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Industrial Specialization, Catching-up and Labour Market Dynamics

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Abstract

This paper presents a dynamic model as a heuristic tool to discuss some issues of changing industrial specialization which arise in the context of catching-up processes of (technologically) less advanced economies and the impact which various scenarios of such catching-up processes might have on the labour market dynamics both in the advanced and the catching-up economies. In analysing the evolution of international specialization, we demonstrate the twin pressures exerted upon the industrial structures of 'northern' economies: competition from 'type-A southern' economies which maintain a comparative competitive strength in labour-intensive and less skill-intensive branches, and competition from 'type-B catching-up' economies, whose catching-up increasingly focuses upon branches in which the initial productivity gaps and hence the scope for catching-up are the highest. The contrast between these two catching-up scenarios allows the explicit analysis of the implications of 'comparative advantage switchovers' between northern and southern (type-B) economies for labour market dynamics.

Keywords: international competition, catching-up, labour market dynamics

JEL classification: C68, C69, F1, F10, F17, F21, J21, F31

1 Introduction

The theme 'globalization and labour markets' has recently been addressed by a large number of researchers (see Wood 1994, Sachs/Shatz 1994, Leamer 1994, Baldwin 1994, etc.). The issues analysed concern particularly the question of whether increasing trade liberalization between industrially more advanced economies (the "North") and less developed economies (the "South") and also the increasing flow of international direct investment might have had a significant impact upon the labour markets of both types of economies. The discussion on these issues is far from concluded and there are significant disputes concerning the analytical framework to be used for this type of analysis and also concerning the validity of the results of the econometric studies in this area.

In this paper we shall attempt to contribute to the discussion of these issues by using a dynamic model as a heuristic tool to discuss issues of changing industrial specialization which arise in the context of catching-up processes of (technologically) less advanced economies and the impact which various scenarios of such catching-up processes might have on labour market dynamics in the more advanced economies. The reasons for emphasizing the issue of catching-up in the context of the debates concerning 'globalization and labour markets' are two-fold:

- Firstly, the whole debate concerning this issue only gained momentum in the late 1980s and the 1990s at a time when the challenge from successful catching-up economies (from South East Asia) became clearly visible.Thus it seems unsatisfactory that the bulk of the existing literature in this area employs almost without exception a static Heckscher-Ohlin framework of analysis to analyse these issues.

- Secondly, it seems to us that the 'twin pressure' both from more traditional 'Southern economies' (which maintain a rather traditional comparative advantage structure towards labour- and resource-intensive industries) as well as from catching-up economies (which also move into higher technology areas) is not sufficiently reflected in the current theoretical and applied literature on this topic.

2 The model

2.1 Description of the model

The model which we shall be using to explore the dynamics of international specialization between a (potential) catching-up economy and a (technologically) advanced economy and ensuing labour market interactions has Schumpeterian features: We shall explore the impact of the introduction of productivity-enhancing technologies upon price-, wage- and quantity systems of the two economies. Let us go over the different components of the model step-by-step:

The model analyses the impact of a (semi-exogenous; see below) 'impulse' which represents the evolution of different industries' 'technological potential'; the sequence of these impulses is formulated as a 'logistic function' (see equ.1 below). We differentiate between a 'high-tech'(industry 2) and a 'low-tech' industry (industry 1) and assume that

(i) the technological potential rises more steeply and reaches a higher level in the high-tech than in the low-tech industry;

(ii) there is a difference in the lags by which the less advanced economy (country B) can draw on the technological potential of the high-tech as against the low-tech industry. One can interpret this as a 'ladder' in the learning process: it is more difficult and thus takes longer to catch up with technologies in the high-tech than it is in the low-tech sectors.

The resulting logistics of the two countries' 'technological potentials' linked to the respective industries can be seen in Fig.1. (We shall see later on that some of the parameters of this logistic function gets endogenized; see formulation equ. 1').

The translation of the evolution of 'technological potentials' into (labour) productivity enhancement is formalized in equs. (2). Here we specify for each skill group of workers (s for skilled, u for unskilled) a relationship between labour (per unit) input coefficients and the evolution of the (industry- and country-specific) technological potentials. This formulation allows for skill-compositional effects of the introduction of new technologies.

Changes in (per unit) labour input coefficients have - given wage rates - an impact upon unit costs (see equs. 3) and through unit costs upon prices.

The price equations (see equs. 4) allow - in Schumpeterian fashion - for the emergence of *technological rents*, i.e. prices do not adjust instantaneously to unit costs (plus a normal mark-up) and hence, a fall in unit costs, given price adjustment parameters $\gamma_i \leq 1$, will give rise to transitory technological rents R_i(see equ. 7).

However, unit costs are not only a function of physical (per unit) labour and other input requirements, but also of the responses of wage rates and prices. As we have already dealt with price adjustments (see equs. 4), we move to the wage rate equations (equs. 5). These have two terms:

- a term $h_i^z R_i / a_{Li}^z$ with $h_i^z = h_i w_i^z / \sum_z w_i^z$ accounts for responses of the different skill groups in their wage demands to the emergence of technological rents in their industries. The parameters h_i^z measure the proportions of technological rents which are absorbed (instantaneously) in the form of higher wage increases by workers of different skill categories. This formulation guarantees that wage rates of each skill group of workers increase or decrease by the same percentage amount. We shall call them 'claw-back' parameters; they are industry-specific;

-the other term, $h^z u^z$, is economy-wide and skill group-specific; it assumes a relationship between wage rate increases and skill group-specific unemployment rates in the economy as a whole (see equs.6).

We now move to a discussion of the different components of demand:

There are two components of *investment demand*:

- Investment fed from 'normal' or 'long-run' mark-up profits (equs. 9 and 10), and

- investment fed from 'innovational profits' $(1 - h_i - j_i^r) R_i q_i$. Innovational (per unit) profits depend upon wage rate movements (in turn a function of 'claw-back' processes and hence of technological rents), price-unit cost adjustment parameters and, of course, the original productivity movements. Investment out of profits also depends upon parameters which stand for the propensities to invest out of profits $(1 - j_i^r)$ and $(1 - j_i^m)$, where the j_i^r, j_i^m parameters will be referred to as the 'whimp factors'. (See the discussion in Landesmann/Goodwin 1994, where these parameters, which at time could also take a negative value, are extensively used to keep track of credit and debt relationships between banks and the enterprise sector). The two types of investment demands (8) and (10) add up to total investment demand (11).

The other components of industry demand are:

- intermediate demands, $\sum_j a_{ij} q_i$,

- wage demands, for which we assume that constant nominal shares s_i of the overall wage bill, W/p_i, are spent on the output of the different industries i, and

- an autonomous expenditure item, d_i, which is required to avoid attraction of the dynamical system to a zero fix-point.

The output equation (12) is formulated as a simple supply-adjusts-to-demand equation. We can see that relative price movements between industries lead to substitution effects as the same amount of nominal spending leads to more 'real' demand; the constant nominal expenditure shares assumed for spending out of wages is compatible with substitution elasticities which emerge from a Cobb-Douglas formulation of an expenditure system.

For an *open economy*, we have to add *export demand* (see equ. 17): Here we again assume a constant nominal expenditure structure in each of the two economies on imports and supplies from domestic producers as regards the final demand components. This allows for substitution effects between importers and domestic producers as their relative prices mediated by exchange rate movements change. Although we formulate our model in a way which allows for changing relative price competitiveness of different producers on the same markets (the price equations are, in the first instance, formulated as mark-up on unit cost equations), we also include some long-run pressure in each market to conform to a 'market price' (made up of the weighted supply prices of the different suppliers; see equations 4 and the modified price equations 14 - 16.)

Adding the export component to overall demand and taking account of import penetration leads to the output equations for an open economy (see equ. 18).

Finally, we elaborate on differences in the formulations of the evolution of 'technological potentials' between the advanced and the catching-up economy (superscripted F):

For the advanced economy, the (partially 'endogenous') dynamics of the 'technological potential' takes the form (1'). We can see here that, both, the 'slope' parameter g_{i1}(of formulation 1) as well as the 'final level' parameter g_{i2} get partly endogenized and made a function of investment activity out of profits. Hence, the ploughing back of innovational profits leads itself to a speeding up in the accumulation of the (industry-specific) stock of new technologies and also affects the final level of these stocks.[1]

For the catching-up economy, we adopt the same formulation as in (1') - see the first expression of equ. (19) - which is however complemented by a '*spillover term*' S. The spillover term (see equ. 20) is formulated as in Verspagen 1991. There the 'technological gap' (defined here as $\ln(k/k^F)$) enters both as a positive term into the spillover expression, since a big gap opens up a great 'potential' for technology transfer (Gerschenkron's 'advantage of backwardness'), but also as a negative term (the negative exponential term in equ. 17), as learning becomes more difficult the further it is from what one already knows or practices. However, the negative effect of a large gap can be mitigated by attempts to improve a country's 'learning capabil-

[1]As mentioned above, the model serves as a heuristic device to analyse the dynamics between two steady states. The analysis can be generalised to analyse the impact of a succession of logistic technology impulses.

ity'; the latter is proxied in our formulation by the share of skilled labour in the total labour force.

In the following section 2.2 we present the formal structure of the model; in section 2.3 we discuss some analytical properties of the model when it is in a steady-state; section 3 presents some preliminary results from model simulations; section 4 draws out policy conclusions and discusses further model extensions.

2.2 The formal structure of the model

See Glossary in the Annex for the definitions of the various variables and parameters of the model and refer back to the non-formal discussion of the model structure in section 2.1.

2.2.1 The closed economy case

Technological potential (i refers to the industry subscript):

$$\dot{k}_i = g_{i1} k_i (1 - k_i / g_{i2}) \tag{1}$$

or

$$\dot{k}_i = g_{i1} (1 + g_{i3} I_i^R) k_i (1 - k_i / g_{i2}) \tag{1'}$$

$$\dot{g}_{i2} = g_{i5} I_i^R$$

We can see that an economy can affect its own pace of technological development ($\dot{k}_i$) through its innovational investment (I^R).

Labour input coefficients (z = s, u refers to skill types):

$$\dot{a}_{Li}^z = -\xi_i^z \dot{k}_i \tag{2}$$

Costs:

$$c_i = \left(\sum_j p_j a_{ji} + \sum_z w_i^z a_{Li}^z \right) \tag{3}$$

Prices:

$$\dot{p}_i = \gamma_i \left((1 + m_i) \, c_i - p_i \right) \tag{4}$$

Wages:

$$\dot{w}_i^z = h_i R_i / \sum_z a_{Li}^z - h^z u^z \tag{5}$$

where $h_i^z = h_i w_i^z / \sum_z w_i^z$ and u^z denotes the unemployment rate (z refers to skill type):

$$u^z = (\sum_i q_i a_{Li}^z - L^{Sz}) / L^{Sz} \tag{6}$$

The labour supply for skill group z, L^{Sz}, is given exogenously.

Innovational profits:

$$R_i = (p_i - (1 + m_i)\, c_i) \tag{7}$$

Invested innovational profits:

$$I_i^R = (1 - h_i - j_i^r) R_i q_i \tag{8}$$

Mark-up profits:

$$M_i = m_i c_i \tag{9}$$

Invested mark-up profits:

$$I_i^M = (1 - j_i^m) M_i q_i \tag{10}$$

Invested total profits:

$$I_i^T = I_i^R + I_i^M \tag{11}$$

Output:

$$\dot{q}_i = \delta_i (\sum_j a_{ij} q_i + s_{ci} W/p_i + I_i^T/p_i + d_i - q_i) \tag{12}$$

with

$$\begin{aligned} \sum_i s_{ci} &= 1 \\ W &= \sum_i \sum_z L_i^{Dz} w_i^z \end{aligned}$$

where $L_i^{Dz} = a_{Li}^z q_i$ is the labour demand for skill type z (z = u, s for skilled and unskilled labour respectively) in sector i and s_{ci} denotes the share of consumption spending on commodity i. This system of equations can be further generalized by introducing terms which account for the interrelatedness of investments across sectors. For a 2-sector system, this could be done by replacing the terms

$$I_i^T/p_i$$

by specifications

$$\begin{aligned} &\left(s_{I1} I_1^T + (1 - s_{I2})\, I_2^T\right)/p_1 \\ &\left((1 - s_{I1}) I_1^T + s_{I2} I_2^T\right)/p_2 \end{aligned} \tag{13}$$

with

$$\sum_i s_{Ii} = 1$$

This allows again for substitution processes in the supply of investment goods (just as equs. 12 already allowed for substitution processes in the case of consumption goods) to the two sectors as the relative price structure between sectors changes. Furthermore, the nominal share parameters s_{Ii} could be made a function of relative profitability of the two sectors, thus speeding up the reallocation of investible resources across sectors. This theme will be taken up in further extensions of the model dealing particularly with the endogenization of foreign direct investment flows in the open economy version of the model (see section 4.)

2.2.2 The open economy case

Prices The foreign (the 'catching-up') economy is now superscripted with F and the domestic (the - at least initially - technologically more advanced) economy is not superscripted. The prices in the market of an economy are now determined by the domestic prices and the import prices (the latter being the export prices of the other country). The average price in one market $\bar{p}_i$ is a weighted sum of both domestic and import prices (the weights being the nominal market shares of domestic producers and imports respectively):

$$\bar{p}_i = (1 - s_i^{dF})p_i^d + s_i^{dF} p_i^{xF} e \tag{14}$$

where p_i^d and p_i^x denotes domestic and import prices, e being the exchange rate. The supply price of the domestic producers of an economy becomes

$$p_i^d = \theta_i^d p_i + (1 - \theta_i^d) p_i^{xF} e \tag{15}$$

where the θ_i^d denotes the weights given to the cost (plus mark-up) price p_i and the supply price of imports $p_i^{xF}e$. The price at which the producers sell on the export market are determined similarly:

$$p_i^x = \theta_i^x p_i / e + (1 - \theta_i^x)\bar{p}_i^F \tag{16}$$

Thus the rents are now determined both by domestic and foreign developments of exchange rates, prices and costs.

Exports The same model specification can be used for the second economy (the 'foreign' economy is superscripted with F), with interrelationships between these countries specified via export flows in the following manner:

$$\dot{x}_i = \delta_i(e((1 - s_{ci}^{dF})s_{ci}^F W^F / p_i^x + (1 - s_{Ii}^{dF}) I_i^{TF} / p_i^x) - x_i) \tag{17}$$

$$\dot{q}_i = \delta_i(\sum_j a_{ij} q_i + s_{ci}^d s_{ci} W / p_i^d + s_{Ii}^d I_i^T / p_i^d + x_i + d_i - q_i) \tag{18}$$

where s_{ci}^{dF} and s_{Ii}^{dF} are the portions of the different final demand components (consumption and investment) satisfied from domestic production and $(1 - s_{ci}^{dF})$ and $(1 - s_{Ii}^{dF})$ from imports; e denotes the exchange rate.

Technological spillover The technological potential of the catching-up economy interacts in the following way with that of the more advanced economy[2] (define the technological gap $G = \ln(k/k^F)$).

$$\dot{k}_i^F = g_{i1}^F(1 + g_{i3}^F I_i^{RF})k_i^F(1 - k_i^F/g_{i2}^F) + S \tag{19}$$

where

$$S = g_{i4}^F G \exp(-G/\eta) \tag{20}$$

where

$$\eta = f(L^{sF}/L^F) \tag{21}$$

2.3 The equilibrium solution for the closed economy

In equilibrium we assume that the technological potential is fully exhausted, i.e. $\dot{g}_{i2} = 0$ and $\dot{k} = 0$, which also means that the labour input coefficients are constant, $\dot{a}_{Li}^z = 0$. Also we assume that wages are constant, $\dot{w}_i^z = 0$, which is only possible - for wage catch-up parameters $h_i^z > 0$ and labour input coefficients $a_{Li}^z > 0$ - when rents are fully eroded by the price wage dynamics, i.e. $r_i = 0$. The conditions for this case will be developed below. Further we assume that, in equilibrium, no wage rate movements result from the (un)employment rate (i.e. $h^z = 0$).

2.3.1 Technology and labour input

The equation for the technological potential in its simple form is a constant coefficient form of the Bernouilli equation which can be solved by standard methods:

$$k_i(t) = \left[\left(\frac{1}{k_{i0}} + \frac{1}{g_{i2}}\right)\exp^{-g_{i1}t} + \frac{1}{g_{i2}}\right]^{-1}$$

The change of the labour input coefficients is a special case of a non- homogeneous ordinary differential equation with variable coefficients with a solution

$$a_{Li}^z(t) = a_{Li0}^z + \int_0^t -\xi_i^z \dot{k}_i(t)\,dt = a_{Li0}^z - \xi_i^z \int_0^t \dot{k}_i(t)\,dt$$

[2]For a theoretical and empirical debate on this formulation see Verspagen 1991.

By definition we know that

$$k_i(t) \equiv k_{i0} + \int_0^t \dot{k}_i(t)\,dt$$

and this way

$$\int_0^t \dot{k}_i(t)\,dt = k_i(t) - k_{i0}$$

Inserting this equation above gives us

$$a^z_{Li}(t) = a^z_{Li0} - \xi^z_i\left(k_i(t) - k_{i0}\right)$$

The stable equilibrium points for $t \to \infty$ are then

$$k^*_i = g^*_{i2} \tag{22}$$

and

$$a^{z*}_{Li} = a^z_{Li0} - \xi^z_i\left(g_{i2} - k_{i0}\right) \tag{23}$$

2.3.2 Prices

In such a technological equilibrium situation at k^* and a^{z*}_{Li} it will be shown later that rents are fully eroded and therefore wages are staying constant at a certain level w^{z*}_i. In such a situation the equilibrium prices can be worked out easily by standard methods. Writing the equations for prices for a 2-sector model and one (skill) type of worker as

$$\begin{pmatrix} \dot{p}_1 \\ \dot{p}_2 \end{pmatrix} = \begin{pmatrix} \gamma_1\left(a_{11}(1+m_1)-1\right) & \gamma_1 a_{21}(1+m_1) \\ \gamma_2 a_{12}(1+m_2) & \gamma_2\left(a_{22}(1+m_2)-1\right) \end{pmatrix}\begin{pmatrix} p_1 \\ p_2 \end{pmatrix} + \\ + \begin{pmatrix} \gamma_1(1+m_1)\,a^*_{L1}w^*_1 \\ \gamma_2(1+m_2)\,a^*_{L2}w^*_2 \end{pmatrix}$$

or in short hand version

$$\dot{\mathbf{p}} = A_p\mathbf{p} + \mathbf{b}_p$$

This is a non-homogenous first order differential equation system with constant coefficients for which the solution can be worked out quite easily

$$\mathbf{p}^* = -A_p^{-1}\mathbf{b}_p \tag{24}$$

These fixpoints are stable for economic parameter values, as the eigenvalues $\lambda_i < 0$. [3]

[3] For given wages and labour inputs also solutions of the differential equation system can be given: $p(t) = \left[(\mathbf{p}_0 + A^{-1}\mathbf{b})\exp(A_p t)\right] - A^{-1}\mathbf{b}$.

2.3.3 Innovational Rents

For the equilibrium prices, the rent equation can be rewritten as

$$\begin{pmatrix} r_1^* \\ r_2^* \end{pmatrix} = \begin{pmatrix} 1-a_{11}(1+m_1) & -a_{21}(1+m_1) \\ -a_{12}(1+m_2) & 1-a_{22}(1+m_2) \end{pmatrix} \begin{pmatrix} p_1^* \\ p_2^* \end{pmatrix} -$$

$$-\begin{pmatrix} \gamma_1(1+m_1)a_{L1}^* w_1^* \\ \gamma_2(1+m_2)a_{L2}^* w_2^* \end{pmatrix}$$

or

$$\mathbf{r} = -A_p \mathbf{p}^* - \mathbf{b}_p$$

Inserting the equilibrium solution for prices $\mathbf{p}^*$ and rearranging the first matrix gives us

$$\mathbf{r} = -A_p\left(-A_p^{-1}\right)\mathbf{b}_p - \mathbf{b}_p$$

from which it can be seen that

$$\mathbf{r}^* = \mathbf{0}$$

This means that for the equilibrium situation described above rents will erode fully.

2.3.4 Wages

We can now work out equilibrium wages for constant labour input coefficients, constant equilibrium prices and assuming that the labour market is cleared (or, expressed differently, that the unemployment level is such that no wage rate movements result from the (un)employment rate). The differential equations for wages can be written by inserting the rent formulas as

$$\begin{aligned} \dot{w}_1 &= h_1\left(p_1^* - (1+m_1)\left(p_1^* a_{11} + p_2^* a_{21} + w_1 a_{L1}^*\right)\right)/a_{L1}^* \\ \dot{w}_2 &= h_2\left(p_2^* - (1+m_2)\left(p_1^* a_{12} + p_2^* a_{22} + w_1 a_{L2}^*\right)\right)/a_{L2}^* \end{aligned}$$

For $\dot{w}_i = 0$ the following condition have to be fulfilled

$$\begin{aligned} w_1^* &= \left(p_1^* - (1+m_1)\left(p_1^* a_{11} + p_2^* a_{21}\right)\right)/\left(a_{L1}^*(1+m_1)\right) \\ w_2^* &= \left(p_2^* - (1+m_2)\left(p_1^* a_{12} + p_2^* a_{22}\right)\right)/\left(a_{L2}^*(1+m_2)\right) \end{aligned}$$

Inserting w_i^* into the matrix $\mathbf{b}_p$ above we get

$$\mathbf{b}_p = -A_p \mathbf{p}^*$$

Inserting this in the price equations gives for the equilibrium solution

$$\mathbf{p} = \mathbf{p}^*$$

This means that in equilibrium the system is underdetermined. That is, for equilibrium situations we have either to determine a numéraire or wages have to be determined from outside. In a dynamical sense this difficulty is solved by the determination of wages as a path-dependent process resulting from the complex dynamic interrelationship of technical progress, the emergence of rents and the resulting price and wage dynamics.

2.3.5 Output

The quantity system can be rewritten as follows given that innovational rents equals zero and inserting the equilibrium wages into wage demand

$$\begin{pmatrix} \dot{q}_1 \\ \dot{q}_2 \end{pmatrix} = \begin{pmatrix} \delta_1 (a_{11} + \left(\frac{w_1^*}{p_1^*}\right) a_{L1}^* s_1 + & \delta_1 (a_{12} + \left(\frac{w_2^*}{p_1^*}\right) a_{L2}^* s_1 + \\ +(1 - j_1^m) M_1^*/p_1^* - 1) & +(1 - j_1^m) M_2^*/p_1^*) \\ \delta_2 (a_{21} + \left(\frac{w_1^*}{p_2^*}\right) a_{L1}^* s_2 + & \delta_2 (a_{22} + \left(\frac{w_2^*}{p_2^*}\right) a_{L2}^* s_2 + \\ +(1 - j_2^m) M_1^*/p_2^*) & +(1 - j_2^m) M_2^*/p_2^* - 1) \end{pmatrix} * \begin{pmatrix} q_1 \\ q_2 \end{pmatrix} + \\ + \begin{pmatrix} d_1 \\ d_2 \end{pmatrix}$$

or in short-hand version

$$\dot{\mathbf{q}} = A_q \mathbf{q} + \mathbf{b}_q$$

The matrix A_q can be rewritten by inserting for equilibrium wages and equilibrium mark-up rents by

$$A_q = \begin{pmatrix} A_q^{11} & A_q^{12} \\ A_q^{21} & A_q^{22} \end{pmatrix}$$

with

$$\begin{aligned}
A_q^{11} &= \delta_1 (a_{11} + \frac{\left(p_1^* - (1+m_1)\left(p_1^* a_{11} + p_2^* a_{21}\right)\right)}{(1+m_1) p_1^*} s_1 + \\ &\quad + \frac{\left(1 - j_1^m\right) a_{11} m_1 p_1^*}{(1+m_1)\left(p_1^* a_{11} + p_2^* a_{21}\right)} - 1) \\
A_q^{12} &= \delta_1 (a_{12} + \frac{\left(p_2^* - (1+m_2)\left(p_1^* a_{12} + p_2^* a_{22}\right)\right)}{(1+m_2) p_1^*} s_1 + \\ &\quad + \frac{\left(1 - j_2^m\right) a_{12} m_2 p_2^*}{(1+m_2)\left(p_1^* a_{12} + p_2^* a_{22}\right)}) \\
A_q^{21} &= \delta_2 (a_{21} + \frac{\left(p_1^* - (1+m_1)\left(p_1^* a_{11} + p_2^* a_{21}\right)\right)}{(1+m_1) p_2^*} s_2 + \\ &\quad + \frac{\left(1 - j_1^m\right) a_{21} m_1 p_1^*}{(1+m_1)\left(p_1^* a_{11} + p_2^* a_{21}\right)}) \\
A_q^{22} &= \delta_2 (a_{22} + \frac{\left(p_2^* - (1+m_2)\left(p_1^* a_{12} + p_2^* a_{22}\right)\right)}{(1+m_2) p_2^*} s_2 + \\ &\quad + \frac{\left(1 - j_2^m\right) a_{22} m_2 p_2^*}{(1+m_2)\left(p_1^* a_{12} + p_2^* a_{22}\right)} - 1)
\end{aligned}$$

and thus in equilibrium only depends on prices, technical coefficients, mark-up ratios and the nominal shares in consumption. The equilibrium output is then

$$\mathbf{q}^* = -A_q^{-1}\mathbf{b}_q \tag{25}$$

which is also stable ($\lambda_i < 0$). Thus in the long run the output system is only determined by real wages and the development of the labour input coefficients. In equilibrium these variables get fully reflected in the prices given above.

2.3.6 Two special cases

In equilibrium two special cases can be observed for the parameter values with either the mark-up ratios set to zero $m_i = 0$ or the mark-up profits being fully reinvested, i.e. $j_i^m = 0$, which is equivalent to the von Neumann-assumption that all profits are fully reinvested. In the latter case the determinant $\det A_q = 0$ and one of the two eigenvalues becomes zero ($\lambda_1 = 0$) the other remains negative ($\lambda_2 < 0$). In this case the equilibrium outputs (fix points) are less than zero, $q_i^* < 0$, but these are unstable as simulations show a stable growth path. This is also valid for the more complicated versions of the output equations shown above.

Another special case emerges by rewriting the wage equations as

$$\dot{w}_i^z = \left(h_{i1}^z R_i + h_{i2}^z M_i\right)/a_{Li}^z$$

i.e. wages are also raised by a proportion of the mark-up rents. Here simulations are showing the following pattern: Wages rise exponentially in the long run as costs and hence wage increases out of mark-up rents never become zero. Costs and prices are thus also growing exponentially. But the most interesting case is - as simulations show - that output becomes stable in the long run although the price system is unstable.[4]

2.4 The solutions for the general model

2.4.1 Prices

$$\begin{pmatrix} \dot{p}_1 \\ \vdots \\ \dot{p}_n \end{pmatrix} = \begin{pmatrix} \gamma_1\left(a_{11}\left(1+m_1\right)-1\right) & \cdots & \gamma_1 a_{n1}\left(1+m_1\right) \\ \vdots & \ddots & \vdots \\ \gamma_n a_{1n}\left(1+m_n\right) & \cdots & \gamma_n\left(a_{nn}\left(1+m_n\right)-1\right) \end{pmatrix} *$$

[4]Further analytical results on these special cases are needed to analyse the dynamics of the system on these critical points, but this is not further pursued in this paper.

$$
* \begin{pmatrix} p_1 \\ \vdots \\ p_n \end{pmatrix} + \begin{pmatrix} \gamma_1 (1+m_1) \sum\limits_z a_{L1}^{z*} w_1^{z*} \\ \vdots \\ \gamma_n (1+m_n) \sum\limits_z a_{Ln}^{z*} w_n^{z*} \end{pmatrix}
$$

or again in matrix notation

$$\dot{\mathbf{p}} = A_p p + \mathbf{b}_p$$

This is a non-homogenous first order differential equation system with constant coefficients for which the solution can be worked out quite easily

$$\mathbf{p}^* = -A_p^{-1} \mathbf{b}_p$$

For stability all eigenvalues of the matrix A_p have to be negative, $\lambda_i < 0$ for all i.

2.4.2 Rents

For stable prices it can be shown as above that in equilibrium rents are zero, $\mathbf{r}^* = 0$.

2.4.3 Wages

In equilibrium the condition has to be fulfilled

$$w_i^{z*} = \left(p_i^* - (1+m_i) \sum_j p_j^* a_{ji} \right) / (1+m_i) \sum_z a_{Li}^{z*}$$

and the same meaning as above holds.

2.4.4 Output

The output equations can be written as[5]

$$
\begin{pmatrix} \dot{q}_1 \\ \vdots \\ \dot{q}_n \end{pmatrix} = \begin{pmatrix} \delta_1(a_{11} + s_1(\sum\limits_z w_1^{z*} a_{L1}^{z*})/p_1 + \\ \quad +I_1^{M*}/p_1^* - 1) & \cdots & \delta_1(a_{1n} + s_1(\sum\limits_z w_n^{z*} a_{Ln}^{z*})/p_1) \\ \vdots & \ddots & \vdots \\ \delta_n(a_{n1} + s_n(\sum\limits_z w_1^{z*} a_{L1}^{z*})/p_n) & \cdots & \delta_n(a_{nn} + s_n(\sum\limits_z w_n^{z*} a_{Ln}^{z*}) + \\ & & \quad +I_n^M/p_n^* - 1) \end{pmatrix} *
$$

$$
* \begin{pmatrix} q_1 \\ \vdots \\ q_n \end{pmatrix} + \begin{pmatrix} d_1 \\ \vdots \\ d_n \end{pmatrix}
$$

[5]The interrelated investments are not introduced, but this does not change the results.

having the same equilibrium solution and stability conditions as above:

$$\mathbf{q}^* = -A_q^{-1}\mathbf{b}_q$$

2.4.5 Long-run international price equalization

In the long run there will be a pressure towards price-equalization within and across markets (here expressed by an international price p_i expressed in an international exchange rate), i.e.

$$p_i^d/e = p_i^x/e = p_i^{xF} = p_i^{dF} = p_i \tag{26}$$

Given this and the result that in equilibrium the rents equal zero, $r_i = 0$, one see that the unit costs must also be equal:

$$c_i/e = \frac{1}{e}\left(\sum_j p_j a_{ji} + \sum_z w_i^z a_{Li}^z\right) = c_i^F \tag{27}$$

Therefore for equal prices and material input coefficients (as assumed) the following condition must hold in equilibrium:

$$\frac{1}{e}\sum_z w_i^z a_{Li}^z = \sum_z w_i^{zF} a_{Li}^{zF} \tag{28}$$

i.e. labour unit costs (denominated in an international currency) must be equal. The wage rate for one skill-group in one industry is thus determined by all the other wages (domestic and foreign) - all expressed in the same currency - and labour input coefficients.

$$w_i^z = \frac{1}{a_{Li}^z}\left(e\sum_z w_i^{zF} a_{Li}^{zF} - \sum_{z-} w_i^{z-} a_{Li}^{z-}\right) \tag{29}$$

where $z-$ denotes all skill groups except the one on the lhs of the equation. But this result does not mean that either the absolute or the relative wage structure in both countries have to be equal; they can be very different as long as the condition above is satisfied.

3 Simulation results

In the following we report on a first set of simulation results which attempt to capture the 'twin pressure' which advanced economies face as a result of increasing international integration. We want thus to emphasize that integration for the 'North' takes place with two sets of economies: traditional 'Southern' economies which maintain a traditional pattern of comparative advantage and 'catching-up' economies. In our model construction, we shall show that a catching-up process involves 'switch-over' points in patterns of comparative advantage.

It will be shown that labour market responses and endogenous patterns of productivity growth are important elements determining the changing structures of international specialization. A more general formulation of the model (increasing the number of industries and countries) would reveal a succession of such switch-over points and a continual dynamic in the hierarchical positioning of different economies in the changing structures of international industrial specialization. The structural implications of such a process for the dynamics of the labour market in both advanced and catching-up economies will be drawn out in the following.

The preliminary simulations reported below refer to a simplified version of the model using equs. (1) instead of (1') which specify exogenously given paths of 'technological potentials' and with no unemployment terms included in the wage rate equations.

As mentioned in section 2.1 of the paper we start off with an assumed lag structure between the evolution curves of the technological potentials of the two industries ('high-tech' and 'low tech') in the advanced and the (potential) catching-up economies: the scope for technological catching-up is higher than in the high-tech industry but it takes more time to get there than in the low-tech industry (see Fig.1). Hence, increases in labour productivity (declines in labour input coefficients) in the low-tech industry of the catching-up economy precedes the productivity catching-up in the high-tech industry. Overall, the scenario presented here (Fig.2) is of 'actual' catching-up, i.e. the gaps in productivity levels between the advanced and the catching-up economies decline in both industries (see Table 5 in which the initial and "final"[6] productivity gaps are given). Notice that we have assumed that the nature of technological change is, in both industries, mostly reducing the labour (per unit) input requirements for unskilled labour (see Fig.2).

The result of this pattern of productivity growth is, given the slightly lower wage catch-up parameters in the catching-up economy than in the advanced economy and the same price adjustment coefficients, that much higher (per unit) rents emerge in the catching-up economy than in the (technologically) advanced economy (see Fig. 3). And productivity growth is fast enough to not only lead to a closing of the wage rate gap between the

[6]By "final" we refer here to the positions after the impact of the two logistics, i.e. the second 'steady-state'.

two economies and higher technological rents in the catching-up economy, but also to an improvement in the relative price position of the catching-up economy in both industries (see Figs. 4).

There are two scenarios possible in the evolution of the comparative advantage positions of the two economies: One scenario would lead to a situation which, despite substantial productivity and wage catching-up processes between the advanced and the catching-up economy, would leave the (technologically) advanced economy in the comparative advantage position in the high-tech industry (the relative unit-cost and relative price structure would remain in its favour in this industry.) In the scenario which we are showing in Fig. 5, however, there is a **switchover in the comparative advantage positions** of the two economies: for some time, the catching-up economy is loosing out in the comparative (unit) cost position of its high-tech industry relative to the advanced economy (the latter is earlier affected by the productivity boost derived from the impact of the logistic while there is only a lagged response in the catching-up economy). During that phase, the catching-up economy is improving its relative cost (and price) competitiveness in the low-tech sector and a traditional pattern of export specialization emerges, with the less developed economy expanding its relative export position particularly in the low-tech area (see Fig. 6 where the relative real export movements in the two industries are plotted). After a while, however, given the greater scope of productivity catching-up in the high-tech sector and with the same labour market reactions in terms of wage claw-back parameters, the comparative advantage position shifts in favour of the high-tech sector. The catching-up economy gains increasingly market shares (in both export and domestic markets) in the high tech sector as well and even more so than in the low-tech sector. Notice that this is in spite of substantial productivity level gaps remaining between the catching-up and the advanced economies (and these remain higher in the high-tech industry) (see Table 5 in the Annex in which the 'final' levels of labour productivities, wage rates, and labour unit costs are presented for different scenarios.)

Of course, the scenario outlined above of a successful catching-up process and the accompanying switchover in the comparative advantage position between the two economies is very dependent upon the parameter constellations adopted for this scenario, particularly those which account for relative wage rate responses in the wake of the postulated pattern of productivity dynamics (see the Appendix for a series of sensitivity exercises with respect to the wage claw back and price adjustment parameters). Indeed, the labour market reactions in the two economies and in the different segments of the labour markets (by industry and skill type) are crucial for the structural pattern of the catching-up process and, especially, for the crucial question whether a cross-over in the comparative advantage positions of the two economies occurs. We shall emphasize in section 4 of the paper that the labour market dynamics are particularly crucial in the phases in which maximum potential catching-up can occur (i.e. in the phases in which the logistic curves k_i have there greatest slopes.)

However, in one sense the simplified model structure adopted in the current simulations understates the case for this 'switchover scenario'. If we included the more general, and partly endogenized versions of the development of technology potentials in the two economies (equs. 1' and 16), we would see a further boost to the speed of catching-up due to the impact of the reinvestment of further productivity-enhancing innovational profits by the catching-up economy. These 'endogenous' productivity catching-up effects correlate with the appearance of differential technological rents in the two industries (see Fig. 3) and would thus accelerate the productivity catching-up in the high-tech industry relative to the low-tech industry. Of course, over time, one has to take account of the relative weakening impact of the spillover terms in the two industries as the levels of the technological potentials between the two economies close.

Let us now turn shortly to relative wage rate movements (see Fig. 7), reminding the reader that in the simulations reported only the first terms of the wage rate equations have been included and not the unemployment terms. We can see that the development of the relative wage rate movements for skilled and unskilled workers in the two economies tracks the differential appearance of relative technology rents in the two industries: While, in the long-run, the gaps in relative wage rates between the two economies decline in both industries and all skill categories, there is at first an increase in the gap in the high-tech industry as the advanced economy increases its technological lead initially in that industry and the catching-up economy responds only with a lag; in the longer run however the relative wage rate gap between the two economies closes even more in the high-tech-sector as there is more scope for productivity catching-up there; this result would be further reinforced with the more general formulations of 'endogenous technology development and technology spillover' effects as in equs. 19 and 20.

4 Policy implications and further research

The use of the heuristic model in this paper has brought out the following features concerning the issue of international economic integration and labour market dynamics:

- By formulating a dynamic model, we attempted to emphasize the structural evolution of international specialization and its impact upon labour markets both in the 'North' and the 'South'. In particular, we concentrated on the twin pressures exerted upon the industrial structures of 'Northern' economies: competition of Southern economies (call them 'type A) which, although experiencing catching-up (i.e. reducing their productivity gaps) across the range of industries in relation to the Northern economies, do nonetheless maintain their relative competitive strength in labour-intensive, less skill-intensive branches. Through trade liberalization and production relocation, these type A Southern economies may exert the type of pressures on the employment and the wage structures in the Northern economies which the current literature on international integration and its impact on labour markets emphasizes.

The paper, however, investigates more extensively the type of pressures exerted by the increased global presence of another set of catching-up economies (call them 'type B') whose catching-up process is characterized by a progression of learning processes in which the early gains (reductions in productivity gaps) do occur in the technologically less sophisticated, less-skill intensive branches; over time, however, this progression continues to traverse across a hierarchy of industries and technologies so that catching-up increasingly focusses upon branches in which the initial productivity gaps and hence where the scope for catching-up are the largest.

The implications of this type of catching-up is that there is an interesting evolution in the comparative advantage positions of 'Northern' and 'type B' Southern economies. In particular, the possibility of a switchover in the comparative advantage positions of these two types of economies may occur as the comparative cost structures of type B economies move in favour of the high-tech industrial branches. The model should, of course, be extended to represent the process of 'comparative advantage switchover' as a continuum in the sense that industrial specialization is not between two discrete sets of industries, high-tech and low-tech, but that there is a continuum of industries/processes with increasing degree of technological and organizational sophistication and switchovers in comparative advantage positions can occur at different points along the entire sequence of such a 'technological ladder' (see also the theoretical models of Grossman/Helpman 1991, Flam/Helpman 1987 and Taylor 1993). The consequence of extending our model in this direction would be that the catching-up economies would similarly not bifurcate into the two groups of type A and type B economies, but it would allow a differentiated and continuously changing positioning of Southern economies in the global ladder of comparative advantage.

- The phenomenon of a 'switchover' in comparative advantage positions is crucially dependent not only upon the productivity dynamics in the different economies, but also upon the labour market and (endogenous) investment dynamics. Labour market dynamics (in particular, wage rate developments in the course of a catching-up process) translate productivity gains or losses into labour unit cost gains or losses. Here an asymmetry between the Southern and Northern economies emerges. As Southern economies have greater scope for productivity growth (Gerschenkron's 'advantage of backwardness') a lag in wage rate growth behind productivity growth could nonetheless mean substantial 'real wage' growth and hence provides a flexibility for the emergence of 'technological profits' which play a major role in our model, particularly with respect to achieving a high speed of structural change and of (endogenous) technological change. The lower trend growth rates in productivity levels of Northern economies reduces that degree of flexibility and hence 'real wage' aspirations of at least some groups of workers might be broken if factor price adjustments take place in the wake of overall structural adjustment; this refers to both the relative factor rewards between labour and other factors of production or between different types of labour (skilled and unskilled). The recovery of technological rents in the form of innovational profits and investments is thus a much more problematic and socially sensitive issue in the Northern as compared to the type B catching-up economies.

- We have also attempted to point out that the labour and investment dynamics during the phase of major catching-up (i.e. when there is the greatest scope for productivity gap closures) is a critical one also for the catching-up economies themselves. It is then that the bifurcation between type A and type B economies is most likely to take place. The reason is the following: In this phase, the major technological rents accrue in the catching-up economies and, consequently, the major moves can be made to speed up the process of structural change and technological upgrading through the focussed allocation of innovational investments into those branches and technologies in which greatest technological catch-up potential exists. This explains, first, the great attention given by successful type B economies (such as those in East Asia) to allow high technological rents to be absorbed in the form of technological profits by allowing wage movements to lag behind productivity gains; secondly, to make sure that innovational profits lead to high rates of innovational investments by providing a stable long-run context which reduces the danger of a high 'whimp factor' (maximizes the propensity to invest out of innovational profits); thirdly, by focussing the allocation of investments into branches/technologies where the potential for productivity/technological catching-up is particularly high.[7]

[7]Alternatively, it also explains why certain catch-up processes do not take place or not to the degree which the potential of technological catching up would indicate. In

- The Northern economies have the following alternative strategic choices to make:

(i) In relation to the competition from type A catching-up economies: Given that competition from type A Southern economies exert pressure particularly upon the labour and less skill intensive branches of the Northern economies, the immediate reaction could be to emphasize wage rate and wage structure adjustments; and, indeed, our model has wage rate and wage structure adjustments built in: as technological rents are squeezed in those branches where the strongest (labour unit cost and price) pressure from the catching-up economies (this time, the type A variety) is being felt, industry-specific wage rate pressures will respond to these reduced technological rents (which, at times, could even be negative in our model); in addition, structural industrial adjustment induced by the deepening of a traditional pattern of international specialization between Northern and Southern economies leads to changes in inter-industry employment structures which express themselves in reduced relative demand for unskilled labour; if these leads to unemployment, the skill-type specific unemployment terms in the wage equations will lead to reduced relative wage pressures from the unskilled segments of the labour force and thus to wage structure adjustments.

There are, however, dangers in relying simply on these labour market adjustments: firstly, labour market adjustments in these directions would reduce the speed of industrial structural change in the direction of high-tech branches and technologies; secondly, the scope to counter the threat to labour and less skill intensive industries through wage and wage structure adjustments will be limited, as - by definition - catching-up economies have greater scope for (labour) productivity growth and hence wage and wage structure adjustments in Northern economies will have to carry the double

some countries the scope for technological catch up is equally high as in the East Asian economies, including the building up of indigenous human and R&D stocks (example: India). Nonetheless, the potential in these countries is not exploited to the same degree as in East Asian economies. The answer to this constellation lies in the violation of the above three conditions: firstly, real wage and/or rent-seeking aspirations by middlemen, bureaucrats, layers of management, etc. do not allow a sufficient translation of high technological/catch up rents into innovational profits; secondly, there is a problem of setting up a long run stable and reliable institutional and political context in which the propensity to invest out of innovational profits (or, for that matter out of the rents derived from rent-seeking behaviour) would be high; thirdly, the particular focus of attention towards investing the investible ressources into branches/technologies in which the potential for catching up processes is the highest requires a long-run view taken by the institutions which affect the allocation of investible resources, i.e. it depends on the ways in which capital markets function, how corporations make their investment decisions and, possibly, the guiding hand of consistent industrial policy measures.

burden of higher labour productivity growth in the Southern economies and the easier scope in Southern economies to allow wage rate increases to lag behind productivity growth (see above).

The alternative strategy by Northern economies is, of course, to accelerate supply-side upgrading: i.e. to view the relative squeeze of technologically less sophisticated branches as an opportunity to channel investible resources in the economy towards those areas in which the productivity/technological gaps remain high and these innovational investments would (endogenously) attempt to sustain or even strengthen these technological leads. Following a defensive wage adjustment strategy would lead to a reduced focus in the allocation of investments towards these industries and technologies. Part of the offensive supply-side strategy would also be to increase the supply of skilled labour as this would reduce pressures (including wage pressures) in this segment of the labour market and thus contribute to sustaining innovational profits expectations in the high-tech sectors.

(ii) In relation to the competition from type B catching-up economies: Alternative responses by Northern economies to the competitive pressures exerted by type B catching-up economies are more complicated to evaluate as this type of competition involves actual or potential reversals of comparative advantage positions of the two types of economies. As mentioned under (i) above, the model shows automatically wage and wage structure adjustments in Northern economies as a result of any type of global competition. In this case, reliance on wage and wage structure adjustments in the early phases of type B catching-up would lead to Northern economies attempting to defend their positions somewhat in industries which are of the more labour and less skill intensive types. This would halt somewhat the speed of their structural adjustment in the direction of more technologically advanced industries and technologies. The catching-up economies would, furthermore, feel less of a specialization advantage in these early phases in the area of low-tech, low-skill industries and technologies and might thus attempt to transgress the early phase rather quickly in order to move towards the switchover point of comparative advantage positions more quickly. This is helped by the fact, that the Northern countries by adopting a defensive strategy (based on wage and wage structure adjustments), spread their investible resources more broadly across branches than if they would utilize their investible resources in those industries in which their technological rents are, in this phase, still higher. An offensive supply-side oriented strategy, on the other hand, could exploit the fact that in this phase the Northern countries are still disposing over a larger accumulated stock of R&D and human capital resources and could thus still exploit the benefit of utilizing the potential economies of scale and scope which might exist in high-tech industries in the development process of new technologies and new products. Once catching-up economies of the B type have accumulated sufficient R&D and human capital (benefiting in addition by new vintage structures of these stocks) this 'size' advantage will be lost. Once the switchover points have been reached, the same policy prescriptions apply to the formerly 'Northern' and the type B 'catching-up' economies, but in reverse order.

Further extensions of the current model:

- Introducing international production relocation through foreign direct investment: The model so far has not introduced international production relocation through foreign direct investment. However, this element could be introduced in the same way at the international level as reallocation of investible resources across branches was introduced into the model at the national level. There the allocation of investible resources (including ex ante financing from the banking sector) was made a function of the relative emergence of technological rents and profits in the different industries. Similarly, at the international level, the allocation of global investible funds (including ex ante financing by global financial institutions) could be sensitive to the relative technological rent/profit structure worldwide. This would lead to international production relocations which are additional (but complementary) to the dynamics of international specialization processes explained by evolving trade structures.

- Exchange rate dynamics in the course of catching-up; options for type B catching-up economies: A previous version of the model (see Landesmann, et al. 1994) has introduced an endogenous exchange rate adjustment mechanism. Countries which consistently build up trade surpluses on current account experience a pressure towards appreciation of their currencies, thus affecting their international cost and price competitiveness. catching-up economies of type B thereby face a choice: If their cost and price competitiveness (at constant exchange rates) remains very high, they will build up consistent current account surpluses; this in turn will act as a pressure to revalue their currency and, over time, this will erode their cost and price competitiveness. There are two options to counter this: one is to disperse the gains from productivity catching-up quickly in the form of higher wages (or rents to rent-seekers) which immediately reduces their cost and price competitiveness and thus lessens the upward pressure on their currencies; the other is to mark-up their costs such as to finance substantial innovational investments which leads to a further speeding up of technological catching-up. We can clearly see in the developing world examples of both these two types of reactions.[8]

[8]The above remarks concern only a very partial implementation of an exchange rate model; there are many other elements to be considered to implement a more comprehensive exchange rate model: one is the impact of differential economic growth which could be introduced through the autonomous expenditure terms and which - at given income elasticities of exports and imports - affects trade balances (see Landesmann/Poeschl 1996); the other, is the impact of international capital flows, the long run (FDI) element of which has been considered above. However, these issues are not taken up in the present paper.

References

[1] Baldwin, R.E. (1994): The Effects of Trade and Foreign Direct Investment on Employment, and Relative Wages, OECD Economic Studies, No. 23.

[2] Flam, H., Helpman, E. (1987): Vertical Product Differentiation and North-South-Trade, American Economic Review, Vol. 77, pp. 810 - 822.

[3] Grossman, G.M., Helpman, E. (1991): Quality Ladders in the Theory of Growth, Review of Economic Studies, Vol. 58, pp. 43 - 61.

[4] Landesmann, M.A., Goodwin, R.M. (1994): Productivity Growth, Structural Change and Macroeconomic Stability, in: Pasinetti, L., Solow, R. (eds.): Economic Growth and the Structure of Long-Term Development, Macmillan, London.

[5] Landesmann, M.A., Goodwin, R.M., Stehrer, R. (1996): Structural Economic Dynamics: Catching-Up and the Global Deflationary Bias, in: Prices, Growth and Cycles, ed. by A. Simonovits and S. Steenge, Macmillan.

[6] Landesmann, M.A., Poeschl, (1996): Balance of Payments Constrained Growth in Central and Eastern Europe, in: M. Knell (ed.), Economics of Transition. Structural Adjustments and Growth Prospects in Eastern Europe, Edward Elgar.

[7] Leamer, E.E. (1994): Trade, Wages and Revolving Door Ideas, NBER Working Paper No. 4716.

[8] Sachs, J.D., Shatz, H.J. (1994): Trade and Jobs in U.S. Manufacturing, Brooking Papers of Economic Activities, 1, pp. 1 - 84.

[9] Taylor, M.S. (1993): 'Quality Ladders' and Ricardian Trade, Journal of International Economics, Vol. 34, pp. 225 - 243.

[10] Verspagen, B. (1991): A New Empirical Approach to Catching-Up or Falling Behind, Structural Change and Economic Dynamics, Vol. 2, pp. 359 - 380.

[11] Wood, A. (1994): North-South Trade: Changing Fortunes in a Skill-Driven World, Oxford.

A Tables

Parameters	
a_{ji}	material input coefficients
g_{i1}, g_{i3}, g_{i5}	parameters of the logistic
ξ_i^z	productivity parameters
γ_i	price adjustment parameter
h_i, h^z	wage catch-up parameters
j_i^r, j_i^m	whimp factors
δ_i	output (supply to demand) adjustment parameters
s_{Ii}	nominal shares of investment
s_{ci}	nominal shares of commodities in wage demand
d_i	autonomous demand
m_i	mark-up ratios
s_{ci}, s_{Ii}	nominal export shares (investment and demand)
g_{i4}^F	spill-over parameter
η	learning rate
θ_i^d, θ_i^x	weights in (international) price adjustment
e	exchange rate $(\frac{x \text{ units of domestic currency}}{1 \text{ unit of foreign currency}})$

Table 1: Parameters

Variables	
k_i	technological potential
g_{i2}	level of potential
a_{Li}^z	labour input coefficients
c_i	costs
p_i	prices
w_i^z	wage rates
u^z	unemployment rate
R_i	innovational profits
M_i	mark-up profits
I_i^R	invested innovational profits
I_i^M	invested mark-up profits
W	wage sum
q_i	output
x_i	exports
G	technological gap
S	spill-over

Table 2: Variables

Parameters	country A	country B
a_{11}	0.3	0.3
a_{12}	0.25	0.25
a_{21}	0.15	0.15
a_{22}	0.4	0.4
ξ_1^s	0	0.1
ξ_1^u	0.15	1.2
ξ_2^s	0	0.35
ξ_2^u	0.15	1
g_{11}	0.3	0.28
g_{21}	0.35	0.18
γ_i	0.1	0.1
δ_1	0.1	0.1
δ_2	0.2	0.2
h_1	0.02	0.01
j_i^m	0.1	0.1
j_i^r	0.1	0.1
h_2	0.03	0.01
s_{ci}	0.5	0.5
s_i^d, s_{Ii}^d	0.25	0.25

Table 3: Values used in simulations

Variable	country A	country B
k_i	0.001	0.001
g_{12}	1	1
g_{22}	2	2
a^s_{L1}	0.4	0.8
a^u_{L1}	1.2	4.8
a^s_{L2}	0.4	1.2
a^u_{L2}	0.8	3.2
p_1	1.751	1.751
p_2	2.146	2.146
w^s_1	0.63	0.315
w^u_1	0.3	0.075
w^s_2	0.63	0.21
w^u_2	0.3	0.075
q_1	12.79	12.79
x_1	4.26	4.26
q_2	11.8	11.8
x_2	3.39	3.39
u^z	0	0

Table 4: Starting values

B Appendix - Figures

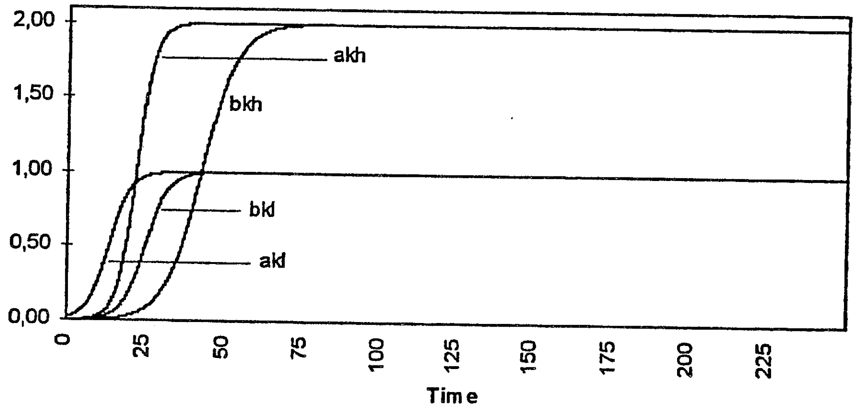

Figure 1: Technological potential

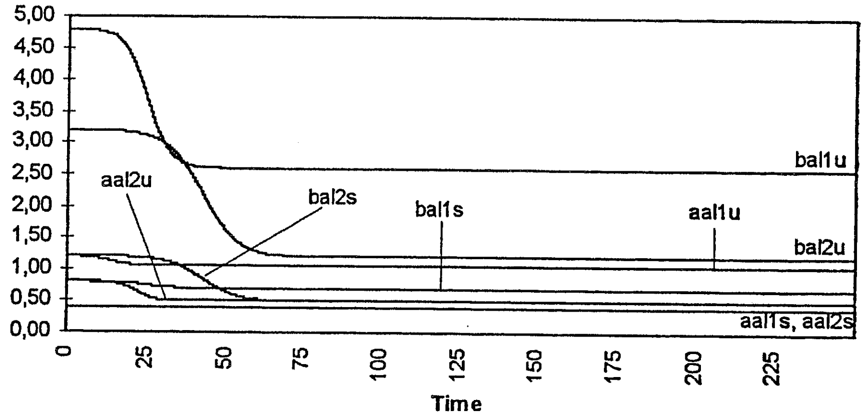

Figure 2: Labour input coefficients

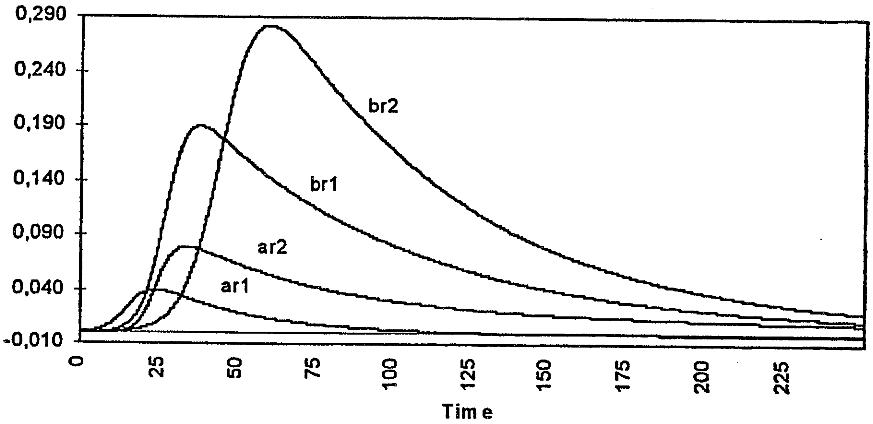

Figure 3: Innovational rents

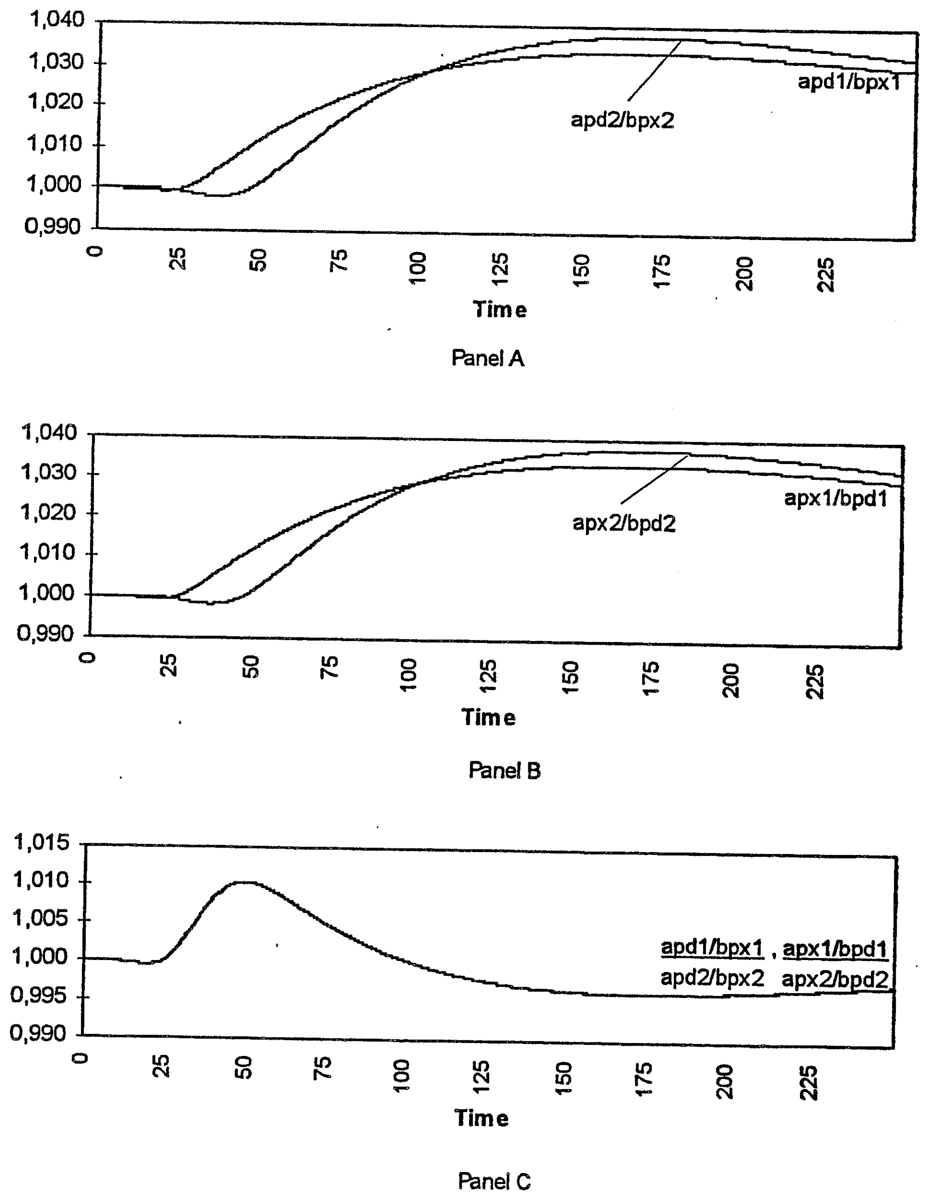

Figure 4: Relative Prices

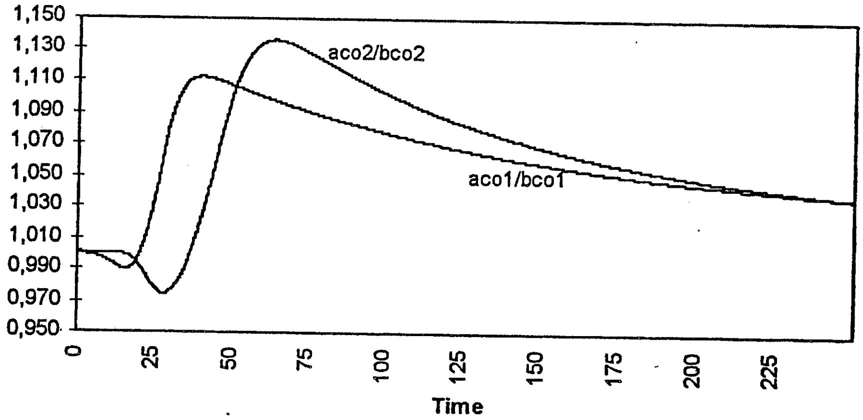

Figure 5: Relative Costs

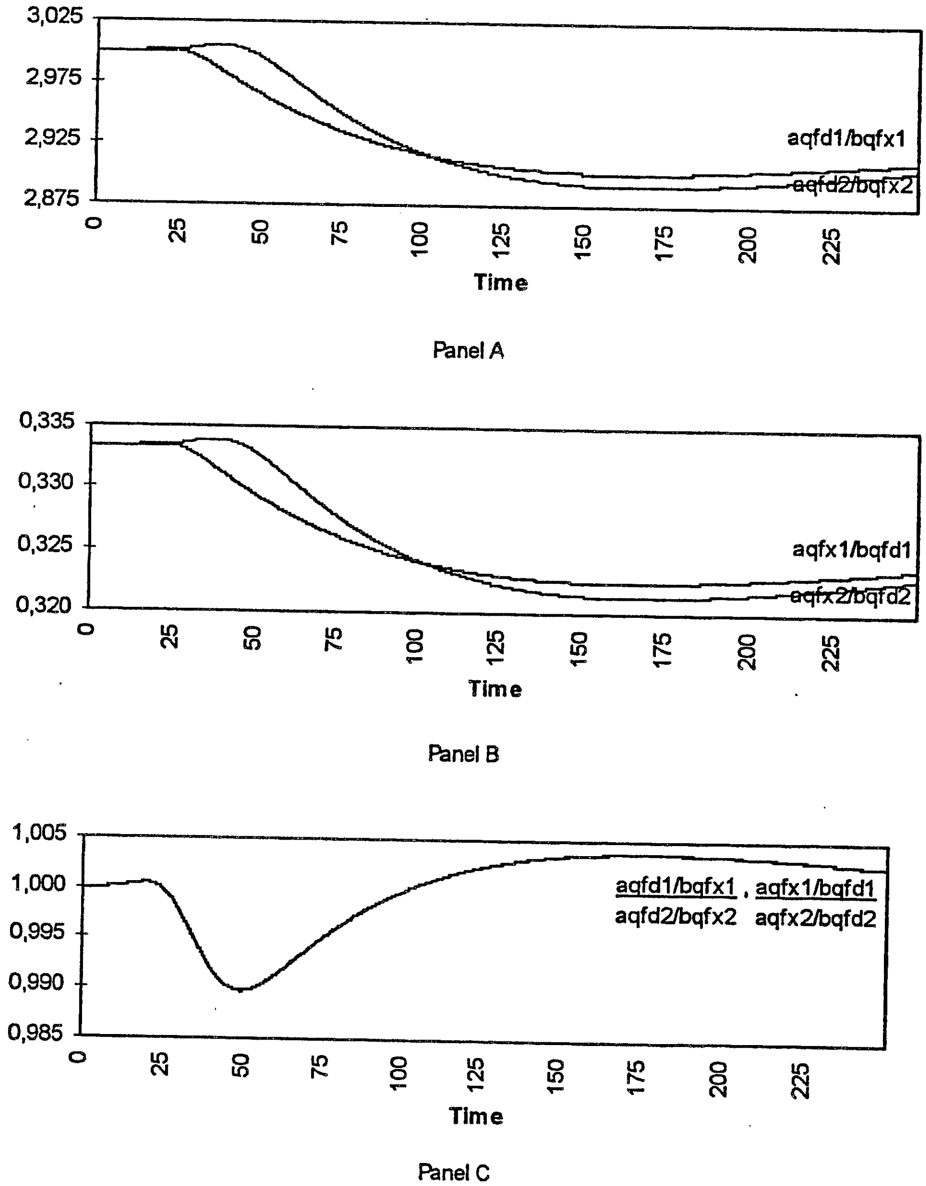

Figure 6: Relative sales (Final demand)

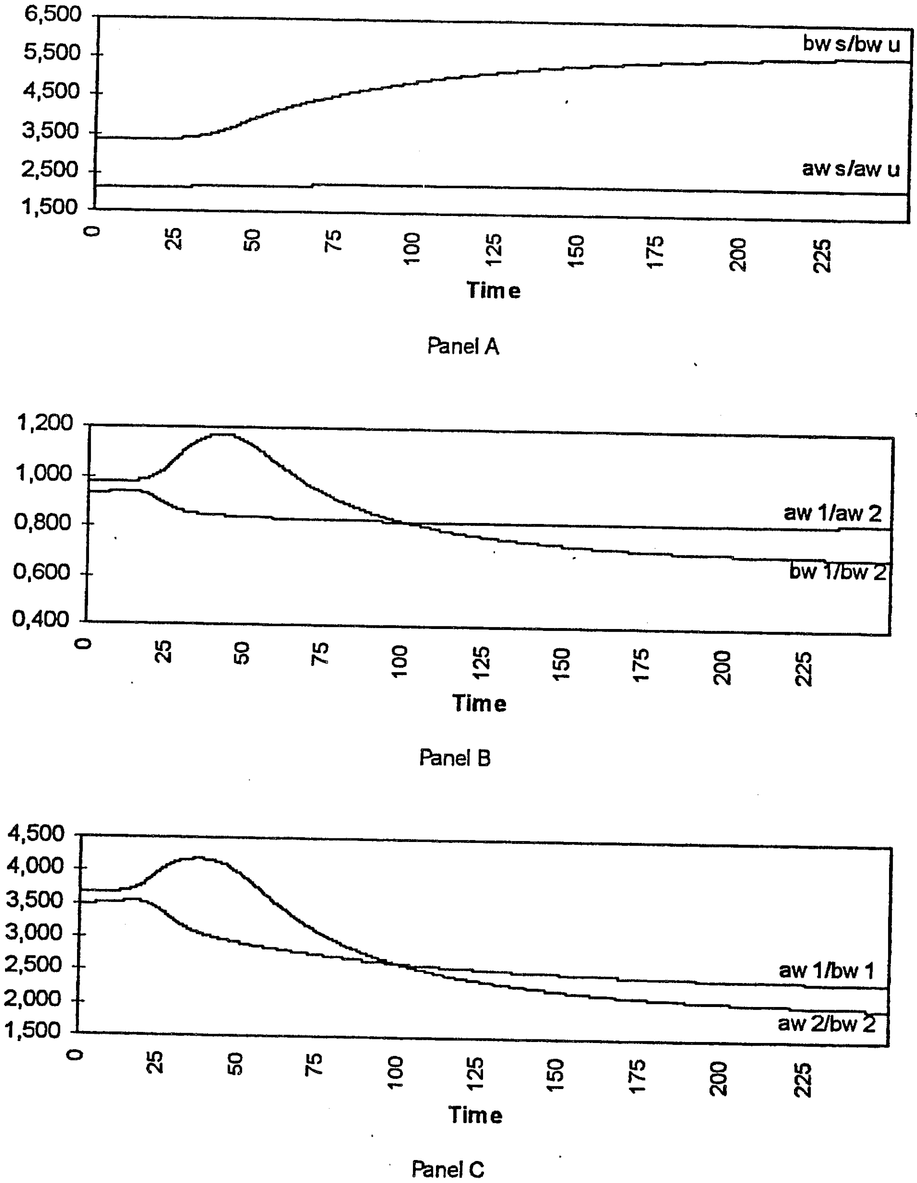

Figure 7: Relative Wages

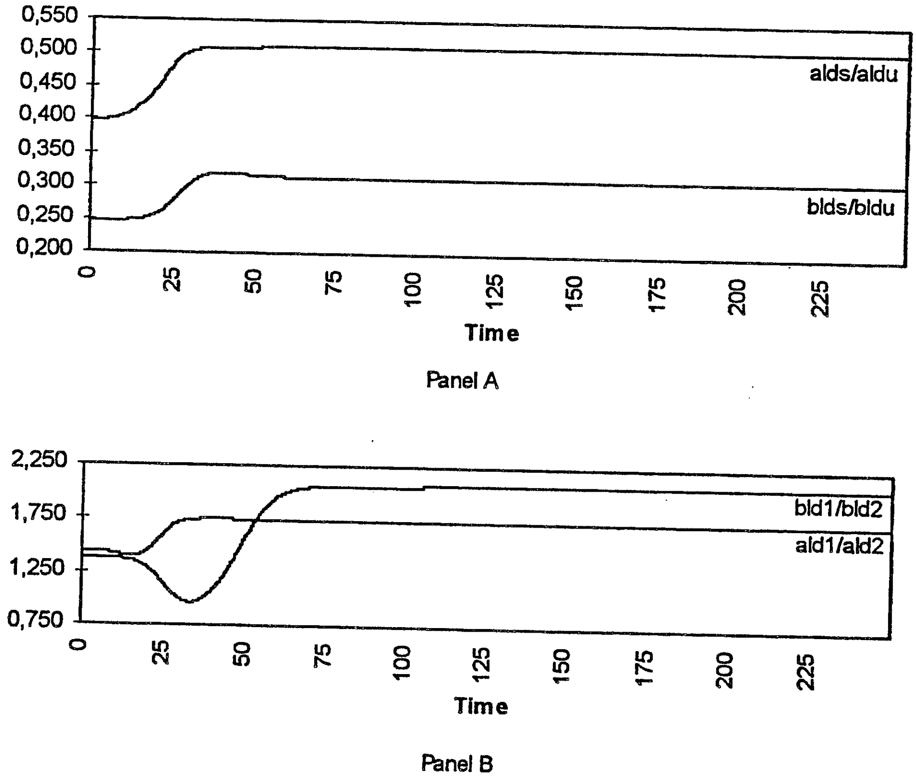

Figure 8: Relative labour demand

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