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Discussion Papers

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**On Regional Convergence in a Transitional Economy:
The Roles of Migration and Wages**

by
Gustav A. Horn*

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Deutsches Institut für Wirtschaftsforschung

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On Regional Convergence in a Transitional Economy: The Roles of Migration and Wages

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Abstract

Regional convergence has emerged as a major topic during recent years. Several theoretical and empirical approaches have been developed which explain in what respect regions converge or diverge. Some have laid special emphasis on the role of migration. This paper applies these approaches to reach some conclusion on regional convergence. Especially wage formation is of major interest since it may turn out as a major obstacle for economic convergence. Several ways of regional wage formation are investigated, among them a full employment wage mechanism as well as a fast regional convergence of wages which is independent of productivity movements. The conclusion is that the impact of wage mechanisms on the convergence of per capita output is ambiguous. However social costs in terms of unemployment are high in case of a wage adjustment which is regardless of productivity growth.

1. Introduction

The convergence of different national economies or different regions within one economy has emerged as one of the major topics in economic research.¹ Motivation for this kind of research may have been originated in severe regional discrepancies during recessions as they occur in the United States between the northeastern and the southern states. However recent political and economic developments in Europe even increase their importance in a far broader aspect.

In western Europe members of the EC and EFTA strive for a single market and a currency union. Such a goal can be reached and maintained only if the participating economies converge at least to some extent. Otherwise a European economic union will never show stability. Even more urgent, to avoid major economic and social problems is the beginning of a convergence process between Eastern and Western Europe. The huge welfare gap between so closely located regions must lead to considerable social and economic tensions. Furthermore albeit to a lower extent, the transition process between East -and West Germany also creates its convergence problems. There are two regions with considerable differences in key economic variables, which now belong to one single economy.

This paper mainly addresses the latter convergence phenomena. A lot of issues discussed below may have a close connection of problems caused by unification in Germany. However, the model setting is not yet sophisticated enough to grasp all features of the unification process like e.g. the impact of public transfers, to be mechanically applied on Germany. Hence the paper describes two abstract regions rather than both parts of Germany. The predominant intention is to investigate the effects of migration and wages on the convergence process between two regions with fundamental differences. These show up particularly by regional gaps of output per capita, productivity and market shares. To capture these impacts a small model is set up which heavily leans on the approach of Blanchard (1991). Then different wage mechanisms are incorporated to get their specific contribution to regional convergence. The paper focuses in particular on a full employment wage formation as well as on what is called enforced wage adjustment which take place regardless of productivity growth. This is not meant to neglect that a lot of other factors like public investment into infrastructure which may play a decisive role for convergence. The results show that these may be very important forces to ensure

¹ See Barro (1990) and (1991).

convergence.

As it turns out migration of labour as well as transfer of capital speed up convergence measured by an adjustment of per capita output. The effect of different kinds of wage formation is far from obvious. If capital is more mobile than labour, a full employment wage process tends to speed up convergence at the beginning of the transition process compared to other ways of wage formation. If labour is more mobile the contrary tends to be true. In the long run, which means after transition is completed output per capita will be independent of the wage formation during the transitional period. However social costs in terms of unemployment are considerable higher with an enforced wage adjustment.

The paper is organized as follows. In the next section some recent approaches on regional convergence will be presented. Section 3 contains an analytical model assuming that labour and capital migration are the leading forces for convergence. In the fourth section a full employment convergence path of output per capita is derived. In the subsequent part a convergence path with wages adjusting very fast across regions is developed. In section 6 the results are illustrated using a tentative simulation model. Section 7 concludes.

2. Some Recent Theoretical Concepts on Regional Convergence

There are two major questions which have to be addressed when dealing with the regional convergence topic. The first one being what is convergence. Secondly by which forces is it achieved or prevented.

The primary motivation for addressing convergence issues originates in major welfare differences between regions and countries. There are two obvious choices for variables to capture these differences. These are taken by Barro and Sala-i-Martin (1991). The first is personal income per capita with or without government transfers. The second is output per capita. The income variable refers to the owners of production factors. It could be used as a proxy for wage rates per capita.² Output per capita measures welfare in those regions where the production factors are actually utilized. It reflects current return on factor inputs and thus

² See Blanchard and Katz (1992).

is relevant for investment decisions.³

In large regions which are scarcely populated at their fringes the differences between both variables mainly arise through the interregional transfers of income out of physical capital. Firm owners, especially when shareholders, may not reside in the location of their firm. Employees will rather live in the region of their assignment to avoid large transportation costs. However, if regions are small and densely populated at their fringes, interregional transfers of labour income are also of importance to determine the difference between the income and the output indicator. This is e.g. the case for Germany which regions are small and heavily populated compared to the US states. Hence in that case the income indicator may be somewhat misleading as far the productive capacities of a region are concerned.

The basic finding of the Barro and Sala i Martin analysis is that there is a tendency towards convergence between regions and countries albeit it occurs at a rather slow pace of about 2pc annually of the initial gap.⁴ Applying this result e.g. to the situation between East- and West Germany the authors conclude that it would take 35 years for half of the initial income per capita gap between East and West to be eliminated.⁵ This conclusion seems questionable for several reasons. Firstly the model does not take into account the presumably high productivity effects induced by massive public investment in East Germany. Secondly the model fails to account for the impacts of migration which also are very important in case of Germany.

The latter point is taken by Blanchard and Katz (1992). Their analysis focusses on the employments aspects investigating the "evolution of relative regional employment" for a number of US states. In accordance with a priori perceptions it turns out that there are significantly diverging regional employment patterns. They did not find a convergence of employment across US states. Among others, the New England states and the Rust belt show a constantly decreasing employment compared to the average US employment whereas western and southern states like California, Florida and Nevada exhibit the opposite trend. On the other hand the authors show that no such trend can be detected for unemployment and income per capita. Thus they confirm the result of Barro and Salla-i-Martin (1991) as far as income per capita is concerned. How can

³ Income per head which reflects the purchasing power of a region will primarily influence investment into non tradeable goods like services.

⁴ See Barro and Salla-i-Martin (1991).

⁵ See Barro and Salla-i- Martin (1991).

these findings be reconciled ?

The key issue for Blanchard and Katz is migration⁶. There are two types of migration which change relative regional performances: labour migration and the moving of firms. If there are wage or unemployment differentials between regions people will migrate such that there is a tendency to level these differences. The same reasoning applies to firms which move towards those regions where they may find increased profit chances which are supposedly found in regions with lower wages.⁷

The "mechanics" of the model can be outlined by considering that a positive shock to labour demand occurs in one region. Assuming for simplicity that all variables were equal across regions prior to the shock, the increased labour demand in one region will raise absolute employment as well as wages above the economy average whereas the unemployment rate will be below average. This induces two kinds of migration. Labour supply in that region will rise due to in-migration of workers leading to a decrease of wages from their above average level whereas the unemployment rate rises approaching the average level too. At the same time firms move out of this region due to the higher relative wages inducing an additional decline in employment as well as a rise of the unemployment rate.

Both adjustments will come to a hold as soon as wages and unemployment rates are equal again across regions leaving no incentives neither for workers nor firms to migrate. Since wages converge to the average level due to the influx of labour labour demand will not return to its originally lower level until wages are equal again in both regions. The equilibrium will establish at an increased level of employment as well as labour supply in this region whereas unemployment rates and wages remain equal across regions.⁸

⁶ Barro and Sala-i-Martin do not include migration in their theoretical model. However they test its empirical impact on the regional distribution of output per capita and conclude that migration can explain only a minor part of the convergence. Their model thus heavily relies on diminishing returns of factor inputs in rich regions.

⁷ The authors remark that this connection may be rather loose since it seems not obvious that firms move in already economically depressed regions even if wages tend to be lower there. The argument seems especially unconvincing as far as non tradeable goods are concerned. Firms providing these goods prefer to move into areas with high purchasing power.

⁸ However unemployment rates as well as wages may show different means across regions which could be due to influences outside the scope of the analysis. But both variables do not show any trend and rather remain stationary.

3. A Model of Convergence

3.1 The Set up

In this section a model will be set up along the lines of an approach which has been developed by Blanchard to comment on the results of Barro and Salla-i-Martin.⁹ This model incorporates capital as a second input in addition to labour. Hence the effects of capital "migration" or transfers can also be analysed within the framework of such a model.

The basic assumption of the model is that each region is a "small open economy each producing different goods under conditions of high factor mobility" (Blanchard (1991),p.160). This approach takes into account that there are regional specializations albeit in reality these will not be as complete as assumed in the model.¹⁰ Furthermore, if regions are comparable to small open economies, firms within each region must be price takers at least as far as tradeable goods are concerned.

In deviation from the original Blanchard model we focus in the following on convergence between single regions and not of single regions to a national average. The latter approach is certainly useful if applied to problems referring to nationwide convergence phenomenons. With respect to questions of the transition process between two fundamentally different regions this is not the case. Blanchard assumes that economic behaviour in the different regions is identical. Regions differ only by initial conditions and specific regional shocks. This clearly does not capture all the differences e.g. between East- and West Germany in Germany especially as far as wage bargaining behaviour is concerned. Thus to allow for heterogenous behaviour, convergence is modelled as convergence between two specific regions, instead of convergence to a national average.

Therefore we assume that there are two regions, 1 and 2, the second one represents the region in transition. The demand function for products out of region 2, expressed as inversed relative demand compared to the demand products out of region 1 at time t then reads in logs:

$$(3-1) \quad (p_{2t} - p_{1t}) = -d(q_{2t} - q_{1t}) + e_{2t}$$

⁹ See Blanchard (1991).

¹⁰ For a more detailed discussion of this assumption see Blanchard (1991) p.161f..

where p are the product prices, q the quantities demanded and e a regional demand shock, which is supposed to be non stationary. The non stationary component of the shock may reflect the fact that at the beginning of the transition process a lot of products provided by firms of region 2 were not sellable any more even at a very low price. Within the framework of this model one can interpret this as firms having to find their specializations on the market. Its only after that they can compete. Part of these disadvantages, may be very transitory. Others, certainly prevail for some time constituting a severe sales problem.

The following straightforward production function - again written in relative terms and logs - is applied:

$$(3-2) \quad (q_{2t} - q_{1t}) = a (l_{2t}^e - l_{1t}^e) + (1-a) (k_{2t} - k_{1t}) + u_{2t}$$

l^e denotes the employed amount of labour, k is capital and u is a regional technological shock. By (3-2) it is assumed that the technology and thus input factor combinations the same in both regions. This is basically the case for all new investment in because it can be expected that relative input costs in will adjust between regions. Thus the production equipment should not differ either.

Even firms which are built up from the scratch or which operate with sophisticated technology face the problem that infrastructure, general economic skills of the labour force, and technological knowledge in the transition region lead to a lower total factor productivity compared to region 1. Therefore (3-2) is not sufficient to capture the transition path completely. To incorporate these developments the technology shock u is supposed to be non stationary and showing a trend component to mirror the transition path.

Thus u is assumed to consist of two different parts.

$$(3-3) \quad u_{2t} = -m_i + m_j + z_{2t} \quad \text{with} \\ -m_i + m_j t = 0 \quad \text{for } t > m_i/m_j =: m \\ \text{and } m_i, m_j > 0.$$

The first component reflects the gap of total factor productivity. The second part is a non stationary regional technology shock. The technology gap is assumed to diminish from its original level m_i with time t at a rate m_j such that after $t = m_i/m_j$ technology in both regions will be the same. This shock represents a model exogenous flow of technological knowledge and infrastructure improvement. The second component z is a stationary shock.

In the light of above arguments concerning the distribution of population an appropriate measure for convergence will be output per capita. This indicator captures the production differentials between regions while neglecting the income differences. In presence e.g. of a relatively high rate of commuters incomes per capita may not reflect that much of the economic problems of a region, since a lot of people may earn their income somewhere else. In addition to that government transfers may also lead to a regional income distribution which does not reflect the regional economic performance.

Within this framework we investigate whether there will be a convergence of per capita output and by which speed this may occur. Relative per capita output is defined as:

$$(3-4) (y_{2t} - y_{1t}) := (q_{2t} - q_{1t}) + (p_{2t} - p_{1t}) - (l_{2t}^s - l_{1t}^s)$$

where l^s is the total labour supply which is taken as total population in our model.¹¹

The difference between employed labour and labour supply then is defined as follows:

$$(3-5) (e_{2t} - e_{1t}) := (l_{2t}^e - l_{1t}^e) - (l_{2t}^s - l_{1t}^s)$$

where e is the employment rate.

Migration of capital and labour is supposed to be the key force to explain convergence. The migration behavior is described by the following equations:

$$(3-6) (l_{2t+1}^s - l_{1t+1}^s) = (l_{2t}^s - l_{1t}^s) + b_1(w_{2t} - w_{1t}) + b_2(e_{2t} - e_{1t})$$

$$(3-7) (k_{2t+1}^s - k_{1t+1}^s) = (k_{2t}^s - k_{1t}^s) + c(r_{2t} - r_{1t})$$

where w are regional wages and r regional returns on capital. The elasticities are supposed to be positive and smaller than one.

These migration equations imply that production factors remain unchanged in every region during the current period. For the following period there will be labour migration if there is a

¹¹ Therefore the problems rising from of different participation rates cannot be dealt with under this assumption. However it is fairly easy to extend the model in an appropriate manner.

wage or employment rate differential between the two regions. In accordance with many studies we assume that the effect of employment differentials is more important for migration than that of a wage differential, i.e. $b_2 > b_1$.¹²

Interpretation of the capital migration equation incorporates another aspect apart from migration. Equation (3-7) can also be seen as a description of regional capital formation. Then the capital stock of a region increases compared to other regions if the returns there are higher than elsewhere, because some of the returns will be used to invest into a capital stock.

Equation (3-6) and (3-7) show another important feature; their long term elasticity is infinite. This implies that neither distribution of capital nor employment will converge across regions. They settle down at values determined by the paths of wages, return on capital and employment rates.

The returns on capital are assumed to be determined by the marginal product of capital, hence:

$$(3-8) (r_{2t} - r_{1t}) = (y_{2t} - y_{1t}) + (l_{2t}^s - l_{1t}^s) - (k_{2t} - k_{1t}).$$

Computing the value of marginal productivity and rearranging, one gets the labour demand function:

$$(3-9) (l_{2t}^e - l_{1t}^e) = (q_{2t} - q_{1t}) - (w_{2t} - w_{1t}) + (p_{2t} - p_{1t})$$

Equation (3-9) implies a short term elasticity of labour demand with respect to real and nominal wages of 1. Given the fact that there are adjustment costs and market imperfections this is clearly the upper limit. Thus the model will overemphasize the wage effects.

3.2 The Convergence Path

From (3-2) and the definition of y , we get the following path for the output per capita differential:

$$(3-10) (y_{2t} - y_{1t}) = -(l_{2t}^s - l_{1t}^s) + [(1-d)(1-a)/s](k_{2t} - k_{1t}) \\ - [(1-d)a/s](w_{2t} - w_{1t}) + [(1-d)/s]u_{2t} + e_{2t}/s \\ \text{with } s = [1 - (1-d)a]$$

¹² See Akerlof et al (1991).

The convergence process follows a higher order than 1 if capital as well as labour mobility is assumed. Notwithstanding the fact that this assumption certainly is the most appropriate, to extract the basic features of the convergence process as clearly as possible it is useful to split the analysis into two parts at this stage. The first one dealing with labour mobility and capital immobility. The second one addresses the symmetric case of capital mobility and labour immobility¹³. Assuming that labour is mobile and migration following (3-6) and capital is immobile i.e. $c=0$, we get after some transformations:

$$\begin{aligned}
 (3-11) \quad (y_{2t} - y_{1t}) &= (1-\beta_L) (y_{2t-1} - y_{1t-1}) - \\
 &\quad [(1-d)a/s] [(w_{2t} - w_{1t}) - (w_{2t-1} - w_{1t-1})] \\
 &\quad + (b_2 - b_1) (w_{2t-1} - w_{1t-1}) + \mu_1 [(1-d)/s] m_5 \\
 &\quad + [(1-d)/s] (z_{2t} - z_{2t-1}) + (e_{2t} - e_{2t-1})/s \\
 &\quad \text{with } \beta_L = b_2 \\
 &\quad \mu_1 = 1 \text{ for } t < m \quad \mu_1 = 0 \text{ for } t > m
 \end{aligned}$$

Nominal wages influences convergence in our model via two channels. Firstly they determine through real wage changes regional employment demand and secondly they affect migration between regions. The first impact is straightforward the latter is slightly more complicated. A pay rise in one region induces migration to that region due to the wage differential. On the other hand employment chances in that region are decreasing, giving an incentive for people to leave the region¹⁴. As we assumed that the latter effect is more important than the former, there would be in fact more out-migration than in-migration in this case. It remains to be shown whether convergence is speeded up in this case.

Investigating now the case of capital mobility and labour immobility, i.e. $b_1 = b_2 = 0$, one gets from (3-10):

$$\begin{aligned}
 (3-12) \quad (y_{2t} - y_{1t}) &= (1-\beta_C) (y_{2t-1} - y_{1t-1}) \\
 &\quad - [(1-a)(1-d)c/s] (l_2^s - l_1^s) \\
 &\quad - [(1-d)a/s] [(w_{2t} - w_{1t}) - c(w_{2t-1} - w_{1t-1})] \\
 &\quad - \mu_1 [(1-d)/s] [(m_t - m_{jt}) - c(m_t - m_5(t-1))]
 \end{aligned}$$

¹³ One may interpret e.g. the setting with labour mobility and capital immobility as an economy where labour mobility is the dominant feature the elasticity c of capital migration is close to zero.

¹⁴See Meckel (1990).

$$+[(1-d)/s] (z_{2t} - c z_{2t-1}) + (e_{2t} - c e_{t-1})/s$$

with $\beta_c = c(1 - (1-d)(1-a)/s)$

With labour being immobile wages now have an unambiguously negative effect on the convergence of regional output per capita. With immobile labour lower regional employment induced by high wages will not induce migration which may offset at least part of per capita effects. Thus only the decrease in labour demand prevails.

Equations (3-11) and (3-12) will now be analysed for different kinds of wage formations and their impacts on the convergence of relative output.

4. A Full Employment Path

As a first approach we assume that wages would move such that both regional labour markets are cleared at any point of time. It is obvious that this assumption is not appropriate to analyse e.g. the present transition process in Germany. Nevertheless it may serve to describe a benchmark transition path with full employment.

In this case employed labour must equal labour supply in each region ($l^e = l^s = 1$). From the demand function (3-1) and the definition of output per capita (3-4) one gets for the full employment wage differential using (3-9):

$$(4-1) (w_{2t} - w_{1t}) = (y_{2t} - y_{1t})$$

In case of full employment y is equal to the regional labour productivity. Thus to ensure full employment the regional wage differential should move in line with the productivity differential. This would imply a highly flexible wages process which always take into account how far convergence has already been achieved.

Plugging (4-1) into (3-11), straightforward algebra leads to the equation for the regional output differential with labour mobility:

$$(4-2) (y_{2t} - y_{1t}) = (1 - \beta_L)(y_{2t-1} - y_{1t-1}) + \mu_1(1-d)m_1 + v_{2t}$$

with $\beta_L^* = b_1[1 - (1-d)a]$,

$$v_{2t} = (1-d)(z_{2t} - z_{2t-1}) + e_{2t} - e_{2t-1},$$

Equation (4-2) is basically the Blanchard result.¹⁵ Since b_1 , d and a are all assumed to be positive and smaller than one, there will be a convergence of regional productivity per capita with full employment. This results from three sources. The first is the so-called β convergence, which can be interpreted as an endogenous convergence. Migration is the decisive force to establish it. If $b_1 = 0$, i.e. people would not move between regions in case a wage differential opens. Then the differential is stationary and regions would permanently show welfare differences. However, if there is a chance to migrate, regional divergencies will vanish. In a region of relatively high labour productivity, higher wages will be paid. Consequently people move in from regions with low productivity and low wages. Per definition per capita output and thus wages then decrease in the first region. At the same time the flow of labour out of the second region increases productivity and wages there. In this setting the incentives to migrate diminish with productivity and wages equalizing across regions.

The second source of convergence called sigma convergence refers to the impact of exogenous shocks, i.e. the distribution of per capita output across regions. Technology as well as demand shocks could lead to divergence, if they show a nonstationary impact. In that case the effects of shocks with an arbitrary sign would prevail in the system preventing per capita outputs from converging.

As (4-2) shows the shock components are stationary, even if the shocks themselves are not. The reason for this is again migration. In case there is e.g. a positive demand shock for one region. Employment, wages and output per capita increase. In the following period people would move in from other regions just to offset the initial effects. Hence stationarity prevails. Technically, this result is established by shocks entering (4-2) as first differences.

The third source which assures convergence given the initially negative output gap, is the adjustment of total factor productivity which exhibits a positive nonstationary influence. From (4-2) it is obvious, even if the transfer of productivity is limited to the extent that the initial gap is closed, a longer run positive impact may prevail. Hence transfer of technological knowledge

¹⁵ Blanchard (1991).

could not just make a contribution to close the productivity gap but rather to put the transition region in an even more competitive position than region 1. At least convergence is achieved significantly earlier¹⁶.

From (4-2) and (3-5) it is obvious that employment will not converge to zero. Labour supply in region 1 increases due to migration. With full employment wages this results in higher employment too. Symmetrically labour supply and employment in region 2 decrease establishing a permanent employment differential. So the result of the Blanchard - Katz approach also holds in this setting.

In case of capital mobility and full employment, one gets from (4-1) and (3-12):

$$(4-3) \quad (y_{2t} - y_{1t}) = (1 - \beta_c^*)(y_{2,t-1} - y_{1,t-1}) \\ - \mu_1 \{ c(1-d)[m_i - m_{it}] - (1-c)(1-d)m_j \} \\ - (1-d)(1-a)c(l_2 - l_1) + v_{2t}$$

with $\beta_c^* = c[1 - (1-d)(1-a)]$ and

$$v_{2t} = (1-d)(z_{2t} - (1-c)z_{2,t-1}) + e_{2t} - (1-c)e_{2,t-1}$$

If capital is mobile we still get β convergence. Now capital migration is the driving force. In a region with lower initial labour productivity the initially employed capital stock will be low too. Due to decreasing returns to scale this will lead to a relatively higher capital productivity and thus returns in that region. As a consequence there will be a capital inflow which leads to higher output. With a constant distribution of labour across regions the increase in production induced by capital inflow will rise labour productivity, diminishing the productivity gap between the regions.

In contrast to the case of labour mobility, the way total productivity growth effects the convergence path is time variant now. It turns out that the initial total productivity gap is essential. It reduces the initial capital productivity gap and diminishes thereby the incentives for capital inflows. To offset this negative starting point and to ensure long term convergence of

¹⁶ This may be one of the special factors which speed up convergence Barro and Sala -i-Martin neglected in their analysis. The described outcome may be considered as the economic "miracle" scenario. See the comments of Dornbush and Wolf (1992).

output per capita a high total productivity growth offsetting the gap is necessary.

Exogenous shocks show a non stationary impact on relative output. If there is a positive technological or a demand shock in one region, marginal productivity and thereby returns on capital rise attracting capital inflow during the next period. This induces another positive albeit weaker shock to regional output. Hence we get Blanchard's conclusion, that " in a world of state specific shocks and no labour mobility, the movement of capital, will amplify the shocks on output per capita." (p.165)

Equation (4-3) also shows that the size of the region measured by the share of labour force is of importance. Since capital flows react on returns and not on returns per capita a smaller region with the same returns for capital will have the higher output per capita effects if the labour force is not mobile. If the transitional region is smaller than region 1 higher returns for capital will be particularly effective.

The convergence paths described above make clear how migration of inputs may lead to a convergence of regional productivity levels. From the two cases discussed above the capital mobility assumption seems to be more relevant. If the transitional region is smaller than region 1 higher returns wage bargaining, it still remains to be seen whether convergence is speeded up or slowed down if this assumption what is very likely does not apply. This will be investigated in the following section.

5. Enforced Convergence of Wages

The wage settlements which have been made e.g. in East Germany so far, link wage development to West German wage rates. The typical target wage is that contract wages in East Germany should reach West German levels after 4 years. So basically East German wage rates were enforced to converge to those of West Germany. Since relative wage rates quite frequently play a decisive role in the wage bargaining process the following considerations may apply more generally.

These wage settlements will be described as a process diminishing the initial wage differential n_i by a constant rate n_j .

$$(5-1) (w_{2t} - w_{1t}) = - n_i + n_j t \text{ for } t < n: = n_i / n_j$$

$$= 0 \text{ for } t > n$$

with n_i and $n_j > 0$.

For $t > n$, we assume that East and West German wage levels are the same, i.e. $w_{2t} = w_{1t}$.¹⁷ Plugging (5-1) into (3-11) to derive the convergence path with labour mobility and enforced wage convergence, one gets :

$$(5-2) \quad (y_{2t} - y_{1t}) = (1-\beta_L) (y_{2,t-1} - y_{1,t-1}) - \mu_2 (b_2 - b_1) n_i \\ + \mu_2 [(b_2 - b_1)(t-1) - (1-d)a/s] n_j \\ + \mu_1 [(1-d)/s] m_j \\ + [(1-d)/s] (z_{2t} - z_{2,t-1}) + (e_{2t} - e_{t-1})/s \\ \text{with } \mu_2 = 1 \text{ for } t < n \text{ and } \mu_2 = 0 \text{ for } t > n$$

Though some properties like the stationarity of shocks do not change compared to the full employment path, there are some striking differences. Whereas β convergence is clearly higher than in the full employment case due to increased migration of unemployed workers, the direct impact of wages is ambiguous. On one side employment demand for labour decreases leading to a lower output per capita¹⁸. On the other hand increased out-migration closes the output gap faster. Hence from (5-2) no immediate conclusions can be drawn whether the convergence process is speeded up.

To derive some more precise results, we shall calculate the difference between the full employment convergence path and (5-2). To do so, we neglect the impact of shocks which may cause deviations from the outlined path at either side. Solving (5-2) and (4-2) recursively and taking the difference, one gets after some transformations:

$$(5-3) \quad [(1-\beta_L)^T - (1-\beta_L^*)^T] (y_{20} - y_{10}) \\ - [A_L^{T-1} - A_L^{*T-1}] [(b_2 - b_1)/b_2] (n_i - n_j) + (1-d)an_j/b_2s \\ + [(A_L^{T-1} - A_L^{*T-1}) - (A_L^{*T} - A_L^{*T-m})] (1-d)m_j/k \\ < [(y_{2T} - y_{1T}) - (y_{2T}^* - y_{1T}^*)] < \\ [(1-\beta_L)^T - (1-\beta_L^*)^T] (y_{20} - y_{10})$$

¹⁷ This assumption is a bit harsh, since present wage settlements only lead to the convergence of contract wages. Effective wage rates in West Germany will still be higher after the agreements have been fulfilled.

¹⁸ Since the full employment assumption no longer holds in this setting, the dependent variable no longer reflects labour productivity, but output per capita of the labour force. Labour productivity in fact increases under this circumstances since employers now will hire or keep workers with a higher productivity.

$$\begin{aligned}
& -[A_L^{T-1} - A_L^{T-n}] [(1-d)an_j/b_2s] \\
& + [(A_L^{T-1} - A_L^{T-m}) - (A_L^{*T} - A_L^{*T-m})] (1-d)m_j/k
\end{aligned}$$

where * denotes the full employment path, with

$$A_L^T := [1 - (1-b_2)^T], A_L^{*T} := [1 - (1-b_1s)^T], k := b_1b_2s.$$

From (5-3) one can draw several conclusions concerning the relative speed of convergence. In the first period, $T=m=n=1$, (5-3) is positive, since $y_{20} < y_{10}$. The reason for this, is the higher β convergence in case of the enforced wage adjustment. That means this kind of mechanism always leads to an higher out- migration thereby reducing labour supply. All other things equal this increases per capita output and the employment chances in the second region. Hence the enforced wage adjustment triggers a push to convergence which is stronger than in case of a market clearing mechanism. One has to keep in mind that this effect is due to the faster restructuring process which causes higher unemployment. Thus this impact has to be paid by high social costs. During the first period this is the only force which is effective. Therefore one gets this is clear cut result.

From the second period onwards until the end of the transition process there is no unique answer to the question which kind of wage process enhances convergence. Now, there are two opposing forces. On one hand wage rise which are independent of productivity growth slow down the convergence speed since they decrease the competitiveness of firms in region 2 and lead to a lower output per capita. On the other hand productivity growth has higher output effects in case of an enforced wage adjustment than in case of market clearing. This is due to the fact that full employment wages increase with productivity growth. Consequently pay rises cause some "crowding -out" of the productivity effects. In an enforced wage convergence setting this effect does not occur. Technological change thus is more effective if wages adjust independently of productivity changes. Taken all three arguments together the model does not lead to a unique conclusion for the convergence speed during the transition period.

In the long run, i.e after completion of all transition processes, (5-3) will converge to zero. This means there will be no difference in output per capita paths between the two different wage adjustment schemes. As soon as wages equalize they will not affect the convergence process any longer. Regional demand for labour then is no longer influenced by regionally different wage rates. In addition to that wages are no longer an incentive for migration. Thus we get the result that in case of labour mobility the long run regional distribution of welfare is independent of

the wage adjustment process. One should keep in mind that this conclusion does only hold as long as the wage process aims to the convergence of regional wages. If trade unions would try to establish some kind of permanent wage differential the distribution of regional welfare would be affected.

These results imply that the question whether output per capital convergence in case of labour mobility and capital immobility is speeded up or slowed down by the enforced wage convergence settlement compared to the full employment path cannot be answered in a unique way. It rather depends on the stage of the transition process. At the beginning a speeding up is likely, then it may slow down. In the long run dramatic differences for the output per capita convergence should not be expected despite the fundamentally different wage path.

The employment pattern differs significantly. The initially low production in region 2 is reflected by higher unemployment figures if wages do not react on the labour market situation. The especially initially somewhat faster convergence of an enforced wage scenario is achieved by this high unemployment and the resulting high migration. From this it follows that at this stage the welfare level in the first region is also affected to larger extent than in a full employment scenario, since in- migration will rise unemployment there leading to downward pressure on per capita output. This kind of adjustment may be considered as a very harsh way of burden sharing.

For the long run conclusions the picture does not change very much in case of capital mobility and labour immobility. Plugging (5-1) into (3-12) yields the convergence path.

$$\begin{aligned}
 (5-4) \quad (y_{2t} - y_{1t}) = & (1-\beta_c) (y_{2,t-1} - y_{1,t-1}) \\
 & -[(1-a)(1-d)c/s] (l_2^s - l_1^s) \\
 & -\mu_2[(1-d)a/s] n_j \\
 & -\mu_1[(1-d)/s] [(1-c)m_1 - (1-c)m_1 t + cm_j] \\
 & + [(1-d)/s] (z_{2t} - c z_{2,t-1}) + (e_{2t} - c e_{1,t-1})/s
 \end{aligned}$$

According to (5-4) the wage adjustment process shows an unanimously negative impact on convergence. Higher wages not only diminish employment but also capital productivity. Consequently there will be a capital outflow. For the same reason β convergence is lower than in the full employment case, since it is difficult to attract capital to a low productivity region.

Calculating the difference between full employment and enforced wage convergence paths neglecting again transitory shocks one gets after similar transformation as for (5-3):

$$\begin{aligned}
(5-5) \quad & [(1-\beta_c)^T - (1-\beta_c^*)^T] (y_{20} - y_{10}) \\
& - [A_C^{T-1} - A_C^{T-n}] [(1-d)a_n/\beta_c s] \\
& - [(A_C^{T-1} - A_C^{T-m})] (1-d)[(1-c)(m_i - m_j) - cm_j]/\beta_c \\
& + [A_C^{*T-1} - A_C^{*T-m}] (1-d)(1-c)m_j/\beta_c^* \\
& - [(A_C^{T-1}\beta_c^* - A_C^{*T-1}\beta_c s)] (1-d)(1-a)c[l_2^s - l_1^s] \\
& < [(y_{2T} - y_{1T}) - (y_{2T}^* - y_{1T}^*)] < \\
& [(1-\beta_c)^T - (1-\beta_c^*)^T] (y_{20} - y_{10}) \\
& - [A_C^{T-1} - A_C^{T-n}] [(1-d)a_n/\beta_c s] \\
& + [(A_C^{T-1} - A_C^{T-m})] (1-d)cm_j/\beta_c \\
& + [A_C^{*T-1} - A_C^{*T-m}] (1-d)[c(m_i - m_j) + (1-c)m_j]/\beta_c^* \\
& - [(A_C^{T-1}\beta_c^* - A_C^{*T-1}\beta_c s)] (1-d)(1-a)c[l_2^s - l_1^s]
\end{aligned}$$

with $A_C^T := [1 - (1-\beta_c)^T]$, $A_C^{*T} := [1 - (1-\beta_c^*)^T]$

With labour market clearing wages the speed of convergence is clearly higher during the first periods. The main reason is the higher β convergence. Again as in the case of labour mobility the initial shock of unemployment leads to a higher migration, in this case of capital. For the subsequent periods the results show the ambiguity for the enforced wage mechanism already outlined above: the wage increases slow down convergence whereas the productivity growth speeds it up compared to the market clearing case. However, after the completion of the transition process, as T converges to infinity both concepts lead to regional convergence. Hence our previous conclusion that the long term regional distribution of welfare is independent of the form of wage adjustment does not depend on the mobility of labour. Even if labour is completely immobile as in (5-5) the result holds. Under this circumstances capital flows will lead to the convergence. With all other things being equal after transition this results from the equalization of capital productivity across regions. Initially, in the region with a lower output per capital the employed capital stock is too low. Hence capital productivity and thus return are higher over there. This attracts capital inflow which leads to higher production. These mechanisms are the same for both, the market clearing case as well as enforced wage adjustment. But again the amount of employed labour is lower during the transition period in case of a fast wage convergence.

As shown in (5-4), shocks are non stationary in case of capital mobility. Therefore their omission out of (5-5) leaves an incomplete picture. In fact they even may be the driving force of convergence, especially in case of Germany. Its permanent impact on welfare can even be more important than that of migration.

6. A Simulation Example

A purely simulative exercise may illustrate above results. The simulation model consists of the equations (3-1) to (3-9). As parameter values we choose 0.8 for d , which means that the price elasticity of demand is about 1.25 in the model. The share of labour, a , is set at 0.7. Due to the lack of empirically sound investigations it seems rather difficult to choose any reasonable values for the migration elasticities. As a first approach b_1 is set at 0.1 and b_2 at 0.2. Thereby it is assumed that people react twice as strong on employment differentials than on wage differentials. For capital migration we assumed c to be 0.5 indicating that regional capital formation is fairly sensitive to returns.

The initial values for an artificial economy are outlined in table 1. Initially both regions have the same labour supply. However since total factor productivity is only one third and capital endowment only one tenth in the second region, output amounts only to about 15 pc compared with region 1. Thus region 2 is significantly lagging Table 1 behind region 1.

Initial Values		
Assumptions		
	Region 1	Region 2
Fatal Factor Productivity	0.1	0.3
Capital Endowment	1 000	100
Labour Supply	1 000	1 000
Implications		
Output	1 000	150.4
Output per Capita	0.398	0.272

There are three different simulations which are distinct by the assumed wage adjustment path. Firstly (Simulation A) wages are supposed to follow a market clearing path in region 2. Wages

in region 1 remain on their initial level, hence there will be unemployment. The second simulation (B) assumes that wages in region 2 will have converged to the wage level in region 1 after 5 periods. Finally, for the third simulation (C), the adjustment period is doubled to 10 periods. This set of assumptions is used to trace the impact of an enforced wage convergence on the regional distribution of output per capita.

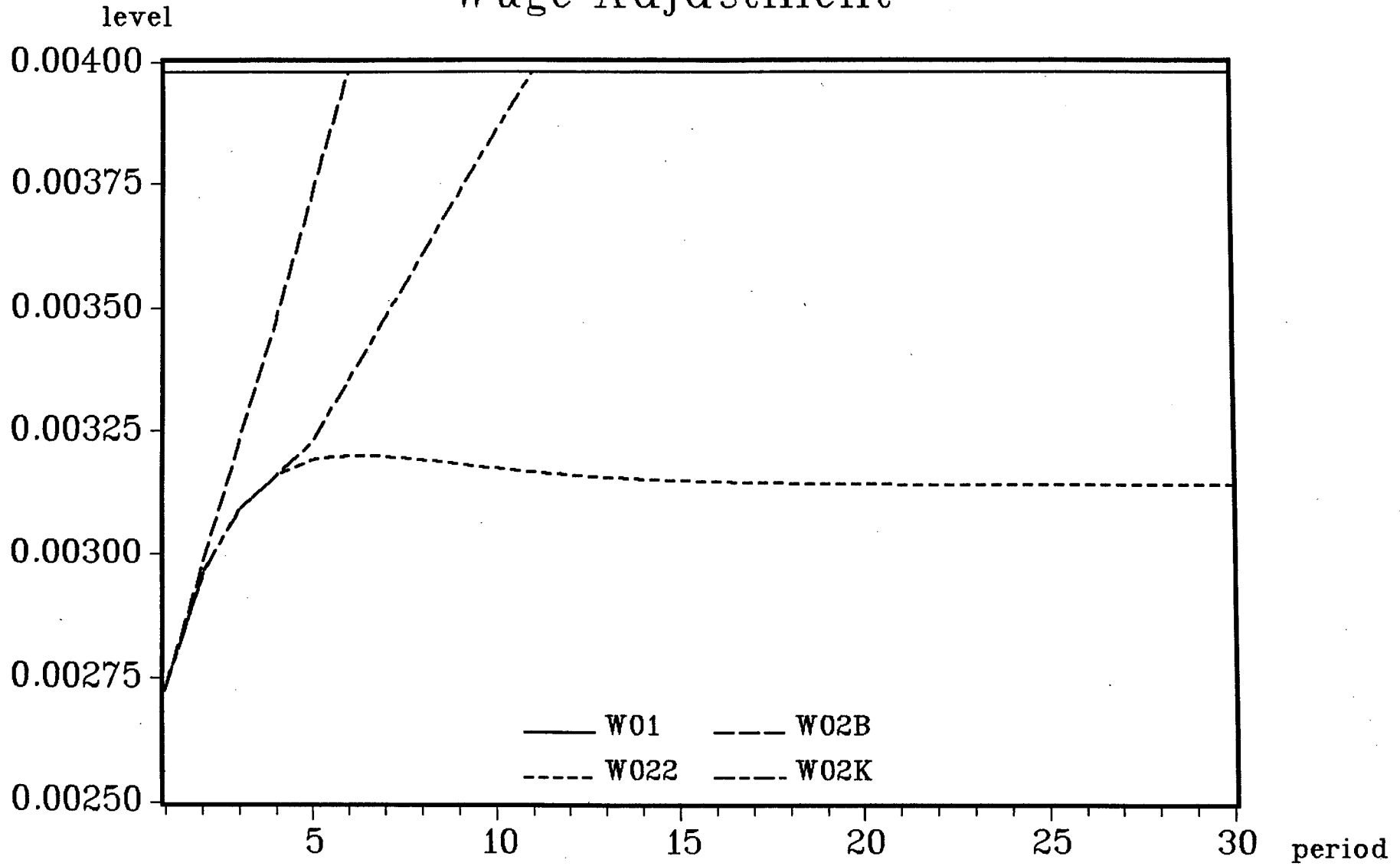
The original model provides two channels for convergence. Firstly, regional labour supply changes via migration and so does regional capital endowment via financial transfers and regional capital creation. We have assumed that labour migration reacts twice as strong on unemployment than on wage differentials. In addition to these two mechanisms we have added for the simulation model a third one. The migration of labour as well as capital flows influence total productivity. We assumed that both, the influx of labour and capital increases total productivity. The supposed elasticities are 0.1 (capital) and 0.01 for labour. Thus labour migration is assumed to increase productivity to a far lesser extent.

The results illustrate the conclusions from our theoretical considerations. Looking at the wage process (graph 1), one can realize that a market clearing process will lead to a lower wage level in region 2 even in the long run. More importantly, in case of market clearing output per capita will not converge completely between both regions. And as it turns out, convergence will be achieved earlier if wages adjust faster (graph 2).

What are the reasons for these somewhat striking results? The basic finding is that the convergence process is dominated by the labour migration process. If wages are market clearing as in the first simulation, migration from region 2 to 1 is relatively low. After five years the labour supply in region 2 is at its minimum level of about 940, i.e. only 6 pc of the labour force have migrated to region 1. In the long run labour supply even increases again up to 980. Hence only 2pc of the labour force has left the region, the main reason being that given the assumed wage process there is no unemployment in region 2. Then, the only reason to migrate is the wage differential. Since the migration elasticity with respect to unemployment is relatively high it is not surprising that migration is much higher when wage movements do not ensure full employment. For both other simulations, B and C, the long term labour supply in region two is only slightly above 900, i.e. there is an almost 10 pc reduction. Interestingly there is no long term difference between a five period and ten period wage adjustment. Thus the speed of the adjustment process does not affect the long term distribution of labour supply. However during the adjustment period there are differences. Unemployment increases faster if wages adjust

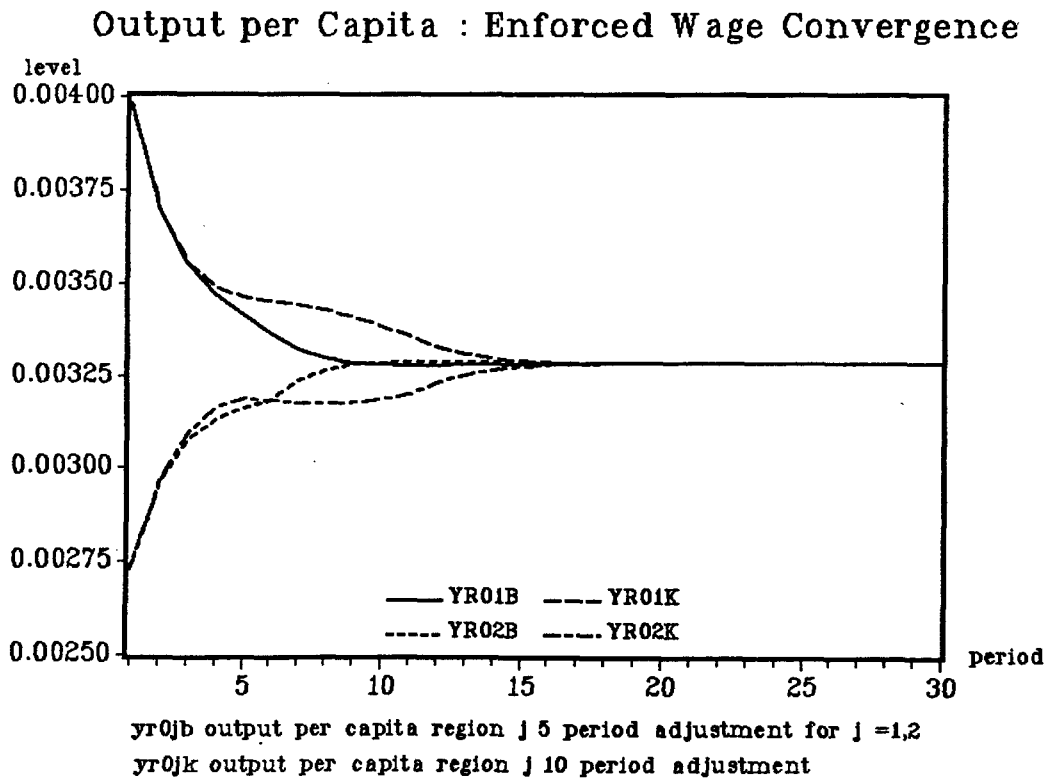
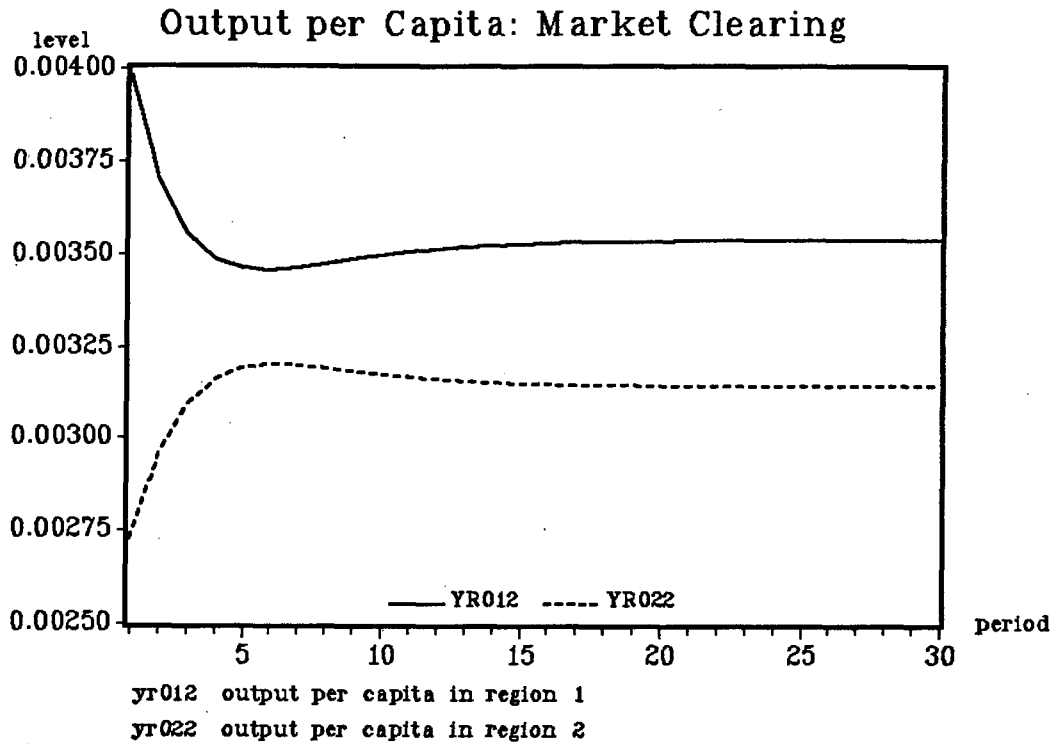
Graph 1

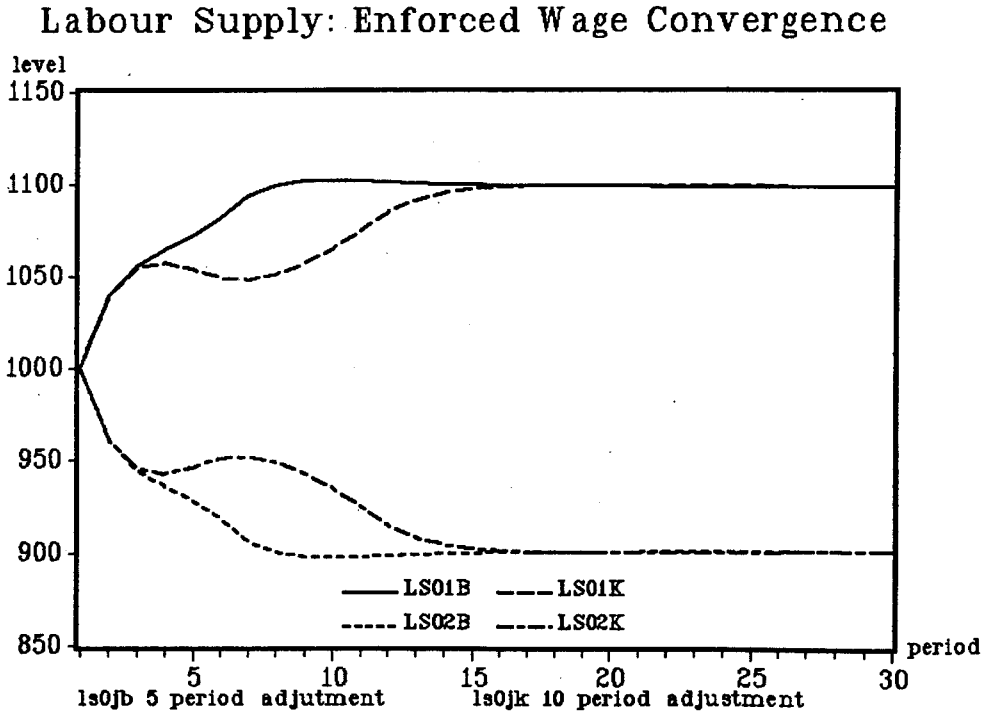
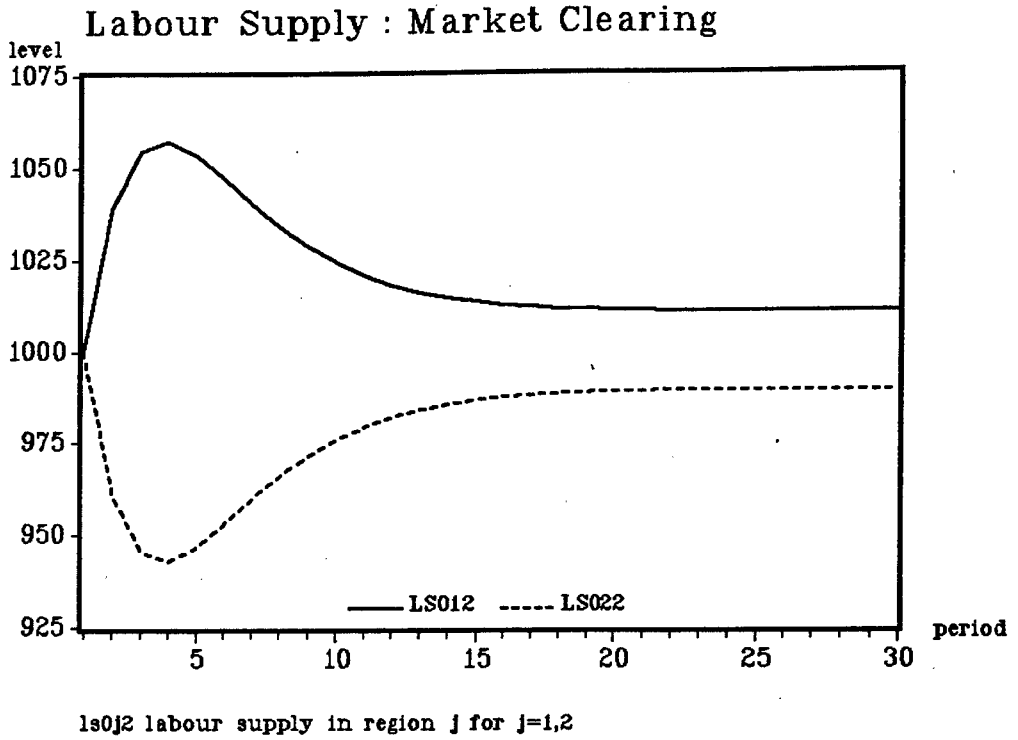
Wage Adjustment



w01 wages in region 1 w02b 5 period adjustment
w022 market clearing w02k 10 period adjustment

Graph 2





faster since firms are losing competitiveness to larger extent (see graph 4). Even if the wage adjustment is smoothed, people will lose employment albeit at a later stage. At the beginning, wage increases hardly affect competitiveness in simulation C.¹⁹ Later on, after 5 periods wages in region two still move towards those in region 1 but now the increase is significantly above market clearing level leading to a steep increase of unemployment. Its maximum level equals that in simulation B. This finding leads to the conclusion that the speed of adjustment basically determines the adjustment pattern but not the level. The choice between fast or slow wage adjustment then is not a choice between a higher or a lower unemployment level, it is a choice between speeded up or delayed unemployment. This result may not hold if an autonomous productivity adjustment path is assumed. Then a delayed wage adjustment will show a lower maximum unemployment level, since firms gain competitiveness for exogenous reasons in course of the adjustment process.

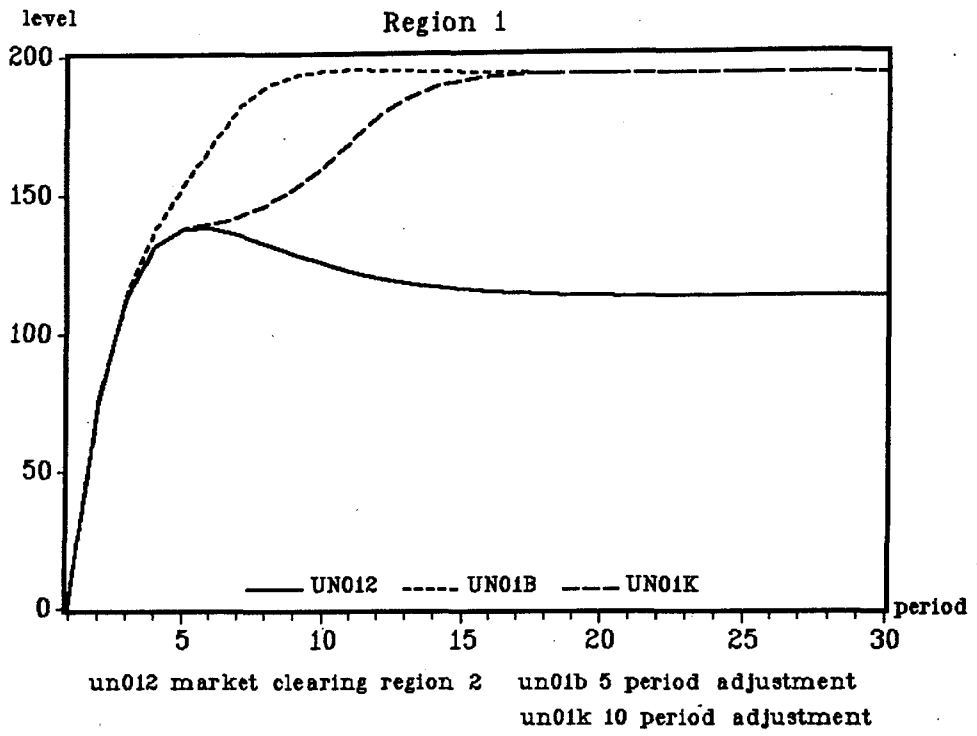
Looking at the output development, one realizes that again the long term level are equal in simulation B and C and higher in the market clearing case (see graph 5). In all cases production in region 2 increases significantly. This is achieved by the capital influx (see graph 6) induced by its higher marginal productivity in region 2. Hence in both simulations A and C, growth in region 2 is achieved by higher capital growth. But given the chosen technology where the production elasticity of capital is only 0.3, its impact on output per capita is smaller than that of labour migration.

Again simulation B and C provide a different output adjustment pattern. In simulation B output approaches its long term level steadily following the continuous influx of capital. In simulation C the increase leads to an output level even above its long term level. Later on output declines. The driving force is again the relatively high wage increase between period 5 and 10.

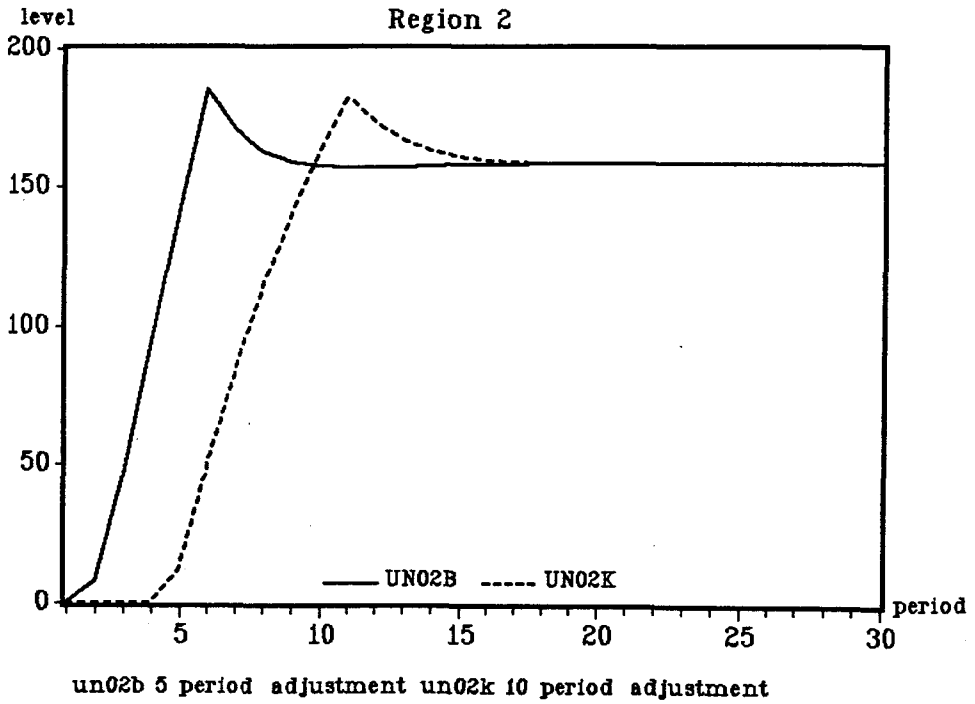
In sum, the adjustment process for the market clearing simulation must be much slower and in our chosen example even never be completed. A different choice of parameters and adjustment patterns especially if the wage migration elasticities is higher may be different. Then convergence may be achieved in market clearing setting, too. But in general the results holds that enforced wage convergence does speed up output per capita convergence. This does not mean that social welfare is necessarily higher since unemployment is also higher in the case of

¹⁹ In fact in above example the 10 period adjustment accidentally equals the market clearing process during the first periods.

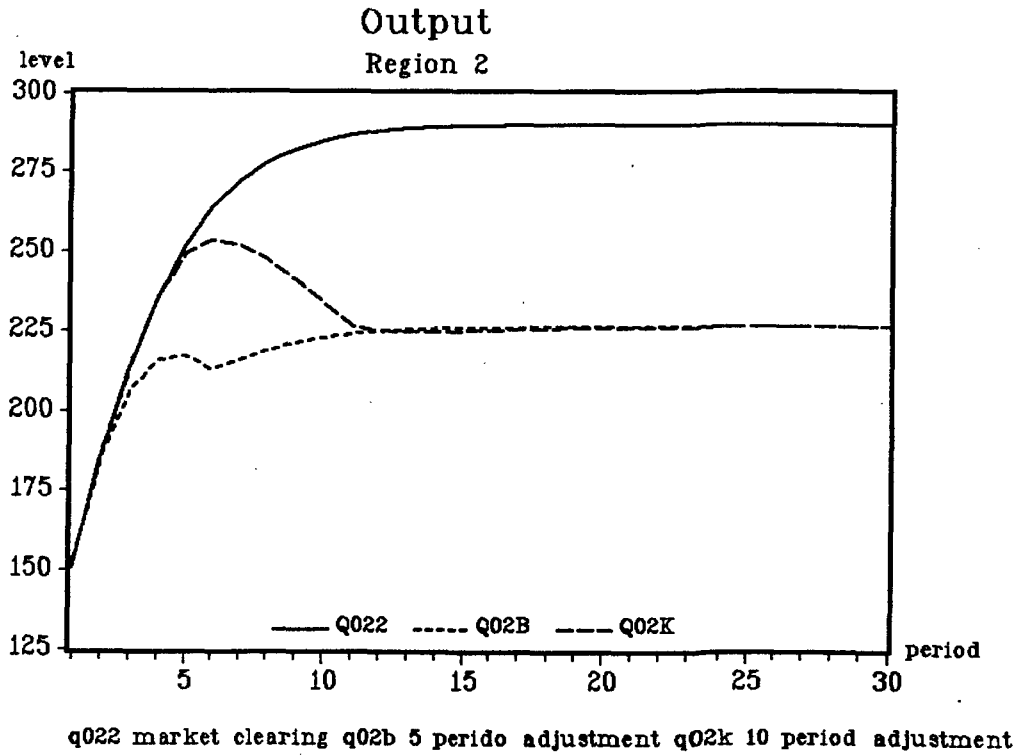
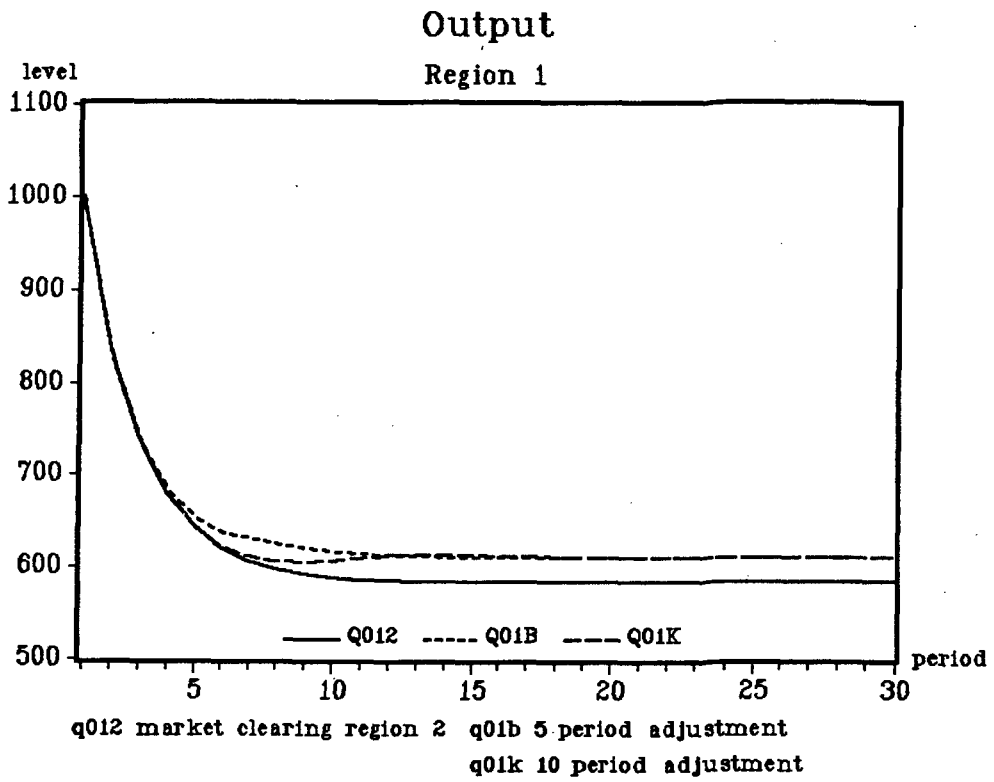
Unemployment



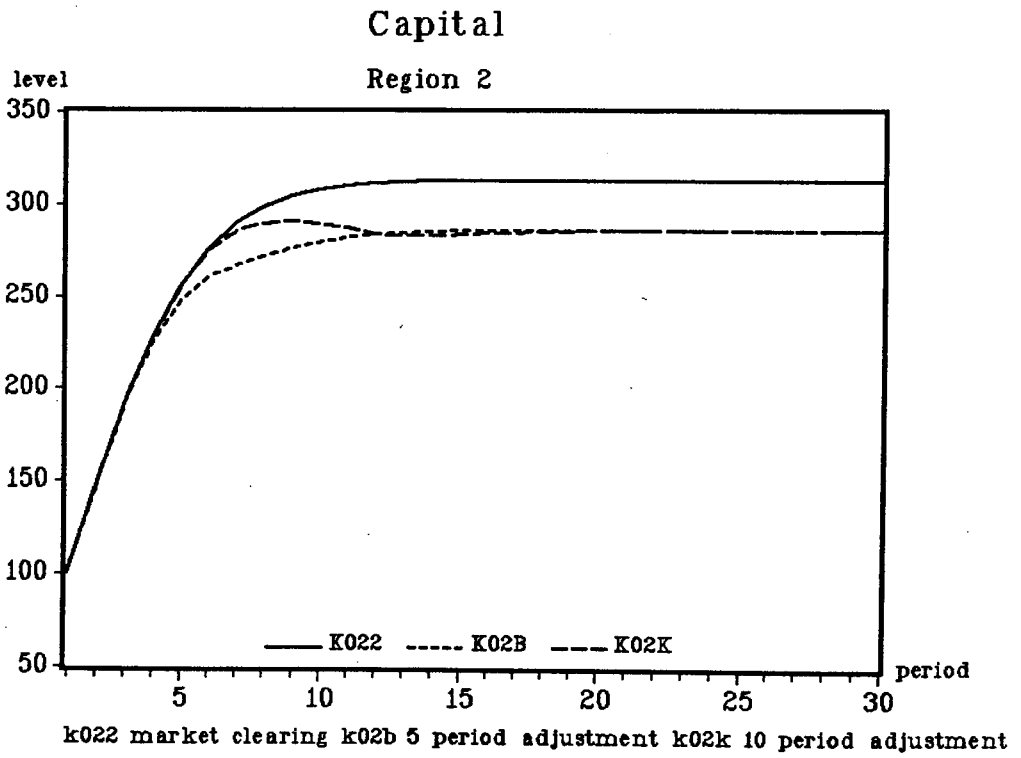
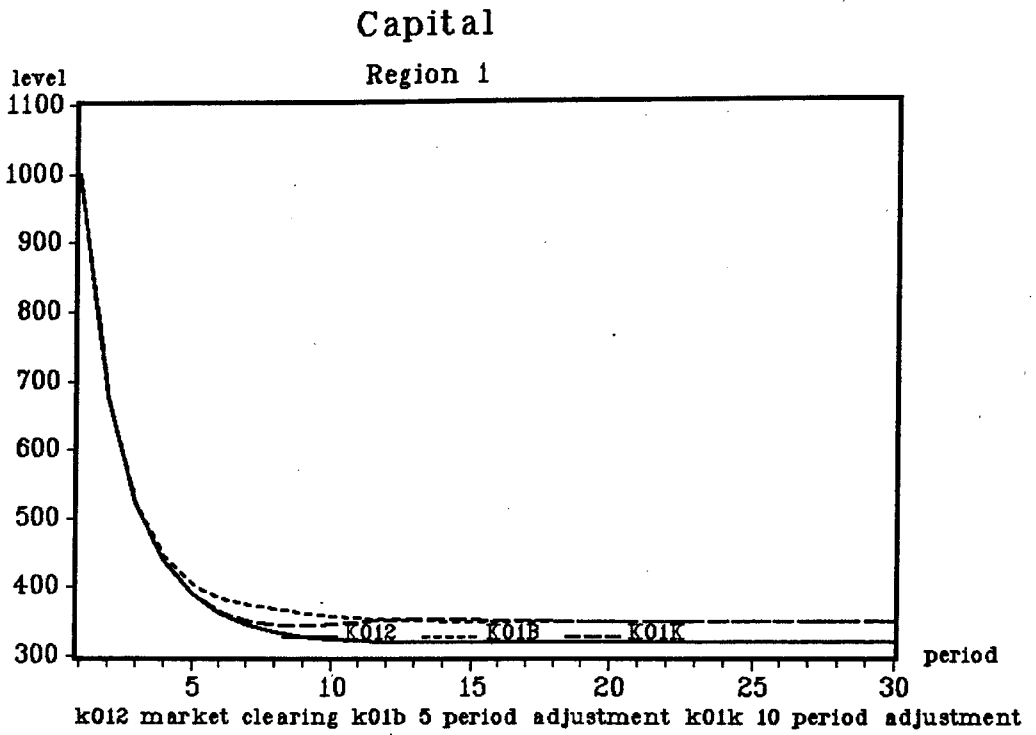
Unemployment



Graph 5



Graph 6



enforced wage convergence. But if the speed of output per capita convergence enters the welfare function too, the answer may not be as simple as it seems at the first glance. In any case the trade off between unemployment and a fast convergence has to be taken into account. Furthermore if a non market clearing wage path is entered the speed of wage adjustment mainly influences the periodical distribution of unemployment not its long term level which is determined by the convergence target.

7. Conclusion

The main conclusion of the paper is that the long term distribution of welfare is basically independent of the chosen way of wage adjustment. Migration of labour and capital will offset any output per capita differentials in the long run. The outcome of the convergence process rather depends on the convergence target

Within the framework presented above the chosen wage adjustment process in fact is important for the way transition takes place, albeit the model overemphasizes its impacts. But clearly, a regional wage formation which is initially independent from productivity growth causes regional unemployment to some extent. However, it is exactly unemployment which initially speeds up the convergence process via migration. Politically this implies there will be a considerable burden sharing during transition.

Nevertheless present approaches on regional convergence model do not yet provide a completely satisfactory analysis of the transition process. Still, exogenous shocks play a dominant role for the outcome. In other words most of the explanation remains exogenous to the model. Therefore two further lines of research seem to be promising. Firstly a theoretical model should be developed endogenizing the non transitory part of the shocks outlined above. Secondly, since the parameters of the model are very important for the speed of adjustment, an empirical analysis - preferably with times series methods - based on data for regions may provide some more insight into the speed of regional convergence. Then conclusions about the duration of the transition process might be more sophisticatedly founded.

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