogous to assuming an infinite elasticity of substitution across different quality versions of the good z sourced from country υ. Henceforth, to ease notation, we denote the *selected* quality of the good z sourced from country υ by $q_{z,\upsilon}$. In addition, we denote by $c_{z,\upsilon}$ the consumed physical quantity of the selected quality $q_{z,\upsilon}$.

Utility is defined over the consumed quantities $c_{z,\upsilon}$ in the selected qualities $q_{z,\upsilon}$. Formally:

$$U = \left[\int_{\mathbb{Z}} \left(\int_{\mathbb{V}} \ln \left(c_{z,\upsilon}\right)^{q_{z,\upsilon}} d\upsilon \right)^{\sigma} dz \right]^{\frac{1}{\sigma}}, \quad \text{where } \sigma < 0. \tag{3}$$

An individual with income w chooses the quantity to consume for each selected quality, subject to the budget constraint:

$$\int_{\mathbb{Z}} \left[\int_{\mathbb{V}} p_{z,\upsilon}\left(q_{z,\upsilon}\right) c_{z,\upsilon}\, d\upsilon \right] dz \leq w, \tag{4}$$

where each $p_{z,\upsilon}(q_{z,\upsilon})$ in Eq. (4) is given by the price functions (2) when q is equal to the selected quality $q_{z,\upsilon}$.

The utility function (3) displays a number of features that are worth discussing in detail. Firstly, considering the quality dimension in isolation, the exponential terms $(c_{z,\upsilon})^{q_{z,\upsilon}}$ in Eq. (3) are instrumental to obtaining our desired non-homothetic behaviour along the quality space. The exponential form implies that, whenever $c_{z,\upsilon} > 1$, the magnifying effect of quality becomes increasingly important as $c_{z,\upsilon}$ rises. Such

[5] To fix ideas, the horizontal dimension refers to different types of goods, such as cars, wines, coffee beans, etc. The varietal dimension refers to the different varieties of any given type of good, originating from different countries, such as Spanish and French wines (differing, for instance, in specific traits like the types of grapes and regional vinification techniques). The vertical dimension refers to the intrinsic quality of each specific commodity (e.g., the ageing and the grapes selection in the winemaking).

non-homothetic feature in turn leads to a solution of the consumer problem where higher incomes will translate into quality upgrading of consumption. Secondly, abstracting now from the quality dimension, Eq. (3) features two nested CES functions: i) the (inner) logarithmic function implies a unit elasticity of substitution across varieties of the same good z; ii) the parameter $\sigma < 0$ governs the elasticity of substitution across goods, which is equal to $1/(1-\sigma) < 1$. Thus, the elasticity of substitution across different goods is smaller than within goods (i.e., across the different varieties of the same good).

2.3. Utility maximisation

Consider a representative individual in a generic country. The consumer's problem requires maximising Eq. (3) subject to Eq. (4). This is a problem that could be in principle solved in terms of physical quantities of consumption for each good. However, Assumption 1 allows us to easily re-state the problem in terms of two other variables that we will henceforth use: *selected qualities* and *budget allocations*. More precisely, denoting by $\beta_{z,\upsilon}$ the share of income spent in the good z sourced from country υ, by using Assumption 1 we may write:

$$c_{z,\upsilon} = \frac{\beta_{z,\upsilon} w}{p_{z,\upsilon}(q_{z,\upsilon})}, \tag{5}$$

where, again, the expression $p_{z,\upsilon}(q_{z,\upsilon})$ in Eq. (5) is given by the price functions (2) with $q = q_{z,\upsilon}$.

In the next sections, we will study how the intensity of sectoral trade partnerships change at different levels of consumer income within a full general equilibrium framework. However, it proves useful to present first the formal solution of the consumer problem in the specific case when the wage is the same for all countries; that is, when $w_\upsilon = w$ for all υ. This will allow us to convey some preliminary intuition for the mechanism underlying the general equilibrium results presented later on.[6]

Lemma 1. **(Optimal selected quality and budget allocation)** *When all countries have the same wage, for each good z produced in country* υ*, the consumer chooses the level of quality:*

$$q_{z,\upsilon} = \left[\frac{(1+\kappa)/A}{e^{\eta_{z,\upsilon}} Q}\right]^{1/(\eta_{z,\upsilon}-1)}, \tag{6}$$

and allocates the share of income

$$\beta_{z,\upsilon} = \left[\frac{(1+\kappa)/A}{(eQ)^{\eta_{z,\upsilon}}}\right]^{1/(\eta_{z,\upsilon}-1)}, \tag{7}$$

where the variable $Q \equiv \int_{\mathbb{Z}}\int_{\mathbb{V}} q_{z,\upsilon}\, d\upsilon\, dz$ *in the denominator of Eqs. (6) and (7) denotes the average quality of the optimal consumption bundle chosen by the consumer.*

Lemma 1 characterises the solution of the consumer's problem in terms of two sets of variables: the expressions in Eq. (6), which stipulate the quality level in which each variety of every good is optimally consumed; the expressions in Eq. (7), describing the optimal expenditure shares allocated to those commodities. An important implication of Lemma 1 is the implicit link between optimal budget shares and optimal qualities. In particular, plugging Eq. (6) into Eq. (7) yields $\beta_{z,\upsilon} = q_{z,\upsilon}/Q$.

[6] The next section shows that, in this symmetric specification of the model, all wages will in any case turn out to be equal in equilibrium. As a consequence, there is no loss of generality by preliminarily proceeding to study the optimum of the consumer problem when $w_\upsilon = w$ for all υ.

Lemma 2. **(Nonhomotheticity in quality of consumption)** *The selected quality of the consumed goods rises as the real income of the consumer increases; that is:* $\partial q_{z,\upsilon}/\partial\kappa > 0$*. Furthermore, the process of quality upgrading is more pronounced for the varieties of the good sourced from countries that can more easily improve its quality; that is:* $\partial^2 q_{z,\upsilon}/(\partial\kappa\,\partial\eta_{z,\upsilon}) < 0$*.*

Lemma 2 summarises the key nonhomothetic aspect present in our model: quality upgrading of consumption. From the result $\partial q_{z,\upsilon}/\partial\kappa > 0$ it follows that, as real incomes grow with a rising κ, individuals substitute lower-quality versions of every good z by better versions of them.[7] Moreover, the cross-derivative $\partial^2 q_{z,\upsilon}/(\partial\kappa\,\partial\eta_{z,\upsilon}) < 0$ implies that the quality rise is faster for commodities supplied by countries that received better sectoral productivity draws (i.e., lower values of η).

Jointly considered, the two lemmas underlie the main source of interaction between supply and demand sides that we will exploit in our general equilibrium analysis: as κ grows, producers better able at upgrading quality in a particular sector will gradually attract larger world expenditure shares in that sector.

2.4. General equilibrium

In equilibrium, total world spending on commodities produced in country v must equal the total labour income in country υ. Denoting by $\beta^i_{z,\upsilon}$ the expenditure share by importer i in the variety of good z produced in country υ, we may write down the market clearing condition as follows:

$$\int_{\mathbb{Z}}\int_{\mathbb{V}} \beta^i_{z,\upsilon}\, w_i\, di\, dz = w_\upsilon, \tag{8}$$

where w_i refers to the income of country i.

More formally, an equilibrium in the world economy is given by a set of wages w_υ for each country v such that: *i*) prices of all traded commodities are determined by Eq. (2); *ii*) all consumers in the world choose their commodity spending by maximising Eq. (3) subject to Eq. (4); and *iii*) the market clearing conditions stipulated in Eq. (8) hold simultaneously for all countries.

In this world economy, the *ex-ante* symmetry across countries implies that, in equilibrium, all country wages w_υ will always turn out to be equal to each other. Thus, we can simply write that $w_\upsilon = w$, for any level of $\kappa > 0$.[8] The reason for this result is the following: as κ rises, and real incomes accordingly increase, *aggregate* demands and supplies grow together at identical speed in all countries. As a consequence, markets clearing conditions in Eq. (8) will constantly hold true without the need of any adjustment in relative wages across economies.

The fact that relative wages remain constant over the path of development conceals the fact that, as κ increases, economies actually experience significant changes in their consumption and production structures at the *sectoral* level. Such sectoral reallocations stem from the interplay of demand and supply side factors. On the demand side, as real incomes grow with a rising κ, individuals consume higher quality versions of each commodity—as can be observed from Eq. (6). On the supply side, heterogeneities in sectoral labour productivities across countries become stronger as producers raise the quality of their output—as can be gleaned from Eq. (1). As we will formally show next, the interplay between income-dependent willingness to pay for quality and intensification of sectoral productivity differences at higher levels of quality leads to a process of ever increasing sectoral specialisation as κ rises.

[7] As we mentioned at the end of Section 2.1, variations in κ affect all prices in Eq. (2) in the same proportion, leaving *all* relative prices unchanged. Thus, a rise in κ leads consumers to upgrade their quality of consumption via a pure *income-effect*. In fact, a rise in κ entails the same effects as an exogenous increase of w (in that regard, the parameter κ plays a role that is isomorphic to that of the units of efficiency labour available to each individual).

[8] For a formal proof of this result, see Proposition 5 in the Online Appendix.

2.5. Sectoral specialisation

We study now the effects of the above-mentioned sectoral reallocations on the sectoral trade flows. With regards to the demand side of the economy, we examine the import penetration (IP) of good z sourced from country υ in the destination country i, defined as:

$$IP^i_{z,\upsilon} \equiv \frac{M^i_{z,\upsilon}}{M^i_z}, \tag{9}$$

where $M^i_{z,\upsilon}$ denotes the value of imports of good z sourced from country υ, and M^i_z is the total value of imports of good z.

For the supply side, we consider the revealed comparative advantage (RCA) of country υ in sector z. Formally:

$$RCA_{z,\upsilon} \equiv \frac{X_{z,\upsilon}/X_\upsilon}{W_z/W}. \tag{10}$$

In the numerator of Eq. (10), $X_{z,\upsilon}$ denotes the value of exports of good z by country υ, and X_υ the value of total exports by country υ. In the denominator of Eq. (10), W_z refers to the value of exports of good z worldwide, and W represents the value of total exports in the world.

Lemma 3. (Import penetration and revealed comparative advantage) *In a world economy where all countries have the same income, for every variety υ of good z, the measures of import penetration and revealed comparative advantage equal the share of income spent on that commodity. Formally:*

1. *For any importer i of variety υ of good z: $IP^i_{z,\upsilon} = \beta_{z,\upsilon}$.*
2. *For any exporter υ of good z: $RCA_{z,\upsilon} = \beta_{z,\upsilon}$.*

In our symmetric world economy, the revealed comparative advantage of country υ in good z and the import penetration of variety υ of good z mirror one another. This is the result of all countries displaying the same income (coupled with individuals having the same preferences worldwide and the absence of trade costs) which entails that all consumers will choose exactly the same optimal consumption bundle. The next proposition shows how these measures of bilateral trade flows relate to countries' sectoral productivity draws, and how they evolve as real incomes rise in the world economy.

Proposition 1. *In a world economy where all countries have the same income, the degree of specialisation in sector z is larger for countries that received better sectoral productivity draws in that sector. In addition, sectoral specialisation intensifies as the real incomes of individuals increase. Formally, for any sector z and any pair of countries υ' and υ'' such that $\eta_{z,\upsilon'} < \eta_{z,\upsilon''}$.*

1. *$\beta_{z,\upsilon'} > \beta_{z,\upsilon''}$. Therefore, $RCA_{z,\upsilon'} > RCA_{z,\upsilon''}$, and $IP^i_{z,\upsilon'} > IP^i_{z,\upsilon''}$ for any importer i.*
2. *$\frac{\partial\beta_{z,\upsilon'}}{\partial\kappa} > \frac{\partial\beta_{z,\upsilon''}}{\partial\kappa}$. Thus, $\frac{\partial(RCA_{z,\upsilon'} - RCA_{z,\upsilon''})}{\partial\kappa} > 0$, and $\frac{\partial(IP^i_{z,\upsilon'} - IP^i_{z,\upsilon''})}{\partial\kappa} > 0$ for any importer i.*

Proposition 1 merges together supply side and demand side results. It firstly describes how export and import specialisation relate to the sectoral productivity draws, and secondly it shows how both measures evolve as real incomes grow with a rising value of κ.

From a supply side perspective, Proposition 1 states that the RCA in sector z are monotonically linked to the sectoral productivity draws $\eta_{z,\upsilon}$: countries that receive better draws for sector z exhibit a higher RCA in that sector. More importantly, the second result in the proposition shows that this gap further intensifies as κ rises. This last result is what we interpret as increasing export specialisation along the growth path.

From a demand side perspective, Proposition 1 may be interpreted in terms of increasing import specialisation along the growth path. More precisely, the result that $\partial(IP^i_{z,\upsilon'} - IP^i_{z,\upsilon''})/\partial\kappa > 0$ means that, as consumers get richer, we observe a process of growing import penetration of the varieties of z produced by exporters who enjoy a higher RCA in sector z.

The joint consideration of these two arguments suggests that, over the path of development, countries with a cost advantage in a given sector will increasingly specialise in that sector. At the same time, these countries will also attract a growing share of the world spending in that particular sector. Intuitively, as world consumers raise the quality of their consumption when κ grows, sectoral productivity differentials across countries widen up, leading to an increase in sectoral trade specialisation. Interestingly, this process takes place both at the importer and at the exporter level. In this regard, a central prediction of our model is the implicit secular tendency of sectoral trade flows to gravitate towards exporters with a rising cost advantage in the sector. This, in turn, means that while some bilateral sectoral trade links will intensify during the path of development, others will gradually fade.[9]

3. A world economy with cross-country inequality

The previous section has dealt with a world economy where all countries exhibit the same real income, while we let the worldwide total factor productivity parameter κ increase. Such an analytical framework allowed us to portray the behaviour of sectoral trade flows (and sectoral specialisation patterns) within a world economy where countries shared a common growth path.

In this section, we slightly modify the previous setup to give room for cross-country inequality. To keep the focus as clean as possible (departing from Section 2) we now hold constant the parameter κ. More importantly, we no longer force sectoral productivity differentials to be drawn from the same probability distribution function, which was the ultimate reason leading to equal equilibrium wages. This alternative setup allows us to generalise the previous results concerning export specialisation to a case in which productivity differentials and cost differentials may *not* always coincide (as a result of equilibrium wages that differ across countries). In addition, introducing cross-country inequality leads to more powerful predictions concerning import penetration (of the different export sources) at different income levels, which we will contrast with cross-sectional data of bilateral trade flows in Section 4.

We keep the same commodity space and preference structure as those previously used in Section 2. However, we now assume that the world is composed by two subsets of countries. We will refer to the two subsets as region H and region L and, whenever it proves convenient, to a generic country by h or l, respectively. We let countries in H and L differ from each other in that they face *different* random generating processes for their sectoral productivity parameters. For any country h, we assume that $\eta_{z,h}$ for each good z is independently drawn from a uniform density function with support $[\underline{\eta}, \overline{\eta}]$, where $\underline{\eta} > 1$, just like before. Instead, for any country l, we assume that $\eta_{z,l} = \overline{\eta}$ for every good z.[10]

This alternative setup still features the fact that sectoral productivity differentials become increasingly pronounced at higher levels of quality.

[9] The equilibrium characterised in this section has the particular feature that revealed comparative advantages coincide with the import penetrations. This is clearly a very specific result that hinges on the assumed symmetry in the distributions of sector-specific productivities across countries. The next section shows that this is no longer the case when we introduce some asymmetry across countries.

[10] None of our results hinge upon countries in region L drawing their sectoral productivity parameters from a degenerate distribution. In the Appendix B, we extend the results of this section to a world economy with multiple regions, and where all sectoral productivities are drawn from non-degenerate uniform distributions.

In addition, it also allows for the presence of absolute advantages (at the aggregate level) across regions.[11]

The *ex-ante* symmetry across countries from the *same* region implies now that, in equilibrium, wages of countries within that region must be equal. By contrast, wages in region H must necessarily be higher than in region L. More formally, in equilibrium: $w_h = w_{h'}$ for any pair of countries $h,h' \in H$, and $w_l = w_{l'}$ for any $l,l' \in L$, where $w_h > w_l$.[12]

The intuition for $w_h > w_l$ is analogous to all Ricardian models of trade with absolute and comparative advantages. Essentially, region H (which displays an absolute advantage over region L) will enjoy higher wages than region L, since this is necessary to lower the production costs in L, thereby allowing countries in L to export enough to countries in H and keep the trade balance in equilibrium. Henceforth, without loss of generality, we take the wage in region L as the *numeraire* of the economy. We accordingly set $w_l = 1$, with $w_h > 1$ hereafter denoting the relative wage between region H and region L.

The first set of results that differ qualitatively from those obtained in a world economy with symmetric countries are to do with quality of consumption and quality of production. Considering the former, nonhomothetic preferences on the quality dimension imply that consumers in H purchase higher quality consumption bundles than consumers in L. For the latter, the difference in wage between the two regions will distort the monotonicity between the monetary cost of production and sectoral productivity draws ($\eta_{z,v}$) present throughout Section 2.

Proposition 2. *In a two-region world where income is higher in region H than in region L:*

1. *Consumers from region H select higher quality versions than consumers from region L.*
2. *All consumers set the level of quality highest for the varieties sourced from countries in H that received the best possible sectoral productivity draw, $\eta_{z,h} = \underline{\eta}$, and lowest for the varieties sourced from countries in H that received the worst possible sectoral productivity draw, $\eta_{z,h} = \overline{\eta}$. Furthermore, the quality level of varieties sourced from countries in L lies within those two extreme levels.*
3. *All consumers choose higher qualities for the varieties sourced from countries in H that received better sectoral productivity draws.*

The first result stems again from the rising willingness-to-pay for quality implied by Eq. (3): richer consumers substitute lower-quality versions of each good z by higher-quality versions of them. The second result shows that the highest quality of each good z, purchased by *any* consumer, is produced in the country in region H that received the best possible draw, $\eta_{z,h} = \underline{\eta}$. Conversely, the lowest quality of each good z, purchased by *any* consumer, is produced in the country in region H that received the worst possible draw, $\eta_{z,h} = \overline{\eta}$. Notice that, although all countries in region L also receive draws equal to $\overline{\eta}$, the lower labour cost there allows them to sell higher qualities than the least efficient producers in region H. Finally, the third result shows that, when considering only commodities produced in region H, the quality of consumption is a monotonically decreasing function of the elasticities of quality upgrading $\eta_{z,h}$. Intuitively, since all countries in region H have the same wage, a larger $\eta_{z,h}$ maps monotonically into a higher production cost (for a given the level of quality), thus consumers worldwide find it optimal to demand higher quality varieties from countries with lower draws of $\eta_{z,h}$.

3.1. Export specialisation

Assume henceforth that a fraction $\lambda \in (0,1)$ of all countries in the world belong to region H. We proceed now to study the patterns of exporters' specialisation in this world economy with cross-country inequality. We let $\beta^H_{z,h}$ and $\beta^L_{z,h}$ denote henceforth the expenditure share in the variety of good z produced in country h by a consumer from regions H and L, respectively.

Lemma 4. **(Revealed comparative advantage in a world with cross-country inequality)** *In a two-region world economy with $w_h > 1$, the measures of revealed comparative advantage for a generic good z are*

1. *for any country l:*

$$RCA_{z,l} = 1; \tag{11}$$

2. *for any country h:*

$$RCA_{z,h} = \frac{\lambda\beta^H_{z,h} w_h + (1-\lambda)\beta^L_{z,h}}{w_h}. \tag{12}$$

The result in Eq. (11) states that in every country in region L the revealed comparative advantages are identical for all goods; this is the consequence of all sectors in those countries receiving the exact same draw, $\eta_{z,l} = \overline{\eta}$. Revealed comparative advantages do vary though across countries in region H. In particular, since $\beta^H_{z,h}$ and $\beta^L_{z,h}$ are decreasing functions of the sectoral productivity draws $\eta_{z,h}$, Eq. (12) implies that the $RCA_{z,h}$ is also a decreasing function of $\eta_{z,h}$. Moreover, such monotonicity of the demand intensities also means that the revealed comparative advantage of the country belonging to H with draw $\overline{\eta}$ will turn out to be lower than that of any country in L. Similarly, the revealed comparative advantage of the country belonging to H with draw $\underline{\eta}$ will be higher than that of any country in L. These results are summarised in the following proposition.

Proposition 3. *Let $RCA_{z,\underline{\eta}}$ and $RCA_{z,\overline{\eta}}$ denote the revealed comparative advantage in sector z of countries in region H that received the best possible productivity draw, $\eta_{z,h} = \underline{\eta}$, and the worst possible productivity draw, $\eta_{z,h} = \overline{\eta}$, respectively. Then:*

1. $RCA_{z,\overline{\eta}} < RCA_{z,l} < RCA_{z,\underline{\eta}}$;
2. *The revealed comparative advantage in sector z of country h is a decreasing function of the sectoral productivity draw: $\partial(RCA_{z,h})/\partial\eta_{z,h} < 0$.*

The main result to draw from Proposition 3 is that the country (in region H) receiving the *best* possible draw in sector z will display as well the *highest* revealed comparative advantage in that sector. Notice that these countries are also those supplying the highest quality varieties of good z, as shown in Proposition 2. Therefore, like in Section 2, countries offering the top quality varieties in a given sector also exhibit the strongest degree of export specialisation in that sector. Finally, note that Proposition 3 also implies that there exists a subset of countries in H exhibiting a lower RCA in sector z than countries in L. The reason is that $w_h > 1$ creates a wedge between the absolute and the comparative advantage, allowing countries in L to supply more competitively the relatively low-quality varieties of good z.

3.2. Import specialisation

We turn now to study the implications of this version of the model in terms of import specialisation. For any destination country in region $j = H,L$, the import penetration of good z originating from country v is given by $IP^j_{z,v} = \beta^j_{z,v} / \int_{\forall} \beta^j_{z,v} dv$. Since the budget constraint implies

[11] Another way to introduce a source of absolute advantages into our framework would be by letting total factor productivity be higher in region H than in region L, namely: $\kappa_h > \kappa_l$. Adding $\kappa_h > \kappa_l$ to the aggregate productivity gap resulting from the regionally different random generating processes for $\eta_{z,v}$ would just reinforce the equilibrium wage differential between H and L, while it would not qualitatively change any of the main results obtained in this section.

[12] For a formal proof of this result, see Proposition 6 in the Online Appendix.

$\int_{\mathbb{V}} \beta^j_{z,v} dv = 1$, we may then track the behaviour of $IP^j_{z,v}$ simply by looking at the demand intensity $\beta^j_{z,v}$.

Proposition 4. *Let $IP^j_{z,\underline{\eta}}$ and $IP^j_{z,\overline{\eta}}$ denote the import penetration in sector z in region j = H, L by countries in region H that received best possible productivity draw, $\eta_{z,h} = \underline{\eta}$, and the worst possible productivity draw, $\eta_{z,h} = \overline{\eta}$, respectively. Then:*

1. *$IP^j_{z,\overline{\eta}} < IP^j_{z,l} < IP^j_{z,\underline{\eta}}$, where $IP^j_{z,l}$ is the import penetration in sector z in region j = H, L by countries in region L. Moreover, for imports sourced from region H, the import penetration in sector z by a country h is decreasing in its sectoral productivity draw: $\partial IP^j_{z,h}/\partial \eta_{z,h} < 0$.*
2. *The difference in import penetration in any given sector z between a country from H that received the best possible productivity draw and any other producer of good z is always larger in region H than in region L. Formally:*

$$IP^H_{z,\underline{\eta}} - IP^H_{z,h} > IP^L_{z,\underline{\eta}} - IP^L_{z,h}, \quad \text{whenever } \eta_{z,h} > \underline{\eta};$$

$$IP^H_{z,\underline{\eta}} - IP^H_{z,l} > IP^L_{z,\underline{\eta}} - IP^L_{z,l}.$$

The first part of Proposition 4 can be seen simply as the demand-side counterpart of Proposition 3: importers source a larger share of good z from exporters with a cost advantage in sector z (this is, ultimately, what turns these exporters into the ones exhibiting the greatest RCA in that sector). More interestingly, the second part of Proposition 4 states that import specialisation in those exporters is stronger for richer importers (that is, for countries in region H).

The intuition for this result rests on the specific nonhomothetic structure of Eq. (3). As shown in Proposition 2, richer importers buy high-quality varieties, which are exactly those for which the cost advantage of countries receiving better sectoral productivity draws widens. In addition, since the preference structure in Eq. (3) also implies that high-quality varieties attract growing consumer expenditure shares, richer importers tend to spend *proportionally* more in commodities sourced from exporters that exhibit a stronger cost advantage in higher-quality varieties.

3.3. Discussion: sectoral trade flows

The previous subsections have dealt separately with the behaviour of exporters facing importers with heterogeneous income, and with the behaviour of importers facing exporters with heterogeneous cost advantages. The joint consideration of these results yields an additional important prediction. To illustrate this prediction, we focus now on two intertwined demand–supply relationships implicit in our model: *i*) the link between the sectoral productivity draw $\eta_{z,v}$ and the RCA of exporter v in sector z; *ii*) the link between $\eta_{z,v}$ and the import penetration by exporter v in the total consumption of good z in a generic destination country i.

Firstly, Proposition 3 implies that, for a given income of the exporter w_v, better productivity draws in sector z lead to a greater RCA in that sector: $\partial RCA_{z,v}/\partial \eta_{z,v} < 0$. Secondly, Proposition 4 adds to this result that (again for a given level of w_v) the import penetration in sector z in any destination country i is larger in the case of exporters that received better productivity draws in sector z: $\partial IP^i_{z,v}/\partial \eta_{z,v} < 0$. Furthermore, that proposition also shows that the association between $IP^i_{z,v}$ and $\eta_{z,v}$ becomes stronger in richer importers: $\partial(\partial IP^i_{z,v}/\partial \eta_{z,v})/\partial w_i < 0$.

The above results can in turn be translated into relations between $IP^i_{z,v}$ and $RCA_{z,v}$. In particular, when holding fixed the income of the exporter w_v, the model delivers: $\partial IP^i_{z,v}/\partial RCA_{z,v} > 0$ and $\partial(\partial IP^i_{z,v}/\partial RCA_{z,v})/\partial w_i > 0$. The first of these predictions is simply stating that import penetrations by exporters with a higher RCA will be larger in all importers. More interestingly, the second entails that, as we move from poorer to richer importers, the positive association between import penetration and RCA becomes even stronger.

The economic intuition behind this last result is analogous to the one discussed in Section 2 for the case of growing world incomes with a rising κ. However, with cross-country inequality this intuition becomes even more apparent because importers with heterogeneous incomes choose different quality levels of all varieties, which in turn implies different distributions of budget shares across the *same* set of exporters. More precisely, since richer consumers purchase higher-quality varieties of each good z, the most productive suppliers of each good z turn out to be better able to exploit their widening cost advantage when dealing with richer importers.

Our model thus delivers a mechanism entailing a simultaneous rise in sectoral trade specialisation by importers and exporters at higher incomes: richer importers tend to increasingly specialise their consumption in the varieties supplied by the exporters who display a stronger revealed comparative advantage in the sector producing the good. In the next section we provide evidence consistent with this prediction using bilateral trade flows at the sectoral level.

4. Empirical analysis

Our theory rests crucially on two fundamental assumptions: one related to cross-country heterogeneities in sectoral production functions; the other one related to nonhomotheticities in the consumers' preference structure. In terms of technologies, we have assumed that cross-country sectoral productivity differentials widen at higher levels of quality of production. Concerning preferences, we postulated a utility function where richer individuals choose a consumption basket comprising higher-quality varieties of all available goods.

Taken independently, each of these two assumptions lead to clear testable predictions in terms of trade flows, which in fact our theory shares with several other papers in the trade literature. First, our model implies that the degree of specialisation of countries in particular goods and the level of quality of their exports of those goods should display a positive correlation.[13] Second, our model implies that richer consumers buy their imports in higher quality levels than poorer consumers do.[14]

Besides these two results, the most interesting testable prediction of our model stems from the interaction between the above-mentioned assumptions. When taste for quality rises with income and sectoral cost advantages deepen at higher levels of quality, richer countries will purchase a larger share of their imports of every good from economies displaying a stronger revealed comparative advantage in the sector producing the good. In other words, our model yields novel predictions regarding import specialisation at *different* income levels,

[13] Several papers provide evidence consistent with this prediction. For example, Alcala (2012) shows that import prices by the US in the apparel industry tend to be higher for imports sourced from exporter displaying a higher revealed comparative advantage in that industry. In a previous working paper version, Jaimovich and Merella (2013), we show that a similar correlation is found considering all 5000 products categorised according to the 6-digit Harmonised System (HS-6), and all pairs of bilateral sectoral trade flows in the world. Furthermore, empirical results consistent with this assumption can also be found in articles using firm-level data. For example, Kugler and Verhoogen (2012) find a positive correlation between output prices in narrowly defined products and plant size for Colombian manufacturing firms, while Manova and Zhang (2012) report a positive correlation between unit values and total export sales by Chinese firms. Similarly, Crino and Epifani (2012) find that Italian manufacturing firms exhibiting higher TFP tend to concentrate their production in high-quality varieties and export relatively more to richer destinations.

[14] There is also vast evidence supporting this prediction: e.g., Hallak (2006, 2010), Choi et al. (2009), Fieler (2012), Feenstra and Romalis (2012), Crozet et al. (2012), Chen and Juvenal (2014), Flach (2014). In particular, Fieler (2012) shows that import prices correlate positively with the level of income per head of the importer, even when looking at products originating from the same exporter and HS-6 category. The use of unit values as proxy for quality dates back to Schott (2004). See Khandelwal (2010) and Hallak and Schott (2011) for some innovative methods to infer quality from prices, taking into account both horizontal and vertical differentiation of products.

which link richer importers more *intensely* to highly specialised exporters in each of the sectors.

4.1. Baseline regression structure

Recall from Section 3.3 that, once we condition on the income of the exporter w_v, our model delivers the following two results:

(i) The import penetration in sector z of country i is larger for exporters that exhibit a higher RCA in z.

(ii) If we compare importers with different incomes, the import penetration in sector z by exporters that exhibit a higher RCA in z is relatively larger in richer importers.

Result (i) is simply saying that all importers tend to buy more of good z from exporters displaying a revealed comparative advantage in sector z. In that regard, result (i) is not really informative about the interplay between our nonhomothetic preferences and the cost advantage of exporters more specialised in a good z intensifying at the high-quality versions of that good. Result (ii), instead, is the direct consequence of that particular mechanism. More precisely, this result is suggestive of a positive correlation between import penetration and the exporter's revealed comparative advantage of varying magnitude depending on the income of the importer. This feature could be captured by a regression that allows for heterogeneous intensity of import penetration at different levels of importer income. For example, a regression including an interaction term between exporter's RCA and importer's GDP per head:

$$\log\left(IP^i_{z,v}\right) = \rho\log(RCA_{z,v}) + \theta\left[\log(RCA_{z,v}) \times \log(w_i)\right] + \varphi\log(w_i) + \psi\log(w_v) + u^i_{z,v}. \tag{13}$$

A regression of this type should yield an estimated value of $\theta > 0$ to be consistent with our model. The theoretical rationale for this prediction lies in the interaction between richer consumers buying higher quality versions of the traded goods, and exporters with a stronger RCA in a sector being increasingly productive at delivering high quality versions of these goods. Notice that Eq. (13) includes the exporter's per-capita GDP, w_v, as additional regressor. This is done in order to account for the fact that prices at which exporters sell their output may differ simply owing to differences in local wages—more precisely, in terms of our model results, once we condition on w_v, we are able to maintain the monotonicity between $RCA_{z,v}$ and $\eta_{z,v}$ that we exploit in results (i) and (ii) above.

In terms of actual implementation, our regression needs to include a number of additional controls. In particular, we consider:

- *Importer fixed effects*. In our main regression, given by Eq. (14) below, we substitute the importer's per-capita GDP (w_i) by a set of importers fixed effects. Since we are using a cross section of countries, these suffice to control for importer income. In addition, our model assumes identical trade openness and barriers across all importers, which in practice does not seem a tenable assumption. Including importer fixed effects partly controls for some of these factors as well.
- *Exporter fixed effects*. Similarly, we substitute exporter's per-capita GDP (w_v) by a set of exporters fixed effects. Like with importer fixed effects, the exporter fixed effects control for additional effects, possibly present in practice, that are assumed away by our model (e.g., differences in openness across exporters).
- *Product fixed effects*. Our model assumes symmetry of technologies for all sectors, while it also assumes no differential trade costs or barriers across sectors. In practice, these assumptions do not seem tenable either. In our main regression (Eq. (14)) we thus include product fixed effects to control for some of these factors. [15]
- *Gravity terms*. Our model assumes away any sort of trade costs or frictions that are partner-specific, hence Eq. (13) applies identically to any importer–exporter transaction. In practice, not only there are trade costs and frictions, but also they affect different partners differently. In our main regression (Eq. (14)) we include the standard gravity terms to control for some of these factors.

In Table 1.A, we therefore show the results of regression (Eq. (14)) using sectoral bilateral trade data for year 2009, where we include product dummies (δ_z), importer dummies (μ_i), exporter dummies (ε_v), and a set of bilateral gravity terms ($\mathbf{G}_{i,v}$) taken from Mayer and Zignago (2006)[16]:

$$\log\left(IP^i_{z,v}\right) = \rho\ \log(RCA_{z,v}) + \theta\left[\log(w_i) \times \log(RCA_{z,v})\right] + \mathbf{G}_{i,v} + \delta_z + \mu_i + \varepsilon_v + \nu_{z,v,i}. \tag{14}$$

Before moving on to the estimation results, we should conclude this subsection by stressing that our regression analysis aims is capturing only a partial correlation coefficient, possibly becoming stronger at higher levels of importer income per head. The coefficient $\theta > 0$ is indeed indicative of such varying partial correlation. We rely on our model to interpret this result as emerging from the interplay between nonhomotheticities in quality and widening productivity differentials at higher levels of the quality ladder. However, as a simple set of correlations, the coefficients in Eq. (14) cannot be directly linked to fundamental parameters of the model. Also for this reason, we cannot make use of those estimates to back out the values of those parameters and thus construct quantitative counterfactuals with them.

4.2. Baseline regression results

Before strictly running regression (Eq. (14)), we firstly regress the dependent variable against *only* the RCA of exporter v in good z (together with product, importer and exporter dummies). Column (1) of Table 1.A shows (quite expectably) that those two variables are positively correlated. Secondly, in column (2), we report the results of the regression that includes the interaction term. We can see that the estimated θ is positive and highly significant, consistent with our theory. Finally, in column (3), we add the six traditional gravity terms, and we can observe the previous results remain essentially intact. We can also observe that the estimates for each of the gravity terms are significant, and they all carry the expected sign.

Notice that regression (14) includes exporter fixed effects (ε_v). This implies that our regressions are actually comparing different degrees of export specialisation across products for a *given* exporter, and the different degrees of import penetration of the exporter across its exports destinations. As such, exporter dummies would control for the fact that richer exporters may be commanding larger market shares and may be specialising in higher quality varieties of goods, which are exactly the varieties mostly purchased by richer importers.

4.3. Robustness checks and Linder term

Table 1.B presents some additional regressions as robustness checks. First, in column (1) we show the results of a regression analogous to column (3) in Table 1.A, but where we control for product–importer fixed effects, instead of product (δ_z) and importer (μ_i) fixed effects

[15] In some specifications, we substitute the importer fixed effects and product fixed effects by importer-product fixed effects. These can account for differences in sectoral market structures and sectoral trade barriers across importers. In addition, they may also account for heterogeneity in importers preferences for different goods, which is assumed away by our common utility function.

[16] Import penetration, as defined by Eq. (9), and revealed comparative advantage, as defined by Eq. (10), are both computed using the dataset compiled by Gaulier and Zignago (2010). This database reports monetary values of bilateral trade (measured FOB in US dollars) for years 1995 to 2009 for more than 5000 products categorised according to the 6-digit Harmonised System (HS-6). As robustness checks, we have also run the regressions reported in Table 1.A separately for all the years in the sample. All their estimates results are of very similar in magnitude to those of year 2009, and available upon request. Notice, also, that the fact that we are looking at a cross-section of countries implicitly works as holding fixed κ in the model.

Table 1.A

	Dep. variable: log impo shares of product z sourced from exporter v		
	(1)	(2)	(3)
Log RCA exporter	0.456***	−0.676***	−0.469***
	(0.026)	(0.138)	(0.106)
Interaction term		0.119***	0.104***
		(0.015)	(0.012)
Distance expo–impo (× 1000)			−0.121***
			(0.009)
Contiguity			1.098***
			(0.101)
Common official language			0.362***
			(0.099)
Common coloniser			0.255*
			(0.152)
Common legal origin			0.204***
			(0.082)
Common currency			0.351**
			(0.149)
Observations	5,773,873	5,773,873	5,571,567
Number of importers	184	184	184
Adj R squared	0.47	0.47	0.53

Robust absolute standard errors clustered at the importer and exporter level reported in parentheses. All data correspond to the year 2009.
All regressions include product dummies, importer dummies and exporter dummies. The total number of HS 6-digit products is 5017.
* Significant 10%.
** Significant 5%.
*** Significant 1%.

Table 1.B

	Dep. Variable: log impo shares of product z sourced from exporter v			
	full sample	excl. OECD	excl. high income	full sample
	(1)	(2)	(3)	(4)
Log RCA exporter	−0.293***	−0.066	−0.184	−0.250**
	(0.107)	(0.104)	(0.132)	(0.103)
Interaction term	0.091***	0.064***	0.078***	0.086***
	(0.012)	(0.012)	(0.016)	(0.012)
Linder term				−0.117***
$\lvert\ln Y_{impo} = \ln Y_{expo}\rvert$				(0.038)
Distance expo–impo	−0.124***	−0.115***	−0.118***	−0.122***
(× 1000)	(0.009)	(0.010)	(0.011)	(0.008)
Contiguity	1.119***	0.963***	0.953***	1.053***
	(0.107)	(0.116)	(0.117)	(0.110)
Common official	0.345***	0.397***	0.451***	0.319***
language	(0.098)	(0.113)	(0.129)	(0.095)
Common coloniser	0.284*	0.167	0.295*	0.239
	(0.165)	(0.161)	(0.174)	(0.160)
Common legal origin	0.214**	0.118	0.071	0.205**
	(0.086)	(0.093)	(0.099)	(0.084)
Common currency	0.396**	0.069	−0.053	0.227
	(0.167)	(0.245)	(0.303)	(0.149)
Exporter dummies	Yes	Yes	Yes	Yes
Importer-product dummies	Yes	Yes	Yes	Yes
Observations	184	163	147	184
Number of importers	5,773,873	3,921,408	3,397,049	5,242,134
Adj R squared	0.57	0.52	0.52	0.57

Robust absolute standard errors clustered at the importer and exporter level reported in parentheses. All data correspond to the year 2009.
* Significant 10%.
** Significant 5%.
*** Significant 1%.

separately. After including the set of product–importer dummies, the estimated coefficient for the interaction term remains essentially intact, as well as its significance level. Next, in columns (2) and (3) we exclude from the importers sample the OECD countries and the high-income countries as classified by the World Bank, respectively. The idea behind these restricted-sample regressions is to see whether our previous results are driven only by the behaviour of the richest importers. As we can observe, in both cases our correlation of interest remains still positive and highly significant.[17]

Our paper emphasises the interplay between nonhomothetic preferences with respect to quality and increasing sectoral specialisation at higher qualities of production. The interaction term in Eq. (14) intends to reflect the impact of such mechanism on the intensity of bilateral trade links at different levels of income per head of the importer. Some recent articles in the trade literature with nonhomothetic preferences have argued that richer countries exhibit a comparative advantage in higher-quality varieties of goods—see Hallak (2010) and Fajgelbaum et al. (2011).[18] If that is actually the case in reality and, moreover, if the share of imports to GDP grows with the importer's income per capita (as it has been widely documented in the trade literature), then our interaction term in Eq. (14) may end up capturing (at least partially) a different type of effect: the fact that richer importers, who tend to source a larger fraction of their final demand from abroad, establish stronger trade links with richer countries, since these tend to specialise in higher-quality varieties which are in turn those demanded by richer importers. In order to deal with this concern, the regression in column (4) adds a Linder term amongst the regressors. In particular, we include as independent variable the absolute difference between the log income per head of the importer and exporter: $|\ln y_{impo} - \ln y_{expo}|$.[19] This regressor should absorb the above-mentioned concern. The results in column (4) indeed show that the Linder term carries a negative and highly significant coefficient, which is consistent with the evidence of the Linder hypothesis holding at the sectoral level previously found in Hallak (2010). Nevertheless, the estimate of the coefficient associated to the interaction term remains positive and highly significant. This last result suggests that our mechanism explaining the intensity of sectoral trade links by export source at different levels of income of importers is playing a role alongside the traditional Linder-type effect.[20]

In our theory, both the measures of import penetration and revealed comparative advantage are endogenous variables, determined simultaneously as general equilibrium outcomes of the model. For this reason, we cannot interpret those estimates for RCA and the interaction term in Tables 1.A and 1.B as quantifying a causal effect. However, it still proves interesting to use the estimates in column (4) of Table 1.B to get a feeling of the magnitudes of the correlations arising from the mechanism proposed by our model relative to those captured by the Linder term.

Our mechanism entails a greater intensity of sectoral bilateral trade between richer importers and exporters displaying a stronger RCA in the sector. For that reason, in what follows, we quantify the difference

[17] The estimate associated to 'common currency' falls essentially to zero in columns (2) and (3). This is because when we remove the Euro-area countries from the sample, we lose practically all its source of variation.

[18] In fact, this result is also present in our model when we extend our basic setup in Section 3 to allow for cross-country income inequality.

[19] When we use $(\ln y_{impo} - \ln y_{expo})^2$ instead, the results remain qualitatively the same as in column (4).

[20] In practical terms, one additional concern may be raised: the possibility that high-quality varieties of goods face lower trade frictions than lower-quality ones. If this were true, then our interaction term in (14) might also be capturing a different type of effect: the fact that richer economies tend to consume higher-quality varieties, and that those varieties are traded more intensely as a result of lower frictions. Since we cannot observe unit trade costs at different layers of quality, and our regressions exploit within-product variation of import shares by source, we cannot envisage a practical way to directly gauge the severity of this concern. Notice, however, that if this issue were quantitatively significant, we should expect to find very different estimate for 'distance' and 'contiguity' in column (1) and column (3), since the latter excludes richer importers. Indeed, the fact that both regressions yield similar estimates suggests that, once we control for all the importer and exporter characteristics, we do not observe huge differences in the effects of sector-specific trade frictions across richer and poorer importers.

Table 2.A

	Animal & anim. prod.	Vegetable products	Foodstuff	Mineral products	Chem. & allied ind.	Plastic & rubbers	Skin, leath. & furs
Log RCA	−0.322***	−0.298***	−0.344***	−0.269**	−0.500***	−0.548***	−0.622***
	(0.106)	(0.104)	(0.096)	(0.145)	(0.138)	(0.138)	(0.155)
Interaction term	0.073***	0.079***	0.089***	0.075***	0.107***	0.118***	0.120***
	(0.012)	(0.011)	(0.011)	(0.015)	(0.015)	(0.015)	(0.016)
Observations	105,332	210,866	215,975	72,839	602,592	317,328	66,347
Adj. R squared	0.44	0.49	0.50	0.46	0.49	0.52	0.60
	Wood & wood prod.	Textiles	Footwear	Stone & glass	Metals	Machinery & electrical	Transport.
Log RCA	−0.444***	−0.411***	−0.644***	−0.527***	−0.541***	−0.711***	−0.554***
	(0.105)	(0.166)	(0.155)	(0.131)	(0.130)	(0.131)	(0.112)
Interaction term	0.101***	0.090***	0.119***	0.107***	0.111***	0.134***	0.114***
	(0.012)	(0.019)	(0.016)	(0.015)	(0.015)	(0.014)	(0.013)
Observations	252,135	795,926	75,522	209,397	630,910	1,296,090	176,916
Adj. R squared	0.53	0.55	0.61	0.53	0.50	0.55	0.53

Robust absolute standard errors clustered at the importer–exporter level in parentheses. All data corresponds to year 2009.
All regression include product, exporter and importer dummies, and the set of gravity terms used before in Table 1.A taken from Mayer and Zignago (2006). *** significant 1%.

Table 2.B

Independent regressions for each HS 6-digit product						
% Positive coefficients			% Negative coefficients			Median
Insignificant	Significant 10%	Significant 1%	Insignificant	Significant 10%	Significant 1%	Coefficient
29.8%	15.7%	38.0%	14.3%	1.6%	0.5%	0.076
83.5%			16.4%			

Total number of different products was 4904 (98 products were lost due to insufficient observations). Data corresponds to year 2009.
Regressions include importer dummies and the set of gravity terms used in Table 1.A taken from Mayer and Zignago (2006).

in the correlation between these two variables for a rich importer and a poor importer, at the level of the logarithm of the RCA corresponding to its 90th percentile (this value equals 1.07).[21] Computing the difference in magnitude yielded by the interaction term for the importer in the 90th percentile of the GDP per head in PPP (which corresponds to Belgium with 34,625) and that one for 10th percentile (which corresponds to Mali with 999), we obtain that the 90th-percentile exporter in a given sector (measured by the RCA) exhibits an income penetration that is approximately 32.6% larger in the high-income importer relative to the low-income importer. Similarly, using the estimate for the Linder term (−0.117) with the absolute difference between the logarithm of Belgium's and Mali's GDP per head in PPP, we obtain that economies in the top 90th and bottom 10th percentile of income tend to exhibit import penetrations approximately 41.5% lower than those displayed by equally rich countries. These simple computations suggest that both mechanisms seem to be driving important quantitative effects in terms of the correlations between sectoral bilateral trade links and income per head observed in the data.

Lastly, the regressions in Table 1.A pool together approximately 5000 different 6-digit products, implicitly assuming the same coefficients for all of them. This might actually be a strong assumption to make. In Table 2.A we split the set of HS 6-digit products according to fourteen separate subgroups at the 2-digit level.[22] In the sake of brevity, we report only the estimates for ρ and θ in Eq. (14). As we can observe, the estimates for each subgroup follow a similar pattern as those in Table 1.A: the estimate for the interaction term is always positive and highly significant for each subgroup. As one further robustness check, in Table 2.B we report the percentage of positive and negative estimates obtained for θ when we run a separate regression for each of the products in the HS 6-digit categorisation. These results again tend to confirm those obtained before Table 1.A.

4.4. A comparison with the empirical predictions in the existing literature

Three recent related articles have also incorporated nonhomothetic preferences into general equilibrium trade models, and study the ensuing patterns of trade flows: Fieler (2011), Fajgelbaum et al. (2011) –FGH–, and Jaimovich and Merella (2012). In the Introduction, we summarised mostly the main theoretical differences between our framework and theirs. We now discuss briefly how some of our empirical predictions differ from theirs, and how these differences may be discerned in the data.

Fieler (2011) focuses on the bilateral trade flows of horizontally differentiated goods displaying heterogeneous income demand elasticities.[23] She finds that including intersectoral nonhomotheticities into a model à la Eaton and Kortum (2002), coupled with productivity dispersions across countries that correlate positively with income demand elasticities, can substantially improve its quantitative predictions on aggregate trade flows. Her empirical predictions then encompass cross-country variation of aggregate trade flows as a result of *intersectoral* changes in trade, while they are silent about *intrasectoral* variations in trade flows. This last source of adjustment is exactly what regression (Eq. (14)) aims at. More precisely, our regressions are exploiting *within-product* variation of export sources by importer, abstracting from intersectoral changes in trade flows. The main novel empirical finding is that, looking at each particular sector in isolation, we can observe that richer importers source a larger share of their

[21] The median number of exporters by product in our sample is 80, therefore the 90th percentile value of the RCA seems a sensible benchmark to look at for a 'highly specialised exporter' of the product.

[22] The subgroups are formed by merging together subgroups at 2-digit aggregation level, according to http://www.foreign-trade.com/reference/hscode.htm. We excluded the subgroups 'Miscellaneous' and 'Service'.

[23] See also Hunter (1991) and Francois and Kaplan (1996) for partial equilibrium frameworks assessing the relevance of intersectoral differences in income demand elasticities in explaining trade patterns.

imports from those exporters that display a stronger degree of specialisation in the sector.

FGH shares with our framework the introduction of nonhomothetic preferences in a context with vertical and horizontal differentiation. Both papers lead to a rise in international specialisation as incomes increase. The underlying driving forces however differ. In FGH, the main driving force is the exploitation of a home-market effect, in the spirit of Linder (1961). [24] In our paper, instead, the leading aspect is the deepening of heterogeneities in the cost of production across countries at higher levels of quality. More importantly, our mechanism leads to some testable predictions that cannot be straightforwardly rationalised by FGH. In particular, FGH leads to patterns of productive specialisation that take place *only* along the quality dimension: richer countries are net exporters of high-quality varieties, while poorer countries are net exporter of low-quality ones. Yet, those patterns of specialisation in quality cannot be ascribed to any specific sector. By contrast, in our model, for each particular sector, richer importers will end up establishing stronger trade links with those exporters more intensely specialised in the sector. From a strict empirical viewpoint, the mechanism suggested by FGH is then reflected in the Linder term included in column (4) of Table 2.A. However, even when we take this factor into account, this does not *fully* explain the fact that richer economies source a larger fraction of their imports of each product from exporters exhibiting a comparative advantage in those products. In that regard, our mechanism seems to play an important role in the determination of sectoral trade links, alongside the more traditional Linder home-market effect.

Nonhomotheticities along both the vertical and horizontal dimensions is also a feature present in Jaimovich and Merella (2012). The main distinction between that model and the one presented here lies in the technological structure. Jaimovich and Merella (2012) remained within a traditional Ricardian framework where comparative advantages apply only at the sectoral level. There, richer economies specialise in goods with longer quality ladders and poorer ones in those with shorter ladders. The model presented here, instead, exploits an intrasectoral comparative advantage. This, in turn, delivers predictions for the degree of specialisation within the same product category, which cannot be rationalised by a model featuring full sectoral specialisation by a single country, like in Jaimovich and Merella (2012). In particular, that model is unable to account for some of the novel empirical findings that we delineate here: i.e., the intensity of sectoral specialisation by exporters at different levels of quality of production, and the varying intensity of import penetration at different levels of importers' income.

5. Further discussion

The next subsections develop two simple extensions to our model in Section 3, in order to study the impact of different policies aimed at promoting the production and size of a particular sector in the economy. We first study the case of import tariffs, then the case of a subsidy to local producers. In the sake of brevity, we relegate the formal analysis of both subsections to the Online Appendix, in Section A.3 and Section A.4 respectively.

5.1. Trade frictions and consumer loss

Although the main focus of the paper is on the behaviour of sectoral import shares, our model carries also implications regarding trade frictions and consumer welfare. In particular, in our framework, import restrictions entail a more severe welfare loss for richer countries than for poorer ones. Intuitively, our nonhomothetic structure implies that richer importers choose higher-quality bundles of goods and devote a larger share of income to goods sourced from exporters who can more efficiently increase quality of production. Therefore, since comparative advantages deepen and gains from trade expand at higher levels of quality, it is rich consumers those who benefit most from frictionless trade.

To illustrate the argument succinctly, it proves more convenient to consider a simplified version of our model with only two levels of sectoral productivity draws $\eta_{z,v} \in \{\underline{\eta}, \overline{\eta}\}$ and a discrete number of countries. In particular, we let region L and region H comprise now two countries each: $L = \{l_1, l_2\}$ and $H = \{h_1, h_2\}$. Like before, countries in L always receive the bad sectoral draw $\overline{\eta}$ in all sectors. Instead, for region H, we assume that in each sector z one country receives $\eta_{z,v} = \underline{\eta}$ and the other one $\eta_{z,v} = \overline{\eta}$. To keep the symmetry we had in Section 3, suppose that h_1 and h_2 have both an equal mass of sectors with good and bad sectoral productivity draws. [25]

Consider first a country from region L. This country (by assumption) receives the bad productivity draw, $\overline{\eta}$, in sector z. Suppose that, for some reason, this country wishes to discourage imports of good z, and thus imposes a tariff on those goods.[26] Since countries in region L are poorer, the welfare loss to local consumers owing to the tariff will not be too large. The reason for this is that individuals in region L tend to purchase lower-quality varieties of z, and for these varieties the productivity gap relative to the most efficient producer in sector z remains relatively narrow. Consider now the country in region H that received the bad productivity draw in sector z. In this case, the welfare loss to local consumer resulting from a tariff on imports of good z becomes more severe. Since richer consumers are those who intend to purchase higher-quality versions of good z, they end up being harmed relatively more by tariffs imposed on sectors where there are other countries that can more easily upgrade quality. In that respect, our model suggests that gains from trade are especially stronger for richer consumers and, therefore, high-income countries should display a more negative stance towards trade barriers to imports.

In order to offer a hint of the relative magnitude of welfare loss between richer and poorer importers, in the Online Appendix A.3 we exploit a pooled estimation of the log of unit values (used as a proxy for quality) on the log of importer's income to back out two figures. First, we pinpoint several implied values of the sectoral productivity draws. Then we derive the respective welfare loss differential, due to import tariff, that each of those draws would generate when comparing individuals from countries with different levels of income.

The fact that the consumer welfare loss owing to the tariff is greater in richer economies rests crucially on our specific non-homothetic structure of preferences. In particular, under homothetic preferences, willingness to pay for higher quality will not rise with income. In such a case, all consumers, regardless of their income, will suffer a welfare loss of equal magnitude after the imposition of an import tariff. In Section A.5 of the Online Appendix we show formally how the unequal welfare effects of a tariff vanish away in the presence of homothetic preferences.

5.2. Sectoral subsidy and comparative advantage

The previous subsection has illustrated the differential welfare effects of a sector-specific import tariff across richer and poorer importers. One could rationalise this tariff as the outcome of a policy that aims at promoting some particular sector of the economy. An

[24] Hallak (2010) provides a partial equilibrium model with a home-market effect that also builds on the original hypothesis in Linder (1961). In his model, countries of similar incomes trade more with each other, when considering sectoral level trade flows. He also provides empirical evidence for this prediction.

[25] That is, for each sector z, there is always only one country in H with draw $\underline{\eta}$ (and only one with draw $\overline{\eta}$), while the mass of sectors that received a draw $\underline{\eta}$ is equal to 0.5 both in h_1 and in h_2.

[26] This could be the result, for example, of policymakers of country i believing sector z represents an important sector where to develop enough local production, hence it needs protection from more efficient foreign producers.

alternative (and, possibly, more direct) policy to foster sector z is simply to subsidise the local producers in that sector.

Consider again the simplified model introduced in the previous subsection, and suppose that a country with a bad productivity draw in sector z (i.e., a country υ with $\eta_{z,\upsilon}=\overline{\eta}$) introduces a subsidy for local producers of good z, with the intention of expanding the size of this sector. In our model, such a subsidy turns out to be more effective in increasing the share of sector z in the GDP in poorer economies than in richer ones. The reason for this is again related to our nonhomothetic preference structure. In our model, in order to absorb a larger share of demand in sector z, a country must be able to offer higher-quality varieties of good z more cheaply than their competitors. When we compare a country from region L with the country from region H that received the bad draw in sector z, it turns out that the impact of the subsidy in fostering sector z is stronger in the former. The intuition for this result is that, given our non-homothetic structure of preferences, higher qualities are instrumental to attracting larger consumer spending shares. Therefore, the expansionary effect of the subsidy turns out to be larger in L than in a country from region H with the same draw of $\eta_{z,\upsilon}=\overline{\eta}$, as in the former the effect of the subsidy on quality expansion is compounded with the lower labour cost in L.[27]

6. Conclusion

We presented a Ricardian model of trade with the distinctive feature that comparative advantages reveal themselves gradually over the course of development. The key factors behind this process are the individuals' upgrading in quality of consumption combined with sectoral productivity differentials that widen up at higher levels of quality. As incomes grow and wealthier consumers raise the quality of their consumption baskets, cost differentials between countries become more pronounced. The emergence of such heterogeneities, in turn, alters sectoral trade flows, as each economy gradually further specialises in producing the subset of goods for which they enjoy a rising comparative advantage.

Our theory yielded a number of implications that find empirical support. Using bilateral trade data at the product level, we showed that the share of imports originating from exporters more intensely specialised in a given product correlates positively with GDP per head of the importer. This is consistent with richer consumers buying a larger share of their consumption of specific goods from countries exhibiting a comparative advantage in the sectors producing those goods.

Our core model assumed away any sort of trade frictions. This was in a sense a deliberate choice, so as to illustrate our proposed mechanism as cleanly as possible. In this respect, we extended our analysis in two directions, discussing some interesting policy implications of our theory in the presence of frictions. First, gains from free trade are stronger for more developed economies. Second, sectoral subsidies to local producers are more effective in stimulating their production and exports when introduced in developing countries. These findings seem to fit well with some recent claims suggesting that policy interventions may help developing countries in becoming stronger competitors in sectors where they previously enjoyed no comparative advantage.

Appendix A. Omitted proofs

A.1. Formal solution of the consumer optimisation problem

By using the expression (5) for physical consumption and the price functions (2), the consumer optimisation problem can be re-stated as one where the consumer must choose the optimal quality $q_{z,\upsilon}$ and optimal budget allocation $\beta_{z,\upsilon}$ for each commodity $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$. Thus, using the index $i\in\mathbb{V}$ to denote country of origin of the consumer, the optimisation problem can be thus re-stated as follows:

$$\max_{\{q^i_{z,\upsilon},\beta^i_{z,\upsilon}\}_{(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}}} \quad U=\left\{\int_{\mathbb{Z}}\left[\int_{\mathbb{V}} q^i_{z,\upsilon}\ln\left(\frac{1+\kappa}{A}\frac{\beta^i_{z,\upsilon}}{\left(q^i_{z,\upsilon}\right)^{\eta_{z,\upsilon}}}\frac{w_i}{w_\upsilon}\right)d\upsilon\right]^{\sigma}dz\right\}^{\frac{1}{\sigma}}$$
$$\text{subject to}: \quad \int_{\mathbb{Z}}\int_{\mathbb{V}}\beta^i_{z,\upsilon}\,d\upsilon\,dz\le 1, \quad \text{and} \quad q^i_{z,\upsilon}\ge 1. \tag{15}$$

Denoting by υ^i the Lagrange multiplier associated to the budget constraint, and by $\delta^i_{z,\upsilon}$ the Lagrange multipliers associated to each constraint $q^i_{z,\upsilon}\ge 1$, we may derive the first-order conditions:

$$\ln\beta^i_{z,\upsilon}-\eta_{z,\upsilon}\ln q^i_{z,\upsilon}+\ln(1+\kappa)-\ln A+\ln\left(\frac{w_i}{w_\upsilon}\right)-\eta_{z,\upsilon}+\delta^i_{z,\upsilon}=0, \tag{16}$$

$$\frac{1}{\Omega\cdot\Lambda_z}\frac{q^i_{z,\upsilon}}{\beta^i_{z,\upsilon}}-\upsilon^i=0, \tag{17}$$

$$q^i_{z,\upsilon}-1\ge 0, \quad \delta^i_{z,\upsilon}\ge 0, \quad \text{and} \quad \left(q^i_{z,\upsilon}-1\right)\delta^i_{z,\upsilon}=0, \tag{18}$$

$$1-\int_{\mathbb{Z}}\int_{\mathbb{V}}\beta^i_{z,\upsilon}\,d\upsilon\,dz\ge 0, \quad \upsilon^i\ge 0, \quad \text{and} \quad \left(1-\int_{\mathbb{Z}}\int_{\mathbb{V}}\beta^i_{z,\upsilon}\,d\upsilon\,dz\right)\upsilon^i=0. \tag{19}$$

where:

$$\Omega\equiv\left\{\int_{\mathbb{Z}}\left[\int_{\mathbb{V}}q^i_{z,\upsilon}\ln\left(\frac{1+\kappa}{A}\frac{\beta^i_{z,\upsilon}}{q^{i\;\eta_{z,\upsilon}}_{z,\upsilon}}\frac{w_i}{w_\upsilon}\right)d\upsilon\right]^{\sigma}dz\right\}^{\frac{\sigma-1}{\sigma}},$$

$$\Lambda_z\equiv\left[\int_{\mathbb{V}}q^i_{z,\upsilon}\ln\left(\frac{1+\kappa}{A}\frac{\beta^i_{z,\upsilon}}{\left(q^i_{z,\upsilon}\right)^{\eta_{z,\upsilon}}}\frac{w_i}{w_\upsilon}\right)d\upsilon\right]^{1-\sigma}.$$

Note that, although Λ_z in Eq. (17) are indexed by z, in the optimum all Λ_z will turn out to be equal. Hence, we may write that, in the optimum, $\Lambda_z=\Lambda$ for all z, and define:

$$\mu^i\equiv(\Omega\cdot\Lambda)\upsilon^i,$$

which in turn allows us to re-write Eq. (17) as $q^i_{z,\upsilon}=\mu^i\beta^i_{z,\upsilon}$. Hence, integrating both sides of the equation over $\mathbb{V}$ and $\mathbb{Z}$, and noting that in the optimum the first expression in (19) always hold with equality, we may obtain:

$$\int_{\mathbb{Z}}\int_{\mathbb{V}}q^i_{z,\upsilon}\,d\upsilon\,dz=\mu^i. \tag{20}$$

This in turn implies that:

$$\beta^i_{z,\upsilon}=\frac{q^i_{z,\upsilon}}{\mu^i}. \tag{21}$$

Finally, note that Eq. (20) can be interpreted as the average quality of the optimal consumption basket. Denoting this by $Q^i\equiv\mu^i$, from Eq. (21) it straightforwardly follows that $\beta^i_{z,\upsilon}=q^i_{z,\upsilon}/Q^i$. ■

Proof of Lemma 1. We first show that when $w_\upsilon=w$ for all υ, none of the constraints $q_{z,\upsilon}\ge 1$ of Eq. (15) binds in the optimum. For this, note that given the expressions in Eqs. (16) and (21), whenever $w_\upsilon=w$

[27] In Section A.5 of the Online Appendix we show formally how this result disappears when we substitute our non-homothetic preferences by homothetic preferences.

for all υ, it must be the case that $q^i_{z',\upsilon'} \ge q^i_{z'',\upsilon''} \Leftrightarrow \eta_{z',\upsilon'} \le \eta_{z'',\upsilon''}$. Thus, if in the optimum $q^i_{z'',\upsilon''} > 1$ holds for a pair (z'',υ'') with $\eta_{z'',\upsilon''} = \overline{\eta}$, then $q^i_{z,\upsilon} > 1$ must be true for all pairs (z,υ). Then, in order to prove that $q^i_{z,\upsilon} > 1$ holds for all (z,υ), it suffices to prove the following: even when all $\eta_{z,\upsilon} = \underline{\eta}$, except for one *single* good-variety (z'',υ'') for which $\eta_{z'',\upsilon''} = \overline{\eta}$, the problem (15) yields $q^i_{z'',\upsilon''} > 1$. If this is the case, then $q^i_{z'',\upsilon''} > 1$ will actually hold true for *any* distribution of the productivity draws $\eta_{z,\upsilon}$ with support in the interval $[\underline{\eta},\overline{\eta}]$.

When all $\eta_{z,\upsilon} = \underline{\eta}$, except for a *single* (z'',υ'') with $\eta_{z'',\upsilon''} = \overline{\eta}$, then when $q_{z'',\upsilon''} = 1$:

$$q^i_{z,\upsilon} = e^{-\frac{\underline{\eta}}{\underline{\eta}-1}}\left(\frac{1+\kappa}{A\mu^i}\right)^{\frac{1}{\underline{\eta}-1}}, \quad \text{for all } (z,\upsilon)\in\mathbb{Z}\times\mathbb{V} \text{ other than } (z'',\upsilon''). \tag{22}$$

Integrating Eq. (22) across the space $\mathbb{Z}$ and $\mathbb{V}$, we obtain $\mu^i = e^{-\underline{\eta}/(\underline{\eta}-1)}[(1+\kappa)/(A\mu^i)]^{1/(\underline{\eta}-1)}$, which in turn yields:

$$\mu^i = \frac{1}{e}\left(\frac{1+\kappa}{A}\right)^{\frac{1}{\underline{\eta}}}. \tag{23}$$

Now, plugging Eq. (23) into Eqs. (16) and (21), computed for (z'',υ''), while using the fact that $\beta^i_{z'',\upsilon''} = 1/\mu^i$ when $q^i_{z'',\upsilon''} = 1$:

$$\ln(1+\kappa) - \ln A - [\ln(1+\kappa) - \ln A]/\underline{\eta} + \ln e - \overline{\eta} + \delta^i_{z'',\upsilon''} = 0. \tag{24}$$

Hence, considering the definition of $A \equiv e^{-\underline{\eta}(\overline{\eta}-1)/(\underline{\eta}-1)}$, Eq. (24) reduces to

$$\ln(1+\kappa) + \delta^i_{z'',\upsilon''}\frac{\underline{\eta}}{\underline{\eta}-1} = 0. \tag{25}$$

However, Eq. (25) cannot be true for any $\kappa > 0$. As a consequence, it must be true that $q_{z'',\upsilon''} > 1$ for all $\kappa > 0$, implying in turn that $q_{z,\upsilon} > 1$ must hold under any distribution of $\eta_{z,\upsilon}$ with support within the interval $[\underline{\eta},\overline{\eta}]$ when $w_\upsilon = w$ for all υ. Now, taking into account the above result, we can use Eqs. (20), (21) and (16), setting $\delta^i_{z,\upsilon} = 0$ for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$, to obtain Eqs. (6) and (7). ■

Proof of Lemma 2. When $w_v = w$ for all $v \in \mathbb{V}$, since $\delta^i_{z,\upsilon} = 0$ for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$, using Eq. (21) into Eq. (16) leads to $\ln(1+\kappa) - \ln A - \ln\mu^i = \eta_{z,\upsilon} + (\eta_{z,\upsilon} - 1)\ln q^i_{z,\upsilon}$ for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$. Defining now $\Upsilon^i(\kappa) \equiv \ln(1+\kappa) - \ln A - \ln\mu^i$, we can observe that:

$$\frac{\partial\Upsilon^i}{\partial\kappa} = \frac{\left(\eta_{z,\upsilon}-1\right)}{q^i_{z,\upsilon}}\frac{\partial q^i_{z,\upsilon}}{\partial\kappa}. \tag{26}$$

But, given that $(\eta_{z,\upsilon} - 1) > 0$, then all $\partial q^i_{z,\upsilon}/\partial\kappa$ must necessarily carry the same sign. Suppose then that $\partial q^i_{z,\upsilon}/\partial\kappa \le 0$, for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$. Recalling Eq. (20), it follows that $\partial\mu^i/\partial\kappa \le 0$ as well. But, since $\partial\Upsilon^i/\partial\kappa = (1+\kappa)^{-1} - (\mu^i)^{-1}\partial\mu^i/\partial\kappa$, the fact that $\partial\mu^i/\partial\kappa \le 0$ implies that $\partial\Upsilon^i/\partial\kappa > 0$, which in turn contradicts the fact that $\partial q^i_{z,\upsilon}/\partial\kappa \le 0$ for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$. As a result, it must be the case that $\partial q^i_{z,\upsilon}/\partial\kappa > 0$ for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$. Finally, the result $\partial^2 q^i_{z,\upsilon}/(\partial\kappa\,\partial\eta_{z,\upsilon}) < 0$ follows immediately from the expression in Eq. (26), after noting that $\partial(\partial\Upsilon^i/\partial\kappa)/\partial\eta_{z,\upsilon} = 0$. ■

Proof of Lemma 3. Notice first that $M^i_{z,\upsilon} \equiv \beta^i_{z,\upsilon}$ and $M^i_z \equiv \int_{\mathbb{V}}\beta^i_{z,\upsilon}d\upsilon$. Also, when all countries in the world have the same wage (and, therefore, the same income), in the optimum $\beta^i_{z,\upsilon} = \beta_{z,\upsilon}$ for all importers. Moreover, the symmetry in the distribution of draws $\eta_{z,\upsilon}$, also implies that, in the optimum, $M^i_z = 1$. Therefore, using Eq. (9), $IP^i_{z,\upsilon} = \beta_{z,\upsilon}$.

To compute the RCA, note that $X_{z,\upsilon} \equiv \int_{\mathbb{V}}\beta^i_{z,\upsilon}di$ $X_v \equiv \int_{\mathbb{Z}}\int_{\mathbb{V}}\beta^i_{z,\upsilon}di\,dz$, $W_z \equiv \int_{\mathbb{V}}X_{z,\upsilon}d\upsilon$ and $W \equiv \int_{\mathbb{Z}}W_z\,dz$. Then, using the fact that $\beta^i_{z,\upsilon} = \beta_{z,\upsilon}$ for all importers, then $X_{z,\upsilon} = \int_0^1\beta_{z,\upsilon}\,di = \beta_{z,\upsilon}$. Moreover, the budget constraint in turn implies that $X_\upsilon \equiv \int_0^1\beta_{z,\upsilon}\,dz = 1$. Also, the symmetry in the distribution of draws $\eta_{z,\upsilon}$ implies that the aggregate world spending in good z will be equal for all goods, thus $W_z = \int_{\mathbb{V}}\beta_{z,\upsilon}d\upsilon = 1$. Plugging in all these results into (10), and using the fact that $W = 1$, the claimed $RCA_{z,\upsilon} = \beta_{z,\upsilon}$ result follows. ■

Proof of Proposition 1. Preliminarily, notice that Eq. (20) together with Eq. (21) yields:

$$\beta_{z',\upsilon'} = \frac{q_{z',\upsilon'}}{\int_{\mathbb{Z}}\int_{\mathbb{V}}q_{z,\upsilon}\,d\upsilon\,dz}. \tag{27}$$

From Eq. (16), together with Lemma 1 we have:

$$\left(\eta_{z,\upsilon}-1\right)\ln q_{z,\upsilon} + \eta_{z,\upsilon} = \ln(1+\kappa) - \ln A - \ln\mu; \tag{28}$$

thus, computing Eq. (28) for any pair of commodities (z',υ') and (z,υ) yields:

$$\left(\eta_{z',\upsilon'}-1\right)\ln q_{z',\upsilon'} + \eta_{z',\upsilon'} = \left(\eta_{z,\upsilon}-1\right)\ln q_{z,\upsilon} + \eta_{z,\upsilon}. \tag{29}$$

Hence, Eq. (29) implies that $q_{z',\upsilon'} > q_{z,\upsilon} \Leftrightarrow \eta_{z',\upsilon'} < \eta_{z,\upsilon}$ By considering this result in conjunction with Eq. (27), our claim immediately follows.

Furthermore, differentiating Eq. (29) with respect to κ yields:

$$\frac{dq_{z',\upsilon'}}{d\kappa} = \frac{\eta_{z,\upsilon}-1}{\eta_{z',\upsilon'}-1}\frac{q_{z',\upsilon'}}{q_{z,\upsilon}}\frac{dq_{z,\upsilon}}{d\kappa}. \tag{30}$$

Using Eqs. (20), (28) and (30):

$$\frac{dq_{z',\upsilon'}}{d\kappa} = \frac{A}{1+\kappa}\left[\frac{\eta_{z',\upsilon'}-1}{q_{z',\upsilon'}} - \frac{1}{\mu}\left(\int_{\mathbb{Z}}\int_{\mathbb{V}}\frac{\eta_{z',\upsilon'}-1}{\eta_{z,\upsilon}-1}\frac{q_{z,\upsilon}}{q_{z',\upsilon'}}d\upsilon\,dz\right)\right]^{-1} > 0 \tag{31}$$

Moreover, from Eq. (27), and considering Eqs. (30) and (31):

$$\frac{d\beta_{z',\upsilon'}}{d\kappa} = \frac{1}{\mu^2}\frac{dq_{z',\upsilon'}}{d\kappa}\left(\int_{\mathbb{Z}}\int_{\mathbb{V}}\left(\frac{\eta_{z,\upsilon}-\eta_{z',\upsilon'}}{\eta_{z,\upsilon}-1}\right)q_{z,\upsilon}\,d\upsilon\,dz\right) \tag{32}$$

It is then easy to observe that Eq. (30) implies that $dq_{z',\upsilon'}/d\kappa > dq_{z,\upsilon}/d\kappa$ when $\eta_{z',\upsilon'} < \eta_{z,\upsilon}$. By considering this result in conjunction with Eq. (32) our claim immediately follows. ■

Proof of Proposition 2.

Part (i). From the FOC (16)–(19) we may obtain that for a consumer in any country in region L the following conditions must hold:

$$-(\overline{\eta}-1)\ln q^L_L - \ln\mu^L + \ln(1+\kappa) - \ln A - \overline{\eta} + \delta^L_L = 0, \quad \text{for all}(z,l)\in\mathbb{Z}\times L; \tag{33}$$

$$-\left(\eta_{z,h}-1\right)\ln q^L_{z,h}-\ln\mu^L+\ln(1+\kappa)-\ln A-\ln w_h-\eta_{z,h}+\delta^L_{z,h}=0,\quad \text{for all}(z,h)\in\mathbb{Z}\times H. \tag{34}$$

Similarly, for a consumer in any country in region H, it must be true that:

$$-(\overline{\eta}-1)\ln q^H_L-\ln\mu^H+\ln(1+\kappa)-\ln A+\ln w_h-\overline{\eta}+\delta^H_L=0,\quad \text{for all }(z,l)\in\mathbb{Z}\times L; \tag{35}$$

$$-\left(\eta_{z,h}-1\right)\ln q^H_{z,h}-\ln\mu^H+\ln(1+\kappa)-\ln A-\eta_{z,h}+\delta^H_{z,h}=0,\quad \text{for all }(z,h)\in\mathbb{Z}\times H. \tag{36}$$

Suppose now there exists some $(z',\upsilon')\in\mathbb{Z}\times\mathbb{V}$ for which $q^L_{z',\upsilon'}>q^H_{z',\upsilon'}$. Then, combining either Eqs. (33) and (35), or Eqs. (34) and (36), in both cases we would obtain that:

$$\ln\left(\frac{\mu^H}{\mu^L w_h}\right)=\left(\eta_{z',\upsilon'}-1\right)\ln\left(\frac{q^L_{z',\upsilon'}}{q^H_{z',\upsilon'}}\right)+\delta^H_{z',\upsilon'}>0. \tag{37}$$

Expression (37) implies, in turn, that $1<\mu^L<w_h\mu^L<\mu^H$. From Eq. (20), it follows there must exist some $(z'',\upsilon'')\in\mathbb{Z}\times\mathbb{V}$ for which $q^L_{z'',\upsilon''}<q^H_{z'',\upsilon''}$. Using the same reasoning, we now obtain $\ln(\mu^L w_h/\mu^H)=(\eta_{z'',\upsilon''}-1)\ln(q^H_{z'',\upsilon''}/q^L_{z'',\upsilon''})+\delta^L_{z'',\upsilon''}>0$, which contradicts Eq. (37). As a consequence, it must be the case that $q^H_{z,\upsilon}\geq q^L_{z,\upsilon}$ for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$.

Now, suppose $q^H_{z',\upsilon'}=q^L_{z',\upsilon'}>1$ for some $(z',\upsilon')\in\mathbb{Z}\times\mathbb{V}$. Again, combining either the pair of Eqs. (33) and (35), or the pair of Eqs. (34) and (36), we obtain:

$$\ln\left(\mu^H/\mu^L w_h\right)=0. \tag{38}$$

Expression (38) implies, in turn, that $1<\mu^L<w_h\mu^L=\mu^H$. Hence, there must exist again some $(z'',\upsilon'')\in\mathbb{Z}\times\mathbb{V}$ for which $q^L_{z'',\upsilon''}<q^H_{z'',\upsilon''}$. Using the same reasoning, we now obtain $\ln(\mu^L w_h/\mu^H)=(\eta_{z'',\upsilon''}-1)\ln(q^H_{z'',\upsilon''}/q^L_{z'',\upsilon''})>0$, which contradicts Eq. (38). Therefore, it must be true that $q^H_{z,\upsilon}>q^L_{z,\upsilon}$ for all $(z,\upsilon)\in\mathbb{Z}\times\mathbb{V}$, whenever $q^H_{z,\upsilon}>1$.

Part (ii). The proof that $q^i_{z,l}=q^i_L$ for all $(z,l)\in\mathbb{Z}\times L$ follows straightforwardly from Eqs. (33) and (35). For the second argument, let $i=L$, and consider the commodity $(z',h')\in\mathbb{Z}\times H$ such that $q^L_{z',h'}=q^L_L>1$. Using Eqs. (33) and (34) we obtain, respectively:

$$-(\overline{\eta}-1)\ln q^L_L-\ln\mu^L+\ln(1+\kappa)-\ln A-\overline{\eta}=0,\ \text{and}$$
$$-\left(\eta_{z',h'}-1\right)\ln q^L_L-\ln\mu^L+\ln(1+\kappa)-\ln A-\ln w_h-\eta_{z',h'}=0.$$

This, in turn, leads to:

$$(\overline{\eta}-1)\ln q^L_L+\overline{\eta}=\left(\eta_{z',h'}-1\right)\ln q^L_L+\ln w_h+\eta_{z',h'}. \tag{39}$$

Isolating now $\eta_{z',h'}$ from Eq. (39) we then have $\eta_{z',h'}=\overline{\eta}-\ln w_h/(1+\ln q^L_L)\equiv\hat{\eta}<\overline{\eta}$. Suppose now that $\hat{\eta}\leq\underline{\eta}$. Since $\partial q^L_{z,h}/\partial\eta_{z,h}\leq 0$, from the definition of $\hat{\eta}$ it follows that $q^L_{z,h}\leq q^L_L$ for all $(z,h)\in\mathbb{Z}\times H$. Next, from the definition of μ^L, we obtain that $\mu^L\leq q^L_L$. In addition, from the market clearing condition for a country in L, we have $\lambda q^H_L w_h/\mu^H+(1-\lambda)q^L_L/\mu^L=1$, where λ is the measure of countries in region H. This leads to $1-\lambda q^H_L w_h/\mu^H=(1-\lambda)q^L_L/\mu^L>1-\lambda$, which in turn implies that $q^H_L w_h/\mu^H<1$. Now, using the fact that $w_h\mu^L>\mu^H$ and the result $\mu^L\leq q^L_L$, the last inequality finally yields $q^H_L<\mu^L\leq q^L_L$, leading to a contradiction. Hence, it must necessarily be that $\hat{\eta}>\underline{\eta}$. Thus, given the fact that $\partial q^L_{z,h}/\partial\eta_{z,h}<0$ whenever $q^L_{z,h}>1$, the result $q^L_{z,\overline{\eta}}<q^L_L<q^L_{z,\underline{\eta}}$ immediately follows. An analogous reasoning, letting $i=H$, may be followed to prove that $q^H_{z,\overline{\eta}}<q^H_L<q^H_{z,\underline{\eta}}$.

Part (iii). The claim follows by differentiation of Eqs. (34) and (36). This yields $\partial q^i_{z,h}/\partial\eta_{z,h}=-q^i_{z,h}(1+\ln q^i_{z,h})/(\eta_{z,h}-1)<0$ whenever $q^i_{z,h}>1$, while $\partial q^i_{z,h}/\partial\eta_{z,h}=0$ whenever $q^i_{z,h}=1$. ■

Proof of Lemma 4. To compute Eqs. (11) and (12), note that total exports by sector z from country υ are $X_{z,\upsilon}=\lambda\beta^H_{z,\upsilon}w_h+(1-\lambda)\beta^L_{z,\upsilon}$, and aggregate exports by country υ are $X_\upsilon=w_\upsilon$. Now, notice that since $\eta_{z,l}=\overline{\eta}$, we must have that $\beta^H_{z,l}=\beta^H_L$ and $\beta^L_{z,l}=\beta^L_L$, for all $(z,l)\in\mathbb{Z}\times L$. Plugging these expressions into Eq. (10) then yields Eq. (11). Moreover, since all h obtain their draws of $\eta_{z,h}$ from independent $U[\underline{\eta},\overline{\eta}]$ distributions, and since all $\beta^H_{z,h}$ are well-defined functions of $\eta_{z,h}$, by the law of large numbers it follows that $\int_{\mathbb{Z}}\beta^H_{z,h}\,dz$ and $\int_{\mathbb{Z}}\beta^L_{z,h}\,dz$ must both yield an identical value for every country $h\in H$. Using these expressions, in conjunction with those for $X_{z,\upsilon}$ and X_υ into Eq. (10) then leads to Eq. (12). ■

Proof of Proposition 3. The proof follows from noting that: (a) both $\beta^H_{z,h}$ and $\beta^L_{z,h}$ in Eq. (12) are functions of $\eta_{z,h}$; (b) Proposition 2 implies that $\partial\beta^H_{z,h}/\partial\eta_{z,h}<0$ and $\partial\beta^L_{z,h}/\partial\eta_{z,h}<0$; (c) β^H_H and β^L_H represent average demand intensities, hence $\beta^H_{z,\overline{\eta}}<\beta^H_H<\beta_{z,\underline{\eta}}{}^H$ and $\beta^L_{z,\overline{\eta}}<\beta^L_H<\beta_{z,\underline{\eta}}{}^L$; and (d) from Eq. (11), it follows that $RCA_{z,h}=RCA_{z,l}$ only if $\beta^H_{z,h}=\beta^H_H$ and $\beta^L_{z,h}=\beta^L_H$. ■

Proof of Proposition 4.

Part (i). Our claim immediately follows from part (iii) of Proposition 2 in conjunction with Eq. (21).

Part (ii). Using Eqs. (35) and (36), together with Eq. (21), for a consumer from H we get:

$$\begin{aligned}\ln(1+\kappa)-\ln A&=\left(\eta_{z,h}-1\right)\ln\beta^H_{z,h}+\eta_{z,h}\ln\mu^H+\eta_{z,h},\quad \text{for all }(z,h)\in\mathbb{Z}\times H.\\&=(\overline{\eta}-1)\ln\beta^H_{z,l}+\overline{\eta}\ln\mu^H-\ln w_h+\overline{\eta},\quad \text{for all }(z,l)\in\mathbb{Z}\times L.\end{aligned}$$

Similarly, considering Eqs. (33) and (34) together with Eq. (21), in the case of a consumer from L we obtain:

$$\begin{aligned}\ln(1+\kappa)-\ln A&=\left(\eta_{z,h}-1\right)\ln\beta^L_{z,h}+\eta_{z,h}\ln\mu^L+\ln w_h+\eta_{z,h}-\delta^L_{z,h},\quad \text{for all }(z,h)\in\mathbb{Z}\times H.\\&=(\overline{\eta}-1)\ln\beta^L_{z,l}+\overline{\eta}\ln\mu^L+\overline{\eta}-\delta^L_L,\quad \text{for all }(z,l)\in\mathbb{Z}\times L.\end{aligned}$$

On the one hand, equating the first expression of the each case, simplifying and rearranging:

$$\ln\beta^H_{z,h}-\ln\beta^L_{z,h}=\frac{\eta_{z,h}(\ln\mu^L-\ln\mu^H)+\ln w_h-\delta^L_{z,h}}{\left(\eta_{z,h}-1\right)}\equiv k_{z,h}.$$

Getting rid of the logs, we then obtain $\beta^H_{z,h}=e^{k_{z,h}}\beta^L_{z,h}$, and hence: $\beta^H_{z,h}-\beta^L_{z,h}=(e^{k_{z,h}}-1)\beta^L_{z,h}$. Consider now two producers $h',h''\in H$ such that $\eta_{z,h'}<\eta_{z,h''}$. Since $\beta^L_{z,h'}-\beta^L_{z,h''}<\beta^H_{z,h'}-\beta^H_{z,h''}$ requires $\beta^H_{z,h''}-\beta^L_{z,h''}<\beta^H_{z,h'}-\beta^L_{z,h'}$, and from part (i) of this proof it follows that $\beta^L_{z,h''}<\beta^L_{z,h'}$, we are left to prove that $k_{z,h''}\leq k_{z,h'}$. Suppose $k_{z,h''}>k_{z,h'}$. Since by assumption $\eta_{z,h'}<\eta_{z,h''}$, and part (ii) of Proposition 2 implies $\delta^L_{z,h'}\leq\delta^L_{z,h''}$, a necessary condition for this to hold is $(\eta_{z,h''}-\eta_{z,h'})(\ln\mu^L-\ln\mu^H)>0$. But this is impossible, since $\ln\mu^H>\ln\mu^L$. So it must be that $k_{z,h''}\leq k_{z,h'}$, hence $\beta^L_{z,h'}-\beta^L_{z,h''}<\beta^H_{z,h'}-\beta^H_{z,h''}$.

On the other hand, equating the second expression of each case, simplifying and rearranging:

$$\ln\beta^H_{z,l} - \ln\beta^L_{z,l} = \frac{\overline{\eta}(\ln\mu^L - \ln\mu^H) + \ln w_h - \delta^L_L}{\overline{\eta} - 1} \equiv k_{z,l}.$$

We can thus write $\beta^H_{z,l} - \beta^L_{z,l} = (e^{k_{z,l}} - 1)\beta^L_{z,l}$ and, following an analogous reasoning, it is straightforward to obtain $\beta^L_{z,\underline{\eta}} - \beta^L_{z,l} < \beta^H_{z,\underline{\eta}} - \beta^H_{z,l}$ (and $\beta^L_{z,l} - \beta^L_{z,\overline{\eta}} < \beta^H_{z,l} - \beta^H_{z,\overline{\eta}}$). ■

Appendix B. Cross-country inequality in a multi-region world

We now consider a setup where the world is composed by $K > 2$ regions, indexed by $k = 1,\ldots,K$. We let $\mathcal{V}_k$ denote the subset of countries from region k, where $\mathcal{V}_k$ has Lebesgue measure $\lambda_k > 0$. In addition, we let each country in region k be denoted by a particular υ_k. (All the results discussed in this section are formalised in the Online Appendix, Section B.)

We assume that for any υ_k and every z, each η_{z,υ_k} is independently drawn from a uniform distribution with support over $[\eta_k, \overline{\eta}]$, where $\eta_k < \overline{\eta}$. To keep the consistency with the previous sections, let $\eta_k = \underline{\eta}$ when $k = 1$. In addition, let $\eta_{k'} < \eta_{k''}$ for any two regions $k' < k''$. In other words, we are indexing regions $k = 1,\ldots,K$ in terms of first-order stochastic dominance of their respective uniform distributions. All uniform distributions are assumed to share the same upper-bound $\overline{\eta}$, while they differ in their lower-bounds η_k.

In this extended setup, equilibrium wages display an analogous structure as the one described in Section 3. Namely, in equilibrium, the wage in each υ_k is w_k. In addition, equilibrium wages are such that $w_1 > \ldots > w_{k'} > \ldots > w_K$, where $1 < k' < K$.

Notice that, since all individuals from the same region earn the same wages, they choose identical consumption profiles. We then let β^j_{z,υ_k} denote the demand intensity by a consumer from region $\mathcal{V}_j$ for good (z,υ_k). Once again, this immediately implies that $IP^j_{z,\upsilon} = \beta^j_{z,\upsilon}$. Furthermore, it follows that, for a country υ_k:

$$X_{z,\upsilon_k} = \sum_{j=1}^{K} \lambda_j w_j \beta^j_{z,\upsilon_k}$$

In equilibrium, it must be the case that $X_{\upsilon_k} = w_k$ for all $\upsilon_k \in \mathcal{V}_k$. In addition, W_z equal for all z is still true in this extended setup. As a result, the RCA of country υ_k in good z is given by:

$$RCA_{z,\upsilon_k} = \frac{\sum_{j=1}^{K} \lambda_j w_j \beta^j_{z,\upsilon_k}}{w_k}. \tag{40}$$

Since wages differ across regions, once again, we cannot find a monotonic relationship between RCA_{z,υ_k} in Eq. (40) and the productivity draws η_{z,υ_k} when all countries in the world are pooled together. However, we can still find a result analogous to Proposition 3. In particular, it is still true that the highest value of RCA_{z,υ_k} corresponds to the country in region $\mathcal{V}_1$ receiving the best possible draw in sector z. That is, RCA_{z,υ_k} is the highest for some country υ_1 with $\eta_{z,\upsilon_1} = \underline{\eta}$.

Lastly, concerning import penetration, this extension also yields a result that is analogous to that in Proposition 4. Following the notation in Proposition 4, we can show that $\beta^1_{z,\underline{\eta}} > \ldots > \beta^{k'}_{z,\underline{\eta}} > \ldots > \beta^K_{z,\underline{\eta}}$, where $1 < k' < K$. Again, this result stems from our nonhomothetic structure along the quality dimension, which implies that richer consumers allocate a larger share of their spending in good z to the producers who can most efficiently offer higher qualities versions of z.

Appendix C. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jinteco.2015.06.004.

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