National Income Distributions and International Trade Flows[#]

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Abstract

In this paper we model the pattern of international trade, and technological innovation and imitation between industrialized and developing regions, when preferences are nonhomothetic. By and large, models of the dynamics of North-South trade impose the assumption of unit income elasticity for all consumption goods. We relax this assumption and incorporate the insight from Engel's Law: The budget share allocated to necessities falls with income. Since the composition of individual consumption depends on income, aggregate demand for newly invented goods depends not only on the distribution of income across countries but also within countries. To account for the impact of income distribution, we introduce preferences where consumers rank *indivisible* goods according to a hierarchy of both needs and desires. In the model we assume that the distribution of wealth is unequal in the less developed country and even in the industrialized country. We show that the composition of the aggregate consumption basket in the integrated economy depends on both *inter*- and *intra*-national inequality. Hence, we identify a demand channel through which inequality affects the international trade pattern. Empirical evidence from a panel of bilateral trade data among 57 countries, for which adequate income distribution measures exist, and spanning three decades supports the conjecture that high inequality in a trading partner yields less bilateral trade flows through lower imports, after controlling for both observed and unobserved heterogeneity.

Keywords: Nonhomothetic preferences; inequality; aggregate import demand; pattern of international trade.
JEL Codes: F12, F15, O11, O31

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1 Introduction

The dynamics of innovation and imitation between industrialized and less developed regions have been investigated in various contexts. The life-cycle structure of the location choice for production of newly invented goods over time, where relatively early manufacturing takes place in industrialized countries and gradually shifts to less developed countries explored by Vernon (1966), has been formalized in models exploring technology diffusion to emerging economies (See e.g. Grossman and Helpman, 1991). By and large, when it is not supposed that there is a representative consumer, the assumption of unit income elasticity is imposed for all consumption goods. Thus, any impact of income distribution on the level and composition of aggregate demand is ruled out.

In this paper, the model incorporates the fact that income elasticity with respect to newly invented goods is larger than the income elasticity with respect to older ones. The assumption is that more recently introduced goods yield less utility because they satisfy less urgent requirements, or desires rather than needs. Then wealth distribution determines aggregate demand. This follows from the insight of Engel's Law: The budget share allocated to necessities decreases with income. As observed by Linder (1961), once the difference in expenditure decisions between rich and poor consumers is acknowledged, the trade pattern between industrialized and less developed regions is determined not only by differentials in technology, factor endowment and income but also by income distribution within each region. To account for the impact of income distribution, we introduce nonhomothetic preferences in an innovation-imitation model of an integrated world economy.

The specification of preferences used is that introduced Murphy, Shleifer and Vishny (1989), and by Zweimueller (1998) in a dynamic setting, where consumers rank goods according to a hierarchy of needs and desires. The configuration of demand for newer goods across households depends on the range of affordable consumption. Aggregate demand for different types of goods is determined by the income distribution within and across regions. The equilibrium pattern of trade is given not only by technology primitives, factor endowments and relative per capita incomes, that is *inter*-regional income distributions, as in standard trade theory but also by *intra*-regional income distributions as pointed out by Linder.

In the model, we assume that the distribution of wealth is unequal in the poor region and even in the prosperous region. This assumption is consistent with the stylized evidence on distribution and development. Hence, our distinction is meant to capture broad modern regional dichotomies of the global North-South or the European East-West type. In particular, we explore the effect of changes in the distribution of wealth within the poor region on the pattern of trade of the integrated economy. The inclusion of nonhomothetic preferences in the model brings about a demand channel through which income distribution, not only between countries but also within trading partners, affects international trade flows. The configuration of global exports will be determined by regional demands for different types of goods.

The effect of wealth distribution in the less developed on trade is ambiguous. On the one hand, since only the rich in the less developed region can afford imported luxurious goods, progressive wealth redistribution leads to a contraction of trade, other things equal. This would occur because the redistribution of wealth is associated with an attendant fall in demand for relatively new goods. On the other hand, if the poor are made wealthier, their range of consumption increases. Then, the varieties of goods produced in the less developed country, and therefore exports, grow. This would occur because the redistribution of wealth is associated with an attendant rise in demand for more recently imitated domestic goods.

The paper is structured as follows. Section 2 reviews the related literature. Section 3 sets up the primitives of the model: endowments, preferences and technology. Section 4 derives the strategic linkages between innovators and imitators under free entry. Section 5 characterizes the steady-state equilibrium of the integrated economy, with particular emphasis on the pattern of trade and income distribution. Section 6 presents the results from the econometric analysis of panel data on bilateral trade flows among 57 countries over three decades on the impact of inequality on imports and total trade. Finally, Section 7 concludes.

2 Related Literature

Although the impact of international inequality has featured in both the modeling and empirical studies of trade under nonhomothetic preferences, the impact of *intra*-national inequality has been largely neglected. The present paper aims to bridge this gap in both the theory and empirics of international trade. In this section, we review the existing theoretical and empirical research about the impact of inequality on international trade when the composition of household consumption depends on income, and aggregate consumption for each good on income distibution.

2.1 Theory

In his now classic treatise, Linder (1961) points out that the dependence of the composition of a household's consumption basket on its income means that aggregate demand for different types of goods is determined by income distribution. In fact, while with homothetic preferences demand for any good only depends on aggregate income, with nonhomothetic preferences the attendant demand for new goods is higher when there are more well off households. Therefore, with fixed costs of innovation, countries with a higher concentration of wealthy households manufacture varieties of the most recent vintages. Some of these varieties are exported from industrialized to less developed countries if enough consumers find them affordable. In particular, bilateral trade will be determined not only by the differences in technology and endowments, as well as the similarity in aggregate incomes, but also by both *inter*- and *intra*-national inequality.

International differences in per capita income are the focus of trade models by Markusen (1986) and Ramezzana (2000). The former combines monopolistic competition and factor endowment differentials with nonhomothetic preferences. Capital is abundant in the industrialized country and goods with high income elasticity are capital intensive. The latter model also combines monopolistic competition with nonhomothetic preferences but introduces transportation costs. Hence, in both models, trade is mostly among countries with higher per capita income. The volume of trade falls with international inequality.

The literature on economic development emphasizes the importance of demand expansion for the adoption of increasing returns technologies that are not viable in small markets. For example, Rosenstein-Rodan (1943) highlights the key role of productive agriculture in generating demand for manufactures and spurring industrialization. But, as Baldwin (1956) points out, the aggregate demand for manufactures may not manifest itself if the wealth generated in agriculture is extremely concentrated. Therofore, *intra*-national inequality can affect industrial structure.

The idea that the emergence of a middle class is needed, as the source of purchasing power for manufactures, is modeled by Murphy, Shleifer and Vishny (1989). Given that agricultural expansion enlarges the middle class, progressive redistribution unambiguously stimulates industrialization through the expansion of demand that makes it possible for manufacturers of new varieties to cover fixed costs. A role for exports of primary goods is allowed akin to that of agriculture, as generators of the resources that spur industrialization. Luxury imports are considered as detrimental for domestic manufacturing and a negative byproduct of inequality.

By contrast, in the model of the present paper, imports by the rich households in the less developed country are the counterpart of exports to the industrialized country. Without “luxury” imports by the rich, the less developed country manufacturers suffer a drop in their demand because exports cease. Furthermore, international trade facilitates adoption of advanced technologies by manufacturers in the less developed country.

In a related model, Matsuyama (1999) considers a Ricardian model of trade in which the less developed country specializes in goods with low income elasticity, and the industrialized country has comparative advantage in goods with high income elasticity. As above, consumption is discrete for each good and satiation is reached after the first unit. Utility rises with the diversity of the consumption bundle rather than with the intensity of consumption of each good. While preferences are nonhomothetic, there is perfect competition. Hence, income distribution has impact on industrial structure only through its effect on trade, without any pecuniary externalities of demand to allow for start-up cost coverage.

Redistribution from rich to poor consumers in the less developed country reduces exports and imports if the ensuing rise in the terms of trade due to the shift in demand is bounded.

Given that early goods provide more utility and that only the first unit of consumption of each good provides utility, the more rich consumers there are the higher the aggregate demand newer goods. In the model of this paper, like in the model of Murphy, Shleifer and Vishny, redistribution of wealth from the rich to the poor can stimulate demand for domestic manufactures and increase the range of exportable goods in the less developed country. But also, as in Matsuyama's model progressive redistribution reduces import demand from the less developed country, and therefore total trade flows. Hence, the impact of inequality and redistribution on international trade is ambiguous in the model of this paper.

2.2 Empirics

With regard to the link between the diversity of the consumption bundle and income, Jackson (1984) finds evidence of a positive correlation among household income and variety of goods in its consumption basket. Hunter and Markusen (1988) explore the link between national per capita income and the composition of demand. The estimation of a linear expenditure system for thirty four countries and eleven commodity groups yields a rejection of the null hypothesis of homothetic preferences at significance levels of 1%.

Also, Francois and Kaplan (1996) find that the composition of imports depends on *intra*-national inequality. Countries with more unequal distributions tend to import more consumer manufactures. However, they do not explore the effect of *intra*-national on either the level of imports or the pattern of bilateral trade. In the present paper, the importance of the Gini coefficient in explaining both bilateral imports and total trade flows is explored empirically. Even after controlling for observed and unobserved heterogeneity of both trading partners, as well as geographic location variables, the lagged Gini coefficient is negatively correlated with bilateral imports and the share of total bilateral exports over the total bilateral product.

Deardorff (1998) points that if preferences are nonhomothetic and goods with high income elasticity are capital intensive, as in Markusen (1986), the gravity model of bilateral can account for the direction of bilateral flows, as long as the relative per capita income is added as an explanatory variable. But, the prediction that capital abundant countries trade mainly with each other, while capital scarce countries do the same, is not borne out. For example, Frankel, Stein and Wei (1996) find that high-income countries trade disproportionately with all countries, not just other high-income countries. The relevance of *intra*-national inequality is neglected in estimations of the gravity equation. In the present paper, regressions of the bilateral trade pattern include national inequality.

3 The Building Blocks

In this section the building blocks of the model are laid out. First, the preference structure is specified following Murphy, Shleifer and Vishny (1989) and Zweimueller (1998). We build in Engel's Law. Second, the endowment structure is characterized. Next, the necessary first-order conditions implied by household optimization are used to write the individual and aggregate consumption functions. Finally, the innovation, imitation and manufacturing technologies are characterized.

3.1 Preferences

The economy is made up of two countries, A and B, populated by L^A and L^B inhabitants respectively. Country A is relatively more prosperous and industrialized than country B. Preferences are defined over consumption goods. It is assumed that all consumers, independently of their income and their nationality, have the same preferences. Lifetime utility of a household of type h in country i is given by,

$$U_h^i = \int_0^\infty u\left(C_h^i(t)\right) e^{-\delta t} dt \,,$$

which is the discounted flow of instantaneous utility from consumption of each infinitely-lived household.

There is a continuum of goods indexed by $j \in \Re^{+}$. A hierarchy of necessity and desirability ranks these goods according to their priority. For all goods, we assume that there is indivisibility in consumption and that utility is derived only from the first unit consumed, at each point in time. Households consume conveniences only after basic needs are met. Goods satisfying necessities are indexed in the unit interval, $j \in [0,1)$, and yield one unit of utility for the first unit consumed. All other goods $j \geq 1$ provide amenities for the first unit consumed, at each moment $t \in \Re^{+}$, worth $\frac{1}{j}$ units of utility.

If prices are not decreasing in j, then each household will consume goods according to the priority specified by the hierarchy. Given equal prices, as *j* increases each unit of utility from consumption becomes more costly. Hence, no good $j \geq 1$ will ever be demanded by a household until all goods indexed below *j* have been consumed. Although the decisión-making criterion has a lexicographic structure, the consumption function is continuous and otherwise well-behaved by construction. Note that there exists a continuum of goods and that the index of last good consumed is *pari passu* a measure of consumption because only one unit of each good is consumed. Indeed, instantaneous utility is given by,

$$u\left(C_h^i(t)\right) = 1 + \int_{j=1}^{C_h^i(t)} \frac{1}{j} dj = 1 + \ln C_h^i(t),$$

where $C_h^i(t)$ is the highest index of all goods consumed at time $t \in \Re^{+}$.

3.2 Endowments

Each household in country A has identical financial asset holdings V^A. In country B, there are two types of households, rich and poor. The proportion of poor households is β. Per capita wealth from financial assets is V^B. Each poor household owns wealth $V_P^B(t) = \alpha V^B(t)$.

Now,

$$V^B(t) = \beta V_P^B(t) + (1-\beta)V_R^B(t),$$

and therefore, the financial holdings of each rich household are given by,

$$V_R^B(t) = \frac{1-\beta\alpha}{1-\beta} V^B(t).$$

The law of motion of the state variable for each type of household is,

$$\dot{V}_h^i(t) = rV_h^i(t) + W^i(t) - \int_0^{C_h^i(t)} p(j,t)dj$$

where r is the world interest rate and wages are determined nationally.[1] The prices depend only on the location where the goods are manufactured. Goods manufactured in country A are set as numeraire. Goods manufactured in Country B are cheaper and priced at $p < 1$. The more recent the invention a good the higher its index $j \in \Re^+$. The goods manufactured in country A are those which since their introduction have not been imitated in country B. We assume that $N(t)$ goods have been introduced at time $t \in \Re^+$ and $M(t)$ imitated. Then the law of motion of wealth becomes,

$$\dot{V}_h^i(t) = \begin{cases} rV_h^i(t) + W^i(t) - pC_h^i(t), when C_h^i(t) < M(t) \\ rV_h^i(t) + W^i(t) + (1-p)M(t) - C_h^i(t), otherwise \end{cases}.$$

[1] Labor supply is inelastic.

We will focus in the case in which (i) households in the relatively prosperous country A purchase all invented varieties, (ii) the rich but not the poor in the less developed country B can afford imported "luxury" goods, and (iii) the poor can afford more than the basic subsistence goods but not all domestically manufactured goods. Hence, we have,

$$N(t) = C^{A}(t) > C_{R}^{B}(t) > M(t) > C_{P}^{B} > 1$$

Since utility is logarithmic, it turns out that the asset distribution is stationary under the present specification of preferences. In particular, the ratio of savings to the value of asset holdings is independent of the level of wealth. The share of wealth of each group is fixed.

3.3 Intertemporal Optimization

Consumer demand for each household type depends on the range of affordable goods. In particular, solving the intertemporal optimization problem of each consumer yields the following consumption functions,

$$C^{A} = W^{A} + \delta V^{A} + (1 - p)M = N \qquad (1),$$

for country A households,

$$C_{R}^{B} = W^{B} + \delta \frac{1 - \beta\alpha}{1 - \beta} V^{B} + (1 - p)M > M \qquad (2),$$

for rich households in country B, and

$$C_{P}^{B} = \frac{W^{B} + \delta\alpha V^{B}}{p} < M \qquad (3),$$

for poor households.[2]

[2] We are concentrating in the steady state without growth, whih implies that $\dot{c} / c = r - \delta = 0$.

4 Innovation and Imitation

To complete the specification of the primitives of the model, we provide the elements that determine the cost structure of manufacturing in each region. First, in the rich economy, there is a sunk cost stemming from the resource requirement for innovative design. The marginal cost of producing each unit gives the mark-up equation. Second, in the developing economy, there is a fixed cost associated with reverse engineering. Limit pricing together with the variable cost define the mark-up relationship for imitated products. These technical parameters together with the aggregate demand functions determine the free-entry equilibrium conditions in each region.

4.1 R&D Primitives

Each firm in country A has exclusive use of a blueprint. Perfect intellectual property protection prevails in country A. But, entrepreneurs in country B can reverse engineer a design without compensating the creator. The deployment cost of R&D ventures is $F(t)$ units of labor. Once a design is made, the firm can manufacture each unit using $A(t)$ units of labor and acquire a monopoly position for the corresponding good. We assume symmetry in the technology across goods.

There is an upper bound on the price to be charged by each incumbent firm. We normalize this limit price to unity. The limit on the price is due to potential production by a competitive fringe. Once invented any good can be produced using a "backyard" technology that has requires $1/W^A(t)$ units of labor to produce each unit of output under constant returns, where $A(t) > 1/W^A(t)$. Hence, the incumbents' price determines the reservation wage.

In particular, since we have normalized the price of country A manufactures to unity, the marginal revenue product of labor using the "backyard" technology is $W^A(t)$. If an incumbent monopolist tried to bid the wage below that level, the competitive fringe could enter without incurring sunk costs and offer slightly higher wages to attract all the required workers to serve the whole market. No incumbent will ever pay a wage lower than the reservation level $W^A(t)$. With a wage rate $W^A(t)$ and a price of unity, the profit flow per unit of output sold is $\pi^A = 1 - A(t)W^A(t)$.

The following assumptions summarize the evolution of technical opportunities:

$$F(t) = f / N(t), A(t) = a / N(t) \text{ and } W^A(t) = w^A N(t).$$

We assume that productivity growth in the relatively prosperous country is driven by innovations. We adopt the simplest way to capture this idea by assuming that the stock of knowledge in the economy can be proxied by the measure of previous innovations $N(t)$ and the labor input requirement of R&D is inversely related to this measure. Moreover, we assume productivity in final output production, by both incumbents and the competitive fringe, also increases with $N(t)$, which is an index of past manufacturing as well.

Hence, efficiency in R&D and production, both manufacturing and backyard, rise *pari passu* with the number of goods introduced. Innovators, entrepreneurs and workers build upon experience of previous successes. The assumption about the impact of new ideas, or designs, on future innovators follows Romer (1990). Learning leading to higher productivity ceases if innovation stops, as in Young (1993). While the wage rate grows with the measure of previous innovations, the profit flow per unit sold remains constant over time as,

$$\pi^A = 1 - A(t)W^A(t) = 1 - aw^A.$$

4.2 Emulation Primitives

Firms in the less developed country B do not have access to the innovation technology. To become manufacturers they emulate producers from the innovating country A. Imitation requires set-up costs of $G(t)$ units of labor. After a good has been imitated in country B, imitators can produce at constant marginal cost $B(t)W^B(t)$, where $B(t)$ is the labor input necessary to produce one unit of output using the imitation technology and $W^B(t)$ is the wage rate in country B. We will discuss later on the endogenous determination of $W^B(t)$.

Technological change for imitation activities evolves analogously to that in innovating activities. In particular, we assume that,

$$G(t) = g / M(t) \text{ and } B(t) = b / M(t).$$

This characterization of the progress of emulation technologies states that efficiency is determined by the history of imitating activities $M(t)$. Productivity in the blueprint imitation and adaptation process increases as a result of learning from reverse-engineering experience. Successful design copying not only adds to the productivity of further imitation but also leads to more efficient production due to the associated increase in manufacturing experience.

In order to be competitive in the world market, country B producers have to underbid country A firms. The lowest price at which country A firms are willing to sell is their marginal cost aw^A. If a country B firm charges a slightly lower price, it can take over the whole world market and drive the country A competitors out of the market. However, the country B firms will only be able to do so if their marginal cost is below that of country A producers. Or equivalently, we assume $aw^A > bw^B$, where $w^B = W^B(t)/M(t)$ denotes the country B wage rate normalized by the measure of previously imitated goods.[3] We obtain the mark-up for imitating producers by invoking limit pricing. In order to capture the market the imitator has to underbid the price of the current producer. The limit price (i.e., the price which drives the country A firm out of the market) is slightly below the marginal cost of the country A firm and the profits per unit sold are thus,

$$\pi^B = A(t)W^A(t) - B(t)W^B(t) = aw^A - bw^B.$$

[3] We will concentrate in equilibria in which the wages grow at the same rate as the other variables.

4.3 Innovation

The free entry condition in country A is given by,

$$F(t)W^{A}(t)=\int_{t}^{T_1}\pi^{A}L^{A}e^{-r(\tau-t)}d\tau+\int_{T_1}^{T_2}\pi^{A}(L^{A}+(1-\beta)L^{B})e^{-r(\tau-t)}d\tau\,,$$

where T_1 is the time at which rich consumers from country B can afford the good introduced at time t and T_2 is the time at which that good is imitated an all rents start accruing to the imitator.

In general, if all variables grow at a common rate γ, we have that,

$$C_R^B(t)e^{\gamma(T_1-t)}=N(t)\qquad\text{and}\qquad M(t)e^{\gamma(T_2-t)}=N(t)\,,$$

so that,

$$T_1=t+\gamma^{-1}\ln\frac{N(t)}{C_R^B(t)}\qquad\text{and}\qquad T_2=t+\gamma^{-1}\ln\frac{N(t)}{M(t)}\quad.$$

If we concentrate in the steady state in which no growth occurs, we have that $fw^{A}=\dfrac{\pi^{A}L^{A}}{\delta}$.

4.4 Imitation

The free entry condition in country B is given by,

$$G(t)W^{B}(t)=\int_{t}^{T_3}\pi^{B}(L^{A}+(1-\beta)L^{B})e^{-r(\tau-t)}d\tau+\int_{T_3}^{\infty}\pi^{B}(L^{A}+L^{B})e^{-r(\tau-t)}d\tau\,,$$

where T_3 is the time at which poor consumers from country B can afford the good imitated at time t.

In general, if all variables grow at a common rate γ, we have that $C_P^B(t)e^{\gamma(T_3-t)} = M(t)$ and $T_3 = t + \gamma^{-1}\ln\frac{M(t)}{C_P^B(t)}$. In particular, if we concentrate in the steady state in which no growth occurs, we have that $gw^B = \frac{\pi^B(L^A + (1-\beta)L^B)}{\delta}$.

Proposition 1 The equilibrium wage in country B falls as the fraction of poor households in country B rises, and as the discount rate gets higher. Also, the wage increases as efficiency, in both imitation and manufacturing, increases in country B, as the cost of manufacturing in country A rises, and as the world population expands.

Proof: Using the mark-up expression, we find the wage in country B as,

$$w^B = \frac{aw^A(L^A + (1-\beta)L^B)}{\delta G + b(L^A + (1-\beta)L^B)} \qquad (4),$$

and the stated results follow directly.

❑

The wage that satisfies the free-entry condition in country B essentially rises with the profitability of imitation. In particular, the higher the fraction of poor households, the smaller the market for high-income elasticity imitated manufactures. The ensuing fall in the wage causes a further contraction in the market size because the income of all country B household decreases, and so does the range of affordable manufactures. Hence, a low industrialization trap of the type highlighted by Murphy, Shleifer and Vishny (1989) can arise. In the present set up, this causes a fall in exportable varieties because of limited supply of manufactures by country B and also limited demand for newly innovated goods. Therefore, higher inequality stemming from a higher fraction of poor households can have a contractionary effect on world trade through the wage effect outlined. Both countries lose out because more expensive manufacturing of relatively old goods takes place in country A, thereby reducing the availability of resources for innovation.

5 The Integrated Economy

In order to characterize the steady state we have to describe the implications of our assumptions on preferences and technology for innovation, imitation, and trade. We assumed that only in country A there is access to the innovation technology. The innovation equilibrium is one where the present discounted value of future profits accruing from an innovation is equal to the fixed cost of discovery. Firms in the country B do not have access to the innovation technology, but there are no barriers to entry in imitation activities. The imitation equilibrium characterization is analogous to the free-entry condition for country A innovators.

The values of innovation and imitation success in steady-state equilibrium were derived under the following conditions. Consumers choose optimally the size and the composition of their consumption basket. The savings are invested in assets until there are no unexploited profit opportunities left, in the sense that neither further incentives to innovate nor to imitate with higher intensity exist. Finally, labor markets have to clear and the current account has to balance. In the steady state without growth, current account balance entails trade balance.

5.1 Resource Balance Constraints

We find the labor market equilibrium in both countries. Since labor is the only factor of production, this is enough to characterize worldwide resource balance. In equilibrium, the manufacturing sector pays reservation wages so that labor is demanded for innovation, imitation and production.

5.1.1 The Less Developed Economy

Since labor supply is inelastic, labor demand is equal to the population in labor market equilibrium. In particular, in country B, work is divided between reverse engineering and production,

$$L^B = G(t)\dot{M}(t) + B(t)[(L^A + (1-\beta)L^B)M(t) + \beta L^B C_P^B(t)]$$

which can be written as,

$$L^B = \gamma g + b\left[L^A + (1-\beta)L^B + \beta L^B \frac{w^B + \alpha\delta V^B(t)}{aw^A M(t)}\right].$$

From here, we obtain the steady-state per capita wealth in country B as,

$$V^B(t) = \left[1 - b(1-\beta + \frac{L^A}{L^B})\right]\frac{aw^A M(t)}{\delta\beta\alpha} - \frac{w^B}{\delta\alpha} \qquad (5),$$

5.1.2 The Industrialized Economy

In country A, the labor force is divided into R&D activities and manufacturing, with no "backyard" production in equilibrium. Hence,

$$L^A = F(t)\dot{N}(t) + A(t)[L^A N(t) + (1-\beta)L^B C_R^B(t)],$$

or,

$$L^A = \gamma f + b\left[L^A + (1-\beta)L^B \frac{w^B + \dfrac{1-\beta\alpha}{1-\beta}\delta V^B(t) + (1-aw^A)M(t)}{w^A + \delta V^A + (1-aw^A)M(t)}\right].$$

Proposition 2 The equilibrium per capita wealth in country A rises with the efficiency of manufacturing in country B and with the range of goods produced in country B. Furthermore, for a given degree of imitation, a higher fraction of poor households in country B lowers wealth in country A because the size of the market for innovations is smaller.

Proof: From (5), we obtain the steady-state per capita wealth in country A as,

$$V^{A}(t) = \left[(1-b(1-\beta))L^{B} - bL^{A}\right]\frac{aw^{A}M(t)}{\delta\beta\alpha L^{B}} \qquad (6),$$

and the stated results follow.

❑

A drop in imitation, as for example discussed in connection to Proposition 1 when the proportion of poor households rises, affects country A household adversely because their consumption bundles become more expensive. This in turn means that less resources are available for innovation. Somewhat paradoxically, imitation spurs innovation.

5.2 Current Account Balance

As mentioned at the beginning of this section, we will concentrate in the case in which income differences between countries are relatively large, so that the poor in the less developed country cannot afford any imported varieties. $M(t)$ goods are produced in country B and all these goods are exported as all households in country A can afford them. The price of these goods is aw^{A}. So the value of total country A imports (in terms of the numeraire goods produced in country A) is therefore given by $aw^{A}M(t)L^{A}$ The demand for exports is given by the number, and wealth, of rich consumers in the country B country. Only this group is assumed to be able to afford imported luxury goods. The level of consumption of this group is $C_{R}^{B}(t)$ so the value of exports country B is $C_{R}^{B}(t)(1-\beta)L^{B}$. In the steady state, the current account balance can therefore be written as,

$$M(t) = \frac{(1-\beta)L^B}{aw^A L^A}\left[w^B + \frac{1-\beta\alpha}{1-\beta}\delta V^B(t) + (1-aw^A)M(t) \right],$$

where the expression in brackets is the optimal consumption of the rich in country B derived in (2).

Proposition 3 The integrated economy will have an equilibrium with international trade if the mark-up of manufactures from country A is sufficiently small and the population of country B relative to that of country A is sufficiently large. Moreover, the degree of manufacturing and exports in country B rises with the wage.

Proof: Now, if we plug in the equilibrium wage and per capita assets in country B obtained in equations (4) and (5) from the free-entry and resource balance conditions, we obtain the range of goods produced in country B as,

$$M(t) = \frac{\Gamma}{\Gamma + \xi} w^B \qquad (7),$$

where,

$$\xi = aw^A \left[1 - b + \beta(1 + b + \alpha(1-\beta) - \mu^A) \right] - \frac{L^A}{L^B}(b + \beta\alpha(1-b)) ,$$

where μ^A is the price mark-up of goods manufactured in country A, that is the marginal cost over the price, and $\Gamma = \beta(1-\alpha)$ is the Gini coefficient derived from the wealth distribution in country B.[4] If the conditions stated in the Proposition are satisfied, then the last expression is positive and so is the range of goods produced in country B.

❑

[4] See Appendix 8.1.

Imposing an upper bound on the mark-up of country A amounts to limiting the magnitude of the price of imitated manufactures. This makes them affordable to more consumers, thereby expanding market size for imitators, as does a large population in country B. A large population in country B relative to country A also ensures that there will be some demand for imports from country B, even if the fraction of poor households is large, while households from the industrialized country always consume all goods produced in the less developed country.

The positive feedback between wage rises and manufacturing expansion in the less developed country illustrates the role of nonhomothetic preferences in bringing about a demand channel whereby income distribution determines industrial activity and the pattern of trade. If less inequality induces more production in the less developed country, the industrialized country benefits also because, as explained above, imitation stimulates innovation. Yet, inequality may stimulate growth as imitation follows innovation, and in particular, rises in “luxury’ imports.

5.3 The Pattern of International Trade

In the steady state, this economic system is characterized by the household optimization rules, by the industrial organization among innovators and imitators in equilibrium, by resource balance, and by the balance of trade described in the last section.

Now, we analyze the determinants of international trade. Total trade flows will be derived in terms of the primitives of the model. In particular, we want to explore the impact of the distribution of wealth in country B. Define total trade flows as total exports,

$$T(t) \equiv X^{B} + X^{A} = aw^{A}M(t)L^{A} + C_{R}^{B}(t)(1-\beta)L^{B}.$$

Proposition 4 Total trade flows in the integrated economy do not change monotonically with variations in the wealth distribution parameters. While inequality contracts the export supply of the less developed country, it also expands its import demand. The net effect is ambiguous.

Proof: If we plug in the equilibrium wage and per capita assets in country B obtained in equations (4) and (5) from the free-entry and resource balance conditions together with the range of production in country B derived from current account balance in the integrated economy, we obtain the steady-state total trade flow as,

$$T(t) = \Psi M(t) - \Gamma w^B L^B = \Gamma w^B \left(\frac{\Psi}{\Gamma + \xi} - L^B \right),$$

where,

$$\Psi = aw^A(\beta\alpha - b(1-\beta\alpha))L^A + [\beta\alpha(1-aw^A)(1-\beta) + aw^A(\beta\alpha - b(1-\beta)(1-\beta\alpha))]L^B,$$

where the expression for total trade clearly does not vary unambiguously with changes in the distribution parameters.

❑

The effect of inequality emphasized in the first three propositions points to a contraction in trade due to less imitation, and indirectly less resources for innovation. Proposition 4 introduces a direct effect of inequality in expanding the market for innovators through higher imports from the less developed country. In equilibrium, higher imports from the less developed country entail higher exports to the industrialized country. Hence, in the dynamic model of international trade, nonhomothetic preferences induce two offsetting effects from *intra*-national inequality. In order to learn more about the impact of inequality on international trade, we turn next to analyze the empirical evidence. Once the importance of national inequality for bilateral international trade in the sample is ascertained, the net effect of the Gini coefficient of trading partners is estimated in an augmented gravity equation.

6 Evidence on Inequality and Bilateral Trade

In this section, the gravity equation approach is used to analyze the impact of national inequality on international trade flows. First, bilateral import demand and export supply functions are fitted controlling for

7 Conclusions

Although the ambiguity in the results so far is relatively unsatisfactory, it does prove the relevance of incorporating nonhomotheticity in preferences in the dynamic analysis of global trade. As observed by Linder (1961) in his classic study, once the difference in expenditure decisions between rich and poor consumers is acknowledged, we conclude that the trade pattern between industrialized and developing regions is determined not only by factor endowment and cross-regional income differentials, as in the Hecksher-Olin-Samuelson and intra-industry trade models, but also by the income distribution within each region. The incorporation of Engel's Law into the preference structure has dramatic implications regarding the importance of income distribution within regions over both the technology diffusion and trade patterns. This feature introduces an aggregate demand channel which raises the possibility of multiple steady states as well as different converging paths even under \QTR{it}{common initial conditions}. As discussed in Section 4, stability of the integrated economy generically implies the existence of multiple equilibria. The latter tend to be Pareto rankable. Equilibria exhibiting high growth in the developing region also display high wages. In spite of the higher production costs entailed by high wages, higher growth is sustainable in view of the demand expansion associated with higher income as well as the ensuing rise in labor supply. The prosperous region should also benefit in view of a higher volume of trade which translates into higher growth.

As pointed out in Section 3, by construction, the model implies balance of the capital account in equilibrium because there is international equalization in rates of return. However, there are incentives for technology transfer, which we rule out by assumption. In order to explore technological diffusion to emerging economies, we characterize the life-cycle structure of the locational choice over time for the production of sophisticated newly invented goods. In the present state of the model, we simply inherit the information exchange structure from dynamic North-South trade models where reverse engineering is the only channel of technological diffusion. In future versions, we shall allow for other mechanisms whereby technical knowledge flows across boundaries. This will enrich our study of the evolution of the trade pattern over time, in the presence of nonhomothetic preferences.

We could treat the stock of technical knowledge as an endowment subject to some type of factor price equalization. When considering technology adoption across boundaries, we must model two types of costs that limit the technological implementation possibilities by late adopters. First, we need to incorporate the resource cost entailed by the required absorptive capacity build-up. Second, we should build-in strategic costs due to intellectual property right protection and nondisclosure clauses that innovators use to limit diffusion and enhance trade secrecy. Hence, whether we model foreign direct investment (FDI) or trade in intermediate goods as the conduits of knowledge, the deployment cost provides a bound on the adoption rate. The conclusions reached should be sensitive to what we assume with regard to each form of information flow. For example, Romer(1994) assumes that intermediates are essential to implement new production methods. Hence, trade barriers to exchange new inputs hamper growth. Feenstra(1996), who considers the impact of trade on growth when knowledge flows are localized, arrives to the same conclusion. However, regarding the impact of FDI, because he assumes that the only benefit to the domestic economy is the generation of low-wage jobs, he concludes that the net effect is domestic industry displacement in the short-run and Dutch disease in the long-run. In contrast, Romer(1993) concludes that FDI is probably the most efficient channel through which less developed countries can bring new technologies and enjoy from their propagation over time due to their nonexcludable nature. Enriching the specification of the technological propagation process will undoubtedly lead to more interesting results, as the considerations to follow suggest.

A technology gap may also persist due to trade secrecy incentives. Beyond the real fixed costs associated with technology transplants, there exists a strategic cost to producers in the industrialized country to the extent that technical knowledge is not fully excludable. Although the benefit of using it in various set-ups stems from the fact that it is nonrival, those possessing technological information will try to erect barriers to its dissemination even if they are only partially successful. The balance of these two effects can be analyzed by studying the impact of intellectual property right (IPR) protection and corporate organization. For instance, Helpman(1993) studies the impact of IPR enforcement in a trade model with innovation-imitation dynamics. To the extent that imitation intensity falls, the monopoly power associated with innovation increases and growth falls. But, Lai(1996) has shown that if FDI is the channel of production transfer the conclusions are exactly reversed. The competitive or predatory impact of imitation on innovation thus depends on the characteristic of the propagation process associated with different conduits of technical knowledge flows.

The main analytical result obtained by introducing a demand channel through which income distribution can affect industrial evolution in a dynamic trade model is the multiplicity of equilibria, even under common initial conditions. This is not just a possible outcome but a highly likely one. Indeed, almost surely multiple equilibria and converging paths obtain because the condition required for the existence of a stable equilibrium is that the rate of time preference be sufficiently high while uniqueness requires a rate of impatience below a very small threshold. This by itself demonstrates the importance of nonhomothetic preferences. These multiple equilibria, arising under\QTR{it}{\ common initial conditions}, are generically Pareto rankable due to the correlation of a high wage with high growth in the developing region and the expanded trade volume for the integrated economy. This suggests a very strong possibility for welfare enhancing policy coordination among the regions which is not present in previous models assuming preference homotheticity. Cooperative arrangements could play a catalytic role not necessarily addressed to overhauling measures meant to change initial conditions but rather targeted to jump starting up the movement toward a better equilibrium.

We are in the process of finding more positive results on the relevance of the \QTR{it}{intra}-regional income distribution, through the impact of Engel's Law on demand, in the determination of the dynamic pattern of international trade. To do so, we are calibrating the model and applying numerical methods to simulate realistic scenarios and comparative steady state exercises.

7 References

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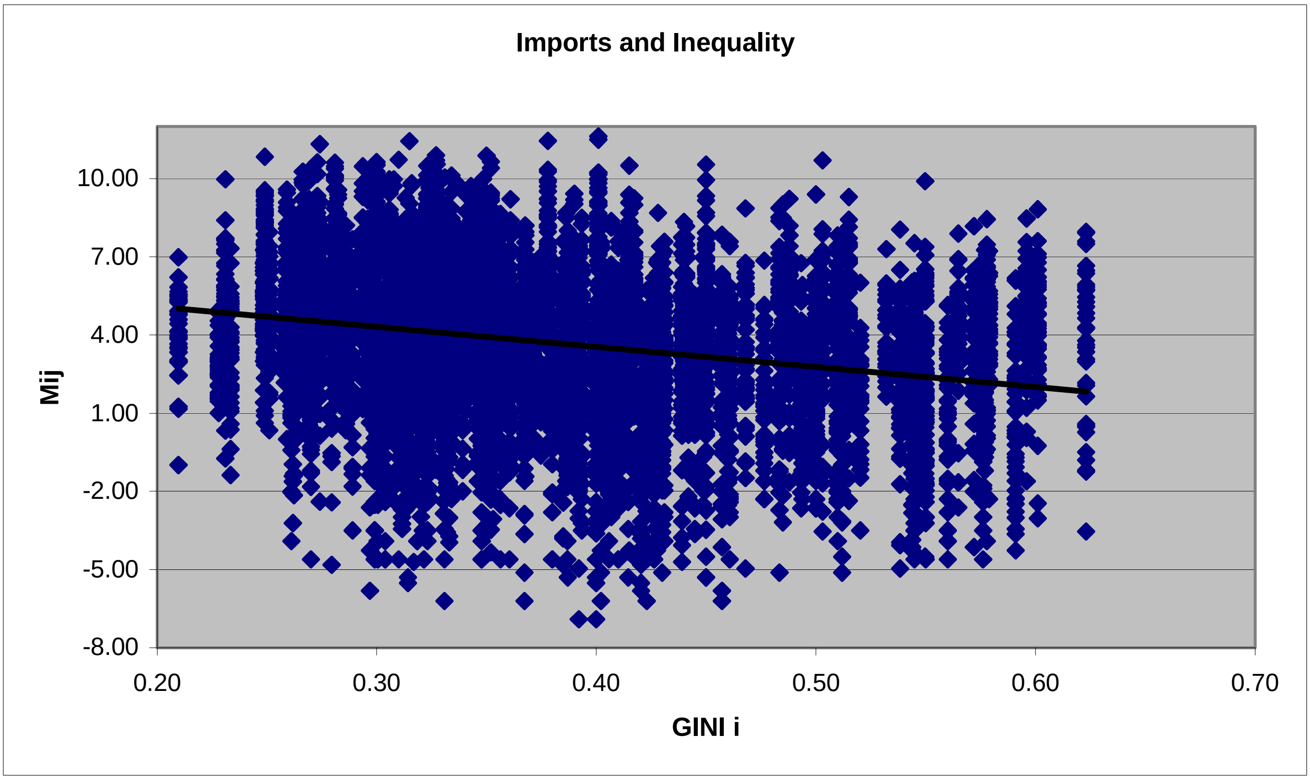
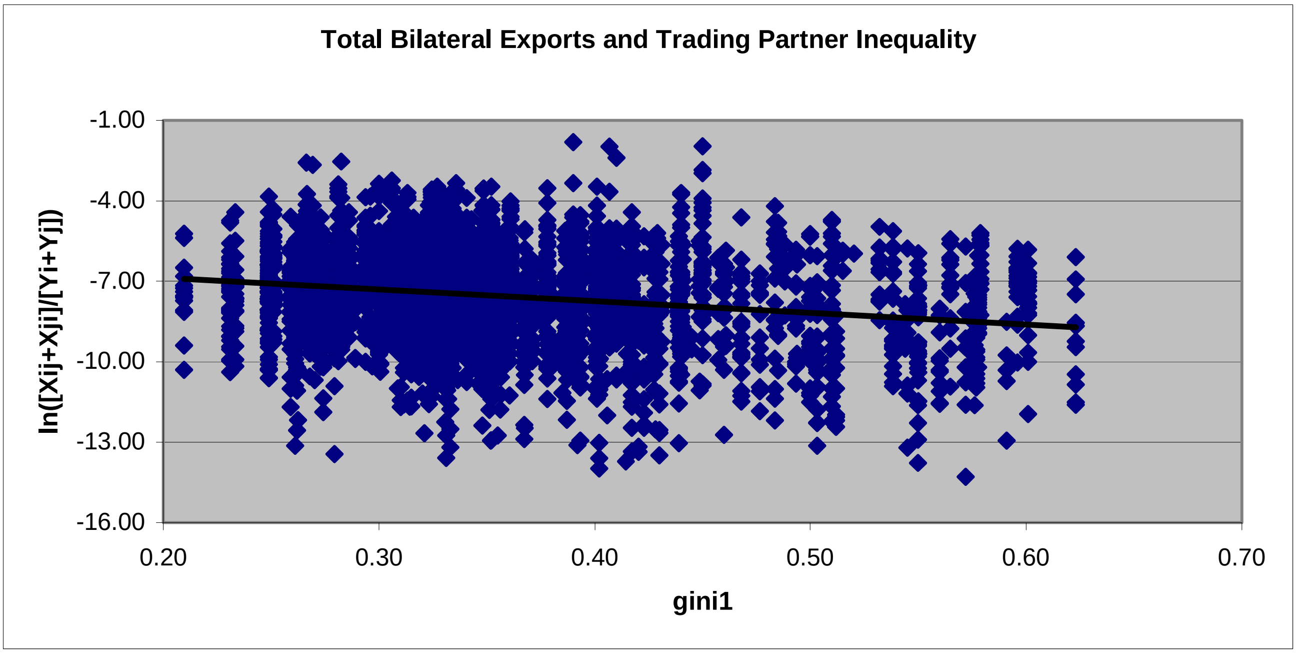
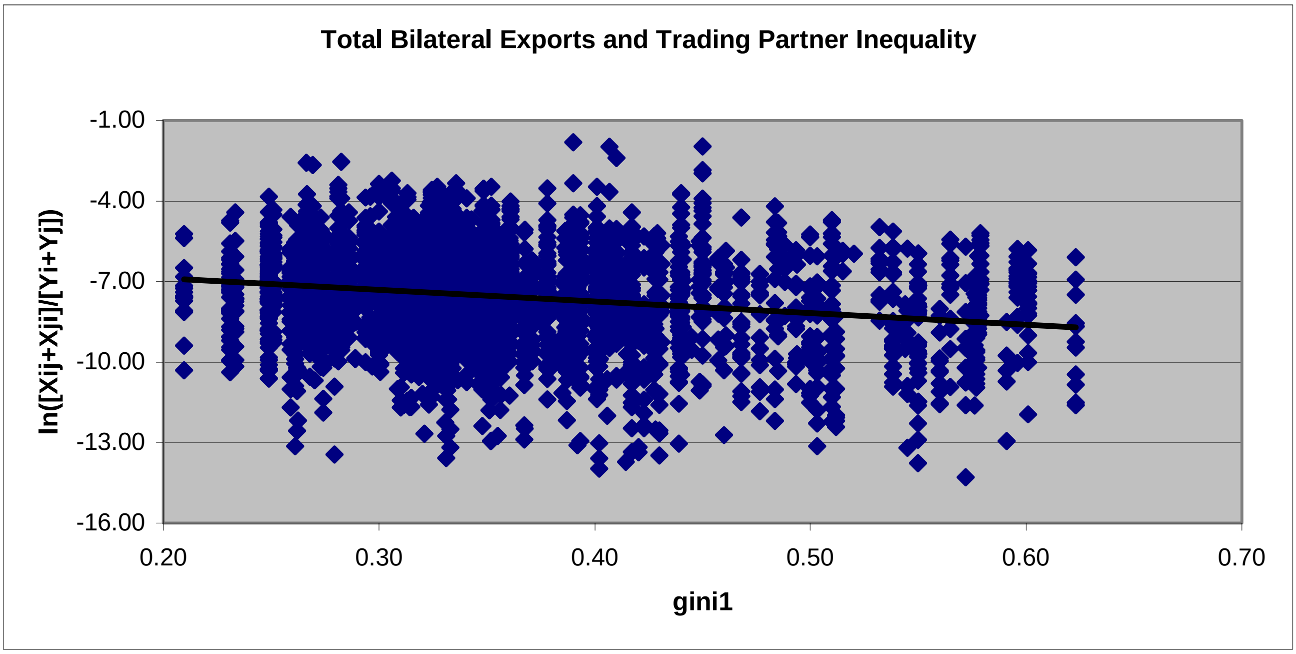
8.1 The Estimation







Data description

```
Fixed-effects (within) regression               Number of obs      =      7148
Group variable (i) : i                          Number of groups   =        58

R-sq:  within  = 0.6995                         Obs per group: min =        19
       between = 0.2384                                        avg =     123.2
       overall = 0.5647                                        max =       177

                                                F(13,7077)         =   1267.23
corr(u_i, Xb)  = 0.0352                         Prob > F           =    0.0000

------------------------------------------------------------------------------
lnbilimp |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
 logdist |  -.6942325   .0286229    -24.254   0.000      -.7503419   -.6381231
    d2ap |   1.671377   .0953699     17.525   0.000       1.484423     1.85833
    d1ap |   .4667906   .0500521      9.326   0.000       .3686735    .5649078
    hsa1 |   .4347359   .1753933      2.479   0.013       .0909127    .7785592
     wh2 |   1.198301   .0988047     12.128   0.000       1.004615    1.391988
adjacent |    .497194   .0963623      5.160   0.000       .3082951    .6860929
linguist |   .5315383   .0496536     10.705   0.000       .4342024    .6288741
loggini1 |  -.6540001     .20824     -3.141   0.002      -1.062213   -.2457874
loggini2 |   .0352501   .0849377      0.415   0.678      -.1312532    .2017534
 loggnp2 |    .869763   .0133058     65.367   0.000       .8436796    .8958464
 logpcg1 |   .2041027   .0272805      7.482   0.000       .1506247    .2575807
 logpcg2 |   .3445702   .0168075     20.501   0.000       .3116224    .3775179
   _cons |   -5.17441    .374427    -13.820   0.000      -5.908398   -4.440421
------------------------------------------------------------------------------
 sigma_u |  1.3742681
 sigma_e |  1.3317613
     rho |  .51570432   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(57,7077) =    88.07             Prob > F = 0.0000
```

Random-effects GLS regression
Group variable (i) : i

Number of obs = 7148
Number of groups = 58

R-sq: within = 0.6993
between = 0.3058
overall = 0.5816

Obs per group: min = 19
avg = 123.2
max = 177

Random effects u_i ~ Gaussian
corr(u_i, X) = 0 (assumed)

Wald chi2(13) = 16311.33
Prob > chi2 = 0.0000

lnbilimp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
logdist	-.7088604	.0286457	-24.746	0.000	-.765005	-.6527159
d2ap	1.661595	.0957685	17.350	0.000	1.473892	1.849297
d1ap	.4817824	.0500387	9.628	0.000	.3837083	.5798566
hsa1	.4303998	.1763467	2.441	0.015	.0847665	.7760331
wh2	1.174346	.0990967	11.851	0.000	.9801205	1.368572
adjacent	.4897403	.0969302	5.053	0.000	.2997607	.6797199
linguist	.5200788	.049873	10.428	0.000	.4223296	.6178281
loggini1	-.8988843	.1946852	-4.617	0.000	-1.28046	-.5173084
loggini2	.0358301	.0853804	0.420	0.675	-.1315124	.2031726
loggnp2	.8630616	.0133598	64.601	0.000	.8368768	.8892463
logpcg1	.2493413	.0263411	9.466	0.000	.1977138	.3009689
logpcg2	.3398445	.0168989	20.110	0.000	.3067232	.3729658
_cons	-5.833791	.3831467	-15.226	0.000	-6.584744	-5.082837
sigma_u	.81288434					
sigma_e	1.3317613					
rho	.27143827	(fraction of variance due to u_i)				

Hausman specification test

lnbilimp	---- Coefficients ---- Fixed Effects	Random Effects	Difference
logdist	-.6942325	-.7088604	.0146279
d2ap	1.671377	1.661595	.0097823
d1ap	.4667906	.4817824	-.0149918
hsa1	.4347359	.4303998	.0043361
wh2	1.198301	1.174346	.0239549
adjacent	.497194	.4897403	.0074537
linguist	.5315383	.5200788	.0114594
loggini1	-.6540001	-.8988843	.2448843
loggini2	.0352501	.0358301	-.00058
loggnp2	.869763	.8630616	.0067015
logpcg1	.2041027	.2493413	-.0452386
logpcg2	.3445702	.3398445	.0047256
dilngini	.1178264	.1205486	-.0027222

Test: Ho: difference in coefficients not systematic

```
chi2( 13) = (b-B)'[S^(-1)](b-B), S = (S_fe - S_re)
          =    49.16
Prob>chi2 =     0.0000
```

```
Fixed-effects (within) regression               Number of obs      =      7148
Group variable (i) : i                          Number of groups   =        58

R-sq:  within  = 0.6895                         Obs per group: min =        27
       between = 0.3319                                        avg =     123.2
       overall = 0.5523                                        max =       175

                                                F(12,7078)         =   1310.08
corr(u_i, Xb)  = 0.0566                         Prob > F           =    0.0000

------------------------------------------------------------------------------
lnbilexp |      Coef.   Std. Err.       t     P>|t|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
 logdist |  -.8937787   .0250568    -35.670   0.000      -.9428976   -.8446597
    d2ap |   1.191062   .0927713     12.839   0.000       1.009203    1.372922
    d1ap |   .3326972   .0481058      6.916   0.000       .2383954    .4269989
    hsa1 |   .3689404   .1723801      2.140   0.032       .0310239    .7068569
     wh2 |   .8333391   .0957815      8.700   0.000       .6455787      1.0211
linguist |   .5699293   .0482527     11.811   0.000       .4753397     .664519
logginil |   .1069954   .2026886      0.528   0.598      -.2903349    .5043258
logginі2 |  -.4870956   .0867225     -5.617   0.000      -.6570976   -.3170935
 logpcg1 |   .4194079   .0263698     15.905   0.000       .3677153    .4711006
 logpcg2 |   .1464208   .0171792      8.523   0.000       .1127444    .1800972
 loggnp2 |   .8264954   .0127864     64.639   0.000       .8014303    .8515605
   _cons |  -2.703383   .3461923     -7.809   0.000      -3.382023   -2.024742
------------------------------------------------------------------------------
 sigma_u |  1.4745177
 sigma_e |  1.2985806
     rho |   .5631899   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(57,7078) =   109.09             Prob > F = 0.0000
```

```
Random-effects GLS regression                   Number of obs      =      7148
Group variable (i) : i                          Number of groups   =        58

R-sq:  within  = 0.6895                         Obs per group: min =        27
       between = 0.3592                                        avg =     123.2
       overall = 0.5606                                        max =       175

Random effects u_i ~ Gaussian                   Wald chi2(12)      =  15684.36
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
lnbilexp |      Coef.   Std. Err.       z     P>|z|       [95% Conf. Interval]
---------+--------------------------------------------------------------------
 logdist |  -.8987311   .0250477    -35.881   0.000      -.9478237   -.8496386
    d2ap |   1.194352   .0928956     12.857   0.000        1.01228    1.376425
    d1ap |   .3447884   .0480637      7.174   0.000       .2505852    .4389916
    hsa1 |   .3684504    .172698      2.133   0.033       .0299686    .7069322
     wh2 |    .828063   .0958331      8.641   0.000       .6402336    1.015892
linguist |    .564131   .0483255     11.674   0.000       .4694146    .6588473
loggini1 |  -.0127696   .1954166     -0.065   0.948      -.3957791    .3702399
loggini2 |  -.4923866   .0868892     -5.667   0.000      -.6626863    -.322087
 logpcg1 |   .4445518   .0258861     17.173   0.000       .3938161    .4952876
 logpcg2 |     .14367   .0172118      8.347   0.000       .1099355    .1774045
 loggnp2 |   .8228904   .0128045     64.266   0.000       .7977941    .8479867
   _cons |  -3.254213   .3720404     -8.747   0.000      -3.983399   -2.525028
---------+--------------------------------------------------------------------
 sigma_u |  1.1324436
 sigma_e |  1.2985806
     rho |  .43197738   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Hausman specification test

lnbilexp	Coefficients: Fixed Effects	Coefficients: Random Effects	Difference
logdist	-.8937787	-.8987311	.0049525
d2ap	1.191062	1.194352	-.0032902
d1ap	.3326972	.3447884	-.0120913
hsa1	.3689404	.3684504	.00049
wh2	.8333391	.828063	.0052761
linguist	.5699293	.564131	.0057984
loggini1	.1069954	-.0127696	.1197651
loggini2	-.4870956	-.4923866	.0052911
logpcg1	.4194079	.4445518	-.0251439
logpcg2	.1464208	.14367	.0027508
loggnp2	.8264954	.8228904	.003605
djlngin2	.2001331	.2008989	-.0007658

Test: Ho: difference in coefficients not systematic

```
chi2( 12) = (b-B)'[S^(-1)](b-B), S = (S_fe - S_re)
          =    45.24
Prob>chi2 =     0.0000
```

Fixed-effects (within) regression
Group variable (i) : i

Number of obs = 3369
Number of groups = 57

R-sq: within = 0.7857
between = 0.4983
overall = 0.7410

Obs per group: min = 2
avg = 59.1
max = 170

F(16,3296) = 755.10
Prob > F = 0.0000

corr(u_i, Xb) = 0.0905

lnplutra	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logdist	-.7072502	.0280994	-25.170	0.000	-.7623442	-.6521563
d2ap	1.600493	.0847851	18.877	0.000	1.434257	1.76673
d2na	-.6646207	.2683821	-2.476	0.013	-1.190833	-.1384082
d1ap	.5198653	.0456675	11.384	0.000	.4303258	.6094048
wh2	.7921349	.0970731	8.160	0.000	.6018052	.9824646
adjacent	.5441098	.0923489	5.892	0.000	.3630428	.7251768
linguist	.6452698	.0472909	13.645	0.000	.5525472	.7379924
loggini1	**.3103716**	**.2712568**	**1.144**	**0.253**	**-.2214773**	**.8422204**
loggini2	.4646067	.0959799	4.841	0.000	.2764204	.652793
lnpcgin1	-.6455658	.2152589	-2.999	0.003	-1.06762	-.2235111
lnpcgin2	.2310558	.0186839	12.367	0.000	.1944226	.267689
loggnp1	.9055891	.1981664	4.570	0.000	.5170476	1.294131
loggnp2	.7074166	.0163083	43.378	0.000	.6754412	.7393919
mijlngin	-.7407607	.1017938	-7.277	0.000	-.9403462	-.5411752
mijlngnp	.0682432	.0177396	3.847	0.000	.0334615	.1030249
mijlpgin	**-.0234487**	**.0197333**	**-1.188**	**0.235**	**-.0621394**	**.015242**
_cons	-4.605697	.588925	-7.821	0.000	-5.760393	-3.451001
sigma_u	1.2774522					
sigma_e	.8610448					
rho	.68760642	(fraction of variance due to u_i)				

F test that all u_i=0: F(56,3296) = 27.58 Prob > F = 0.0000

Fixed-effects (within) regression Number of obs = 3369
Group variable (i) : i Number of groups = 57

R-sq: within = 0.7855 Obs per group: min = 2
between = 0.5844 avg = 59.1
overall = 0.7570 max = 170

F(14,3298) = 862.59
corr(u_i, Xb) = 0.2197 Prob > F = 0.0000

lnplutra	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logdist	-.707228	.0280839	-25.183	0.000	-.7622917	-.6521642
d2ap	1.598169	.0847779	18.851	0.000	1.431947	1.764392
d2na	-.6591565	.2683555	-2.456	0.014	-1.185317	-.1329962
d1ap	.5176556	.0456519	11.339	0.000	.4281467	.6071645
wh2	.7883687	.0970467	8.124	0.000	.598091	.9786465
adjacent	.5385997	.0922749	5.837	0.000	.3576779	.7195215
linguist	.6456025	.0472951	13.651	0.000	.5528717	.7383332
loggini2	**.4510161**	**.0956261**	**4.716**	**0.000**	**.2635236**	**.6385086**
lnpcgin1	-.4866535	.1525158	-3.191	0.001	-.7856887	-.1876184
lnpcgin2	.2176713	.0145479	14.962	0.000	.1891474	.2461952
loggnp1	.7538761	.1376926	5.475	0.000	.4839046	1.023848
loggnp2	.712691	.0157041	45.382	0.000	.6819002	.7434819
sijlngin	-.7112763	.1001815	-7.100	0.000	-.9077005	-.5148521
sijlngnp	.0576587	.0148508	3.883	0.000	.0285411	.0867763
_cons	-4.373803	.5511488	-7.936	0.000	-5.454431	-3.293175
sigma_u	1.1767234					
sigma_e	.86113954					
rho	.65123338	(fraction of variance due to u_i)				

F test that all u_i=0: F(56,3298) = 28.43 Prob > F = 0.0000

Fixed-effects (within) regression
Group variable (i) : j

Number of obs = 3369
Number of groups = 57

R-sq: within = 0.7914
between = 0.5067
overall = 0.6440

Obs per group: min = 4
avg = 59.1
max = 143

F(16,3296) = 781.49
Prob > F = 0.0000

corr(u_i, Xb) = -0.1368

lnplutra	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logdist	-.9410296	.0302071	-31.153	0.000	-1.000256	-.8818031
d2ap	1.081797	.0999408	10.824	0.000	.8858452	1.27775
dja	-.3784135	.173929	-2.176	0.030	-.7194333	-.0373937
d1ap	.408205	.0565621	7.217	0.000	.2973045	.5191055
hsa1	.4332478	.16986	2.551	0.011	.100206	.7662897
wh2	.4205478	.0968738	4.341	0.000	.2306089	.6104867
adjacent	.2766568	.0967818	2.859	0.004	.0868983	.4664153
linguist	.5493785	.0492445	11.156	0.000	.4528256	.6459313
lnpcgin1	**-.1747095**	**.1090828**	**-1.602**	**0.109**	**-.3885864**	**.0391673**
lnpcgin2	.5688443	.1329551	4.278	0.000	.3081614	.8295273
loggnp1	.8639809	.0151578	56.999	0.000	.8342613	.8937005
loggnp2	-.1892749	.1135799	-1.666	**0.096**	-.4119692	.0334194
logpcg1	.2922337	.1014263	2.881	0.004	.0933688	.4910985
sijlngin	-.7435173	.106744	-6.965	0.000	-.9528085	-.534226
sijlngnp	.075959	.0188669	4.026	0.000	.0389669	.1129511
sijlpgin	-.078793	.020327	-3.876	0.000	-.1186479	-.0389382
_cons	-1.183643	.4988506	-2.373	**0.018**	-2.161731	-.2055545
sigma_u	1.2975573					
sigma_e	.89689505					
rho	.67668962	(fraction of variance due to u_i)				

F test that all u_i=0: F(56,3296) = 21.33 Prob > F = 0.0000

Fixed-effects (within) regression
Group variable (i) : ij

R-sq: within = 0.8281	Number of obs		=	3369
between = 0.3827	Number of groups		=	1377
overall = 0.4569	Obs per group:	min	=	1
		avg	=	2.4
		max	=	4
	F(9,1983)		=	1061.59
corr(u_i, Xb) = -0.3748	Prob > F		=	0.0000

lnplutra	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
loggnp1	1.550995	.1618791	9.581	0.000	1.233525	1.868466
loggnp2	.8644355	.1321203	6.543	0.000	.6053263	1.123545
loggini1	1.088552	.1960572	5.552	0.000	.7040519	1.473051
loggini2	.5682854	.1923803	2.954	0.003	.1909967	.9455742
lnpcgin1	-1.099925	.1570185	-7.005	0.000	-1.407864	-.7919865
lnpcgin2	**-.2076647**	**.1269664**	**-1.636**	**0.102**	**-.4566662**	**.0413368**
sijlngin	-.4161245	.0960629	-4.332	0.000	-.6045192	-.2277298
sijlngnp	.0806086	.0175021	4.606	0.000	.0462842	.114933
sijlnpcg	-.0737776	.0181961	-4.055	0.000	-.1094631	-.0380922
_cons	-11.79181	.3789443	-31.118	0.000	-12.53499	-11.04864
sigma_u	1.9947776					
sigma_e	.50965323					
rho	.93872292	(fraction of variance due to u_i)				

F test that all u_i=0: F(1376,1983) = 15.51 Prob > F = 0.0000