Jahrbuch für Wirtschaftswissenschaften

Herausgegeben von
Dieter Duwendag, Karlhans Sauernheimer
und Eberhard Wille

Band 50/1999

Vandenhoeck & Ruprecht in Göttingen

Satz: Tutte Druckerei GmbH, Salzweg/Passau
Druck und Bindung: Hubert & Co., Göttingen

Wage Gaps in Textbook Models: Do they Account for the German Unemployment Experience?

By Alfred Maußner

1. Introduction[1]

Like in most other countries of the European Community, German unemployment has steadily increased since the mid-seventies. In 1997 it peaked at an unprecedented level in the post World War II period: In the first month of that year over 3,2 million West Germans were officially registered as unemployed.

The vast literature on the European unemployment problem (Bean, Ch. R. 1994, Siebert, H., 1997, Nickell, S. 1997) offers no single explanation. It holds that a series of adverse supply and demand shocks triggered layoffs propagated through different channels into the persistently high level of unemployment. Most papers closely tie their explanation of persistence to the generous welfare state. One line of reasoning holds that labor market regulations increase hiring and firing costs. By that they enable employed workers to increase wages above market clearing levels (see, e.g., Berthold, N. and Fehn, R. 1996). Another argument states that the provision of unemployment compensation for an indefinite span of time provides incentives to increase search time and to lower search effort. In periods of rapid economic change, when the human capital of dismissed workers quickly depreciates, this may raise the number of voluntarily unemployed people substantially (Ljungqvist, L. and Sargent, Th. 1995, 1996). Still another strand of the literature argues that international trade with less-developed countries exerts a downward pressure on the wages of unskilled workers. Inasmuch as trade unions successfully resist wage cuts, unemployment piles up (see, e.g., Krugman, P. 1995, Burtless, G. 1995, and the books surveyed therein).

Except the search theoretic approach these arguments share a common theme: for the one or the other reason wages do not clear labor markets. Economists, thus, have devoted much effort to compare real wages with various estimates of market clearing rates (see, e.g., Bruno, M. and Sachs, J. 1985 and Sachverständigenrat, 1994, p. 259f.). Yet, I doubt, whether the concept of the so called wage gap, i.e., the spread between market clearing and actually observed wages, is empirically meaningful. The notion of market clearing wages is specific to the considered model. For instance, the real wage that clears the labor market in a

[1] I am grateful to an anonymous referee. The usual disclaimer applies.

Jb. f. Wirtschaftswissenschaften 50 (1999), 156–177

ISSN 0075-2770

perfectly competitive environment causes unemployment if competition on product markets becomes imperfect. If markups vary over the business cycle or change in the long run, wages that increase according to labor productivity may not secure full employment. Since it is impossible to uncover the true economic model, the search for market clearing real wages is futile.

Instead, I will pursue another approach. Among business cycle researchers it has become common practice to employ small scale models that explain the stylized facts of economic fluctuations. I will therefore contrast the quantitative implications of wage gaps within two textbook models: a static model of North-South trade and a dynamic model of capital accumulation. My focus is on West German unemployment, since, evidently, the literature referenced above does not aim at a transitional economy. I choose rather simple models that require few parameters. There are two reasons for doing so. The first, clearly, is tractability. It is well known from the fixprice approach to macroeconomics (Benassy, J.-P. 1982, 1986 provides an overview of this line of research) that agents revise their plans on other markets if they are rationed on the labor market. These spillover effects account for multiple types of equilibria in general settings. I want to avoid the ambiguities associated therewith and, thus, specify production and preferences in the simplest possible manner. The second reason is my believe that textbook models do not only serve as a means to illustrate the working of economic mechanisms. Besides that their quantitative implications should be studied.

I use an extended version of the Krugman (1995) model calibrated to German data and show that the international trade argument explains only a small fraction of unemployment. I will then draw attention to a much neglected aspect of the rigid wage argument. In a dynamic framework unemployment reduces capital accumulation. Future labor productivity and, thus, market clearing wages are lower than they otherwise would have been. Malinvaud (1982, 1983) explores the implications of both, fixed wages and interest rates, on employment within a putty-clay type growth model. His focus is on the interplay between demand and supply side determinants of investment expenditures. Long run unemployment may result from a lack of profitability as well as from insufficient demand. There are two reasons why I do not consider this framework as adequate. First, the wage gap hypothesis relates to sticky wages and not to fixed remuneration rates per se. Second, fixprice models with different regimes are difficult to calibrate. One must guess the economic regime in order to estimate the model's parameters from observed data. Therefore, I resort to a much simpler, albeit empirically successful model (see Hamilton, J.D. and Monteagudo, J. (1998)): the Mankiw, Romer, and Weil (1992) extension of the Solow (1956) growth model. Within that framework even a small but a prolonged wage gap may explain considerable increases in unemployment.

I do not introduce the source of wage stickiness explicitly into this model. My argument is that major supply shocks, namely an increased work force and the capital shortage in the wake of German unification, required wage rates to temporarily drop below their long run growth path. Insiders resistance to wage

cuts enhanced by the increasing tax wedge[2] (including mandatory contributions to the various social security funds) prevented wages from doing so. The ceteris paribus lower rate of capital formation, then, widened the gap between actual and market clearing wage rates. At the same time, the increased share of long term unemployed workers reduced the pressure on wages.[3]

In the next section I asses the international trade argument. Section 3 considers the Mankiw, Romer, and Weil (1992) extension of the Solow model under rigid real wages. Section 4 concludes, and an appendix covers technical details.

2. International trade and fixed relative wages

It is well known that trade between the human capital abundant, industrialized North and the labor abundant, developing South puts the wages of unskilled Northern workers under pressure. Krugman (1995) presents this argument in a simple two-factors-two-goods model. He calibrates this model to OECD economic data and calculates that the rigid wage structure explains a fall in employment of over 1.4 percent.

I use an extended model. It admits capital as a factor of production and considers a third sector producing a non-tradeable good. It should be clear from the outset that a large service sector employing a considerable share of the unskilled work force lessens the impact of trade on employment. However, the conclusions remain untouched, if capital is not explicitly introduced. So, consider the following model:

Sector $i = 1, 2, 3$ combines H_i units of skilled labor, N_i units of unskilled labor, and K_i units of capital to produce Y_i units of output according to a constant returns to scale Cobb-Douglas function:

$$\text{(II.1)} \quad Y_i = N_i^{\alpha_i} H_i^{\beta_i} K_i^{\gamma_i}, \ \alpha_i + \beta_i + \gamma_i = 1.$$

The representative firm in sector i is a price taker. I denote the price of good i as p_i and the prices of skilled labor, unskilled labor and capital as q, w and r, respectively. Profit maximization implies the following first order conditions:

$$\text{(II.2)} \quad \begin{aligned} &\alpha_i h_i^{\beta_i} k_i^{\gamma_i} = w/p_i, \\ &\beta_i h_i^{\beta_i - 1} k_i^{\gamma_i} = q/p_i, \\ &\gamma_i h_i^{\beta_i} k_i^{\gamma_i - 1} = r/p_i, \\ &k_i := \frac{K_i}{N_i}, \ h_i := \frac{H_i}{N_i}, \end{aligned}$$

[2] Between 1970 and 1985 the relation between the producers real wage and the consumers real wage increased from about 1.6 to 1.9 and varies since then around 1.8.

[3] See Layard, Nickell, and Jackman (1991), Chapter 9 on this point.

where h_i and k_i denote inputs of human and physical capital per unskilled worker, respectively.

Household $j \in [0, 1]$ has the money income B_j and maximizes a Cobb-Douglas utility function

$$\text{(II.3)} \quad U_j = C_{1j}^{c_1} C_{2j}^{c_2} C_{3j}^{c_3}, \; c_1 + c_2 + c_3 = 1,$$

subject to his budget constraint

$$\text{(II.4)} \quad \sum_{i=1}^{3} p_i C_{ij} = B_j.$$

Therefore, aggregate demand for good i is[4]

$$\text{(II.5)} \quad C_i = c_i \frac{B}{p_i}, \; B := \int_0^1 B_j dj.$$

The total supply of factors is independent of prices and remuneration rates. In obvious notation, the respective magnitudes are N, H, and K.

Equations (II.1) to (II.5), the market clearing conditions,

$$\text{(II.6)} \quad \begin{aligned} Y_i &= C_i, \; i = 1, 2, \\ \textstyle\sum_i N_i &= N, \\ \textstyle\sum_i H_i &= H, \\ \textstyle\sum_i K_i &= K, \end{aligned}$$

and the accounting identity

$$\text{(II.7)} \quad B = w \sum_{i=1}^{3} N_i + q \sum_{i=1}^{3} H_i + r \sum_{i=1}^{3} K_i \equiv \sum_{i=1}^{3} p_i Y_i,$$

imply the following market clearing relative wage of the closed economy:[5]

$$\text{(II.8)} \quad (w/q)^* = \frac{\sum_i \alpha_i c_i}{\sum_i \beta_i c_i} \frac{H}{N}.$$

Let us introduce bilateral trade as an exogenous shock to which relative wages (w/q) do not respond whereas all other relative prices adjust. The shock origins

[4] A continuum of mass one of identical consumers allows using aggregate and per-capital variables interchangeably.

[5] The Appendix describes the derivation of this equation.

from the "sudden" appearence of the South, and its size depends on the properties of the offer curve of the South. I do not explicitly model the offer curve of the South. Instead, I control for the volume of trade, and thus, the shock size by postulating an import function:

$$\text{(II.9)} \quad M = m\frac{(p_1 Y_1 + p_2 Y_2 + p_3 Y_3)}{p_2},$$

with the marginal propensity to import, m, as a parameter of the model. Note, however, that this equation is not a behavioral equation of the household sector; it is an implicit assumption on the properties of the offer curve of the South: since capital is present, the fixed wage structure is not sufficient (as it is in Krugman's (1995) model) to pin down the terms of trade p_2/p_1, which are a function of both, the wage structur (w/q) and the wage-rental ration (w/r). I prove in the Appendix that with w/q fixed the terms of trade in the new equilibrium are related to m according to

$$\text{(II.10)} \quad \frac{p_2}{p_1} = \left(\frac{p_2}{p_1}\right)^* \left[\frac{\sum_i \gamma_i c_i}{\sum_i \beta_i c_i}\frac{\sum_i \beta_i c_i + m(\beta_1 - \beta_2)}{\sum_i \gamma_i c_i + m(\gamma_1 - \gamma_2)}\right]^{\gamma_1 - \gamma_2},$$

where $(p_2/p_1)^*$ is the autarkic price of the less skill intensive good in terms of the skill intensive good. The offer curve of the South T, thus, must satisfy the balanced trade condition $(Y_1\text{-}C_1)/M = T(p_2/p_1)$, with imports M and terms of trade (p_2/p_1) being given by equation (II.9) and (II.10), respectively.

How does the Northern economy react in response to that shock? In the new equilibrium it must absorb the Southern excess supply of the less skill intensive good. These imports depress the production of sector 2 whereas exports of the skill intensive good increase sector 1 output. The fixed relative wage (w/q) implies that in each sector the number of employed unskilled workers per skilled worker, h_i, does not change. Consequently, the less skill intensive sector 2 lays off relatively more unskilled workers than the skill intensive sector 1 can profitably employ. The ensuing unemployment triggers a multiplier process. The reduced income lowers the demand for all three goods. This effect (which is caputered by the tem $\sum_i \beta_i c_i + m(\beta_1 - \beta_2)$ in equations (A.9) in the Appendix) dampens the increase of demand for unskilled labor in sector 1, further reduces employment of unskilled persons in sector 2, and even leads to lay offs in sector 3 (again, see equation (A.9)). The assumed flexibility of the wage-rental ratio (w/r) ensures that the market of capital services clears along with the market of skilled labor. Since relative product prices depend on the relative wage rate (w/q) and the wage-rental ratio (w/r) these prices adjust to the new cost structure (see equations (A.10) in the Appendix).

Formally, I derive the employment rate of unskilled workers, $\sum_i N_i/N$, in the Appendix from equations (II.1), the profit maximizing conditions (II.2), the

demand functions (II.5), the accounting identity (II.7) and the market clearing conditions for good 2 and 3, the capital and the skilled labor market, respectively:

$$\text{(II.11)} \quad \begin{aligned} C_2 &= m(p_1/p_2 Y_1 + Y_2 + p_3/p_2 Y_3) + Y_2, \\ C_3 &= Y_3, \\ K &= \textstyle\sum_i K_i, \\ H &= \textstyle\sum_i H_i. \end{aligned}$$

After some tedious algebra the following formula emerges:

$$\text{(II.12)} \quad b(m) := \frac{\sum_i N_i}{N} = \left(\frac{\sum_i \beta_i c_i}{\sum_i \alpha_i c_i}\right)\left(\frac{\sum_i \alpha_i c_i + m(\alpha_1 - \alpha_2)}{\sum_i \beta_i c_i + m(\beta_1 - \beta_2)}\right).$$

It determines the employment rate b of unskilled workes as a function of m. The share of good 2 in consumption, c_2, binds the marginal propensity to import, m, from above to ensure that the home country is still producing good 2. Thus, nominator and denominator of the second term in brackets are positive. b is a decreasing function of m, if the following condition holds:

$$\text{(II.13)} \quad (1 - c_3)(\alpha_1\beta_2 - \alpha_2\beta_1) + c_3(\alpha_1\beta_3 - \alpha_3\beta_1 + \alpha_3\beta_2 - \alpha_2\beta_3) < 0.$$

It is an assumption on the relative skill intensity of the three sectors. For instance, if the three sectors can be ranked according to

$$h_1(w/q) > h_3(w/q) > h_2(w/q) \Leftrightarrow \frac{\beta_1}{\alpha_1} > \frac{\beta_3}{\alpha_3} > \frac{\beta_2}{\alpha_2}$$

condition (II.13) is fullfilled.

The solid line in Figure II.1 is a plot of this function. I adapted the values of the parameters in equation (II.12) to German data. Since it proved rather difficult to combine data on employment, occupational qualification and sectoral consumption shares to obtain reliable estimates of the model's parameters, I picked values with an eye at the model's chances to explain a rather large increase in unemployment. The value of $c_3 = 0.45$ reflects the share of the German service sector (i.e. wholesale and retail trade, transportation, banking, insurance, and housing services) in private sector gross value added at the end of the nineteen eighties (cf. private sector gross value added at the end of the nineteen eighties (cf. Sachverständigenrat 1994, Table 26*). Lacking better data, I split the remaining 55 percent equally between c_1 and c_2.

The German statistical office (Statistisches Bundesamt) classifies blue collar workers according to three skill groups and splits white collar workers into five ones. White collar jobs in group V require no finished formal occupational training

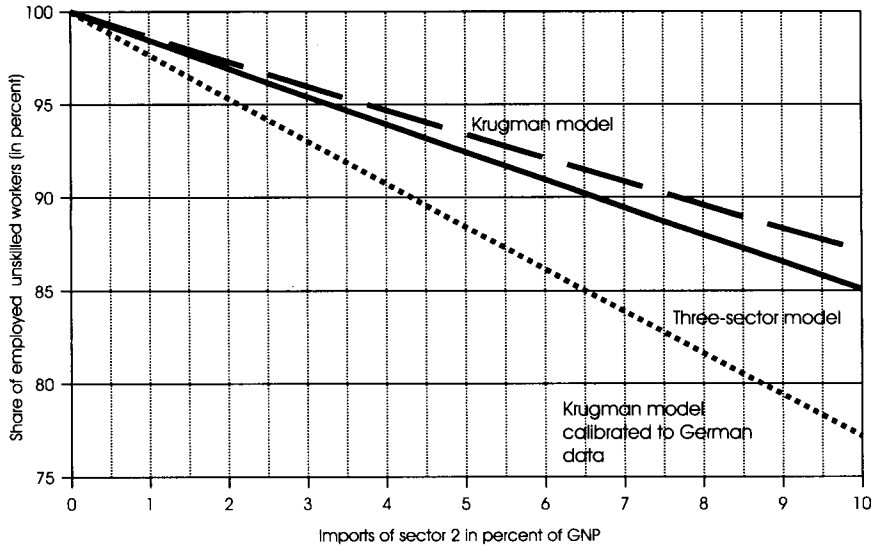

Figure II.1

(in terms of the German statistic "abgeschlossene Berufsausbildung"). That also holds true for blue collar jobs in groups II and III. Therefore, I consider workers in these groups as unskilled.[6] In April 1993 their share in the total number of West German employees covered by the wage statistic is 23.4 percent.[7] This number is in accordance with a figure derived from another source. According to the employment survey of the Statistisches Bundesamt and Deutsche Bundesbank (1996) about 22.9 percent of the West German workforce of 1993 were without a finished formal occupational training. According to the wage statistic of April 1993, the skilled to unskilled ratio in the manufacturing sector ranges from about 17 (electricity) to 0.6 (rubber and mining). The respective wage shares in gross

[6] The data on wages and employment are from Statistisches Bundesamt (1994a) Table 2, pp. 12–85 and Table 3, pp. 86–159, Statistisches Bundesamt (1994b), Table 2, pp. 12–33 and Table 5, pp. 78–99, Statistisches Bundesamt (1994c), Table 3.4, p. 163. Wages were corrected upwards by the average share of employers' contributions to social security in gross wage and salary income. These figures were taken from Sachverständigenrat (1996), p. 360 and p. 366. Data on gross value added are from Statistisches Bundesamt (1996), pp. 145, 146, and 148.

[7] The wage statistic provides no data on unskilled blue collar workers in the sectors wholesale and retail trade, insurance and banking. The overall share of unskilled workers is an estimate that assumes equal shares of unskilled blue and white collar workers in these sectors. The share of unskilled workers in the manufacturing sector is 31 percent. This figure is an upper bound of the estimate, since the share of unskilled white collar workers in the manufacturing sector is considerably larger than that in the service sectors for which data are available.

value added are 0.39 (skilled) and 0.02 (unskilled) in the former and 0.28 and 0.06, respectively, in the latter sector. Obviously, both sectors are highly capital intensive. In less capital intensive, yet also skill intensive sectors, like the production of office equipment, the wage share of skilled (unskilled) workers is about 0.87 (0.02). In the less skill intensive foundry industry skilled (unskilled) workers earn about 56 (32) percent of value added. The wage statistic provides no data on wage income in the service sector. Therefore, I used the commonly employed, economy-wide estimates $\alpha = \beta = \gamma = 1/3$ (cf. Mankiw, Romer, and Weil, 1992, p. 432). Together, I chose the following, slightly rounded figures: $\alpha_1 = 0.05$, $\beta_1 = 0.75$, $\alpha_2 = 0.30$, $\beta_2 = 0.55$, $\alpha_3 = \beta_3 = 0.33$, which meet condition (II.13).

German imports from non industrialized countries amount to about 5 percent of GNP[8]. This value of m implies that about 7 percent of the unskilled workforce is laid off. If unskilled labor is a less important factor of production in the service sector, i.e. if $\alpha_3 = 0.25$ and $\beta_3 = 0.50$, the share of unemployed unskilled persons increases to 7.5 percent. This example illustrates that the results are not too sensitive to the chosen values of the model's parameters. The dashed line in Figure II.1 gives the share of employed unskilled workers emerging from the Krugman (1995) two-factors-two-goods model. Since his estimates of $\alpha_1 = \beta_2 = 1/3$ and $\alpha_2 = \beta_1 = 2/3$ are less extreme, his model predicts at $m = 0.05$ that about 93.4 percent of the unskilled workforce remain employed. Using my values of the factor shares but leaving Krugman's value of $c_1 = 5/7$ unchanged, his model predicts a much larger fall in employment of roughly 11.5 percent. This big difference demonstrates the importance of non-tradeable goods. Their omission in the Krugman model accounts for the wedge between the solid and the dotted line in Figure II.1.

Under the less extreme conditions of the three sector model the international trade argument explains only a small part of the German employment problem. Between 1977 and 1995 the number of West German employees without finished formal occupational training decreased by 27.7 percent.[9] The seven percent predicted by the three sector model are only one quarter of this number. In 1977 about one third of the West German work force were unskilled. Thus, about 2.3 percentage points of the West German overall unemployment rate of currently more than 9 percent may be due to trade with less developed countries. What, then, may explain the huge increase in German unemployment? The model presented in the next section hints at another answer to that question.

[8] This figure is based on data from Statistisches Bundesamt (1994d), Table 12.11.1.

[9] These data were taken from Statistisches Bundesamt and Deutsche Bundesbank (1996); the share of unskilled workers is defined as sum of the number of employees given in series #2198108 and #2198216 in percent of all employees (listed in series #2198036).

3. *Wage gaps and capital accumulation*

I shall tackle the long run consequences of rigid wages within a framework that has proven quite successful in explaining cross country differences in per capita income, namely the Mankiw, Romer, and Weil (1992) extension of the Solow (1956) growth model.

There are three factors of production, effective labor, AN, human capital, H, and physical capital, K. They produce output, Y, according to a constant returns to scale Cobb-Douglas technology:

$$\text{(III.1)} \quad Y = (AN)^{\alpha} H^{\beta} K^{\gamma}, \quad \alpha + \beta + \gamma = 1.$$

The level of labor augmenting technical progress, A, increases exogenously at rate a. Labor supply, N, grows at rate n. Households supply factor services independent of wages and rental rates. They invest the fraction s_H of their gross income in human capital, which depreciates at rate δ_H. Similarly, s_K is the fraction of gross income Y invested in physical capital depreciating at rate δ_K. This economy evolves according to

$$\text{(III.2)} \quad \dot{k} = s_K h^{\beta} k^{\gamma} - (a + n + \delta_K)\, k, \quad k := \frac{K}{AN},$$

$$\dot{h} = s_H h^{\beta} k^{\gamma} - (a + n + \delta_H)\, h, \quad h := \frac{H}{AN},$$

where k and h denote physical and human capital per effective worker, respectively. It is straightforward to show that the economy approaches a balanced growth path were k and h are fixed at

$$\text{(III.3)} \quad k^* = \left(\frac{s_K}{a + n + \delta_K}\right)^{\frac{1-\beta}{\alpha}} \left(\frac{s_H}{a + n + \delta_H}\right)^{\frac{\beta}{\alpha}},$$

$$h^* = \left(\frac{s_K}{a + n + \delta_K}\right)^{\frac{\gamma}{\alpha}} \left(\frac{s_H}{a + n + \delta_H}\right)^{\frac{1-\gamma}{\alpha}},$$

respectively (cf. Maußner and Klump, 1996, p. 69). The labor market continuously clears, since the marginal product of labor equals the real wage rate w. At the steady state this requires

$$\text{(III.4)} \quad w^* = A\alpha (h^*)^{\beta} (k^*)^{\gamma}.$$

To illustrate the working of this model with an exogenously given real wage rate, consider the following experiment. Assume the wage were set according to

$$\text{(III.5)} \quad \tilde{w} := (1 + x)(w^*/A),$$

where $x \times 100$ measures the size of the wage gap in percent of the steady state market clearing rate. Thus, the wage increases still at the same rate, yet a higher level. As an immediate consequence, firms dismiss workers and output shrinks relative to its equilibrium path. Households accumulate less capital than they otherwise would have done. Therefore, assuming that $\tilde{w}$ is unchanged, the gap between the marginal product of labor and the real wage widens in the next period, and unemployment increases further. If $\tilde{w}$ is fixed for a long period of time, the economy settles at a new steady state where capital per effective employee is constant. Given the exogenous growth of the work force, the rate of employment, $b := L/N$, decreases at a constant rate. I prove this proposition in the Appendix. In the special case of identical rates of depreciation, $\delta = \delta_K = \delta_H$, there is a simple analytical solution:

$$\text{(III.6)} \quad \frac{\dot{b}}{b} = (a + n + \delta)[(1 + x)^{-\frac{\alpha}{1-\alpha}} - 1].$$

Thus, if the wage gap were to persist indefinitely, unemployment would increase steadily. To get a feeling for the involved magnitudes consider the following: Between 1960 and 1990 West German output per worker grew at an average exponential rate of $a = 0.028$, and the West German work force increased at rate $n = 0.004$. The average ratio between capital consumption and the net capital stock in the same period is $\delta = 0.046$.[10] $\alpha = 1/3$ is an estimate of the wage share in growth models with human capital emerging from the cross country study of Mankiw, Romer, and Weil (1992) p. 432. Given these numbers, each percentage point of the wage rate $\tilde{w}$ above its steady state level decreases the growth rate of employment by approximately 0.04 percentage points. Within ten years, then, the rate of employment decreases by 0.4 percentage points.

I illustrate this dynamic effect in Figure III.1 using the values of a, n, and δ from above.[11] Starting at time $t = 10$ the real wage leaves its balanced growth path. Within five years it climbs to a level that is five percent above the steady state path. The wage stays there for a period of 25 years and returns to its former value within the next five years. After five more years the wage adjusts to the market clearing level. The dotted line in Figure III.1 displays the wage path. The solid line marks the according time path of unemployment, $u := 1 - b$. The rising wage pushes unemployment to 7.5 percent of the work force. Then, the dynamic effect sets in and raises u to 11.5 percent. When the wage returns to its former path, it cannot compensate this additional unemployment. Due to a shortage of both physical and human capital, the marginal product of labor is smaller than that along the undisturbed growth path. Thus, while from now on labor supply

[10] The data underlying these figures were taken from Statistisches Bundesamt (1994e), Table 3.6.4 and Sachverständigenrat (1994), pp. 339, 351, and 355.

[11] A close inspection of the equations of motion reveals that the time path of b is independent of the savings rates if $\delta_K = \delta_H$.

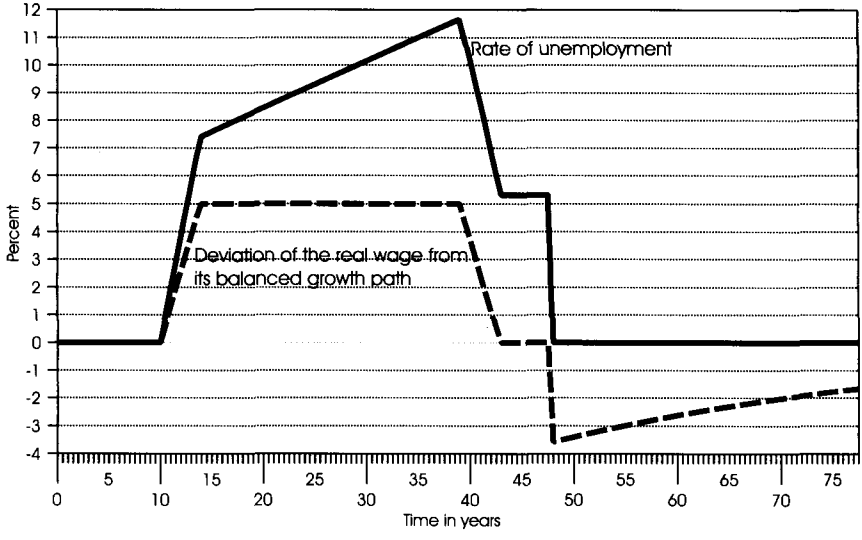

Figure III.1

and demand increase at the same rate, unemployment remains above five percent. Wages must drop substantially below their long run growth path to recover full employment. They return to that path only gradually during an extended period of time.

I do not suppose that wage gaps arise endogenously. Yet, as in the Section 2, there are shocks that require wages to deviate temporarily from the balanced growth path. The German unification is a very prominent example. To consider it within the present model assume that the West German economy was on its balanced growth path before 1990, and that the West German production technology became immediately available to the East German economy. It is generally acknowledged that East German workers are well trained. Thus, we may neglect noticeable differences in embodied human capital between the West and East German workforce. The partical restructuring of East German universities and the foundation of research institutes, on the other hand, hint at differences in non-embodied human capital. Nevertheless, let me suppose that human capital per effective worker was the same in both parts of Germany. There was, however, a sizeable difference in physical capital. In the western part the real value of physical capital per member of the work force totaled at 198 thousand Deutschmark[12]. An estimate for the eastern part is 63.5 thousand (1989) Deutschmark.[13]

[12] Cf. Statistisches Bundesamt (1994e), Table 3.64, Sachverständigenrat (1994), Table 21*, p. 339.

[13] I took the capital stock figure from Sinn (1992), p. 88, who calculates the wage decrease within a static framework, and the number of the East German workforce from Institut der Deutschen Wirtschaft (1997), Table 13.

The much smaller East German capital stock amounts to a higher real interest rate in East Germany shortly after the fall of the Berlin wall. The interest rate differential triggered capital flows to the eastern part. In the frictionless environment of the model these flows equalize the stock of physical capital per worker in both parts of Germany. Given the much smaller size of the East German work force, West German capital per worker must fall by 15.6 percent. If physical capital's elasticity of production is $\gamma = 1/3$, West German wages had to decrease by 5.2 percent to maintain full employment.[14]

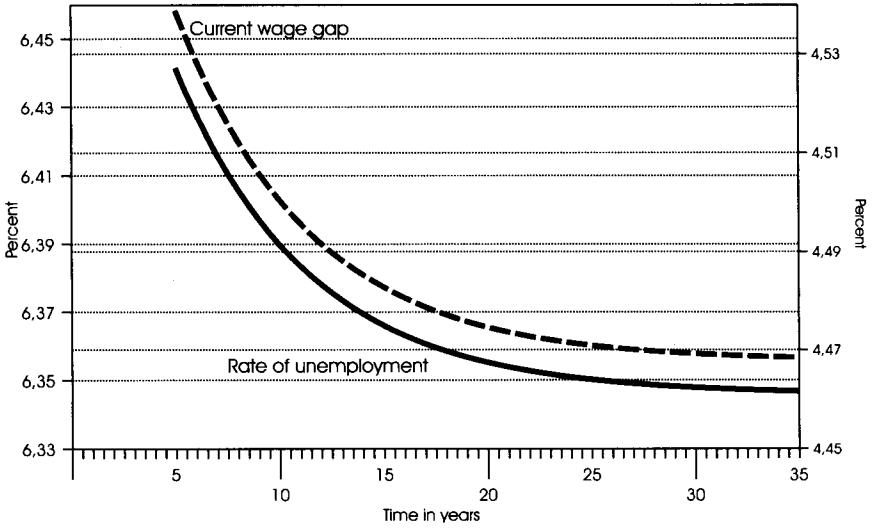

Figure III.2

Figure III.2 displays the time path of the rate of unemployment predicted by the model, if the wage rate does not adjust to the capital loss occurring at time $t = 5$. There is an upsurge in unemployment due to the sudden gap opening between labor productivity and the real wage. Almost 6.5 percent of the work force are immediately laid off.[15] Afterwards, capital per effective worker slowly

[14] Full employment requires the real wage rate w to equal the marginal product of labor. This condition reads:

$$w = aA(h^{\beta}k^{\gamma}).$$

It implies that the elasticity of w with respect to k is γ.

[15] The elasticity of labor demand L with respect to physical capital K in the face of rigid wages is $\gamma/(1-\alpha)$. To get this result write the labor market clearing condition as $w/A = \alpha(AL)^{\alpha-1}H^{\beta}K^{\gamma}$ and differentiate with respect to L and K holding w and A fixed.

approaches its unchanged steady state value. Thereby labor productivity increases relative to the real wage. The wedge between the current wage, $w = A\tilde{w}$, and the wage securing immediate full employment, $w_f := A\alpha(AN)^{\alpha-1}H^{\beta}K^{\gamma}$, shrinks. The dotted line in Figure III.2 refers to the time path of this wedge, labeled current wage gap and measured on the right scale. Capital accumulation, however, has little effect on the rate of unemployment, which does not fall below six percent.

A shock with similar consequences is the rapid increase of the West German labor force. Between 1960 and 1977 there was an almost negligible upward sloping trend of potential labor supply. Yet, the period between 1977 and 1990 witnessed a fivefold increase of the average exponential growth rate of the labor force from 0.153 to 0.794 percent. During that period over 3.3 million additional people entered the labor market.[16] Wages had to depart from their former growth path to induce an according growth of jobs. Consider, then, what happens, if wages do not adjust. To apply equation (III.6), we need to know the size of the hypothetical wage gap. I assume that except n none of the model's parameters changed between the two periods. In addition to $\alpha = 1/3$, a $= 0.028$ and $\delta = 0.046$ the savings rates must be chosen. The average share of gross investment in West German GNP between 1960 and 1990 is 23.46 percent. The sum of private R&D expenditures and public expenditures on science promotion, education and schooling is between 8.2 and 8.4 percent of GNP in the first half of the nineties.[17] I used the slightly rounded values $s_K = 0.235$ and $s_H = 0.085$. Given these numbers, equation (III.3) to (III.5) imply a wage gap of more than 17.5 percent. Figure III.3 illustrates the time path of unemployment. The shock occurs at year $t = 5$. The labor force grows at the new rate for 14 years. Then, n drops to its former value. Governed by equation (III.6) unemployment steadily grows to over 8.5 percent and remains at that level after year $t = 19$. The dotted line in Figure III.3 marks the current wage gap as defined in the previous paragraph.

There is an important qualification of these considerations. Capital imports from abroad mitigate the impact of sudden capital losses on unemployment. Consider, e.g., the framework of Barro, Mankiw, and Sala-i-Martin (1995). There, the small home economy can borrow unconstrained amounts of physical capital on the world market. Immediate capital imports compensate a sudden loss of home capital that disturbs a balanced growth path. Thus, there is no need for wage adjustments. However, the increased foreign debt lowers future consumption. Thus, agents trade current wage reductions against smaller rates of consumption in the future.

---

[16] Lestimated the growth rates of the labor force from the data supplied in Sachverständigenrat (1994), Table 21*.

[17] I took the data on private R&D expenditures and public expenditures on science promotion and education from various issues of Institut der Deutschen Wirtschaft, Zahlen zur wirtschaftlichen Entwicklung der Bundesrepublik Deutschland. Interestingly, 8.4 percent is the estimated ratio of the West German workforce enrolled in secondary school employed in the paper of Mankiw, Romer, and Weil (1992) as proxy of s_H.

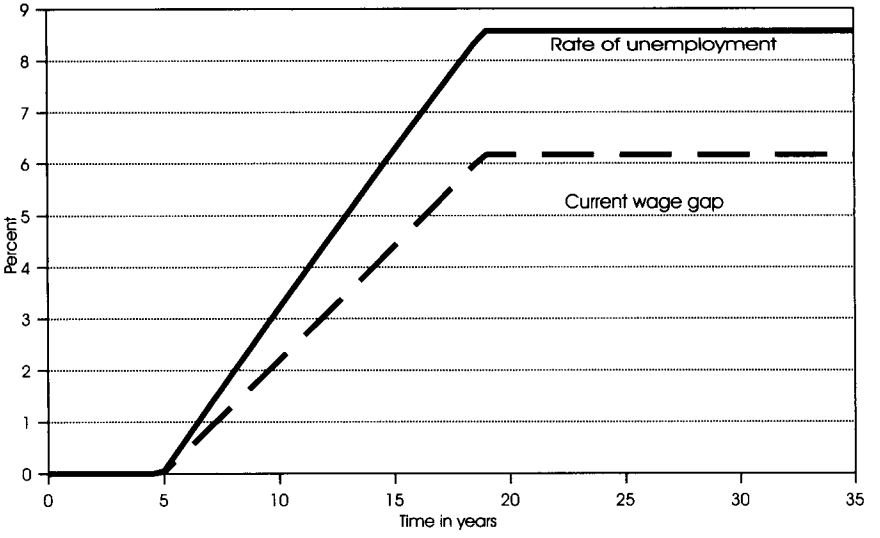

Figure III.3

Under less extreme assumptions on capital imports exogenous shocks together with wage rigidities in the long run may well explain unemployment of the size actually observed in the recent German economic history.

4. Conclusion

Economists tend to blame non market clearing wages for unemployment. I argue that it is impossible to assess the empirical content of this statement by comparing observed wages to various measures of full employment wage rates. The notion of market clearing wages is specific to the applied model. And since it is impossible to identify the true structure of the economy it is also impossible to estimate the size of wage gaps.

I propose an alternative approach that is well known from recent business cycle research. The method is to confront the results of computable models with the facts of the labor market.

I consider two types of models. A static model of international trade where the wage structure is kept at its autarkic, full employment level explains about one quarter of current West German unemployment. Quantitatively more important are the consequences of prolonged wage gaps. In a standard growth model with fixed real wages the capital shortage that occurred in the wake of the German unification implies unemployment over six percent of the work force. Similarly, non adjustment of wages to the rapid growth of the labor force between 1977 and 1990 accounts for unemployment rates up to 8.5 percent.

I used simple textbook models far apart from the complexity of huge econometric models often employed in this context. Yet, it is this simplicity that helps to understand and to assess the empirical relevance of various mechanisms by which non market clearing wages may induce unemployment.

Zusammenfassung

Die deutsche Arbeitslosigkeit wird gemeinhin auf überhöhte Reallöhne zurückgeführt. Ich vergleiche die quantitativen Implikationen dieser Hypothese im Rahmen eines Modells mit Nord-Süd-Handel mit denen im Rahmen eines Wachstumsmodells. Das erstgenannte Modell vermag 2,3 Prozentpunkte der westdeutschen Arbeitslosenquote zu erklären. Wesentlich bedeutsamer sind die langfristigen Folgen überhöhter Reallöhne im Rahmen des Wachstumsmodells. Die Kapitalverknappung im Zuge der deutschen Wiedervereinigung und der rasche Anstieg der Erwerbspersonen zwischen 1977 und 1990 könnten die Arbeitslosigkeit kräftig erhöht haben.

Appendix

In this Appendix I derive the key equations of the trade model of Section 2 and the growth model of Section 3.

The Trade Model: In next few steps I derive the solution of the trade model given the marginal propensity to import, $m \geq 0$. $m = 0$ corresponds to the autarkic solution.

The market clearing condition for good 2 reads:

$$C_2 = M + Y_2 = m((p_1/p_2)\,Y_1 + Y_2 + (p_3/p_2)\,Y_3) + Y_2.$$

The budget identity (II.7) and the demand functions (II.5) imply:

$$C_2 = c_2((p_1/p_2)\,Y_1 + Y_2 + (p_3/p_2)\,Y_3).$$

Eliminate C_2 from these two equations to get:

$$\text{(A.1)} \quad Y_1(c_2 - m) = (p_2/p_1)(1 + m - c_2)\,Y_2 + (p_3/p_1)(m - c_2)\,Y_3.$$

Since $Y_i = H_i h_i^{\beta_i - 1} k_i^{\gamma_i}$ (from the production functions (II.1)) and

$$\text{(A.2)} \quad p_2/p_1 = (\beta_1/\beta_2) h_1^{\beta_1 - 1} k_1^{\gamma_1} h_2^{1-\beta_2} k_2^{-\gamma_2},$$
$$p_3/p_1 = (\beta_1/\beta_3) h_1^{\beta_1 - 1} k_1^{\gamma_1} h_3^{1-\beta_3} k_3^{-\gamma_3},$$

(from the second row of equations (II.2)) equation (A.1) implies:

$$(A.3)\quad H_1 = \frac{\beta_1(1+m-c_2)}{\beta_2(c_2-m)} H_2 - \frac{\beta_1}{\beta_3} H_3.$$

Apply the same procedure to the market clearing condition for good 3,

$$C_3 = c_3\left(\frac{p_1}{p_3} Y_1 + \frac{p_2}{p_3} Y_3 + Y_3\right) = Y_3,$$

$$\Rightarrow (1-c_3)\frac{p_3}{p_1} Y_3 = c_3 Y_1 + c_3 \frac{p_2}{p_1} Y_2$$

to get:

$$(A.4)\quad H_3 = \frac{\beta_3 c_3}{\beta_1(1-c_3)} H_1 + \frac{\beta_3 c_3}{\beta_2(1-c_3)} H_2.$$

Equation (A.3), (A.4) and the market clearing condition, $H = \sum_i H_i$, determine the allocation of skilled labor:

$$(A.5)\quad H_1 = \frac{\beta_1(m+c_1)}{\sum_i \beta_i c_i + m(\beta_1 - \beta_2)} H,$$

$$H_2 = \frac{\beta_2(c_2-m)}{\sum_i \beta_i c_i + m(\beta_1 - \beta_2)} H,$$

$$H_3 = \frac{\beta_3 c_3}{\sum_i \beta_i c_i + m(\beta_1 - \beta_2)} H.$$

Since

$$\frac{h_i}{h_j}\frac{k_j}{k_i} = \frac{\beta_i}{\beta_j}\frac{\gamma_j}{\gamma_i} \text{ for } i,j = 1,2,3$$

(from (II.2)) the solution of

$$\frac{H_1}{H_2} = \frac{\beta_1}{\beta_2}\frac{\gamma_2}{\gamma_1}\frac{K_1}{K_2},$$

$$\frac{H_1}{H_3} = \frac{\beta_1}{\beta_3}\frac{\gamma_3}{\gamma_1}\frac{K_1}{K_3},$$

$$K = K_1 + K_2 + K_3$$

provides the allocation of capital:

$$\text{(A.6)}\quad K_1 = \frac{\gamma_1(c_1+m)}{\sum_i \gamma_i c_i + m(\gamma_1-\gamma_2)} K,$$

$$K_2 = \frac{\gamma_2(c_2-m)}{\sum_i \gamma_i c_i + m(\gamma_1-\gamma_2)} K,$$

$$K_3 = \frac{\gamma_3 c_3}{\sum_i \gamma_i c_i + m(\gamma_1-\gamma_2)} K.$$

Analogously, under autarky ($m = 0$) the solution to

$$\text{(A.7)}\quad \frac{H_1}{H_2} = \frac{\beta_1}{\beta_2}\frac{\alpha_2}{\alpha_1}\frac{N_1}{N_2},$$

$$\frac{H_1}{H_3} = \frac{\beta_1}{\beta_3}\frac{\alpha_3}{\alpha_1}\frac{K_1}{N_3},$$

$$N = N_1 + N_2 + N_3$$

provides the distribution of unskilled labor between the sectors:

$$\text{(A.8)}\quad N_i = \frac{\alpha_i c_i}{\sum_i \alpha_i c_i} N, \quad i = 1, 2, 3.$$

The autarkic relative wage, equation (II.11), follows from $(w/q)^* = (\alpha_1/\beta_1)(H_1/N_1)$, (A.8), and (A.5).

The system of equations (A.7) is replaced by $H_i = (\beta_i/\alpha_i)(w/q)^* N_i$ in the case of north-south trade under fixed relative wages. Using these relations together with equations (A.5) and the solution for $(w/q)^*$ from equation (II.8) one can derive the allocation of unskilled labor:

$$\text{(A.9)}\quad N_1 = \left[\frac{\sum_i \beta_i c_i}{\sum_i \alpha_i c_i}\right]\left[\frac{\alpha_1(m+c_1)}{\sum_i \beta_i c_i + m(\beta_1-\beta_2)}\right] N,$$

$$N_2 = \left[\frac{\sum_i \beta_i c_i}{\sum_i \alpha_i c_i}\right]\left[\frac{\alpha_2(c_2-m)}{\sum_i \beta_i c_i + m(\beta_1-\beta_2)}\right] N,$$

$$N_3 = \left[\frac{\sum_i \beta_i c_i}{\sum_i \alpha_i c_i}\right]\left[\frac{\alpha_3 c_3}{\sum_i \beta_i c_i + m(\beta_1-\beta_2)}\right] N.$$

These equations, in turn, imply equation (II.12) in Section II. From

$$\frac{p_2}{p_1} = \frac{\alpha_1}{\alpha_2} \frac{h_1^{\beta_1} k_1^{\gamma_1}}{h_2^{\beta_2} k_2^{\gamma_2}},$$

$$\frac{p_3}{p_1} = \frac{\alpha_1}{\alpha_3} \frac{h_1^{\beta_1} k_1^{\gamma_1}}{h_3^{\beta_3} k_3^{\gamma_3}},$$

and (A.5) through (A.9) the impact of imports upon relative prices can be determined (where an asterix marks relative prices under autarky):

$$\text{(A.10)} \quad \frac{p_2}{p_1} = \left(\frac{p_2}{p_1}\right)^* \Delta(m)^{\gamma_1 - \gamma_2},$$

$$\frac{p_3}{p_1} = \left(\frac{p_3}{p_1}\right)^* \Delta(m)^{\gamma_1 - \gamma_3},$$

$$\Delta(m) := \frac{\sum_i \gamma_i c_i \sum_i \beta_i c_i + m(\beta_1 - \beta_2)}{\sum_i \beta_i c_i \sum_i \gamma_i c_i + m(\gamma_1 - \gamma_2)}.$$

Finally, using the skill intensive good als numeraire, $p_1 \equiv 1$, and defining the price index

$$p := \left(\frac{p_2}{p_1}\right)^{c_2} \left(\frac{p_3}{p_1}\right)^{c_3}$$

the purchasing power of unskilled labor income, relative to autarky, is given by

$$\text{(A.11)} \quad \frac{w/p}{(w/p)^*} = \Delta(m)^{\sum_i \gamma_i c_i}.$$

Hence, the real wage of unskilled labores decreases with m, iff workers $\Delta'(m) < 0$. Using $\alpha_i + \beta_i + \gamma_i = 1$ this requires

$$\text{(A.12)} \quad \beta_1 - \beta_2 + (1 - c_3)(\alpha_1\beta_2 - \alpha_2\beta_1) + c_3(\alpha_1\beta_3 - \alpha_3\beta_1 + \alpha_3\beta_2 - \alpha_2\beta_3) < 0,$$

which is slightly stronger than condition (II.13).

The Growth Model: Let L denote the number of employed workers and consider the production function

$$Y = (AL)^\alpha H^\beta K^\gamma, \quad \alpha + \beta + \gamma = 1.$$

Profit maximization with respect to labor input requires

$$\text{(A.13)}\quad \tilde{w} = (w/A) = \alpha(AL)^{\alpha-1}H^{\beta}K^{\gamma},$$

where w is the real wage and $\tilde{w}$ the real wage per efficiency unit of labor. Thus, holding $\tilde{w}$ fixed, labor demand L must grow at rate

$$\text{(A.14)}\quad l := \frac{\dot{L}}{L} = \frac{\beta}{1-\alpha}\frac{\dot{H}}{H} + \frac{\gamma}{1-\alpha}\frac{\dot{K}}{K} - a,$$

and capital accumulates according to

$$\text{(A.15)}\quad \frac{\dot{K}}{K} = s_K(AL)^{\alpha}H^{\beta}K^{\gamma-1} - \delta_K,$$

$$\frac{\dot{H}}{H} = s_H(AL)^{\alpha}H^{\beta-1}K^{\gamma} - \delta_H.$$

Eliminating the growth rates of physical and human capital along with (AL) from equation (A.14) gives l as a function of $z := K/H$:

$$\text{(A.16)}\quad l = \frac{1}{1-\alpha}\left(\frac{\alpha}{\tilde{w}}\right)^{\frac{\alpha}{1-\alpha}}\left[\beta s_H z^{\frac{\gamma}{1-\alpha}} + \gamma s_K z^{-\frac{\beta}{1-\alpha}}\right] - \frac{\beta\delta_H + \gamma\delta_K}{1-\alpha} - a.$$

Now, define k and h as physical and human capital per effective, employed unit of labor, $k := K/AL$ and $h := H/AL$, respectively. Differentiate these definitions with respect to time and substitute from equations (A.15) and (A.14). This yields

$$\text{(A.17)}\quad \frac{\dot{k}}{k} = \frac{\beta}{1-\alpha}\left(\frac{\alpha}{\tilde{w}}\right)^{\frac{\alpha}{1-\alpha}}\left[s_K h^{\frac{\beta}{1-\alpha}}k^{-\frac{\beta}{1-\alpha}} - s_H h^{-\frac{\gamma}{1-\alpha}}k^{\frac{\gamma}{1-\alpha}}\right] + \frac{\beta(\delta_H - \delta_K)}{1-\alpha},$$

$$\frac{\dot{h}}{h} = \frac{\gamma}{1-\alpha}\left(\frac{\alpha}{\tilde{w}}\right)^{\frac{\alpha}{1-\alpha}}\left[s_H h^{-\frac{\gamma}{1-\alpha}}k^{\frac{\gamma}{1-\alpha}} - s_K h^{\frac{\beta}{1-\alpha}}k^{-\frac{\beta}{1-\alpha}}\right] + \frac{\gamma(\delta_K - \delta_H)}{1-\alpha}.$$

Since

$$\frac{\dot{z}}{z} = \frac{\dot{k}}{k} - \frac{\dot{h}}{h},$$

the evolution of z is governed by

$$\text{(A.18)}\quad \frac{\dot{z}}{z} = \left(\frac{\alpha}{\tilde{w}}\right)^{\frac{\alpha}{1-\alpha}}\left[s_K z^{-\frac{\beta}{1-\alpha}} - s_H z^{\frac{\gamma}{1-\alpha}}\right] + \delta_H - \delta_K.$$

The steady state value of z, z^*, solves

$$(A.19)\quad s_K(z^*)^{-\frac{\beta}{1-\alpha}} - s_H(z^*)^{\frac{\gamma}{1-\alpha}} = \left(\frac{\tilde{w}}{\alpha}\right)^{\frac{\alpha}{1-\alpha}}(\delta_K - \delta_H).$$

The left hand side of this equation is a monotonically decreasing function of $z^* \in (0, \infty)$ with range $(-\infty, +\infty)$. Thus, given any $\tilde{w} > 0$, there exits a unique $z^*(\tilde{w})$ solving equation (A.19). Figure A.1 illustrates this result. In the special case

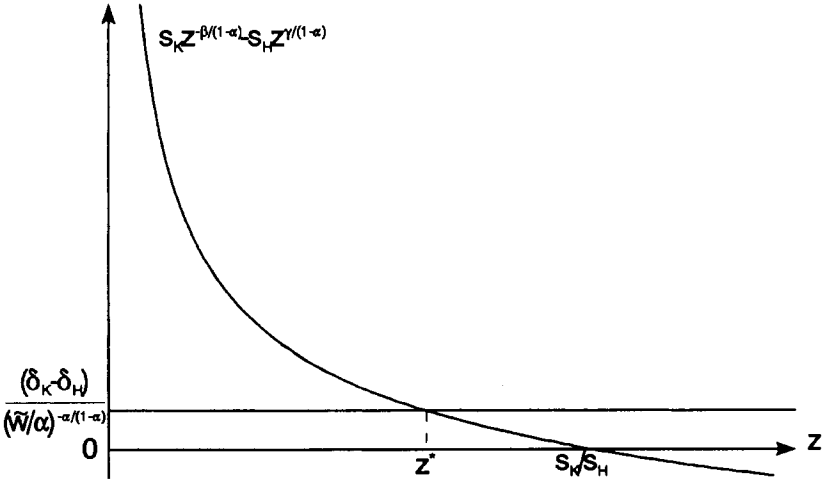

Figure A.1

of equal rates of depreciation, $\delta = \delta_K = \delta_H$, this solution is given by

$$(A.20)\quad z^* = \frac{s_K}{s_H}.$$

It is also obvious from Figure A.1 that $\dot{z} > 0$ (< 0) to the left (right) of z^*. Hence, the rest point is globally stable in $(0, \infty)$. z and l approach stationary values that are uniquely determined by the size of the wage gap x. If both types of capital depreciate at the same rate δ, equation (A.20) and (A.16) imply that the rate of employment $b := L/N$ grows at rate

$$(A.21)\quad \frac{\dot{b}}{b} = l(x) - n = (a + n + \delta)[(1 + x)^{-\frac{\alpha}{1-\alpha}} - 1],$$

which is equation (III.6) given in Section 3.

References

Barro, Robert J., Mankiw, M. Gregory and Sala-i-Martin, Xavier (1995), Capital Mobility in Neoclassical Models of Growth, American Economic Review, Vol. 85, 103–115.

Bean, Charles R. (1994), European Unemployment: A Survey, Journal of Economic Literature, Vol. 32, 573–619.

Benassy, Jean-Pascal (1982), The Economic of Market Disequilibrium, Academic Press: New York.

Benassy, Jean-Pascal (1986), Macroeconomics: An Introduction to the Non-Walrasian Approach, Academic Press: New York.

Berthold, Norbert and Fehn, Rainer (1986), The Positive Economics of Unemployment and Labor Market Inflexibility, Kyklos, Vol. 49, 1996.

Bruno, Michael and Sachs, Jeffrey D. (1985), Economics of Worldwide Stagflation, Havard University Press: Cambridge, MA.

Burtless, Gary (1995), International Trade and the Rise in Earnings Inequality, Journal of Economic Literature, Vol. 33, 800–816.

Hamilton, James D., Monteagudo, Josefina (1998), The Augmented Solow Model and the Productivity Slowdown, Journal of Monetary Economics, 42, 495–509.

Institut der deutschen Wirtschaft Köln (1997), Zahlen zur wirtschaftlichen Entwicklung der Bundesrepublik Deutschland, Deutscher Instituts-Verlag: Köln.

Krugman, Paul R. (1995), Growing World Trade: Causes and Consequences, Brookings Papers on Economic Activity, 1, 327–377.

Layard, Richard, Nickell, Stephen, Jackman, Richard (1991), Unemployment, Macroeconomic Performance and the Labour Market, Oxford University Press: Oxford.

Ljungqvist, Lars and Sargent, Thomas J. (1995), Welfares States and Unemployment, Economic Theory, Vol. 6, 143–160.

Ljungqvist, Lars and Sargent, Thomas J. (1996), A Supply-Side Explanation of European Unemployment, Federal Reserve Bank of Chicago Economic Perspectives, Vol. 20, Issue 5, Sept.–Oct. 2–15.

Malinvaud, Edmond (1982), Wages and Unemployment, Economic Journal, Vol. 92, 1–12.

Malinvaud, Edmond (1983), Notes on Growth Theory with Imperfectly Flexible Prices, in: Jean-Paul Fitoussi (Ed.), Modern Macroeconomic Theory, Basil Blackwell: Oxford, 93–114.

Mankiw, N. Gregory, Romer, David and Weil, David N. (1992), A Contribution to the Empirics of Economic Growth, Quarterly Journal of Economics, Vol. 57, 407–437.

Maußner, Alfred and Klump, Rainer (1996), Wachstumstheorie, Springer: Berlin.

Nickell, Stephen (1997), Unemployment and Labor Market Rigidities: Europe versus North America, Journal of Economic Perspectives, Vol. 11/3, 55–74.

Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (1994), Den Aufschwung sichern – Arbeitsplätze schaffen, Jahresgutachten 1994/95, Metzler-Poeschel: Stuttgart.

Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (1996), Reformen voranbringen, Jahresgutachten 1996/97, Metzler-Poeschel: Stuttgart.

Siebert, Horst (1997), Labor Market Rigidities: At the Root of Unemployment in Europe, Journal of Economic Perspectives, Vol. 11/3, 37–54.

Sinn, Hans-Werner (1992), Macroeconomic Aspects of German Unification, in: Paul J.J. Welfens (Ed.), Economic Aspects of German Unification, Springer: Berlin, 79–133.

Solow, Robert M. (1956), A Contribution to the Theory of Economic Growth, Quarterly Journal of Economics, Vol. 70, 1956, 65–94.

Statistisches Bundesamt (1994a), Fachserie 16: Löhne und Gehälter, Reihe 2.2: Angestelltenverdienste in Industrie und Handel, April 1993, Wiesbaden.

Statistisches Bundesamt (1994b), Fachserie 16: Löhne und Gehälter, Reihe 2.1: Arbeiterverdienste in der Industrie, April 1993, Wiesbaden.

Statistisches Bundesamt (1994c), Fachserie 1: Bevölkerung und Erwerbstätigkeit, Reihe 4.1.1: Stand und Entwicklung der Erwerbstätigkeit, 1993, Wiesbaden.
Statistisches Bundesamt (1994d), Statistisches Jahrbuch für die Bundesrepublik Deutschland 1994, Wiesbaden.
Statistisches Bundesamt (1994e), Fachserie 18: Volkswirtschaftliche Gesamtrechnungen, Reihe 1.3: Konten und Standardtabellen, Hauptbericht 1993, Wiesbaden.
Statistisches Bundesamt (1996), Fachserie 18: Volkswirtschaftliche Gesamtrechnungen, Reihe 1.3: Konten und Standardtabellen, Hauptbericht 1995, Wiesbaden.
Statistisches Bundesamt and Deutsche Bundesbank (1996), Statis-Bund database.

Prof. Dr. Alfred Maußner, Otto-Friedrich-Universität, Lehrstuhl für Volkswirtschaftslehre, insbes. Wirtschaftspolitik, 96045 Bamberg