# How many forms do I have to fill in to export my coffee? The role of transaction costs in explaining economic performance in Latin America

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# 1 Introduction

The quest for large numbers has been going on for some time in international trade economy. Unsatisfied by the meagre benefits estimates derived from their standard model with deadweight loss triangle disappearances, economists have been trying hard to build new models that better explain the big gains observed for internationally integrating countries. Mainly they have gone into two directions, that of dynamics or that of non-convexities, i.e. economies of scale and imperfect competition.

A large literature emphasises the important role that openness may have in boosting economic performances and growth rates. In a variety of theoretical approaches, a liberal external policy by facilitating financial and trade flows helps an economy to get its domestic prices right, to allocate its resources to their best uses, to acquire new technologies, to increase its primary factors' productivity, to increase competition and X-efficiency, to reduce rent seeking, and even to improve its domestic governance. The strength of the links between trade policy and some of these positive effects is challenged by some authors and indeed the debate is still open, however models that include some of these dynamic and non-convex features have produced larger numbers.

Instead of challenging this literature or building variations on it, this paper proposes another approach by considering transaction costs reductions as an important factor explaining a developing reforming economy's performance in the real world. A straightforward observation of international travellers is that doing business, or even simply renting a car, can be far easier in an OECD country than in a least developed one: less paper work, less waiting, more opportunities. It is clear that during the development process a crucial role is played by the reduction of transaction costs, and this paper shows how the introduction of transaction costs in a standard trade model can produce some fairly large numbers.

The connected and important additional issue of the link between transaction costs and factor income distribution (relative poverty) is also a central subject of this paper. By comparing the distributional effects of productivity changes to those due to a reduction in transaction costs, some fresh insights in the trade and wage gap debate are offered here.

A focus on Latin America is provided by actually calibrating a series of trade models with transaction costs on Colombian data for the mid 90s. This country undertook extensive trade

liberalisation towards the end of the 80s and serious discussions were initiated to enter NAFTA soon after its implementation. Although its current trade barriers are not too high, a renewed trade-led reform process, granted by the western hemisphere trade area agreement, would most likely help Colombia in reducing its quite high transaction costs. Besides, the choice of Colombia is not crucial, in fact its main characteristics underlying the numerical implementation of the models used here are quite commonplace in other Latin American countries, so that the results shown below may be fairly easily generalised.

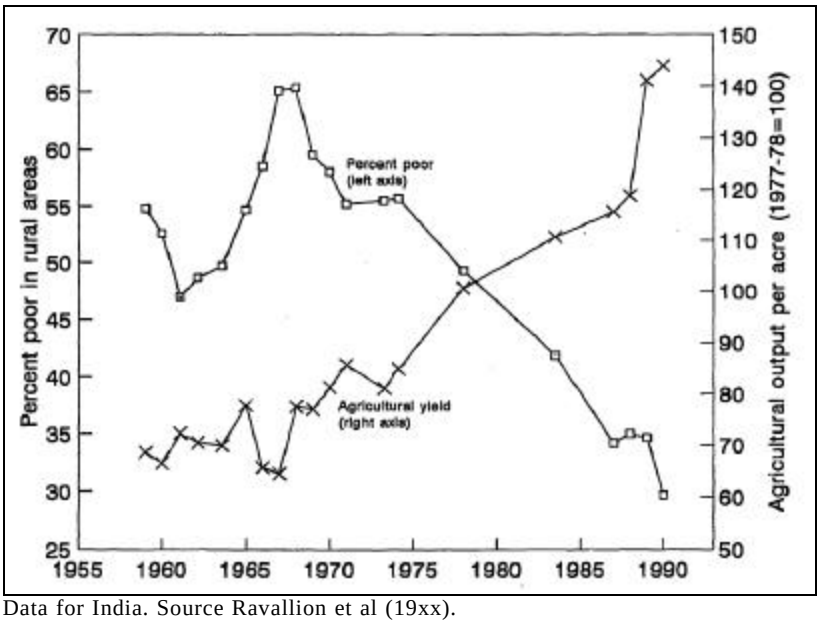
The paper is organised as follows: the next section reviews the main productivity approach used to explain how technology affects factor income distribution; section 3 discusses the transaction cost approach by describing a simple partial equilibrium model followed by a brief review of the theoretical pedigree of the transaction cost idea and concluded by some evidence of its empirical relevance; section 4 presents the structure of general equilibrium models used to study the effects of transaction cost reductions, its calibration on Colombian data and the main numerical results; section 5 concludes.

## 2 Technology and relative poverty: the productivity approach

Although a clear pattern appears in Figure 1, most research focussing on growth or on technological change does not really consider the income distribution or poverty effects of these two phenomena.

A partial justification for this neglect is due to the fact that pioneer researchers who opened the field of development economics believed in the 'trickle down' effect: with time growth would lift the whole population above the minimum poverty levels. This idea crystallized in the so-called Kuznet's curve. This is an inverse-U shaped relationship between a country's income per capita and its equality of income distribution postulating that the dynamic growth process would initially produce increasing levels of inequality which then fade once higher levels of income per capita are reached. Another important theory supporting this view is represented by one of the workhorse models in growth economics: Solow's model. This model predicts that poorer countries would grow faster than richer ones or, in other words that, through this process of convergence to the same level of growth, inequalities across countries' income levels would decrease.

*Figure 1: Productivity and poverty*




Data for India. Source Ravallion et al (19xx).

In some sense Kuznet's and Solow's theories produced a sort of theoretical optimism which diverged economists' attention away from the poverty consequences of the processes of technological change and growth. Some of the analytical tools widely used in growth economics simply cannot accommodate distributional issues. Growth accounting, for instance, mostly used to identified technology's contribution to growth, is normally conducted at aggregate economy wide levels with no room to consider sector specific or household specific distributional effects.

Despite its apparent initial disregard for absolute and relative poverty, this important branch of economics has produced much empirical evidence contrary to the strong distributional predictions of Kuznet and Solow's hypotheses and, in doing so, has sparked innovative approaches to explicitly consider income distribution as an important variable in the growth process.

This renewed interest coincided somehow with the emerging of the trade and growth debate. In turn, this debate originated by the observation of the simultaneous increase in manufacturing imports from developing to OECD countries and the deterioration of the wage gap between skilled and unskilled workers in the rich countries. Was trade the culprit for the worsening of the living standards of poorer workers in the US or Europe? And if so, was it improving the conditions in the developing countries? Or were unskilled labour-saving technologies the cause for this situation?

In contrast with growth economics, international trade economics, with its general equilibrium multi-sector and multi-factor apparatus, has always been a standard tool to study income distribution and poverty. One of its fundamental results, the factor price equalization theorem, directly deals with the strong re-distributive effects of international trade. In addition, technological changes can easily be introduced in a simple trade general equilibrium model and the trade and technology potential effects on the poor can be clearly identified and weighted one against the other.

This approach is quite relevant for our task of mapping the links between technology changes and poverty and, even by focussing only on technology and leaving international trade aside, deserves further examination. The simplest and probably most used methodology to work out the effect of technological progress on the poor consists of constructing a demand-supply model where the production function includes some technological parameter. Then, via comparative statics, a shock to this parameter can be mapped to changes in factors demands, factors prices, goods prices, income distribution and finally poverty.

In order to clarify how this approach works and to compare it to the transaction costs approach proposed below, a brief digression is necessary.

The reason why technological progress can have a strong distributional and poverty effect is intuitive: if a new technology increases the efficiency of a certain factor of production over that of the others, then it directly confers higher economic rewards to the owners of this more efficient factor given that its demand will increase proportionally more than that of the other less efficient factors.

More formally, consider an economy where goods are produced using just two factors, skilled and unskilled labour, and that unskilled workers represent the poor. Firms demand labour of the two categories up to the point where the value of the production of an additional worker covers the cost of employing her. In a simple formula this is:

$$L_d = P * MPL \qquad (1)$$

Equation (1) states that labour demand is equal to the marginal product of labour ($MPL$) in value (i.e. multiplied by the price $P$ at which it can be sold in the market). Factors' rewards are determined by the equality of their demands and supplies. To keep things very simple, assume full employment that is equivalent to have fixed labour supplies.

In this framework we can consider two types of technological shocks. In the first, the shock affects the efficiency of skilled and unskilled workers in the same way (factor neutral case); in the second, technological progress is skill-biased and one factor becomes more efficient than the other (factor biased case). Poverty effects are easily traceable since they correspond to the wage ratio of skilled over unskilled workers, as defined in equation (2):

$$\frac{W_S}{W_U} = \frac{P \cdot MPL_S}{P \cdot MPL_U} = \frac{MPL_S}{MPL_U} \qquad (2)$$

Clearly, with factor neutrality the same change affects both marginal productivities thus leaving the wage ratio equal to the value it had in its initial equilibrium. The whole economy becomes more efficient, goods production goes up (with the same quantity of resources), and the rewards go to the poor in the same way as they go the non-poor. If a hypothetical poverty line were exceeded thanks to the new higher wage, no more poor would exist in this simple economy.

With factor bias, and suppose that the new technology makes skilled labour more efficient, inequality would rise given that the wage ratio would be higher after the technological shock. However notice that this particular increase in inequality does not translate into an increase in *absolute* poverty, given that the wage rate of the poor (unskilled) goes up as well. These two cases are graphically shown in figure 1.

Figure 1. xx

A straightforward variation of this simple framework can be used to construct a case where technological progress, even in its factor-neutral form, can indeed increase relative as well as absolute poverty. The variation consists of moving from a partial equilibrium approach exemplified above to a general equilibrium setting where there are two sectors of production that employ skilled and unskilled labour with different intensities. Consider, for instance, an economy with an advanced and a traditional sector, and that the former uses proportionally more skilled workers than the latter. Assume now that a new factor neutral technology is introduced in this economy and that it is initially adopted by the advanced sector and not by the other. Production in the advanced sector becomes more profitable and more firms enter the sector. Its expansion occurs at the expenses of a contracting traditional sector, now less profitable. Given the different factor intensities of the two sectors, skilled workers, employed in the advanced sector at a rate

exceeding that at which they are released by the traditional sector, experience high demand for their services and rising wages; the opposite situation affects unskilled workers whose demand in production as well as wages are decreasing. If unskilled workers were initially above the poverty line and the wage decrease leaves them below, then absolute poverty would have been caused by a factor neutral sector biased technological change.

Numerous variations of this basic set-up have been provided in the literature. One can think of production that requires more than two factors and that certain factors are complements and other substitute. A realistic case may involve firms adopting a technology that uses simultaneously more of capital and skilled labour thus leaving less capital available for unskilled labour and reducing its productivity and wage.

Another extension considers more sophisticated modelling of labour supply including either education and training, or migration. In such models, the larger the initial wage ratio the larger the incentive to acquire education or to migrate; the equalizing forces ensuing from increasing supply of skilled workers, would probably take time to materialize and may be at the origin of an inverted-U shaped curve mentioned above.

Finally international flows of goods, factors, and technologies may be considered.

# 3 Reforms, Technology and relative poverty: a transaction costs approach

## *3.1 A very simple transaction costs model*

The following four equations representing demand, supply and equilibrium conditions in a generic market can exemplify a simple partial equilibrium model with transaction costs:

$$P_d = a - b\ Q_d \qquad \text{(demand function)}$$

$$P_s = c + d\ Q_s \qquad \text{(supply function)}$$

$$Q_d = Q_s \qquad \text{(market equilibrium)}$$

$$P_d = P_s + T \qquad \text{(Transaction cost mark-up)}$$

In the last equation transaction costs represent a wedge between the supplier and demander's price that is a fixed mark-up equal to T and paid by the demander on each unit of the good exchanged. The equilibrium quantity $Q_e$ can easily be calculated as a function of $T$ and of the other parameters as follows:

$$Q_e = \frac{a - c - T}{b + d}$$

and the basic comparative statics result is:

$$\frac{\partial Q_e}{\partial T} = -\frac{1}{b + d}$$

Thus it clearly appears that the quantity exchanged is reduced by rising transaction costs and that it can go to zero if these reach or are above the value (a – c), which may be labelled the autarky limit. On the other hand and depending on the initial level of transaction costs, their reduction may *create* a market or simply increase the quantity exchanged.

In this simple analysis a crucial question should be asked: "where do transaction costs go in an economy?" To see this more clearly, think of $T$ as if it were an excise tax; the above question would then become: "what happens to the *revenues* ($Q_e$ * $T$) collected from this tax?" If these revenues simply disappear, then clearly a reduction in $T$ would be a sort of windfall with positive effects. If other agents in the economy instead received these revenues, then the net effect of a reduction in transaction costs should be calculated by considering both winners and losers.

Before fully answer this question, a clarification of the concept of transaction costs and its empirical basis are provided.

## 3.2 Transaction costs theory

Since the seminal work of Coase, transaction costs economics has tried to resolve the apparent inconsistence in the co-existence of markets and firms or, in modern terms, of markets and institutions. Coase observed that if markets were perfect forms to organize production and exchange there would not be a need for firms to emerge or, by turning the argument around, if firms had advantages over markets why shouldn't we observe a single giant firm producing all that is demanded. His fundamental intuition was that differential transaction costs generate situations where both firms (or institutions) and markets are observed. In terms of the simple model above, there are certain types of activities for which transaction costs are above the autarky limit and exchanges take place inside institutions, and other types for which a market exists

because transaction costs are below that limit. This has been an extremely significant contribution and it is probably one of the founding ideas for the voluminous transaction costs and institutional economics literature that followed.[1] This literature is not free from criticism, in particular sceptics point out the difficulty in making the concept of transaction cost operational. In Goldberg words, explaining economic phenomena by appeals to transaction costs "is the all encompassing answer that tells us nothing".

Another approach uses the concept of transaction costs in a less abstract and perhaps less interesting way but they may be more helpful for our purpose of understanding how changes in transaction costs may benefit or hurt the poor. The crucial difference of this approach is that rather than being concerned about changes in transaction costs close to the breaking point of the autarky limit, it considers how exchanges already taking place in the market may be affected by variations in transaction costs.

The antecedents to this approach may be once again found in general equilibrium theory and international trade. In an effort to enrich the theory of general equilibrium as formulated by Arrow and Debreu[2], a few authors[3] have studied how this should be modified to incorporate transaction costs and what would be the consequences of such a modification on the major predictions of the standard theory. In Foley's words "the key aspect of the modification I propose is an alteration in the notion of 'price'. In the present model there are […] a buyer's and a lower seller's price [and their] difference yields an income which compensate the real resources used up in the operation of the markets". This can be considered as a first answer the question posed above: where do transaction costs go? When the operation of a market needs intermediaries that provide information or other services to buyers and sellers so that they can realize an exchange, then these intermediaries would receive the income generated by charging a transaction *fee* (=cost).

Another form of transaction costs has been considered in international trade and explicitly incorporated into models since Samelson's paper[4] of transport costs. The basic idea here is that trade involves transaction costs and that these may be simply thought of as a fraction of the traded good itself, as if "only a fraction of the ice exported reaches its destination as un-melted ice". This 'iceberg model' provides another answer to the basic question on the fate of the transaction costs'

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[1] A few fundamental contributions can be found in: xxx . For a recent survey see Williamson on JEL xxx
[2] See Arrow xxx and Debreu (1959).
[3] Kurz xxx, Hahn xxx, Foley xxx.

revenues and it clarifies how a reduction in transaction costs saves real resources and makes an economy more efficient.

### *3.3 Transaction costs: empirical basis.*

There are numerous examples of transaction costs in real world situations. Obviously transportation costs are the easiest to observe and possibly to measure. In an international context they can be measured by the c.i.f./f.o.b. ratio giving the 'carriage, insurance and freight' costs of countries' imports. Henderson, Shalizi, and Venables (1999) estimate that they can "range from a few percent of the value of trade, up to 30-40% for the most remote and landlocked (and typically African) economies." Limao and Venables (1999) find that being landlocked raises transport costs by more than 50% and that the level of infrastructure development is an important variable in explaining differences in shipping costs. Estimates for within country trade and transport costs are not easily available, however, even if smaller, distances may still play a role in generating transaction costs in national markets. In developing countries, poor people usually living in rural or remote areas are often victims of high transaction costs that partially disconnect them from the rest of the society. Jalan and Ravallion (1998) find that road density was one of the significant determinants of household-level prospects of escaping poverty in rural China.[5] Any technological advance providing the poor with better and cheaper access to national and international markets should, at least in principle, help them.

More in general, drastic technological innovations that affect the whole infrastructure of an economy and that have the potential to be used in a variety of sectors, such as steam power, electricity, telecommunications, can have profound effects on transaction costs and indirectly on the poor.[6] As it is shown in Table xx the margin of manoeuvre in improving access to basic infrastructure for the poor is quite large.

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[4] Samuelson P.A. (1954) The transfer problem and transport costs, II: analysis of effects of trade impediments. Economic Journal.

[5] See also Antle, J.M. 1983 "Infrastructure and Aggregate Agricultural Productivity: International Evidence" Economic Development and Cultural Change 31(3): 609-19. Fan, Shenggen, Peter Hazel and Sukhadeo Thorat. (1999). "Linkages Between Government Spending, Growth and Poverty in Rural India." Research Report 110, International Food Policy Research Institute, Washington DC.

[6] A recent literature labels these technologies as 'General Purpose Technologies'. See Helpman, Elhanan (1998) "Introduction." In Helpman, Elhanan, ed. (1998) 'General Purpose Technologies and Economic Growth' Cambridge: MIT Press, and Bresnahan, T. and Manuel Tratjenberg (1995) General Purpose Technologies: 'Engines of Growth' Journal of Econometrics 65: 83-108.

Table xx: Percent of poor households with infrastructure in home, in poorest urban and rural deciles in each country

| Country | Electricity | | In-house water | | Sewer | | Telephone | |
|---|---|---|---|---|---|---|---|---|
| | Urban[4] | Rural[4] | Urban | Rural | Urban | Rural | Urban | Rural |
| **Asia** | | | | | | | | |
| Pakistan | 88 | 44 | 34 | 5 | 20 | 0 | 1 | 0 |
| Vietnam | 57 | 16 | 4 | 0 | - | - | - | - |
| Nepal | 43 | 1 | 7 | 4 | 7 | 0 | 0 | 0 |
| **Eastern Europe & Central Asia** | | | | | | | | |
| Russia | - | - | 84 | 31 | 78 | 12 | 39 | 13 |
| Kazakhstan | 100 | 100 | 78 | 12 | 70 | 8 | 38 | 20 |
| Bulgaria | 100 | 100 | 84 | 27 | 86 | 18 | 51 | 20 |
| Albania[5] | 100 | 100 | 90 | 0 | - | - | 0 | 0 |
| Kyrgyz | 99 | 99 | 54 | 5 | 22 | 3 | 20 | 5 |
| **Latin America & the Caribbean** | | | | | | | | |
| Panama | 91 | 2 | 36 | 4 | 25 | 0 | 20 | 0 |
| Jamaica | 55 | 44 | 23 | 2 | 15 | 6 | 10 | 6 |
| Ecuador | 92 | 63 | 25 | 7 | 42 | 5 | 5 | 0 |
| Nicaragua | 71 | 13 | 44 | 4 | 9 | 0 | 0 | 0 |
| **Sub-Saharan Africa** | | | | | | | | |
| South Africa | 32 | 8 | 23 | 1 | - | - | 6 | 0 |
| Cote d'Ivoire | 39 | 8 | 7 | 0 | - | - | - | - |
| Ghana | 38 | 0 | 2 | 0 | - | - | - | - |

Although just indicative and not directly transferable to a developing country, some estimates for the cost savings (i.e. reduction in transaction costs) due to B2B electronic commerce are available for a few sectors of the US economy and shown in table xx.

Table xx

Another way to estimate transaction costs indirectly is by looking at the inventories

Finally economic policies may generate transaction costs directly.

[to be completed]

In summary even if in identifying empirical estimates for transaction costs we have stretched their definition to include quite different things, it seems clear that geographic characteristics, poor transportation and communication infrastructure, and bad economic policies may directly affect transaction costs, and that their presence can be documented in a variety of ways.

# 4 Transaction costs and poverty: some theory-consistent numerical simulations for Colombia.

The following section considers two different ways of modelling transaction costs and several analytical structures to test how these modelling choices influence the evaluation of relative poverty and aggregate effects of a reduction in transaction costs. The ultimate objective is to draw

conclusions on the main channels of transmission from transaction costs reduction to income determination (its level and distribution) and their likely empirical relevance in the real world, and to do that different model versions are parameterised on a typical Latin American country.

Transaction costs are modelled as either a mark up on the seller's price or as icebergs melting a la Samuelson. With the former approach transaction margins generate income and they are fully comparable to transportation margins, with the latter they simply produce costless inefficiencies.

The basic general equilibrium model used here represents a small price taker economy and it is implemented here in three main versions: the first version is a standard Heckscher-Ohlin international trade model with homogeneous goods, the second introduces intermediate consumption, and the third considers a model with differentiated goods which generalizes the Heckscher-Ohlin structure. A main contribution of the paper consists of pointing out how differences in structural models matter for the estimation of the effects of transaction cost reductions.

## *4.1 The Colombian economy: stylised facts of a Latin American country*

The crucial characteristics of our initial data for Colombia are shown in Table 1, where it is possible to observe some of the stylised facts of a typical Latin American country. The economy has been aggregated into two sectors: an export intensive sector (*Exportables*) and an import intensive one (*Importables*). The first two rows in the table show the relative size of the two sectors and their trade intensity (measured as exports or imports over production). As expected by observing that Colombia is relatively abundant in unskilled labour, its exportables sector uses more intensively this factor of production. The initial wage gap, measured as the ratio of skilled over unskilled labour average incomes, is quite high with more skilled workers' earnings almost two and an half times above those of unskilled ones. Exportables use slightly less intermediates than importables but bear an almost identical transaction cost, as shown by the 'ad valorem' estimate.

*Table 1: Initial data –main characteristics*

| | *Sectors* | |
|---|---|---|
| | *Exportables* | *Importables* |
| **Production shares %** | 31 | 69 |
| **Trade Intensity %** | 33 | 16 |
| **Skill Abundance Unskill / Skill** | 3.6 | |
| **Skill Intensity Unskill / Skill** | 18.0 | 1.9 |
| **Skill Wage gap** | 2.4 | |
| **Intermediates as % of Production** | 30 | 42 |
| | | |
| **Transaction Costs sector allocation** | 26 | 74 |
| **Transaction Costs ad valorem %** | 11.6 | 11.9 |

| **Ownership shares** | *Skill labour* | *Unskill labour* |
|---|---|---|
| *Skilled Head* | 100 | 0 |
| *Unskilled Head* | 0 | 100 |

| **Consumption Shares** | *Skill Head* | *Unskill Head* |
|---|---|---|
| *Exportables* | 17 | 19 |
| *Importables* | 83 | 81 |

Notice also that transaction margins (when modelled as mark-ups) generate income that is allocated across sectors in the same way as total demand (26 percent goes to exportables and 74 to importables). This deserves some further comment: whenever transaction margins are reduced, the price wedge between seller and buyer is narrowed, and the total revenues raised fall; initially these revenues are used to buy exportables and importables in fixed shares and these shares are chosen to reflect the structure of total demand so that they should be as neutral as possible. With this assumption, a fall in revenues should not directly affect the overall demand structure.

Clearly, another way of thinking of the sectoral allocation of transaction margin income is that transaction costs are produced using exportables and importables as inputs. The current sectoral allocation may not reflect the real world "production structure" of transaction costs nevertheless, without additional empirical evidence, the current choice allows to by-pass the problem without introducing unjustifiable biases.[7]

[7] In fact one can think of two alternatives to this assumption: in the first, if it were known that producers of transaction services are include exclusively in the importables sector, then transaction cost revenues could be entirely allocated to buy output from the importables sector. Alternatively, it may be possible to estimate a transaction cost production function that uses a mix of primary factors. In this case producers of transaction services would minimize their cost of production subject to a budget constraint that equals transaction costs revenues.

Additionally, Table 1 displays households' shares of factor ownership and goods consumption. Households have been classified according to their main income source and this is reflected in the ownership structure, but different classification, such as rural-urban, can be considered. Overall consumption shares do not differ greatly across households.

Most of the estimates shown in the table are direct calculations from Colombia's national accounts and input-output tables, however transaction costs have been estimated using raw data on geographic distances and inputs of transport/communication/distribution services. [8]

In summary – in this set-up given similar sectoral ad valorem transaction margins, their neutral revenue allocation and the across household similar consumption pattern – a reduction in transaction costs *should* affect households' poverty and income mainly through changes in factor rewards.

## 4.2 Model 1. A simple Heckscher-Ohlin homogeneous good trade model

The model includes two tradable homogeneous commodities, two factors of production and two households.

Production. The economy produces two goods, an aggregate exportable commodity (X) and an importable commodity (M), using combinations of skilled and unskilled labour in a Cobb-Douglas constant returns to scale technology as follows:

$$Q_i = h_i Ls_i^{a_i} Lu_i^{1-a_i} \quad \text{with the commodities index i = X, M} \qquad (1)$$

where $Q_i$ represents the quantity produced of the two goods, $h_i$ a parameter standing for sector specific technical level, and $a_i$ and (1- $a_i$) the Cobb-Douglas output elasticities with respect to skilled and unskilled labour ($Ls$ and $Lu$). Factor neutral technology shocks similar to those mentioned above would entail changes in the parameter $h_i$.

Factor markets. We assume full employment of fixed endowments of skilled ($\overline{Ls}$) and unskilled ($\overline{Lu}$) labour, so that their supplies will be completely un-elastic with respect to their prices. These are thus determined by firms' demands that, in competitive markets, are equal to their marginal product in value:

[8] These data were obtained from a Social Accounting Matrix estimated by Bussolo and Correa (1998). More details are available upon request.

$$ws = a_i P_i \frac{Q_i}{Ls_i} \qquad \text{i = X, M} \qquad (2)$$

$$wu = (1 - a_i) P_i \frac{Q_i}{Lu_i} \qquad \text{i = X, M} \qquad (3)$$

where *ws* and *wu* are the wages for the two types of labour respectively, and $P_i$ is the producer commodity sale price.

Transaction costs. These are modelled as a mark-up on commodity prices. This is equivalent to an excise tax or a transport margin and, since they do not increase with the value of the exchanged commodity but are proportional to their quantity, they are consistent with the empirical hypotheses on transaction costs described above:

$$Pt_i = P_i + t_i \qquad \text{i = X, M} \qquad (4)$$

revenues generated by the wedge $t_i$ between the seller and buyer's price are equal to $\sum_i t_i Q_i$ , and are used to buy transaction services from both sectors of the economy according to the fixed structure described above.

Consumption. The model includes two households, a skilled headed (HHs) and an unskilled headed (HHu) household, that receive income from selling factor services and demand commodities via an optimisation of a Cobb-Douglas utility function. Households are thus differentiated by their consumption patterns and according to their ownership shares, with the skilled-headed household representing loosely the rich household. Derived consumption demands are as follows:

$$Qd_{Hi} = b_{Hi} \frac{Y_H}{Pt_i} \quad \text{with the household index H = hs, hu and i = X, M} \qquad (5)$$

where Qd represents the household-specific quantity demanded, $b$ an utility share parameter, and *Y* the household's income.

Trade and equilibrium conditions. Imports, exports and domestically produced goods are homogeneous, so that trade, in any of the two goods, can only be one-way (either import or export) and it originates only when domestic demand and supply differ. In equilibrium, trade balance as shown below will hold:

$$\sum_i Pw_i T_i = 0 \qquad \text{i = X, M} \qquad (6)$$

Producers' prices are equal to the world prices given the small country assumption, and export or import flows quantities will be derived from the equality of supply and demand where the latter includes final consumption as well as transaction services demands:

$$P_i = Pw_i \qquad \text{i = X, M} \qquad (7)$$

$$Q_i + M_i = \sum_H Qd_{H\,i} + Qt_i + X_i \qquad \text{i = X, M} \qquad (8)$$

Factors' market-clearing conditions simply state that the sums of factors demands must equal the fixed factors' endowments.

$$\sum_i L_i = \overline{L} \quad \text{and} \quad \sum_i K_i = \overline{K} \qquad \text{i = X, M} \qquad (9)$$

In this simple model our poverty measure would be a relative poverty index equal to the ratio of skilled to unskilled labour rewards similar to that used above in the discussion of the productivity changes. Given fixed factors ownership shares for the rural and urban households and setting a poverty line it would not be difficult to calculate absolute households' poverty measures. The advantage of considering household-specific absolute poverty indices is that we would be able not only to trace the effects of changes in transaction costs on the supply/income generation side, but also on the demand/income use side.

## 4.3 Model 2. A simple Heckscher-Ohlin homogeneous good trade model with intermediate goods

This model introduces a simple variation in the previous one: the use of intermediate goods in the production process. Intermediates are employed in fixed proportion to production with a standard Leontief structure, so that equations (7) and (8) now become:

$$P_i = Pw_i - \sum_i (Pw_i + tc_i) a_{ji} \qquad \text{i = X, M} \qquad (7b)$$

$$Q_i + M_i = \sum_H Qd_{H\,i} + \sum_i Q_i a_{ji} + Qt_i + X_i \quad \text{i = X, M} \qquad (8b)$$

where $a_{ji}$ are the Leontief intermediate shares; notice that $P_i$'s now become value added prices and these are equal to world prices minus the cost of intermediates which are valued at world prices plus transaction cost mark-ups.

## 4.4 Model 3. A heterogeneous good trade model

This third model introduces several variants to the ones described above. First of all transaction costs are modelled as iceberg wedges, i.e. the quantities sold by suppliers reach the purchasers with a certain fractional loss (some quantity of the commodity melts away). In this way transaction costs do not generate any income (or revenue) and they are in fact denominated in the same units of measurement (i.e. real value or quantity) of the good exchanged. In simplified terms the quantity equilibrium in a specific market would be:

$$Q_i^S = Q_i^D tc_i \qquad (9)$$

where *tc* is a number greater than 1 representing the "melting" due to the transaction cost.

In addition imports and domestically produced goods are imperfect substitutes in consumption. Of the domestically produced goods one is not traded and only consumed at home and the other is either exported or consumed. These changes alter the fixed world price structure of the homogeneous goods model and allow for the price of the domestically good, which is imperfectly substitutable with the imported one, to differ from the world price. This type of model has been extensively used in the literature and its properties are quite well known.[9]

In the model there are 3 goods which enter the consumer utility function, an import good M, a domestic non traded good D, and an export good X. Domestic production occurs only for D and M with a CES technology that includes only skilled and unskilled inputs (the CES function represents another difference form the models shown above).

The production function is:

$$Q_i = \left[ bu_i (Lu_i)^{-r_i} + bs_i (Ls_i)^{-r_i} \right]^{1/r_i} \qquad \text{i = M, D}$$

Factor markets equations remain unaltered apart from the obvious changes due to the new functional form. Prices for commodities M and X are fixed and endogenously determined for the

[9] See de Melo and Robinson (1989) or more recently Bhattarai et al (1999).

non-traded commodity D; in fact supply and demand equilibrium such as in equation (9) determines the price of D.

Table 2 displays the main changes that affect the structure of the initial Colombian data for this third model and it should be contrasted with Table 2 above. Salient features are the high skill intensity in the production of domestic non-traded goods (this is derived mainly from the production structure of non-tradable services that include a high percentage of white collar workers of the government sector, a large employer in Latin American countries), and the lower transaction wedge experienced in exchanges in the same sector.

*Table 2: Initial data –main characteristics with three sectors*

| | *Sectors* | | |
|---|---|---|---|
| | *Importables* | *Exportables* | *Domestic* |
| **Production shares %** | | 22 | 78 |
| **Trade Intensity %** | 100 | 76 | 0 |
| **Skill Intensity Unskill / Skill** | | 34.9 | 2.2 |
| **Transaction wedge** | 1.16 | 1.16 | 1.05 |

## *4.5 Numerical results*

These simple general equilibrium models can be used to conduct a basic experiment aimed at investigating the analytics of the link between relative poverty and transaction cost and the aggregate effects of a reduction of the latter; the following numerical results should not be considered exact estimates, but just indications on the potential magnitude and sign of that effects.

A similar experiment is conducted for the three models and it represents the simulation of a situation where new transaction technologies are adopted or more transparent economic policies are implemented. In terms of the exogenous parameter, the experiment consists of a shock that reduces transaction costs $tc_i$. As already described in the introduction, for a large body of literature, both empirical and theoretical, openness improves an economy's performance beyond the near disappearance of tariffs' deadweight loss triangles. In this study, openness is supposed to bring innovations in the transaction technology and their adoption is modelled by a decrease in transaction costs without any indirect effect on the productivity of primary factors. This analysis should complement and not substitute productivity approaches.

The main effects of the experiment for model 1 are summarised in Table 3. Given the fixed world prices and un-elastic supplies of labour, a reduction in transaction costs does not produce any change neither in domestic producers' prices nor in factor rewards so that incentives to alter output levels do not arise and output of both sectors stays constant. Relative poverty, the ratio of skilled over unskilled wage, does not change due to the fact that resources do not move across sectors. In this model, consumption due to transaction costs revenues is substituted by households' consumption (or exports) that can increase without an accompanying increase in domestic output.

*Table 3: Basic experiment of reduction in transaction costs, percentage variations with respect to initial equilibrium – model 1*

| Percent variations | % | | % |
|---|---|---|---|
| Output of Exportables | 0.0 | Exportables demand by HHs | 4.7 |
| Output of Importables | 0.0 | Importables demand by HHs | 10.3 |
| Producer price of Exp.ble | 0.0 | Exportables demand by HHu | 4.7 |
| Producer price of Imp.ble | 0.0 | Importables demand by HHu | 10.3 |
| Exports | 12.4 | Tc demand of exportables | -47.0 |
| Imports | 7.3 | Tc demand of importables | -44.2 |
| | | | |
| Wage S | 0.0 | Real HHs income | 9.4 |
| Wage U | 0.0 | Real HHu income | 9.4 |
| Ratio Ws / Wu | 0.0 | | |

It should be emphasised that even with different initial transaction cost mark-ups across sectors or with a sector bias in reductio n of transaction costs, these results would not qualitatively change: output and factor rewards will be still unaltered.

An important result obtained with this very simple model is that large increases, of almost 10 per cent, are registered in real incomes. These are large numbers and their occurrence is entirely due to the elimination of the deadweight *rectangles* of transaction costs (rather than the elimination of triangles associated for example to tariff reductions).

The same experiment, reduction of fifty percent of transaction costs mark-ups, produces quite different relative poverty results when intermediates are introduced in the production process as in model 2. It seems that B2B is far more important than B2C… In this case the reduction of transaction costs changes the relative profitability of the two sectors: the importables sector, using a larger share of intermediates, enjoys larger savings than the exportables one. This translates via equation (7b) into a larger increase of the value added price of importables, 4.6 percent in contrast

with 2.7 percent for exportables, and into a large increase of importables output, see Table 4. Importables use intensively skilled labour that now enjoys an increase in its reward: the relative poverty index worsens by about 4 percent.[10]

It should be stressed though that a reduction in transaction costs brings positive increases in both labour types wages so that absolute levels of poverty (and welfare) should be reduced (increased) with a reduction in transaction costs.

How robust is the relative poverty result? It can be easily shown that it crucially depends on the sectoral differences in the Leontief $a_{ij}$ coefficients, which directly influence the size of the savings due to the reduction in transaction costs. The same experiment performed on a Colombian economy where all sectors were assigned the same intermediates coefficients would produce identical changes in both skilled and unskilled wages, even in the case of sectorally unequal transaction costs mark-ups.

*Table 4: Basic experiment of reduction in transaction costs, percentage variations with respect to initial equilibrium – model 2*

| Percent variations | % | | % |
|---|---|---|---|
| Output of Exportables | -5.6 | Exportables demand by HHs | 10.0 |
| Output of Importables | 3.0 | Importables demand by HHs | 13.2 |
| Val.Added price of Exp.ble | 2.7 | Exportables demand by HHu | 5.4 |
| Val. Added price of Imp.ble | 4.6 | Importables demand by HHu | 8.4 |
| Exports | -9.2 | Tc demand of exportables | -48.4 |
| Imports | -12.0 | Tc demand of importables | -47.0 |
| | | | |
| Wage S | 6.6 | Real HHs income | 12.6 |
| Wage U | 2.1 | Real HHu income | 7.9 |
| Ratio Ws / Wu | 4.4 | | |

Aggregate results are still positive and large as shown by the increases in real households' incomes. In summary, reduction in transaction costs can have strong positive effects on private consumption and therefore on households welfare and their absolute poverty, however its effect on relative poverty depends more directly on the economic structure of the country under investigation, and in particular on the intermediates as well as primary factor intensities. A country pushing policies to reduce its transaction costs can indeed experience increased factor

[10] To put this number in context consider that between 1980 and 1995 UK wage gap worsened by about 15 percent.

income inequality whenever its sectors that use intensively the more abundant factor experience lower savings due to better transaction technologies.

Results from the basic experiment performed with the third model are shown in Table 5. The main novelty here is that a reduction in transaction cost seems to reduce wage dispersion, the measure of relative poverty. This qualitatively different outcome can be fully explained by the initial difference in transaction wedges[11] (no longer mark-ups). In model 2, sectoral differences in transaction cost mark-ups would not matter for relative poverty, but in this model they are crucial. This model differs from the previous in the fact that domestic goods are not perfect substitutes with importables and that allows a sectorally differential transaction cost shock to alter relative prices across these two categories of commodities, triggering a series of additional effects in output levels, factors' allocation and rewards.

*Table 5: Basic experiment of reduction in transaction costs, percentage variations with respect to initial equilibrium – model 3*

| Percent variations | % | | % |
|---|---|---|---|
| Output of X | 0.7 | HH demand of M | 9.0 |
| Output of D | -0.2 | HH demand of X | 7.4 |
| Price of M | 0.0 | HH demand of D | -0.2 |
| Price of X | 0.0 | | |
| Price of D | -0.5 | Tc demand of exportables | 0.0 |
| Exports | 1.1 | Tc demand of importables | 0.0 |
| Imports | 1.1 | | |
| | | HH income | 1.8 |
| Wage S | -0.90 | | |
| Wage U | 0.07 | | |
| Ratio Ws / Wu | -0.98 | | |

[to be completed]

Up to this point, our analysis has focussed mainly on the production and income generation side of the story, however important links between transaction costs and poverty operate on the consumption side. It seems clear that whenever transaction costs affect more heavily commodities figuring prominently among those demanded by the poor, a reduction in their price should benefit them.

[11] See Table 2

# 5 Conclusions

These experiments discussed above show that different analytical structures highlight different transmission channels and can produce quite different final results.

From a static or long term equilibrium point of view, the debate on whether an improvement in transaction costs should benefit the poor seems essentially to be an empirical one. This paper's results though clearly show that transaction cost reductions can account for a large share of income changes normally recorded in internationally integrating economies, a novelty when contrasted with more traditional trade models. Clearly these conclusions echo very closely those reached when technology advances are modelled as productivity changes, and the transaction cost approach may indeed complement that of productivity. However, unless technology is modelled endogenously, a daunting task especially when developing countries are the object of study, a productivity shock represents a totally exogenous windfall, whereas a reduction in transaction costs feeds back in the models used here in a reduction of intermediation, and may be simpler to implement empirically. Notice also that, in the models examined here, transaction costs affects only commodity exchanges, but it should not be too difficult to introduce them also in factors markets. In this way it would then be possible to simulate changes in education, training, health, or even migration, that originate from lower transaction costs, even larger numbers may thus emerge.

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[TO BE COMPLETED]

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