Stages of Globalization, Inequality and Unemployment

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Abstract. *To analyse the impacts of globalization upon inequality and unemployment, 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 countries. 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/or unemployment at the first stage of globalization and growing inequality 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 and 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, for a review). 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 and Dickerson, 2001; Esquivel and Rodriguez-Lopez, 2003; Galiani and Sanguinetti, 2003; Lopez and 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 and Machin, 2004; Milanovic, 2005; Conte and Vivarelli, 2007; Meschi and Vivarelli, 2009). Several theoretical explanations can account for these evolutions. When the comparative advantage is based on natural resources, openness may increase inequality in the South 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 and Trefler, 2005; Xu 2003). Finally, if openness results in the adoption by the South of Northern technologies that require the implementation of more skilled labour, this can increase the skill premium and inequality in the South (Pissarides, 1997; Berman and 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, unemployment subsidies, collective bargaining etc.). This model nevertheless fails to account for the 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 $2 \times 2 \times 2$ HOS model. Inserting an efficiency wage hypothesis inside a Hecksher-Ohlinian model with capital and labour, Albert and Merckl (2001) show that most of the HOS results are 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 and 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 and 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 and 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[1] (Kreickemeier and 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 and Oswald, 1996, Section 2 for a review). Several recent works have shown that it also applies to emerging countries (Rao, 2001; Narayan and Petesch, 2002; Senik, 2004; Ravallion and Lokshin, 2010). 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. Empirical evidence seems to confirm the existence of an inequality unemployment trade-off. From a panel of Northern countries, Checchi and Garcia-Penalosa (2008) find that all the labour market institutions except the tax wedge generate such a trade-off, with albeit very different intensities. Within a HOS model with a continuum of goods, Hellier and 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 decreases in the South and increases in the North during the first stage whereas it constantly increases in the South and remains unchanged in the North during the third stage. Unemployment decreases in the South and can increase in the North at the first stage, whereas it experiences an upward trend in the South and a stabilisation in the North at the third stage. Finally, an increase in the countries' relative skill endowments can counteract the rise in inequality and unemployment but this skill upgrading must typically be implemented at different stages of globalization according to the country.

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[1] Akerlof and Yellen (1990) define the reference wage as a combination of the wage of the other group and the market clearing wage of the group an individual belongs to.

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 in which relative deprivation is fully microfounded. By introducing the growing size of the South as a key element of globalization, it secondly distinguishes several stages and generates 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 and Section 3 the impact of North-South openness when both countries produce both goods. The different stages of globalization and their characteristics are examined in Section 4. Section 5 extends the model by introducing exogenous changes in the skill endowments. A discussion of the main findings and the conclusion are provided in Section 6.

2. The model

We construct a North-South HOS model with efficiency wage deriving from 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 $\bar{\lambda}_i = \bar{L}_i / \bar{H}_i$, $i = N, S$, 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 $\omega \equiv w_H / w_L$ 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 $Y_j = A_j (E_{Hj} \times H_j)^{1-\alpha_j} (E_{Lj} \times L_j)^{\alpha_j}$, $j = l, h$, where E_{ij} depicts the effort of i-workers, $i = H, L$, in j-industry.

In both countries, each worker maximises the same utility function $u = v_1(x_h, x_l) - v_2(w, E)$, where x_i is her/his consumption of good i, $i = h, l$, w her/his wage and E the effort s/he provides, subject to the income constraint $w \geq p_h x_h + p_l x_l$, with p_i the price of good i, and to the non-negativity of effort $E \geq 0$. We assume $v_1 = (x_l)^\beta (x_h)^{1-\beta}$ so that each good accounts for a constant share of total expenditure in both countries and at the World level, i.e., β on good l and $(1-\beta)$ on good h. In addition, $v_2(w, E)$ depicts the fact that a wage considered as unfair has a negative impact on the worker's utility, but that this loss of welfare can be offset by the punishment s/he inflicts upon the employer by reducing her/his effort. We assume:

$$v_2(e, w) = \left(\left(\frac{w - aq\overline{w}}{(1-aq)\overline{w}} \right)^\gamma - E \right)^2$$

with $\overline{w}$ the average wage of the workers who are better paid (and $w = \overline{w}$ if nobody is better paid), q their proportion in the working population, $0 < \gamma < 1$ and coefficient a, $0 < a < 1/q$, depicting envy.

The effort corresponding to the utility maximisation is:

$$E(w) = \begin{cases} \left(\dfrac{w - aq\overline{w}}{(1-aq)\overline{w}} \right)^\gamma & \text{if } w \geq aq\overline{w} \\ 0 & \text{if } w < aq\overline{w} \end{cases} \tag{1}$$

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 ($w = \overline{w}$), s/he makes the effort $E = (\overline{w}/\overline{w})^\gamma = 1$. In the opposite case ($w < \overline{w}$), s/he reduces her/his effort $E(w) = \left(\dfrac{w - aq\overline{w}}{(1-aq)\overline{w}} \right)^\gamma = \left(1 - \dfrac{\overline{w} - w}{(1-aq)\overline{w}} \right)^\gamma$ by an amount that increases with the difference $\overline{w} - w$ 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 $w \leq aq\overline{w}$, 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 $\overline{w}$ and q (see Appendix A), which establishes a relative deprivation behaviour.

It can be easily verified that skilled workers provide the maximum effort[2] $E(w_H) = 1$. The effort of the unskilled $E(w_L)$ is determined by:

$$E(w_L) = \begin{cases} \left(\dfrac{w_L - a\overline{q}_H w_H}{(1-a\overline{q}_H)w_H} \right)^\gamma & \text{if } w_L \geq a\overline{q}_H w_H \\ 0 & \text{if } w_L < a\overline{q}_H w_H \end{cases} \tag{2}$$

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[2] For the skilled workers, $q = 0$ and $w = \overline{w} = w_H$.

with $\bar{q}_H = \bar{H}/(\bar{L}+\bar{H}) < 1$, which shows that $\bar{q}_H w_H$ is always lower than w_H.

The firms in country i and sector j firstly determine the unskilled workers' efficiency wage w_i^{eff} that maximise their profit $\pi_j^i = p_j Y_j^i - w_H^i H_j^i - w_L^i L_j^i$ such that

$$Y_j^i = A_j H_j^{i\,1-\alpha_j}\left(E_i(w_L^i)\times L_j^i\right)^{\alpha_j} \quad \text{and} \quad E_i(w_L^i) = \left(\frac{w_L^i - a\bar{q}_H w_H^i}{(1-a\bar{q}_H^i)w_H^i}\right)^{\gamma}.$$ If the market forces

determine a full employment wage that is higher than w_i^{eff}, 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 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_i^{eff}, the efficiency skill premium $\omega_i^{eff} = w_H^i / w_i^{eff}$ and the optimal effort E_i^{eff} (calculations in Appendix B):

$$w_i^{eff} = \frac{a}{1-\gamma}\bar{q}_H^i w_H^i \tag{3}$$

$$\omega_i^{eff} = \frac{1-\gamma}{a\bar{q}_H^i} = \frac{1-\gamma}{a}(1+\bar{\lambda}_i) \tag{4}$$

$$E_i^{eff} = \left(\frac{\gamma}{1-\gamma}\frac{a\bar{q}_H^i}{1-a\bar{q}_H^i}\right)^{\gamma} = \left(\frac{\gamma}{1-\gamma}\frac{a}{1-a+\bar{\lambda}_i}\right)^{\gamma} \tag{5}$$

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 $\omega_i^{eff} > 1$.

3. Since firms never pay unskilled workers below the efficiency wage, then the skill premium never exceeds its efficiency value ω_i^{eff}. 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 $\hat{\omega}_i = \min\{\hat{\omega}_i, \hat{\omega}_i^{eff}\}$.*

4. The higher the proportion of skilled workers inside a country, the lower this country's efficiency skill premium ($\partial\omega_i^{eff}/\partial\bar{q}_H^i < 0$), and since $q_H^N > q_H^S$:

Lemma 2: *The efficiency skill premium is higher in the South than in the North: $\omega_S^{eff} > \omega_N^{eff}$.*

2.3. Equilibria in autarky

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

$$\hat{\omega}_i^A = \frac{1-\alpha}{\alpha} \overline{\lambda}_i = \frac{1-\alpha}{\alpha} \frac{1-\overline{q}_H^i}{\overline{q}_H^i} , \ i = N,S \tag{6}$$

with $\alpha \equiv \beta\alpha_l - (1-\beta)\alpha_h$.

It can be noted that, given the comparative advantages $\overline{\lambda}_S > \overline{\lambda}_N$, the full employment skill premium is higher in the South than in the North: $\hat{\omega}_S > \hat{\omega}_N$.

Lemma 3: *When the full employment skill premium $\hat{\omega}_i$ is higher than the efficiency skill premium ω_i^{eff}, this generates unemployment of unskilled workers in country i.*

Proof. Since $\hat{\omega}_i$ is higher ω_i^{eff}, the firms enforce the latter. The related employment of unskilled workers (Relation 7) generates unemployment ($L_i < \overline{L}_i$):

$$L_i = \frac{\alpha}{1-\alpha} \omega_i^{eff} \overline{H}_i < \overline{L}_i \tag{7}$$

Lemma 4: *Consider country i in autarky with the proportion $\overline{q}_H^i$ of skilled labour in its working population. This country is at its full employment skill premium $\hat{\omega}_i$ if $\overline{q}_H^i \geq q_H *$, and it is at its efficiency skill premium ω_{eff}^i and exhibits unemployment of unskilled labour if $\overline{q}_H^i < q_H *$, with $q_H *= \frac{1-(2-\gamma)\alpha}{1-\alpha}$.*

Proof. see Appendix D.

It can be noted that when $\gamma < 2 - \alpha^{-1}$, then $q_H *< 0$ and both countries are always at their full employment skill premium in autarky.

From Lemmas 1, 2, and 4 and inequality $\overline{q}_H^N > \overline{q}_H^S$, we derive the following proposition:

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

1) *Full employment in both the North and the South with $\omega_N = \hat{\omega}_N$ and $\omega_S = \hat{\omega}_S$ if $\overline{q}_H^N > \overline{q}_H^S \geq q_H^*$*

2) *Full employment in the North and underemployment of the unskilled in the South with $\omega_N = \hat{\omega}_N$ and $\omega_S = \omega_S^{eff}$ if $\overline{q}_H^N > q_H^* > \overline{q}_H^S$.*

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 $q_H^* > \overline{q}_H^N > \overline{q}_H^S$.*

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. North-South openness with diversification

We now assume free trade between the North and the South.

We 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. Openness significantly changes the countries' equilibria because the wages and the skill premium are now determined at the World level whereas the efficiency skill premia depend on a purely domestic characteristic, i.e., the proportion of skilled labour within the country's working population.

We finally suppose that both countries are situated inside the diversification cone for both the World full employment skill premium $\hat{\omega}_W$ and the North efficiency skill premium ω_N^{eff}, and thus (see Appendix C): $\dfrac{\alpha_h}{1-\alpha_h}\omega < \dfrac{\bar{L}_N}{\bar{H}_N} < \dfrac{\bar{L}_S}{\bar{H}_S} < \dfrac{\alpha_l}{1-\alpha_l}\omega$, for $\omega = \hat{\omega}_W$ and $\omega = \omega_N^{eff}$.
This signifies that, for both these skill premia, both the North and the South can produce both goods.

The full employment equilibrium determines the following skill premium at the World level (from Equation 6):

$$\hat{\omega}_W = \frac{1-\alpha}{\alpha}\frac{\bar{L}_W}{\bar{H}_W} \tag{8}$$

with $\bar{L}_W = \bar{L}_N + \bar{L}_S$ 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 $\hat{\omega}_i^A$ and $\hat{\omega}_S$ being the full employment skill premium of country i, $i = N,S$, in autarky. As a consequence, North-South openness entails:

1) In the North, an increase in the full employment skill premium that moves from $\hat{\omega}_N$ to $\hat{\omega}_W > \hat{\omega}_N$.

2) In the South, a decrease in the full employment skill premium that moves from $\hat{\omega}_S$ to $\hat{\omega}_W < \hat{\omega}_S$.

When skilled labour is fully employed ($H_W = \bar{H}_W$) and the skill premium ω_W is the same in both countries but lower than its World full employment value $\hat{\omega}_W$, i.e., $\omega_W < \hat{\omega}_W$, there is unemployment of the unskilled at the World level and the unskilled labour utilised in production is given by:

$$L_W = \frac{\alpha}{1-\alpha}\omega_W\bar{H}_W < \bar{L}_W \tag{9}$$

Let us start from a situation where, in autarky, the North is at full employment, i.e., $\hat{\omega}_N^A \le \omega_N^{eff}$. As $\hat{\omega}_W > \hat{\omega}_N^A$, two cases may be distinguished:

1) If the World full employment skill premium $\hat{\omega}_W$ is lower than ω_N^{eff} (and thus than ω_S^{eff}), the market clearing process results in full employment in both countries with $\omega_N = \omega_S = \hat{\omega}_W$, i.e., the usual HOS outcome. This also means a decrease in the South skill premium because, as $\omega_N^{eff} < \omega_S^{eff}$ and $\hat{\omega}_W < \omega_N^{eff}$, then $\hat{\omega}_W < \omega_S^{eff}$.

2) If the World full employment skill premium $\hat{\omega}_W$ is higher than ω_N^{eff}, the firms enforce the efficiency skill premium ω_N^{eff} in the North and the South skill premium moves downwards to ω_N^{eff}.[3] In fact, as the South is inside the diversification cone for $\omega_W = \omega_N^{eff}$, this case is similar to the setting of a minimum wage as analysed by Davis (1998), except that the setting of a lower skill premium is now enforced by the firms and not by the State. As in Davis (1998) and for the same reason, this creates unemployment that is concentrated in the North. This result is in agreement with Albert and Merckl (2001)'s finding that openness can reverse the countries' ranking in terms of unemployment.

In both cases, the adjustment to openness results in a higher effort by the unskilled in the South compared to autarky, and less effort in the North. From the discussion above, we can state the following proposition:

Proposition 2: *Assume that both the Northern and Southern factor endowments stand inside the two diversification cones corresponding to $\omega_W = \hat{\omega}_W$ and to $\omega_W = \omega_N^{eff}$. Then:*

1) *North-South openness results in both countries being at the World full employment skill premium $\hat{\omega}_W$ if $\hat{\omega}_W < \omega_N^{eff}$.*

2) *North-South openness results in both countries being at the North efficiency skill premium ω_{eff}^N if $\hat{\omega}_W > \omega_N^{eff}$, which results in unemployment of the unskilled being concentrated inside the North.*

3) *In all cases, the effort by unskilled workers decreases in the North and increases in the South.*

4. Globalization

We introduce a globalization process characterised by:

1) An increase with time in the size (working population) of the South whereas the size of the North remains unchanged. 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 the end.

2) The difference in the relative factor endowments is large enough to place the South outside the diversification cone for the World full employment skill premium $\hat{\omega}_W$ at the beginning of the globalization process.

We also suppose that both the North and the South relative endowments $\bar{\lambda}_i = \bar{L}_i / \bar{H}_i$, $i = N, S$, remain constant. This assumption will be relaxed in the next section. We finally assume full employment in the North in autarky, i.e., at the outset of globalization.

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[3] Because $\omega_N^{eff} < \omega_S^{eff}$ and $\omega_N^{eff} < \hat{\omega}_W < \hat{\omega}_S$.

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 $\hat{\omega}_i^j = \dfrac{1-\alpha_j}{\alpha_j}\bar{\lambda}_i$, $i = N,S$ and $j = h,l$.
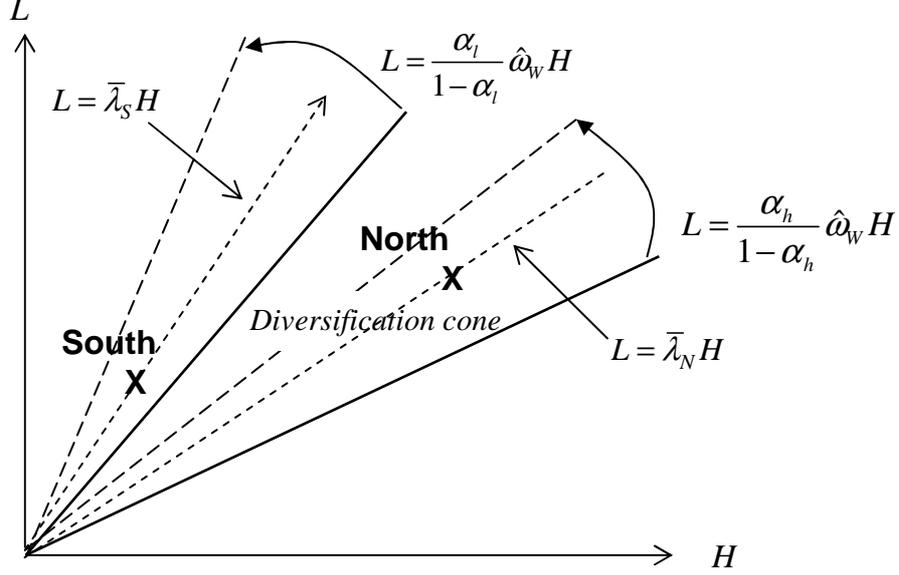
Figure 1. Globalization, the diversification cone and factor endowments

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 $L = \dfrac{\alpha_l}{1-\alpha_l}\hat{\omega}_W H$ and $L = \dfrac{\alpha_h}{1-\alpha_h}\hat{\omega}_W H$ (Appendix C), and since $\hat{\omega}_w = \dfrac{1-\alpha}{\alpha}\bar{\lambda}_w$ (Relation 8), the increasing size of the South entails a rise in $\hat{\omega}_W$ 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 $\left(\bar{H}_S,\bar{L}_S\right)$ along the line $L = \bar{\lambda}_S H$ (Figure 1). In Figure 1, the globalization process is thus depicted (i) by an upward displacement of the South along the line $L = \bar{\lambda}_S H$, (ii) by a rotation to the left of the diversification cone, and (iii) by an immobility of the factor endowments of the North $\left(\bar{H}_N,\bar{L}_N\right)$.

At the outset of globalization, the South is minute 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.

$$\hat{\omega}_N^A \qquad \omega_N^{eff} \qquad\qquad\qquad \omega_S^{eff} \qquad \hat{\omega}_S^A$$

$$\times \qquad\quad \times \qquad\qquad\qquad \times \qquad\quad \times \longrightarrow$$

$$\hat{\omega}_W \qquad\qquad \longrightarrow$$
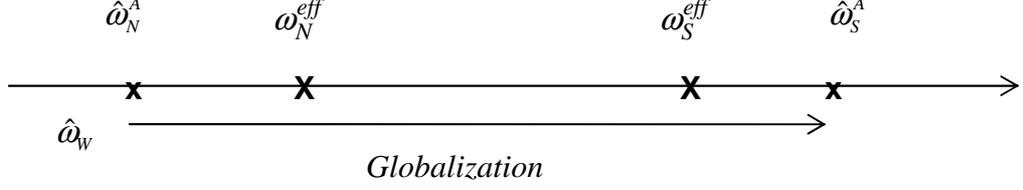
$$\textit{Globalization}$$

Figure 2. The globalization process

Lemma 5: *Assume that the South is outside the diversification cone at the beginning of globalization. Then, there is a moment of the globalization process from which the North moves away and remains outside the diversification cone.*

Proof: Appendix E.

As the size of the South increases, three stages of globalization may be distinguished:

1. At the first stage, the South is small enough and the North large enough so that the former produce good l only whereas the latter produces both goods. The line $L = \bar{\lambda}_S \times H$ remains outside the diversification cone and the Northern endowments $(\bar{H}_N, \bar{L}_N)$ inside. This corresponds to globalization with a small South.

2. 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. Both the line $L = \bar{\lambda}_S H$ and the North endowments $(\bar{H}_N, \bar{L}_N)$ are inside the diversification cone in the first case, whereas they are both outside the cone in the second. This corresponds to globalization with a medium-sized South.

3. At the third and last stage, the South becomes sufficiently large to produce both goods with the North producing good h only (Lemma 5). Line $L = \bar{\lambda}_S \times H$ is inside the cone and the Northern endowments $(\bar{H}_N, \bar{L}_N)$ outside. This is globalization with a large South.

4.1. Stage 1: Small South

The South. The South producing good l only, its full employment skill premium is constant and equal to:

$$\hat{\omega}_S^l = \frac{1-\alpha_l}{\alpha_l}\,\bar{\lambda}_S \tag{10}$$

Since l is the unskilled labour intensive good, we have: $\hat{\omega}_S^l < \hat{\omega}_S^A$ and the South skill premium moves from $\min\{\hat{\omega}_S^A, \omega_S^{eff}\}$ in autarky to $\min\{\hat{\omega}_S^l, \omega_S^{eff}\}$. Two cases are thus possible:

1. When the South is in a position of full employment in autarky, i.e. $\hat{\omega}_S^A < \omega_S^{eff}$, openness maintains full employment ($\hat{\omega}_S^l < \hat{\omega}_S^A < \omega_S^{eff}$) and reduces inequality ($\hat{\omega}_S^l < \hat{\omega}_S^A$), which entails greater efforts by the unskilled workers.

2. When $\omega_S^{eff} < \hat{\omega}_S^A$, the Southern firms in autarky enforce the efficient skill premium ω_S^{eff} and the South demonstrates unemployment of the unskilled before openness. If $\hat{\omega}_S^l < \omega_S^{eff}$, openness causes a move to full employment in the South with a lower inequality and a higher effort by the unskilled. If $\hat{\omega}_S^l > \omega_S^{eff}$, the Southern firms still enforce the efficiency wage after openness and the South still suffers under employment of the unskilled. The unemployment rate however diminishes because the employment of unskilled workers moves from $L_S = \dfrac{\alpha}{1-\alpha} \omega_S^{eff} \overline{H}_S$ up to $L_S = \dfrac{\alpha_l}{1-\alpha_l} \omega_S^{eff} \overline{H}_S$, with $\alpha_l > \alpha$.

Finally, since the first stage of globalization is characterised by the South producing good l only, the Southern skill premium remains constant and equal to $\min\{\hat{\omega}_S^l, \omega_S^{eff}\}$ throughout this period.

From the discussion above, we can state the following proposition:

Proposition 3: *At the first stage of globalization, the South skill premium is equal to* $\min\{\hat{\omega}_S^l, \omega_S^{eff}\}$, *which results in the following changes compared to autarky:*

1) *A preservation of full employment with less inequality and a greater effort from unskilled workers if* $\omega_S^l < \hat{\omega}_S^A < \omega_S^{eff}$.

2) *A return to full employment with a reduction in inequality and a greater effort from the unskilled if* $\omega_S^l < \omega_S^{eff} < \hat{\omega}_S^A$.

3) *A reduction in the unemployment rate without full employment and without change in inequality and effort if* $\omega_S^{eff} < \omega_S^l < \hat{\omega}_S^A$.

The North. At the beginning of the globalization process, the size of the South is negligible as well as its production of l. Consequently, the North full employment skill premium is equal to the North autarkic skill premium $\hat{\omega}_N^A$. As $\hat{\omega}_N^A < \omega_N^{eff}$, the North remains at full employment as long as the South remains minute. However, the growing size of the South causes an increase in the South's production of l, a growing specialisation of the North in the production of h, and finally a hike in its full employment skill premium. This development can lead to two possible situations, namely, one in which the North can maintain full employment throughout the first phase of globalization, and the other in which the North endures unemployment from a certain moment during this phase.

Proposition 4: *The first stage of globalization results in the following developments in the North:*

1) *Full employment and growing inequality if* $\overline{\lambda}_N > \dfrac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)} \overline{\lambda}_S$ *and* $\overline{\lambda}_N > \dfrac{(1-\alpha_l)\overline{\lambda}_S}{(1-\gamma)\alpha_l} - 1$

or if $\overline{\lambda}_N < \dfrac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)} \overline{\lambda}_S$ *and* $\overline{\lambda}_N < \dfrac{(1-\gamma)\alpha_h}{1-(2-\gamma)\alpha_h}$;

2) *A phase of full employment with growing inequality as long as $\hat{\omega}_N < \omega_N^{eff}$, followed by a phase of growing unemployment with constant inequality when and as $\hat{\omega}_N > \omega_{eff}^N$, if*

$$\bar{\lambda}_N > \frac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)}\bar{\lambda}_S \quad and \quad \bar{\lambda}_N < \frac{(1-\alpha_l)\bar{\lambda}_S}{(1-\gamma)\alpha_l}-1 \quad or \quad if \quad \bar{\lambda}_N < \frac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)}\bar{\lambda}_S \quad and$$

$$\bar{\lambda}_N > \frac{(1-\gamma)\alpha_h}{1-(2-\gamma)\alpha_h}$$

3) *In all cases, a decrease in the unskilled workers' effort compared to autarky.*

Proof. See Appendix F.

Full employment occurs (i) when, for both countries being inside the diversification cone at Stage 2 (they produce both goods), $\hat{\omega}_N < \omega_N^{eff}$ at the end of stage 1, and (ii) when, for each country producing one good only (*h* in the North and *l* in the South) at Stage 2, the skill premium corresponding to full employment of the North producing good *h* only is lower than ω_N^{eff}. Unemployment appears during Stage 1, (i) when, for both countries being inside the diversification cone at Stage 2, $\hat{\omega}_N > \omega_N^{eff}$ at the end of stage 1, and (ii) when, for each country producing one good only at Stage 2, the skill premium corresponding to full employment of the North producing good *h* only is higher than ω_N^{eff}.

4.2. Stage 2: Medium-sized South

In the case of a medium-sized South two situations are possible depending on ratio $\bar{\lambda}_N / \bar{\lambda}_S$ (see Appendix E):

1. If $\dfrac{\bar{\lambda}_N}{\bar{\lambda}_S} > \dfrac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)}$, then both countries produce both goods.

2. If $\dfrac{\bar{\lambda}_N}{\bar{\lambda}_S} < \dfrac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)}$, then the North produces good *h* only and the South good *l* only.

Both countries produce both goods. In this case, the factor price equalisation operates and the North and the South share the same skill premium. As described in Section 3, this can lead to two possible skill premia: (i) $\omega_W = \hat{\omega}_W$, which ensures full employment in both countries, and (ii) $\omega_W = \omega_N^{eff}$, which causes unemployment located uniquely in the North. Consequently, the second stage of globalization with both countries producing both goods can take three forms:

1. If $\hat{\omega}_W > \omega_N^{eff}$ when the South begins to produce both goods, the skill premium ω_N^{eff} is maintained in both countries throughout the second phase. Since the full employment skill premium $\hat{\omega}_W$ continuously increases because of the growing size of the South, the difference $\hat{\omega}_W - \omega_N^{eff}$ also increases and the unemployment of the unskilled increases in the North.

2. If $\hat{\omega}_W < \omega_N^{eff}$ from the moment when the South begins to produce both goods (beginning of Stage 2) to the moment when the North begins to produce good *h* only (beginning of stage 3), then both the North and the South experience full employment throughout Stage 2. Since $\hat{\omega}_W$ increases, Stage 2 is characterised by a continuous increase in

inequality and a continuous decrease in the unskilled workers' effort in both the North and the South.

3. If $\hat{\omega}_W < \omega_N^{eff}$ at the beginning of Stage 2 and $\hat{\omega}_W > \omega_N^{eff}$ at the end of Stage 2, full employment is maintained in both countries as long as $\hat{\omega}_W < \omega_N^{eff}$. The North suffers unemployment of the unskilled as and when $\hat{\omega}_W$ becomes higher than ω_N^{eff}, whereas the South maintains full employment throughout the second stage. In this third case, the unskilled workers' effort declines as long as $\hat{\omega}_W < \omega_N^{eff}$ and remains constant once $\hat{\omega}_W > \omega_N^{eff}$.

Each country is fully specialised. The North produces good h only and the South good l only. Thus, the full employment skill premium is $\hat{\omega}_N = \hat{\omega}_N^h = (1-\alpha_h)\bar{\lambda}_N / \alpha_h$ in the North and $\hat{\omega}_S = \hat{\omega}_S^l = (1-\alpha_l)\bar{\lambda}_S / \alpha_l$ in the South. The skill premium is thus $\min\{\hat{\omega}_N^h, \omega_N^{eff}\}$ in the North and $\min\{\hat{\omega}_S^l, \omega_S^{eff}\}$ in the South. These skill premia remain unchanged throughout the second phase as well as inequality and the efforts in both countries.

4.3. Stage 3: Large South

The South produces both goods and the North good h only.

The North. The North full employment skill premium is now $\hat{\omega}_N = \hat{\omega}_N^h$ and it remains unchanged throughout the third stage. If $\hat{\omega}_N^h < \omega_{eff}^N$, i.e., if $\dfrac{\bar{H}_N}{\bar{L}_N} > \dfrac{a(1-\alpha_h)}{(1-\gamma)\alpha_h} - 1$, then the North remains at full employment.

If $\dfrac{\bar{H}_N}{\bar{L}_N} < \dfrac{a(1-\alpha_h)}{(1-\gamma)\alpha_h} - 1$, then the North efficiency wage is lower than the full employment wage $\hat{\omega}_N^h$. In this case, the North remains at its efficiency skill premium, which results in unemployment of the unskilled. In addition, as (i) the North always produces good h only and (ii) its relative skill endowment is constant, unemployment as well as the unskilled workers' effort remains unchanged.

The South. The South produces both goods. As its size is growing whereas that of the North remains unchanged, the weight of good h in the South's production augments, thereby increasing its full employment skill premium that tends towards $\hat{\omega}_S^A$ as the size of the South increases. This comes with a decrease in the effort by the Southern unskilled workers. If $\omega_S^{eff} < \hat{\omega}_S^A$, there is a moment when the full employment skill premium $\hat{\omega}_S$ catches ω_S^{eff} up. Henceforth, the South remains at its efficiency skill premium, the effort remains constant and the unemployment of the unskilled increases. From this discussion, we can state the following proposition:

Proposition 5: *During the third stage of globalization:*

1) The North remains at full employment with $\hat{\omega}_N = \dfrac{1-\alpha_h}{\alpha_h}\bar{\lambda}_N$ *if* $\dfrac{\bar{H}_N}{\bar{L}_N} > \dfrac{a(1-\alpha_h)}{(1-\gamma)\alpha_h} - 1$

and suffers a constant under employment of the unskilled with the skill premium ω_N^{eff} *if*

$\overline{H}_N / \overline{L}_N < a(1-\alpha_h)\big((1-\gamma)\alpha_h\big)^{-1} -1$. *In both case, the effort by the unskilled remains constant throughout Stage 3.*

2) The South full employment skill premium increases and tends towards $\hat{\omega}_S^A$. If $\omega_S^{eff} < \hat{\omega}_S^A$, then the South skill premium $\hat{\omega}_S$ (i.e., inequality) firstly increases resulting in lower effort and no unemployment, and it subsequently remains constant as and when $\hat{\omega}_S = \omega_S^{eff}$, with a constant effort by the unskilled and growing unemployment. If $\hat{\omega}_S^A < \omega_S^{eff}$, the skill premium increases and tends towards $\hat{\omega}_S^A$, the South remains at full employment and the effort decreases and tends towards $E\big(\hat{\omega}_S^A\big)$.

5. Inequality, unemployment and skill upgrading

We firstly summarize the main variations in inequality (the skill premium) and unemployment in the North and the South throughout the globalization process. We subsequently analyse the impact of skill upgrading at each stage of globalization.

5.1. Inequality and unemployment throughout the globalization process

From the main findings described in Section 4, we can derive the variations in inequality and unemployment during the different phases of globalization. These evolutions are summarised in Proposition 6.

Proposition 6: *Suppose that the South is outside the diversification cone at the beginning globalization. Then, throughout the globalization process:*

1) *The World full employment skill premium moves from $\hat{\omega}_N^A$ up to $\hat{\omega}_S^A$.*

2) *The North skill premium moves from $\hat{\omega}_N^A$ up to $\min\{\hat{\omega}_N^h, \omega_N^{eff}\}$, and the South skill premium from $\min\{\hat{\omega}_S^l, \omega_S^{eff}\}$ to $\min\{\hat{\omega}_S^A, \omega_S^{eff}\}$.*

3) *The condition for the North to experience full employment throughout the globalization process is $\dfrac{\overline{H}_N}{\overline{L}_N} \geq \dfrac{a(1-\alpha_h)}{\alpha_h(1-\gamma)} -1$, and the condition for the South to experience full employment throughout the globalization process $\dfrac{\overline{H}_S}{\overline{L}_S} \geq \dfrac{a}{1-\gamma}\dfrac{1-\alpha}{\alpha} -1$.*

Proof: Features 1) and 2) stem directly from the findings of the Section 4. Feature 3) is shown in Appendix G.

5.2. Skill upgrading

We have assumed until now that both skill relative endowments $\overline{\lambda}_i$, $i = N, S$, were constant throughout the globalization process. However, empirical evidence shows that the skill endowment has risen and that this move has been particularly significant in the North and in certain emerging countries, particularly the first wave of NICs. An increase in one country i's skill endowment induces a rise in $\overline{q}_H^i$ and a decrease in $\overline{\lambda}_i$, which causes:

(i) A decrease in the efficiency skill premium ω_i^{eff} and thereby an increase in the corresponding effort E_i^{eff}.

(ii) A decrease in the autarkic full employment skill premium that is even more intense than that of the efficiency skill premium since $\hat{\omega}_i^A / \omega_i^{eff} = \dfrac{1-\alpha}{(1-\gamma)\alpha}(1-\overline{q}_H^i)$. In the case of unemployment ($\hat{\omega}_i^A > \omega_i^{eff}$) this could thus restore full employment in autarky.

(iii) A decrease in the full employment skill premium $\hat{\omega}_i$ at any moment of the globalisation process and thereby an increase in the corresponding effort.

The country's skill premium is $\omega_i = \min\{\hat{\omega}_i, \omega_i^{eff}\}$ when the diversification cone does not include both countries, and $\omega_i = \min\{\hat{\omega}_W, \omega_N^{eff}\}$ when both countries are inside this cone. These features show that an increase in country i' s skill relative endowment $\overline{\lambda}_i$, $i = N, S$, produces the following changes in the successive stages of globalization:

Proposition 7: *At the first stage of globalization:*

1) *An increase in the Southern skill relative endowment reduces unemployment (when it exists) and/or inequality (the skill premium) in the South.*

2) *An increase in the Northern skill relative endowment results in a decrease in inequality and/or in unemployment (when it exists) in the North, and a rise in the terms of trade and no change in inequality and unemployment in the South.*

Proposition 8: *At the second stage of globalization, an increase in one country's skill relative endowment entails:*

1) *If both countries produce both goods, a decrease in inequality and in unemployment (when it exists) in both countries.*

2) *If each country produces one good only, a decrease in both inequality and unemployment (when it exists) in the North and no impact in the South.*

3) *If the increase occurs in the South, this can cause the second stage to change from the case where each country produces one good only into the case where both countries produce both goods.*

Proposition 9: *At the third stage of globalization:*

1) *An increase in the Southern skill relative endowment reduces inequality and unemployment (when it exists) in the South.*

2) *An increase in the Northern skill relative endowment results in a decrease in inequality (the skill premium), in unemployment (when it exists) in the North and no change in the South.*

6. Discussion and conclusion

By introducing a relative deprivation based efficiency wage within a North-South HOS model, and assuming (i) that the size of the South increases throughout the globalization process, and (ii) that the North and the South have significantly different factor endowments, we have generated the following outcomes:

1. Globalization can be divided into *three successive stages* according to the relative size of the South, each of these stages showing different characteristics in terms of inequality, unemployment and effort in each country. At the first stage (small South), the North produces both goods and the South the unskilled-intensive good only. At the second stage (medium-sized South), two cases may be distinguished, corresponding (i) to both countries producing both goods, or (ii) to each country producing one good only. At the third stage (large South), the South produces both goods whereas the North produces the skill-intensive good only.

2. In terms of *inequality* (the skill premium), the first stage of globalization is typically characterised by an increase in inequality in the North and a decrease in the South (except if $\omega_S^l > \omega_S^{eff}$) compared to autarky. The second stage shows three possible developments: (i) an increase in inequality in both countries when they both produce both goods and when their skill premia are equal to the World full employment skill premium, (ii) a constant inequality in both countries when they both produce both goods and when their skill premia are equal to the Northern efficiency skill premium, (iii) a constant inequality in the North and the South respectively equal to $\min\left\{(1-\alpha_h)\bar{\lambda}_N / \alpha_h, \omega_N^{eff}\right\}$ and $\min\left\{(1-\alpha_l)\bar{\lambda}_S / \alpha_l, \omega_S^{eff}\right\}$ when each country produces one good only. Finally, the third stage is characterised by a constant inequality in the North with the skill premium $\min\left\{(1-\alpha_h)\bar{\lambda}_N / \alpha_h, \omega_N^{eff}\right\}$, and a growing inequality in the South provided that the full employment skill premium is lower than ω_S^{eff}.

3. The *rate of unemployment* remains nil (if $\hat{\omega}_N < \omega_N^{eff}$) and/or increases (as soon as $\hat{\omega}_N > \omega_N^{eff}$) in the North during the first stage of globalization, whereas it decreases compared to autarky and remains constant throughout this stage in the South, being nil if $(1-\alpha_l)\bar{\lambda}_S / \alpha_l < \omega_S^{eff}$ and positive in the opposite case. At the second stage, (i) if both countries produce both goods, then the rate of unemployment is nil in both countries as long as $\hat{\omega}_W \le \omega_N^{eff}$ and it becomes positive and increases uniquely in North when and as $\hat{\omega}_W > \omega_N^{eff}$, and (ii) if each country produces one good only, then the rate of unemployment is constant in country i and it is nil if $(1-\alpha_j)\bar{\lambda}_i / \alpha_j \le \omega_i^{eff}$ and positive if $(1-\alpha_j)\bar{\lambda}_i / \alpha_j > \omega_i^{eff}$ with $(i, j) = \{(N, h), (S, l)\}$. In the third phase of globalization, unemployment remains positive and constant in the North if $(1-\alpha_h)\bar{\lambda}_N / \alpha_h > \omega_N^{eff}$, and it remains nil for $(1-\alpha_h)\bar{\lambda}_N / \alpha_h \le \omega_N^{eff}$. In the South, the third stage shows no unemployment if $\hat{\omega}_S \le \omega_S^{eff}$, and a growing unemployment as soon as $\hat{\omega}_S > \omega_S^{eff}$. As the South full employment skill premium tends towards $\hat{\omega}_S^A$ during the third stage of globalization, the condition for the South to remain at full employment throughout the globalization process is $\hat{\omega}_S^A \le \omega_S^{eff}$, i.e., that the South was at full employment on the eve of North-South openness.

4. The model results in an inequality unemployment trade-off at the early stages of globalisation in the North, and at the latter stage in the South.

5. In each countries, the *effort* of unskilled workers $E(\omega_i) = \left(\dfrac{1/\omega_i - a\overline{q}_H^i}{1 - a\overline{q}_H^i} \right)^\gamma$, $i = N,S,$

moves in the opposite direction of the skill premium during the globalization process. Given the variations of the skill premia described above, the effort typically decreases from its autarkic value and can subsequently remain constant with growing unemployment, in the North during the first two stages of globalization, while remaining constant at the later stage. In the South, this effort remains constant and significantly higher than in autarky in the first stage of globalization, it can remain constant or decrease but at a level still higher than in autarky in the second stage, ant it decreases and tends towards its autarkic value in the later stage. It must be noted that, as the effort is typically not inserted in the production functions utilised for the estimations of the countries' total factor productivities (TFP), the changes in effort have a direct influence on the levels of the estimated value of this productivity. This means that compared to autarky, the effort should jeopardize productivity in the North and foster productivity in the South during the first stages of globalisation. At the later stage, this should in contrast reduce the South's productivity.

6. Skill upgrading makes it possible to reduce inequality and/or unemployment and to boost effort (productivity) in both countries. However, an equalitarian, full employment oriented and pro-productivity government should foster skill acquisition from the beginning of globalization in the North, whereas globalization itself typically promotes these goals in the South in its early stages. In contrast, skill upgrading could become an important goal for the Southern government in the third phase of globalization that is characterised by an increase in inequality and/or unemployment in the South.

These outcomes are in line with a number of changes observed in advanced and emerging countries over the last forty years. If we assume that the very start of globalisation occurred when the first wave of NICs (Hong Kong, Singapore, South Korea and Taiwan) opted for openness, i.e. in the late sixties, and that the weight of the South became significant enough to exert a non negligible influence upon the North in the early nineties, then the findings of the model can help in explaining several observed facts:

1. As regards the North, a number of economists now acknowledge both (i) the fact that trade had had a rather low impact on inequality at the onset of North-South openness, but that it has had an increasing impact since the nineties, i.e., when the size of the South has become large enough, as well as (ii) the existence of a related inequality-unemployment trade-off. The model also provides an additional and possible explanation for the slow down in productivity that has been observed in advanced countries (the so-called 'Solow's paradox'). Finally, the model shows that the substantial skill upgrading that has occurred in the advanced countries since the eighties has certainly limited the impact of globalisation upon inequality, unemployment and productivity.

2. As regards emerging countries, the model firstly shows that a part of the significant increase in productivity observed in East Asian countries in the first phase of their integration to the World economy, i.e., until the early nineties, could derive from an increase in the workers' effort due to higher pay. However, the Latin American experience seems to refute the model findings. One must nevertheless consider that our model assumes globalization acting alone, i.e., without any change in technology. In addition, several empirical works confirm that globalisation has produced its usual Hecksher-Ohlinian impact upon inequality in Latin America, the rise in the skill premium resulting from the technological transfers from the North (e.g., Esquivel and Rodriguez-Lopez, 2003, for Mexico). As a consequence, the downward move of Southern inequality and the related rise in workers' effort at the early stage of globalization must be regarded as a *ceteris paribus* result that can be reversed by skill biased technological transfers. Finally, the model shows that Southern country should

implement a skill upgrading action so as to offset rising inequality, productivity slow down and/or unemployment at the later stage of globalization. This is in line with the policies implemented by the first NICs in which skill has now caught up with the Northern level. The significant educational effort in China since the late nineties can also illustrate this finding, even if its main objective is not to avoid the possible emergence of an inequality-unemployment trade-off.

By assuming two goods only and no change in technology, the model clearly provides a very simplified framework to analyse the variation in inequality and unemployment in both the North and the South. Assuming a bigger number of goods (or a continuum) would smooth the evolutions and avoid the jumps in inequality or unemployment, particularly in the South. In addition, introducing skill biased technical change in the North (through R&D) and in the South (through technological transfer) would provide a more accurate picture of the observed developments. The results described here must thus be considered as determined by globalisation acting alone.

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APPENDIX A

$$E(w) = \left(\frac{w - aq\overline{w}}{(1 - aq)\overline{w}} \right)^{\gamma} = \left(\frac{w\overline{w}^{-1} - aq}{1 - aq} \right)^{\gamma}$$

$$\frac{\partial E}{\partial \overline{w}} = -\gamma E^{\gamma-1} \frac{w\overline{w}^{-2}}{1-aq} < 0 \ ; \ \frac{\partial E}{\partial q} = \gamma E^{\gamma-1} a \frac{w\overline{w}^{-1}-1}{(1-aq)^2} \Rightarrow \frac{\partial E}{\partial q} < 0 \ \text{ since } \ w < \overline{w}.$$

APPENDIX B

In sector j, $j = h,l$, and country i, $i = $ N,S, the firm's maximisation programme is:

$$\max_{L_j, w_L^i, H_j} \pi_j = A_j H_j^{1-\alpha_j} \left(\left(\frac{w_L^i - a\overline{q}_H^i w_H^i}{(1-a\overline{q}_H^i)w_H^i} \right)^\gamma L_j \right)^{\alpha_j} - w_H^i H_j - w_L^i L_j$$

$$\frac{\partial \pi}{\partial L} = \alpha_j Y_j L_j^{-1} - w_L^i = 0 \Rightarrow Y_j = w_L^i L_j / \alpha_j \tag{A1}$$

$$\frac{\partial \pi_j}{\partial w_L^i} = \alpha_j \gamma Y_j \left((1-a\overline{q}_H^i)w_H^i \right)^{-1} \left(\frac{w_L^i - a\overline{q}_H^i w_H^i}{(1-a\overline{q}_H^i)w_H^i} \right)^{-1} - L_j = 0 \Rightarrow Y_j = \left(w_L^i - a\overline{q}_H^i w_H^i \right) \frac{L_j}{\alpha_j \gamma} \tag{A2}$$

$$\frac{\partial \pi}{\partial H} = (1-\alpha)YH^{-1} - w_H = 0 \Rightarrow Y = w_H H / (1-\alpha) \tag{A3}$$

(A1) and (A3) determine the usual relation between L_j and H_j:

$$L_j = \frac{\alpha_j}{1-\alpha_j} \omega_i H_j \tag{A4}$$

with $\omega_i = w_H^i / w_L^i$ being the country's skill premium.

Combining (A1) and (A2), the firm's optimum is such that $\frac{w_L^i L_j}{\alpha_j} = \left(w_L^i - a\overline{q}_H^i w_H^i \right) \frac{L_j}{\alpha_j \gamma}$, which determines $w_{eff}^i = \frac{a\overline{q}_H^i w_H^i}{1-\gamma}$, $\omega_N^{eff} = \frac{1-\gamma}{a\overline{q}_H^i} = \frac{1-\gamma}{a}(1+\overline{\lambda}_i)$

because $\overline{q}_H^i = \frac{1}{1+\overline{\lambda}_i}$, $E_{eff} = \left(\frac{\gamma}{1-\gamma} \frac{1}{\overline{\lambda}_i} \right)^\gamma$, $L_j = \frac{\alpha_j}{1-\alpha_j} \frac{1-\gamma}{\overline{q}_H^i} H_j$.

APPENDIX C

1. 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_l^-) and h (Y_h^-) are $p_l Y_l^- = \beta I$ and $p_h Y_h^- = (1-\beta)I$, with $I = w_L L + w_H H$ being the country total income. Equalising supply (Y_l^+ and Y_h^+) and demand on both markets yields:

$$p_l Y_l^+ = \beta(w_L L + w_H H) \tag{A5}$$

$$p_h Y_h^+ = (1-\beta)(w_L L + w_H H) \tag{A6}$$

Because of the production functions, the demands for unskilled labour in both sectors at the firms' optimum are $L_l = \alpha_l \frac{p_l Y_l^+}{w_L}$ and $L_h = \alpha_h \frac{p_h Y_h^+}{w_L}$, and thereby at the country's level:

$$L^- = L_l + L_h = \alpha_l \frac{p_l Y_l^+}{w_L} + \alpha_h \frac{p_h Y_h^+}{w_L} \tag{A7}$$

Inserting (A5) and (A6) into (A7) yields $L = \dfrac{\beta\alpha_l + (1-\beta)\alpha_h}{w_L}(w_L L + w_H H)$, and therefore:

$$\omega \equiv \frac{w_H}{w_L} = \frac{1-\alpha}{\alpha}\frac{L}{H} \qquad (A8)$$

with $\alpha \equiv \beta\alpha_l - (1-\beta)\alpha_h$. The full employment skill premium is thus:

$$\hat{\omega} = \frac{1-\alpha}{\alpha}\frac{\bar{L}}{\bar{H}} \qquad (A9)$$

Finally, the demand for unskilled workers resulting from $\bar{\omega} < \hat{\omega}$ and full employment of the skilled is:

$$L = \frac{\alpha}{1-\alpha}\hat{\omega}\bar{H} < \bar{L} \qquad (A10)$$

Relations (A9) and (A10) 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.

2. The diversification cone

For both countries to produce both goods at the World full employment skill premium $\hat{\omega}_W$, the North skill relative endowment must be lower than the skill intensity in the skill intensive sector h corresponding to $\hat{\omega}_W$, and the South skill relative endowment must be higher than the skill intensity in the unskilled labour intensive sector l corresponding to $\hat{\omega}_W$, which can be written: $\dfrac{\alpha_h}{1-\alpha_h}\hat{\omega}_W < \dfrac{\bar{L}_N}{\bar{H}_N} < \dfrac{\bar{L}_S}{\bar{H}_S} < \dfrac{\alpha_l}{1-\alpha_l}\hat{\omega}_W$. This is equivalent to the condition stipulating that the North and the South endowments $(\bar{H}_N, \bar{L}_N)$ and $(\bar{H}_S, \bar{L}_S)$ are located in-between the lines $L = \dfrac{\alpha_h}{1-\alpha_h}\hat{\omega}_W H$ and $L = \dfrac{\alpha_l}{1-\alpha_l}\hat{\omega}_W H$. These lines draw the diversification cone.

More generally, for any given skill premium $\bar{\omega} \leq \hat{\omega}_W$, the condition for diversification in country i being at full employment is $\dfrac{\alpha_h}{1-\alpha_h}\bar{\omega} < \dfrac{\bar{L}_i}{\bar{H}_i} < \dfrac{\alpha_l}{1-\alpha_l}\bar{\omega}$, which signifies that its endowments $(\bar{H}_i, \bar{L}_i)$ are located in-between the lines $L = \dfrac{\alpha_h}{1-\alpha_h}\bar{\omega}H$ and $L = \dfrac{\alpha_l}{1-\alpha_l}\bar{\omega}H$.

APPENDIX D

We know that $\omega_i^{eff} = \dfrac{1-\gamma}{\bar{q}_H^i}$ and $\hat{\omega}_i = \dfrac{1-\alpha}{\alpha}\dfrac{1-\bar{q}_H^i}{\bar{q}_H^i}$. Then:

$$\omega_i^{eff} \gtreqless \hat{\omega}_i \Leftrightarrow \frac{1-\gamma}{\bar{q}_H^i} \gtreqless \frac{1-\alpha}{\alpha}\frac{1-\bar{q}_H^i}{\bar{q}_H^i} \Leftrightarrow \bar{q}_H^i \gtreqless \frac{1-(2-\gamma)\alpha}{1-\alpha} \equiv q_H{}^*$$

We thus have: $\omega_i^{eff} \gtreqless \hat{\omega}_i \Leftrightarrow \bar{q}_H^i \gtreqless q_H{}^*$.

The two possible cases are:

1) $\bar{q}_H^i \geq q_H{}^* \Rightarrow \omega_i^{eff} \geq \hat{\omega}_i \Rightarrow \omega_i = \hat{\omega}_i$ and country i is at its full employment equilibrium

2) $\overline{q}_H^i < q_H^* \Rightarrow \omega_i^{eff} < \hat{\omega}_i \Rightarrow \omega_i = \omega_i^{eff}$ and country i suffers unemployment of the unskilled (Lemma 3).

Finally, the condition for $q_H^* > 0$ is: $1 - (2 - \gamma)\alpha < 0 \Leftrightarrow \gamma < (2\alpha - 1)/\alpha$.

APPENDIX E: Proof of Lemma 5

In Figure A1, the lines that determine the diversification cones are dashed and bold for the cone at the beginning of globalization, and bold at the end of the globalisation process.

For the North to be outside the diversification cone at the end of the globalisation process, we must have (Figure A1): $\overline{\lambda}_N < \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_S$, i.e., $\dfrac{\overline{\lambda}_N}{\overline{\lambda}_S} < \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}$.

Since the North is inside and the South outside the diversification cone at the beginning of globalization, we have (Figure A1): $\overline{\lambda}_S > \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_N > \overline{\lambda}_N > \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_N$. Since the

South is inside the diversification cone at the end of globalization, then $\overline{\lambda}_S < \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_S$,

which implies: $\dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_S > \overline{\lambda}_S > \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_N > \overline{\lambda}_N > \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_N$, and thus:

$\dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}\overline{\lambda}_S > \overline{\lambda}_N \Rightarrow \dfrac{\overline{\lambda}_N}{\overline{\lambda}_S} < \dfrac{\alpha_h}{1-\alpha_h}\dfrac{1-\alpha}{\alpha}$. This shows that the North is outside the diversification cone at the end of the globalisation process.
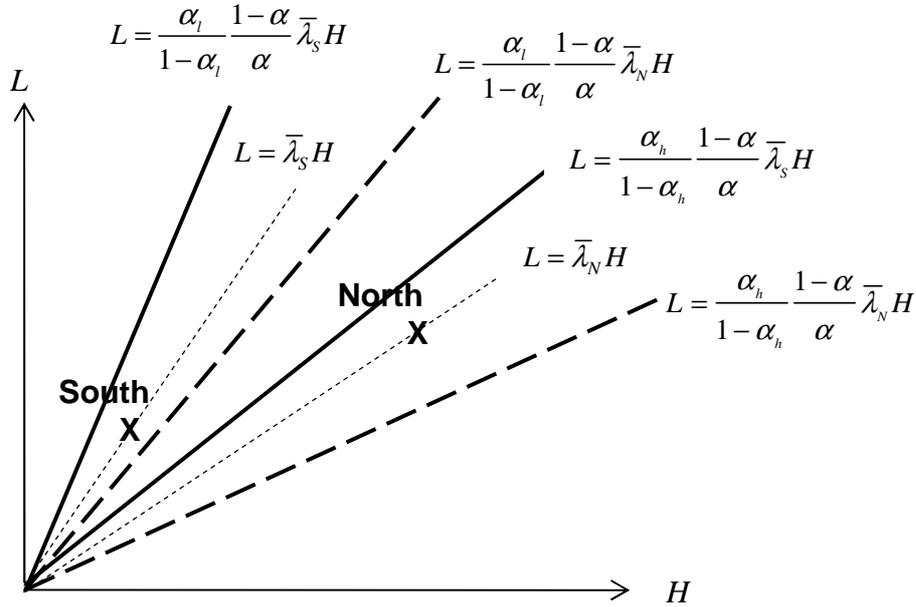
Figure A1. The diversification cones at the beginning and the end of globalization

APPENDIX F: Proposition 4

At the outset of the globalization process, the weight of the South is negligible compared to the North. The World full employment skill premium is equal to the North full employment skill premium and the North is at full employment by assumption.

The condition for the North to maintain full employment throughout the first stage of globalization is that it still enjoys full employment at the end of this phase. Two cases must thereby be analysed: a) both the North and the South are in the diversification cone at the beginning of the second stage, and b) They are both outside the cone at this time.

a) The North and the South are inside the cone at the second stage

At the end of the first stage, the line $L = \bar{\lambda}_S H$ merges with the line $L = \frac{\alpha_l}{1-\alpha_l} \hat{\omega}_W H$, which

entails $\hat{\omega}_W = \frac{1-\alpha_l}{\alpha_l} \bar{\lambda}_S$. In addition, the North endowments belong to the cone, i.e.,

$\frac{\alpha_h}{1-\alpha_h} \hat{\omega}_W < \bar{\lambda}_N = \frac{\bar{L}_N}{\bar{H}_N} < \frac{\alpha_l}{1-\alpha_l} \hat{\omega}_W$, and thus: $\bar{\lambda}_N > \frac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)} \bar{\lambda}_S$.

1) If the World full employment skill premium at the end of phase 1 is lower than the

North efficiency skill premium, i.e., $\hat{\omega}_W = \frac{1-\alpha_l}{\alpha_l} \bar{\lambda}_S < \omega_{eff}^N$, then the North remains at full

employment throughout this phase. By introducing $\omega_{eff}^N = (1-\gamma)/\bar{q}_H^N$ and $\bar{q}_H^N = (1+\bar{\lambda}_N)^{-1}$ into the preceding inequality, this determines the following condition for full employment in

the North throughout the first stage of globalisation: $\bar{\lambda}_N > \frac{(1-\alpha_l)\bar{\lambda}_S - (1-\gamma)\alpha_l}{(1-\gamma)\alpha_l}$.

2) If the World full employment skill premium at the end of phase 1 is higher than the

North efficiency skill premium, i.e., $\hat{\omega}_W = \frac{1-\alpha_l}{\alpha_l} \bar{\lambda}_S > \omega_{eff}^N \Leftrightarrow \bar{\lambda}_N < \frac{(1-\alpha_l)\bar{\lambda}_S - (1-\gamma)\alpha_l}{(1-\gamma)\alpha_l}$, then

there is a moment during this phase when ω_W becomes equal to $\omega_{eff}^N < \hat{\omega}_W$, thereby creating unemployment of the unskilled in the North.

b) The North and the South are outside the cone at stage 2

In this case, the North is outside the cone when the South enters the cone, i.e., $\bar{\lambda}_N < \frac{\alpha_h}{1-\alpha_h} \hat{\omega}_W$

when the South enters the cone. When the South enters the cone, the line $L = \bar{\lambda}_S H$ merges

with the line $L = \frac{\alpha_l}{1-\alpha_l} \hat{\omega}_W H$, which entails $\hat{\omega}_W = \frac{1-\alpha_l}{\alpha_l} \bar{\lambda}_S$. Hence: $\bar{\lambda}_N < \frac{\alpha_h(1-\alpha_l)}{\alpha_l(1-\alpha_h)} \bar{\lambda}_S$.

There are thus two possibilities:

1) At the end of Stage 1, the Northern skill premium is lower than ω_N^{eff}, i.e.,

$\frac{1-\alpha_h}{\alpha_h} \bar{\lambda}_N = \frac{1-\alpha_h}{\alpha_h} \frac{1-\bar{q}_H^N}{\bar{q}_H^N} < \omega_N^{eff}$, and the North remains at full employment during the whole

Stage 1. Since $\omega_N^{eff} = \frac{1-\gamma}{\bar{q}_H^N} = (1-\gamma)(1+\bar{\lambda}_N)$, this inequality can be written $\bar{q}_H^N > \frac{1-(2-\gamma)\alpha_h}{1-\alpha_h}$

and, assuming that $(2-\gamma)\alpha_h < 1$: $\bar{\lambda}_N < \frac{(1-\gamma)\alpha_h}{1-(2-\gamma)\alpha_h}$

2) At the end of Stage 1, the Northern skill premium is higher than ω_N^{eff}, which implies

$\frac{1-\alpha_h}{\alpha_h} \bar{\lambda}_N > \omega_{eff}^N$, i.e., $\bar{q}_H^N < \frac{1-(2-\gamma)\alpha_h}{1-\alpha_h}$ and $\bar{\lambda}_N > \frac{(1-\gamma)\alpha_h}{1-(2-\gamma)\alpha_h}$. Then, the North skill

premium is ω_{eff}^N and the North suffers unemployment of the unskilled when and as $\hat{\omega}_N$ become higher than ω_{eff}^N.

APPENDIX G

To ensure full employment in both the North and the South throughout the globalization process, the full employment skill premium must always be lower than or equal to the efficiency skill premium in both countries at any time, i.e., $\hat{\omega}_i(t) \le \omega_i^{eff}$, $i = N, S$, $\forall t$. Since the highest value of the full employment skill premium is $\hat{\omega}_N = \dfrac{1-\alpha_h}{\alpha_h} \bar{\lambda}_N$ in the North and

$\hat{\omega}_S^A = \dfrac{1-\alpha}{\alpha} \bar{\lambda}_S$ in the South, we must have $\dfrac{1-\alpha_h}{\alpha_h} \bar{\lambda}_N \le \omega_N^{eff} \Leftrightarrow \dfrac{\bar{H}_N}{\bar{L}_N} \ge \dfrac{a(1-\alpha_h)}{\alpha_h(1-\gamma)} - 1$ and

$\dfrac{1-\alpha}{\alpha} \bar{\lambda}_S \le \omega_S^{eff} \Leftrightarrow \dfrac{\bar{H}_S}{\bar{L}_S} \ge \dfrac{a}{1-\gamma} \dfrac{1-\alpha}{\alpha} - 1$.