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Trade liberalization by less developed countries with a large market size: meager welfare gains?

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Abstract

In this paper we present a one-sector Dixit-Stiglitz-Krugman model of North-South trade, in order to evaluate the welfare and convergence implications of a gradual, bilateral trade liberalization. Using the same formal setting that generated the "new trade theory" wave, we show that a poorer and technologically disadvantaged South may diverge in welfare terms with the North, provided that its population and market size were large enough. Both regional blocks are shown to benefit from freer trade in absolute terms.

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1 Introduction[1]

Paul Krugman inaugurated a major research line in which scale economies and imperfect competition were the main modelling features that allowed for gains from international trade, even in the absence of any form of comparative advantage at the country level. Later on, several articles on "new trade theory" and "new economic geography" have addressed the welfare and convergence effects of higher trade freeness (see e.g. Das (2005), Charlot et al (2006), Behrens et al (2007),...).

Broadly speaking, the conclusions on welfare seem to be strongly assumption-and-model dependent: sometimes the welfare benefits of trade come after its costs; other times regional inequalities initially rise to eventually fall; other times disparities evolve in a monotonic fashion. Here we have explored the original modelling source of the literature, based on the one-sector Dixit-Stiglitz-Krugman model, to study analytically multiple implications of a *gradual* trade liberalization.

According to Krugman (1979), when we consider a one-sector economy under a monopolistically competitive market structure, a comparison between autarky and fully open trade between countries always yields welfare benefits for them. Under any possible level of trade costs (see e.g. Krugman (1980)) the country with the largest market will be more prosperous in terms of real wages (via a home-market effect); and all welfare differences between technologically symmentric countries will naturally disappear in the absence of trade costs. These findings suggest that a progressive trade liberalization may yield gradual convergence in terms of real wages. This convergence presumption has been often characterized as a "market size effect".

Our purpose in the present paper is proving that, if we incorporate to the analysis some technological asymmetries between countries, a range of parameter values is derived for which trade liberalization will lead to divergence in real wages. Consequently, we conclude here that countries with a sizeable market, due to a large labor force, but relatively lower levels of productivity and wellbeing (e.g. China today) will experience limited gains from barely liberalizing trade. To the extent that they had better take further advantage of parallel opportunities offered by globalization, like the diffusion of ideas or the international relocation of productive activities (see e.g. Baldwin (2016)).

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2 Main features of a well known model

The economy represented by the model consists of two countries: A and B. Their local populations (L_A and L_B) work in a single manufacturing sector and receive wages w_A and w_B, respectively. Let us denote by n_A (n_B), $p_A(p_B)$ and x_A (x_B) the existing number of product varieties, their prices and their individual output levels in country A (B).

Preferences and technology are characterized by the well-known Dixit-Stiglitz monopolistically competitive setting, with a CES utility function over manufacturing varieties and increasing returns to scale in production. In particular, let us denote by f_A (f_B) and m_A (m_B) the country-specific levels of fixed costs and marginal costs in terms of labor, respectively, exhibited by firms in country A (B).

The potential heterogeneity of firms with respect to marginal costs links our analysis with the literature spanned by Melitz (2003). Moreover, the constant elasticity of substitution between product varieties will be denoted by σ (> 1). Therefore, given the available technology in each country we can already advance as follows the local labor market-clearing conditions:

$$L_A = n_A\left(f_A + m_A x_A\right)\ ;\ L_B = n_B\left(f_B + m_B x_B\right) \tag{1}$$

Since the firms' pricing decision determines a constant markup over marginal costs, then necessarily $p_A = \frac{\sigma}{\sigma-1} m_A w_A$ and $p_B = \frac{\sigma}{\sigma-1} m_B w_B$. Given the assumption of free entry into the product markets and the abovementioned existence of fixed costs, the corresponding zero-profit-condition determines the equilibrium output per firm in each country (x_A and x_B):

$$\begin{array}{ll} \pi_A = \frac{m_A w_A x_A}{(\sigma-1)} - f_A w_A = 0, \text{ i.e.} & x_A = \frac{(\sigma-1) f_A}{m_A} \\ \pi_B = \frac{m_B w_B x_B}{(\sigma-1)} - f_B w_B = 0, \text{ i.e.} & x_B = \frac{(\sigma-1) f_B}{m_B} \end{array} \tag{2}$$

where π_A (π_B) stands for the net profits per firm in country A (B). Therefore, from (1) and (2),

$$n_A = \frac{L_A}{\sigma f_A};\ n_B = \frac{L_B}{\sigma f_B} \tag{3}$$

The measures of active manufacturing firms depend positively on the population size of the country and negative on the fixed costs. Both countries trade with each other and $\tau > 1$ stands for the iceberg trade cost parameter between A and B. By a trade balance condition, the local aggregate income must be equal to the revenue obtained by local firms. In particular, $w_A L_A = n_A p_A x_A = n_A \frac{\sigma}{\sigma-1} m_A w_A x_A$. Now we can use the fact that, taking into account the demand function for any variety,

$$
\begin{aligned}
L_A &= \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (4) \\
&= \frac{n_A L_A \left(\frac{\sigma}{\sigma-1} m_A w_A\right)^{1-\sigma}}{n_A \left(\frac{\sigma}{\sigma-1} m_A w_A\right)^{1-\sigma} + \delta n_B \left(\frac{\sigma}{\sigma-1} m_B w_B\right)^{1-\sigma}} + \frac{\delta n_A L_B \left(\frac{w_B}{w_A}\right) \left(\frac{\sigma}{\sigma-1} m_A w_A\right)^{1-\sigma}}{\delta n_A \left(\frac{\sigma}{\sigma-1} m_A w_A\right)^{1-\sigma} + n_B \left(\frac{\sigma}{\sigma-1} m_B w_B\right)^{1-\sigma}}
\end{aligned}
$$

where $\delta \equiv \tau^{1-\sigma}$ is the typical indicator of trade freeness associated with the iceberg specification. If we rearrange in (4) we will come to the conclusion that

$$
\theta = \frac{\theta}{1+\delta\, q} + \frac{(1-\theta)\,\delta\omega}{\delta+q} \tag{5}
$$

where we define $\omega \equiv \frac{w_B}{w_A}$, $\theta \equiv \frac{L_A}{L}$, $\bar{K} \equiv \left(\frac{1-\theta}{\theta}\right)\frac{f_A}{f_B}\left(\frac{m_B}{m_A}\right)^{1-\sigma}$ and $q \equiv \bar{K}\ \omega^{1-\sigma}$.

And then, solving implicitly for ω in (5), we can find that

$$
\omega = \left(\frac{\theta}{1-\theta}\right)\frac{q\,(q+\delta)}{(1+\delta q)}, \text{ where } q \equiv \bar{K}\omega^{1-\sigma} \tag{6}
$$

In order to obtain another useful, implicit characterization of the endogenous variable q it is possible to manipulate (6) and derive that

$$
q^{\sigma}\left(\frac{q+\delta}{1+\delta q}\right)^{\sigma-1} = \left(\frac{1-\theta}{\theta}\right)^{\sigma}\frac{f_A}{f_B}\left(\frac{m_B}{m_A}\right)^{1-\sigma} \tag{7}
$$

The variable q is an indicator of the market size in country B relative to country A. At this point, the following auxiliary Lemma 1 will be necessary to obtain our conditions for nominal and real con / - divergence between A and B (see Proposition 1).

Lemma 1: The expression (7) above characterizes implicitly the variable q as a function of all the exogenous parameters in our model (f_A, f_B, m_A, m_B, θ, σ, δ). It is possible to derive that $q < (>)\, 1$ if and only if $\frac{(1-\theta)^{\sigma}}{f_B m_B^{\sigma-1}} < (>) \frac{\theta^{\sigma}}{f_A m_A^{\sigma-1}}$, regardless of the level of δ.

Proof. See the Appendix ■

3 Conditions for trade-induced con / - divergence

Since we have already solved implicitly for the nominal, relative wage $\omega \equiv \frac{w_B}{w_A}$ in the expression (6), it is possible now to analyze the necessary and sufficient conditions for convergence in welfare levels, as a result of a gradual trade liberalization.

Let us denote by $\omega_R \equiv \omega \frac{I_A}{I_B}$ the relative welfare level (i.e. the relative real wage) of country B with respect to country A. The endogenous variables I_A and I_B refer to the relevant price indices in A and B, respectively. Firstly, we will restate the ratio of both price indices in terms of our variable q and our level of trade freeness (δ) as follows:

$$\frac{I_A}{I_B} = \left(\frac{n_A p_A^{1-\sigma} + \delta n_B p_B^{1-\sigma}}{\delta n_A p_A^{1-\sigma} + n_B p_B^{1-\sigma}} \right)^{\frac{1}{1-\sigma}} = \left(\frac{1+\delta q}{\delta + q} \right)^{\frac{1}{1-\sigma}} \tag{8}$$

Then, combining equations (6) and (8) above, we will come to the conclusion that $q < 1$ is both a necessary and a sufficient condition for country B's relative wage (ω) and relative welfare level (ω_R) to rise. However, our variable q is endogenous, so we need to use the previous Lemma 1 to establish the following result in terms of the parameters.

Proposition 1: A necessary and sufficient condition for both ω and ω_R to rise with a gradual trade liberalization, regardless of the initial level of δ, is

$$\theta > \frac{\left(\frac{f_A^{\frac{1}{\sigma}} m_A^{1-\frac{1}{\sigma}}}{f_B^{\frac{1}{\sigma}} m_B^{1-\frac{1}{\sigma}}} \right)}{1 + \left(\frac{f_A^{\frac{1}{\sigma}} m_A^{1-\frac{1}{\sigma}}}{f_B^{\frac{1}{\sigma}} m_B^{1-\frac{1}{\sigma}}} \right)} \tag{9}$$

Proof. See the Appendix. ■

It is straightforward to observe in (9) that, in the case of a symmetric technology for both countries ($f_A = f_B$ and $m_A = m_B$), convergence will be the rule since our country B will be smaller and poorer ($\theta > \frac{1}{2}$) and then it will gain in relative terms from trade liberalization. However, the possibility of differentiated technologies opens the way to new phenomena, which will allow for international divergence as will be emphasized in section 5.

Trade liberalization will enlarge the size of the foreign market available for each local variety, and this phenomenon will be especially significant for the country with the smallest internal market size. Therefore, the country B will gain (lose) relatively from trade liberalization when its local market size is smaller (bigger), i.e. when θ and / or their firms' fixed and variable costs are high (low) enough, which amounts to low (high) initial wages.

4 Welfare analysis

In order to analyze the effect of a gradual trade liberalization on the representative welfare levels in countries A and B, first we need to express the local real wages in terms of q and the parameters of the model. In particular,

$$\begin{aligned} \text{Welfare}_A &= \frac{w_A}{\left(n_A p_A^{1-\sigma} + \delta n_B p_B^{1-\sigma}\right)^{\frac{1}{1-\sigma}}} \\ \text{Welfare}_B &= \frac{w_B}{\left(\delta n_A p_A^{1-\sigma} + n_B p_B^{1-\sigma}\right)^{\frac{1}{1-\sigma}}} \end{aligned} \tag{10}$$

Let us take w_A as our numeraire ($w_A = 1$). Then it is possible to observe from (10) that Welfare_A will be increasing in δ if so is the term δq. Similarly, Welfare_B will be increasing in δ if so is the term $\frac{\delta}{q}$. Finally, it is possible to check from (7) that both circumstances necessarily happen, which is summarized by the following proposition.

Proposition 2: A marginal rise in trade freeness unambiguously increases the welfare levels in A and B, regardless of the initial level of trade costs.

Proof. See the Appendix. ■

Here both countries gain from freer trade in absolute terms because the international market grows larger for their firms and the demand for labor consequently rises. Moreover, imports become cheaper in both countries as well. Notice that, according to Proposition 1, *relative* welfare levels always evolve monotonically as δ increases. And absolute welfare levels rise in parallel.

Krugman (1979) presented two potential sources of gains from trade: a competitive reduction of markups and an expansion of product variety. He compared autarky with perfectly free trade. However, neither of these reasons for higher welfare levels appear in our model, which exhibits a gradual decrease in positive trade costs: the world mass of varieties stays constant (see (3)) and so does the typical markup. Therefore, our particular market size effect is a distinct motive that favors especially the smaller national markets.

5 Less developed countries with a large market size

From (6), (7) and (10) it is also possible to derive the following Lemma 2, which will become an essential ingredient for our final conclusions.

Lemma 2: When trade tends to become perfectly free (i.e. when $\delta \to 1^-$), the welfare level (equal to the real wage) in country B will be lower (higher) than the welfare level in country A, if and only if $f_B m_B^{\sigma-1} > (<)\ f_A m_A^{\sigma-1}$.

Proof. See the Appendix. ■

It is true that a more realistic picture of a less developed economy (our country B) could contain another productive sector, with a homogeneous primary good. However, the current industrialization of vast and heavily populated areas of the world (especially in East and South Asia) could make the conclusions from this one-sector model relevant in a forward-looking sense.

If our country B encompasses the largest market size due to its overwhelming population, although its wellbeing is scant due to the limits of its own technology, B would still gain from a trade liberalization, though at a lower rate than country A. The next Proposition 3 shows particular conditions for divergence at the last stages of trade liberalization.

Proposition 3: If trade freeness is sufficiently close to being perfect, the relatively poorer country B will diverge with respect to A, by further liberalizing trade, if and only if

$$1 < \frac{f_B m_B^{\sigma-1}}{f_A m_A^{\sigma-1}} < \left(\frac{1-\theta}{\theta}\right)^{\sigma} \tag{11}$$

Proof. See the Appendix ■

The last expression (11) just restates (9) in such a way that our country B exhibits the largest market size, though its wellbeing is lower due to a technological disadvantage. Therefore, further trade liberalization is followed by international divergence.

6 Conclusions

This paper tries to shed light, from a new trade theory perspective, on the welfare and convergence implications of bilateral trade reforms. To that purpose, we have chosen the simplest setting that gave rise to this novel wave of literature in the last four decades. And we have obtained insights that may have been overlooked, often in contrast to the implications of recent models. This fact suggests that the connection between trade and welfare is not yet settled in the literature, and requires further theoretical and empirical exploration.

7 References

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8 Appendix

Proof of Lemma 1:

In the expression (6) above it was established that $\omega = \left(\frac{\theta}{1-\theta}\right)\frac{q(q+\delta)}{(1+\delta q)}$, where $q \equiv \bar{K}\omega^{1-\sigma}$. Let us first make sure that this equilibrium relative wage is unique for every value of δ.

It is possible to observe that the right hand side of (6) is strictly decreasing in ω. Moreover, it becomes zero as ω approaches infinity and infinity as ω approaches zero, which implies that the continuous, strictly decreasing and differentiable function $G(\omega) = \left(\frac{1-\theta}{\theta}\right)\left(\frac{q(\omega)(q(\omega)+\delta)}{1+\delta q(\omega)}\right)$ has a single fixed point. Therefore, an equilibrium relative wage exists and is also unique for every value of δ.

Now our starting point is again the expression (7): $q^{\sigma}\left(\frac{q+\delta}{1+\delta q}\right)^{\sigma-1} = \left(\frac{1-\theta}{\theta}\right)^{\sigma}\frac{f_A}{f_B}\left(\frac{m_B}{m_A}\right)^{1-\sigma}$. Let $\bar{e} = \left(\frac{1-\theta}{\theta}\right)^{\sigma}\frac{f_A}{f_B}\left(\frac{m_B}{m_A}\right)^{1-\sigma}$. Notice that the implicit function $q(\delta)$ characterized in (7) is necessarily monotonic. Otherwise there would be several equilibrium values of ω and q for every value of δ, which is precluded by our previous uniqueness result.

Moreover, since from (6) $\frac{\frac{d\omega(\delta)}{d\delta}}{\omega} = -\left(\frac{1}{\sigma-1}\right)\frac{\frac{dq(\delta)}{d\delta}}{q}$, then it is possible to infer that

$$\begin{aligned}
&\forall\bar{e} < 1, \quad 1 > q\left(0\right) = \bar{e}^{\frac{1}{2\sigma-1}} > q(1) = \bar{e}^{\frac{1}{\sigma}}; \quad q\left(\delta\right)\left(\omega\left(\delta\right)\right) \text{ is monotone decreasing (increasing) in } \delta \\
&\forall\bar{e} > 1, \quad 1 < q\left(0\right) = \bar{e}^{\frac{1}{2\sigma-1}} < q(1) = \bar{e}^{\frac{1}{\sigma}}; \quad q\left(\delta\right)\left(\omega\left(\delta\right)\right) \text{ is monotone increasing (decreasing) in } \delta
\end{aligned} \tag{12}$$

Consequently, $q < (>) 1$ if and only if $\bar{e} = \left(\frac{1-\theta}{\theta}\right)^{\sigma}\frac{f_A}{f_B}\left(\frac{m_B}{m_A}\right)^{1-\sigma} < (>)\, 1$.

Proof of Proposition 1:

If we totally differentiate our expression (7) with respect to δ and use the implicit function theorem, we will end up getting that

$$\frac{\frac{dq}{d\delta}}{q} = \frac{-\left(\sigma-1\right)\left(1-q^2\right)}{\sigma\left(1+\delta q\right)\left(q+\delta\right)+\left(\sigma-1\right)q\left(1-\delta^2\right)} \tag{13}$$

And then, from (6) and (13),

$$\frac{d\omega}{d\delta} = \frac{\left(1-q^2\right)}{\sigma\left(1+\delta q\right)\left(q+\delta\right)+\left(\sigma-1\right)q\left(1-\delta^2\right)} \tag{14}$$

This implies that ω will increase if and only if $q < 1$, i.e. if $\left(\frac{1-\theta}{\theta}\right)^{\sigma}\frac{f_A}{f_B}\left(\frac{m_B}{m_A}\right)^{1-\sigma} < 1$, according to our previous Lemma 1.

Let us now consider the conditions for a rise in $\omega_R \equiv \omega\frac{I_A}{I_B}$. From (6) we know that

$$\omega = \left(\frac{\bar{K}}{q}\right)^{\frac{1}{\sigma-1}} \tag{15}$$

Taking into account (8) and (15), it is straightforward to derive that

$$\omega_R = \bar{K}\left(\frac{q+\delta}{q\left(1+\delta q\right)}\right)^{\frac{1}{\sigma-1}} \tag{16}$$

Using then (13), (14) and (16), we can conclude again that ω_R is increasing in δ if and only if $q < 1$, i.e. if $\left(\frac{1-\theta}{\theta}\right)^{\sigma}\frac{f_A}{f_B}\left(\frac{m_B}{m_A}\right)^{1-\sigma} < 1$.

Proof of Lemma 2:

From the expression (7) we can see that, for values of δ sufficiently close to one, $\lim_{\delta\to1} q = \left(\frac{1-\theta}{\theta}\right)\left(\frac{f_A}{f_B}\right)^{\frac{1}{\sigma}}\left(\frac{m_B}{m_A}\right)^{\frac{1-\sigma}{\sigma}}$.

Therefore, using our expression (6) as well, we conclude that $\lim_{\delta\longrightarrow1}\left(\omega\right) = \left(\frac{\theta}{1-\theta}\right)\lim_{\delta\to1} q = \left(\frac{f_A}{f_B}\right)^{\frac{1}{\sigma}}\left(\frac{m_A}{m_B}\right)^{\frac{\sigma-1}{\sigma}}$.

We can then infer that $\omega < 1$ if and only if $f_B m_B^{\sigma-1} > f_A m_A^{\sigma-1}$, provided that trade is sufficiently free. Exactly the same happens to the real wages, since both price indices will become identical as $\delta \to 1$.

Proof of Proposition 2:

Straightforward differentiating in (10) and considering (13) and (14).