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TRADE UNIONS, WAGES AND STRUCTURAL ADJUSTMENT IN THE NEW GERMAN STATES

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Abstract

The rapid wage increases observed in Eastern Germany over the past two years have important implications for the direction taken by structural change in this region. These implications are not solely negative, and remain controversial in the public debate. This paper discusses four aspects of a "high wage policy" on the economic transformation in the East and evaluates the economic assumptions necessary to generate them.

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1. Introduction

The celebrated absence of one-handed economists has been apparent in the economic debate surrounding German unification. Considerable disagreement has characterized the discussion of the effects of high wages in the five new German states. Many institutions (including the Bundesbank, the Sachverständigenrat (Council of Economic Advisors) and the five major economic research Institutes) have argued that moderate wage settlements are essential for accelerating the process of structural change. According to this position, steep wage increases will retard the process of retooling the East German economy. At the other end of the spectrum, trade unions reply that high wages in East Germany are necessary precisely to guarantee that the forces of structural change are brought to bear on industry.

The objective of this paper is to evaluate the wage explosion in East Germany and assesses some of its potential theoretical effects on structural change, as well as the economic arguments that can be brought for either side. The following section of the paper presents a current assessment of the wage situation in East Germany as well as the role of the trade unions in this development. The drastic rise in real product wages is documented, despite a much more moderate increase in nominal and consumption wages.

The third section relates collective bargaining directly to structural change in the context of two different models. The first more conventional model stresses the interaction of union driven collective bargaining in a simple two-sector model. In such models collective bargaining can be expected to prolong the course of structural change by preventing the release of workers into the alternative (here: secondary or new private sector). The results support claims by the Sachverständigenrat that wage subsidies "only preserve old structures and the very inefficencies that the reforms are expected to correct." [Sachverständigenrat (1991), p. 9; authors' translation]. An alternative position, however, is that industrial policy may be necessary to guide the economy towards a superior high-productivity equilibrium. We sketch this view in a model of "learning-by-doing" which is suggestive of explicit high-wage

policies pursued, for example, in Singapore [see Chadha (1991)]. Here human capital external to the firm accumulates on the job rather than away from it. One central conclusion is the possibility of multiple equilibria: a high wage policy rules out a learning-by-doing equilibrium in which the economy is specialized in the low tech, low human capital sector.

The following section takes a different tack. Given a high wage policy, the paper examines two medium to long-run effects on structural change. The first model reviews the effect of wage policies on physical investment in a dynamic setting. An important conclusion here is that the initial reduction of employment in the aftermath of a permanent increase in wages is followed by a longer phase of declining employment: higher wages imply a lower shadow value of capital and will be associated with a protracted period of low investment and greater capital intensity in the East. A second conclusion is that high wage polices reduce the marginal value of capital to the firm, which can explain the massive subsidies apparently necessary for the Treuhand to dispose of its portfolio of firms.

Unions has often argued the opposite position, claiming that high wages encourage investment in human capital. As a counter-argument, we therefore present an alternative line of economic reasoning in favor of a high wage policy in East Germany which relates to incentives for retraining. According to this argument, the only future for East Germany is with a human capital constellation similar to that of the West. The only means to this end in a decentralized market economy is to offer sufficient incentives for private agents to undertake this investment in human capital on their own. A high wage policy is associated initially with high unemployment, but this unemployment is accompanied by households' engaging in retraining in the hopes of improving their earnings prospects. This analysis is conducted in the context of a dynamic model of human capital investment.

2. The Rise of Collective Bargaining and the Wage Explosion in Eastern Germany

It is ironic that the ex-GDR -- der Bauern- und Arbeiterstaat (that is the proletarian state) -- was so willing, so rapidly, to give up its trade unions in the aftermath of the opening of the wall. Within a few months following November 1989, the Freie Deutsche Gewerkschaftsbund came under intense criticism for its extensive collaboration with the communist party and the generous privileges its functionaries enjoyed. This extreme loss of credibility was exemplified in the indictment of Harry Tisch, the former FDGB head, for embezzlement of union funds and fraud.

Even before the prospect of unification was imminent, the Western trade unions began to see the danger of a low wage, "right-to-work" region in their backyard. Monetary union without any change in compensation structure -- even at 1:1 exchange of Ostmarks for DM -- portended a dramatic integration shock: an investment boom in the East as West German enterprises diverted their resources across the Elbe; and migration, which threatened to send the best workers West looking for jobs. Both developments implied massive changes in operating conditions of German labor markets, and, if not managed properly, the monopoly position enjoyed by the German trade union movement. In this historic moment the Deutsche Gewerkschaftsbund (DGB) staged an impressive organizational campaign, that as Table 1 shows, was so successful that the percentage of members from the East was significantly higher than that in the West.

Table 1:

Membership in the DGB in Eastern States (000s)

	Employment	Union members	Union density
Berlin & Brandenburg	1995	1085	38.0
Saxony	2276	1342	59.0
Saxony-Anhalt	1378	727	52.8
Thuringia	1220	613	50.2
Mecklenburg-West Pommerania	909	439	48.3
Total (excl. West Berlin)	-	-	50.6
Memo item: West Germany		-	32.3

Note: All data as of 30 June 1991. Source: Kleinhenz (1992)

The DGB's organizational success had several key economic consequences for both East and West Germany. It is widely recognized that the aggressive bargaining position taken by West German unions in their wage negotiations was responsible for the wage explosion. At the outset of monetary union (June 1990) nominal wages after 1:1 conversion were roughly a third of West German levels. Within a year, average wages had reached roughly 50% of Western levels. Several recent contracts, including the metalworkers' pilot contract in Mecklenburg-Vorpommern, commit to parity of contractual wages by mid-decade.[1] Most important is the increase in product wages -- of roughly 280%. See Table 2 for details.

The economic consequences of such aggressive wage setting were foreseeable. In addition to outmoded production facilities, bloated bureaucracies and nonexistent distribution networks, East German enterprises were faced with sharp increases in their unit labor costs. It is surprising that so many enterprises have managed to survive despite this staggering shock.[2] Production fell to a third of 1989 levels, and unemployment has

1) It should be noted however that the contractual wage is only one aspect of the compensation package. As is well-known, East German workers work roughly three to five hours per week longer, receive fewer bonus payments and take shorter vacations than their West German counterparts. See also Franz (1991).

2) Perhaps too pessimistic were the forecasts of Akerlof et al, (1991), who forecast that less than 20% of the firms would survive 1:1.

risen to roughly 15% of the labor force or 30% when make-work, retraining, and early retirment are taken into account.

Table 2:

Changes in Wages and Prices Following Currency Union

	W_E	W_E/W_W	P_O	P_C	W_E/P_O	W_E/P_C
1/90	1184	0.31	-	-	-	-
2/90	-	-	-	-	-	-
3/90	-	-	-	-	-	-
4/90	1168	0.30	-	-	100.0	100.0
5/90	-	-	98.4	98.3	-	-
6/90	-	-	-	87.9	-	-
7/90	1393	0.35	64.2	94.5	182.8	124.1
8/90	-	-	63.1	94.9	-	-
9/90	-	-	62.8	99.0	-	-
10/90	1588	0.39	62.9	100.6	212.6	132.8
11/90	-	-	62.5	100.7	-	-
12/90	-	-	62.1	101.9	-	-
1/91	1667	0.42	63.3	108.9	221.9	128.8
2/91	-	-	63.4	109.7	-	-
3/91	-	-	63.2	111.4	-	-
4/91	1926	0.47	63.2	112.6	256.7	144.0
5/91	-	-	63.1	113.4	-	-
6/91	-	-	63.0	114.1	-	-
7/91	1996	0.47	63.1	115.1	266.3	146.0
8/91	-	-	63.1	115.2	-	-
9/91	-	-	63.2	115.4	-	-
10/91	2086	0.49	63.3	126.9	277.9	138.4
11/91	-	-	63.2	127.6	-	-

Notes: W_E = Average gross monthly wages of blue and white collar workers in the East (total industry); W_E/W_W = wage ratio East to West in percent; *Source:* Statistisches Bundesamt, FS 16, Reihe 2.1, various issues; P_O (P_C) = price index of industrial producer prices (price index of the cost of living) in the five Eastern Länder, 1989=100; *Source:* Statistisches Bundesamt, FS 17, Reihe 3 and Wirtschaft und Statistik, various issues; W_E/P_O (W_E/P_C) = real product wages (real consumption wages), 4/1990 = 100. Due to missing data the real wages indices for 4/90 were calculated using the price indices for 5/90.

One important caveat is that despite the press coverage of recent wage agreements guaranteeing parity of wages within a limited time horizon, actual remuneration to workers in the East remains roughly half of that in the West. The explanation for this discrepancy lies in the considerable differences in hours worked as well as nonwage compensation between the two regions. It seems that while real consumption and especially product wages have risen dramatically, they are still far from "Japanese levels" predicted by Sinn and Sinn (1991). Nevertheless these

wage increases have made the transformation even more difficult for the representative firm by reducing already thin margins.

In general the (Western) trade unions were well-aware of the impending implications of their actions, and one is forced to conclude that their behavior reflected other considerations than merely preserving jobs at any price. Burda and Funke (1991) have reviewed some of these reasons, from the perspective of a monopoly union, behaving either as such or as a partner in a noncooperative Nash bargain. If the union simply considers the East as a segmented labor market, it will price labor as a markup on the competitive fallback wage. As usual, the markup depends negatively on the elasticity of demand for labor. Given the situation in the East, however, high labor demand elasticities would predict a much larger wage gap across the two Germanies than currently evident. Burda and Funke (1992) also adduce econometric evidence that indeed the labor demand curve in the East is more elastic. Another explanation of the wage explosion is the migration threat. If the union takes the competitive wage as a fallback, this wage is likely to be considerably higher after unification, and thus for given markups higher wages in the East were implied. Third, the short-term subsidy policy of the Treuhandanstalt may have played an important role in short-term wage developments. Only this can explain the remarkably high labor shares in East German industry -- for many sectors well in excess of 150% [Scheremet (1992)]. Finally, simply recruiting members to maintain a viable organizational base must not be overlooked.

3. Unions, High Wages and Structural Change: Two Points of View

3.1 The Standard View

The standard view is that the existence of collective bargaining can retard structural change. The point can be made in the context of the following simple two-sector model, in which employment adjustment in response to a permanent sectoral shock for the five new German states is analyzed.[3] The larger unionised sector (i) is assumed to possess some degree of bargaining power while the non-unionised sector (s) is modelled as perfectly competitive.[4] The unionised sector is assumed to face a downward-sloping demand curve for its products. Its revenue function $R(L_i,\epsilon)$ is a function of the sectoral employment level L_i and a shock term ϵ with the properties $R_\epsilon < 0$, $R_L > 0$, $R_{L\epsilon} > 0$, and $R_{LL}(\cdot) < 0$. The shock variable ϵ represents the collapse of industrial production after the dissolution of the former central planning system.

The i-sector unions are assumed to bargain with the employers over wages. The well-known Nash solution to the bargaining problem maximises the product of the gains of both the employers and the union over and above the outcome that would have emerged for both groups if no contract had been agreed upon. Here, it will choose L_i and w_i in order to maximise

$$(1)\quad [R(L_i,\epsilon) - w_iL_i][w_iL_i + (N_i-L_i)F_L(L_s) - N_iF_L(L)]$$

subject to

$$(2)\quad L = L_i + L_s$$

where w_i is the wage in the unionised sector, $F_L(\cdot)$ is the marginal productivity of labour in the competitive sector and N_i is fixed union membership.[5] The first term in braces is the company's contract outcome.[6] The term $w_iL_i + (N_i-L_i)F_L(L_s)$ gives the wages received by workers working in the unionised sector plus the wages of union members who, after having lost their jobs in the imperfect competitive sector i are now wor-

3) Related problems are discussed in Djajic and Purvis (1987).

4) East Germany, like the rest of Eastern Europe, suffers from an overgrown industrial sector and an underdeveloped service sector. One can, therefore, think of the high-wage unionised sector representing the declining industry employment while the low-wage competitive sector is formed by the (new) private service sector.

5) Strictly speaking, the wage rate takes into account nonwage costs such as payroll taxes and employer contributions to health insurance and retirement plans. The *short-run* production function $F(\cdot)$ is assumed to have standard properties in terms of first and second derivatives, i.e. $F_L(\cdot) > 0$ and $F_{LL}(\cdot) < 0$.

6) Equation (1) implicitly assumes that the firm's income during a strike is zero.

king in the competitive sector s.[7] Finally, we assume the existence of union income during a strike. In equation (1) this amounts to $N_i F_L(L)$, i.e. it is assumed that union members have the option to work in the competitive sector during a strike. The first-order conditions for the solution of this maximisation problem are:

$$(3)\quad w_i = \frac{R(L_i,\epsilon) - (N_i - L_i)F_L(L_s) + N_i F_L(L)}{2L_i}$$

and

$$(4)\quad R_L = F_L(L_s) + (N_i - L_i)F_{LL}.$$

These two can be combined to obtain[8]

$$(5)\quad w_i = \frac{R(L_i,\epsilon)/L_i + R_L + L_i F_{LL}}{2}$$

Equation (4) differs in the last term in the numerator from the usual Nash solution in which the wage is equal to the arithmetic mean of the average and marginal revenue products of labour. This term arises because union power vis-á-vis employer organisations in the event of a strike is reduced by the fact that the inflow into the competitive s-sector reduces the prevailing wage there. The socially efficient levels of employment require that the first order condition

$$(6)\quad R_L(\cdot) = F_L(\cdot),$$

i.e. equality between the value marginal revenue product of labour in sector i and the value marginal product in sector s is

7) i-sector job losses have been assumed to be by random draw. The output price of the competitive sector remains constant throughout the analysis and has been normalized to unity.
8) Equation (5) is derived from (3) using a Taylor series expansion to write $F_L(L)$ in terms of $F_L(L_s)$.

satisfied.[9] This would clearly be achieved under conditions of *perfect intersectoral labour mobility*.

The i sector in the former GDR is now assumed to be subjected to a drastic structural change, represented by an increase in ϵ, reducing revenues permanently. An efficient response of the economy would involve a decline in i-sector employment and wages, labour mobility from i to s, and lower wages alongside increased production in the s-sector of the economy. The *efficient* response is described by the following two equations:

$$(7)\quad \frac{dL_i^*}{d\epsilon} = \frac{-R_{L\epsilon}}{R_{LL} + F_{LL}} < 0$$

$$(8)\quad \frac{dw_i^*}{d\epsilon} = \frac{R_{L\epsilon}F_{LL}}{R_{LL} + F_{LL}} < 0$$

Analysing the effects of greater product market competition on a competitive labour market is a straightforward exercise. Increased product market competition, regardless of its source, will result in a lower product price which is equivalent to a reduction in the value of the marginal worker's contribution to output. According to equations (7) employers will respond by hiring fewer workers than they had previously. Aside from this reduction in employment, increased competition results in a lower wage rate [equation (8)].[10] The observable *actual* response of the system, however, differs from the socially optimal response. Differentiating equations (3) to (5) the actual response of the economy can be derived as

$$(9)\quad \frac{dL_i}{d\epsilon} = \frac{-2R_{L\epsilon}L_i}{2L_i(R_{LL} + 2F_{LL})} < 0$$

9) If N_i is equal to L_i initially, then equation (5) reduces to equation (6) and the equilibrium of the economy is efficient.
10) The experience of the recently deregulated US trucking industry, for example, is in line with this hypothesis. When the trucking industry was regulated, union drivers earned substantial rents. After five years of deregulation and therefore increased competition these rents were largely dissipated. See Rose (1987) for details.

$$(10)\quad \frac{dw_i}{d\epsilon} = \frac{R_\epsilon(R_{LL}+2F_{LL})+R_{L\epsilon}(F_{LL}L_i-0.5R_{LL}L_i)}{2L_i(R_{LL}+2F_{LL})}$$

A comparison of equation (7) and (9) immediately reveals that the amount of labour transferred into the competitive sector is *less* than required for social efficiency. On the other hand the impact of a shock on the union wage is ambiguous. A reduction in profits leads to a downward tendency to the industry wage. At the same time, however, any decline in industry employment must be "purchased" from the union in the present model in the form of an increase in the negotiated wage. A perverse short-run impact of increased competition on wages is most likely in unionised declining industries with relatively few dominant firms having long-lasting immobile or industry-specific equipment. Because of the high costs of shutting down capacity, management cannot resist higher union wage demands and consequently wages will rise in the short run.[11]

Finally, the model can now be used to analyse the effects of a *lump-sum wage subsidy* τ to the declining sector.[12] In case of the five new German states, such a subsidy is called for to provide "breathing room" in the hope that industrial competitiveness would be restored or that excess capacity could be eliminated in a socially acceptable way. The modified definition of profits would then be

$$(11)\quad R(L_i,\epsilon) + \tau L_i - w_i L_i$$

and the modified Nash solution becomes

$$(12)\quad R_L = F_L(L_S) + (N_i-L_i)F_{LL} - \tau$$

11) For evidence on the "slow game" and "end game" issue see Harrigan (1980) and (1983) and Lawrence and Lawrence (1985). In the long run, however, as the existing capital stock wears out and plant closing becomes likely, management's bargaining power will be restored, resulting in downward pressure on wages in addition to employment losses.

12) It is assumed that the employment subsidy is paid in the form of a direct cash grant to the firm. Such a subsidy has been suggested by Klodt (1990) and Akerlof, et al. (1991).

The corresponding subsidy effects on i-sector wages and employment are

$$(13)\quad \frac{dL_i}{d\tau} = \frac{-2L_i}{2L_i(R_{LL}+2F_{LL})} > 0$$

$$(14)\quad \frac{dw_i}{d\tau} = \frac{L_i(0.5R_{LL}+3F_{LL})}{2L_i(R_{LL}+2F_{LL})} > 0$$

Due to the protection caused by the wage subsidy, profitability, employment and wages in the i-sector are increasing, i.e. the situation is aggravated rather than corrected by subsidisation. Finally, since the number of workers released into the competitive sector is reduced, wages in the s-sector are also increasing. In other words, the model shows that the consequences of an employment subsidy to sector i faced with a permanent decline is undesirable on efficiency grounds. By providing subsidies, governments override market signals by artificially boosting the profitability in sector i. The result is that more resources will flow to the subsidised activities but those resources will produce *less* output that they could have in other activities.[13]

The analysis sheds some light on more appropriate policy measures during the adjustment process in East Germany. Subsidies which reduce efficiency less include direct subsidies for intersectoral labor mobility, tax policies directed against the declining sector, and subsidies for production in the competitive sector.

3.2. A Not-So Standard View: Learning-by-Doing

The previous section, as Burda and Funke (1991), concentrated on short run effects of collective bargaining on wages and employment. It is likely that longer run considerations will be as important. Another possibility often cited in the development literature -- but seldom mentioned in the unification de-

13) It is worth mentioning that support to sunset industries in the past has often removed the incentive to undertake necessary adjustments. For a recent analyses of industrial subsidies see Ford and Suyker (1990).

bate -- is that a high wage policy may actually accelerate structural change in the medium to long run. This possibility is raised by Krugman (1987) and Chadha (1991), who applies Lucas's (1988) model of "learning-by-doing" to Singapore. In this class of models, the rate of economy-wide productivity growth is a function of the extent to which an economy produces in sectors with high potential for learning or, equivalently, where the rate of innovation is the highest.

Consider the same two-sector full employment economy of section 2, with the following modification: The revenue function in the industrial sector is given by

$$(15) \quad H_i R(\epsilon, L_i)$$

and the production function in the competitive sector is

$$(16) \quad H_s F(L_s)$$

H_j (j=i,s) can be thought of as the human capital in the jth sector. In (15) and (16) we have assumed that while there are constant returns at any point in time, there is learning-by-doing. Human capital accumulates to the extent that the activity itself is undertaken. This is, however, an industry phenomenon and therefore *external* to the firm.[14] To complete the model, we need to specify how the H's evolve over time. Here we assume that they are determined according to the differential equations

$$(17) \quad \dot{H}_i = g_i \theta H_i,$$

$$(18) \quad \dot{H}_s = g_s(1-\theta)H_s, \qquad \text{with } g_i > g_s$$

where θ is the fraction of the labor force engaged in sector i. Henceforth the labor force is normalized to equal 1, so θ also represents employment in that sector. The assumption that the

14) We thus assume increasing returns to scale. But the returns to scale are external to single economic agents and internal to a sector or larger parts of the economy. Consequently competition can prevail. This approach avoids complications of market conduct and structure that arise when economies of scale are internal to firms.

rate of learning by doing in sector i is greater than sector s is a crucial one.

It is straightforward to see that steady state growth in the economy ranges from g_s to g_i, depending on the concentration of industrial activity. If $\theta = 1$ then economy-wide output grows at rate g_i; if $\theta = 0$, then growth proceeds at rate g_s. Define H as the *relative* level of human capital in the two sectors (H_i/H_s), so that H evolves over time according to

$$(19) \quad \dot{H} = \dot{H}_i/H_s - (H_i/H_s^2)\dot{H}_s$$

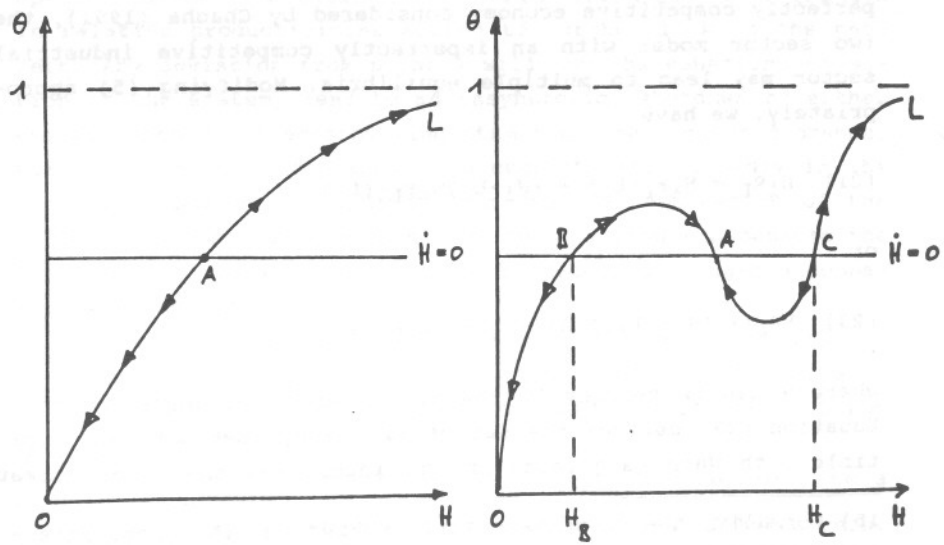
$$= g_i \theta H - g_s(1-\theta)H,$$

or

$$(20) \quad \dot{H}/H = \theta(g_i+g_s) - g_s$$

We are now in a position to describe the dynamics of resource allocation over time. To interpret (20), we can use Figure 1 which is drawn in the (θ,H) space.

Figure 1: The Dynamics of the Economy under Learning-by-Doing: Two Examples



Equation (20) defines the set of all resting points in the system for the relative productivities of the two sectors. It is drawn as the $\dot{H}=0$ locus the in the phase diagram. The arrows indicate the direction of movement of the relative skill level when the economy is off the $\dot{H} = 0$ line.

The planner's outcome in such a context seems clear enough: given that world output prices do not change, the planner shuts down the low productivity sector and diverts all employment into the high growth sector. This is of course one way of understanding industrial policy of "picking winners". The private sector outcome is different, since firms take the evolution of H as given and do not attempt to manipulate its growth. Neither wage bargainers nor competitive sector firms internalize the effects of their wage and output decisions on the evolution of human capital. Only if relative prices push firms into such production, or if initial conditions are sufficiently favorable will the market replicate the planner's problem and choose the high-growth trajectory. As Chadha (1991) shows, this outcome can be attained through an aggressive union wage policy and/or a wage subsidy because the locus of initial conditions converging to eventual specialization in the high-technology good thus increases.[15]

Like the closed economy studied by Lucas (1988) or the open and perfectly competitive economy considered by Chadha (1991), the two sector model with an imperfectly competitive industrial sector may lead to multiple equilibria. Modifying (5) appropriately, we have

$$(21)\quad H_i R_L = H_S F_L(L_S) + (N_i - L_i) H_S F_{LL}(L_i)$$

or

$$(23)\quad HR_L(\epsilon,\theta) = F_L(1-\theta) + (N-\theta)F_{LL}(\theta)$$

where N can be thought of now as the union organization rate. Equation (23) defines the set of all (θ,H) combinations compatible with Nash bargaining in the industrial and labor market clearing in the competitive sector. This curve is drawn as the OL locus in same figure. Unlike the model considered by Chadha (1991), this locus need not be monotonically increasing. To see this consider the differential of (23):

$$(24)\quad \frac{dH}{d\theta} = \frac{-F_{LL}(1-\theta) - F_{LL}(\theta) + (N-\theta)F_{LLL} - HR_{L\theta}}{R_L}$$

The denominator of (24) is positive, as are the first, second and last terms of the expression. With N fixed, $(N-\theta)$ will generally change sign as θ passes through the interval $[0,1]$. The possibility of a downward sloping segment of the OL locus cannot be ruled out.

We draw two of many possible cases in Figure 1. The first corresponds to that in which the the OL locus is everywhere upward sloping. This includes the case of quadratic R and F functions ($F_{LLL}=0$) as well as the isoelastic specification when the entire economy is unionized.[16] As the figure shows, there are two stable equilibria (full specialization in either sector) and one unstable point, point A. To the left of A the economy will, over time, specialize in good s, while to the right means that the economy will move towards point B. In the absence of exogeneous shocks arising from outside sources a pattern of specialisation once established remains unchanged, with changes in relative productivities acting to further lock in the pattern. Any deviation from point A will, by the equations of motion of the system, lead to an (asymptotic) shutdown of either sector. Should the economy find itself on the rightward branch, human capital will continue to accumulate more rapidly in the industrial sector, leading to its eventual domination of the economy. History matters here even for the long run because the human capital ratio will dynamically determine long-run comparative advantage.[17]

In the second case, shown in the second panel of Figure 1, there are three stable equilibria. Here there are values of H for which the OL locus is decreasing. As a result, point A now

15) Formally, the OL curve shifts upwards and therefore intersects the $\dot{H}=0$ curve at a lower relative skill level.

16) If F and R take quadratic forms, the LL locus will be a straight line.

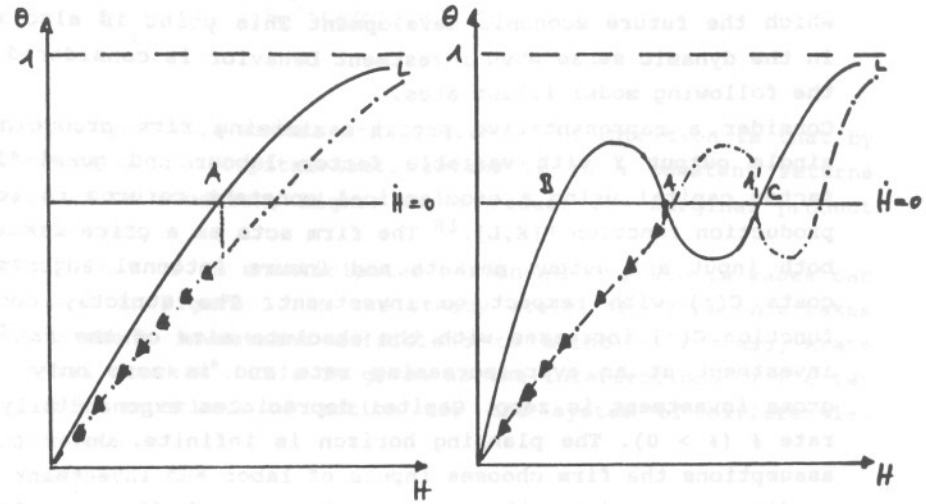
17) The model therefore contains strong elements of hysteresis.

represents a stable equilibrium for values of H between H_B and H_C, the economy will converge to point A. Outside of this range however, the economy still tends to complete specialization. Dynamics may be accompanied by violent contractions of either sector, depending on the behavior of marginal productivity in the competitive sector.

Now consider the effect of an ϵ-shock which by (23) shifts the OL curve rightwards for any value of θ. For the two examples in Figure 1, we show that such a shock could lead to an "industrial reversal" in which an economy moves into a low tech production configuration. In the first case, the economy was on its way to specialization after which the shock drives it underneath the $\dot{H}=0$ locus and thereby in the other direction. In the second case, the economy was resting at point A, which after the shock became unstable, thereafter leading to specialization in the low-tech sector.

In the case of learning-by-doing -- since the effects are assumed a priori to be external and thus not mediated by the market -- there is a role for policy. The shape of the OL curve will therefore determine the dynamics and the implications for policy response to the negative shock. A wage subsidy in general will stem this development; in the previous section it was shown that employment in the industrial sector increases unambigously if it is represented by collective bargaining. In this sense such as subsidy serves as a type of industrial policy. On the other hand, there are probably more efficient means of accomplishing this end, such as subsidizing production directly.

Figure 2: The Effect of a Negative Shock Under Learning-by-Doing



4. The Longer-Run Dynamic Effects of High Wage Policies on Investment: Two Relevant (and Contrasting) Models

It is likely however that households and firms consider a much longer horizon when taking their decisions. Several of these factors directly concern the effects of union wage policy on economic integration and development. In the following sections we elaborate on some of the effects that a high wage policy might have, taken exogenously, on structural change. We thereby ignore feedback from the consequences of such policies on the wage itself.

4.1 Wages and Physical Capital Formation

Up to this point our discussion of wage policy has disregarded investment in plant and equipment. A high wage policy will adversely affect the profitability of capital and therefore its valuation. Akerlof et al. (1991) have noted that the short term value of firms privatized by the Treuhandanstalt is negatively

affected by wages. This point also holds for capital at the margin, or the value of investment. The following model shows how a high-wage policy can advsersely affect investment, on which the future economic development This point is also true in the dynamic sense when investment behavior is considered, as the following model illustrates.

Consider a representative profit-maximising firm producing a single output Y with variable factor labour and quasi-fixed factor capital using a neoclassical constant returns to scale production function $F(K,L)$.[18] The firm acts as a price taker in both input and output markets and incurs internal adjustment costs $C(\cdot)$ with respect to investment. The strictly convex function $C(\cdot)$ increases with the absolute size of the rate of investment at an ever-increasing rate and is zero only when gross investment is zero. Capital depreciates exponentially at rate δ ($\delta > 0$). The planning horizon is infinite. Under these assumptions the firm chooses inputs of labor and investment expenditure to maximize the present value of cash flow or solve

$$(25) \quad \max_{L,I} \int_0^\infty [pF(K,L) - wL - I - C(I)]e^{-rt}dt$$

where K, L and I are capital, employment, and investment respectively, and p, w are the price of output and the wage rate, respectively.[19] The price of investment goods is assumed to be unity. r is the firm discount rate, here assumed constant for simplicity. Additionally the capital accumulation constraint is given by

$$(26) \quad \dot{K} = I - \delta K.$$

The solution to the problem, which is derived in the Appendix, is a labor demand function $\phi(w/p) = KF_L^{-1}(w/p)$ with $\phi' < 0$, and an investment function $I(q)$, with $I' > 0$, where q is the shadow value of an additional unit of capital in place and is given by

18) The production function is assumed to satisfy the Inada conditions $\lim_{K\to\infty}F_K = \lim_{L\to\infty}F_L = 0$ and $\lim_{K\to 0}F_K = \lim_{L\to 0}F_L = \infty$.
19) Time subscripts have been supressed when possible.

$$(27) \quad q = \int_0^\infty [pF_K(1,L/K)]e^{-rt}dt$$

$$= \int_0^\infty [pF_K(1,F_L^{-1}(w/p))]e^{-rt}dt$$

Notice that wage enters q negatively. The intuition is that by increasing the capital-labor intensity in a constant returns production function, higher wages reduce the marginal product of capital.

The effect of an unanticipated permanent increase in wages can be seen in Figure 3. In the steady state, the firm undertakes replacement investment sufficient to maintain a steady-state capital stock K^*. This is given as the intersections of the two dynamic equations of motion for the system of differential equations

$$(28) \quad \dot{q} = q(r+\delta) - pF_K(\cdot)$$

and (26) with $I = I(q)$ in the conventional phase diagram. Following the increase in the wage rate from w_0 to w_1, the rate of investment I and the shadow price of capital q jump instantaneously to lower levels. Over time the capital stock declines to K^{**} and q declines to q^{**}. The time paths of investment, the capital stock, and employment are shown in Figure 4.

Figure 3: The Adjustment of the Capital Stock to a Wage Increase

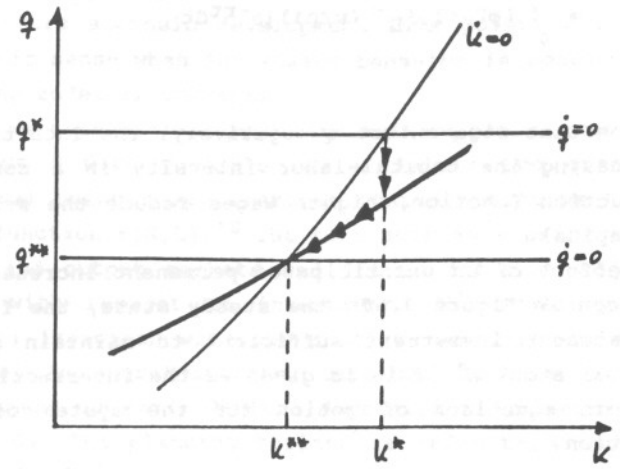
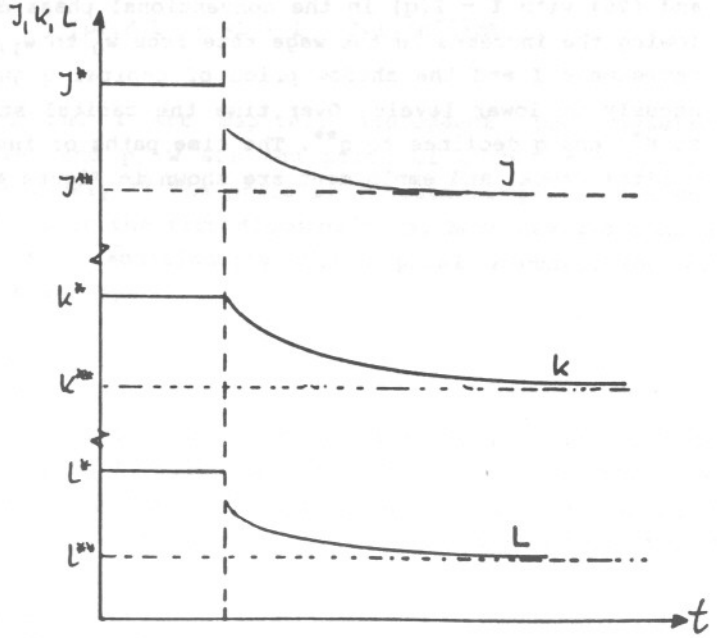


Figure 4: The Time Paths of Investment, the Capital Stock, and Employment



When the wage rises, the capital-labour ratio must rise instantaneously to its higher new level. Since convex adjustment costs rule out infinite disinvestment, the capital stock is given and the firm accomplishes this objective in the first instance by shedding labour. Thereafter, lower q and lower investment leads to a reduction in the capital stock; to keep K/L constant as required, employment and output are further reduced. This process continues until the capital stock has reached its lower equilibrium level K^{**}.[20] Capital accumulation therefore clearly accentuates the adverse effects of higher real wages on employment.[21]

4.2 Wages and Human Capital Formation

A claim made often by the leaders of prominent West German trade unions is that high wage will increase the return to training and thereby induce workers to acquire new skills or a better education. High wages in this sense are ultimately "validated" by an endogenous improvement in productivity. This argument, which focuses on the returns to human capital formation, has also appeared prominently in the recent literature on endogenous growth.[22] Ironically, it emphasizes a decentralized market solution to the retraining problem, rather than one run by the state employment offices, as is the case in Scandinavia. The economics behind this line of argument can be rationalized by a simple model of the representative household, which is assumed constrained to work whatever hours demanded by the representative firm. This demand is given by the labor demand function $L^D = \phi(w/H)$, with $\phi' < 0$, where w is the real wage and H is the level of human capital with which workers operate. The household is assumed to have instantaneous utility over consumption c with u' and $u'' < 0$. The household is assumed to supply labor demanded as long as $L^D < \bar{L}$, the total allocation of time. The household can also invest in the accumulation of skills, ie the increase of the level of H. Human capital accumulates according to

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20) It is interesting to note that with *decreasing* returns to scale q and I initially *overshoot* and afterwards recover and increase towards their new equilibrium levels.
21) Van der Ploeg (1987) has explored these feedback effects in a dynamic setting.
22) See Lucas (1988), or more recently Sala-i-Martin (1990).

(29) $\dot{H} = \psi(\theta,H) - \delta H,$

where ψ exhibits constant returns to its two arguments, so

(29') $\dot{H} = \psi(\theta/H,1)H - \delta H,$

and ψ_θ, $\psi_H > 0$, and $\psi_{\theta\theta}$, $\psi_{HH} < 0$, and $\psi_{\theta H} > 0$. We impose $\psi < \delta+r$ for all values of θ and H. As before δ is the rate of depreciation of accumulated (human) capital and θ is the time dedicated to human capital formation.

The household is assumed to maximize the utility of its dynasty[23]

(30) $\max_{c,\theta} \int_0^\infty u(c)e^{-rt}dt$

subject to (29'), $L \geq \phi$ and the evolution of financial wealth Ω given by

(31) $\dot{\Omega} = r\Omega + w\phi(w/H) - c - t\theta$

income in unemployment is assumed to be zero and r is the fixed real rate of interest on financial wealth. Training time θ is assumed to have constant cost t; training can occur on the job or in unemployment.

Assuming an interior solution, the human capital investment policy which solves this problem can be characterized as $\theta^*(\mu)H$ with $\theta^{*\prime}>0$, where μ is the shadow value of human capital in the solution to (30). The derivation of θ^* is presented in the Appendix. The evolution of μ and H are governed by the differential equations

(32) $\dot{H} = \psi(\theta^*(\mu),1)H - \delta H$

and

(33) $\dot{\mu} = \mu(r+\delta-\psi(\theta^*(\mu),1)) + \lambda(w/H)^2\phi'$

23) We assume away problems of finite lifetimes for simplicity; none of the key results is changed if the houshold is assumed to have a finite life.

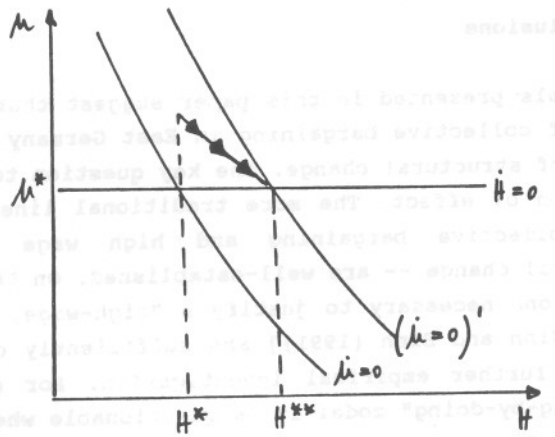
where λ is the marginal utility of wealth. Under the assumption that the household discounts its utility at rate r, λ is constant. The value of μ is given by

(34) $\mu = \lambda\int_0^\infty (w/H)^2(-\phi')e^{-(r+\delta-\psi)t}dt$

As in the previous section, the dynamics of the system can be investigated using the phase diagram. The $\dot{H}=0$ curve has zero slope, whereas the $\dot{\mu}=0$ curve has ambigous slope. We shall assume that the latter is downward sloping.

Figure 5 plots the $\dot{H} = 0$ and $\dot{\mu} = 0$ loci, as well as the arrow depicting the equations of motion and the stable path along which μ approaches its steady state value.

Figure 5: Human Capital Investment: The Effect of a Permanent Unanticipated Wage Increase



The most important implication of the analysis we stress here is the effect of an increase in the wage. The reasoning put forward by the unions suggests that an increase in the wage causes a shift upwards in the $\dot{\mu} = 0$ locus, as depicted in

Figure 5. The immediate consequence is a decline in employment and an increase in the unemployment rate as firms move back along their given labor demand schedules. At the same time, the shadow value of human capital jumps, inducing retraining investment and an increase in H. As H accumulates, the demand for labor increases and unemployment declines, although the equilibrium unemployment rate is not generally the same as at the outset. On the other hand, it is possible that an increase in the wage might shift the μ curve *downwards* causing disinvestment in human capital and an increase in unemployment.
Under which conditions will $dH_{SS}/dw > 0$? In the Appendix we show that in the case of logarithmic utility, the union's case will hold only under certain conditions. One set of sufficient conditions is that the labor demand curve not be too concave to the origin, and that the elasticity of labor demand exceed unity. Even if dH_{SS}/dw is positive, $(dH_{SS}/dw)/(H_{SS}/w)$ will generally be less than unity, so that an increase in the wage will not be fully "validated" by an endogenous increase in training.

4. Conclusions

The models presented in this paper suggest that the mere existence of collective bargaining in East Germany will affect the course of structural change. The key question to resolve is the direction of effect. The more traditional line of argument -- that collective bargaining and high wage polices retard structural change -- are well-established. On the contrary, the assumptions necessary to justify a "high-wage, high-tech strategy" [Sinn and Sinn (1991)] are sufficiently controversial to warrant further empirical investigation. For example, in the "learning-by-doing" model it is questionable whether the industrial sector of East Germany is characterized by a higher exogenous growth rate. It may be well be the case that the "competitive sector" has the fastest growth potential, either due to Schumpeterian dynamics or more rapid adoption of new technologies by competitive firms. In addition, the results on human capital formation depend on the shape of the labor demand function. In any case, both learning-by-doing and retraining

incentives are probably better achieved by direct tax and subsidy policies rather than by distorting the price of labor.

Appendix

1. Physical Investment

We solve the problem (25) using Pontryagin's maximum principle. The Hamiltonian is

$$(A1)\quad e^{-rt}([pF(K,L) - wL - I - C(I)] + q[I - \delta K])$$

where q is the costate (current value) variable associated with (16). The sufficient conditions for the solution to this optimal control problem are:[24]

$$(A2)\quad \dot{q} + pF_K(\cdot) = q(r+\delta)$$

$$(A3)\quad pF_L(\cdot) = w$$

$$(A4)\quad q = 1 + C'(I)$$

and the transversality condition

$$(A5)\quad \lim_{t\to\infty} (qK)e^{-rt} = 0.$$

Equation (A2) equates the return from holding an extra unit of capital to its opportunity cost. Since the price of capital goods is assumed to be unity, q here represents *Tobin's marginal q*. Since $C''(\cdot) > 0$, (A4) says that investment is an increasing function of marginal q as first shown formally by Abel (1979) and Hayashi (1982). We can therefore write

$$(A6)\quad I = I(q) \qquad I'(\cdot) > 0$$

By constant returns $F_L(K,L)=F_L(1,L/K)$ and $F_K(K,L)=F_K(1,L/K)$. Implicitly at least, (A3) defines a labor demand curve of the form $K\phi(w/p)$, which can be inserted into (A2) to obtain

$$(A7)\quad \dot{q} + pF_K(1,\phi(w/p)) = q(r+\delta)$$

Equation (A7) and the capital accumulation constraint

$$(A8)\quad \dot{K} = I(\lambda) - \delta K$$

are thus a pair of equations of motion for q and K which can be used to construct a phase diagram.[25] It is straightforward to show that the first locus is flat, the second upward-sloping.

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24) See Kamien and Schwartz (1981). Sufficiency requires concavity of the profit function which is ensured as the production function $F(\cdot)$ is concave and the adjustment cost function $C(\cdot)$ is strictly convex.

25) The dynamics of the system correspond to a *saddlepoint* because for any point above or below the $\dot{q}=0$ locus, the system will blow up asymptotically and the only stable path to the long-run equilibrium lies along this $\dot{q}=0$ locus. The transversality condition (21) ensures that this stable solution is chosen.

2. Human Capital

The Hamiltonian for problem (30) is

$$(A13)\quad e^{-rt}(u(c) + \lambda[r\Omega + w\phi(w/H) - c - t\bar{\theta}] + \mu[\psi(\theta^*(\mu),1)H - \delta H])$$

where $\phi=\phi(w/H)$, λ is the costate variable on the financial wealth constraint (the marginal utility of wealth) and μ is the costate variable on the human capital accumulation constraint (the marginal value of an additional unit of human capital). Conditions for optimality are:

$$(A14)\quad u' = \lambda = \text{constant.}$$

$$(A15)\quad \mu\psi_\theta(\theta/H,1) = t$$

$$(A16)\quad \dot{\mu} = \mu(r+\delta-\psi(\theta^*(\mu),1)) + \lambda(w/H)^2\phi'$$

The relevant transversality conditions are

$$(A17)\quad \lim_{t\to\infty} \mu e^{-rt} = 0.$$

and

$$(A18)\quad \lim_{t\to\infty} \lambda e^{-rt} = 0.$$

The optimal human capital investment policy can be written (at least locally) as

$$(A19)\quad \theta^*(\mu)H \quad \text{with} \quad \theta^{*\prime} > 0,$$

The equations of motion (32) and (33) in the main text can be derived from (29'), (A19), and (A16). The former is flat, whereas the latter can be downward or upward-sloping. In the figure we assume it is downward sloping. We now turn to the steady-state relationship between w and H. Since households discount at rate r, λ is constant. The value of μ is given by

$$(A20)\quad \mu = \lambda\int_0^{\infty} (w/H)^2(-\phi')e^{-(r+\delta-\psi)t}dt$$

We now examine the steady state values of the system, which are denoted by the subscript ss. First it is clear that $\delta=\psi_{ss}$, fixing μ_{ss}. This in turn implies from (A20) that

$$(A21)\quad \mu_{ss} = -\lambda\int_0^{\infty} (w/H_{ss})^2\phi'e^{-rt}dt = -\lambda(w/H_{ss})^2\phi'/r$$

and therefore $H_{ss} = w[-r\mu/\lambda\phi']^{\frac{1}{2}}$. In order to determine the link between H and w, we require a link between the marginal utility of wealth and total wealth in the steady state. We consider here the case of logarithmic utility, u=ln(c), in which case

(A22) $\lambda = W^{-1}$.

where $W=\Omega_{ss}+[w\phi-\theta H_{ss}t]/r$ is total resources available to the household in the steady state. Inserting (A22) in (A21), totally differentiating we obtain

$$(A23)\quad \frac{(dH_{ss}/dw)}{(H_{ss}/w)} = \frac{(\cap/\mu H_{ss})[2+(\phi''/\phi')(w/H_{ss})] + \cap - 1}{(\cap/\mu H_{ss})[2+(\phi''/\phi')(w/H_{ss})] + \cap - \theta^{*}tH_{ss}/\phi w}$$

where $\cap$ is the elasticity of labor demand with respect to w/H. For the union's argument to be correct in this model the sign of this last expression must be positive. One set of sufficient conditions is $(\phi''/\phi')(w/H_{ss}) > -2$ and $\cap > 1 > \theta^{*}H_{ss}t/\phi w$. The first requires that the labor demand curve not be "too concave." (Linear and Cobb-Douglas demand curves satisfy this condition); the second is that the elasticity of demand for labor exceed unity (for financial wealth to be constant in the steady state, outlay for replacement human capital cannot exceed labor income). In general, $(dH_{ss}/dw)/(H_{ss}/w)$ is less than unity; that is, wage increases are not exactly "validated" in the steady state by higher productivity.

References

Abel, A.B. (1979) *Investment and the Value of Capital*, New York (Garland).

Akerlof, G. A.Rose, J.Yellen and H Hessenius, "East Germany In from the Cold: The Economic Aftermath of Currency Union", *Brookings Papers on Economic Activity*, 1:1991, 1-105.

Burda, M. and Funke, M. (1991) "Germans Trade Unions after Unification: Third-Degree Wage Discriminating Monopolists?", CEPR Discussion Paper No. 573, London.

Burda, M. and Funke, M. (1992) "Labour Demand in East Germany: Some Empirical Evidence from Cross-Section Data", Berlin, mimeo.

Chadha, B. (1991) "Wages Profitability and Growth in a Small Open Economy", *IMF Staff Papers* 38, 59-82.

Djajic, S. and Purvis, D.D. (1987) "Intersectoral Adjustment and the Dynamics of Wages", *Weltwirtschaftliches Archiv* 123, 216-231.

Ford, R.P. and Suyker, W.S. (1990) "Industrial Subsidies in the OECD Economies", *OECD Economic Studies*, No. 15, Paris.

Franz, W. "Im Jahr danach: Die Ostdeutsche Arbeitsmarktentwicklung," *Wirtschaftsdienst* 71 (1991) 573-577

Harrigan, K.R. (1980) *Strategies for Declining Businesses*, Lexington.

Harrigan, K.R. (1983) "End-Game Strategies for Declining Industries", *Harvard Business Review* 61, No. 4, 111-120.

Hayashi, F. (1982) "Tobin's Marginal q and Average q: A Neoclassical Interpretation", *Econometrica* 50, 213-224.

Kamien, M.I. and Schwartz, N.L. (1981) *Dynamic Optimization: The Calculus of Variations and Optimal Control in Economics and Management*, New York/Oxford (North-Holland).

Kleinhenz, Gerhard, "Tarifpartnerschaft im Vereinten Deutschland," *Aus Politik und Zeitgeschicte. Beilage zur Wochenzeitung das Parlament*, No. B12/92, 14-31.

Klodt, H. (1990) "Wirtschaftshilfen für die neuen Bundesländer", *Wirtschaftsdienst* 70, 617-622.

Krugman, P. (1987) "The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher", *Journal of Development Economics* 27, 41-55.

Lawrence, C. and Lawrence, R.Z. (1985) "Manufacturing Wage Dispersion: An End Game Interpretation", *Brooking Papers on Economic Activity*, No. 1/1985, 47-106.

Lucas, R.E. Jr. (1988) "On the Mechanics of Economic Development," *Journal of Monetary Economics* 22, 3-32.

Rose, N. (1987) "Labor Rent Sharing and Regulation: Evidence from the Trucking Industry", *Journal of Political Economy* 95, 1146-1178.

Sachverständigenrat zur Begutachtung der Gesamtwirtschaftlichen Entwicklung (1991) *Marktwirtschaftlichen Kurs halten. Zur Wirtschaftspolitik für die neuen Bundesländer.* Sondergutachten, April 13, 1991, Wiesbaden.

Sala-i-Martin, X. (1990) "Lecture Notes on Economic Growth (II): Five Prototype Models of Endogeneous Growth", NBER Working Paper No. 3564.

Scheremet, W. (1992) "Der Arbeitsmarkt in Deutschland," *DIW-Wochenbericht* 59, 49-57.

Sinn, G., and H.-W. Sinn (1991) *Kaltstart.* Tübingen, J.C. Mohr.

Van der Ploeg, R. (1987) "Trade Unions, Investment and Employment," *European Economic Review* 31, 1465-1492.

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