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## International spillovers and employment in a disequilibrium macroeconomic model for Germany

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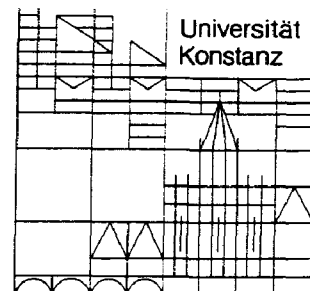
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Wolfgang Franz  
Gustav Heidbrink

**International Spillovers  
and Employment in a Disequilibrium  
Macroeconomic Model for Germany**

**INTERNATIONAL SPILLOVERS AND EMPLOYMENT IN A  
DISEQUILIBRIUM MACROECONOMIC MODEL FOR GERMANY**

**Wolfgang Franz**  
**Gustav Heidbrink**

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### **Abstract**

This paper gives a short overview of the unemployment problem in Germany during the last decade. In a disequilibrium macroeconomic framework there are strong linkages between spillovers of domestic demand on trade flows and labor demand. In the econometric part of the paper these linkages are estimated. For the determination of spillovers special emphasis is put on the trade flows between Germany and a group of four main EEC trading partners. It follows a discussion of employment and labor demand series for Germany and the group of EEC countries with some remarks on possible macroeconomic causes of the German unemployment problem.

# International Spillovers and Employment in a Disequilibrium Macroeconomic Model for Germany

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September 1992

## 1 Introduction

Europe's unemployment problem has been the common theme of the Chelwood Gate conference series. In their summary of Chelwood Gate Mark II Drèze and Bean (1990) conclude that "from a long-run perspective there is ground to be concerned about the vulnerability of Europe to inflation as well as to output and employment fluctuations. The division into relatively open national economies compounds these problems by creating complex interdependencies between countries. This also leads to a need for international cooperation in demand management, public investment, and so on" (p. 61).

Yet at least for the German paper presented at Chelwood Gate II the foreign sector did not receive that much attention despite the considerable openness of the German economy.<sup>1</sup> During the eighties the share of exports among GNP amounted to some 33 percent for Germany.<sup>2</sup> Hence, there is every reason to have a more closer look on international linkages than previously and our current research work on the disequilibrium model attempts to fill this gap.

There are obvious linkages between (un-)employment and the foreign sector in the disequilibrium model. One outcome of such a model is the determination and explanation of different employment series such as actual employment, capacity employment or demand-determined employment. The latter type results from rationing stemming from aggregate demand. However, in an open economy it is not always clear why quantity rationing can be observed. For example, demand pressure may spill over into foreign trade: An excess demand for domestic goods may induce additional imports to bypass this constraint while, on the other side, an excess demand

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<sup>1</sup>See Entorf, Franz, König and Smolny (1990).

<sup>2</sup>Unless stated otherwise "Germany" refers to the Federal Republic of Germany before unification.

on the world market may restrain imports into Germany. Moreover, domestic constraints may hinder foreign imports of domestic products while rationing prevailing on foreign markets may enhance German exports.

Previous work of ours for Germany has elaborated on this aspect by estimating export and import equations explaining trade flows between Germany and major trading partners taking into account different exchange rate regimes.<sup>3</sup> Clearly, this can be only an intermediate step because variables such as foreign GNP were treated as exogenous variables. Hence, repercussions of, say, monetary or fiscal actions in Germany from foreign countries could not be allowed for and questions remained unanswered such as to what extent the German economy may serve as a "locomotive" for other economies in the aftermath of German unification.

The present paper takes a major step in that direction although much remains on the research agenda. While building on previous work of ours and summarizing it briefly, this paper contains the following novelties:

- (i) Three blocks of trade partners are distinguished for which export and import equations are estimated: first, four EC countries (France, Italy, Netherlands, UK) are treated as one group; second, a block of OECD countries (without Germany and the EC countries mentioned before) is analyzed as one trade partner; and third, Germany. This procedure allows us to carry out partially an international comparison of spillovers via international trade.
- (ii) More emphasis is put in this paper on the dynamic specification of the trade flows. More specifically, three variants of the error correction approach are considered which include the proposal by Phillips and Loretan (1991), i.e., the introduction of lagged error correction terms.
- (iii) The paper contains a discussion of a dynamic specification of the capacity utilization rates as rationing indicators and the appropriateness of these variables with other proxies such as business survey data.
- (iv) An estimation of productivity equations for the EC4-block countries is carried out. From these productivities labor demand given the optimal utilization of existing capacities can be derived.
- (v) A comparison of a static version of the CES-function with its dynamic counterpart is displayed. This CES-function stems from the aggregation over micro markets and yields labor transacted.

The plan of this paper is as follows. The next section contains a brief description of the development of unemployment in Germany including some remarks on the labor market situation in East Germany. While the latter aspect is, for obvious data deficiencies, beyond the scope of our present study it may well contribute to an overall assessment of Europe's unemployment problem. Section 3 is devoted to a brief outline of the basic philosophy of the model. Section 4 is concerned with

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<sup>3</sup>See Franz, Heidbrink and Scheremet (1992) and Franz and Heidbrink (1991).

the theoretical and econometric analysis of the trade equations and the resulting spillovers. Special attention is given to the dynamics of exports and imports in section 4.1. From a brief discussion of the productivity equations in section 5 we are in a position to calculate and discuss various types of labor demand and employment. This is carried out in section 6 with a special reference to labor demand derived from an optimal utilization of existing capacities and from expected goods demand, respectively. This discussion enables us to draw some conclusions about which developments contribute to an explanation of employment in Germany in the eighties. In order to be more specific about structural unemployment section 7 is devoted to an estimation of several mismatch parameters both for the EC4 countries and Germany and for a mismatch on the labor market stemming from the goods market and directly from the labor market. Finally, the conclusion in section 8 summarizes some of our findings and caveats.

## 2 Unemployment in Germany 1980–1992

The beginnings of the eighties were characterized by a combination of a supply-side policy and a rigorous consolidation of the public budget. The general government budget deficit as a percentage of GNP fell from nearly 4 percent in 1981 to about 1 percent in 1985. The main reason for embarking upon such a course was the concern about the public debt and the current account deficit (after fourteen consecutive years of surpluses). Due to the fiscal consolidation and a restrictive monetary policy as a response to the current account deficit, the German economy was trapped in a combination of low growth and high persistent unemployment.

Figure 1 highlights the development of the official unemployment rate and its persistence until 1988 as well as the share of long-term unemployment which rose to unprecedented levels of some 35 percent.<sup>4</sup> Moreover, table 1 provides some insights into the structure of unemployment by age, sex, and qualifications. As can be seen there is a shift of the percentages towards to the advantage of younger people and the disadvantage of qualified workers.

While the rise in unemployment in the first half of the eighties was caused by a lack of aggregate demand due to the restrictive policies mentioned above, figures 2 and 3 present tentative evidence that structural factors are at work, too, as is highlighted by the apparent shift of the NAIRU and the Beveridge curve, respectively. The amount of this increase of structural unemployment and the underlying causes are much less clear. NAIRU estimates for the second half of the eighties vary between 5 and 9 percent.<sup>5</sup> Estimates of the Beveridge curve are subject to considerable data deficiencies which cloud the issues and, except long-term unemployment, no convincing explanatory variable emerged from various studies.<sup>6</sup> In particular, several mismatch indicators seem to be less promising candidates for an explanation of a possible outward shift of the  $u/v$ -curve.

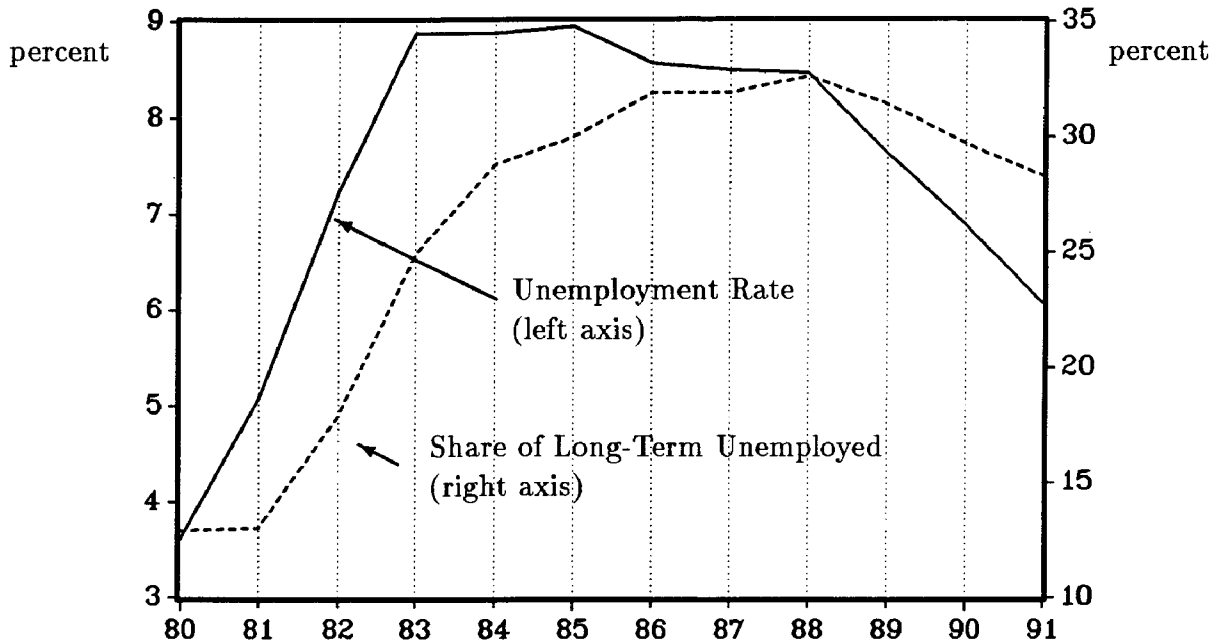
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<sup>4</sup> "Long-term" means unemployed for more than one year.

<sup>5</sup> See Franz and Gordon (1992) for a summary.

<sup>6</sup> A collection of more recent studies is contained in Franz (1992).

**Figure 1:** Unemployment Rate and Share of Long-Term Unemployment 1980–1991 in West Germany (percentages)



While the previous remarks were concerned with the developments in West Germany, skyrocketing unemployment rates in East Germany are clearly the most important issue. Table 2 sets out the evidence and displays various components of the underutilization of labor in East Germany. In addition to officially registered unemployment the following elements have to be taken into account in order to obtain a more realistic assessment of the unemployment problem. (i) Short-time workers multiplied by the percentage of working hours lost (approximately 56 percent on average) yields an estimated value for full-time unemployed workers as converted from short-time workers.<sup>7</sup> (ii) The overwhelming number of persons leaving unemployment take part in work-creating measures or in qualification within their further vocational training. (iii) A considerable number of persons claim benefits by early retirement regulations. Most if not all of these persons would be registered as unemployed otherwise.

As can be seen from col.(6) “hidden” unemployment defined in that way is, for 1991, nearly two times higher than officially registered unemployment. Moreover, a corrected unemployment rate for 1992 which includes both official and hidden unemployment exceeds considerably a 30 percent mark. As a mirror of these developments, the number of employed persons – net of short-time workers and participants

<sup>7</sup>The drop of short-time workers in 1992/1 is due to the expiry of favourable (financial) regulations concerning short-time work.



Table 1: Structure of Unemployment in West Germany (percentages)

Structure	1980	1990
Sex		
Males	44.8	46.2
Females	55.2	53.8
Age (years)		
20-	9.9	3.5
20-25	17.4	12.3
25-45	42.5	46.0
45-55	14.7	19.8
55+	15.5	18.4
Vocational Training		
Completed	46.0	53.2
Not completed	54.0	46.8

Source: Bundesanstalt für Arbeit, Amtliche Nachrichten July 1991.

in work creating measures – declined from 8.1 mill. persons in 1990 to 5.4 in 1991 which is expected to be roughly the figure for 1992, too.<sup>8</sup>

There is a complex of several reasons which come into consideration when explaining the exorbitant losses in employment, but the following three causes stand out:

- (i) Layoffs due to failures in organizing and planning, inherent in the socialist system, as well as to political impediments such as employees and working hours spent on political tasks (political cadres, party functionaries, paramilitary actions and the like);
- (ii) Layoffs due to demand and supply shocks such as the break-down of exports of the former GDR to Eastern Europe, the shift of consumer demand to Western products, the distortions of the output structure (for example, the sectoral distribution of employees), various misallocations, and the catch-up with West German negotiated wages which caused difficulties more for existing firms fighting for survival rather than for newly established plants.
- (iii) Retardation of investment from West Germany and other countries due to obstacles stemming from institutional regulations such as legal problems in the acquisition of real estate and delays in obtaining business licences and building permits.

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<sup>8</sup> Yearly averages; source: DIW-Wochenbericht 16/17-1992, p. 213.

Table 2: Unemployment in East Germany (see text)

Quarter	Registered Unemployment		Short-time Workers (1000)	Particants in WCM and FVT <sup>a)</sup> (1000)	Early Retirement (1000)	Hidden Unem- ployed <sup>b)</sup> (1000)
	(1000)	p.c.				
	(1)	(2)	(3)	(4)	(5)	(6)
90/3	309	4.1	1295	20	270	1015
90/4	557	6.7	1736	47	305	1324
91/1	757	8.9	1926	88	501	1668
91/2	843	9.5	1899	188	509	1760
91/3	1029	11.7	1333	378	564	1782
91/4	1038	11.8	1035	559	643	1782
92/1	1220	15.5	494	650 <sup>c)</sup>	640 <sup>c)</sup>	1567

a) WCM = work-creating measures; FVT = further vocational training (full-time)

b) Calculated as:  $0.56 \times \text{col.}(3) + \text{col.}(4) + \text{col.}(5)$

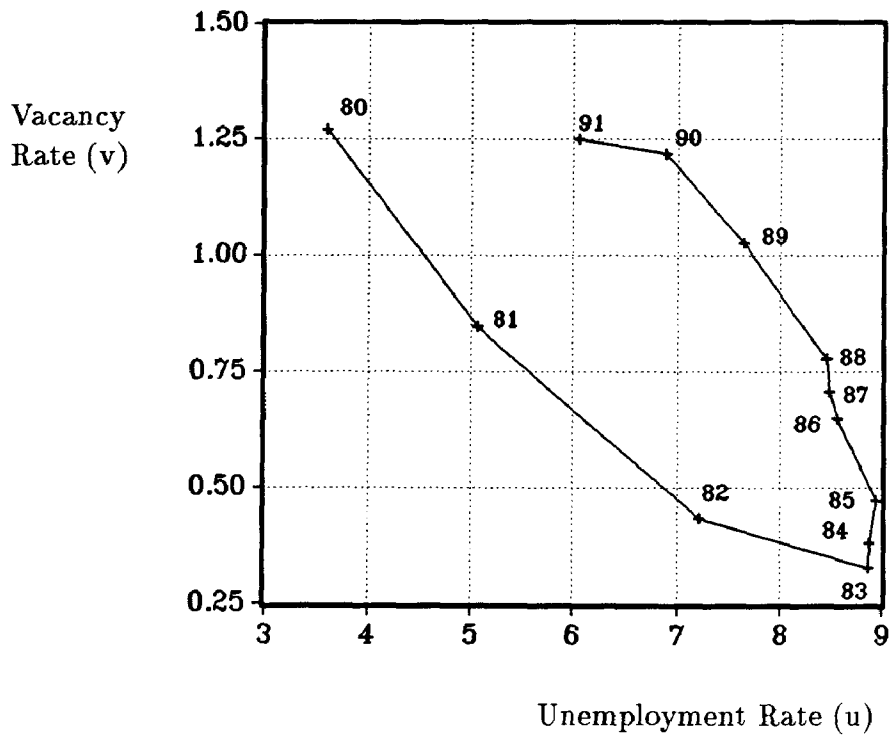
c) Estimates for 1992.

Source: Bundesanstalt für Arbeit, Amtliche Nachrichten; DIW-Wochenbericht 16/17-1992; Institut der Deutschen Wirtschaft, Zahlen 1992; calculations by the authors.

**Figure 2: Unemployment and Change of Inflation Rate in West Germany 1980-1991**



**Figure 3: Beveridge Curve in West Germany 1980-1991**



### 3 Structure of the Model

In this brief section we highlight the basic structure of the model. The basic philosophy of the approach has its origin in the work by Sneessens and Drèze (1986) and Lambert (1988) and is discussed in the conference volume edited by Drèze and Bean (1990). Given this literature, we concentrate on where the present model departs from that work and what is necessary to understand our modelling of international linkages.

Basically, two issues emerge which distinguishes our model from others. First, the flexibility of output and employment decisions of the firm depend on the time span under consideration. Secondly, as a consequence from such a stepwise decision procedure of the firm it follows that the firm does not decide on output and employment simultaneously. Therefore, the labor and goods market can be treated separately. This recognition rests on the work by Smolny (1991) and stands in contrast to the earlier studies mentioned above in which no special treatment of both markets is necessary because rationing regimes on the goods market determine those on the labor market.

More specifically, three time intervals are distinguished where an index  $n$  refers to the firm's level: In the *short run*, the firm adjusts output given employment, capital stock and the capital-labor ratio as predetermined variables. Then, output ( $YT_n$ ) is the minimum of demand ( $YD_n$ ) and supply ( $YS_n$ ):

$$YT_n = \min(YD_n, YS_n). \quad (1)$$

In the *medium run*, employment is under control by the firm whereas the capital stock is still a fixed factor of production. Employment ( $LT_n$ ) is then the minimum of labor demanded ( $LD_n$ ) and labor supplied ( $LS_n$ ), i.e.,

$$LT_n = \min(LD_n, LS_n). \quad (2)$$

Given labor supply, how is labor demand determined in the medium run? The firm has to recognize two different constraints: firstly, existing capacities ( $YC_n$ ) from which labor demand  $L_{YC_n}$  results, or, secondly, expected goods demand ( $YD_n$ ) from which labor demand  $L_{YD_n}$  can be derived.

Consider  $L_{YC_n}$  first and note that, by definition,

$$L_{YC_n} \equiv \frac{YC_n}{(Y/L)_n^*} \equiv K_n \cdot \left(\frac{Y_n}{K_n}\right)^* / \left(\frac{Y_n}{L_n}\right)^* \quad (3)$$

where the terms in brackets denote optimal capital and labor productivity, respectively. These optimal productivities are derived from the first-order conditions of a profit maximizing firm which produces according to a CES-technology. As a result, these productivities depend on factor price ratios such as wages to capital costs and efficiency terms stemming from the production function which reflect labor and capital saving progress, respectively.

For the determination of  $L_{YD_n}$ , i.e., labor demand derived from expected goods demand ( $YD_n$ ), the firm has to recognize that in the optimum marginal costs of

labor, i.e., the real wage rate  $W/P$ , should equal marginal returns from labor. The latter variable is productivity of labor times the probability that expected goods demand in fact exceeds those quantities which otherwise can be produced with optimal labor demand. Taking into account that the inverse of optimal labor productivity times the real wage rate equals labor's share in output at full utilization of labor, it can be shown that  $L_{YD_n}$  is determined by expected goods demand, optimal labor productivity (as determined above), labor's share and the variance of goods demand:

$$L_{YD_n} = E(YD_n) \cdot \left(\frac{L_n}{Y_n}\right)^* \cdot \left[ \exp(-0.5 \cdot \sigma_{y d_n}^2) \cdot \left(\frac{1 - sl_n}{sl_n}\right)^\alpha \right] \quad (4)$$

where  $E$  is the expectations operator,  $\sigma_{y d_n}^2$  is the logarithmic variance of goods demand, and

$$sl_n = \frac{W_n}{P_n} \cdot \left(\frac{L_n}{Y_n}\right)^*, \quad \alpha = \frac{\sigma_{y d_n} \cdot \sqrt{3}}{\pi}.$$

Finally, in the *long run* firms can adjust capacities ( $YC_n$ ) by changing the capital stock ( $K_n$ ) and/or the production technology. More specifically,  $YC_n$  is determined by the condition that expected marginal returns from capital should equal capital costs. By making use of a similar procedure as in determining  $L_{YD_n}$ , capacities  $YC_n$  are chosen by the firm according to profitability and the expected value and the variance of  $Y_n^A$ , where

$$Y_n^A = \min(Y_{LS_n}, Y_{LYD_n}, YD_n). \quad (5)$$

Eq. (5) states that  $Y_n^A$  is the minimum of the constraints that may prevent from full utilization of capital and labor. These constraints are available labor supply ( $Y_{LS_n}$ ), output produced with optimal labor demand as derived previously ( $Y_{LYD_n}$ ), and goods demand ( $YD_n$ ). Optimal capacities are then proportional to  $E(Y_n^A)$ . The capital stock is obtained by:

$$K_n = \left(\frac{K_n}{Y_n}\right)^* \cdot YC_n \quad (6)$$

where  $(K_n/Y_n)^*$  has been discussed in context with eq. (3).

Aggregation of demand and supply quantities from the micro goods and labor market, respectively, rests on the smoothing by aggregation procedure put forward by Lambert (1988). The joint statistical distribution can be developed, on theoretical grounds, to be a bivariate lognormal distribution.<sup>9</sup> Aggregation over micro markets then yields a tractable functional form for goods transacted:

$$YT = \{YS^{-\rho_G} + YD^{-\rho_G}\}^{-\frac{1}{\rho_G}}. \quad (7)$$

The two variables  $YS$  and  $YD$  in the CES-function have the following interpretation.  $YS$  is output supply determined by employment times optimal productivity, i.e. labor productivity at full utilization of labor. As mentioned before [(see the

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<sup>9</sup>See Smolny (1991).

discussion of eq.(3)], the latter is obtained by regressing actual labor productivity on, among others, factor prices and capacity utilization. Using this regression and calculating labor productivity for full utilization gives the aforementioned optimal labor productivity [see eq. 19].

$YD$  is goods demand, which is not observable. As will be discussed in more detail in the next section, goods demand is transacted output corrected for spillovers into export and import demand [see eq. 16].

The mismatch parameter  $\rho_G$  measures the mismatch of supply and demand on the goods markets. For  $\rho_G \rightarrow \infty$  equation (7) tends to the usual minimum-condition, i.e., now not only some micro markets but also the aggregate economy is subject to only one of the constraints.

Similar arguments can be applied to the labor market. Transacted labor  $LT$ , i.e., employment, is determined either by labor supply  $LS$  or by labor demand  $LD$ . The latter is split into labor demand based on expected goods demand ( $L_{YD}$ ) and labor demand brought about by productive capacities  $L_{YC}$ . By the same way of reasoning we obtain:<sup>10</sup>

$$LT = \{LS^{-\rho_{LT}} + (L_{YD})^{-\rho_{LT}} + (L_{YC})^{-\rho_{LT}}\}^{-\frac{1}{\rho_{LT}}}. \quad (8)$$

Eq. (7) can be transformed into elasticities of  $YT$  with respect to  $Y_{LT}, YD$ . Moreover, these elasticities can be shown to represent share of firms (“regimes”) being constrained either by supply or goods demand:

$$\left. \begin{aligned} \epsilon_{YT, Y_{LT}} &= \left\{ \frac{YT}{Y_{LT}} \right\}^{\rho_G} \\ \epsilon_{YT, YD} &= \left\{ \frac{YT}{YD} \right\}^{\rho_G} \end{aligned} \right\} \quad (9)$$

Similar elasticities can be derived from eq. (8) for the labor market. The elasticities represent share of firms (“regimes”) being constrained either by labor supply, goods demand, or capacities.

## 4 International Linkages: Trade Equations and Spillovers

Exports and imports play an important role in the model not only as the usual components of aggregate demand but also due to the idea that an excess of goods demand ( $YD$ ) over goods transacted ( $YT$ ) spills over into the trade balance or is absorbed by inventories (not considered here). The notion that domestic consumers’ and investors’ demand spill over, if rationed, to foreign markets gives rise to a distinction between actual and structural imports and exports, respectively, where “structural” is a short-hand expression for “in the absence of rationing.” These structural trade equations are calculated for a hypothetical situation where no rationing occurs. For example, parts of imports may be due to domestic rationing. If such a bottleneck depends on, say, conditions on the goods markets, the domestic capacity utilization

<sup>10</sup>Note that the aforementioned variables, variance of excess demand and labor share, turned out to be insignificant in the estimation of  $L^*$ . Hence, we have dropped these variables in eq. 4.

rate variable enters the equation for actual imports as an additional variable (with a positively signed coefficient). A convenient procedure to calculate structural imports is then to use the regression equation for actual imports and to obtain structural imports for the historical minimum of the capacity utilization rate thereby assuming that in such a situation no rationing is present. From this it follows that structural imports usually fall short of actual imports. The opposite holds for structural exports which exceed actual exports because domestic constraints may hinder foreign imports as long as domestic firms prefer to serve domestic customers.

On this background the following themes emerge:

- (i) Trade equations have to be estimated where, in addition to previous work of ours<sup>11</sup>, much more emphasis is put on the dynamics of domestic imports and exports. Moreover, this paper extends previous work of ours<sup>12</sup> by estimating trade equations not only between Germany and four EC countries (France, Italy, Netherlands, and the U.K., EC4 countries for short) but also between those EC4 countries and OECD countries and between Germany and OECD countries (where OECD in this context means, of course, without Germany and EC4 countries).
- (ii) Since the hypothesis is that an excess demand on domestic and foreign goods markets affect foreign trade, a crucial question is as to how to measure such an excess demand. Both, capacity utilization rates and business survey data are considered and their appropriateness is evaluated.

These topics are considered in turn. To begin with German exports, a foreign income variable  $Y_i$  is measured as real foreign GNP, where  $i$  refers to country  $i$ . Moreover, a relative price variable enters the export equation. It is defined as the ratio of German export prices ( $P_x$ ) to the foreign export prices, where the latter is multiplied with the exchange rate (defined as Deutsche Mark per units of foreign currency). While this variable measures the competitiveness of German exports as compared with prices prevailing in the importing country, the following variable reflects the competitiveness of German exports with those of other exporting countries: the ratio of German export prices ( $P_x$ ) to export prices of other major industrial countries ( $P_x^w$ ).

Taken together, in general we obtain the following equations for exports to country  $i$ , where lowercase letters denote logs.

$$x^i = f_{x_i} \left( \underset{+}{y^i}, \underset{-}{p_x - p_x^i} - e^i, \underset{-}{p_x - p_x^w}, \underset{-}{q}, \underset{+}{q^i} \right) \quad (10)$$

The signs below the explanatory variables denote the influence we expect on theoretical grounds. The variable  $q$  stands for excess demand on the goods market. For trade flows between Germany and the EC4 countries the capacity utilization rates are employed as proxies for excess demand. Excess demand for the remaining countries is proxied by the U.S. utilization rate.

<sup>11</sup>Franz, Heidbrink and Scheremet (1992).

<sup>12</sup>Franz and Heidbrink (1991).

## 4.1 Dynamics and Specification Problems

As has been mentioned in the introduction already, some efforts are made in this paper to elaborate on the dynamic specification of the trade equations. Basically, three different but not mutually exclusive dynamic specifications are considered. First we employ the by now traditional error correction specification:

$$\Delta x_t^i = \Delta c_t \cdot \psi_1 - \lambda \cdot (x_{t-1}^i - c_{t-1} \cdot \psi_2 - Z_{t-1}^i \cdot \phi_1) + \sum_{k=0}^n \Delta Z_{t-k}^i \cdot \phi_{2,k} \quad (11)$$

where  $c$  denotes the vector of different rationing variables discussed before and  $Z$  is the vector of the aforementioned other explanatory variables.  $\psi_1$  and  $\psi_2$  represent the short-term and long-term influences, respectively, of the rationing variables. Testable hypotheses about the dynamics stemming from changes of the rationing barriers are<sup>13</sup>

- (i)  $\psi_{1,j} = \psi_{2,j}$ : In this case an increase of domestic rationing affects exports immediately and negatively. This holds in the short run as well as in the long run.
- (ii)  $|\psi_{1,j}| > |\psi_{2,j}|$ : An increase of domestic rationing leads to an immediate rationing of German exports. To some extent, however, this increased rationing of exports is mitigated as time passes because firms do not ultimately give up export markets even if domestic rationing still holds. This may mean that firms have some preference of serving export markets.
- (iii)  $|\psi_{1,j}| < |\psi_{2,j}|$ : In contrast to the previous case the timing of the preferences is reversed. In this case firms favor export markets only in the short run.

Similar arguments hold for increasing rationing barriers on foreign markets.

In a second step, we enlarge the error correction eq. (11) by lagged values of the endogenous variable as additional explanatory variables. Such a specification may be suitable for a more general specification of the adjustment process as compared with eq. (11) where the dynamics stem only from changes of the exogenous variables and the error correction term.

$$\begin{aligned} \Delta x_t^i = & \Delta c_t \cdot \psi_1 + \sum_{k=0}^n \Delta Z_{t-k}^i \cdot \phi_{2,k} + \sum_{k=1}^n \theta_k \cdot (\Delta x_{t-k}^i - \Delta c_{t-k} \cdot \psi_1) \quad (12) \\ & - \lambda \cdot (x_{t-1}^i - c_{t-1} \cdot \psi_2 - Z_{t-1}^i \cdot \phi_1) . \end{aligned}$$

A third variant of the dynamics is based on a proposal by Phillips and Loretan (1991) which requires non-linear specifications of several lagged error correction terms. The advantage of this procedure is that the persistence of unit roots in the system can be

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<sup>13</sup>  $j = 1, 2$  is associated with the element for domestic rationing.



better captured as compared with the introduction of lagged endogenous variables as in eq. (12). A fairly general specification based on this methodology is as follows:

$$\Delta x_t^i = \Delta c_t \cdot \psi_1 + \sum_{k=0}^m \Delta Z_{t-k}^i \cdot \phi_{2,k} \quad (13)$$

$$- \sum_{k=0}^n \lambda_k \cdot (x_{t-1-k}^i - c_{t-1-k} \cdot \psi_2 - Z_{t-1-k}^i \cdot \phi_1) .$$

We now consider German imports. The import equations basically exhibit the same structure as the export equations. Both rationing variables are included and we expect signs opposite to the export equations. An increasing excess demand on German goods markets should increase imports, whereas excess demand on foreign markets should have the opposite effect. As for exports we test two relative price variables, one reflecting the direct competition of foreign goods coming from country  $i$  with German products and the other taking into account the competition with imports coming from other exporting countries. The first is defined as the German price deflator divided by foreign export prices. It is expected to have a positive coefficient. The second is a competitive price with other imports. This variable is the export price of the exporting country divided by the export price index of the competing country.

The import equations are also estimated in the error correction forms outlined before. To give an example, the first variant corresponds with eq. (11):

$$\Delta m_t^i = \Delta c_t \cdot \psi_1 - \lambda \cdot (m_{t-1}^i - c_{t-1} \cdot \psi_2 - Z_{t-1}^i \cdot \phi_1) + \sum_{k=0}^n \Delta Z_{t-k}^i \cdot \phi_{2,k} . \quad (14)$$

Again testable hypotheses about the dynamics stemming from changes of rationing barriers emerge:

- (i)  $\psi_{1,j} = \psi_{2,j}$  : Increases of the importance of domestic rationing barriers immediately lead to higher imports and the same amount of this change can be observed in the long run, too.
- (ii)  $\psi_{1,j} < \psi_{2,j}$  : In this case the increase of imports is spread over time due to adjustment costs and time lags which occur because domestic firms must find adequate foreign producers. Hence, in the short run domestic customers cannot bypass supply constraints fully by additional imports if there are adjustment costs of increasing imports.<sup>14</sup>

Similar arguments hold if foreign rationing gains importance.

As has been mentioned before, the second aspect concerns the measurement of excess demand as an indicator for rationing. At this stage, however, excess demand  $YD/YT$  is not known because  $YD$  is not observed. Another tension variable

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<sup>14</sup>On the other hand, the assumption of a full spillover stemming from domestic excess supply on imports holds in the long run. Rationing of consumer demand for domestic goods is neglected, however, although it can be mitigated by domestic firms by reducing exports.

which corresponds with excess demand is the share of supply constrained firms ( $\epsilon_{YT, Y_{LT}} = (YT/Y_{LT})^{\rho_G}$ ). Both variables are highly correlated with the difference that  $\epsilon_{YT, Y_{LT}}$  is restricted to lie in the interval  $[0, 1]$ . In order to measure the share of supply constrained firms two possible variables are considered. One proxy is the capital utilization rate. More specifically, in a previous study (Franz, Heidbrink and Scheremet (1992)) we used the ratio of actual capital utilization to its minimum value during the sample period or, in logs,  $(q - q^{min})$  and  $(q - q^{min})^i$ , where  $q$  is the log of capital utilization, and the superscript min denotes its minimum value. The use of the  $q^{min}$ -variables assumes no rationing (excess demand) if capital utilization is at its minimum value.

An alternative proxy for excess demand rests on business survey data of the manufacturing sector published by the Ifo-Institute (Munich).<sup>15</sup> Two questions of this survey are relevant for the problem under consideration:

1. Is your domestic production hindered?
2. If so, is it hampered by
  - lack of order,
  - shortage of workers,
  - shortage of materials, or
  - shortage of technical capacities?

Hence, the Ifo-questionnaire deals mainly with a possible rationing on the goods market although the “shortage of workers” corresponds with rationing on the labor market, too. The central variable we want to proxy is excess demand on the goods market. This is equivalent to the notion of supply constrained firms regardless of the source of the constraint (shortage of workers and/or of capacities). As compared with the capacity utilization rate as the alternative proxy for excess demand, the share of constrained firms from the questionnaire covers potential sources for rationing barriers. This advantage has, however, to be balanced against several shortcomings of the survey data. Most importantly, multiple answers are possible for the second question. Hence, shares do not add up to 100 per cent. Moreover, a non-negligible percentage of firms answered that their domestic production is not constrained at all. This, however, represents only a borderline case in the theoretical model. This stands in contrast to the empirical relevance of firms which declare not being rationed. With the recession of 1982 as an exception this share is increasing since the mid-seventies up to 80 per cent in the mid-eighties. There are several hypotheses about this time pattern. First, firms are in fact in an equilibrium situation; second, firms simply refuse to answer question 2 for reasons whatsoever;<sup>16</sup> third, firms mistakenly view themselves as being in an equilibrium and do not identify, for example, an existing capacity constraint. There are several ways to cope with this problem empirically.

<sup>15</sup>See Franz and Heidbrink (1991) for more details.

<sup>16</sup>A related explanation is given by Kooiman (1986) who points out that respondents are urged to reply as quick as possible such that they respond in the most convenient way, i.e., they are unwilling to continue with question 2 of the questionnaire.

In an earlier study Marnet (1988) regards all firms which give a negative answer to the first question as being in a “classical regime” in the sense of Malinvaud’s terminology since they are neither constrained on the goods market nor on the labor market.<sup>17</sup> König and Entorf (1990) take a similar approach but in addition make use of informations about overtime hours and backlog of orders which are also contained in the survey. While the levels of the regimes differ as compared with Marnet (1988) their change does not. In Franz and Heidbrink (1991) two different procedures are tested, namely to consider the share of firms regarding themselves in an equilibrium as a separate explanatory variable or to treat these firms as being constrained by the supply side. Although the latter hypothesis may result in an overestimation of the supply constrained regime it can be motivated by the idea that firms are less likely to be aware of supply constraints whereas demand constraints are much more easier to be identified. To some extent the estimated coefficients of the “equilibrium share” and the “supply constrained share” allow us to discriminate between both procedures.

## 4.2 Econometric Results

This subsection discusses some of the estimation results. Lack of space prohibits us to present all results which are available on request, however.

To begin with the trade flows between Germany and the EC4 countries, [table 3](#) displays some basic results for German exports to the EC4 countries and EC4 exports to Germany, respectively. For each of these exports two different variants can be compared in [table 3](#). Variants I are based on the specification outlined in [eq. 12](#). Variants II follow the structure proposed by [eq. 13](#) in that lagged values of the error correction term are introduced as additional explanatory variables.

A comparison of both export equations and both variants reveals similar long-run relationships with the EC4-capacity utilization rate in the EC4 export regressions as an exception (see below). Both output  $y^*$  and the capacity utilization rate  $q^*$  of the importing country are significant with a higher demand elasticity of the EC4 countries as compared with Germany. Therefore, the German economy gains more from a trend increase of the EC4-GNP rather than the other way around. On the other hand, exports of the EC4-countries seem to be more influenced by business fluctuations in Germany (coefficients 1.055 and 0.915, respectively) as compared with the dependance of German exports on the EC4-capacity utilization rates (coefficients 0.645 and 0.620, respectively).<sup>18</sup> Taken at face value and referring to the theme of this

<sup>17</sup>Moreover, one can follow the procedure proposed by Seitz (1988). The theoretical model can be modified in a way that a positive mass of the joint distribution of  $Y_{LT}$  and  $YD$  is allotted to the “no-constraint” answering category: Rather than to assume that  $YD/Y_{LT} < 1$  and  $YD/Y_{LT} > 1$  triggers the demand and supply constrained responses, respectively (with zero mass for the event  $YD = Y_{LT}$ ), one could assume that those firms regard themselves as unconstrained for which  $YD/Y_{LT}$  falls into an intervall  $[1 - a, 1 + b]$ . While this procedure undoubtedly has its merits, it is not straightforward to estimate such an interval due to the increasing share of these answers. Moreover, there are several possible interpretations of the “no-constraints”-answers and the introduction of an ad hoc interval seems equally ambiguous.

<sup>18</sup>The coefficients associated with  $q^*$  are not significantly different at the 5 percent level, however.

paper, the spillover effects of a rationed German goods market on the EC4 countries somewhat outweigh the respective spillovers from rationed EC4 goods markets on the German economy.<sup>19</sup>

There is, however, no major difference between the coefficients associated with the short-run and long-run spillovers for both countries.<sup>20</sup> An excess demand in one country leads to an immediate increase of imports. This absence of substantial delays points to well established exports markets between both countries under consideration.

So far we have examined spillovers on exports of each country originated by rationed goods markets of the trade partner. This is, of course equivalent to evaluating the spillovers on imports of each country stemming from domestic rationing. What about domestic rationing on domestic exports? As can be seen by inspection of the coefficients associated with  $q$  in table 3, these spillover effects fall short of those on domestic imports. This holds for the EC4 countries as well as for Germany. Note that the aforementioned coefficients are restricted to be equal for German exports<sup>21</sup> (because they are not significantly different) but not for the EC4 exports. Taken together, these findings are in line with the argument that exporting firms are not likely to be inclined to regard foreign markets as buffers to be built up in domestic recessions periods and to be given up when the domestic economy is booming. This reasoning is especially put forward by the hysteresis in trade argument [Baldwin (1990)].

In table 3 capacity utilization rates serve as proxies for rationing. This leads to the question of the adequateness of this variable as compared with the business survey data (see section 4.1). As has been shown in Franz and Heidbrink (1991) business survey data do not outperform capacity utilization rates. This is mainly due to the shortcomings of those survey data discussed previously.<sup>22</sup>

Table 4 reports the estimation results for the trade flows between (i) Germany and the remaining countries (= ROW) and (ii) EC4-countries and ROW.<sup>23</sup> Since the structure and many results are similar to the findings in Table 3 only a few comments are necessary. With one exception all demand pressure variables  $y^*$  and  $q^*$  are highly significant. Note that the US capacity utilization rate serves as the rationing indicator for ROW countries. Hence, these results reinforce strong spillover effects of domestic business conditions on domestic imports (with the exception of ROW imports from Germany). As in the EC4-Germany trade, the impact of domestic rationing ( $q$ ) on exports falls short of the spillovers on imports. While for German exports the variable  $q$  displays some significant influence,  $q$  lacks significance for EC4 exports. At a first glance, the result may point out to some persistence in EC4 trade.

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<sup>19</sup>Note that,  $y^*$  in table 3 is the GNP of the importing country, i.e., for German exports  $y^*$  is the GNP of the EC4 countries and for EC4 exports  $y^*$  stands for German GNP. The same holds for  $q^*$ . In contrast to  $y^*$ , however, also  $q$  enters the equation, i.e., the domestic capacity utilization rate.

<sup>20</sup>Therefore, the short-run and long-run coefficients are restricted to be equal.

<sup>21</sup>Moreover,  $\Delta q$  is lagged one period in both countries in order to circumvent problems with simultaneity.

<sup>22</sup>See Franz and Heidbrink (1991) for more details.

<sup>23</sup>To be specific ROW  $\equiv$  OECD minus Germany minus EC4.

Table 3: Trade between Germany and the EC4-countries<sup>a)</sup>

Version	German Exports		EC4 Exports	
	I	II	I	II
$y^*$	2.131 (25.08)	2.140 (27.68)	1.527 (14.63)	1.508 (14.46)
$px - px^*$	-0.362 (-4.85)	-0.315 (-4.07)		
$px - px^c$			-0.030 (-0.65)	-0.034 (-0.74)
$q$	-0.346 (-1.78)	-0.319 (-2.18)	-0.581 (-1.93)	-0.392 (-1.36)
$q^*$	0.645 (3.30)	0.620 (2.87)	1.055 (4.20)	0.915 (3.58)
$\Delta q$		-0.319 <sup>†</sup>	-0.443 (-1.43)	-0.643 (-1.64)
$\Delta q^*$	0.645 <sup>†</sup>	0.620 <sup>†</sup>	1.055 <sup>†</sup>	0.915 <sup>†</sup>
$\lambda$	-0.727 (-6.05)	-0.658 (-5.20)	-0.621 (-4.14)	-0.925 (-6.87)
$\theta^b$		-0.201 <sup>(3)</sup> (-1.92)	-0.342 <sup>(1)</sup> (-2.70)	0.275 <sup>(2)</sup> (2.07)
			0.141 <sup>(4)</sup> (1.45)	
$\bar{R}^2$	0.873	0.879	0.825	0.813
SEE	2.395	2.331	2.596	2.690
Q(8)	7.41	4.46	10.4	6.39
Q(12)	8.07	4.73	12.3	7.03
Q(16)	11.0	9.24	12.6	7.38

- a) Sample period: 1975:1–1989:4;  $t$ -values in parentheses; † indicates that the short-run and long-run coefficients are restricted to be equal;  $\bar{R}^2$  is the squared correlation coefficient corrected for degrees of freedom, SEE stands for standard error of estimates, and  $Q$  denotes the Ljung-Box  $Q$ -statistic; version I refers to eq. (12), version II refers to eq. (13) in the text; dynamics with regard to exogenous variables and relative prices are skipped from table 3;  $(px - px^*)$  is the export price of the exporting country (in logs) divided by the export price of the importing country (in logs); in the competitive price variable  $(px - px^c)$   $px^c$  denotes the log of the export price of the competing country; see text for further explanations.
- b) The superscripts in parentheses at various coefficients denote the lag-order of the explanatory variable associated with  $\theta$  where  $\theta$  means the coefficients associated with the lagged endogenous variables in version I and the coefficients associated with lagged error correction terms in version II, respectively.

However, this seems to be at variance with the negative influence of  $EC4-q$  on  $EC4$  exports to Germany (see table 3, coefficients -0.581 and -0.392, respectively). While small this effect, however, may be due to higher sunk costs in ROW countries as compared with Germany, but this argument is speculative at this stage of research. Moreover, simultaneity problems – exports influence the capacity utilization rate – cloud the issues here more severely because  $EC4$  exports to Germany are much less important as compared with  $EC4$  exports to ROW countries thus exhibiting a stronger influence of the capacity utilization rate. Put differently, the capacity utilization rate  $q$  in  $EC4$  exports to ROW countries is hardly an exogenous variable any longer.<sup>24</sup>

Finally, from the export and import equations we can calculate “structural” exports and imports, respectively, i.e., exports and imports in the absence of rationing. Using both structural variables we are able to determine the unobservable goods demand  $YD$ .

To begin with structural exports  $XD$  they are obtained on the basis of a dynamic simulation of the non-restricted export equations presented before. More specifically, spillover effects due to rationing in Germany are calculated as the difference between simulated exports without rationing variables and simulated exports with rationing variables. These spillovers plus actual exports yield structural exports.

Domestic rationing causes additional imports to bypass (partly) such an excess demand. Structural imports are calculated on the basis of the following equation:

$$MD_i = MT_i - \psi_i \cdot q \quad (15)$$

The long-term influences  $\alpha_i$  are used to determine excess demand. In contrast to the export equation the short-run coefficients only mirror the dynamic adjustment of imports with respect to changes in excess demand. Domestic rationing implies, however, an immediate and corresponding increase of imports and must therefore be captured by the long-run coefficients.

Table 5 reports the ratio of structural exports and imports to their actual values. It can be seen that spillovers on imports are more relevant than those concerning exports.

After the calculation of structural exports and imports we are now in a position to calculate the demand for goods  $YD$ . This is done by correcting  $YT$  for the differences  $XD - XT$  and  $MD - MT$ . More precisely, we obtain the following equation:

$$YD = YT + (XD - XT) - (MD - MT). \quad (16)$$

To some extent this is a simplification because an excess demand for non-tradable goods cannot be mitigated by imports.

<sup>24</sup>As a consequence we obtained in many regression equations a positive coefficient associated with  $\Delta q$ . This holds for the US capacity utilization rate, too, which serves as a proxy for excess demand of ROW countries.

Table 4: Trade of Germany and the EC4 with ROW<sup>a)</sup>

Version	Exports to ROW				Imports from ROW			
	Germany		EC4		Germany		EC4	
	I	II	I	II	I	II	I	II
$y^*$	1.260 (27.14)	1.282 (30.39)	1.075 (24.12)	1.013 (24.10)	1.910 (19.81)	1.896 (19.95)	1.572 (10.31)	1.727 (10.05)
$px - px^*$	-0.160 (-4.38)	-0.148 (-4.93)					0.224 (1.55)	0.097 (1.39)
$px - px^c$	-0.167 (-1.92)	-0.140 (-1.94)			0.074 (1.80)	0.082 (1.70)		
$q$	-0.185 (-1.68)	-0.318 (-2.45)	-0.174 (-1.13)		-0.376 (-2.35)	-0.416 (-2.15)	-0.322 (-1.27)	-0.035 (-0.20)
$q^*$			0.200 (2.32)	0.364 (2.84)	0.779 (2.66)	0.946 (2.95)	0.847 (3.81)	0.472 (1.91)
$\Delta q$	-0.185 <sup>†</sup>	-0.318 <sup>†</sup>		-0.374 (-1.63)				
$\Delta q^*$			0.200 <sup>†</sup>	0.165 (1.35)	0.542 (2.64)	0.494 (2.03)	0.847 <sup>†</sup>	0.472 <sup>†</sup>
$\lambda$	-0.780 (-7.11)	-0.697 (-6.25)	-0.639 (-5.25)	-0.699 (-5.61)	-0.601 (-5.19)	-0.637 (-5.17)	-0.213 (-2.25)	-0.382 (-3.72)
$\theta$		-0.254 <sup>(3)</sup> (-2.29)		0.266 <sup>(3)</sup> (2.49)	0.316 <sup>(3)</sup> (3.39)	0.339 <sup>(3)</sup> (3.04)	-0.211 <sup>(1)</sup> (-1.65)	0.154 <sup>(6)</sup> (1.88)
						-0.176 <sup>(4)</sup> (-1.67)	0.181 <sup>(6)</sup> (1.60)	
						-0.133 <sup>(6)</sup> (-1.65)		
$\bar{R}^2$	0.840	0.852	0.764	0.793	0.695	0.682	0.791	0.784
SEE	2.531	2.436	1.888	1.768	2.255	2.302	1.974	2.009
Q(8)	5.44	7.33	7.58	7.81	6.31	4.00	6.72	8.00
Q(12)	5.96	8.04	10.8	11.6	8.13	5.98	9.20	10.7
Q(16)	10.7	14.5	12.1	12.5	10.1	7.96	14.2	13.2

a) Notes see table 3.

**Table 5: Ratio of structural exports and imports and demand to transacted values**

Spillover in %	Germany			EC4		
	mean	stand.dev.	max/min	mean	stand.dev.	max/min
$(XD/XT) - 1$	3.04	1.5	6.02	1.75	0.6	2.9
$(MD/MT) - 1$	-9.19	4.4	-17.3	-7.0	3.6	-14.1
$(YD/YT) - 1$	2.95	1.6	6.66	1.93	1.1	4.2

## 5 Productivity Equations

As has been outlined in section 3 optimal labor and capital productivities determine labour demand  $L_{YC}$  derived from capacities ( $YC$ ) which in turn is fixed by existing capacities [see eq. 3]. This section is devoted to a closer look at the theoretical underpinnings of the productivity equations and a presentation of the econometric results for Germany and the EC 4 country block, respectively. For ex-ante substitution possibilities between production factors, the technical productivities of labor and capital are determined by the long-run decisions of the firms with respect to the capital stock and technology. The production function is modelled as a CES-technology with constant returns to scale and with labor-saving ( $\gamma_L$ ) and capital-saving ( $\gamma_K$ ) technical progress. Maximizing profits at given output prices ( $p$ ) and factor costs ( $w, uc$ ) gives for the technical productivities of labor ( $yc - l$ )\* and of capital ( $yc - k$ )\*, respectively, the following equations:

$$(yc - l)^* = \text{const} + \sigma(w - p) + (1 - \sigma)\gamma_L(t) + \delta_1 \cdot h \quad (17)$$

and

$$(yc - k)^* = \text{const} + \sigma(uc - p) + (1 - \sigma)\gamma_K(t) + \delta_2 \cdot h \quad (18)$$

where  $\sigma$  denotes the elasticity of substitution. Hence, the productivities are explained by the factor-product-price ratios and technical progress.

Due to ex-post rigidities of substitution possibilities, actual productivities may deviate from technical values when production factors are not fully utilized. Therefore, actual productivities depend on the technology *and* on the degree of factor utilization. Moreover, both productivity equations contain hours  $h$  as an explanatory variable in order to capture the exogenous usage time of both production functions e.g. due to different holidays. Of course, the usage of hours is not unambiguous since it certainly also measures utilization of labor and may also capture "efforts" in the meaning of efficiency wages. We found, however, that the coefficient associated with the utilization variable does not change very much if hours are included as an additional explanatory variable.

To begin with the estimation results for Germany, the labor and capital utilization ( $Q$ ) rates are measured by business survey data taken by the Ifo-Institut (Mu-



nich) which reflect the capacity utilization of the German industry. Both utilization rates are supposed to exhibit similar movements. Because employment decisions are taken in the medium run we employ a dynamic specification of the utilization rate of capital.<sup>25</sup> Factor prices are hourly wages and the price of investment goods. Actual labor and capital productivities are jointly estimated using an error correction specification with four lagged endogenous variables. We employ cross equations restrictions on the adjustment process in the long-run solution as well as on the lagged endogenous variables. Short-run and long-run effects of utilization on the productivities are restricted to be equal in both equations. Labor- and capital-saving progress is modelled by linear and quadratic time trends. Table 6 displays our results for labor productivity and capital productivity for Germany, respectively. The estimates yield an elasticity of substitution of  $\sigma = 0.636$ .

Labor-saving technical progress decreases slowly during the period under consideration. The corresponding coefficient for capital productivity displays a negative time trend which might result from the energy price shocks which rendered parts of the capital stock obsolete.

**Table 6: Main Coefficients of the Productivity Equations for Germany**

	$q_t$	$q_{t-1}$	$\lambda$	$\sigma$	$\delta$	$\gamma_1$	$\gamma_2$
$(yt - l)$	0.416 (7.30)	-0.463 (-5.19)	-0.194 (-3.68)	0.639 (7.43)	0.420 (6.70)	0.003 (4.41)	
	$\bar{R}^2$ : 0.997    SEE in %: 0.910    Q(8/12/16): 6.15/12.97/16.24						
$(yt - k)$	0.501 (13.37)	0	-0.194 (-3.24)	0.639 (6.55)	0.431 (6.27)		$-1.8 \cdot 10^{-5}$ (-6.52)
	$\bar{R}^2$ : 0.988    SEE in % : 1.032    Q(8/12/16): 11.64/14.07/16.62						

Notes: In this table the constant and the seasonal dummies are dropped as well as the lagged endogenous variables; t-values in parentheses; sample period 67:1 - 89:4.

Q(8/12/16) is the Ljung-Box Q-Statistic with (8/12/16)-lags.

$\lambda$  denotes the coefficient of the error correction term and  $\gamma_1, \gamma_2$  stand for coefficients associated with the linear and quadratic time trend, respectively.

Both regressions highlight the significant influence of capital utilization on measured productivities. Optimal productivities are given by the following equations:

$$(yc - l)^* = (yt - l) - \log(DUL) \quad (19)$$

$$(yc - k)^* = (yt - k) - \log(DUC). \quad (20)$$

<sup>25</sup>Smolny (1991) employs different labor utilization rates. His results show that a dynamic specification of the capital utilization rate outperforms other versions. This is in line with the theoretical model.

$DUC$  and  $DUL$  are defined as:

$$\hat{duc} = 0.501 \cdot (q - q^{\max}) \quad (21)$$

$$\hat{dul} = 0.416 \cdot [(q - q^{\max}) - 0.463 \cdot (q - q^{\max})_{t-1}]. \quad (22)$$

With the hours variable in eq. (17) and (18) as a notable exception, the structure of the productivity equations for Germany carries over for the EC4 countries.<sup>26</sup> Table 7 displays the results. Rather than to comment on these findings extensively, we concentrate briefly on two aspects. Firstly, productivities exhibit a procyclical time pattern which is highlighted by the significant positive influence of the capacity utilization rate. Secondly, in the short-run the influence of capacity utilization is the same for both productivities. In the medium run, however, adjustment speeds differ because labor adjusts faster than capital. This is evidenced by the quasi-difference of  $q$  entering the equation for labor productivity which implies that labor has adjusted already after one quarter in response to a change of the capacity utilization rate.

**Table 7: Main Coefficients of the Productivity Equations for the EC4 Countries**

	$q_t$	$q_{t-1}$	$\lambda$	$\sigma$	$\gamma_1$	$\gamma_2$
$(yt - l)$	0.344 (6.98)	-0.384 (-4.58)	-0.230 (-5.06)	0.474 (4.09)	0.005 (15.1)	
	$\bar{R}^2$ : 0.842    SEE : 0.391    Q(8/12/16): 10.3/13.6/15.2					
$(yt - k)$	0.351 (8.34)	0	-0.230†	0.474†	-0.007 (-4.28)	$4 \cdot 10^{-5}$ (0.316)
	$\bar{R}^2$ : 0.734    SEE : 0.399    Q(8/12/16): 5.2/10.9/16.4					

†: restricted coefficients

Using our estimates of productivities, we can derive goods supplied determined by employment ( $Y_{LT}$ ), labor demand determined by expected goods demand ( $L_{YD}$ ) and labor demand brought about by capacity output ( $L_{YC}$ ).

## 6 Employment and Labor Demand

As has been shown above from the actual productivities estimated in the previous section optimal productivities can be calculated. In a next step, labor demand  $L_{YC}$  derived from an optimal utilization of existing capacities  $YC$  and, moreover, labor demand  $L_{YD}$  derived from expected goods demand  $YD$  can be obtained.

Figures 4 and 5 display, for the EC4 countries and for Germany, respectively, the time series for  $L_{YC}$  and  $L_{YD}$  as well as for employment  $LT$  and labor supply  $LS$ . For the sake of a better comparison all series are seasonally adjusted. To begin with

<sup>26</sup>In contrast to German wages, EC wages are measured per capita rather than per hour.

the EC4 countries, these series have been estimated for the first time for this paper. They show, firstly, that labor supply constraints play a minor role and are prevailing mainly in the seventies.<sup>27</sup> While  $L_{YC}$  exceeds employment  $L_{YD}$  until 1986 (with the exception in 1979/80),  $LT$  approaches  $L_{YC}$  in the second half of the eighties. By the end of the eighties, existing capacities are the dominant rationing barrier. Besides this, we observe a comovement between  $LT$  and  $L_{YD}$  with a considerable adjustment delay of  $LT$  in response to  $L_{YD}$ . This can be seen very clearly during the recession 1980/83: The reduction of  $L_{YD}$  only partly carries over to a decrease of  $LT$  (about one half), hence, there is a substantial amount of labor hoarding. With a few exceptions the time pattern of these series shows a similar picture for Germany. One of the exceptions is the higher volatility of the German  $L_{YD}$  series as compared with EC4- $L_{YD}$ . This is not only due to the estimated importance of rationing in the export and import equations, which is greater for Germany, but may also be the result of an aggregation effect which considers EC4 as one block despite differences such as the timing of business fluctuations in each of the EC4 countries.

How then can employment in Germany in the eighties be characterized? In 1979/80 goods demand exceeded existing capacities. As a consequence labor demand  $L_{YD}$  was higher than employment although the latter was increasing. As a consequence unemployment went down to less than a four percent mark (see section 2). However, despite of its increase  $LT$  was never rationed by existing capacities in this time period. Hence, whatever the arguments for the restrictive monetary and fiscal measures embarked upon in 1981, such a policy was harmful for  $LT$ ,  $L_{YC}$ , and  $L_{YD}$ . Moreover, employment in the second half of the eighties had to pay dearly for these restrictive policies. As can be seen from figure 5  $L_{YD}$  speeds up and goes beyond  $LT$  and  $L_{YC}$ . Especially the latter variable gives rise to some concern. Due to the fact that the aforementioned restrictive policies resulted in an investment squeeze, existing capacities simply fell short of capacities required by labor demand  $L_{YD}$ . Together with a mismatch on the labor market (see next section) these developments contribute largely to an explanation of employment and unemployment in Germany.

## 7 Mismatch in Germany and in the EC4 countries

In order to be more specific about the supposition of an increased mismatch, the CES-function discussed in section 3 [eq. (8)] has to be estimated. In extension of previous work such relationships are estimated for the EC4 countries, too, and some emphasis is put on an elaboration on the dynamics underlying these functions.

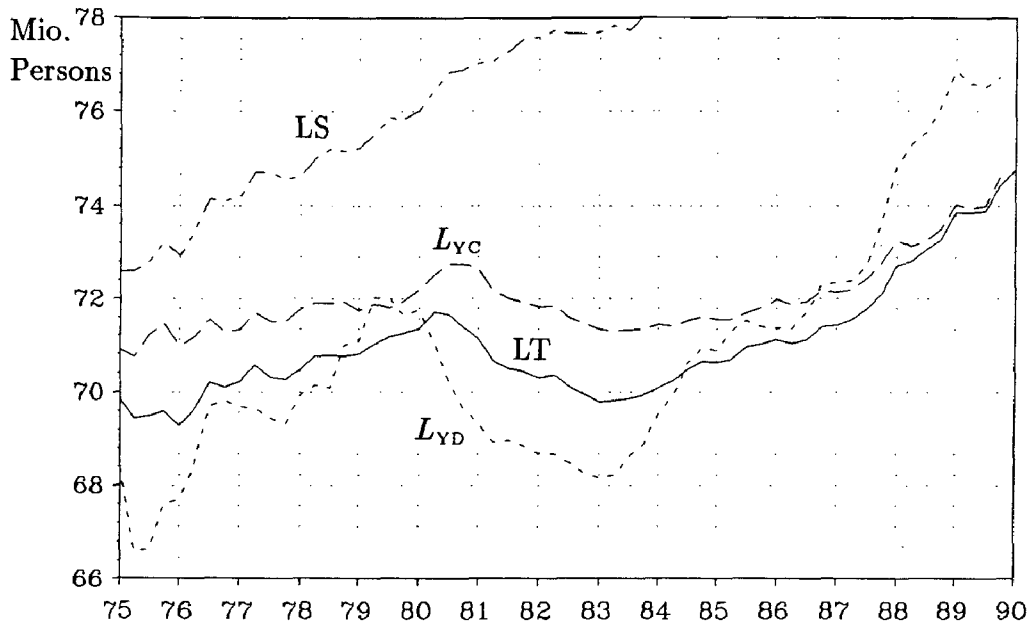
To begin with the labor market the static version is as follows:

$$LT = \{[(1 + \alpha_1) \cdot L_{YD}]^{-\rho} + [(1 + \alpha_2) \cdot L_{YC}]^{-\rho} + LS^{-\rho}\}^{-1/\rho}. \quad (23)$$

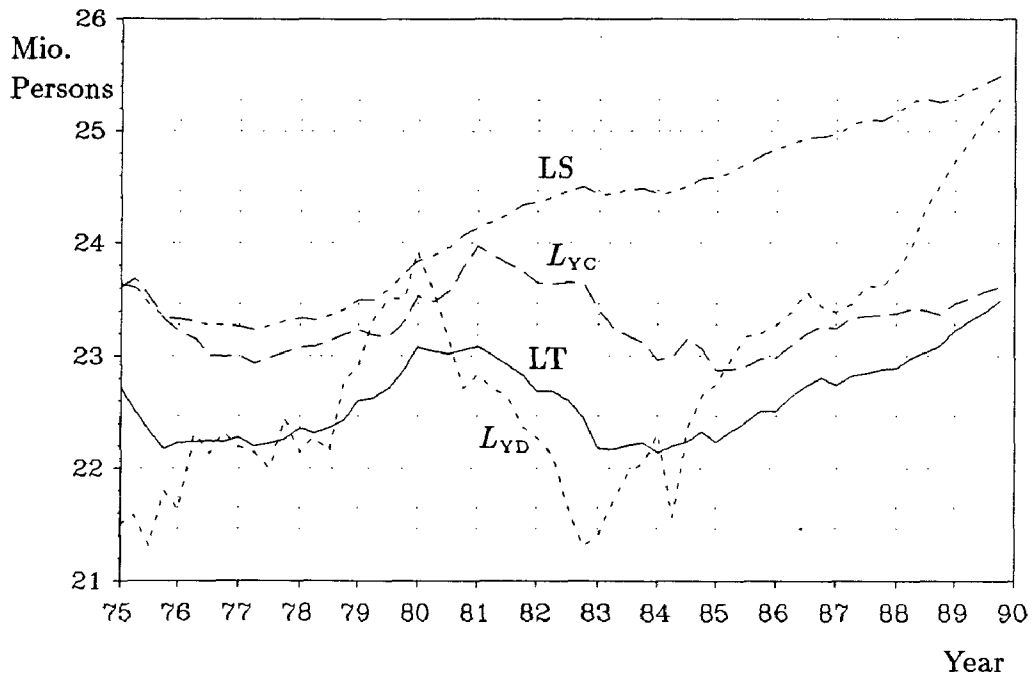
Since the condition that  $LT = \min(LS, L_{YC}, L_{YD})$  does not always hold, eq. (8) cannot be estimated directly but two constants  $\alpha_1$  and  $\alpha_2$  are introduced. They allow for the sources of the aforementioned empirical failure of the minimum condition,

<sup>27</sup>Labor supply increases up to some 82 million people by the end of the eighties.

**Figure 4: Employment series for EC4**



**Figure 5: Employment series for Germany**



namely labor hoarding due to slow adjustment of employment ( $\alpha_1$ ) and imprecise measurement of productivities ( $\alpha_2$ ).<sup>28</sup> However, labor hoarding causes autocorrelation in the static version of the CES-function which cannot be removed by the constant  $\alpha_1$ . Moreover, persistent mismatch may also give rise to autocorrelation not adequately taken into account by a constant mismatch parameter  $\rho$ . Since no a priori knowledge of the adjustment process is available we have experimented with several hypotheses about how to model the adjustment mechanism.

The first variant is a nested maximum-minimum relationship, i.e., for

$$LT = \{LS^{-\rho_1} + LD^{-\rho_1}\}^{-1/\rho_1} \quad (24)$$

we have labor supply  $LS$  and labor demand  $LD$  to be determined by

$$LS = \left\{ \overline{LS}^{-\rho_1} + [(1 + \delta_2) \cdot LT_{t-1}]^{-\rho_1} \right\}^{-1/\rho_1} \quad (25)$$

and

$$LD = \left\{ LD^{\ast\rho_1} + [(1 - \delta_1) \cdot LT_{t-1}]^{\rho_1} \right\}^{1/\rho_1}. \quad (26)$$

In eq. (25) it is assumed that not only exogenous labor supply  $\overline{LS}$  but also lagged employment constitutes available labor for the firm. Due to search time and settling-in periods the firm can expand employment only by  $\delta_2 \cdot LT_{t-1}$  per period of time (i.e., per quarter). In eq. (26)  $LD^*$  denotes optimal labor demand given by existing capacities and expected goods demand.  $LD$  is the maximum of  $LD^*$  and a fraction of past employment  $LT_{t-1}$  (in contrast to eq. (25) where the minimum condition holds). If, for example,  $LD_t^* < LT_{t-1}$  firm's adjustment takes some time, represented by  $\delta_1$ , due to, say, costs of dismissals. Referring to eq. (23),  $LD^*$  is determined by  $L_{YC}$  and  $L_{YD}$ , respectively:

$$LD^* = \left\{ [(1 + \alpha_1) \cdot L_{YD}]^{-\rho_2} + [(1 + \alpha_2) \cdot L_{YC}]^{-\rho_2} \right\}^{-1/\rho_2}. \quad (27)$$

Note that the mismatch parameters differ in eqs. (27) and (25). While  $\rho_2$  in eq. (27) captures a mismatch between capacities and goods demand ("capacity mismatch"),  $\rho_1$  stems from misallocations between labor demand and supply due to different qualifications or regional imbalances and the like. Combining eqs. (24) to (27) yields:

$$LT = \left\{ \left\{ \overline{LS}^{-\rho_1} + [(1 + \delta_2) \cdot LT_{t-1}]^{-\rho_1} \right\} + \left\{ [(1 + \alpha_1) \cdot L_{YD}]^{-\rho_2} + [(1 + \alpha_2) \cdot L_{YC}]^{-\rho_2} \right\}^{-\rho_1/\rho_2} + [(1 - \delta_1) \cdot LT_{t-1}]^{\rho_1} \right\}^{-1/\rho_1}. \quad (28)$$

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<sup>28</sup>To some extent  $\alpha_1$  may also capture measurement errors of domestic goods demand stemming from the estimated import and export equations. One possible bias is, for example, that no distinction is made between tradable and non-tradable goods.

An alternative to eq. (27) is provided by the recognition that  $LD^*$  may be subject to the conventional partial adjustment mechanism:

$$LT = \left\{ LS^{-\rho_1} + \left\{ \lambda \cdot \{ [(1 + \alpha_1) \cdot L_{VD}]^{-\rho_2} + [(1 + \alpha_2) \cdot L_{VC}]^{-\rho_2} \}^{-1/\rho_2} \right. \right. \quad (29)$$

$$\left. \left. + [(1 - \lambda) \cdot LT_{t-1}] \right\}^{-\rho_1} \right\}^{-1/\rho_1}$$

Tables 8 and 9 display the econometric results of the estimates for the EC4-countries and Germany, respectively. To begin with the EC4 countries the estimates show significant differences between the two mismatch parameters  $\rho_1$  and  $\rho_2$ .<sup>29</sup> Recalling that the greater  $|\rho|$ , the smaller the mismatch [see the discussion of eq. (7)], from table 8 it can be seen that the capacity mismatch exceeds considerably the respective figure of the labor market. The latter mismatch, stemming from misallocations of labor supply and demand, seems fairly negligible. Put differently, the strong minimum condition even holds, by and large, on the aggregate level in this case, too. This is due to the fact that labor supply was never a constraint during the whole period under consideration. Given the tremendous literature on mismatch on labor markets in Western Europe<sup>30</sup>, this result is surprising and worth further investigations. This is also true for the somewhat troublesome adjustment coefficients  $\delta_1$  and  $\delta_2$ . Note that the restriction that the firm cannot adjust is more binding the smaller the values  $\delta_1$  and  $\delta_2$ . In the version without (with) the restriction put on  $\rho_1$  and  $\rho_2$  only  $\delta_2$  ( $\delta_1$ ) turns out to be significant. Since we view the result  $\rho_1 \neq \rho_2$  as the more reliable one on empirical grounds, only a non-negligible adjustment of lagged employment towards optimal labor demand emerges as the outcome. Obviously, this deserves further research.

While both types of mismatches are invariant over time in the EC4 countries, experiments with time varying mismatch parameters were more successful for Germany. As can be seen from the dynamic versions displayed in table 9 we obtain a significant negative trend for the mismatch for the partial adjustment model and a negative but weakly significant trend for the nested maximum-minimum model whereas the results were rather mixed for the static version.<sup>31</sup> Therefore we cannot reject the hypothesis of an decreased mismatch on the labor market. Although this is consistent with our previous findings, some parts of what we attributed simply to "mismatch" in earlier studies may be due to an adjustment given the highly significant coefficients  $\lambda$  and  $\delta_2$ . It is an open question as to what extent slow adjustment is caused by mismatch.

Comparing the results for the EC4 countries with those for Germany yields similarities and differences. For both mismatch parameters  $\rho_1$  and  $\rho_2$  we receive similar orders of magnitude. Hence, our conclusion that the capacity mismatch

<sup>29</sup>The coefficients  $\alpha_2$  is rather low and does not contribute to an explanation of  $LT$ . Therefore it is restricted to zero in all but one regressions.

<sup>30</sup>See the volume edited by Padoa-Schioppa (1991).

<sup>31</sup>Note that an increasing  $\rho$  means a decreasing mismatch.

Table 8: EC4-CES regressions for the labor market

	static version		partial adjustment		MAX/MIN-adjustment	
$\rho_1$	38.25 (9.29)	30.03 (16.17)	55.15 (6.10)	60.25 (4.79)	59.50 (5.05)	64.50 (5.14)
$\rho_2$			55.15 <sup>†</sup>	23.61 (8.53)	59.50 <sup>†</sup>	14.64 (3.74)
$\alpha_1$	0.051 (8.35)	0.058 (8.81)	0.029 (5.70)	0.066 (6.48)	0.025 (4.23)	0.088 (6.75)
$\alpha_2$	-0.006 (-4.86)	0	0	0	0	0
$\delta_1$					0.004 (1.03)	0.013 (4.24)
$\delta_2$					0.014 (3.69)	0.363 (0.0)
$\lambda$			0.332 (7.15)	0.601 (8.88)		
$\bar{R}^2$	0.965	0.953	0.985	0.990	0.985	0.992
SEE	0.325	0.379	0.214	0.177	0.216	0.158
Q(8)	77.12	119.68	19.96	29.71	14.92	12.21
Q(12)	77.81	132.94	20.79	29.82	16.54	12.95
Q(16)	84.83	133.67	22.42	33.51	18.44	17.76

Sample: 75:1-89:4; †: coefficients  $\rho_1$  and  $\rho_2$  are restricted to be equal.

seems to be the more important issue holds for the EC4 countries and Germany. On the other hand, adjustment paths exhibit more differences. The partial adjustment model for Germany displays a slower adjustment speed for Germany ( $\lambda = 0.393$  in contrast to  $\lambda = 0.601$  for the EC4 countries). Moreover, while  $\delta_2$  lacks significance for the EC4 countries (in the non-restricted version), it is significant though small for Germany indicating that there may be some restrictions for firms expanding employment in Germany but less in the EC4 countries. The coefficients  $\delta_1$  are not significantly different on the 5 percent level pointing to similar difficulties for firms reducing their staff.

## 8 Conclusion

Since the introduction has summarized the contents of our paper already, we focus in our conclusion on how our findings shed light on the behavior of employment and unemployment in Germany in the eighties.

In the very beginnings of the eighties goods demand exceeded existing capacities and, as a consequence, employment fell short of labor demand determined either by existing capacities or by expected goods demand, respectively. Parts of the rationing barriers on the goods market could be bypassed, however, through additional imports. Starting in 1981 the situation changed dramatically. In the aftermath of high public deficits and due to the Bundesbank's concern about the trade balance deficit, both fiscal and monetary policy embarked upon a restrictive

Table 9: CES-Regressions for the German labor market

	static version		partial adj.	MAX/MIN-adjustment	
$a_0^a)$	21.53 (19.59)	57.43 (3.19)	50.62 (2.80)	78.57 (3.41)	72.15 (2.17)
$a_1$	0	0	3.088 (6.82)	0	2.556 (1.04)
$\rho_2$	21.53 <sup>†</sup>	10.15 (12.05)	15.10 (5.26)	78.57 <sup>†</sup>	14.60 (4.69)
$\alpha_1$	0.077 (7.85)	0.139 (7.35)	0.071 (3.17)	0.021 (3.99)	0.102 (4.80)
$\lambda$			0.393 (4.29)		
$\delta_1$				0.003 (1.16)	0.030 (1.70)
$\delta_2$				0.006 (2.60)	0.007 (4.12)
$AR(i)^b)$		(2) -0.388 (-3.19)			(1) -0.263 (-1.91) (4) -0.360 (-2.67)
$\bar{R}^2$	0.820	0.964	0.974	0.969	0.985
SEE	0.750	0.342	0.286	0.314	0.223
Q(8)	174	7.27	40.0	37.6	11.2
Q(12)	197	7.58	54.6	48.8	17.3
Q(16)	199	13.4	59.1	53.0	20.0

a)  $\rho_1 = a_0 + a_1 \cdot \text{Trend}$

b) AR(i) denotes the coefficient of an autoregressive process of order i.

course. Now employment decreased but exceeded, until 1984, labor demand from expected goods demand. Moreover, those restrictive policies caused an investment squeeze, hence, labor demand derived from the optimal use of existing capacities also declined. However, until the end of the eighties existing capacities were never the bottleneck because employment always fell short of labor that could be employed with existing capacities. Such a situation may have occurred at the very end of the eighties. While labor demand stemming from goods demand considerably exceeds both employment and labor demand derived from existing capacities, the latter two components coincided, by and large, in 1989. Labor supply was increasing rather steadily during the eighties. Further, structural unemployment plagued the German labor market. Two types of a mismatch in the labor market could be identified. The distinction between both depends on whether they have their origin from misallocations between labor demand and supply due to, say, a qualification mismatch, or from mismatch spillovers on the labor market coming from a mismatch between existing capacities and demand on the goods market. Tentative econometric results point out to the possibility that the latter mismatch outperforms the first type. This result seems to hold not only for Germany but also for some EC member countries.



How do international linkages fit into this picture? Concentrating on spillovers on the trade between Germany and the EC4 countries, effects stemming from a rationed goods market in Germany on German imports from the EC4 countries outweigh the respective spillovers from rationed EC4 goods markets on the imports of those countries. On the other hand, since the demand elasticity of the EC4 countries exceeds the respective figure for Germany, the latter economy gains more from a trend increase of the EC4-GNP than the EC4 economy does when Germany's GNP increases. In view of the high degree of capacity utilization due to high goods demand in Germany in the late eighties Germany may served partly as a locomotive for the EC4 countries. Although the time period considered in our paper ends in 1989 we expect this result to hold also in 1990–1991, i.e. the EC4 countries benefitted considerably from German unification.

It goes without saying that we have a long list of caveats implying that much work has to be done. On the top of our research agenda is the network of trade flows between the trade blocks outlined in the paper and a careful modelling of international capital flows. Moreover, deeper insights into the causes of various types of mismatches is warranted even facing the risk that mismatch will have disappeared until we have understood its causes ultimately.

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