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# China's unique features and the consequences of the opening of trade with advanced countries

**Abstract:**

The opening of trade between China and advanced countries should lead to an across-the-board increase in welfare. Because of the endowment in factors of production, the advanced countries will specialize in the production of sophisticated goods, while China in the manufacturing of traditional goods.

However, China shows three specific characteristics: a sharp increase in the supply of unskilled labour due to internal migration; technological transfers due to trade and direct investment; and, above all, the fact that the convergence of price levels is very slow and, therefore, deviations from the law of one price appear.

In this paper, we study the effects how these three specific features affect the normal welfare effect of trade opening between advanced countries and China.

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## Introduction

The opening of trade between emerging countries (hereafter China in this text) and advanced theoretically enhances for both categories of countries (see for example Burtless (1995), Guesnerie (1998), Krugman (1995), Leamer (1996), Topel (1997), etc.). We build in this paper a two-country model (China and the advanced country), with two goods (the advanced good and the traditional good) and with three factors of production (skilled labour, unskilled labour and capital). China enjoys better factor endowment in unskilled labour, and the advanced country in skilled labour and, at least initially, in capital. We seek to show how the opening of trade leads to an increase in welfare and international specialisation through different endowments in factors of production.

According to economic literature, the opening of trade could be unfavourable for either China and the advanced country:

- if China specialises in traditional types of production, and if the production of sophisticated goods is what contributes to increasing the long-term growth rate, then the opening of trade reduces growth in China (Grossman-Helpman (1990-1991), Young (1991)); Lucas (1988), Matsuyama (1991));
- if unskilled workers in the advanced country, because labour market rigidities fail to find a job, then unemployment grows among unskilled labour, instead of participation of unskilled workers in the production of advanced goods in the advanced country: (Fontagné-Guérin (1997), Nickell-Bell (1995), Agenor-Aizenman (1996)),
- if through direct investment (Coe-Helpman (1995), Coe-Helpman-Hoffmaister (1997) Neven-Siotis (1996), Borensztein de Gregorio – Lee (1995), Blomström – Lipsey – Zesan (1992)) or trade flows (Pissarides (1997), Berthelemy – Chauvin (2000), Berthélemy – Varoudakis (1997)), or the relocation of R&D activities (Markusen – Venables (2000), Fujita – Krugman – Venables (1999), Markusen (1997, 2002), Ekholm – Hakkala (2003)), China acquires sophisticated technologies from the advanced country, the latter loses its technological lead. The situation is different if the advanced country transfers exclusively intermediate technologies into China (Artus (2003)).
- if the emerging country (China) is endowed with abundant skilled labour, it is not certain that it will specialise in the production of traditional goods (Baldwin – François – Portes (1997), Boeri and Alïï (2002), Breuss (2001), Doyle – Fidrmuc (2004)).

What are the anomalies, in relation to conventional trade theory, which we hold to be most important in the case of China?

- the opening of trade coincided with **a substantial increase in labour resources** i.e. primarily unskilled labour, resulting from migration from the countryside into cities **(Chart 1)**[1]**;**
- current labor market conditions, especially in Europe, make it difficult for unskilled workers to find a new job, as is shown by the structure of unemployment **(Table 1)**, job creation is weak in the sectors sheltered from competition from emerging countries **(Chart 2)** and nominal wage are sticky;

[1] NdT : Le titre du graphique n°1 est incomplet dans l'original.

**Table 1**

**Unemployment rates by level of schooling (labour aged 25 to 64)**

| as % of the population | France | | | Germany | | | Italy | | |
|---|---|---|---|---|---|---|---|---|---|
| | Primary | Secondary | Higher | Primary | Secondary | Higher | Primary | Secondary | Higher |
| 1994 | 14.7 | 10.5 | 6.8 | 13.9 | 8.8 | 5.4 | 13.9 | 8.8 | 5.4 |
| 1996 | 14.8 | 9.7 | 6.7 | 14.2 | 8.9 | 5.2 | 14.2 | 8.9 | 5.2 |
| 1998 | 14.9 | 9.5 | 6.6 | 16.6 | 10.8 | 5.6 | 16.6 | 10.8 | 5.6 |
| 2000 | 13.9 | 7.9 | 5.1 | 13.7 | 7.8 | 4.0 | 15.8 | 8.8 | 4.9 |
| 2001 | 11.9 | 6.9 | 4.8 | 13.5 | 8.2 | 4.2 | 9.1 | 6.8 | 5.3 |
| 2002 | 11.8 | 6.8 | 5.2 | 15.3 | 9.0 | 4.5 | 9.0 | 6.4 | 5.3 |

| as % of the population | Spain | | | Japan | | |
|---|---|---|---|---|---|---|
| | Primary | Secondary | Higher | Primary | Secondary | Higher |
| 1994 | 21.3 | 19.4 | 15.0 | - | - | - |
| 1996 | 20.1 | 17.4 | 14.3 | - | - | - |
| 1998 | 17.0 | 15.3 | 13.1 | 4.4 | 3.3 | 2.7 |
| 2000 | 13.7 | 11.0 | 9.5 | 6.0 | 4.7 | 3.5 |
| 2001 | 10.2 | 8.4 | 6.9 | 5.9 | 4.8 | 3.1 |
| 2002 | 11.2 | 9.5 | 7.7 | 6.6 | 5.3 | 3.9 |

| as % of the population | United States | | | United Kingdom | | |
|---|---|---|---|---|---|---|
| | Primary | Secondary | Higher | Primary | Secondary | Higher |
| 1994 | 12.6 | 6.2 | 3.2 | 13.0 | 8.3 | 3.9 |
| 1996 | 10.9 | 5.1 | 2.4 | 10.9 | 7.1 | 3.5 |
| 1998 | 8.5 | 4.4 | 2.1 | 10.5 | 5.0 | 2.6 |
| 2000 | 7.9 | 3.6 | 1.8 | 8.9 | 4.5 | 2.1 |
| 2001 | 8.1 | 3.8 | 2.1 | 7.6 | 3.9 | 2.0 |
| 2002 | 10.2 | 5.7 | 3.0 | 8.5 | 4.1 | 2.4 |

**Chart 1**

**China: Urban and rural population (as % per year)**

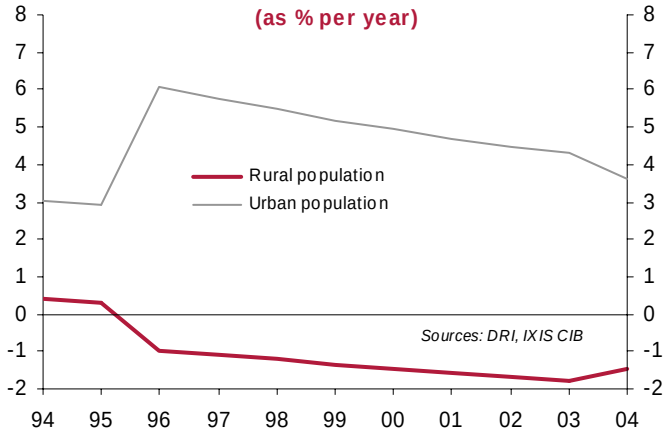
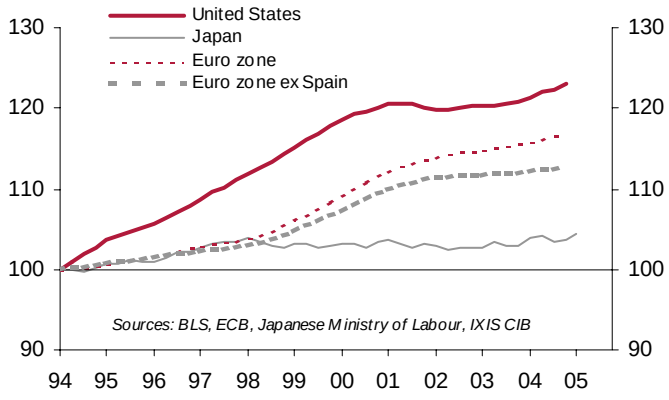



**Chart 2**

**Total employment ex manufacturing sector (Q1 1994 = 100)**




– finally, there is **no law of one price**. Made in China goods are sold at lower prices than the same good produced by the developed country. **Divergences in price levels are considerable (Chart 3)**, and will fade very slowly.

– lastly, there is effectively **transfer of technology** to China, via FDI, trade and subcontracting, as is shown by the rapid growth in China in productivity gains and the output of electronics **(Chart 4).**

**Chart 3**
**Price level* (United States = 100)**

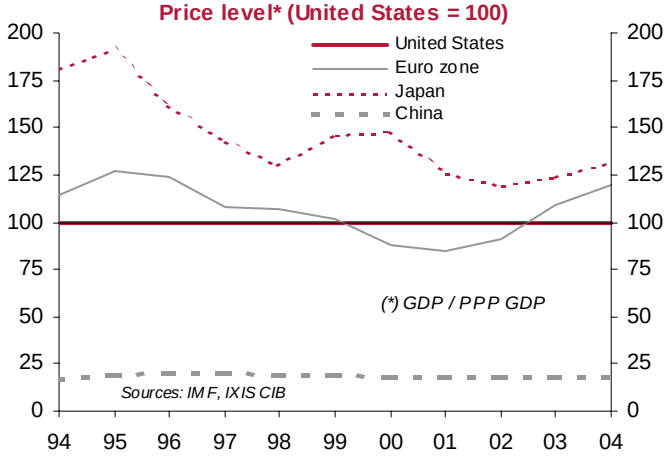
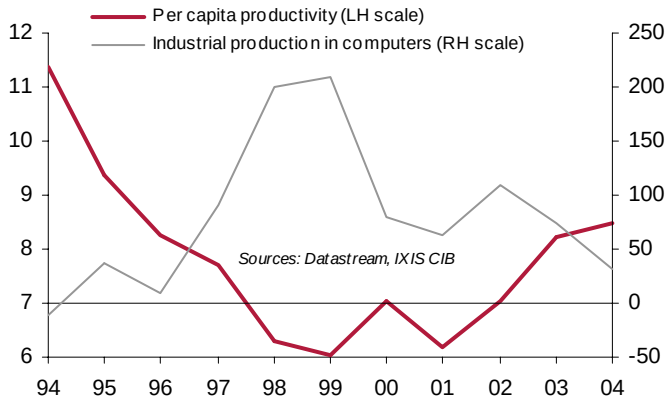



**Chart 4**
**China: Production of computers and per capita productivity (as % per year)**




In what follows, we study how **the international specialisation and welfare** of China and the advanced country are affected by the opening of trade, given the above stated characteristics:

– noteworthy increase in the supply of unskilled labour,
– transfer of technology to China,
– lower level of prices made in China goods (the law of one price does not hold)

## 1 – Our model

We build a **model with 2 countries**: the **advanced country** and **China**. In both countries, two goods are manufactured: an **advanced good**, which requires skilled labour, unskilled labour and capital; as well as a **traditional good**, which requires only unskilled labour. **Production functions are the following**:

### Advanced good

$$(1)\ \begin{cases} Y = AL^{a}N^{b}K^{1-a-b} \text{ (advanced country)} \\ Y^{*} = AL^{*a}N^{*b}K^{*1-a-b} \text{ (China)} \end{cases}$$

### Traditional good:

$$(2)\ \begin{cases} Z = BM \text{ (advanced country)} \\ Z^{*} = BM^{*} \text{ (China)} \end{cases}$$

$Y(Y^{*})$ is the production of the advanced good; $Z(Z^{*})$ the production of the traditional good; $L(L^{*})$ is skilled employment; $N(N^{*})$ unskilled employment used to produce the sophisticated good; $M(M^{*})$ unskilled employment used to produce the traditional good; $K(K^{*})$ capital; and $A, B$ total factor productivity.

We denote with:

$q(q^*)$ the relative price of the advanced good (the traditional good has its price standardised at 1)
$w(w^*)$ the wage for skilled labour
$s(s^*)$ the wage for unskilled labour
$C(C^*)$ consumption of the advanced good
$D(D^*)$ consumption of the traditional good.

The log **utility functions** are:

$$(3)\ \begin{cases} U = \alpha \ell n(C) + (1-\alpha)\ell n(D) & \text{(advanced country)} \\ U^* = \alpha \ell n(C^*) + (1-\alpha)\ell n(D^*) & \text{(China)} \end{cases}$$

where $U(U^*)$ is the utility function, $\alpha$ the preference for the advanced good; the **budgetary constraints are**:

$$(4)\ \begin{cases} qC + D = qY + Z & \text{(advanced country)} \\ q^*C^* + D^* = q^*Y^* + Z^* & \text{(China)} \end{cases}$$

This leads to the **demand functions:**

- for the **advanced good**

$$(5)\ \begin{cases} C = \alpha\left(Y + Z/q\right) & \text{(advanced country)} \\ C^* = \alpha\left(Y^* + Z^*/q^*\right) & \text{(China)} \end{cases}$$

- for the **traditional good**

$$(6)\ \begin{cases} D = (1-\alpha)(qY + Z) & \text{(advanced country)} \\ D^* = (1-\alpha)(q^*Y^* + Z^*) & \text{(China)} \end{cases}$$

## 2 – Equilibrium before the opening of trade

To determine the equilibrium before the opening of trade for the advanced country we proceed as follows (the one for China is perfectly symmetrical).

The equality of the **marginal productivity of labour and real wages** implies:

$$(7)\ \begin{cases} s = B \\ s/q = bAL^{a}N^{b-1}K^{1-a-b} \\ w/q = aAL^{a-1}N^{b}K^{1-a-b} \end{cases} \Big\} \text{ unskilled labour}$$

The supply of skilled labour is $\overline{L}$, the supply of unskilled labour $\overline{M}$, and we have:

$$(8)\ \begin{cases} L = \overline{L} \\ N + M = \overline{M} \end{cases}$$

**The equilibrium in the market of the advanced good** (for example) implies:

$$(9)\ \begin{cases} Y = C \quad \text{soit :} \\ Y(1-\alpha) = \alpha Z/q \quad \text{or} \quad q = \dfrac{\alpha}{1-\alpha}\dfrac{Z}{Y} \end{cases}$$

An increase in production $Z$ of the traditional good increases income and demand for the advanced good, hence leads to a rise in the relative price $q$ of the advanced good. The equilibrium of **marginal capital productivity and the interest rate implies** (we suppose that the capital consists of an advanced good):

$$(10)\ r = (1-a-b)AL^{a}N^{b}K^{-a-b}$$

Hence, by solving (7) (8) and (9), the equilibrium:

$$(11)\ \begin{cases} N = \dfrac{b\overline{M}}{b + \dfrac{1-\alpha}{\alpha}} \\ M = \dfrac{\dfrac{1-\alpha}{\alpha}\overline{M}}{b + \dfrac{1-\alpha}{\alpha}} \\ q = \dfrac{B\overline{M}^{1-b}}{A\overline{L}^{a}K^{1-a-b}} b^{-b}\left(b + \dfrac{1-\alpha}{\alpha}\right)^{b-1} \end{cases}$$

Comparative statics are as follows:

- As the supply of unskilled labour $\overline{M}$ rises, the output of the traditional good and income increase, resulting in a rise in the relative price $q$ of the advanced good.
- As the supply of skilled labour $\overline{L}$ increases or if capital $K$ is higher, the output of the advanced good increases and its relative price decreases.
- As the preference $\alpha$ for the advanced good increases, its relative price rises.

## 3 – Opening of trade between the advanced country and China

### *3-1 Without international capital mobility*

Suppose that the stocks of capital $K$ (advanced country) and $K^*$ (China) remain unchanged, i.e. productive capital is immobile. The opening to trade modifies the condition of equilibrium of the market of the advanced good that becomes:

$$(12)\begin{cases} Y+Y^* = \alpha\left(Y+Z/q\right)+\alpha^*\left(Y^*+Z^*/q\right) \\ \text{or :} \\ q=\left(\dfrac{\alpha}{1-\alpha}\right)\left(\dfrac{Z+Z^*}{Y+Y^*}\right) \end{cases}$$

**Before the opening of trade**, we had:

$$(13)\ \frac{Y^*}{Y} < \frac{Z^*}{Z}$$

China had lower resources in skilled labour and in capital than the advanced country. Therefore, its output of the advanced good was relatively lower than the one of the advanced country, relative to what happens for the traditional good.

The foregoing implies that:

| | | |
|---|---|---|
| (14) $q$ | $< q$ | $< q^*$ |
| Advanced country before opening to trade | after opening | China before opening |

As is well known, the opening to trade leads to a rise in the relative price of the advanced good in the advanced country and reduces it in China.

The equilibrium results from (7), (8), their equivalents for China and (12). After opening of trade:

$$(15)\begin{cases} N+N^* = \dfrac{b\left(\overline{M}+\overline{M}^*\right)}{\dfrac{1-\alpha}{\alpha}+b} \\ M+M^* = \dfrac{\dfrac{1-\alpha}{\alpha}\left(\overline{M}+\overline{M}^*\right)}{\dfrac{1-\alpha}{\alpha}+b} \end{cases}$$

And, by denoting:

$$(16)\begin{cases} X = \overline{L}^a K^{1-a-b} \\ X^* = \overline{L}^{*a} K^{*1-a-b} \end{cases}$$

$$(17)\quad \begin{cases} N = \dfrac{b\left(\overline{M}+\overline{M}^{*}\right)}{\left(\dfrac{1-\alpha}{\alpha}+b\right)} \bullet \dfrac{1}{\left(1+\left(X^{*}/X\right)^{\frac{1}{1-b}}\right)} ; M = \overline{M} - N \\ N^{*} = \dfrac{b\left(\overline{M}+\overline{M}^{*}\right)}{\left(\dfrac{1-\alpha}{\alpha}+b\right)} \bullet \dfrac{1}{\left(1+\left(X/X^{*}\right)^{\frac{1}{1-b}}\right)} ; M^{*} = \overline{M}^{*} - N^{*} \end{cases}$$

We have:

$\overline{M}^{*} > \overline{M}$ (the supply of unskilled labour is larger in China than in the advanced country)

$\begin{cases} \overline{L} > \overline{L}^{*} \\ K > K^{*} \end{cases}$ (the supply of skilled labour and capital are larger in the advanced country)

hence:

$$\begin{cases} X >> X^{*}\ ,\ X^{*}/X << 1 \\ \overline{M} + \overline{M}^{*} > \overline{M}^{*} \end{cases}$$

(17) then shows that the **opening to trade**:

- increases unskilled employment that is used to produce advanced goods in the advanced country ($N$ rises)
- increases unskilled employment allocated to the production of traditional goods in China ($N^{*}$ decreases and $M^{*}$ increases).

There is definitely specialisation of the advanced country in the production of advanced goods and specialisation of China in the production of the traditional good, because of the endowment of both countries in factors of production.

**The opening of trade improves welfare in both countries**

We have:

$$(18)\quad \begin{cases} U = \alpha \ell n\left(Y + \dfrac{Z}{q}\right) + (1-\alpha)\ell n(qY + Z) \ \text{(advanced country)} \\ U^{*} = \alpha \ell n\left(Y^{*} + \dfrac{Z^{*}}{q^{*}}\right) + (1-\alpha)\ell n\left(q^{*}Y^{*} + Z^{*}\right) \quad \text{(China)} \end{cases}$$

Before the opening of trade, $q = \dfrac{\alpha}{1-\alpha}\dfrac{Z}{Y}, q^{*} = \dfrac{\alpha}{1-\alpha}\dfrac{Z^{*}}{Y^{*}}$;

After the opening of trade, $q = \frac{\alpha}{1-\alpha}\frac{Z+Z^*}{Y+Y^*}$

**The first effect is that of the change in the relative price $q$ of advanced goods.**

We thus have:

**Before the opening of trade**

$$(19\text{ a})\quad \begin{cases} U = \alpha\ell n\left(Y/\alpha\right) + (1-\alpha)\ell n\left(\frac{Z}{1-\alpha}\right) \\ U^* = \alpha\ell n\left(Y^*/\alpha\right) + (1-\alpha)\ell n\left(\frac{Z^*}{1-\alpha}\right) \end{cases}$$

**After the opening of trade**

$$(19\text{ b})\quad \begin{cases} U = \alpha\ell n\left(Y + \frac{1-\alpha}{\alpha}Z\frac{Y+Y^*}{Z+Z^*}\right) + (1-\alpha)\ell n\left(Z + \frac{\alpha}{1-\alpha}Y\frac{Z+Z^*}{Y+Y^*}\right) \\ U^* = \alpha\ell n\left(Y^* + \frac{1-\alpha}{\alpha}Z^*\frac{Y+Y^*}{Z+Z^*}\right) + (1-\alpha)\ell n\left(Z^* + \frac{\alpha}{1-\alpha}Y^*\frac{Z+Z^*}{Y+Y^*}\right) \end{cases}$$

Let $u = \frac{Z}{Y}\frac{Y+Y^*}{Z+Z^*}$ ; $u^* = \frac{Z^*}{Y^*}\frac{Y+Y^*}{Z+Z^*}$

$u < 1, u^* > 1$

Without ambiguity; since $\alpha\ell n\left(\alpha + (1-\alpha)u\right) + (1-\alpha)\ell n\left(1-\alpha+\frac{\alpha}{u}\right)$ is minimum

and is worth 0 in $u = 1$:

$$(20)\quad \begin{cases} \alpha\ell n\left(\alpha Y + (1-\alpha)Yu\right) + (1-\alpha)\ell n\left((1-\alpha)Z + \alpha\frac{Z}{u}\right) \\ \qquad > \alpha\ell n(Y) + (1-\alpha)\ell n(Z) \\ \alpha\ell n\left(\alpha Y^* + (1-\alpha)Y^*u^*\right) + (1-\alpha)\ell n\left((1-\alpha)Z^* + \alpha\frac{Z^*}{u^*}\right) > \alpha\ell n\left(Y^*\right) + (1-\alpha)\ell n\left(Z^*\right) \end{cases}$$

**The second effect is that of international specialisation**

The change (denoted $\Delta$) in total income in the two countries is written, given (11) and (17):

$$\Delta\left(qY + Z + qY^* + Z^*\right) = qAX\left[\frac{b}{\frac{1-\alpha}{\alpha}+b}\right]^b\left[\left(\frac{\overline{M}+\overline{M}^*}{1+\left(\frac{X^*}{X}\right)^{\frac{1}{1-b}}}\right)^b - \overline{M}^b\right]$$

$$\frac{-Bb}{\frac{1-\alpha}{\alpha}+b}\left[\frac{\overline{M}+\overline{M}^*}{1+\left(\frac{X^*}{X}\right)^{\frac{1}{1-b}}} - \overline{M}\right] \tag{21}$$

$$+ qAX^*\left[\frac{b}{\frac{1-\alpha}{\alpha}+b}\right]^b\left[\frac{\left(\overline{M}+\overline{M}^*\right)}{1+\left(\frac{X}{X^*}\right)^{\frac{1}{1-b}}} - \overline{M}^{*b}\right]$$

$$\frac{-Bb}{\frac{1-\alpha}{\alpha}+b}\left[\frac{\overline{M}+\overline{M}^*}{1+\left(\frac{X}{X^*}\right)^{\frac{1}{1-b}}} - \overline{M}^*\right]$$

with $\overline{M}^* > \overline{M}$ (more resources in unskilled labour in China)

$X > X^*$ (more resources in skilled labour and capital in the advanced country).

- **First study the effect of** $\overline{M}^* > \overline{M}$ with $X = X^*$

We have:

$$\Delta\left(q\left(Y+Y^*\right)+Z+Z^*\right)=qAX\left[\frac{b}{\frac{1-\alpha}{\alpha}+b}\right]^b\left[2\left(\frac{\overline{M}+\overline{M}^*}{2}\right)^b-\left(M^b+\overline{M}^b\right)\right]>0 \quad (22)$$

$$\text{since}\left(\frac{\overline{M}+\overline{M}^*}{2}\right)^b>\frac{\overline{M}^b+\overline{M}^{*b}}{2}\ \text{si}\ \overline{M}^*>\overline{M}$$

- **Then study the effect of** $X > X^*$ with $\overline{M} = \overline{M}^*$

We have:

$$\Delta\left(q\left(Y+Y^*\right)+Z+Z^*\right)=qAX\left[\frac{b}{\frac{1-\alpha}{\alpha}+b}\right]^b\overline{M}^b\left[\left(\frac{2}{1+y^{-\frac{1}{1-b}}}\right)^b-1+\frac{1}{y}\left(\left(\frac{2}{1+y^{\frac{1}{1-b}}}\right)^b-1\right)\right] \quad (23)$$

$$-\frac{Bb\overline{M}}{\frac{1-\alpha}{\alpha}+b}\left[\frac{2}{1+y^{-\frac{1}{1-b}}}-1+\frac{2}{1+y^{\frac{1}{1-b}}}-1\right]$$

By denoting $y=\frac{X}{X^*}>1$

where the coefficient of $\frac{Bb\overline{M}}{\frac{1-\alpha}{\alpha}+b}$ is nil in the first order condition and where the coefficient of $qAX\left[\frac{b}{\frac{1-\alpha}{\alpha}+b}\right]^b\overline{M}^b$ is positive without ambiguity.

**Overall, then, the opening to trade increases welfare both via the effect of the relative price and the income effect.**

### *3-2 International capital mobility*

Let's now suppose that:

– the global stock of capital $\left(K + K^*\right)$ is exogenous

– the distribution of capital between the advanced country and China is the one for which the marginal productivity of capital in both countries is the same:

$$(24)\quad \begin{cases} \overline{L}^a N^b K^{-a-b} = \overline{L}^{*a} N^{*b} K^{*-a-b} \\ \text{or}: K = K^* \left( \dfrac{\overline{L}^a N^b}{\overline{L}^{*a} N^{*b}} \right)^{\frac{1}{a+b}} \end{cases}$$

Then, (17) shows that we have:

$$(25)\quad \frac{N}{N^*} = \left( \frac{\overline{L}^a K^{1-a-b}}{\overline{L}^{*a} K^{*1-a-b}} \right)^{\frac{1}{1-b}}$$

hence:

$$(26)\quad \frac{K}{K^*} = \frac{\overline{L}}{\overline{L}^*} = \frac{N}{N^*}$$

if, before the opening of trade, $r^* > r$, there is transfer of capital from the advanced country to China until equalisation (determined by the supply of skilled labour) of the three factors of production in the two countries.

Before the transfer of capital, we have:

$$r = \overline{L}^a N^b K^{-a-b}$$

$$r^* = \overline{L}^{*a} N^{*b} K^{*-a-b} = \overline{L}^{*a\frac{1}{1-b}} \overline{L}^{a\frac{-b}{1-b}} N^b K^{*\frac{(1-a-b)b}{1-b}-a-b} K^{-\frac{b}{1-b}(1-a-b)}$$

and $r^* > r$ before the transfer of capital if:

(27) $\dfrac{K}{K^*} > \dfrac{\overline{L}}{\overline{L}^*}$, i.e. if the advantage in factor endowment enjoyed by the advanced country over China is larger with regard to capital than skilled labour and, in all likelihood, this is the case.

## 4 – Countryside unemployment and the increase in the supply of unskilled labour in China

We are therefore back to the case where $K$ and $K^*$ are constant, and we focus on an important characteristic of the Chinese economy: at trade developed and demand for Chinese goods increased, then 'unemployed' labor force in the countryside moved to the cities to find employment: this lead to **a sharp rise in the supply of unskilled labour** $\left(\overline{M}^*\right)$**.**

**This large inflow in the supply of labor, makes it possible for the production of the advanced good in China to continue, even as international specialization increases the production of the traditional good.**

By analogy, we can represent this situation by letting the employment $N^*$ (unskilled employment used in China in the production of the sophisticated good) remaining unchanged after the opening to trade.

We denote by $\overline{P}^*$ the supply of unskilled labour in China after the opening to trade and $\overline{M}^*$ before the opening to trade. We thus want (see (17) and (11)):

$$(28)\quad \begin{array}{l} N^* \\ \text{(after opening)} \end{array} = \frac{b\left(\overline{M}+\overline{P}^*\right)}{\frac{1-\alpha}{\alpha}+b}\frac{1}{1+\left(X/X^*\right)^{\frac{1}{1-b}}} = \begin{array}{l} \mathrm{N}^* \\ \text{(before opening)} \end{array} = \frac{b\overline{M}^*}{\frac{1-\alpha}{\alpha}+b}$$

$$\text{or: (29)}\quad \overline{P}^* = \overline{M}^*\left(1+\left(\frac{X}{X^*}\right)^{\frac{1}{1-b}}\right) - \overline{M} > \overline{M}^*$$

since $X > X^*$ (which represents the larger factor endowment of the advanced country in skilled labour and capital).

**The equilibrium** is then determined by:

$$(30)\quad \begin{cases} q = \dfrac{\alpha}{1-\alpha}\dfrac{Z+Z^*}{Y+Y^*} \\ B = qbA\overline{L}^a N^{b-1}K^{1-a-b} = qbA\overline{L}^{*a} N^{*b-1}K^{*1-a-b} \\ N+N^*+M+M^* = \overline{M}+\overline{P}^* \end{cases}$$

hence:

$$(31)\quad \begin{cases} N^* = \dfrac{b\overline{M}^*}{\frac{1-\alpha}{\alpha}+b} = N^* \text{ (before opening)} \\ \mathrm{N} = \mathrm{N}^*\left(\dfrac{X}{X^*}\right)^{\frac{1}{1-b}} >> N \text{ (before opening)} = \dfrac{b\overline{M}}{\frac{1-\alpha}{\alpha}+b} \\ M = \overline{M} - N = M \text{ (before opening)} \\ M^* = \overline{P}^* - N^* > M^* \text{ (before opening)} \\ Y \text{ (after opening)} >> Y \text{ (before opening)} \\ Y^* \text{ (after opening)} = Y^* \text{ (before opening)} \\ Z \text{ (after opening)} << Z \text{ (before opening)} \\ Z^* \text{ (after opening)} > Z^* \text{ (before opening)} \end{cases}$$

Since unskilled employment used for the production of advanced goods in China does not change, as the $N/N^*$ relationship is linked to $X/X^* > 1$ after the opening of trade, production of advanced goods in the advanced country will increase.

Note that $N/N^*$ is determined by equalization in marginal productivity of unskilled labour for the production of advanced goods $\left(bXN^{b-1} = bX^*N^{*b-1}\right)$ (as the wage of unskilled labour is the same $(B)$ in the advanced country and in China.

As such, production of traditional goods in the advanced country $(Z)$ contracts significantly, as unskilled labour moves into the production of advanced goods.

**The fact that the supply of unskilled labour increases in China with the opening to trade** thus implies:

- a noteworthy increase in the global production of advanced goods
- no decline in the production of advanced goods in China
- in the advanced country further specialisation in the production of the advanced good.

**Should the supply of unskilled labour had remained unchanged in China, we would have had:**

$$(32)\ \begin{cases} Y\ (\text{after opening}) > Y\ (\text{before}) \\ Y^*\ (\text{after}) < Y\ (\text{before}) \\ Z\ (\text{after}\ ) < Z\ (\text{before}) \\ Z^*\ (\text{after}) > Z^*\ (\text{before}) \end{cases}$$

The relative price $q$ of advanced goods varies in line with $\left(\overline{M} + \overline{M}^*\right)^{1-b}$.

**As such, the rise from $\overline{M}^*$ to $\overline{P}^*$ in the supply of unskilled labour in the emerging country leads to a rise in the relative price $q$ of the advanced good**.

We can also see (see (3)), that the relative wage of skilled workers $w/s = qa\dfrac{A}{B}\overline{L}^{a-1}N^bK^{1-a-b}$ in comparison with unskilled wage earners in the advanced country rises far more here than if the supply of unskilled labour was fixed, due to both the rise in $q$ and that in $N$ (unskilled employment used in the production of advanced goods).

**The growth in the supply of unskilled labour in China therefore enhances the effects of the opening of trade on the relative price of advanced goods $q$ and on the process of productive specialisation.** Hence, it does not prevent the opening of trade to improve welfare, quite the opposite.

## 5 - Transfer of technology

We suppose now that total factor productivity in the advanced sector in China, $A^*$, is initially lower than in the advanced country $A$.

The equilibrium is given by:

$$(33)\quad \begin{cases} s = B \\ s/q = bA\bar{L}^a N^{b-1} K^{1-a-b} = bA^* \bar{L}^{*a} N^{*b-1} K^{*1-a-b} \\ w/q = aA\bar{L}^{a-1} N^b K^{1-a-b} \\ w^*/q = aA^* \bar{L}^{*a-1} N^{*b} K^{*1-a-b} \\ N + M = \bar{M}\ ;\ N^* + M^* = \bar{M}^* \\ q = \dfrac{\alpha}{1-\alpha}\dfrac{Z+Z^*}{Y+Y^*} \\ Z = BM\ ;\ Z^* = BM^* \\ Y = A\bar{L}^a N^b K^{1-a-b} = AN^b X\ ;\ Y^* = A^* \bar{L}^{*a} N^{*b} K^{*1-a-b} = A^* N^{*b} X^* \end{cases}$$

We still denote $X = \bar{L}^a K^{1-a-b}\ ;\ X^* = \bar{L}^{*a} K^{*1-a-b}$

The only difference with the previous equilibrium is that $A^* \neq A$.

Then (33) leads to:

$$(34)\quad \begin{cases} N = \dfrac{b\left(\bar{M}+\bar{M}^*\right)}{\left(\dfrac{1-\alpha}{\alpha}+b\right)} \bullet \dfrac{1}{1+\left(\dfrac{A^* X^*}{AX}\right)^{\frac{1}{1-b}}} \\ N^* = \dfrac{b\left(\bar{M}+\bar{M}^*\right)}{\left(\dfrac{1-\alpha}{\alpha}+b\right)} \bullet \dfrac{\dfrac{A^* X^{*\frac{1}{1-b}}}{AX}}{1+\left(\dfrac{A^* X^*}{AX}\right)^{\frac{1}{1-b}}} \end{cases}$$

and

$$(35)\quad q = B\frac{\left(\bar{M}+\bar{M}^*\right)^{1-b} b^{-b}\left(\dfrac{1-\alpha}{\alpha}+b\right)^{b-1}}{\left[(AX)^{\frac{1}{1-b}} + \left(A^* X^*\right)^{\frac{1}{1-b}}\right]^{1-b}}$$

**Now suppose that the opening to trade triggers a transfer of technology to China (an increase in $A^*$).**

There is then:

- a rise in production (in supply) $Y^*$ of the advanced good in China, therefore a fall in the relative price $q$ of the advanced good (see (35)).
- Lower production specialisation ( $N$ decreases if $A^*$ increases, see (34)).

So, the transfer of technology

- has the favourable effect of increasing production of the advanced good in China,
- has the unfavourable effect of reducing the magnitude of international specialisation.

**Let us take the simple case** where $\overline{M}^* = \overline{M}$, $X = X^*$

If $A^* < A$, the opening of trade leads to a rise in $N$, a fall in $N^*$. Also, the relative price of the advanced good will increase in the advanced country, and will fall in China.

We move from:

$$\text{(36 a)} \begin{cases} \text{before opening} \\ N = \dfrac{b\overline{M}}{\dfrac{1-\alpha}{\alpha} + b} = N^* \\ Y = AXN^b \;;\; Y^* = A^* XN^b \\ q(\text{advanced country}) = B\dfrac{\overline{M}^{1-b} b^{-b} \left(\dfrac{1-\alpha}{\alpha} + b\right)^{b-1}}{(AX)} \\ q(\text{China}) = B\dfrac{\overline{M}^{1-b} b^{-b} \left(\dfrac{1-\alpha}{\alpha} + b\right)^{b-1}}{(A^* X)} \end{cases}$$

(36 b)

$$\begin{cases} \text{after opening} \\ N = \dfrac{2b\overline{M}}{\dfrac{1-\alpha}{\alpha}+b}\dfrac{1}{1+\left(\dfrac{A^*}{A}\right)^{\frac{1}{1-b}}} \\ N^* = \dfrac{2b\overline{M}}{\dfrac{1-\alpha}{\alpha}+b}\dfrac{\left(\dfrac{A^*}{A}\right)^{\frac{1}{1-b}}}{1+\left(\dfrac{A^*}{A}\right)^{\frac{1}{1-b}}} \\ q = \dfrac{B\left(2\overline{M}\right)^{\frac{1}{1-b}} b^{-b}\left(\dfrac{1-\alpha}{\alpha}+b\right)^{b-1}}{AX\left(1+\left(\dfrac{A^*}{A}\right)^{\frac{1}{1-b}}\right)^{1-b}} \end{cases}$$

- If $A^*$ (total factor productivity in China) is unaltered by the opening of trade, with $A^* < A$, the situation is analogous to that seen above where $X < X^*$ (the advanced country is richer in skilled labour and capital). The opening of trade between the advanced country and China then improves welfare in both countries;

- If trade results in the equalisation of total factor productivities, via the transfer of technology to China, then, with $A = A^*$, $N$ and $N^*$ unskilled jobs used in the production of advanced goods in the advanced country and in China are also unaltered by the opening of trade. Also $q$ (the relative price of the advanced good) will not be changed by the opening of trade (see (36 a) (36 b)). **Welfare in the advanced country therefore remains unchanged with the opening of trade.**

In China, we have:

- a fall in the relative price of the advanced good;
- a rise in $Y^* = A^* N^b X$ production of the advanced good.

Denoting with a + the variables after the opening of trade, we have

$$Z_+ = Z_+^* = Z^* = Z$$
$$Y_+ = Y$$
$$Y_+^* = Y > Y^*$$

**Welfare in China** is:

- before the opening of trade:

$$U = \alpha \ell n\left(\frac{Y^*}{\alpha}\right) + (1-\alpha)\ell n\left(\frac{Z}{1-\alpha}\right)$$

- after the opening of trade:

$$U_+ = \alpha \ell n\left(\frac{Y}{\alpha}\right) + (1-\alpha)\ell n\left(\frac{Z}{1-\alpha}\right)$$

There is obviously an increase in welfare in China;

**So, while there is still an improvement in welfare as a consequence of trade, the gains are concentrated on China, whereas welfare is unaffected by the opening of trade in the advanced country.**

## 6 – Law of one price does not hold

What if, now, as it is in real, the law of one price does not hold for the traditional good: **in the market of the advanced country, the traditional good made in China has a lower price than the one produced domestically**.

Suppose that the price of the traditional good in China is unity. $p$ is the price of the traditional good made in the advanced country; $e$ is the nominal exchange rate; a rise in $e$ indicates a depreciation of the Chinese currency (the RMB). The price of the traditional good manufactured in China in the advanced country is therefore $1/e$ and we suppose that:

$$(37)\ 1/e < p$$

This represents either stickiness in the level of price $p$ in the advanced country, or rigidity in the nominal exchange rate $e$. Then (37) implies that **the traditional good is produced only in China**. As such, since there is such production in the advanced country, the price of the traditional good is $1/e$, the same as in China.

On the other hand the law of one price holds for the advanced good which is produced by China. Its price is $q$ in China, $q/e$ in the advanced country, $q$ is the relative price of the advanced good.

Finally, we let **the wage of unskilled labour** $s$ **in the advanced country equal to what it was before the opening of trade** (as it is happening):

$$(38)\ s = Bp > B/e$$

For the sake of simplicity, we let $e = 1$.

The equilibrium is then given by:

$$(38\text{ a})\quad \begin{cases} \dfrac{Bp}{q} = Ab\bar{L}^{a} N^{b-1} K^{1-a-b} \\ p > 1 \end{cases}$$

(equality of the real wage of unskilled labour and of the marginal productivity of unskilled labour in the advanced country).

$$(38\text{ b})\quad B/q = Ab\bar{L}^{*a} N^{*b-1} K^{*1-a-b}$$

(equality between the real wage and the marginal productivity of unskilled labour in China).

$$(38\text{ c})\quad \begin{cases} Z = 0 \\ Y + Y^{*} = \alpha Y + \alpha\left(Y^{*} + Z^{*}/q\right) \end{cases}$$

(equilibrium of the market of sophisticated goods)

$$(38\text{ d})\quad \begin{cases} N^{*} + M^{*} = \bar{M}^{*} \\ N < \bar{M} \end{cases}$$

(equilibrium of the unskilled labour market)

As the nominal wage $S = Bp$ of unskilled labour in the advanced country is rigid, there is unemployment among unskilled labour in the advanced country.

Hence:

$$(39)\quad \begin{cases} N = \left[\dfrac{AbXq}{Bp}\right]^{\frac{1}{1-b}} \quad ; \quad Y = AXN^{b} \\ q = \dfrac{\alpha}{1-\alpha}\dfrac{Z^{*}}{Y+Y^{*}} \quad ; \quad Z^{*} = BM^{*} \quad ; \quad q = \dfrac{\alpha}{1-\alpha}\dfrac{BM^{*}}{AXN^{b} + AX^{*}N^{*b}} \\ N^{*} = \left[\dfrac{AbX^{*}q}{B}\right]^{\frac{1}{1-b}} \quad ; \quad Y^{*} = AX^{*}N^{*b} \end{cases}$$

**Before the opening of trade**, we had:

$$(40)\quad \begin{cases} N = \left[\dfrac{AbXq_0}{Bp}\right]^{\frac{1}{1-b}} \\ q_0 = \dfrac{\alpha}{1-\alpha}\dfrac{Z}{Y} = \dfrac{\alpha}{1-\alpha}\dfrac{BM}{AXN^{b}} \end{cases}$$

where $q_0$ is the relative price in the advanced country before the opening of trade

and, for China:

$$(41)\quad \begin{cases} N^{*} = \left[\dfrac{AbX^{*}q_0^{*}}{B}\right]^{\frac{1}{1-b}} \\ q_0^{*} = \dfrac{\alpha}{1-\alpha}\dfrac{Z^{*}}{Y^{*}} = \dfrac{\alpha}{1-\alpha}\dfrac{BM^{*}}{AX^{*}N^{*b}} \end{cases}$$

By solving, we obtain:

- **before the opening of trade**

$$(42\text{ a})\quad \begin{cases} N = \dfrac{b\overline{M}}{p\dfrac{1-\alpha}{\alpha}+b}\ ;\ M = \dfrac{p\dfrac{1-\alpha}{\alpha}\overline{M}}{p\dfrac{1-\alpha}{\alpha}+b} \\ q_0 = \dfrac{B\overline{M}^{1-b}b^{-b}}{AX}\left(p\dfrac{1-\alpha}{\alpha}+b\right)^{b-1} \bullet p \end{cases}$$

and

$$(42\text{ b})\quad \begin{cases} N^* = \dfrac{b\overline{M}^*}{\dfrac{1-\alpha}{\alpha}+b}\ ;\ M^* = \dfrac{\dfrac{1-\alpha}{\alpha}\overline{M}^*}{\dfrac{1-\alpha}{\alpha}+b} \\ q_0^* = \dfrac{B\overline{M}^{*1-b}b^{-b}}{AX^*}\left(\dfrac{1-\alpha}{\alpha}+b\right)^{b-1} \end{cases}$$

- **after the opening of trade**

$$(43\text{ a})\quad \begin{cases} N = \dfrac{b\overline{M}^*}{p^{\frac{1}{1-b}}\left(\dfrac{X^*}{X}\right)^{\frac{1}{1-b}}}\ \dfrac{1}{\left(b+\dfrac{1-\alpha}{\alpha}\left(1+p^{\frac{-b}{1-b}}\left(\dfrac{X^*}{X}\right)^{\frac{1}{1-b}}\right)\right)} = \dfrac{b\dfrac{\alpha}{1-\alpha}M^*}{p\left(1+p^{\frac{b}{1-b}}\left(\dfrac{X^*}{X}\right)^{\frac{1}{1-b}}\right)} \\ M = 0 \end{cases}$$

and

$$(43\text{ b})\quad \begin{cases} N^* = \dfrac{b\overline{M}^*}{b+\dfrac{1-\alpha}{\alpha}\left(1+p^{\frac{-b}{1-b}}\left(\dfrac{X^*}{X}\right)^{\frac{1}{1-b}}\right)} \\ M^* = \dfrac{\dfrac{1-\alpha}{\alpha}\left(1+p^{\frac{-b}{1-b}}\left(\dfrac{X}{X^*}\right)^{\frac{1}{1-b}}\right)\overline{M}^*}{b+\dfrac{1-\alpha}{\alpha}\left(1+p^{\frac{b}{1-b}}\left(\dfrac{X}{X^*}\right)^{\frac{1}{1-b}}\right)} \\ q = \dfrac{B\overline{M}^{*1-b}b^{-b}}{AX^*}\left(b+\dfrac{1-\alpha}{\alpha}\left(1+p^{-\frac{b}{1-b}}\left(\dfrac{X}{X^*}\right)^{\frac{1}{1-b}}\right)\right)^{b-1} \end{cases}$$

Note that:

$$\begin{cases} \overline{M}^* > \overline{M} & \text{(supply of unskilled labour is larger in China than in the advanced country)} \\ p > 1 & \text{(the price of the traditional good, before the opening of trade, was higher in the advanced country than in China)} \\ X > X^* & \text{(supply of skilled labour and capital are more abundant in the advanced country)} \end{cases}$$

The effect of the opening of trade is *a priori* ambiguous.

What are the effects of the law of one prices and its deviation?

We take $p > 1, \overline{M} = \overline{M}^*, X = X^*$. We then have without ambiguity:

$$q < q_0^* < q_0$$

**Hence, the opening of trade drives down the relative price of the advanced good in the two countries.**

This is normal in the case of China.

In the advanced country, the **opening of trade leads to the disappearance of the production of traditional good**; in order to rebalance the market of the traditional good, we then have to have a rise in its relative price.

This then leads, without ambiguity, to:

$$\begin{cases} N < N_0 \\ N^* < N_0^* \; ; M^* > M_0^* \end{cases}$$

where $N_0$ et $N_0^*$ are the unskilled jobs used in the production of the advanced good in the two countries before the opening of trade, $M_0^*$ is unskilled employment used in the production of the traditional good in China before the opening of trade.

**In China, there is a normal process of specialisation: fall in the relative price of the advanced good, contraction in the output of the advanced good and an increase in the production of the traditional good.**

**Conversely, in the advanced country, there is a highly unfavourable development: fall in the relative price of the advanced good, accordingly a contraction in the production of the advanced good and disappearance of production of the traditional good.**

## Conclusion

We have first shown that, as usual, the opening of trade between advanced countries and China improved welfare in all these countries. Because of factor endowment, China will specialize in the production of traditional goods and the relative price of advanced goods prevailing in China will fall; in the advanced countries, there is specialisation in the production of advanced goods and a rise in the relative price of advanced goods.

We then studied the effects of three important characteristics of the development process in China.

The rapid growth in the supply of skilled labour in China amplifies the specialisation process as well as its mutually beneficial nature.

As trade opens, if there is transfer of technology to China, welfare will only improve in China, while staying put in the advanced country.

The fact that the law of one price does not hold for traditional goods, (those made in China are less expensive when sold in the advanced countries, than those produced domestically) has dramatic effects on production of the advanced country: not only production of traditional goods disappears but the production of advanced goods contracts after the opening of trade.

Therefore, one would have to wait until the convergence in price levels is completed for the opening of trade with China to be favourable for the advanced country.

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