# Intersectoral adjustment and unemployment in a two-country Ricardian model

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## 1 Introduction

Recent episodes of trade liberalization (*e.g.* NAFTA, Eastern Europe) have lead to a revival of interest for adjustment issues. The reduction of trade barriers implies a slow and costly reallocation of production factors which gives rise to a lot of conflicting interests and controversy. Given the multilateral dimension of these reforms, it seems natural to analyze the adjustment process in an environment where countries are interdependent. In this paper, we attempt to explore this issue.

Where the adjustment process has been examined, the aim has primarily been to study the qualitative properties of factor reallocation within countries (*e.g.* Lapan (1976), Neary (1982), Mussa (1978)) and the welfare implications of domestic government intervention (*e.g.* Karp and Paul (1994, 1998), Terra (1999), Dehejia (1997)). In order to focus on the domestic adjustment process, the small economy assumption has been generally adopted, thereby ignoring the possible interactions between domestic and foreign factor adjustments. A notable exception is a paper by Fung and Staiger (1994) which studies the relationship between programs of trade adjustment assistance in a context of a reciprocal trade liberalization. The authors argue that trade adjustment assistance can contribute to the success of trade reforms because an assistance to trade-impacted sectors introduced by one

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country can reduce the distortionary costs of its trading partner's remaining tariffs. Although this paper helps to understand how governments may cooperate in order to enhance welfare during the transition to free trade, the theoretical framework remains very specific particularly regarding the demand side of the economy.

We want to study a situation where two countries undertake a bilateral trade liberalization reform and need to reallocate production between sectors. The creation of new jobs is not instantaneous because of the presence of adjustment costs. At the beginning of the transition toward the long-run free trade equilibrium, the two countries produce both goods irrespective of their comparative advantages. Questions are then the following: how do the two adjustment processes interact each other? What are the trajectories of these adjustments? Does welfare in both countries always increase throughout the transition?

In order to answer these questions, we use the simplest framework. The world is described as a two-country Ricardian model. While labour is assumed to be perfectly mobile across sectors, the number of jobs available in each sector in both countries is fixed in the short run and slowly adjust. The creation of new jobs in a particular sector depends on the excess labour supply in that sector and a parameter which measures the rate of job creation.

We identify several free trade regimes during the adjustment process according to whether or not the world relative price is between the two autarkic prices. In regimes where the world relative price is not between the two autarkic prices, we show that one of the two countries overshoots its autarkic equilibrium, *i.e.* temporarily specializes in the wrong direction, in order to increase the production of the good which is too rare at the world level. In such a case, the world price formation mechanism ensures that production and consumption in the two countries are harmonized at the world level. In these regimes, in both countries, there is unemployment in the same sector and welfare increases. When the world relative price is between the two autarkic prices, sectoral reallocation is monotonic in both countries but welfare in the two countries moves in opposite directions. Finally, we find that when the two countries have "very" different rates of job creation/destruction, because of institutional differences for instance, the world relative price adjusts so that the adjustment speed differential between the two countries decreases.

These conclusions may have some policy implications. There is a strong belief among trade economists that, if there are no adjustment costs or if the adjustment speed can be totally controlled by a government, a country should specialize instantaneously in the goods for which it has comparative advantages. This paper demonstrates that this view may be incorrect: speeding up the domestic adjustment process could be inappropriate in an interdependent world where foreign countries adjust too. Our conclusions suggest that, in some circumstances, it could be better either to slow down sectoral reallocation or to encourage temporarily the production of the good in which there is a comparative *disadvantage.*

There is an interesting analogy between these results and the famous conclusions reached by Neary (1982). Where we assume that there is only one factor of production in the economy and concentrate on the interdependence of two open economies, Neary ignores the latter by assuming that the economy at hand takes the world prices as given and focuses instead on the simultaneous adjustment of two different factors of production. Neary emphasizes the importance of simultaneously consider the adjustment process in both labour and capital markets. If government policy can control the speed of adjustment in both markets in a nondistorting way, the first best policy is to bring the economy to its long-run equilibrium instantaneously. However, if for some reasons the government's instruments are constrained, the second best policy is to harmonize in time the two reallocation processes in order to avoid costly cyclical movements in factor prices and allocations.

Our conclusions are somewhat similar in the sense that the home and foreign adjustment processes must be in phase in order to guarantee a balanced production of the two goods during the transition. An interdependence among factor markets is then replaced by an interdependence among countries.

The plan of the paper is as follows. Section 2 presents the model and the autarkic equilibrium. A particular attention is devoted to the description of the labour market. In section 3, we study the free trade equilibrium with and without unemployment. Section 4 analyzes the dynamic aspects of the transition towards the long-run Ricardo equilibrium. Section 5 contains concluding remarks.

# 2 Autarky

We consider a closed economy (denoted $H$) which produces two goods $i = 1, 2$.

## 2.1 Production and consumption

### 2.1.1 Production

Both sectors use labour with constant returns-to-scale:

$$L_i = a_i Y_i, \ i = 1, 2 \tag{2.1}$$

where $L_i$ and $Y_i$ are respectively labour and production in sector $i$ and $a_i$ is a constant which represents the inverse of labour productivity in sector $i$. There is perfect competition among firms in each sector.

### 2.1.2 Consumption

There are $N$ individuals in the economy. Each of them supplies one unit of labor. All have the same utility function which depends on their levels of consumption $c_1$ and $c_2$ of goods 1 and $2: U(c_1, c_2) = c_1^{\gamma} c_2^{1-\gamma}$, $0 < \gamma < 1$. Denoting $v_k$, the income of agent $k$, utility maximization subject to the budget constraint $p_1 c_{k1} + p_2 c_{k2} \leqslant v_k$ yields the individual demand functions $c_{k1} = \gamma v_k / p_1$ and $c_{k2} = (1-\gamma) v_k / p_2$. Aggregating individual demands for goods in the whole economy, we obtain:

$$\begin{aligned} C_1 &= \gamma W^H / p_1 \\ C_2 &= (1-\gamma) W^H / p_2 \end{aligned} \tag{2.2}$$

where $W^H$ is the country $H$ total income, *i.e.* $W^H = \sum\limits_{k=1} N v_k$

## 2.2 The labour market

A central feature in this Ricardian model is that there can be unemployment in the short run. We assume that there is a maximum employment level, $\overline{L}_i$, in each sector at each date and that $\overline{L}_1 + \overline{L}_2 = N$. The labour market is governed by the following institutional rule: all workers in a particular sector are effectively employed in that sector. If the labour demand is smaller than the number of workers, denoted $N_i$ for sector $i$, each worker reduces his working time so that everybody in the sector can work the same amount of time. This mechanism of the labour market is intended to capture the phenomenon of "partial unemployment" but is not essential to our results[1]. Let $u_1$, $u_2$ be the partial unemployment rates in sector 1 and 2 respectively, $w_1$, $w_2$, the wages and $L_1$, $L_2$ the effective employment levels; we have the following definition of the labour market equilibrium:

**Definition 1** *Given* $(\overline{L}_1, \overline{L}_2) > 0$, $(w_1, w_2, N_1, N_2, L_1, L_2)$ *is a labour market equilibrium if:*

*(i)* $N_1 + N_2 = N$

*(ii)* $L_i = \min\{N_i, \overline{L}_i\} = \begin{cases} N_i \text{ if } N_i \leqslant \overline{L}_i \\ \overline{L}_i \text{ if } N_i > \overline{L}_i \end{cases}$

*(iii) workers have no incentive to change sector i.e.*

$(1-u_1)w_1 = (1-u_2)w_2$ *where* $u_i = \max\left\{0, \frac{N_i - \overline{L}_i}{N_i}\right\}$, $i = 1, 2$.

Note that since $\overline{L}_1 + \overline{L}_2 = N$, there cannot be unemployment in the two sectors simultaneously.

[1] Alternatively, we could assume that some workers are fully unemployed and that there exists a perfect unemployment benefit redistribution.

## 2.3 The goods market

We use the following assumption :

**Assumption 1** $p_i = a_i w_i,\ i = 1, 2$

This zero-profit assumption may reflect the fact that, due to the pressure of labour unions, wages are indexed to prices so that profits are zero. Using the definition of the country's total income together with the above assumption, we have :

$$W^H = w_1 L_1 + w_2 L_2 = \frac{p_1}{a_1} L_1 + \frac{p_2}{a_2} L_2 \tag{2.3}$$

The equilibrium on goods market requires :

$$C_1 = Y_1 = \frac{L_1}{a_1} \tag{2.4}$$

$$C_2 = Y_2 = \frac{L_2}{a_2} \tag{2.5}$$

Combining (2.2), (2.4) and (2.5), we get :

$$\begin{aligned} w_1 L_1 &= \gamma W^H \\ w_2 L_2 &= (1 - \gamma) W^H \end{aligned} \tag{2.6}$$

## 2.4 The short run equilibrium

In the short run, the number of jobs available in each sector $\overline{L}_i > 0,\ i = 1, 2$ is fixed. We first look at the situation where there is full employment in the economy; we then turn to the case where there is partial unemployment in one of the two sectors. In each case, we compute the individual consumption levels that will be used in the next section.

### 2.4.1 The full employment equilibrium

Full employment in the economy is characterized by : $N_1 = \overline{L}_1 = L_1$, $N_2 = \overline{L}_2 = L_2$ and $w_1 = w_2$. Using (2.6), we get $\dfrac{\overline{L}_1}{\gamma} = \dfrac{\overline{L}_2}{1-\gamma} = \dfrac{N - \overline{L}_1}{1-\gamma}$. This in turn leads to :

$$\overline{L}_1 = \gamma N,\ \overline{L}_2 = (1 - \gamma) N$$

In equilibrium with full employment, the number of jobs in a particular sector is equal to the product between the share of total consumption devoted to the good produced in the sector and the total number of workers in the economy. Equilibrium prices are : $w_1 = w_2 = \frac{p_1}{a_1}, \frac{p_2}{p_1} = \frac{a_2}{a_1}$.

Equilibrium levels of production and consumption are:

$$Y_1 = C_1 = \frac{\gamma N}{a_1},\ Y_2 = C_2 = \frac{(1-\gamma)N}{a_2}$$

Individual consumption levels are therefore:

$$c_1 = \frac{\gamma}{a_1},\ c_2 = \frac{(1-\gamma)}{a_2} \tag{2.7}$$

### 2.4.2 Partial unemployment equilibrium

Suppose for instance that there is partial unemployment in sector 1. This happens when $\overline{L}_1 < \gamma N$, $L_1 = \overline{L}_1 < N_1$, $L_2 = N_2 < \overline{L}_2$ and $(1-u_1)w_1 = w_2$. Using (2.6), we get:

$$N_1 = \gamma N,\ L_2 = N_2 = (1-\gamma)N$$

and,

$$w_1 = \frac{p_1}{a_1},\ w_2 = w_1\frac{\overline{L}_1}{\gamma N},\ \frac{p_2}{p_1} = \frac{a_2}{a_1}\frac{\overline{L}_1}{\gamma N}$$

Equilibrium levels of production and consumption are $Y_1 = C_1 = \frac{\overline{L}_1}{a_1}$, $Y_2 = C_2 = \frac{(1-\gamma)N}{a_2}$. Individual consumption levels are:

$$c_1 = \frac{\overline{L}_1}{a_1 N},\ c_2 = \frac{(1-\gamma)}{a_2} \tag{2.8}$$

When there is partial unemployment in sector 1, the level of consumption in that sector is lower than under full employment.

The analysis of partial unemployment equilibrium in sector 2 is similar and gives the following equilibrium values for individual consumptions:

$$c_1 = \frac{\gamma}{a_1},\ c_2 = \frac{\overline{L}_2}{a_2 N} \tag{2.9}$$

## 2.5 Dynamics in autarky

Whereas in the short run, jobs are fixed in both sectors, we assume that labour demand gradually adjusts to the number of workers working in the sector. The adjustment process is governed by the following differential equation:

$$\dot{\overline{L}}_i(t) = \beta\left(N_i(t) - \overline{L}_i(t)\right),\ i = 1,2 \tag{2.10}$$

where a "·" represents a time derivative; the parameter $\beta$ is a measure of the rate of job creation/destruction and can be viewed as an indicator of flexibility of the labour demand. Note that, at each date $t$, the short-run analysis of the previous section applies.

If $N_i(t) - \overline{L}_i(t) > 0$, the above adjustment rule can be rewritten as $\dot{\overline{L}}_i(t) = \beta N_i(t)u_i(t)$, which says that sector $i$ grows whenever there is unemployment there. A microeconomic justification for this reduced form can be given. When unemployment is high in a given sector, the rate at which workers fill vacant jobs is high. This reduces the expected firms' hiring costs and then increases the aggregate amount of job openings in the sector. This interpretation of the adjustment process is in line with the recent literature on search models (e.g. Pissarides, 1990). Note that it is possible to give an alternative interpretation for this adjustment process. Dividing (2.10) by $\overline{L}_i(t)$ and using $(1-u_i)\frac{p_i}{a_i} = \frac{p_j}{a_j}$, labour dynamics can be rewritten as: $\frac{\dot{\overline{L}}_i(t)}{\overline{L}_i(t)} = \beta\frac{a_j}{p_j}\left(\frac{p_i}{a_i} - \frac{p_j}{a_j}\right)$, $i = 1, 2$. With this latter expression, job creation (and therefore employment in the next instant) occurs in sector $i$ as long as the value of the marginal productivity of labor is larger in that sector[2].

Of course, many of the variables that are likely to be important in a full microeconomic analysis are left out in equation (2.10). For instance, the frictions that must underlie the job creation process such that firms' hiring costs or workers' search costs are not made explicit. The reason for not having explicit microeconomic foundations for the adjustment rule is that the combination of a sophisticated dynamics with the large-economy assumption is too costly in terms of analytical tractability. Since we are primarily interested in doing a positive analysis of the adjustment process[3] in a model with two interdependent countries, equation (2.10) seems a reasonable approximation.

It is straightforward to see that, given an initial disequilibrium, the economy converges monotonically to its long-run full employment equilibrium. Suppose for instance that there is partial unemployment in sector 1 at the beginning of the adjustment process; in such a case: $\dot{\overline{L}}_1(t) = \beta(N_1(t) - \overline{L}_1(t)) > 0$ where $N_1 = \gamma N$. Therefore $\overline{L}_1$ increases until $N_1 = \gamma N$; this in turn implies that $\frac{w_2}{w_1} = \frac{\overline{L}_1}{\gamma N}$, $\frac{p_2}{p_1} = \frac{a_2}{a_1}\frac{\overline{L}_1}{\gamma N}$ and $c_1 = \frac{\overline{L}_1}{a_1 N}$ increase throughout the adjustment process.

We now want to know whether these properties of monotonicity of the adjustment process still hold in an interdependent world. For the sake of clarity, we omit the variable $t$ in the rest of the text.

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2 e.g. Saint-Paul (1996) exhibits an arbitrage condition for posting vacancies which depends on the productivity differential of workers.

3 For instance, Karp and Paul (1994,1998) demonstrate the sensitivity of policy prescriptions to the microeconomic foundations of the adjustment process.

# 3 Free trade

## 3.1 The world economy

In this section, we consider that country $H$ (the home country) moves from autarky to free trade with an other country denoted $F$ (the foreign country). We would like to study the implications of this trade liberalization on sectoral adjustment in both countries. Like country $H$, country $F$ produces two goods $i = 1, 2$ using labour with constant returns-to-scale. The production technology of $F$ is given by:

$$L_i' = a_i' Y_i', \ i = 1, 2 \tag{3.1}$$

We assume that country $H$ (resp. $F$) has a comparative advantage in the production of good 1 (resp. good 2), i.e.

**Assumption 2** $a_2/a_1 > a_2'/a_1'$

The demand and supply sides of country $F$ are based on similar assumptions than in country $H$. In order to save space, we do not present them again; we denote all variables associated to country $F$ with the superscript $'$: for instance $N'$ and $w_1'$ are respectively the total number of workers and sector 1 wage in country $F$. We remind the reader that the preferences are identical and that firms' profits are zero in both countries.

### 3.1.1 The labour market and the case of full specialization

If a country produces both goods at the international equilibrium, the labour market works along the lines described in the previous section. If, however, only one good is produced, two configurations can occur.

The first configuration occurs when there is no labour supply in one of the two sectors *i.e.* $N_i = 0$, $N_j > 0$. Suppose for instance that there are no workers in sector 2 of country $H$; we have: $N_1 = N$, $N_2 = 0$ and $\overline{L}_1 > 0, \overline{L}_2 = N - \overline{L}_1 > 0$. This implies $L_1 = \overline{L}_1$ and $L_2 = 0$. In order for this to be an equilibrium, the following inequality must be verified: $(1 - u_1)w_1 \geqslant w_2$ where $u_1 = \frac{N - \overline{L}_1}{N}$.

The second possible configuration happens when one of the two sectors is inactive *i.e.* $\overline{L}_i = N$, $\overline{L}_j = 0$. Suppose there is full specialization in sector 1 of country $H$, then $\overline{L}_1 = N$, $\overline{L}_2 = 0$. Since there are no jobs available in sector 2, there is no wage there. We have therefore: $N_1 = N = \overline{L}_1, \forall w_1 > 0$.

### 3.1.2 The goods market

The world income $W^*$ is

$$\begin{aligned} W^* &= w_1 L_1 + w_2 L_2 + w_1' L_1' + w_2' L_2' \\ &= p_1(Y_1 + Y_1') + p_2(Y_2 + Y_2') \end{aligned} \tag{3.2}$$

Since preferences are identical in the two countries, we have:

$$C_1^* = \frac{\gamma W^*}{p_1} \text{ and } C_2^* = \frac{(1-\gamma)W^*}{p_2} \tag{3.3}$$

where $C_i^*$ is the world consumption of good $i$.

Equilibrium on international markets requires:

$$\begin{aligned} C_1^* &= Y_1^* = \frac{L_1}{a_1} + \frac{L_1'}{a_1'} \\ C_2^* &= Y_2^* = \frac{L_2}{a_2} + \frac{L_2'}{a_2'} \end{aligned} \tag{3.4}$$

where $Y_1^* = Y_1 + Y_1'$ and $Y_2^* = Y_2 + Y_2'$.

Combining equations (3.4) and (3.3), we get:

$$(1-\gamma)Y_1^* = \frac{p_2}{p_1}\gamma Y_2^* \tag{3.5}$$

Hereafter, good 1 is the numeraire and we define $p = p_2$ as the relative price of good 2.

## 3.2 Short-run equilibrium with two countries

We are now able to characterize the short-run equilibrium in our two-country economy. To begin with, we note that when both countries are at the long-run full employment equilibrium, the traditionnal Ricardian analysis applies. In that case, there are two types of equilibrium configuration: (i) both countries are completely specialized in accordance with their comparative advantage with $\frac{a_2'}{a_1'} \leqslant p \leqslant \frac{a_2}{a_1}$, or (ii) one of the two countries is incompletely specialized with a world relative price equal to the autarkic price of the incompletely specialized country.

If the two countries are not at the long-run full employment equilibrium, we distinguish below three possible short-term regimes depending on whether unemployment occurs in sector 1 or sector 2 in each country. For each regime of unemployment, we compute the short-run equilibrium world relative price in terms of the state variables $\overline{L}_1$, $\overline{L}_2'$ and the other parameters of the model ($a_i$, $a_i'$, $N$, $N'$ and $\gamma$) and we derive a necessary condition for the existence of such a regime.

### 3.2.1 *Case* 1: Unemployment in sector 1 in both countries

Since, in equilibrium, workers must be indifferent between the two sectors, $u_1$, $u_1' > 0$ implies

$$\begin{aligned} (1-u_1)w_1 &= w_2 \\ (1-u_1')w_1' &= w_2' \end{aligned} \tag{3.6}$$

and therefore $w_1 > w_2$ and $w'_1 > w'_2$ : in both countries the wage rate in sector 1 is larger than the wage rate in sector 2. Using these latter inequalities, Assumption 2 and $w'_1 = \frac{1}{a'_1}$, $w'_2 = \frac{p}{a'_2}$, we deduce that :

$$p < \frac{a'_2}{a'_1} < \frac{a_2}{a_1} \tag{3.7}$$

In country $H$, the labour supplies are given by $N_1 = \frac{\overline{L}_1}{1-u_1}$ and $N_2 = N - N_1$. The employment levels are respectively $L_1 = \overline{L}_1$ and $L_2 = N_2$. From (3.6), we get $L_2 = N - \overline{L}_1 \frac{w_1}{w_2} = N - \overline{L}_1 \frac{a_2}{pa_1}$. A similar analysis applies in country $F$ and gives $L'_1 = \overline{L}'_1$, $L'_2 = N' - \overline{L}'_1 \frac{a'_2}{pa'_1}$.

Using the above expressions and the market equilibrium condition (3.5), we finally obtain the equilibrium world relative price in terms of $\overline{L}_1$ and $\overline{L}'_2$ :

$$p = \frac{\overline{L}_1/a_1 + \left(N' - \overline{L}'_2\right)/a'_1}{\gamma\left(N/a_2 + N'/a'_2\right)} \tag{3.8}$$

Substituting (3.8) into (3.7) leads to :

$$\gamma\left(N\frac{a'_2}{a_2} + N'\right) > \overline{L}_1\frac{a'_1}{a_1} + (N' - \overline{L}'_2) \tag{3.9}$$

Condition (3.9) means that a *Case* 1 equilibrium emerges if the number of jobs available in sector 1 in both countries is small.

### 3.2.2 *Case* 2 : Unemployment in sector 2 in both countries

$u_2, u'_2 > 0$ implies

$$\begin{aligned}(1-u_2)w_2 &= w_1\\ (1-u'_2)w'_2 &= w'_1\end{aligned} \tag{3.10}$$

and therefore $w_2 > w_1$ and $w'_2 > w'_1$ : in both countries the wage rate in sector 2 is larger than the wage rate in sector 1. Using Assumption 2 and $w_1 = \frac{1}{a_1}$, $w_2 = \frac{p}{a_2}$, we get

$$\frac{a'_2}{a'_1} < \frac{a_2}{a_1} < p \tag{3.11}$$

Using a procedure similar to the one used for *Case* 1, the employment levels are given by : $L_2 = \overline{L}_2$, $L_1 = N - \overline{L}_2\frac{pa_1}{a_2}$ for country $H$ and $L'_2 = \overline{L}'_2$, $L'_1 = N' - \overline{L}'_2\frac{pa'_1}{a'_2}$ for country $F$. Using these expressions and condition (3.5), we get $p$ in terms of $\overline{L}_1$ and $\overline{L}'_2$ :

$$p = \frac{(1-\gamma)\left(N/a_1 + N'/a'_1\right)}{\left(N - \overline{L}_1\right)/a_2 + \overline{L}'_2/a'_2} \tag{3.12}$$

Combining (3.12) with (3.11) leads to:

$$(1-\gamma)\left(N+\frac{a_1}{a_1'}N'\right) > N-\overline{L}_1+\frac{a_2}{a_2'}\overline{L}_2' \tag{3.13}$$

*Case* 2 occurs when the number of jobs available in sector 2 in both countries is small.

### 3.2.3 *Case* 3: Sector 1's unemployment in country *H* and sector 2's unemployment in country *F*[4]

$u_1$, $u_2' \geqslant 0$ implies:

$$\begin{aligned}(1-u_1)w_1 &= w_2\\(1-u_2')w_2' &= w_1'\end{aligned} \tag{3.14}$$

and therefore $w_1 \geqslant w_2$ and $w_2' \geqslant w_1'$. These two inequalities, together with $w_1 = \frac{1}{a_1}$, $w_2 = \frac{p}{a_2}$, $w_1' = \frac{1}{a_1'}$ and $w_2' = \frac{p}{a_2'}$ lead to:

$$\frac{a_2'}{a_1'} \leqslant p \leqslant \frac{a_2}{a_1}$$

By analogy with *Case* 1 and *Case* 2, we obtain the following employment levels: $L_1 = \overline{L}_1$, $L_2 = N - \overline{L}_1\frac{a_2}{pa_1}$, $L_2' = \overline{L}_2'$ and $L_1' = N' - \overline{L}_2'\frac{pa_1'}{a_2'}$.

Substituting these expressions into the goods market equilibrium condition (3.5) gives:

$$p = \frac{\overline{L}_1/a_1 + (1-\gamma)\,N'/a_1'}{\overline{L}_2'/a_2' + \gamma N/a_2} \tag{3.15}$$

Inequality $\frac{a_2}{a_1} \geqslant p$ is equivalent to

$$(1-\gamma)\left(N+\frac{a_1}{a_1'}N'\right) \leqslant N-\overline{L}_1+\frac{a_2}{a_2'}\overline{L}_2' \tag{3.16}$$

which is the opposite of (3.13) for *Case* 2. One the other hand, $p \geqslant \frac{a_2'}{a_1'}$ is equivalent to

$$\gamma\left(N\frac{a_2'}{a_2}+N'\right) \leqslant \overline{L}_1\frac{a_1'}{a_1}+N'-\overline{L}_2' \tag{3.17}$$

which is the opposite of (3.9) for *Case* 1. In order to write individual consumptions for *Case* 1, *Case* 2 and *Case* 3, we note that, for these three

[4] *Case* 3 includes the cases where there is full-employment in one country.

cases, the individual incomes in countries $H$ and $F$, $v$ and $v'$, are given by the following expressions:

$$v = \min\left(\frac{1}{a_1}, \frac{p}{a_2}\right)$$

$$v' = \min\left(\frac{1}{a'_1}, \frac{p}{a'_2}\right)$$

Using the fact that $c_1 = \gamma v$ and $c_2 = \frac{(1-\gamma)}{p}v$, country $H$'s individual consumptions in *Cases* 1 and 3 are:

$$c_1 = \frac{\gamma}{a_2}p,\ c_2 = \frac{(1-\gamma)}{a_2} \tag{3.18}$$

whereas in *Case* 2,

$$c_1 = \frac{\gamma}{a_1},\ c_2 = \frac{(1-\gamma)}{a_1}\frac{1}{p} \tag{3.19}$$

Similarly in country $F$,we have in *Case* 1:

$$c'_1 = \frac{\gamma}{a'_2}p,\ c'_2 = \frac{(1-\gamma)}{a'_2} \tag{3.20}$$

whereas in *Cases* 2 and 3,

$$c'_1 = \frac{\gamma}{a'_1},\ c'_2 = \frac{(1-\gamma)}{a'_1}\frac{1}{p} \tag{3.21}$$

At this stage and before analyzing the dynamics of this two-country world, it is important to briefly address the issue of the pattern of trade. In particular, we would like to know whether in *Case* 1 and *Case* 2, where the relative price is outside the interval $(\frac{a'_2}{a'_1}, \frac{a_2}{a_1})$, the two countries are going to export the good for which they have a comparative advantage. To answer this question, we derive in Appendix 3 an expression for country's $H$ net exports of good 1 under *Case* 1 (the study of *Case* 2 is similar). The sign of the expression includes two terms. The first term is always positive because of our assumption about the structure of comparative advantages: other things being equal, country $H$ tends to export good 1 because it has a comparative advantage in that good. The sign of the second term depends on the difference between the rates of sector 1's activity in the two countries. It turns out that, providing that the comparative advantages are sufficiently small, if sector 1's activity in country $H$ is low compared to the one in country $F$, country $H$ may end up exporting good 2 in which it has a comparative disadvantage.

We close the section by emphasizing that it is possible to show that conditions (3.9), (3.13) and the associated inequalities (3.16) and (3.17) are also sufficient for guaranteeing the existence of an equilibrium. In other words, for any state $\left(\overline{L}_1, \overline{L}'_2\right)$ and any set of admissible parameters satisfying one of the above conditions, there exists a short-run equilibrium with positive unemployment. This introduces the dynamic analysis of the next section.

## 3.3 Dynamics

In this section, we study the adjustment process of the two economies following a move from autarky to free trade. We first introduce the adjustment rules of the two economies. Then, we describe the trade liberalization experiment we want to analyze and the properties of the adjustment process.

### 3.3.1 The adjustment rules

Dynamics in the two countries is similar to the description of the adjustment process in autarky *i.e.* at each date $t$, the change in the maximum employment level in each sector is governed by the excess of labour supply : we have

$$\begin{aligned} \dot{\overline{L}}_i &= \beta(N_i - \overline{L}_i) \\ \dot{\overline{L}}'_i &= \beta'(N'_i - \overline{L}'_i) \end{aligned} \tag{3.22}$$

where $\beta$ and $\beta'$ are measures of the rates of job creation / destruction in both countries. A difference between $\beta$ and $\beta'$ can be thought as an institutional difference in terms of flexibility of the labour demand between the two countries.

### 3.3.2 Properties of the adjustment

3.3.2.1 Explaining the trade liberalization experiment

We study a situation in which, for a given initial state $(\overline{L}_1(0), \overline{L}'_2(0))$, both countries suddendly move from autarky (described in section 2) to free trade (described in section 3). This initial trade chock gives rise to a change in the equilibrium relative price which in turn affects the sectoral wages and the labour supplies in both countries.

At each point $(\overline{L}_1(t), \overline{L}'_2(t))$ along the subsequent free trade adjustment trajectory, the short-run analysis of section 3.2 applies. In particular, the expression of the equilibrium price $p(t)$ depends on whether $(\overline{L}_1(t), \overline{L}'_2(t))$ satisfy (3.9), (3.13) or the associated inequalities (3.16) and (3.17).

3.3.2.2 Partitioning the $(\overline{L}_1, \overline{L}_2')$ space

We would like to construct a graphic summing up the dynamics of the adjustment process. In order to do that, we draw two lines in the $(\overline{L}_1, \overline{L}_2')$ space whose equations are:

$$\overline{L}_2' = \frac{a_1'}{a_1}\overline{L}_1 - \gamma\left(N\frac{a_2'}{a_2} + N'\right) + N' \tag{3.23}$$

$$\overline{L}_2' = \frac{a_2'}{a_2}\overline{L}_1 + (1-\gamma)\frac{a_1}{a_1'}\frac{a_2'}{a_2}N' - \gamma\frac{a_2'}{a_2}N \tag{3.24}$$

These frontiers determine three regions which correspond to *Cases* 1,2,3 analyzed in the previous section.

Region 1 corresponds to *Case* 1 and is such that $\frac{a_2'}{a_1'} \geqslant p(t)$. In both countries there is unemployment in sector 1. In this case $\dot{\overline{L}}_1 > 0$ and $\dot{\overline{L}}_2' < 0$. From (3.8), we deduce that the world relative price of good 2 increases.

Region 2 corresponds to *Case* 2 and is such that $p(t) \geqslant \frac{a_2}{a_1}$. In both countries there is unemployment in sector 2. In this case $\dot{\overline{L}}_1 < 0$ and $\dot{\overline{L}}_2' > 0$. From (3.12), the world relative price of good 2 decreases.

Region 3 corresponds to *Case* 3 and is such that $\frac{a_2'}{a_1'} \leqslant p(t) \leqslant \frac{a_2}{a_1}$. We have $\dot{\overline{L}}_1 > 0$ and $\dot{\overline{L}}_2' > 0$. In each country there is partial unemployment in the sector in which the country has a comparative advantage. The world relative price may increase or decrease.

3.3.2.3 Characterizing the adjustment trajectories

Figure 1 shows, in the $(\overline{L}_1, \overline{L}_2')$ space, the long term Ricardian equilibrium with full specialization in each country, denoted $R$.

In this figure, all trajectories beginning in regions 1 or 2 necessarily go to region 3. In region 3, after some time, one country becomes specialized in the sector in which it has a comparative advantage *i.e.* one of the two axis is reached. Then the other country keeps on adjusting until the long run Ricardo equilibrium is reached.

The important point to emphasize here is that the trajectory of employment may not be monotonic if free trade starts in region 1 or region 2: in one of the two countries, the productive structure temporarily moves in the wrong direction *i.e. one of the two countries overshoots its autarkic equilibrium before specializing in accordance with its comparative advantage.* To explain this result, we simply observe that in region 1 or region 2, the world production of one of the two goods is large compared to the other good. In order to restore a more balanced world production, one of the two countries must produce the good in which it has a comparative disadvantage.

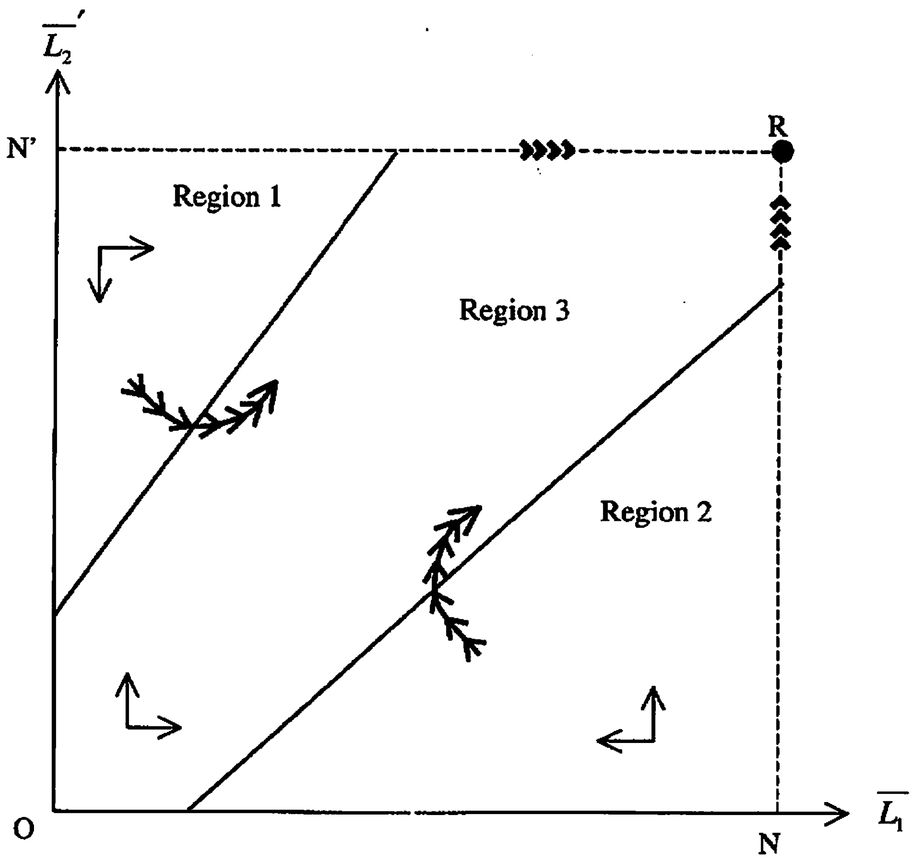


**Figure 1**

Which country will overshoot its autarkic equilibrium depends on the level of the world relative price. If, for instance, the initial world relative price of good 2 is very low (region 1), good 1 is too rare. This implies that country $F$ must produce this good for a while at a level larger than its autarkic level even though country $F$ has a comparative advantage in good 2.

When the process of adjustment obeys the dynamics of region 3, the interdependence between the two countries can be summarized by a surprisingly simple relationship between the two rates of unemployment :

$$[1 - u_1]\left[1 - u_2'\right] = \frac{a_1 a_2'}{a_1' a_2} \tag{3.25}$$

The lower is $\frac{a_1 a_2'}{a_1' a_2}$, the more different the two countries in terms of technology, the larger the rates of unemployment in these countries. Expression (3.25) also says that the rates of unemployment moves in opposite directions in the two countries; moreover, the increase of one rate must exactly offset the decrease of the other rate in region 3 of the adjustment.

Once the vertical or the horizontal axis has been reached, the dynamics is similar to the dynamics in autarky. To see that, we simply note from equation (3.5) that the world relative price only depends on variables of the adjusting country.

A similar analysis applies to the case in which there is only one country which is fully specialized at the long run Ricardo equilibrium $R'$. For example, Figure 2 shows that the adjustment trajectory goes from region 1 or region 2 towards region 3 and converges to a specialization of country $F$.

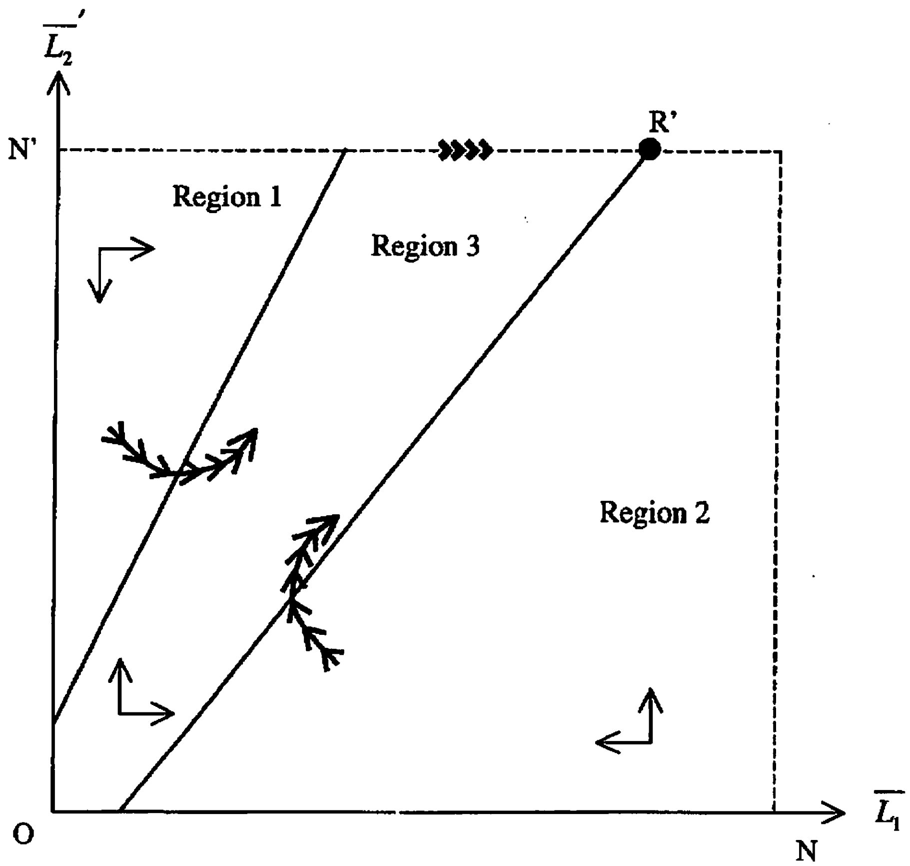


Figure 2

3.3.2.4 Small versus large rates of job creation/destruction

It is possible to give a more formal description of the dynamics in region 3 by looking explicitly at the laws of motion of the economy. To make the analytical study easier, we define the variable $\pi$ and the constant $\lambda$ as follows:

$$\pi = \frac{a_2}{pa_1}, \ \lambda = \frac{a'_1 a_2}{a'_2 a_1}$$

where $\pi$ is a function of the world relative price and $\lambda$ is an indicator of the structure of comparative advantages between the two countries. Since $\frac{a'_2}{a'_1} \leqslant p \leqslant \frac{a_2}{a_1}$ in region 3, we have $1 \leqslant \pi \leqslant \lambda$. Using equations (3.22), (3.14) and the definitions of $\pi$ and $\lambda$, the dynamics of the economy can be expressed by the two laws of motion:

$$\begin{aligned} \dot{\overline{L}}_1/\overline{L}_1 &= \beta(\pi - 1) \\ \dot{\overline{L}}'_2/\overline{L}'_2 &= \beta' \left(\frac{\lambda}{\pi} - 1\right) \end{aligned} \tag{3.26}$$

together with the following dynamic equation (see Appendix 1 for the derivation):

$$\dot{\pi}/\pi = \frac{\beta' \lambda}{a'_1 \pi (\overline{L}_1/a_1 + b_1)} (\frac{\lambda}{\pi} - 1)\overline{L}'_2 - \frac{\beta}{a_1(\overline{L}_1/a_1 + b_1)}(\pi - 1)\overline{L}_1 \tag{3.27}$$

$b_1 = (1 - \gamma) N'/a_1$.

Thanks to the above dynamic equation, we can analyze a situation where the rate of job creation/destruction of one country is very slow compared to the other country. This may illustrate a case where there are large differences in terms of flexibility of labour markets between the two countries. Suppose for instance that the rate of job creation in country $F$ is very small *i.e.* $\beta' \to 0$. In such a case, the first term of the right-hand side of expression (3.27) is negligible. The only force which governs $\pi$ is the growth of new jobs in sector 1 of country $H$, which decreases $\pi$, which in turn, from (3.26), decreases the growth of new jobs in sector 1 of country $H$. Therefore, when the adjustment process in the foreign country becomes very slow because of the existence of strong rigidities in labour demand, this affects the adjustment process in the home country which slows down too. The intuition behind this result is clear. Suppose that the two countries initially produce close to point O in region 3 of Figure 1. If the foreign adjustment process is very slow compared to the domestic one, the world will soon produce too many of good 1. The only way to avoid such an unbalanced situation is for the home country to slow down its reallocation process. We generalize this latter result as follows: in region 3, *when the two countries have "very" different rates of job creation/destruction, the world price adjusts so that the adjustment speed differential between the two countries decreases*

**Remark 1** *The dynamic system expressed by equations (3.26) and equation (3.27), goes to infinity; this means that the axis will be reached in finite time. To show that, suppose that* $\pi \to 1$ *such that* $\dot{\overline{L}}_1/\overline{L}_1 \to 0$*; from (3.27) we get* $\dot{\pi}/\pi > 0$ *which is a contradiction. Similarly* $\pi \to \lambda$ *leads to a contradiction. Since the growth of* $\overline{L}_1$ *and* $\overline{L}'_2$ *never stops, we know that their* *time trajectories will cross the axis in finite time. It is worth mentioning here that there is a discontinuity in the rate of unemployment of the country which becomes the first specialized. The rate of unemployment in the growing sector of that country is strictly positive and satisfies (3.25) until one of the axis is reached. When the adjustment trajectory hits the axis, the declining sector of this economy disappears and the rate of unemployment in the growing sector becomes zero.*

### 3.3.3 Welfare analysis

Having described the adjustment trajectory in the two countries, we can now concentrate on the change in welfare along the trajectory for both countries. An important issue relative to any reform of trade liberalization is the short-term and transitional effects of the reform and therefore its political feasibility. To study the change in welfare along the trajectory, we use the simple fact that when the individual consumption of one good increases in one country, the individual utility and so welfare in that country increases *ceteris paribus.* We first analyze the impact effects of reciprocal full trade liberalization. We then study the dynamics of welfare during the adjustment process leading to the long run free trade equilibrium.

3.3.3.1 Impact effects of reciprocal trade liberalization

To assess the short-term effects, in terms of welfare, of a sudden move to free trade, we first need to determine what is the initial position of the two countries in the $(\overline{L}_1, \overline{L}'_2)$ space just *after* the trade shock. This position depends on the autarkic equilibria of the two countries just before the shock : were the two countries at full employment ? Alternatively, was there unemployment in country $H$ ? If so, in which sector ? What about country $F$ ?

Given the number of possible combinations of autarkic equilibria, we restrict our attention to two possible configurations. In the first configuration, the two countries are at full employment just before the shock. In this case, it is easy to show (see Appendix 2) that, after a sudden move to free trade, the two countries start adjusting in region 3. A quick inspection of the consumption levels in autarky (see (2.7)) with the ones corresponding to region 3 (see (3.18),(3.21)) shows that, in terms of consumption and utility, the impact effect of reciprocal trade liberalization is negative in both countries.

This contrasts with an other possible configuration where the two countries exhibit unemployment in sector 1 in autarky. Here, we can show that the free trade initial position is in region 1 or region 3. Assuming that the two countries start the transition in region 1, the impact effect of trade liberalization in terms of welfare is positive in one country and negative in the other[5]. A symmetric result is obtained when the two countries exhibit unemployment in sector 2 in autarky.

3.3.3.2 Transitional and long-term effects on welfare

We now want to study the dynamics of utility during the adjustment process. From expressions (3.18), (3.21), (3.19) and (3.20), we see that in region 1 and region 2, welfare increases in both countries. This is because, in these cases, there is too much of one good and too little of the other good. Therefore any change which favors a more balanced world production of the two goods increases welfare in both countries.

Region 3 is again a region where the two countries move in opposite directions until one of the axis has been reached. Expressions (3.18) and (3.21) tell us that welfare in one country can increase only at the expense of the other country. This conflict[6] in terms of welfare between the two countries can be clearly expressed by using an adequate log-linear combination of expressions (3.18) and (3.21):

$$\left(\frac{1}{\gamma}\right)\ln U(c_1,c_2)+\left(\frac{1}{1-\gamma}\right)\ln U(c_1',c_2')=\alpha$$

where $\alpha$ is a constant[7]. Once specialization in one of the two countries is achieved, welfare in the other country increases monotonically until reaching point $R$.

Finally, and not surprisingly, it is straightforward to show that at the long-term equilibrium, the level of utility is higher than the one under autarky.

In summary, (i) in region 3, the impact effect of a move to free trade is negative in terms of welfare in both countries, (ii) the welfare change along the trajectory need not be monotonic and differs depending on price regimes and countries. These contrasting conclusions illustrate the conflicting interests associated with a move to free trade not only within each country but also between the two countries.

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5 As for the pattern of trade in regions 1 and 2, the sign on the impact effect on welfare turns out to depend on the structure and the intensity of comparative advantages and on the rates of activity in sector 1 in the two countries.

6 Since the terms of trade determine the share of gains from trade between the two countries, it is not surprising that, in region 3, there is a conflict between the two countries as the terms of trade are changing. The interesting point is that such a conflict does not appear in region 1 and 2. We thank a referee for mentioning this point.

7 $\alpha=\ln\frac{\gamma}{a_2}+\ln\frac{1-\gamma}{a_1'}+\frac{1-\gamma}{\gamma}\ln\left[\frac{1-\gamma}{a_2}\right]+\frac{\gamma}{1-\gamma}\ln\left[\frac{\gamma}{a_1'}\right]$

# 4 Concluding remarks

The objective of this paper was to analyze the interactions between the adjustment processes of two countries following a once and for all move to free trade. We have used a dynamic two-country Ricardian model where the process of job creation/destruction is slow in both sectors. The most striking conclusion is that, for some free trade initial conditions, one of the two countries temporarily specializes in a direction which is opposed to its comparative advantage. It is important to emphasize that this result is obtained through the world price formation mechanism and therefore from a spontaneous harmonization process. The same "invisible hand" mechanism is at work in a situation where the home adjustment process slows down because of a "very" small job creation/destruction rate in the foreign country.

There is no doubt that the setup used to reach these conclusions is restrictive. In particular, the adjustment technology is myopic and *ad hoc* and does not permit to distinguish clearly between the positive and the normative aspects of the adjustment process. A more sophisticated analysis would have certainly required the use of numerical methods. We think however that this work, as it stands, is a first interesting attempt to understand the complex relationships between trade liberalization and factor reallocation when countries are interdependent.

The existence of high unemployment and other possible initial disequilibria in some countries and the way the economies are able to adjust to free trade generate some important interactions among countries during the transition to the long-run free trade equilibrium. This should deserve more attention in the design and the coordination of trade liberalization reforms and trade adjustment assistance programs.

## References

Baldwin, R. and A.J. Venables (1994), "International Migration, Capital Mobility and Transitional Dynamics", *Economica*, 61 (243), pp. 285-300.

Bhagwati, J.N. (1982), "Introduction", in *Import Competition and Response*, ed. by J. Bhagwati, University of Chicage Press, Chicago.

Burda, M. (1995) "Migration and the Option Value of Waiting", Center for Economic Policy Research, discussion paper no. 1229.

Dehejia, V.H. (1997), "Will Gradualism Work when Shock Therapy doesn't ?", Center for Economic Policy Research, Discussion paper no. 1552.

Dixit, A. (1989), "Intersectoral Capital Reallocation under Price Uncertainty", *Journal of International Economics*, 26, pp. 309-325.

Dixit, A. and R. Rob (1994), "Risk-Sharing, Adjustment and Trade", *Journal of International Economics*, 36(3-4), pp. 263-287.

Feenstra, R. and T. Lewis (1994), "Trade Adjustment Assistance and Pareto Gains from Trade", *Journal of International Economics*, 36 (3-4), pp. 201-222.

Fung, K. and R. Staiger (1994), "Trade Liberalization and Trade Adjustment Assistance", National Bureau of Economic Research, Working paper no. 4847.

Hamermesh, D. and G. Pfann (1996), "Adjustment Costs in Factor Demand", Center for Economic Policy Research, Discussion paper no. 1371.

Harris, J. and M. Todaro (1970) "Migration, unemployment and development : a two-sector analysis", *The American Economic Review*, (March).

Karp, L. and Th. Paul (1994), "Phasing in and Phasing out Protectionism with costly adjustment of Labor", *The Economic Journal*, 104, pp. 1379-1393.

Karp, L. and Th. Paul (1998), "Labor Adjustment and Gradual Reform : When is Commitment Important ?", *Journal of International Economics*, December, 46.2.

Karp, L. and Th. Paul (2002), "Intersectoral Adjustment and Policy Intervention : The Importance of General Equilibrium Effects", *Review of International Economics*, forthcoming.

Mayer, W. (1974), "Short-Run an Long-Run Equilibrium for a Small Open Economy", *Journal of Political Economy*, 82. no.5, pp. 955-967.

Mussa, M. (1974), "Tariffs and the Distribution of Income : the Importance of Factor Specificity, Substituability, and Intensity in the Short and Long Run", *Journal of Political Economy*, 82, no. 6, pp. 1191-1203.

Mussa, M. (1978), "Dynamic Adjustment in the Hecksher-Ohlin-Samuelson Model", *Journal of Political Economy*, 86, pp. 775-791.

Mussa, M. (1982), "Government policy and the Adjustment process", in *Import Competition and Response*, ed. by J. Bhagwati, University of Chicago Press, Chicago.

Mussa, M. (1986), "The Adjustment Process and The Timing of Trade Liberalization", In Choksi and Papageorgiou, eds., *Economic Liberalization in Developing Countries*, Oxford, Blackwell.

Neary, J. P. (1982), "Intersectoral Capital Mobility, Wage Stickiness, and the Case for Adjustment Assistance", in *Import Competition and Response*, ed. by J. Bhagwati, University of Chicago Press, Chicago.

Pissarides, C.A. (1990), *Equilibrium unemployment theory*, Basil Blakwell.

Saint-Paul, G. (1996), *Dual Labor Markets : A macroeconomic perspective*, The MIT Press, Cambridge, Massachusetts, London.

Terra, C. (1999), "Tariff Design with Varying Degrees of Commitment", *Journal of Development Economics*, 58.1, pp. 123-148.

## Appendix 1

In this appendix, we derive equation (3.27) of the text.

Expression (3.15) can be rewritten as follows :

$$p = \frac{\overline{L}_1/a_1 + b_1}{\overline{L}'_2/a'_2 + b_2}$$

where $b_1 = (1-\gamma)\, N'/a'_1$ and $b_2 = \gamma N/a_2$.

Using this expression for $p$, we have :

$$\begin{aligned}\dot{\pi} &= \frac{a_2}{a_1}\dot{p} \\ &= \frac{a_2}{a_1}\left[\frac{\dot{\overline{L}}'_2/a'_2}{\overline{L}_1/a_1 + b_1} - \frac{\left(\overline{L}'_2/a'_2 + b_2\right)\dot{\overline{L}}_1/a_1}{\left(\overline{L}_1/a_1 + b_1\right)^2}\right]\end{aligned}$$

Using dynamic equations (3.26) and $\pi = \frac{a_2}{a_1}\frac{1}{p}$, we get :

$$\begin{aligned}\dot{\pi} = {} & \frac{\beta'\lambda}{a'_1(\overline{L}_1/a_1 + b_1)}\left(\frac{\lambda}{\pi} - 1\right)\overline{L}'_2 \\ & - \frac{\beta\pi}{a_1(\overline{L}_1/a_1 + b_1)}(\pi - 1)\overline{L}_1\end{aligned}$$

Dividing the above equation by $\pi$ gives equation (3.27) of the text.
QED

## Appendix 2

In this appendix we show that when the two countries are at full employment in autarky, a sudden move to free trade leads the two economies to start their adjustment process in region 3.

In autarky, we have:

$$\overline{L}_1 = \gamma N,\ \overline{L}_2 = (1-\gamma)N$$

and

$$\overline{L}'_1 = \gamma N',\ \overline{L}'_2 = (1-\gamma)N'$$

The world production of good 1 and good 2 are therefore:

$$Y_1^* = \frac{\gamma N}{a_1} + \frac{\gamma N'}{a'_1},\ Y_2^* = \frac{(1-\gamma)N}{a_2} + \frac{(1-\gamma)N'}{a'_2}$$

Suppose that free trade is instituted between the two countries. Using expression (3.5), we compute the world relative price:

$$p = \frac{\frac{N}{a_1} + \frac{N'}{a'_1}}{\frac{N}{a_2} + \frac{N'}{a'_2}}$$

We have:

$$p = \frac{\frac{N}{a_1} + \frac{N'}{a'_1}}{\frac{N}{a_2} + \frac{N'}{a'_2}} = \frac{a_2}{a_1}\left[\frac{N + \frac{a_1}{a'_1}N'}{N + \frac{a_2}{a'_2}N'}\right] < \frac{a_2}{a_1}$$

and,

$$p = \frac{\frac{N}{a_1} + \frac{N'}{a'_1}}{\frac{N}{a_2} + \frac{N'}{a'_2}} = \frac{a'_2}{a'_1}\left[\frac{\frac{a'_1}{a_1}N + N'}{\frac{a'_2}{a_2}N + N'}\right] > \frac{a'_2}{a'_1}$$

Therefore:

$$\frac{a'_2}{a'_1} < p < \frac{a_2}{a_1}$$

QED.

## Appendix 3

In this appendix, we derive an expression for the net exports of good 1 for country $H$ in *Case* 1. By symmetry, the same method applies in *Case* 2.

From (3.18), we deduce that consumption of good 1 in country $H$ in *Case* 1 is $C_1^H = N\frac{\gamma}{a_2}p$. Since production of good 1 in country $H$ is just $\frac{L_1}{a_1}$, net exports in good 1 for country $H$ in *Case* 1 are given by

$$X_1^H = \frac{L_1}{a_1} - N\frac{\gamma}{a_2}p$$

Substituting (3.8) for $p$ into the above expression gives

$$X_1^H = \frac{\overline{L}_1 N' \frac{a_2}{a_2'} - \overline{L}_1' N \frac{a_1}{a_1'}}{a_1 \left[N + N' \frac{a_2}{a_2'}\right]} \tag{A3.1}$$

Since we are only interested in the sign of $X_1^H$, we concentrate on the numerator of (A3.1). After some manipulations, we get

$$sgn(X_1^H) = sgn\left[\frac{\overline{L}_1'}{N'}\left(\frac{a_2}{a_1} - \frac{a_2'}{a_1'}\right) + \frac{a_2}{a_1}\left(\frac{\overline{L}_1}{N} - \frac{\overline{L}_1'}{N'}\right)\right] \tag{A3.2}$$

Whether country $H$ is a net exporter of good 1 in *Case* 1 depends on two terms. The first term of expression (A3.2) represents the intensity of comparative advantages; by Assumption 2, this term is always positive. The second term is the difference between the rates of activity in sector 1 in the two countries; this term can be positive or negative. If, at a point in time, $\frac{\overline{L}_1'}{N'}$ is very large compared to $\frac{\overline{L}_1}{N}$ (the second term is negative), country $F$ produces relatively more of good 1 than country $H$ and may end up exporting this good to country $H$ irrespective of the structure of comparative advantages.