Stages of Globalization, Inequality and Unemployment

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Abstract

To analyse the impacts of globalization upon inequality and unemployment in both advanced and emerging countries, we build a North-South HOS model with efficiency wages based on relative deprivation. Globalization is characterised by the South growing in size and significant differences in skill endowments between the two areas. We generate three stages of globalization depending on the size of the South and showing substantial divergences in terms of inequality, unemployment and productivity. The North is characterised by growing inequality and unemployment and by a decrease in productivity at the early stages of globalization. The South shows a decrease in inequality and unemployment at the first stage of globalization and growing inequality and/or unemployment at the later stage.

Key Words: Efficiency wage; Globalization; Inequality; Relative deprivation; Unemployment.

JEL Classification: E24, E25, F16.

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1. Introduction

This article analyses the impact of globalization upon inequality and unemployment in both advanced and emerging countries.

As regards advanced countries (the North), the impact of North-South trade upon growing inequality between skilled and unskilled workers was initially disputed because of its theoretical shortfalls (Krugman and Lawrence, 1993; Lawrence and Slaughter, 1993) and its lack of empirical evidence (Borjas et al, 1992; Katz & Murphy, 1992). This first diagnosis has subsequently been reconsidered on the basis of both new empirical works and new theoretical approaches (Chusseau et al., 2008, for a review). In this respect, one of the main arguments in favour of the impact of globalization upon Northern inequality is that, with the advent of China and India, the South has become a major actor in international trade and production, which was not the case in the eighties and early nineties (Krugman, 2007).

In the case of emerging countries (the South), the results of the literature on the impact of openness upon inequality are rather ambiguous (Anderson, 2005, and Chusseau & Hellier, forthcoming, for reviews). Until the early nineties, the reduction in inequality in East Asian countries (Krongkaew, 1994) appeared to confirm the Heckscher-Ohlin-Samuelson (HOS) prediction of a rise in the relative price of the abundant factor, i.e., unskilled labour in southern countries. This result has subsequently been disputed when considering (i) the developments in Latin America (Feenstra & Hanson, 1997; Green & Dickerson, 2001; Esquivel & Rodriguez-Lopez, 2003; Galiani & Sanguinetti, 2003; Lopez & Miller, 2008) and (ii) the fact that inequality has increased in most of the Asian countries since the mid-nineties (Ragayah, 2005). A number of recent empirical works conclude that openness has increased inequality in emerging countries (Berman & Machin, 2004; Milanovic, 2005; Conte & Vivarelli, 2007; Meschi & Vivarelli, 2009). Several theoretical explanations can account for these evolutions. When the southern country’s comparative advantage is based on natural resources, openness may increase inequality when these resources are in the hands of a minority (Leamer, 1987). When there is a continuum (or a large number) of goods with different skill intensity, the cornering of new more skill-intensive goods by the South prompts an increase in the demand for skill, and thereby in inequality (Feenstra & Hanson, 1996; Zhu & Trefler, 2005; Xu 2003). Finally, if openness results in the adoption by the South of northern technologies that require the use of more skilled labour, this can increase the skill premium and inequality in the South (Pissarides, 1997; Berman & Machin, 2000).

The impact of openness upon unemployment has been analysed within a HOS framework by Davis (1998) so as to explain the divergence between Europe and the US. In Davis’ model, Europe sets a minimum wage that moves the skill premium below its full employment value whereas the US lets market forces work. This shifts the world skill premium towards the European skill premium, thereby generating unemployment of the unskilled, all of which is located in Europe. Davis’ explanation can easily be extended to the case of North-South trade if northern countries prevent the increase of their skill premium through labour market institutions (minimum wage, collective bargaining etc.). This model nevertheless fails to account for situations in which the North and the South do not produce the same goods, i.e., when the two countries are not situated within the diversification cone.

The fair wage hypothesis provides another way to generate trade-driven unemployment in the North. Agell and Lundborg (1995) generate unemployment by introducing fair wage into a $2\times2\times2$ HOS model. Inserting an efficiency wage hypothesis inside a Heckscher-Ohlinian model with capital and labour, Albert & Merckl (2001) show that most of the HOS results are

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1 Dreher and Gaston (2008) also find that economic globalization has had a positive impact upon wage inequality in developing countries, but this impact is non significant.
preserved. However, neither of these approaches makes any distinction between skilled and unskilled labour, which makes them unsuitable for analysing the unemployment of unskilled workers due to North-South openness. Kreickemeier & Nelson (2006) propose a North-North HOS model with a fair wage-driven effort for both skilled and unskilled workers, the model being subsequently extended by the introduction of an unskilled labour-abundant South. These authors focus however on the intra-North disparities and interactions and not on the North-South differences. Egger & Kreickemeier (2009) analyse the effects of trade in a model with firm-specific fair wages. However, their model does not account for North-South differences and skill differences. In the approaches with two types of workers, the skilled and the unskilled, fair wages are typically defined following Akerlof & Yellen (1990) as a combination of the wage of the other group and the wage the worker expects to receive if s/he resigns and searches for another job\(^2\) (Kreickemeier & Nelson, 2006; Kreickemeier, 2008). However, another means of defining fair wage is to associate it with relative deprivation. In the case of advanced countries, the relative deprivation hypothesis rests upon a large body of empirical evidence and is used in a large number of works on inequality, migration and happiness (Clark & Oswald, 1996, Section 2 for a review). Several recent works have shown that it also applies to emerging countries (Rao, 2001; Narayan & Petesch, 2002; Senik, 2004; Ravallion & Lokshin, 2010). Consequently, in contrast with minimum wages, matching and bargaining stories that are better tailored to model imperfections in northern labour markets, relative deprivation based efficiency wage can account for wage rigidity in both advanced and emerging countries. When relative deprivation is based on the frustration provided by the situation of those who are better treated, this hypothesis links the reference wage that a worker considers to determine her/his effort to the deprivation s/he suffers from both the incomes and the number of those who earn more than s/he does.

Finally, the emergence of an inequality-unemployment trade-off in Northern countries has been analysed to explain the empirical observation of ‘jobless Europe versus penniless America’ (Krugman, 1994). For Krugman (1994, 1995) this trade-off comes from the different responses that have been given to the same increase in the relative demand for skilled workers. By preventing the related rise in the skill premium (inequality) through labour markets institutions, Europe has created unemployment whereas the US has allowed inequality to worsen. From a panel of Northern countries, Checchi & Garcia-Penalosa (2008) find that all the labour market institutions except the tax wedge generate an inequality unemployment trade-off, with albeit very different intensities. Within a HOS model with a continuum of goods, Hellier & Chusseau (2010) provide theoretical bases for the globalization-driven inequality unemployment trade-off and they show that this trade-off is more intense in those countries that were inequality-oriented at the outset of the globalization process. These analyses are however centred on Northern countries.

We introduce efficiency wages based on relative deprivation into a North-South HOS model so as to analyse the impact of globalization upon inequality and unemployment in both the North and the South. Globalization is defined by the growing size of the South and a significant difference in the relative endowments of skilled labour between the two areas. Three stages of globalization are put forward that correspond to the South being successively small, medium-sized and large. We find that the developments in the North and the South in terms of inequality, unemployment and productivity critically change according to the phase of globalization. In particular, inequality and/or unemployment decrease in the South and increase in the North during the first stage whereas they constantly increase in the South and remain unchanged in the North during the third stage. Productivity decreases in the North and

\(^2\)Akerlof & Yellen (1990) define the reference wage as a combination of the wage of the other group and the market clearing wage of the group the individual belongs to.
increase in the South during the first stage(s), and it decreases in the South and remains unchanged in the North over the last stage.

The article is original in several respects. It firstly analyses the impacts of globalization upon inequality and unemployment in both the North and the South within a unified framework. By introducing the growing size of the South as a key element of globalization, it secondly distinguishes three stages of the globalization process. It thirdly provides an analysis of the changes in inequality, unemployment and productivity in each of these three stages. It finally generates several outcomes that are consistent with certain observed developments. These include the increase in both inequality and unemployment and the slow down in productivity in the North as and when the South becomes large enough, and the reversal of the pro-equality trend at the later stages of globalization in the South.

Section 2 presents the model and its possible equilibria in autarky. Section 3 determines the three stages of globalisation. The changes in inequality, unemployment and productivity in each country at each stage are analysed in section 4. We discuss these findings and conclude in Section 5.

2. The model

We construct a North-South HOS model with efficiency wages based on relative deprivation.

2.1. General framework

There are two factors, skilled labour $H$ and unskilled labour $L$, two goods $h$ and $l$ that are respectively $H$-intensive and $L$-intensive, and two countries, the North ($N$) and the South ($S$), the former being relatively better endowed with skilled labour and the latter with unskilled labour. Markets for goods and factors are competitive.

Technologies are identical and the relative endowments $\lambda_i = L_i / H_i$, $i = N, S$, are constant in both the North and the South. These relative endowments are such that the wage of the unskilled $w_L$ is always lower than the wage of the skilled $w_H$, which indicates that the skill premium $\omega = w_H / w_L$ that measures inequality is always higher than 1. The working population is constant in the North. Conversely, we allow for an increase in the working population in the South, and thereby in the South’s endowments of both $H$ and $L$.

In both sectors, output is determined by the amount of skilled and unskilled labour utilised in production and by the effort made by workers. This effort depends on the difference between the wage a worker receives and a reference wage that denotes relative deprivation. Consequently, a worker decides on her/his effort by considering both the wages and the proportion in the working population of those who earn more that s/he does. In addition, a worker supplies one unit of labour time whatever her/his skill.

In line with the usual efficiency wage framework, we assume that firms cannot control the workers’ efforts but know their effort function. They can thereby determine the efficiency wage that maximises their profit. If the full employment wage is higher than the efficiency wage, the former stands out. In contrast, if the full employment wage is lower than the efficiency wage, firms enforce the latter and this results in unemployment.
2.2. Efficiency wage and efficiency skill premium

The production functions in sectors \( h \) and \( l \) are 
\[
Y_j = A_j (E_{Hj} \times H_j)^{1-\alpha_j} (E_{Lj} \times L_j)^{\alpha_j}, \quad j = l,h,
\]
where \( E_{ij} \) depicts the effort of \( i \)-workers, \( i = H,L \), in \( j \)-industry.

The utility function is similar to that presented by Kreickemeier and Nelson (2006), except in the definition of the reference effort. In both countries, workers maximise the same utility function
\[
U = v_1(x_H, x_L) - v_2(E), \quad \text{where } x_j \text{ is their consumption of good } j, \text{ } w \text{ their wage and } E \text{ the effort they provide, subject to the income constraint } w \geq p_j x_{jH} + p_j x_j, \text{ with } p_j \text{ the price of good } j, \text{ and to the non-negativity of effort } E \geq 0.
\]
We assume \( v_1 = (x_j)^{\beta} (x_{jH})^{1-\beta} \) so that each good accounts for a constant share of total expenditure in both countries and at the world level, i.e., \( \beta \) for good \( l \) and \( (1-\beta) \) for good \( h \). In addition, \( v_2(E) = (E - E^*)^2 \) depicts the disutility of effort above the reference value \( E^* \). We suppose \( E^* = \left( \frac{w - aq \bar{w}}{1 - aq} \right)^{\gamma} \) if \( w \geq aq \bar{w} \) and \( E^* = 0 \) if \( w < aq \bar{w} \), with \( \bar{w} \) the average wage of the workers who are better paid (and \( w = \bar{w} \) if nobody is better paid), \( q \) their proportion in the working population, \( 0 < \gamma < 1 \), and coefficient \( a \), \( 0 < a < 1/q \), depicting the deprivation intensity. It is assumed that \( a \) is the same in both countries. The maximisation of utility results in the following effort function:
\[
E(w) = \begin{cases} 
\left( \frac{w - aq \bar{w}}{1 - aq} \right)^{\gamma} & \text{if } w \geq aq \bar{w} \\
0 & \text{if } w < aq \bar{w}
\end{cases}
\quad (1)
\]

The interpretation of this result is as follows. The individual considers the wage of those who are the better paid. If s/he belongs to the better paid (\( w = \bar{w} \)), s/he makes the maximum effort \( E(\bar{w}) = (\bar{w}/\bar{w})^{\gamma} = 1 \). In the opposite case (\( w < \bar{w} \)), s/he reduces her/his effort \( E(w) = \left( \frac{w - aq \bar{w}}{1 - aq} \right)^{\gamma} = \left( 1 - \frac{\bar{w} - w}{(1 - aq) \bar{w}} \right)^{\gamma} \) by an amount that increases with the difference \( \bar{w} - w \) between the wage of the better paid and her/his wage. This denotes the punishment the worker inflicts upon the employer for being unfair to her/him, which lies at the very core of the fair wage hypothesis. If \( w \leq aq \bar{w} \), the pay is considered so unfair that the worker provides zero effort. Finally, function \( E(w) \) varies between 0 and 1 and decreases in both \( \bar{w} \) and \( q \), which establishes a relative deprivation behaviour.

It can be easily verified that skilled workers provide the maximum effort\(^3\): \( E(w_H) = 1 \).

The effort of the unskilled \( E(w_L) \) is determined by:
\[
E(w_L) = \begin{cases} 
\left( \frac{w_L - aq_H w_H}{(1 - aq_H) w_H} \right)^{\gamma} & \text{if } w_L \geq aq_H w_H \\
0 & \text{if } w_L < aq_H w_H
\end{cases}
\quad (2)
\]
with \( q_H = H / (L + H) < 1 \), which shows that \( q_H w_H \) is always lower than \( w_H \).

\(^3\) For the skilled workers, \( q = 0 \) and \( w = \bar{w} = w_H \).
The firms in country $i$ and sector $j$ firstly determine the unskilled workers’ efficiency wage $w^e_{ij}$ (equal in both industries, see hereafter) that maximises their profit

$$
\pi^j = p_j Y^j - w^H_j H^j - w^L_j L^j \text{ such that } Y^j = A_j H^j^{1-\alpha_j} \left( E_i(w^L_i) \times L^j \right)^{\alpha_j}
$$

and $E_i(w^L_i) = \left( \frac{w^L_i - a \bar{q}^H_i w^H_i}{(1 - a \bar{q}^H_i) w^H_i} \right)^\gamma$. If the market forces determine a full employment wage that is higher than $w^e_{ij}$, then the full employment wage stands out. If the full employment wage is lower than the efficiency wage, then the firms enforce the latter.

**Definition:** The *efficiency skill premium* is the ratio of the skilled workers’ wage $w^H_i$ to the efficiency wage determined by the firms.

In country $i$ and sector $j$, the firms’ maximisation programme generates the following values of the efficiency wage $w^e_{ij}$, the efficiency skill premium $\omega^e_i = w^H_i / w^e_{ij}$ and the optimal effort $E^e_i$ (calculations in Appendix A):

$$
w^e_{ij} = \frac{a}{1 - \gamma} \bar{q}^H_i w^H_i \quad (3)
$$

$$
\omega^e_i = \frac{1 - \gamma}{a \bar{q}^H_i} = \frac{1 - \gamma}{a} (1 + \lambda_i) \quad (4)
$$

$$
E^e_i = \left( \frac{\gamma}{1 - \gamma - a \bar{q}^H_i} \right)^\gamma = \left( \frac{\gamma}{1 - \gamma 1 - a + \lambda_i} \right)^\gamma \quad (5)
$$

Remarks:

1. The efficiency wage, the efficiency skill premium and the corresponding effort are identical in both sectors.
2. We henceforth suppose that $\bar{q}^H_i < (1 - \gamma) / a$ which is the condition for $\omega^e_i > 1$.
3. Since firms never pay unskilled workers below the efficiency wage, the skill premium never exceeds its efficiency value $\omega^e_i$. As a consequence:

**Lemma 1:** Let $\hat{\omega}_i$ be country $i$’s full employment skill premium. Then, country $i$’s skill premium at the equilibrium is $\omega^*_i = \min \{ \hat{\omega}_i, \omega^e_i \}$.

4. The higher the proportion of skilled workers inside a country, the lower this country’s efficiency skill premium ($\partial \omega^e_i / \partial \bar{q}^H_i < 0$), and since $\bar{q}^N_i > \bar{q}^S_i$:

**Lemma 2:** The efficiency skill premium is higher in the South than in the North: $\omega^e_S > \omega^e_N$. 

2.3. Equilibria in autarky

In autarky the model generates the following full employment skill premium (Appendix B):

\[
\hat{\omega}_i^A = \frac{1 - \alpha}{\alpha} \bar{\omega}_i^A = \frac{1 - \alpha}{\alpha} \frac{1 - \bar{q}_H^i}{\bar{q}_H}, \quad i = N, S
\]

with \( \alpha = \beta \alpha - (1 - \beta) \alpha_h \).

Given the comparative advantages \( \bar{x}_S > \bar{x}_N \), the full employment skill premium is higher in the South than in the North in autarky:

\[ \hat{\omega}_S^A > \hat{\omega}_N^A \]

**Lemma 3:** Consider country \( i \) in autarky with the proportion \( \bar{q}_H^i \) of skilled labour in its working population. This country is at its full employment skill premium \( \hat{\omega}_i^A \) if \( \bar{q}_H^i \geq q_H^* \), and it is at its efficiency skill premium \( \omega_i^{eff} \) and exhibits unemployment of unskilled labour if \( \bar{q}_H^i < q_H^* \), with \( q_H^* = 1 - \frac{\alpha(1 - \gamma)}{a(1 - \alpha)} \).

**Proof.** see Appendix C.

As usual in efficiency wage models, when the full employment skill premium \( \hat{\omega}_i^A \) is higher than the efficiency skill premium \( \omega_i^{eff} \), this generates unemployment of unskilled workers.

From Lemmas 1, 2, 3 and inequality \( \bar{q}_H^N > \bar{q}_H^S \), we derive the following proposition:

**Proposition 1:** In autarky, country \( i \)'s skill premium is \( \omega_i^* = \min \{ \hat{\omega}_i^A, \omega_i^{eff} \} \), \( i = N, S \), and three situations only are possible:

1) Full employment in both the North and the South with \( \omega_N^* = \hat{\omega}_N^A \) and \( \omega_S^* = \hat{\omega}_S^A \) if \( \bar{q}_H^N > \bar{q}_H^S \geq q_H^* \).
2) Full employment in the North and underemployment of the unskilled in the South with \( \omega_N^* = \hat{\omega}_N^A \) and \( \omega_S^* = \omega_S^{eff} \) if \( \bar{q}_H^N > q_H^* > \bar{q}_H^S \).
3) Underemployment of the unskilled in both the North and the South with \( \omega_N^* = \omega_N^{eff} \) and \( \omega_S^* = \omega_S^{eff} \) if \( q_H^* > \bar{q}_H^N > \bar{q}_H^S \).

Both countries being in autarky, Proposition 1 shows that if the South is at full employment, then the North is at full employment as well, whereas the North being at full employment can come with full employment or under employment in the South.
3. The stages of Globalization

We introduce globalization with free trade between the North and the South.

3.1. Globalization

The globalization process is characterised by:

1) An increase with time in the size (working population) of the South whereas the size of the North remains unchanged. Assuming a growing size of the South aims at portraying the fact that new southern regions and countries continuously enter the globalised economy, and that this process comes to an end once the whole world has joined this economy. We also suppose that the size of the South is negligible at the outset of the globalization process, and that the North becomes minute compared to the South at its conclusion. This results in the world factors endowment being that of the North at the beginning, and that of the South at the final stage of globalization.

2) The difference in the relative factor endowments is large enough to place the South outside the diversification cone (henceforth D-cone) for the world full employment skill premium at the beginning of the globalization process, and to place the North outside the cone for the world full employment skill premium at the conclusion of globalization\(^4\). The condition for this is

\[
\frac{\bar{\lambda}_S}{\bar{\lambda}_N} > \max \left\{ \frac{\alpha_i}{1-\alpha_i} \frac{1-\alpha_h}{\alpha_h} \right\} \text{ (see Appendix D, Section 2)}.
\]

This aims at portraying the large divergence in skill relative endowments between advanced and emerging countries that characterises the globalisation process.

We also assume that:

1. The South is at full employment when producing good \(l\) only, which implies that its full employment skill premium when producing \(l\) only is lower than its efficiency skill premium:

\[
\hat{\omega}_S^l < \omega_S^{\text{eff}} \tag{7}
\]

This does not mean that there is no unemployment in developing countries when the South produces \(l\) only, but that the regions that are inserted in the world economy and thereby participate in the globalisation process are at full employment when they only produce good \(l\).

2. The North is at full employment at the outset of the globalization process, which indicates that its autarkic full employment skill premium is below its efficiency skill premium. In contrast the South can, either be at full employment, or suffer unemployment of the unskilled at the start of globalization (Proposition 1).

3. The North suffers unemployment when producing good \(h\) only, and unemployment appears for a distribution of its production between the two goods with a non-zero production of \(l\). This indicates that its efficiency skill premium is lower than its full employment skill premium when producing good \(h\) only. Assumptions 2 and 3 entail:

\[
\hat{\omega}_N^h < \omega_N^{\text{eff}} < \hat{\omega}_N^h \tag{8}
\]

The release of these assumptions is discussed in Section 5

We finally suppose that relative deprivation is domestically determined, i.e., that unskilled workers consider the wage and the proportion of skilled workers inside their own country when determining their effort. This indicates that the efficiency skill premia \(\omega_i^{\text{eff}}, i = N,S,\) as

\(^4\) See the definition of the diversification cone in Appendix D, Section 1.
determined by equation (4) hold in autarky as well as in North-South openness. Consequently, efficiency skill premia are constant during the whole globalization process (as $\lambda_i$ is constant).

The full employment skill premium at the world level is (Appendix B):

$$\hat{\omega}_w = \frac{1 - \alpha}{\alpha} \bar{\lambda}_w$$

(9)

with $\bar{\lambda}_w = \bar{L}_w / \bar{H}_w$, $\bar{L}_w = \bar{L}_N + \bar{L}_S$ and $\bar{H}_w = \bar{H}_N + \bar{H}_S$.

As $\bar{L}_N / \bar{H}_N < \bar{L}_w / \bar{H}_w < \bar{L}_S / \bar{H}_S$, then:

$$\hat{\omega}_N^A < \hat{\omega}_w < \hat{\omega}_S^A,$$

with $\hat{\omega}_i^A$ being the autarkic full employment skill premium of country $i$ as defined by (6).

Hereafter, country $i$‘s full employment skill premium is denoted $\hat{\omega}_i$, the world full employment skill premium when both countries produce both good $\hat{\omega}_w$, and country $i$‘s full employment skill premium when $i$ produces good $j$ only $\hat{\omega}_i^j$ with:

$$\hat{\omega}_i^j = \frac{1 - \alpha_i}{\lambda_j} \bar{\lambda}_i, \ i = N,S, \ j = h,l.$$

(10)

It must be noted that:

1) The full employment skill premia $\hat{\omega}_i, i = N,S,W$, are changing over time with globalisation.

2) The values $\hat{\omega}_i^{eff}$, $\hat{\omega}_i^A$ and $\hat{\omega}_i^j$ are constant over time and fully determined by the model parameters and the given relative endowments.

3) $\hat{\omega}_i^j < \hat{\omega}_i^A < \hat{\omega}_i^h$, $i = N,S$, since both countries produce both goods in autarky.

At the outset of globalization, the size of the South negligible and thus $\hat{\omega}_w = \hat{\omega}_N^A$. At the end of the globalization process, the North becomes minute compared to the South and thus $\hat{\omega}_w = \hat{\omega}_S^A$. As a consequence, the world full employment skill premium $\hat{\omega}_w$ moves from $\hat{\omega}_N^A$ up to $\hat{\omega}_S^A$ throughout the globalization process. Figure 2 depicts this development when the North is at full employment and the South suffers underemployment in autarky.

$\hat{\omega}_N^A \quad \hat{\omega}_N^{eff} \quad \hat{\omega}_S^{eff} \quad \hat{\omega}_S^A$

$\hat{\omega}_w$

Globalization

Figure 1. The globalization process

The Southern relative endowment $\bar{\lambda}_S$ and the Northern endowments $\bar{L}_N$ and $\bar{H}_N$ being constant, an increase in the weight of the South results in an increase in the world relative endowment $\bar{\lambda}_w \equiv \bar{L}_w / \bar{H}_w$ because the South is the unskilled labour abundant country. As the diversification cone is determined by the two lines $L = \frac{\alpha_i}{1 - \alpha_i} \hat{\omega}_w H$ and $L = \frac{\alpha_h}{1 - \alpha_h} \hat{\omega}_w H$
(Appendix D, Section 1), and since \( \hat{\alpha}_W = \frac{1 - \alpha}{\alpha} \lambda_W \) (Relation 9), the increasing size of the South entails a rise in \( \hat{\alpha}_W \) and thereby a rotation to the left of the diversification cone (Figure 1). In addition, since the Southern relative endowment remains constant, the growing size of the South may be represented by an upward translation of its endowments \((\overline{H}_S, \overline{L}_S)\) along the line \( L = \overline{\lambda}_S H \) (Figure 2).

![Figure 2. Globalization, the diversification cone and factor endowments](image)

In Figure 2, the globalization process is thus depicted (i) by an upward displacement of the South along the line \( L = \overline{\lambda}_S H \), (ii) by a rotation to the left of the diversification cone, and (iii) by an immobility of the factor endowments of the North \((\overline{H}_N, \overline{L}_N)\).

### 3.2. The three stages

**Proposition 2:** Globalization is characterised by three successive stages such that:

1) **The North produces both goods and the South good \( l \) only during the first stage.**

2) During the second stage, either both countries produce both goods, or the North produces \( h \) only and the South \( l \) only.

3) **The North produces good \( h \) only and the South both goods during the third stage.**

The way the increasing size of the South generates the three successive stages as well as the different possible configurations of each stage are analysed and discussed in Appendix E.

Since the successive stages are generated by the increase in the size of the South, we call the first stage ‘Small South’, the second stage ‘Medium-sized South’ and the third stage ‘Large South’. Each stage is thus characterised by both the size of the South and the corresponding specialisation of each country in the production of goods.

Figures 3-5 depict the position of each country in relation to the diversification cone at each stage of the globalization process.
Figure 3. Small South

Figure 4. Medium-sized South

Figure 5. Large South
Stage 1 firstly corresponds to the North being inside the cone and producing both goods, whereas the South stands outside the cone, producing thereby good $l$ only (Figure 3a). But the first stage can continue even when both countries are inside the D-cone (Figure 3b). This is when the North is at its efficiency skill premium and the South cannot attain full employment at this skill premium even when producing good $l$ only (the South is situated above line $L = \alpha l, \omega N l H / (1 - \alpha)$ and thus $\omega N l < \hat{\omega} l$). Then, the skill premia of the North and the South cannot equalise and both countries cannot produce both goods simultaneously. Thus, as long as the South is not sufficiently large for its production to meet the world total demand for good $l$, the South produces $l$ only and the North both goods.

At the second stage, the South becomes large enough so that, either both the North and the South produce both goods, or the South produces good $l$ only and the North good $h$ only. In the former case, both the North and the South are inside the cone and they share the same skill premium (Figure 4a). The latter case typically occurs when both countries are outside the D-cone (Figure 4b). There are however two cases in which the second stage with each country producing one good only is limited to one point of time corresponding to the passage from stage 1 to stage 3. This firstly happens when lines $L = \frac{\alpha}{1 - \alpha} \hat{\omega} H$ and $L = \lambda S H$ merge at the same time as lines $L = \frac{\alpha}{1 - \alpha} \hat{\omega} H$ and $L = \lambda H$, which is unlikely. It also happens in the case already mentioned where both countries are still in the first stage when being both inside the D-cone because they cannot produce both goods at the same time (see above). With the South growing in size, the North production of $l$ diminishes and a moment comes when the North produces $h$ only and the South both goods, i.e., stage 3. Then, the passage from stage 1 to stage 3 goes through the moment (point of time) when the North produces $h$ only and the South $l$ only.

At the third stage of globalization, the South becomes sufficiently large to produce both goods with the North producing good $h$ only. Line $L = \lambda S H$ is inside the cone and the Northern endowments $(\lambda N, \lambda H)$ outside (Figure 5).

**Proposition 3.** During the globalization process:

1) If $\hat{\omega} S < \omega N S < \hat{\omega} H$, then (i) the North remains at its full employment skill premium during stage 1 and (ii) both countries produce both goods during stage 2, with the world skill premium $\hat{\omega}$ firstly increasing and subsequently remaining at value $\omega N S$.

2) If $\omega N S < \hat{\omega} S < \hat{\omega} H$, then the North attains and subsequently remains at its efficiency skill premium during stage 1, and there is one sole point of time, corresponding to the passage from stage 1 to stage 3, when the North produces $h$ only and the South $l$ only.

3) If $\omega N S < \hat{\omega} S < \hat{\omega} S$, then the North skill premium increases to attain its efficiency value and subsequently remains at this value during stage 1, and the North produces $h$ only and the South good $l$ only during stage 2.

4) During stage 3, the North remains at its efficiency skill premium and the southern skill premium increases from $\hat{\omega} S$ to $\hat{\omega} H$ if $\omega N S > \hat{\omega} S$, and from $\hat{\omega} S$ to $\hat{\omega} S$ if $\omega N S > \hat{\omega} S$.

**Proof.** Appendix E.

Proposition 3 provides the conditions for each possible configuration of globalization.
4. Inequality, unemployment and productivity

We analyse the changes in inequality, unemployment and productivity in both the North and the South during the three stages of globalisation. We start from the different configurations defined in Proposition 3 and we apply the following features determined above:

1) When a country is at its efficiency skill premium, the latter being lower than its full employment skill premium, this entails unemployment of the unskilled in the country, and an increase in the difference between the full employment and the efficiency skill premium raises unemployment.

2) An increase (decrease) in the skill premium entails a decrease (increase) in unskilled workers’ effort.

3) An increase (decrease) in unskilled workers’ effort entails an increase (decrease) in productivity.

Tables 1-3 depict the developments in inequality, unemployment and productivity during the first two stages of globalization for each possible configuration. Table 4 depicts these developments at stage 3 since they are the same in the three configurations.

---

Table 1. The case $\hat{\omega}_k^l < \omega_N^{\text{eff}} < \hat{\omega}_k^N$

<table>
<thead>
<tr>
<th>Stages</th>
<th>Inequality (skill premium)</th>
<th>Employment / Unemployment</th>
<th>Productivity (effort)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>The North produces both goods and the South l only</strong></td>
<td>North. Continuously increasing. &lt;br&gt; South. Constant $\hat{\omega}_S^l$, lower than in autarky.</td>
<td>North. Full employment &lt;br&gt; South. Full employment</td>
</tr>
<tr>
<td>2</td>
<td><strong>Both countries produce both goods</strong></td>
<td>North. Increasing at first and constant $\omega_N^{\text{eff}}$ afterwards. &lt;br&gt; South. Increasing at first, and constant $\omega_N^{\text{eff}}$ afterwards</td>
<td>North. Full employment at first; continuously rising unemployment as soon as $\omega_N^{\text{eff}}$ is attained. &lt;br&gt; South. Full employment</td>
</tr>
</tbody>
</table>

Table 2. The case $\omega_N^{\text{eff}} < \hat{\omega}_S^l < \hat{\omega}_k^N$

<table>
<thead>
<tr>
<th>Stage</th>
<th>Inequality (skill premium)</th>
<th>Employment / Unemployment</th>
<th>Productivity (effort)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>The North produces both goods and the South l only</strong></td>
<td>North. Increasing at first and constant $\omega_N^{\text{eff}}$ afterwards. &lt;br&gt; South. Constant $\hat{\omega}_S^l$, lower than in autarky.</td>
<td>North. Full employment at first; continuously rising unemployment as soon as $\omega_N^{\text{eff}}$ is attained. &lt;br&gt; South. Full employment</td>
</tr>
</tbody>
</table>

---

$^5$ We thus consider apparent total factor productivity.
Table 3. The case $\omega_N^\text{eff} < \omega_S^\text{eff} < \omega_S^A$

<table>
<thead>
<tr>
<th>Stage</th>
<th>Inequality (skill premium)</th>
<th>Employment / Unemployment</th>
<th>Productivity (effort)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>The North produces both goods and the South l only</strong></td>
<td><strong>North.</strong> Increasing at first and constant $\omega_N^\text{eff}$ afterwards. <strong>South.</strong> Constant $\omega_S^l$, lower than in autarky.</td>
<td><strong>North.</strong> Decreasing at first and constant after. <strong>South.</strong> Constant and higher than in autarky (highest possible for $\lambda_S$)</td>
</tr>
<tr>
<td>2</td>
<td><strong>The North produces h only and the South produces l only</strong></td>
<td><strong>North.</strong> Constant $\omega_N^\text{eff}$ <strong>South.</strong> Constant $\omega_S^l$</td>
<td><strong>North.</strong> Constant highest possible unemployment for $\lambda_S$ <strong>South.</strong> Full employment.</td>
</tr>
</tbody>
</table>

Table 4. The developments in stage 3

<table>
<thead>
<tr>
<th>Stage</th>
<th>Inequality (skill premium)</th>
<th>Employment / Unemployment</th>
<th>Productivity (Effort)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td><strong>The North produces good h and the South both goods</strong></td>
<td><strong>North.</strong> Constant $\omega_N^\text{eff}$ <strong>South.</strong> Continuous increase if $\omega_N^\text{eff} &gt; \omega_S^k$; increase at first and constant $\omega_S^\text{eff}$ after if $\omega_N^\text{eff} &lt; \omega_S^k$</td>
<td><strong>North.</strong> Constant with effort $E(\omega_N^\text{eff})$ <strong>South.</strong> Continuous increase if $\omega_N^\text{eff} &gt; \omega_S^A$ and increase at first and constant as soon as $\omega_N^\text{eff}$ is attained if $\omega_N^\text{eff} &lt; \omega_S^A$.</td>
</tr>
</tbody>
</table>

The developments in inequality at each stage of globalization and for each configuration directly stem from Proposition 3 (see the analyses in Appendix E).

The developments in unemployment and productivity are straightforward given the features recalled at the beginning of section 4.

However, one point deserves to be discussed, i.e., the fact that the South remains at full employment in the second stage of globalization when both countries produce both goods (case $\omega_S^l < \omega_N^\text{eff} < \omega_S^k$, Table 1) even when its skill premium is $\omega_N^\text{eff}$, which is lower than the world full employment skill premium. In fact, it is the North that imposes this lower skill premium, whereas the skill premium can increase in the South since $\omega_N^\text{eff} < \omega_S^A$. We are thus in the same situation as that analysed by Davis (1998), except that it is the northern firms that enforce the skill premium $\omega_N^\text{eff}$ here whereas this is enforced by the government in Davis’ model. Consequently, and for the same reason as in Davis (1998), the world unemployment generated by the skill premium $\omega_N^\text{eff}$ is totally located in the country that imposes the lower skill premium, i.e., the North.

From the developments depicted in Tables 1-4, it is clear that:

1) During the first stage(s) of globalization, the North suffers growing inequality, growing unemployment as well as a decline in productivity (effort), whereas the South benefits from lower inequality (compared to autarky), full employment and a rise in productivity.
2) The last stage of globalization is characterised by steady inequality, unemployment and effort in the North, and by growing inequality and/or unemployment and declining productivity in the South.

5. Discussion and conclusion

The main findings of the model are firstly discussed in the light of the observed developments. We subsequently relax the assumption of constant skill endowments and explore the impacts of skill upgrading. We finally come back to certain simplifying assumptions and examine the effects of their waiving, which opens new fields of research.

5.1. The main findings facing observed facts

We compare the model’s predictions with the observed developments in the forty last years.

A first diagnosis must be made concerning the beginning and the present stage of the globalisation process. We suppose that globalisation has begun in the mid or late sixties, when the first wave of NICs (New Industrialised Countries) decided to lean their economic development on exports to advanced countries. Then came a second wave of NICs in the seventies/eighties. Globalization has accelerated in the nineties and 2000s with the development of China and India as major actors of the world economy. Finally, considering (i) that unskilled-intensive manufactured goods are no longer produced in northern countries (Japan, the US and Western Europe), and (ii) that southern countries do not produce skill intensive goods yet, we can suppose that we are now in the second stage of globalisation with each country producing one good only.

Certain predictions of the model clearly fit with the observed developments, whereas others appear more controversial. The confirmed predictions comprise growing inequality and growing unemployment in the North during the first stage(s) of globalisation. The fall in productivity due to lower effort can provide an additional explanation to the productivity (Solow) paradox that occurred in the eighties and early nineties in advanced countries. The model also predicts the substantial increase in productivity observed in emerging countries when they join the globalized economy.

Certain results concerning the South are more disputable.

Firstly, unemployment still exists in emerging countries. However, as already mentioned, the South must not be understood as a sum of countries, but rather as an aggregate of regions that are inserted into the globalised economy. This means that the areas that are still specialised in traditional sectors (subsistence agriculture, traditional craft industries) do not belong to the South as defined here. There is however a situation in which unemployment can persist in certain southern regions even when they are fully globalized and they only produce good 1. This is when there is a high flow of low skilled workers who migrate to certain globalized areas. In this case, the induced fall in skill endowment can move the southern full employment skill premium above the southern efficiency skill premium, and create thereby unemployment in the South. This case is not analysed here because we draw attention to the South as a whole and do not account for migrations.

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6 By assuming this, we consider that the first wave of NICs (Korea, Hong Kong, Singapore and Taiwan) no longer belongs to the South. In addition, if China is present in skill-intensive industries (ICT) its production is still concentrated in unskilled intensive segments (Krugman, 2008).

7 Harris and Todaro (1970) have shown that immigration can create unemployment when the benefit from migrating is high enough to offset the decrease in the expected return resulting from unemployment.
Another questionable result is the decrease in inequality in the South at the first stage(s) of globalisation. This is consistent with East Asia in the eighties and early nineties, but not with the experiences of Latin America, China and even East Asia from the mid-nineties. Both the theoretical and empirical literatures point to the globalization-induced technological transfers from the North to explain these increases in inequality. By inserting such transfers in the model, we could easily generate two situations. Inequality augments in the South when the imported technology in sector $l$ is sufficiently skill-intensive to increase the demand for skilled worker after North-South openness (the South producing $l$ only with the northern technology) compared to autarky (the South producing both goods with its own technology). In the opposite case, inequality decreases in the South at the first stage of globalization. As a consequence, the model can easily be modified to generate the two cases observed in the reality.

Finally, the model provides several predictions for the last stage of globalization. This concerns future developments. However, as certain early emerged economies have gone up the skill intensity ladder, some of them having even integrated the North (Korea, Taiwan, Singapore), one can draw on these experiences to diagnose the main characteristics of stage 3. In this respect, three observed developments are in line with the model’s results. Firstly, even with a large increase in their skill endowments, these countries have experienced increasing inequality since the mid-nineties. Secondly, the rhythm of growth of their productivity has decreased compared to the seventies and eighties, even if this growth is still elevated. Thirdly, these countries’ production structures have moved from purely unskilled-intensive sectors to increasingly skill intensive ones. These features can be seen as indications that the mechanisms generated by the model have operated, even if other factors may also explain these development (public policies, skill upgrading, technological catch-up etc.).

5.2. Skill upgrading

We have assumed unchanged skill endowments in both areas. For the South, this assumption is justified by the fact that new areas with a high proportion of low skilled labour continuously join the globalized economy. However, all northern countries have known significant increases in their skill endowments for the thirty last years. Similarly, the education policy implemented in China since the late nineties has substantially increased the number of students in tertiary education, which will result in skill upgrading of the working population.

Globalization itself can generate endogenous changes in skill endowments. Since the seminal work of Findlay and Kierzkowski (1983), the impact of trade upon skill accumulation has been abundantly analysed. Two opposite mechanisms have been put forward. Firstly, North-South trade induces a rise in the skill premium in the North and a decrease in the South, which fosters skill accumulation in the former and discourages it in the latter, reinforcing thereby the initial comparative advantages (Findlay and Kierzkowski, 1983; Borsook, 1986). On the other hand, trade favour the North-South convergence in skill endowments because skilled labour is the main factor used in education. By increasing the skill premium, openness raises the cost of education and hinders education in the North, and the opposite mechanism operates in the South (Cartiglia, 1997; Eicher, 1999). Finally, globalization can encourage northern governments to support education so as to adapt their economies.

The influence of globalization on endogenous skill accumulation is not analysed here. We only assume exogenous rises in the countries’ skill endowments and discuss their impact upon inequality and unemployment.
An increase in the skill endowments in the North and/or in the South decreases ratio $\lambda_i$, $i = N$ and/or $S$, and thereby the world relative endowment $\lambda_W = \overline{W}_W / \overline{H}_W$. This reduces the world full employment skill premium. It also reduces the efficiency skill premium as well as the full employment skill premia in the country in which skill upgrading occurs. Finally, the increase in the skill endowment of the North and/or the South always reduces inequality in both countries, except in the case of a country that (i) produces one good only and (ii) knows no change in its skill endowment.

The impact of skill upgrading upon unemployment is less obvious because a decrease in $\lambda_i$, $i = N,S$, lowers both the efficiency skill premium and the full employment skill premium in country $i$. The possible cases are many and they depend on the stage and shape of globalization, on the country(ies) that experience(s) skill upgrading, and on its intensity. It can however been shown that the increase in one country’s skill endowment can lead to three possible outcomes: (i) a decrease in unemployment in both countries; (ii) a decrease in unemployment in the country that experience skill upgrading without impact on the other country’s employment; (iii) no change in (un)employment in both countries.

5.3. Assumptions and further researches

We now reconsider certain simplifying assumptions.

We have assumed that the South is at full employment when producing good $l$ only ($\hat{e}_S^l < \omega^S_l$). In the opposite case, the South remains at its efficiency skill premium and suffers unemployment throughout the globalization process. The lowest unemployment occurs in the first stage(s) of globalisation, and unemployment subsequently increases when and as the South begins to produce good $h$.

We have also supposed that the North is at full employment at the outset of the globalization process and suffers unemployment when it produces good $h$ only ($\hat{e}_N^l < \omega^H_l < \hat{e}_N^h$). If there is unemployment in the North in autarky ($\hat{e}_N^l < \omega^H_l$), then the North remains at its efficiency skill premium with unemployment throughout the globalization process. Unemployment firstly increases as long as the North produces both goods, and subsequently remains unchanged and high once the North produces good $h$ only. In contrast, if the North is at full employment when producing good $h$ only ($\hat{e}_N^l < \omega^H_l$), then the North is always at full employment and its inequality rises until it reaches $\hat{e}_N^l$.

Finally, even when considering changing skill endowments, we have implicitly assumed that the difference in endowments between the North and the South was large enough to make the North quit the diversification cone at a moment during the globalisation process, i.e., to generate the third stage of globalisation. Another possibility is that the South skill endowment catches up the North skill endowment from a certain time. That is what happened with the first wave of NICs that can now be considered as northern countries. This catch-up dynamics, the conditions for southern countries to enter the northern area, and the induced changes in inequality and unemployment are important issues to analyse. But this is another story.

APPENDIX A

In sector $j$ and country $i$ the firms maximise their profit $\pi^i_j = p_j Y^i_j - w^i_H H_j^i - w^i_L L^i_j$ such that

$$Y^i_j = A_j \left( H_j^i \right)^{\alpha_j} \left( E_i(w^i_L) \times L^i_j \right)^{\alpha_j} \text{ and } E_i(w^i_L) = \left( \frac{w^i_L - a\overline{q}_j^i w^i_H}{(1-a\overline{q}_j^i) w^i_H} \right)^\gamma.$$
\[ \frac{\partial \pi_j}{\partial L_j} = 0 \Rightarrow p_j Y_j^i = w^i L_j / \alpha_j \quad (A1) \]
\[ \frac{\partial \pi_j}{\partial w^i} = 0 \Rightarrow p_j Y_j^i = \left( w^i - a q^i H^i w^i \right) \frac{L_j}{\alpha_j \gamma} \quad (A2) \]
\[ \frac{\partial \pi_j}{\partial H^i} = 0 \Rightarrow p_j Y_j^i = w^i H^i L_j (1 - \alpha_j) \quad (A3) \]

(A1) and (A3) determine the usual relation between \( L_j \) and \( H^i_j \) (with \( \omega = w^i_H / w^i_L \)):
\[ L_j = \frac{\alpha_j}{1 - \alpha_j} \omega H^i_j \quad (A4) \]

Combining (A1) and (A2), the firm’s optimum is such that \( \frac{w^i L_j}{\alpha_j} = \left( w^i - a q^i H^i w^i \right) \frac{L_j}{\alpha_j \gamma} \)
which determines \( w^i_{\text{eff}} = \frac{a q^i H^i w^i}{1 - \gamma} \), \( \alpha^i_{\text{eff}} = \frac{1 - \gamma}{a} \frac{1}{\alpha_j (1 + \lambda)} \), and \( E_{\text{eff}} = \left( \frac{\gamma}{1 - \gamma \lambda} \right) \).

**APPENDIX B. Determination of the skill premium and employment**

To simplify, the subscript indicating the country is omitted.

Because of the utility function, the total demand for \( l (Y^d_l) \) and \( h (Y^d_h) \) are \( p_l Y_l^d = \beta I \) and \( p_h Y_h^d = (1 - \beta) I \), with \( I = w^i L + w^i H \) being the country’s total income. Equalising supply \( (Y^s_l \text{ and } Y^s_h) \) and demand on both markets yields:
\[ p_l Y_l^s = \beta (w^i L + w^i H) \quad (A5) \]
\[ p_h Y_h^s = (1 - \beta) (w^i L + w^i H) \quad (A6) \]

Because of the production functions, the demands for unskilled labour in both sectors at the firms’ optimum are \( L_l = \alpha_l p_l Y_l^s / w^i_L \) and \( L_h = \alpha_h p_h Y_h^s / w^i_L \), and thereby at the country’s level:
\[ L = L_l + L_h = \alpha_l p_l Y_l^s / w^i_L + \alpha_h p_h Y_h^s / w^i_L \quad (A7) \]

Inserting (A5) and (A6) into (A7) yields \( L = \left( \beta \alpha_l + (1 - \beta) \alpha_h \right) w^i_L (w^i L + w^i H) \). Hence \( \omega \equiv \frac{w^i_L}{w^i_L} = \frac{1 - \alpha}{\alpha} \frac{L}{H} \), with \( \alpha \equiv \beta \alpha_l - (1 - \beta) \alpha_h \). The full employment skill premium is thus:
\[ \hat{\omega} = \frac{1 - \alpha}{\alpha} \frac{L}{H} \quad (A8) \]

Finally, the demand for unskilled workers resulting from any \( \tilde{\omega} < \hat{\omega} \) and full employment of the skilled is:
\[ L = \frac{\alpha}{1 - \alpha} \tilde{\omega} H < \hat{L} \quad (A9) \]

Relations (A8) and (A9) apply for each country being in autarky as well as at the world level when both the North and the South are inside the diversification cone. Consequently The world full employment skill premium is \( \omega_w = \frac{1 - \alpha}{\alpha} \frac{\tilde{L}_w}{H_w} \), with \( \tilde{H}_w = \tilde{H}_N + \tilde{H}_S \) and \( \tilde{L}_w = \tilde{L}_N + \tilde{L}_S \).
APPENDIX C

When the full employment skill premium $\hat{\omega}_i$ is higher than the efficiency skill premium $\alpha_i^{\text{eff}}$, this generates unemployment of unskilled workers in country $i$. In fact, as $\hat{\omega}_i > \alpha_i^{\text{eff}}$, then the firms enforce $\alpha_i^{\text{eff}}$. The related employment of unskilled workers is $L_i = \frac{\alpha}{1-\alpha} \alpha_i^{\text{eff}} \bar{H}_i$, which generates unemployment ($L_i < \bar{L}_i$) since $L_i = \frac{\alpha}{1-\alpha} \hat{\omega}_i$ and $\hat{\omega}_i > \alpha_i^{\text{eff}}$.

We know that $\alpha_i^{\text{eff}} = \frac{1-\gamma}{\alpha q_i^H}$ and $\hat{\omega}_i = \frac{1-\alpha}{\alpha} \frac{1-q_i^H}{q_i^H}$. Thus:

$$\omega_i^{\text{eff}} > \hat{\omega}_i \iff \frac{1-\gamma}{\alpha q_i^H} > \frac{1-\alpha}{\alpha} \frac{1-q_i^H}{q_i^H} \iff \bar{q}_i^H > \frac{1-\alpha(1-\gamma)}{a(1-\alpha)} \equiv q_i^*.$$

Hence: $\omega_i^{\text{eff}} > \hat{\omega}_i \iff \bar{q}_i^H > q_i^*$.

The two possible cases are:
1) $\bar{q}_i^H > q_i^* \Rightarrow \omega_i^{\text{eff}} > \hat{\omega}_i \Rightarrow \omega_i = \hat{\omega}_i \Rightarrow \text{Country } i \text{ is at its full employment equilibrium}$
2) $\bar{q}_i^H < q_i^* \Rightarrow \omega_i^{\text{eff}} < \hat{\omega}_i \Rightarrow \omega_i = \omega_i^{\text{eff}} \Rightarrow \text{Country } i \text{ suffers unemployment of the unskilled.}$

This establishes Lemma 3.

Finally, the condition for $q_i^* > 0$ is $a > \frac{\alpha(1-\gamma)}{1-\alpha}$.

APPENDIX D.

1. The diversification cone

The diversification cone (henceforth D-cone) is the set of all the couples $(H,L)$ of factor utilisations corresponding to all the production mix of goods $h$ and $l$ for a given value of the world full employment skill premium $\hat{\omega}_W$. In the quadrant $(H,L)$, the D-cone is thus the set in-between the lines $L = \frac{\alpha_h}{1-\alpha} \hat{\omega}_W H$ and $L = \frac{\alpha_l}{1-\alpha} \hat{\omega}_W H$. For country $i$ to reach full employment at the HOS equilibrium with the world full employment skill premium $\hat{\omega}_W$, its factor endowment $(\bar{H}_i, L_i)$ must thereby belong to the corresponding D-cone.

2. The condition for the South to be outside the D-cone at the start of globalization and the North outside the D-cone at its conclusion

The world full employment skill premium $\hat{\omega}_W$ is equal to $\hat{\omega}_N = (1-\alpha) \bar{\lambda}_N / \alpha$ at the beginning of the globalization process and to $\hat{\omega}_S = (1-\alpha) \bar{\lambda}_S / \alpha$ at its conclusion. For the South to be outside the D-cone at the start of globalisation, we must have $\bar{\lambda}_N > \frac{\alpha_l}{1-\alpha_i} \hat{\omega}_W$, i.e.,

$$\frac{\bar{\lambda}_S}{\bar{\lambda}_N} > \frac{\alpha_l}{1-\alpha_i} \frac{1-\alpha}{\alpha}.$$ For the North to be outside the D-cone at the conclusion of the
The globalization process, we must have \( \bar{\lambda}_N < \frac{1}{1-\alpha_h} \hat{\omega}_W \), i.e., \( \frac{\bar{\lambda}_N}{\bar{\lambda}_S} < \frac{1}{1-\alpha_h} \). Finally, for the South to be outside the cone at the start of globalization and the North to be outside at its conclusion, we must have \( \frac{\bar{\lambda}_S}{\bar{\lambda}_N} > \max \left\{ \frac{1}{1-\alpha_i} - \frac{1}{1-\alpha_h}, \frac{1}{1-\alpha_i} \right\} \).

**APPENDIX E**

We firstly establish the following Lemma that will be utilised below:

**Lemma 4.** *If both countries produce both goods, then \( \hat{\omega}_S < \omega^\text{eff}_N \).*

**Proof:** When both countries produce both goods in free trade, they share the same skill premium. As \( \hat{\omega}_S < \omega^\text{eff}_N \) (inequality 7) the lowest possible skill premium in the South is \( \hat{\omega}_S \). In addition, the Northern skill premium cannot be higher than \( \omega^\text{eff}_N \). Consequently, the set of the possible skill premia of the North and the set of the possible skill premia of the South do not overlap for \( \omega^\text{eff}_N < \hat{\omega}_S \). Hence, if \( \omega^\text{eff}_N < \hat{\omega}_S \), both countries never share the same skill premium and they cannot produce both goods at the same time.

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**Figure A1. The D-cone and the countries’ endowments throughout globalization**

The globalization process consists in (i) an upward displacement of the South along the line \( L = \bar{\lambda}_S H \), (ii) a rotation to the left of the D-cone, and (iii) an immobility of the northern endowments \( (\bar{H}_N, \bar{L}_N) \) on the line \( L = \bar{\lambda}_N H \). Finally, the D-cone is delimited by lines \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\omega}_W H \) and \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\omega}_W H \) (Figure A1).

At the beginning of globalization, the North is inside the D-cone and the South outside, with the world full employment skill premium being \( \hat{\omega}_W = \hat{\omega}_N^\text{eff} < \omega^\text{eff}_N \). At the conclusion of the globalization process, the South is inside the D-cone and the North outside, with
\[ \hat{\alpha}_W = \hat{\alpha}_S. \] Consequently, (i) the line \( L = \bar{\lambda}_N \) stands in-between lines \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \), and the line \( L = \bar{\lambda}_S \) above the line \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \) at the outset of the globalization process, and (ii) the line \( L = \bar{\lambda}_N \) stands in-between lines \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \), and the line \( L = \bar{\lambda}_S \) under the line \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \) at the conclusion of the process.

To analyse the characteristics of stages 1 and 2, we firstly make a distinction between the two ways by which the world economy can leave the situation in which the North is inside and the South outside the D-cone:

**Case 1.** When lines \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \bar{\lambda}_N \) merge before lines \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \) and \( L = \bar{\lambda}_S \), the North quits the D-cone before the South enters the D-cone, and both the North and the South are outside the D-cone from the moment when \( \hat{\alpha}_W = \frac{1-\alpha_h}{\alpha_i} \bar{\lambda}_N = \hat{\alpha}_N \) (corresponding to the merging of \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \bar{\lambda}_N \)) until the moment when \( \hat{\alpha}_W = \frac{1-\alpha_i}{\alpha_h} \bar{\lambda}_S = \hat{\alpha}_S \) (merging of \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \) and \( L = \bar{\lambda}_S \)). The condition for being in this configuration is \( \hat{\alpha}_N < \hat{\alpha}_S \) (because line \( L = \bar{\lambda}_S \) is located above line \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \)), hence \( \hat{\alpha}_w < \frac{1-\alpha_i}{\alpha_h} \bar{\lambda}_S = \hat{\alpha}_S \) when \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \bar{\lambda}_N \) merge, i.e. when \( \hat{\alpha}_w = \frac{1-\alpha_h}{\alpha_i} \bar{\lambda}_N = \hat{\alpha}_N \). In this case, there is a period of time, corresponding to stage 2, during which each country produces one good only (\( l \) for the South and \( h \) for the North).

In addition, since \( \hat{\alpha}_N^\text{eff} < \hat{\alpha}_N^\text{eff} \) by assumption, we have \( \hat{\alpha}_N^\text{eff} < \hat{\alpha}_N^\text{eff} < \hat{\alpha}_S^\text{eff} \) and the North has thus already attained its efficiency skill premium before the merging of \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \bar{\lambda}_N \). Hence, the North attains and remains at the skill premium \( \hat{\alpha}_N^\text{eff} \) before entering the second stage of globalization.

**Case 2.** When lines \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \) and \( L = \bar{\lambda}_S \) merge before lines \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \bar{\lambda}_N \), the South enters the D-cone before the North leaves it, and both the North and the South are inside the D-cone from the moment when \( \hat{\alpha}_W = \hat{\alpha}_S \) (merging of \( L = \frac{\alpha_i}{1-\alpha_i} \hat{\alpha}_W \) and \( L = \bar{\lambda}_S \)), until the moment when \( \hat{\alpha}_W = \hat{\alpha}_N \) (merging of \( L = \frac{\alpha_h}{1-\alpha_h} \hat{\alpha}_W \) and \( L = \bar{\lambda}_N \)). This corresponds to \( \hat{\alpha}_S < \hat{\alpha}_N \). Two cases can then be distinguished:
Case 2a. If $\omega_N^{\text{eff}} < \omega_S^h < \omega_N^h$, then the North is at its efficiency skill premium $\omega_N^{\text{eff}}$ when the South enters the cone (at this moment $\omega_N = \omega_N^h$ and $\omega_S^h > \omega_N^{\text{eff}}$). In addition, as $\omega_N^{\text{eff}} < \omega_N^h$, then both countries cannot produce both goods even if they are in the cone (Lemma 4). As a consequence, the North and the South are inside the D-cone ($\omega_S^h < \omega_N^h$) but they cannot produce both goods ($\omega_N^{\text{eff}} < \omega_N^h$). When the South enters the cone, its skill premium is thus $\omega_S^h$ and the South continues to produce $l$ only as long as the North is large enough to provide the world with its total demand for $h$. During this time the world economy thus remains in stage 1 of globalization (since the North produces both goods and the South $l$ only) even with both countries being inside the D-cone. With the increase in the size of the South, there is a moment from which the North becomes too small to meet the world demand for $h$. From then, (i) the North produces good $h$ only with the skill premium $\omega_N^{\text{opt}}$ (since $\omega_N^{\text{eff}} < \omega_N^h$), and (ii) the South produces both goods with a skill premium that continuously increases from $\omega_S^h$ to $\omega_S^h$ if $\omega_S^h < \omega_N^{\text{opt}}$, and to $\omega_N^{\text{opt}}$ in the opposite case. This is stage 3 of globalization. There is thus one point of time that corresponds to the passage from stage 1 to stage 3, when the South produces $l$ only and the North $h$ only. This is the moment when the sizes of the North and the South are such that, for the respective skill premia $\omega_N^{\text{opt}}$ and $\omega_S^h$ in each country, the North is just large enough to meet the world total demand for $h$, and the South large enough to meet the world total demand for $l$.

Case 2b. If $\omega_S^h < \omega_N^{\text{opt}} < \omega_N^h$, then the North is not at its efficiency skill premium $\omega_N^{\text{opt}}$ when the South enters the cone (at this moment $\omega_N = \omega_N^h$ and $\omega_S^h < \omega_N^{\text{opt}}$). Consequently, both countries are in the D-cone ($\omega_N < \omega_N^h$) and share the same skill premium as long as $\omega_N \leq \omega_S^{\text{opt}}$. Thus, both countries produce both goods during the second stage. As both countries are in the D-cone for $\omega_N \in [\omega_N^h, \omega_N^h]$ and since $\omega_N^{\text{opt}} < \omega_N^h$, then there is a moment during the time when both countries are in the cone when $\omega_N$ reaches $\omega_N^{\text{opt}}$. From then, the North remains at its efficiency skill premium (it cannot go beyond) and there is always a production mix of $l$ and $h$ that ensures full employment in the South for this value (since $\omega_S^h < \omega_N^{\text{opt}} < \omega_N^{\text{opt}}$).

The cases presented above are summarised in Table A1, which establishes Proposition 3.

<table>
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<th>Condition</th>
<th>Shape of the globalization process</th>
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| $\omega_S^h < \omega_N^{\text{opt}} < \omega_N^h$ | - The North remains at its full employment skill premium throughout the first stage of globalization and attains its efficiency skill premium during the second stage.  
- During stage 2, both the North and the South have the same skill premium and produce both goods. |
| $\omega_N^{\text{opt}} < \omega_S^h < \omega_N^h$ | - The North attains its efficiency skill premium during the first stage of globalization at remains at this skill premium value later on.  
- There is one sole point of time when the North produces good $h$ only and the South good $l$ only and which corresponds to the passage from stage 1 to stage 3. Stage 2 is thus limited to this point of time. |
| $\omega_N^{\text{opt}} < \omega_S^h < \omega_S^h$ | - The North attains its efficiency skill premium during the first stage of globalization and remains at this skill premium value later on.  
- There is one period of time corresponding to stage 2 during which the North produces good $h$ only and the South good $l$ only. |
References


