

Gradual globalization and inequality between and within countries

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Abstract. This paper investigates the effects of gradual trade liberalization on intra-country and inter-country inequality. It assumes two countries, North and South, and two factors, skilled labour and unskilled labour. North is defined as the one that is relatively skilled-labour abundant and larger. A marginal trade liberalization from autarky is shown to (a) increase (decrease) in skilled-unskilled wage differential in the North (South) and (b) raise the inequality between North and South. As the global economy approaches free trade, a marginal trade liberalization has effects, which are the *opposite* of (a) and (b); that is, the relative wage *falls* in the North and *rises* in the South, and North-South inequality decreases.

Mondialisation graduelle et inégalité à l'intérieur et entre les pays. Ce mémoire étudie les effets de la libéralisation graduelle du commerce sur les inégalités à la fois à l'intérieur des pays et entre eux. On postule l'existence de deux pays (Nord et Sud) et de deux facteurs de production (travail spécialisé et non-spécialisé). Le Nord est le pays qui a une abondance de travail spécialisé et est plus grand. Une libéralisation du commerce à la marge à partir d'une situation d'autarcie engendre: (a) un accroissement (décroissement) du différentiel de salaires entre spécialisés et -non-spécialisés dans le Nord (Sud) et (b) accroît l'inégalité entre Nord et Sud. A proportion qu'on s'approche du libre-échange, une libéralisation marginale du commerce a les effets opposés de ceux notés en (a) et (b): le salaire relatif chute dans le Nord et s'accroît dans le Sud, et l'inégalité Nord-Sud décroît.

1. Introduction

Recently, a lot of emphasis – both theoretical and empirical – has been placed on how trade liberalization or globalization causes income distributional

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changes within countries – in terms of relative wage movements. Among others, see Katz and Murphy (1992), Krugman and Lawrence (1993), Wood (1994), Bhagwati and Dehejia (1994), Jones (1997), Xu (2003), and Das (2003). Elsewhere, in the new theory of economic geography, Krugman and Venables (1995) have analysed how trade liberalization, by generating a core-periphery structure across countries through agglomeration effects, affects inequality between countries. The aim of this paper is to propose an alternative framework in which inequality within a country and inequality between trading countries both are endogenous and relate to each other. Furthermore, instead of globalization's being viewed as a discrete jump from no trade to complete free trade (as is typical in the theoretical literature on trade and relative wages), in this paper it is seen as a gradual process, modelled by a continuous decline in the Samuelsonian iceberg type of transport cost.

An economy has two sectors, skilled-labour-intensive manufacturing and unskilled-labour-intensive agriculture, with increasing returns and constant returns, respectively. Monopolistic competition in the former sector, augmented by factor endowment differences across countries and factor specificity (to be outlined later), constitutes the production side of an economy. The standard Dixit-Stiglitz preference structure characterizes the consumption side. The end product is an economy in general equilibrium, which has resemblance with models of intra-industry trade (as in, e.g., Dixit and Norman 1980; Krugman 1980; and Helpman 1981) as well as the theory of economy geography (e.g., Krugman 1991; Krugman and Venables 1995; Fujita, Krugman, and Venables 1999; Baldwin 1999; Puga 1999; Neary 2001; and Ottaviano, Tabuchi, and Thisse 2002; among many others). But it differs from the former class of model in that globalization is seen as a gradual process and the emphasis is on the intra-country and the inter-country inequality in a North-South context rather than on aggregate gains from trade. It is different from the latter in that, by assumption, there is only forward linkage (no backward linkage) – such that agglomeration does not arise. A particular work by Puga and Venables (1999), which investigates trade liberalization or import substitution as a decrease or an increase in transport costs, comes close to this paper. However, their focus is on agglomeration and the effects on total real income, rather than on intra- and inter-country distribution without agglomeration.

There are two main results in this paper. First, while in the initial stage of globalization (near autarky), relative wage increases in the North and falls in the South, in the final stage of globalization (near free trade) it falls in the North and rises in the South. Second, in terms of inequality between countries, the "rise and fall" in the gap between North and South can happen – reminiscent of the classic Krugman-Venables result, although not as dramatic. Both results follow from the combined implications of differences in the relative factor endowment and absolute factor endowments (or country sizes), rather than from the interplay of forward and backward linkages.

Near autarky, both differences, through their comparative-advantage effects, imply that a marginal decrease in trade costs results in an expansion of manufacturing in the North and a contraction of the same in the South. This sector being skilled-labour intensive, the skilled-unskilled wage differential increases in the North and decreases in the South. In turn, this implies that North-South inequality may very well increase. In the neighbourhood of the free trade however, the comparative advantage effects are absent. Thus, the relative factor endowment differences do not play any role in how a further decline in trade cost affects the wage differential. But the size or absolute-endowment difference creates an asymmetric market access effect in manufacturing: since the North's market size is larger than the South's, the latter's manufacturing sector expands at the cost of the former's (just the opposite of what happens near autarky). This decreases the wage differential in the North and increases the same in the South. These movements, in turn, tend to lower the North-South inequality. In other words, between the initial and the final phases of globalization, not only do the relative wage movements reverse but the North-South gap can do so.

We now turn to formal analysis.

2. The model

It is a mix of the K-V (Krugman and Venables 1995) model and the sector-specific model of international trade. There are two countries. In each, there are two sectors/goods, manufacturing (M) and agriculture (A), produced, respectively, in a monopolistically competitive market under scale economies and a perfectly competitive market under constant-returns.

There are transport costs in exporting a unit of good M from one country to the other, while good A is costless to export. The latter is produced by one factor which is mobile across sectors. Good M is produced by two primary factors with diminishing returns: the mobile factor and a sector-specific input. These are respectively interpreted as unskilled labour and skilled labour. Thus, skilled labour is sector-specific; this assumption captures, in an extreme fashion, that the manufacturing sector is relatively more skilled labor intensive than the agricultural sector.¹ Both factor endowments are given.

Also, the two countries are asymmetric. We wish to capture the fact that one country, say, North, would unambiguously possess higher aggregate as well as per capita real income. Thus, the North can be thought of as the richer country, having a larger market size, and the ratio of North's per capita real income or welfare to that of the South can be interpreted as North-South inequality.

¹ For an analysis of agglomeration in the context of two regions within a single country and in the presence of skilled and unskilled workers, see Fujita and Thisse (2001). The typical assumption in such models is that skilled workers are mobile (footloose) between regions, whereas unskilled workers are not. In contrast, here, unskilled workers are footloose across production sectors, while skilled workers are not.

The last feature is articulated through technology differences that 'act' like endowment differences in the following manner. Let both countries be endowed with the same amount of skilled labour and the same amount of unskilled labour. For notional simplicity, let them be normalized to one. But let the service flows from them (the number of 'jobs' per unit of time or worker) differ. In the South, both are equal (normalized) to one; that is, $L_S = Z_S = 1$, where L and Z refer to unskilled- and skilled-labour service flow and S denotes South. In the North, $\bar{L}_N, \bar{Z}_N \geq 1$, with strict inequality holding for at least one, where N denotes North.² This implies an equivalence of ranking of countries in terms of aggregate and percapita income, North having higher aggregate and per capita income than South. Let the production functions in both sectors be defined in terms of service flows from each factor.³

The model further assumes that in the North the ratio of skilled- to unskilled-labour service flow is either equal to one or greater than one; that is, $\bar{Z}_N \geq \bar{L}_N$. The former case captures North-South size difference only. The latter captures the relative factor-service endowment difference, which corresponds to the relative factor endowment difference in the conventional sense. As long as this is understood, from now on we will term the relative factor-service endowment difference as simply the relative factor endowment difference.

On the demand side, the Dixit-Stiglitz love-of-variety preference is assumed as usual. Let μ denote the expenditure share on good M and σ (>1) the elasticity of substitution between any two brands of good M . The underlying utility function is of the form: $U = BM^\mu A^{1-\mu}$, where $M = \left(\int_0^{\infty} x_i^{\frac{\sigma-1}{\sigma}} di\right)^{\frac{\sigma}{\sigma-1}}$ and x_i is the amount consumed of variety i .

Let the unskilled-labour coefficient in sector A be normalized to one, such that perfect competition and free entry/exit in this sector tie the agricultural wage to one. We presume that μ is not high enough, and accordingly good A is produced in each economy irrespective of the extent of trade liberalization. This ties the 'unskilled wage' in each country to one. If we denote the wage of skilled labour by w_R , where R denotes the country, it also reflects the relative wage or the skilled-unskilled wage differential in that country.⁴

As in Fujita, Krugman, and Venables (1999, Chap. 14), which contains a lucid adaptation of the K-V model, let the production of each variety of good M (m_i) be represented by the total cost function $(1 - 1/\sigma)w_R^\beta u_R^{1-\beta}(m_i + B) = (1 - 1/\sigma)w_R^\beta(m_i + B)$, where u_R is the unskilled

2 In other words, if a skilled or an unskilled worker is moved from the South to the North, the worker finds herself more productive in the North.

3 Neither factor of production being non-human, a simple difference in factor endowment in the standard way would not have implied a 1-1 link between total and per capita income. However, this assumption on differences in the total factor service flows – rather than that in total factor endowments per se – is used only to interpret the ratio of North's aggregate welfare to that of South (not the inverse) as 'North-South inequality.' It is not needed elsewhere in the model.

4 Wages here refer to payment per unit of the respective labour service.

wage, normalized to one. The underlying production function is of the form, $x_i = -B + kz^\beta l^{1-\beta}$, where z and l are, respectively, the firm-level employment of skilled labour and unskilled labour. The parameters β and $1 - \beta$ are the shares of skilled and unskilled labour in the total cost. The marginal cost is equal to $(\sigma - 1)w_R^\beta/\sigma$. Monopolistic competition implies that each producer faces a constant-elasticity demand function for its brand. Denoting the producer price of a variety in country R as p_R , the standard profit-maximizing rule is

$$p_R = w_R^\beta. \quad (1)$$

Free entry/exit under monopolistic competition implies zero profits. This condition, together with the above pricing rule, gives rise to firm-level output, say, q^* , dependent on the fixed cost parameter B . Let B be chosen such that $q^* = 1/(1 - \beta)$.

Let L_{MR} denote the employment of unskilled labour in country R 's manufacturing sector. Total payments to it equal $L_{MR} = (1 - \beta)n_R p_R q^* = n_R p_R$, where n_R is the number of firms or varieties produced in country R . Thus,

$$n_R = \frac{L_{MR}}{p_R}. \quad (2)$$

Cost minimization links the skilled and the unskilled wages through

$$w_R = \frac{\beta L_{MR}}{(1 - \beta)Z_R} u_R = \frac{\beta L_{MR}}{(1 - \beta)Z_R}. \quad (3)$$

The last three equations yield a very convenient feature of this model. Equation (3) gives a direct relationship between L_{MR} and w_R . If we substitute (1) and (2) into (3) and eliminate w_R , we also get a direct relationship between L_{MR} and n_R . Thus, *higher employment of unskilled labour in the manufacturing is associated with a higher economy-wide relative wage as well as a greater number of firms and varieties the manufacturing sector*. Intuitively, the cost-minimizing behaviour of firms, together with skilled labour's being specific to manufacturing, implies that, in equilibrium, there is a positive relationship between the employment of unskilled labour in manufacturing and the relative wage in the economy. Because of scale economies, a higher employment of unskilled labour tends to lower unit cost and encourage entry of firms into the industry. Thus, unskilled labour employment in manufacturing is also positively associated with the number of firms and the number of varieties.

The degree of integration or globalization is captured via transport cost of Samuelson's iceberg type: only τ (< 1) fraction of good M exported from one country to the other reaches its destination. It will be convenient to define $\mathcal{T} = \tau^{\sigma-1}$. Autarky and free trade correspond to $\mathcal{T} = 0$ and $\mathcal{T} = 1$, respectively. Increasing globalization is conceived as a continuous increase in \mathcal{T} from 0 to 1.

Given such transport costs, the Dixit-Stiglitz framework implies the following national price indices:

A is produced in equilibrium in both countries. This completes the description of the model.

Our model differs from the K-V model in two important aspects. First, good M does not serve as an intermediate: it is consumed only by households. Hence, the model has forward linkage (since the number of varieties affects the consumer price index), but no backward linkage.⁵ Second, the two countries are asymmetric in size as well as relative factor endowments.

In terms of an international trade model, while it has a sector-specific factor, there are still two goods and two factors. Hence, it 'works' like a 2×2 model. Equation (1) links the producer price and the relative wage uniquely, and, as we will see, factor price equalization holds in free trade.

3. Autarky vis-à-vis free trade

We now solve autarky and free trade equilibria and compare them. Not much is new here. But it sets the stage for our 'transitional' analysis later.

3.1. Autarky

Substituting $T = 0$ into (4) and (7)–(8), solving them, and using (3), we obtain

$$w_N^U = \frac{\bar{L}_N}{\bar{Z}_N} \cdot \frac{\mu\beta}{1 - \mu\beta}; \quad w_S^U = \frac{\mu\beta}{1 - \mu\beta} (\geq w_N^U), \quad (9)$$

where the superscript U denotes autarky. That is, the relative wage is higher in the relatively unskilled-labour-abundant South.

In general, the aggregate welfare of country R is given in the indirect form as

$$\Omega_R = (\bar{L}_R + w_R \bar{Z}_R) G_R^{-\mu}. \quad (10)$$

Note that, the population and its composition being fixed, this expression also represents per capita welfare. A change in the aggregate/per-capita welfare has two components: an income effect (captured by the term in parentheses, which is the aggregate income in the country) and a cost-of-living effect (represented by the term $G_R^{-\mu}$). An increase in the relative wage tends to increase income and welfare. An increase in the cost-of-living has a negative effect on welfare.

Using $T = 0$, as well as expressions (3), (4), and (9) and defining $\gamma = \mu(1 - \beta)/(1 - \mu\beta)$, the respective welfare levels in autarky are given by

$$\begin{aligned} \Omega_N^U &= \frac{\bar{L}_N^{1-\mu}}{1 - \mu\beta} \left(\frac{1 - \beta}{\beta} \right)^{\frac{\mu\alpha}{1-\mu}} \left(\frac{\bar{Z}_N}{\bar{L}_N} \right)^{\frac{\mu\beta}{1-\mu}} \gamma^{\frac{\mu(1-\mu\beta)}{1-\mu}}; \quad \Omega_S^U \\ &= \frac{1}{1 - \mu\beta} \left(\frac{1 - \beta}{\beta} \right)^{\frac{\mu\alpha}{1-\mu}} \gamma^{\frac{\mu(1-\mu\beta)}{1-\mu}}. \end{aligned} \quad (11)$$

⁵ I am thankful to a referee for clearly pointing out this difference.

is not possible. But much can be said about what happens in the 'neighbourhoods' of autarky (initial phase of globalization) and free trade (final phase). We begin with the former. In general, let $\hat{\cdot}$ denote a proportionate change in a variable.

4.1. Inequality within nations

Turn to the system (4) and (7)–(8). Differentiating it with respect to T , using $\hat{w}_R = \hat{L}_{MR}$ and the initial conditions that $T = 0$ and $L_{MN}^U/\bar{L}_N = L_{MS}^U = \gamma$, we obtain the following solutions:

$$\frac{\hat{w}_N}{dT} = \frac{1}{(1 - \mu\beta)\bar{L}_N} \left[\bar{L}_N \left(\frac{Z_N}{\bar{L}_N} \right)^{\sigma\beta} - \left(\frac{\bar{L}_N}{Z_N} \right)^{\sigma\beta} \right] > 0 \quad (15)$$

$$\frac{\hat{w}_S}{dT} = - \frac{1}{1 - \mu\beta} \left[\bar{L}_N \left(\frac{Z_N}{\bar{L}_N} \right)^{\sigma\beta} - \left(\frac{\bar{L}_N}{Z_N} \right)^{\sigma\beta} \right] < 0. \quad (16)$$

The details are given in appendix B.⁸ The relative wage increases in the North and falls in the South, as one would expect. These relative wage movements imply that inequality rises in the North and falls in the South. There are two reasons. First, there is the relative factor endowment effect, which is all too familiar.⁹ Second, suppose there were size differences only; that is, $\bar{L}_N = Z_N > 1$. Also, then, the relative wage rises in the North and falls in the South. Intuitively, size difference is a source of comparative advantage in the presence of scale economies: North has a comparative advantage in manufacturing partly because its market size is greater. Hence, the size difference works the same way as the relative factor endowment difference.

4.2. Welfare and inequality between nations

How does initial liberalization affect the welfare of the two countries individually? Evaluating at $T = 0$, in the North

$$\begin{aligned} \frac{\hat{\Omega}_N}{dT} &= \frac{\hat{Y}_N}{dT} - \mu \frac{\hat{G}_N}{dT} = \mu\beta \frac{\hat{w}_N}{dT} - \frac{\mu}{\sigma - 1} \left[(\sigma\beta - 1) \frac{\hat{w}_N}{dT} - \frac{1}{\bar{L}_N^{1-\sigma\beta} Z_N^{\sigma\beta}} \right] \\ &= \frac{\mu(1-\beta)}{\sigma-1} \cdot \frac{\hat{w}_N}{dT} + \frac{\mu}{(\sigma-1)\bar{L}_N^{1-\sigma\beta} Z_N^{\sigma\beta}} > 0. \end{aligned} \quad (17)$$

⁸ As soon as trade opens up marginally, there is a discrete jump in the number of varieties available to either country. But the costs of importing foreign varieties remain arbitrarily high, and therefore the cost of the basket of manufactures, G_N or G_S , does not change discretely. In (4') we see that as $T \rightarrow 0$, $G_R \rightarrow \sigma_R^{(1-\sigma)\beta} p_R$, where σ^N and p_R refer to their autarky values. This is exactly the same expression of G_R in autarky equilibrium. Thus, marginal analysis is applicable.

⁹ A marginal opening of trade makes the relatively skilled-labour abundant North a net exporter of manufactures. As relatively more of manufacturing is produced, the relative wage is pushed upward, since this sector is more intensive in using skilled labour. The opposite holds for the South.

The first term captures the net positive effect of an increase in w_N on total income and welfare, and the second is the cost-of-living gain.¹⁰

In the South, the fall in w_S tends to lower welfare. But it is dominated by the cost-of-living gain. Algebraically,¹¹

$$\frac{\hat{\Omega}_S}{dT} = \frac{\mu(1-\beta)}{\sigma-1} \cdot \frac{\hat{w}_S}{dT} + \frac{\mu \bar{L}_N^{1-\sigma\beta} \bar{Z}_N^{\sigma\beta}}{\sigma-1} \quad (18)$$

$$= \frac{\mu}{\sigma-1} \left[\frac{(1-\mu)\beta}{1-\mu\beta} L_N \left(\frac{\bar{Z}_N}{\bar{L}_N} \right)^{\sigma\beta} + \frac{1-\beta}{1-\mu\beta} \left(\frac{\bar{L}_N}{\bar{Z}_N} \right)^{\sigma\beta} \right] > 0. \quad (19)$$

We now subtract (18) from (17) and obtain an expression for the change in the North-South inequality.

$$\frac{d\rho}{\rho dT} = \frac{\mu(1-\beta)}{\sigma-1} \left(\frac{\hat{w}_N}{dT} - \frac{\hat{w}_S}{dT} \right) - \frac{\mu}{\sigma-1} \left(\bar{L}_N^{1-\sigma\beta} \bar{Z}_N^{\sigma\beta} - \frac{1}{\bar{L}_N^{1-\sigma\beta} \bar{Z}_N^{\sigma\beta}} \right) \quad (20)$$

$$= \frac{\mu}{(1-\mu\beta)(\sigma-1)} \left\{ (1-\beta) \left[\left(\frac{\bar{Z}_N}{\bar{L}_N} \right)^{\sigma\beta} - \left(\frac{\bar{L}_N}{\bar{Z}_N} \right)^{\sigma\beta} \right] - \frac{(1-\mu)\beta}{1-\mu\beta} \left[\bar{L}_N \left(\frac{\bar{Z}_N}{\bar{L}_N} \right)^{\sigma\beta} - \frac{1}{\bar{L}_N} \left(\frac{\bar{L}_N}{\bar{Z}_N} \right)^{\sigma\beta} \right] \right\} \geq 0. \quad (21)$$

The combined effect of the relative-wage changes widens the North-South gap. This is captured by the first term of (20). Further, a reduction in transport cost lowers the cost-of-living in both countries. But proportionately, this effect is greater in the South, because the number of varieties imported by it from the North exceeds the number of varieties imported by the North from the South at any given T . This difference tends to increase the ratio of price indices, G_N/G_S and thereby lower the North-South gap. This is reflected in the second term in (20). The overall effect, as given in (21), is ambiguous.

It is noteworthy that the narrowing effect, via the cost-of-living changes, of a decline in the trade cost on the North-South inequality holds *regardless* of the initial extent of liberalization.

However, the roles played by size difference and difference in relative factor endowments can be distinguished. Suppose $\bar{L}_N - \bar{Z}_N > 1$, so that there is a size difference only. In (21), the first term inside the braces drops to zero and $d\rho/dT$ is negative unambiguously; that is, initial liberalization narrows the North-South inequality. It is because, in the absence of relative factor endowment difference, the magnitudes of changes in relative wages are relatively small, implying that the income effects on welfare are small. The negative

10 In deriving (17), we have made use of (A1), (A3), and (A5).

11 We use expressions (A2), (A4), (A5), and (16).

effect of a decrease in trade costs on the North-South inequality through changes in the costs of living dominates.

Relative factor endowment differences present, in the neighbourhood of autarky a decrease in the trade cost has strong positive and negative effects on the Northern relative wage and the Southern relative wage, respectively. This tends to increase the North-South inequality via respective changes in income. It is quite possible, then, that this effect outweighs the narrowing effect on the North-South inequality through the cost-of-living changes. For example, let $\bar{L}_N = 1$. Then (21) reduces to

$$\frac{d\rho}{\rho dT} = \frac{\mu(1-\beta)}{\sigma-1} \left(\bar{Z}_N^{\sigma\beta} - \frac{1}{\bar{Z}_N^{\sigma\beta}} \right) (1 + \mu\beta - 2\beta). \quad (22)$$

North-South inequality rises if and only if $\beta < 1/(2 - \mu)$. Any value of $\beta \leq 1/2$ meets this inequality, regardless of how small μ is, and, the higher μ , the greater is the range of β in which the inequality is satisfied. Thus, an increasing North-South gap is quite plausible when relative factor endowment differences are present.

This implication is somewhat similar to the Krugman-Venables finding of an increase in inequality of nations due to globalization. In their model, backward and forward linkages in the presence of a manufacturing good's being used in consumption and production deliver the outcome, whereas, in this model, having the forward linkage only and no agglomeration effects, it is driven by how differences in relative and absolute endowments affect the relative wages and the costs of living in the two countries.

PROPOSITION 2. *In the initial phase of globalization (near autarky), the intra-country inequality rises in the North and falls in the South, and the North-South inequality may increase.*

Compared with proposition 1, we see that the movements in intra-country inequalities in the near-autarky phase of globalization are qualitatively similar to those from autarky to free trade, but changes in the North-South inequality can be different qualitatively.

5. Final phase: near free trade

Suppose the international economy is arbitrarily close to free trade. Formally, it allows us to evaluate changes in variables at the free-trade level. We return to the system consisting of (4) and (7) (8) once again. Differentiating it with respect to T , evaluating at $T = 1$, and solving, we obtain

$$\frac{\hat{w}_N}{\hat{T}} = -\frac{Y_N - Y_S}{\sigma\beta(\bar{Z}_N + 1)(Y_N + Y_S)} < 0; \quad \frac{\hat{w}_S}{\hat{T}} = \frac{\bar{Z}_N(Y_N - Y_S)}{\sigma\beta(\bar{Z}_N + 1)(Y_N + Y_S)} > 0 \quad (23)$$

$$\frac{\hat{G}_N}{\hat{T}} = -\frac{1}{(\sigma-1)(\bar{Z}_N-1)} < 0; \quad \frac{\hat{G}_S}{\hat{T}} = -\frac{\bar{Z}_N}{(\sigma-1)(\bar{Z}_N+1)} < 0, \quad (24)$$

the details of which are given in appendix C.

From (23), it is remarkable to see that, qualitatively, the effects on the relative wages are exactly opposite of what they were in the neighbourhood of autarky. Moreover, the standard relative factor endowment (i.e., the Stolper-Samuelson) effects are completely absent, and the directions of changes are governed entirely by differences in country size. Most notably, the size-difference effects are the *opposite* of what they are in the neighbourhood of autarky – the relative wage *falls* in the North and *rises* in the South.

Intuitively, substantial liberalization having already taken place, the comparative-advantage effects of further liberalization are negligible. The relative factor endowment difference matters towards changes in the relative wage only insofar as its comparative-advantage effects are present. Therefore, the effects because of the relative factor endowment difference are negligible.

It is not the same for the size difference. Although its comparative-advantage effects are zero, it has an asymmetric market access effect when markets are already open to some extent. A reduction in trade cost leads to a greater export-market expansion for the Southern firms in the North than for the Northern firms in the South – since the Northern market size is larger. The Southern manufacturing sector tends to expand, and the Northern manufacturing sector tends to decline. As a result, the relative wage falls in the North and rises in the South.

In terms of welfare, the South unambiguously gains. This is because the aggregate income increases as the Southern relative wage rises, and the price index falls unambiguously. The effect on North's welfare is not apparent: both the relative wage and the price index fall. However, it can be shown that the North benefits as well.¹² How does inter-country inequality change? From (10), we can write

$$\rho = \frac{\bar{L}_N + w_N \bar{Z}_N}{1 + w_S} \cdot \left(\frac{G_N}{G_S}\right)^{-\mu}.$$

Since w_N decreases and w_S increases, the ratio of North's income to South's falls, which tends to lower the North-South inequality. As discussed earlier, a decrease in the trade costs tends to increase the cost-of-living ratio G_N/G_S and thereby lower the North-South inequality. Hence, ρ falls unambiguously.

12 The proof is given in an earlier version of the paper, which is available on request.

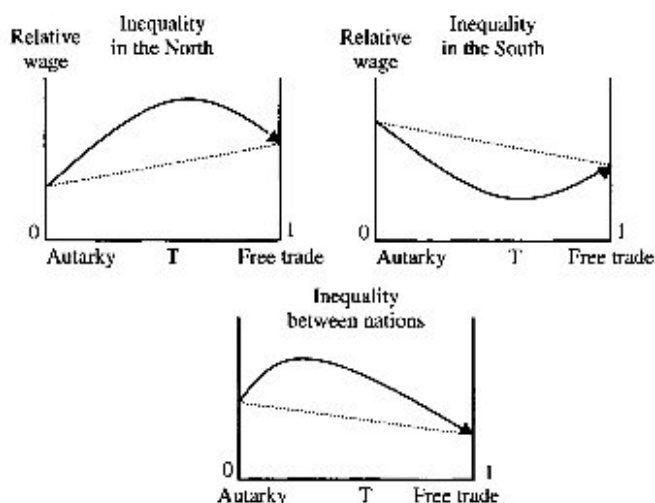


FIGURE 1 Trade liberalization: differences in size and relative factor endowment

PROPOSITION 3. *During the final phase of globalization (near free trade), the intra-country inequality decreases in the North and rises in the South, and the North-South inequality falls.*

As noted earlier, propositions 2 and 3 together imply a rise-and-fall effect of trade liberalization on the North-South inequality.

6. Interior of the transition path

The analyses of trade liberalization in the neighbourhoods of autarky and free trade imply that, over the transition from zero to full liberalization, there are non-monotonic movements of the inequalities within the two countries and the inequality between them. Unfortunately, an analytical characterization of changes in the interior of the transition path does not seem possible. However, our results at the two ends of liberalization strongly suggest the patterns indicated in figure 1. In the North (South) the relative wage increases (decreases) first and then declines (rises), along with the free-trade level of relative wage being greater (less) than the relative wage in autarky. Further, the North-South gap can very well increase initially and then decrease.

However, we do not carry out here a comprehensive simulation exercise in order to rigorously establish the patterns shown in figure 1. In what follows, we illustrate their plausibility. Indeed, there exists a special case ($\sigma\beta = 1$) in which all variables of the model have closed-form solutions, and it is relatively straightforward to numerically trace the entire time-path of any variable of interest.

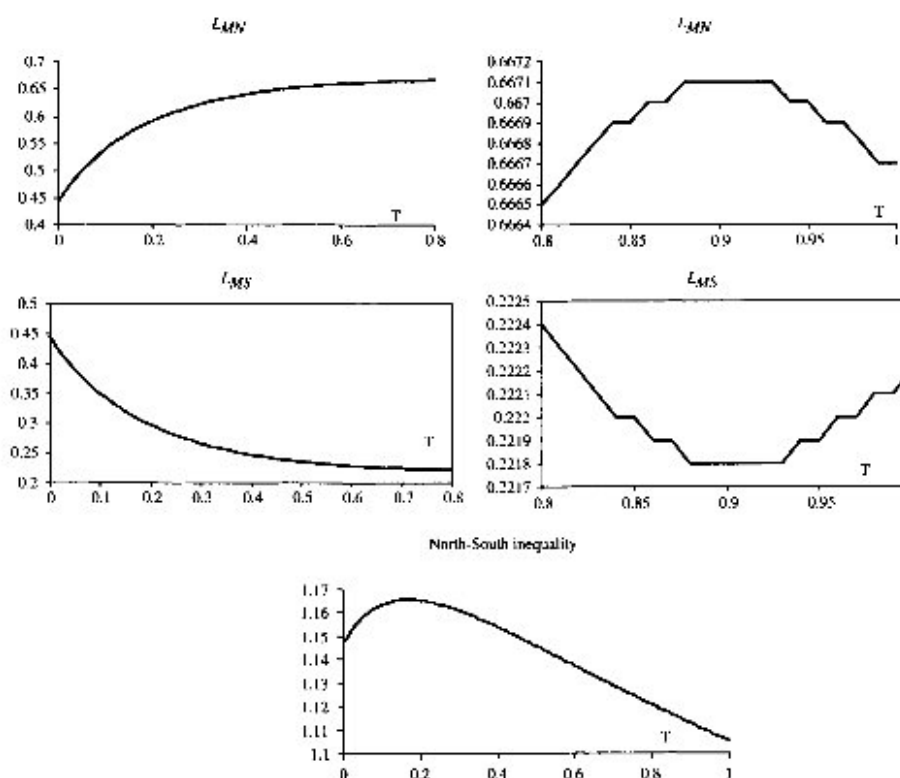


FIGURE 2 Differences in size and relative endowment: numerical example

Figure 2 illustrates a particular example of this special case, where $\bar{L}_N = 1$, $\bar{Z}_N = 3$, $\mu = 0.5$, and $\beta = 0.2$. Unskilled-labour employment in manufacturing, which is proportional to the relative wage in the economy, is shown in two parts for each country, namely, over $0 \leq T \leq 0.8$ and over $0.8 \leq T \leq 1$; this is due to scale differences in the diagram. The first and the second row represent North and South, respectively. The reversal of the initial upward (downward) trends in L_{MN} and L_{MS} – thus in w_N and w_S – occurs in the range $0.8 \leq T \leq 1$. However, the reversal of the North-South inequality happens during the earlier phase of globalization.

The patterns exhibited in the top two rows in figure 2 indeed held for the whole range of parameter configurations as long as the regularity condition (R1) and the condition $\bar{Z}_N/\bar{L}_N \geq 1$ were met. Recall, however, that the non-monotonicity of North-South inequality holds only when \bar{Z}_N/\bar{L}_N exceeds a certain threshold. As mentioned earlier, figure 2 assumes $\bar{L}_N = 1$ and $\bar{Z}_N = 3$. Thus, the same pattern of North-South inequality held for values of \bar{Z}_N greater than 3. But as its value was lowered gradually from 3, the ‘hump’

became flatter and eventually disappeared. This suggests a 'trade-off' between the magnitudes of non-monotonicity of intra-country inequality and that of inter-country inequality over the integration process. The less the relative factor endowment difference, (a) the less is the discrepancy between autarky-level and free-trade-level relative wage and hence the *more* nonmonotonic is its path, while (b) the less is the magnitude of non-monotonicity of North-South inequality.

7. Concluding remarks

The paper has analysed the effects of gradual trade liberalization on inequality within and across North-South countries. It has done so by using a model having two countries; two sectors, namely, manufacturing, in which there are scale economies and production differentiation, and agriculture, producing a homogeneous good by a constant-returns technology; and two factors: unskilled labour and skilled labour. Gradual liberalization is modelled through a continuous decrease in the Samuelsonian transport cost associated with trade in manufactures. The differences with the Krugman-Venables model are that countries are heterogeneous in terms of size and relative factor endowments, and, moreover, the manufacturing sector's output is not used as an intermediate in production. Hence, there is no backward linkage. This, together with the assumption of diminishing returns to both primary factors in the production of manufactures, implies that agglomeration effects do not arise.¹³

The relative wage movements within countries are shown to reverse during the course of liberalization: the Stolper-Samuelson-like results hold in the neighbourhood of autarky, while just the opposite holds as the global economy is sufficiently close to free trade.

The classic Krugman-Venables result of rise and fall of North-South gap is shown to hold in a weaker form. As Krugman-Venables themselves reflect aptly, North-South inequality is a very complex issue; any single model can hope to be only suggestive of some particular mechanisms at work. The same observation applies to North-South inequality as well as the intra-country wage differential considered in this paper, although a lot has been said on the latter issue lately. In analysing the movement of inter- and intra-country inequalities over different stages of globalization, this paper has captured the roles played by differences in the relative factor endowment and sizes between trading countries.

13 This is not meant to downplay the effects of agglomeration effects.

Appendix A

We prove here that $\rho^U > \rho^F$. From (12), ρ^U is an decreasing function of σ . Hence,

$$\rho^U > \lim_{\sigma \rightarrow \infty} \bar{L}_N^{1-\frac{\mu}{\sigma}} \left(\frac{Z_N}{\bar{L}_N} \right)^{\frac{\mu\beta}{\sigma-1}} = \bar{L}_N^{1-a} \bar{Z}_N^a,$$

where $a \equiv \mu\beta$. It is then sufficient to prove that $L_N^{1-a} \bar{Z}_N^a > \rho^F$; that is,

$$f(a) \equiv (1-a) \ln \bar{L}_N + a \ln \bar{Z}_N + \ln \left[1 - \frac{a(\bar{Z}_N - \bar{L}_N)}{\bar{Z}_N + 1} \right] - \ln \left[\bar{L}_N + \frac{a(\bar{Z}_N - \bar{L}_N)}{\bar{Z}_N + 1} \right] > 0,$$

in the interval $0 < a < 1$. It is straightforward to prove that $f''(a) < 0$, i.e. $f(\cdot)$ is strictly concave in a . Verify that $f(0) = f(1) = 0$. Thus, strict concavity of $f(a)$ implies that for any $a \in (0, 1)$, $f(a) > 0$.

Appendix B

We obtain the expressions (15) and (16) as follows. We first differentiate the system (4) and (7)–(8) with respect to T . Next, we substitute $T = 0$ and $L_{MN}^U/L_N = L_{MS}^U = \gamma$. Noting that $\hat{w}_R = \hat{L}_{MR}$, we obtain the following four equations of change.

$$(\sigma - 1)\hat{G}_N = (\sigma\beta - 1)\hat{w}_N - \frac{1}{\bar{L}_N^{1-\sigma\beta} \bar{Z}_N^{\sigma\beta}} dT \quad (\text{A1})$$

$$(\sigma - 1)\hat{G}_S = (\sigma\beta - 1)\hat{w}_S - \bar{L}_N^{1-\sigma\beta} \bar{Z}_N^{\sigma\beta} dT \quad (\text{A2})$$

$$\sigma\beta\hat{w}_N = \hat{Y}_N + (\sigma - 1)\hat{G}_N + \frac{\bar{Z}_N^{\sigma\beta}}{\bar{L}_N^{\sigma\beta}} dT \quad (\text{A3})$$

$$\sigma\beta\hat{w}_S = \hat{Y}_S + (\sigma - 1)\hat{G}_S + \frac{\bar{L}_N^{\sigma\beta}}{\bar{Z}_N^{\sigma\beta}} dT. \quad (\text{A4})$$

From the income expression in (5), at the autarky point,

$$\hat{Y}_N = \frac{\beta\gamma}{1 - \beta - \beta\gamma} \hat{w}_N = \mu\beta\hat{w}_N; \quad \hat{Y}_S = \mu\beta\hat{w}_S. \quad (\text{A5})$$

Substituting these into (A3) and (A4), respectively, and solving the resulting equations simultaneously give equations (15) and (16).

Appendix C

The expressions in (23) and (24) are obtained as follows. Differentiating (4) and (7) (8) with respect to T , using $\hat{w}_R = \hat{L}_{MR}$ and evaluating the derivatives at $T = 1$ give the following equations of change:

$$(\sigma - 1)\hat{G}_N = \frac{Z_N(\sigma\beta - 1)}{\bar{Z}_N + 1}\hat{w}_N + \frac{\sigma\beta - 1}{\bar{Z}_N + 1}\hat{w}_S - \frac{\hat{T}}{\bar{Z}_N + 1} \quad (\text{A6})$$

$$(\sigma - 1)\hat{G}_S = \frac{\bar{Z}_N(\sigma\beta - 1)}{\bar{Z}_N + 1}\hat{w}_N + \frac{\sigma\beta - 1}{\bar{Z}_N + 1}\hat{w}_S - \frac{Z_N\hat{T}}{\bar{Z}_N - 1} \quad (\text{A7})$$

$$\begin{aligned} \sigma\beta\hat{w}_N = & \frac{Y_N}{Y_N + Y_S}[\hat{Y}_N + (\sigma - 1)\hat{G}_N] \\ & + \frac{Y_S}{Y_N + Y_S}[\hat{Y}_S + (\sigma - 1)\hat{G}_S] + \frac{Y_S\hat{T}}{Y_N + Y_S} \end{aligned} \quad (\text{A8})$$

$$\begin{aligned} \sigma\beta\hat{w}_S = & \frac{Y_N}{Y_N + Y_S}[\hat{Y}_N + (\sigma - 1)\hat{G}_N] + \frac{Y_S}{Y_N + Y_S}[\hat{Y}_S + (\sigma - 1)\hat{G}_S] \\ & + \frac{Y_N\hat{T}}{Y_N + Y_S}. \end{aligned} \quad (\text{A9})$$

We now 'try' the expressions in (23) and (24) as solutions of these equations. It is straightforward to see that these solutions are consistent with each of equations (A6) and (A7). It remains to check that they are consistent with each of equations (A8) and (A9).

Note that the solutions (23) imply $\bar{Z}_N\hat{w}_N = -\hat{w}_S$. But at the free trade point, there is factor price equalization; that is, $w_N = w_S$. Hence, $\bar{Z}_N d\hat{w}_N = -d\hat{w}_S$. This is equivalent to $dY_N = -dY_S$, or

$$\frac{Y_N^E}{Y_N^E + Y_S^E}\hat{Y}_N + \frac{Y_S^E}{Y_N^E + Y_S^E}\hat{Y}_S = 0.$$

Using this relation, equations (A8) and (A9) reduce to

$$\sigma\beta\hat{w}_N = \frac{\sigma - 1}{Y_N^E + Y_S^E}(Y_N^E\hat{G}_N + Y_S\hat{G}_S) + \frac{Y_S^E\hat{T}}{Y_N^E + Y_S^E};$$

$$\sigma\beta\hat{w}_S = \frac{\sigma - 1}{Y_N^E + Y_S^E}(Y_N^E\hat{G}_N + Y_S\hat{G}_S) + \frac{Y_N^E\hat{T}}{Y_N^E + Y_S^E}.$$

Substituting our solutions (24) into this pair of equations gives

$$\sigma\beta\hat{w}_N = -\frac{(Y_N^E - Y_S^E)\hat{T}}{(Y_N^E + Y_S^E)(\bar{Z}_N + 1)}; \quad \sigma\beta\hat{w}_S = \frac{(Y_N^E - Y_S^E)\bar{Z}_N\hat{T}}{(Y_N^E + Y_S^E)(\bar{Z}_N + 1)}.$$

These are our solutions (23). Hence, our trial solutions are indeed the true solutions.

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