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QUANTITATIVE ANALYSIS OF LABOUR MARKET RELATIONS FOR THE FEDERAL REPUBLIC OF GERMANY

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QUANTITATIVE ANALYSIS OF LABOUR MARKET RELATIONS FOR THE FEDERAL REPUBLIC OF GERMANY

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1. Introduction

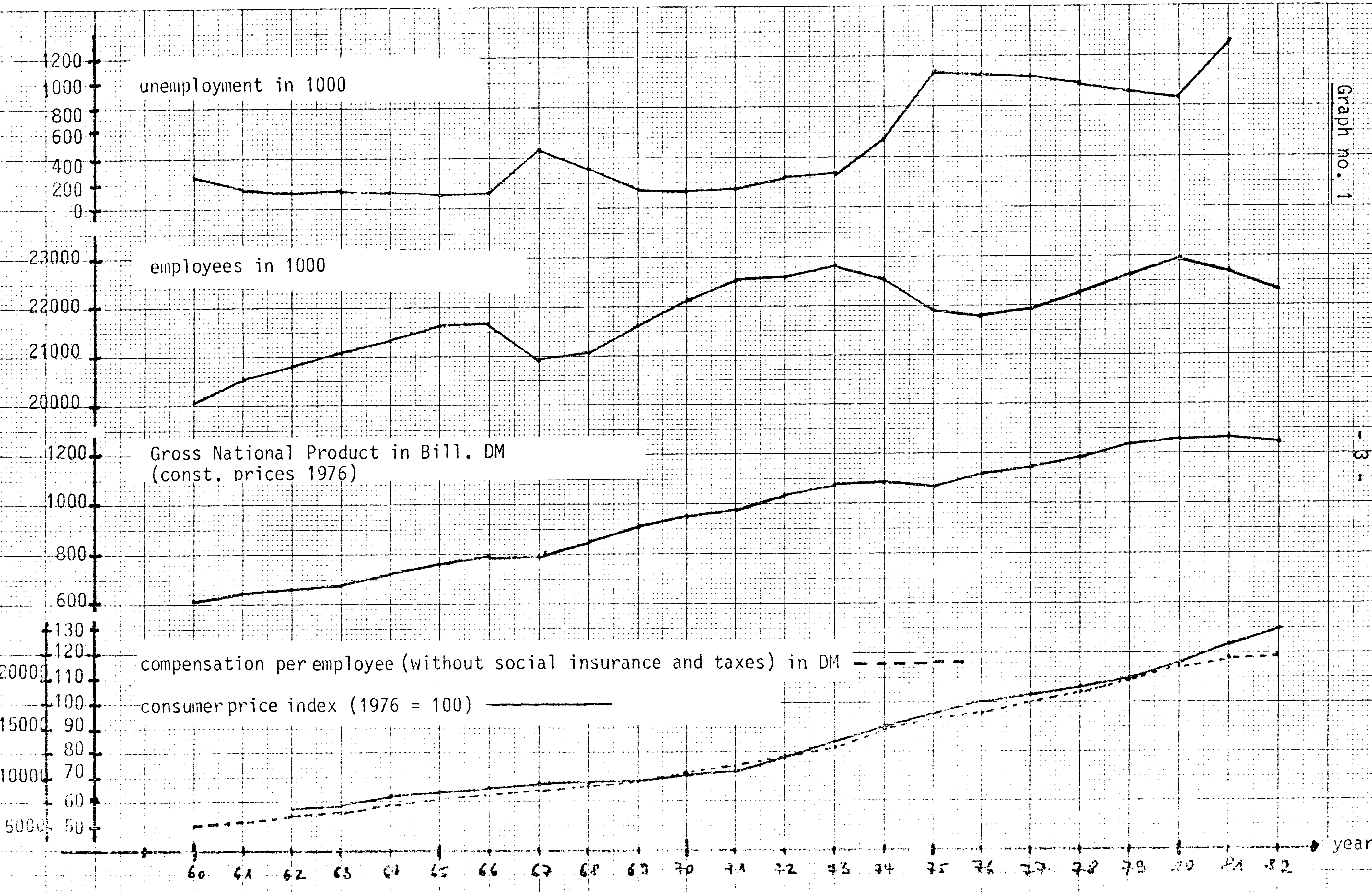
This presentation deals with the description of quantitative methods for the analysis and prognosis of developmental processes on the labour market of the Federal Republic of Germany.
The starting point for analysis is the often observed phenomenon of existing supply and demand surplus on the german labour market.
The deviation from equilibrium as a typical market situation results from the rigidity of real wages, if it is assumed that the Walras market conditions are valid.
Either the supply side or the demand side is quantitatively rationed in such a disequilibrium situation. The hypotheses of the "new macroeconomics" [see for example Barro/Grossman (1976), Malinvaud (1977)] are trying to explain a continuing disequilibrium situation on the labour market (involuntary unemployment) by means of disequilibrium or rationing models respectively (quantity- instead of price-tâtonnement).
The problems resulting from these unbalanced or rationed markets have been discussed in the literature initially from separate theoretical and econometrical points of view.
The theoretical analyses have been dealing with dynamic models and the problems arising from the existence of a general temporary equilibrium based on quantity rationing in a system of multi markets (labour-, money-, commodity-market).
Econometric analyses, however, were initially limited to individual markets without taking into account the spill over-effects on other markets.
Estimation problems in determining the coefficients of the supply and the demand régimes for analytical approaches not within the market equilibrium were in these analyses of prime importance.
Only recently [Gourieroux/Laffont/Montfort (1980), Ito (1980), Kooiman/Kloek (1981)] attempts were made to utilize multi market models for an econometric analysis [review in Quandt (1982)].
In spite of these efforts the development of effective estimation algorithms and tests suitable for this purpose have so far proven unsuccessful.

Thus it is useful in the framework of an empirical analysis to initially look at single market models in order to empirically examine the validity of the hypothesis of the "new macroeconomics". While the theoretical basis of the "new macroeconomics" is continually developing, corresponding empirical research is scarce even for single market models, in particular macroeconomic models for the western german labour market.
Single market models for the labour market - to the author's knowledge - have only been estimated for the U.S.A.(Rosen/Quandt (1978)), Austria (Böhm/Tintner (1979)), Great Britain (Lewis/Makepeace (1981)) and Malta (Brigulio (1984)).
Single market models that test the methodological instrumentarium and empirically verify the theoretical hypotheses by means of the western german labour market shall be the subject of this presentation.

The switching regression model (Hujer/Bauer (1983)) and a sequential estimation procedure (Schierjott (1984)) will be predominantly utilized.
Graph no. 1 (page 3) shows a survey of the development of some economic variables for the Federal Republic of Germany between 1960 and 1982.

2. Labour market models

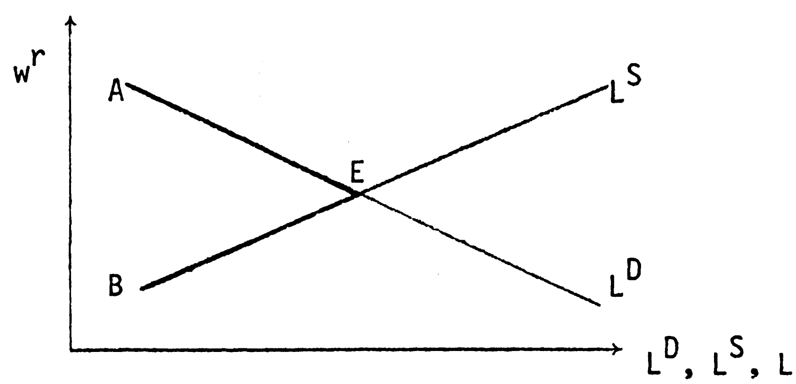
The traditional econometric market analyses assume an equilibrium between supply and demand at any time. When estimating the labour market situation by means of yearly data, both the supply as well as the demand would include all actual employees.
Looking at graph no. 1 however, it can be easily recognized from the development of the figures for employees and unemployment that at certain times clear changes in the structure are observable. Assuming the structure parameters in economic models to be constant is rather problematic considering the economical framework in the F.R.G. If, on the other hand, it is necessary to deal with structural changes in the behaviour structures within the labour market model, then methods have to be utilized that allow the estimation of different régimes each with their own relationship between regressor and regressand.


unemployment in 1000
1200
1000
800
600
400
200
0
employees in 1000
23000
22000
21000
20000
Gross National Product in Bill. DM
(const. prices 1976)
1200
1000
800
600
compensation per employee (without social insurance and taxes) in DM
consumer price index (1976 = 100)
130
120
110
100
90
80
70
60
50
20000
15000
10000
5000
year

Graph no. 1

The starting point for the analysis of this situation is the following thought:
If the agents of the market (supply and demand side) are unable to fully conduct their transactions under the present conditions, because the wage adaptation mechanism fails to clear the market, then the "longer" (i.e. the surplus) side of the market will be quantitatively rationed.
The actual quantity of transaction is equivalent to the "shorter" market side. For any quantity of labour it is then true that $L_t = \min (L_t^D, L_t^S)$ without any deviation. L_t^D and L_t^S show the demand and the supply of labour within a period t respectively. If there is a demand surplus at a certain price level, then the observed quantities are equivalent to the ones actually offered. If, on the other hand, a supply surplus is present, then only the quantities actually in demand are identifiable.
This often leads to estimation problems since only the actually exchanged but not the desired quantities (for example, employed and unemployed people) are known.
Graph no. 2 shows the possible points of transaction on a not-cleared market through line AEB.

Graph no. 2



Above point E (equilibrium point) the demand determines the volume of transaction (labour supply surplus), while below point E we have a demand surplus, i.e. the labour supply is responsible for the rationing of the market.
The rationing model for the labour market is therefore as follows:

$$(1) \quad L_t^D = f\,(X_t^D, w_t^r) + \varepsilon_{1t}$$

$$(2) \quad L_t^S = g\,(X_t^S, w_t^r) + \varepsilon_{2t}$$

$$(3) \quad L_t = \min\,(L_t^D, L_t^S)$$

where w_t^r is the real wage and X_t^D and X_t^S represent the exogenous variables. The wage w_t^r can either be defined as an exogenous variable or it can be explained as the endogenous variable in different equation approaches.
Because of eq. (3) this approach is also called "short side model".
The estimation of the model described through eq. (1) to (3) is without further information of the actual rêgime only possible by an ML-approach.
It turns out, however, that the maximization of the suitable ML-function depends on the numerical optimization procedure that is used as well as the chosen starting values of the estimation parameters [Goldfeld/Quandt (1976)].
The above model can be supplemented by different hypotheses about the wages [review in Bowden (1981)]. Such wage determination equations contain additional information about the rêgime present at any particular time period.
Bowden takes into account for example the equilibrium wage w* to be able to estimate also the deviations from the state of equilibrium:

$$(4) \quad w_t = \mu\, w_{t-1} + (1-\mu)\, w_t^* + \varepsilon_{3t}$$

where μ is a measure for the adaptation at the state of equilibrium. The determination of the equilibrium wage, however, presents considerable problems.
The following régime determination equation can be chosen:

$$(5) \quad \Delta w_t = h\,(L_t^D - L_t^S) + \gamma X_t + \varepsilon_{4t}$$

where X_t is an exogeneous variable.

If the difference is greater than zero, the demand is larger than the supply, hence the traded quantity at this time period is equivalent to the value of the supply.

3. Estimations of labour market models for the Federal Republic of Germany

After the general presentation two concrete models which have been estimated for the western german labour market shall be discussed.

3.1. Switching regressions (Hujer/Bauer (1983))

The specification of the disequilibrium model presented by Hujer and Bauer is mainly based on the neoclassical labour market theory and on microeconomic behaviour equations.
The model consists of a labour supply and a labour demand function. The labour demand is derived from a Cobb Douglas production function with exogenous technical progress and validity of the theory of marginal productivity. The labour demand function, linearized by logarithming is as follows:

$$(6) \quad \ln L_t^D = \alpha_0 + \alpha_1 \ln X_t + \alpha_2 \ln \left(\frac{w}{p}\right)_t + \alpha_3 t + \alpha_4 \ln L_{t-1} + \varepsilon_{1t}$$

with L_t^D : labour demand (volume)

X_t : production, as real gross national product

w_t : wage rate

p_t : price index of GNP

t : time (trend)

L_{t-1}: effective volume of the pre-period (payed working hours)

On the opposite side of this demand determined by the enterprises we have the households' decision for labour supply, which is specified as follows:

$$(7)\ \ln L_t^S = \beta_0 + \beta_1 \ln \left(\frac{w}{p}\right)_t + \beta_2 \ln LMT_t + \beta_3 \ln POP_t + \beta_4 \ln L_{t-1} + \varepsilon_{2t}$$

with L_t^S : labour supply (volume)

w_t : wage rate

p_t : price index of GNP

LMT_t : indicator for labour market tension, in this case: quotient of vacancies and unemployment

POP_t : labour volume potential of 15 - 65 years

L_{t-1} : effective volume of the pre-period

As a data basis for estimation of this model, the quarterly national account of western Germany is used from the first quarter of the year 1961 to the fourth quarter of the year 1981.
To endogenously determine structural switch points in this analysis the switching regression method (for example Goldfeld/Quandt (1976), Johnston (1984)) is applied.
For T observation values and the simplest case of two régimes (A and B) and one switch point the corresponding regression model is as follows:

(8) Rêgime A: $Y_t = \alpha_o + \alpha_1 X_t + \varepsilon_{1t}$ für $t \leq t^*$

(9) Rêgime B: $Y_t = \beta_o + \beta_1 X_t + \varepsilon_{2t}$ für $t > t^*$

where t* is the switch point.

If t* is to be determined endogenously, the ML-function has to be introduced. With the usual assumption of the distribution of the latent variables

$\varepsilon_{1t} \sim N(0; \sigma_1^2)$ und $\varepsilon_{2t} \sim N(0; \sigma_2^2)$

we obtain

$$(10)\ \ln L = -\frac{T}{2} \ln 2\pi - \frac{t^*}{2} \ln \sigma_1^2 - \frac{T-t^*}{2} \ln \sigma_2^2 - \frac{1}{2\sigma_1^2} \sum_{t=1}^{t^*} (Y_t - \alpha_o - \alpha_1 X_t)^2 - \frac{1}{2\sigma_2^2} \sum_{t=t^*+1}^{T} (Y_t - \beta_o - \beta_1 X_t)^2$$

At first the likelihood function must be computed T-times. Then the value of t - maximizing the ML-function - is to be used as the estimation value for the switch point t*. Finally two separate OLS-regressions for both rêgimes are estimated.
The classification of the rêgimes can be done not only endogenously based on the time index, but also by means of exogenous variables. These can be exogenous labour market indicators such as the potential labour volume or exogenous commodity market indicators such as the quotient of orders and turnover. Such variables may be called "indication variables" from their rêgime-attaching function [Lehner/Möller (1981)] .

Hujer and Bauer show the importance of analyzing structural changes initially by the coefficients of the labour demand function (6).

The structural influences on the employment during the observed period are described by 53 partial regressions, where in each case one period is removed and a new period at the end of the estimation intervall is added.
Their results show a systematic change in the short-run elasticities of employment in relation to production and wage rates.
Thus the elasticity of employment diminished during the '70 recession phase, while the influence of wage rate increased. A higher increase in employment could be reached at equal percentages of production changes during the phases of increased growth in the Sixties.

To discover structural changes during the whole observation interval the observation values have to be divided in two groups with only one switch point in the observed period. Hujer and Bauer obtained this point between the 2. and 3. quarter of the year 1971. Hereby the régime A represents the phase of increased growth from the first quarter of the year 1961 to the second quarter of the year 1971. The régime B shows a weak economic development and extends from the third quarter of the year 1971 to the fourth quarter of the year 1981. Indicators of the régime A are high adaptation velocity to an desirable level of employment and a high influence of the gross national product.
On the other hand, the wage rate is an important negatively influencing variable for employment under régime B.
In a further step Hujer and Bauer use a procedure with "indication variable" allowing more than one switch point between the two régimes A and B. This allows a more differentiated assignment of the observation values. The values around 1967 and 1979 - for example - are attached to the economically weaker régime B.
The disequilibrium model and the estimation procedure with an "indicator variable" is based on the assumption of exogenous prices. It is also possible to build a short side model with an endogenous price variable. There are a lot of possibilities and it may be useful to distinguish the models according to the specification and

the price equation [Bowden (1981)] ,with (12) or without (11) a stochastic term, as the following equations

$$(11) \quad w_t = \mu\, w_{t-1} + (1-\mu)\, w_t^* \qquad \text{or}$$

$$(12) \quad w_t = \mu\, w_{t-1} + (1-\mu)\, w_t^* + \varepsilon_t$$

Hujer and Bauer use a nonstochastic equation and this leads to the model (6), (7), the short side assumption (3) and the price-equation

$$(13) \quad \ln w_t = \mu \ln w_{t-4} + (1-\mu) \ln w_t^* .$$

Equation (13) includes a partial adjustment process with the short-term coefficient μ and for the long run the coefficient $(1-\mu)$. w^* is the nonobservable equilibrium price. We have a common equilibrium model, if μ equals zero.
Usually the wage debates result in a certain yearly growth rate of wages. That is the reason why Hujer and Bauer use logarithmic values in the wage equation, where through a lag of 4 periods the annual change rates are considered. In addition the reflection of seasonal effects on the change rates can thereby be avoided. The equilibrium wage w^* is a nonobservable variable. Its value is determined with the aid of the average growth rate of the nominal wages within the observation period.
Hujer and Bauer are estimating the equations (1) to (4) of the short-side model by two- and three-stage non-linear LS-methods. The non-linear three stage method leads to the most significant results. All parameters have the right sign, most of them are significant and show plausible values. Nevertheless this result may not be regarded as definitely confirmed, but has to be verified by further analyses, for example Monte Carlo simulations. Noticeable are the relatively low wage elasticities compared with the output elasticities of the labour demand function.

The obtained positive sign of the wage variable in the labour supply function suggests that a growing real wage rate also leads to an increasing labour supply (permanent wage theory). The obtained elasticities of wage are lower than those obtained by the indicator variables procedure, probably depending on the omitted simultaneous parameter estimation of the supply and the demand function.

The equilibrium and disequilibrium model may be tested by the adaptation velocities towards higher and lower levels. In equilibrium both variables may not be significantly different from zero. This seems to be disproved by Hujer and Bauer, therefore a disequilibrium model of the labour market of the Federal Republic of Germany can be assumed.

3.2. Sequential Estimation Procedure [Schierjott (1984)]

A second estimation approach of a rationing model for the western german labour market was used by A. Schierjott at the Institute for Statistics and Econometrics, University Mainz.

Contrary to the switching regression method the association of data to different régimes and the estimation of the parameters is not done simultaneously in one step.

Here the estimation of the rationing model consists of two steps:

1. By the use of cluster analysis the actually observed quantity on the labour market - here employees - is associated with the demand or the supply side according to the minimum condition (3). Hereby the observation points are united by statistical criteria, where the association may not necessarily result from a price equation but also from other external information.
2. After associating the observation points with the demand or supply side, the OLS-method or, in the case of interdependent systems, the 2 SLS-method respectively can be used to estimate the model parameters.

Hereby the 2 SLS estimators are consistent and asymptotically efficient, since through the preceding data sharing the expectation value of the latent variables is no longer determined by the relations between demand and supply.
In analogy to (1) to (3) and (5) the model is specified as follows:

(14) $$\ln VL_t^D = \ln \alpha_o + \alpha_1 \ln EMP_{t-1} + \alpha_2 \ln RW_t + \varepsilon_{1t}$$

(15) $$EMP_t^S = \beta_o + \beta_1 POT_t + \beta_2 RW_t + \beta_3 UN_{t-1} + \varepsilon_{2t}$$

(16) $$\Delta BRU = \gamma_o + \gamma_1 \frac{1}{UN_t} + \gamma_2 \Delta P_t + \gamma_3 \Delta PROD_t + \varepsilon_{3t}$$

(17) $$EMP_t = \min (EMP_t^D , EMP_t^S)$$

with VL : volume of labour
EMP : employees
RW : real wage (compensation per employee deflated by the priceindex of GNP (1976 = 100))
POT : employee potential (total population from 15 - 65 years)
BRU : compensation per employee
P : price index of GNP (1976 = 100)
PROD: index of productivity (1976 = 100)

Those values associated with the demand or the supply must be marked for the demand rêgime with D (EMP^D, VL^D) and for the supply rêgime with S (EMP^S).
The labour demand (EMP^D), as the number of persons, is defined as follows

(18) $$EMP_t^D = VL_t^D / AH_t$$

where AH_t stands for the effective yearly hours of work per employee and is exogenously determined.

The unemployment (UN) may be computed from the supply and the demand with

$$(19) \quad UN_t = EMP_t^S - EMP_t^D$$

where the vacancies are excluded.
The real wage is computed by the given price level P

$$(20) \quad RW_t = \left(BRU_{t-1}\ (1 + \Delta BRU_t)\right) \ / \ P_t$$

Since only the traded quantities (number of employees) are known, additional information must be present that identifies the ruling rêgime. For the labour market this may be for example the unemloyment or the vacancies.
The cluster analysis is a method to divide a larger number of objects into homgeneous groups (cluster), in this case rêgimes. It is a purely statistical method and therefore has no connection to the model of quantitative rationing. The associations depend on the used information and its interpretation. This, nevertheless, can also be regarded as an advantage since more detailed results can be obtained when not only the price but also additional informations about the market status are used. In comparison to the switching regression approach here in the second step a simpler estimation method can be applied.

The principle of the cluster analysis lies in the formation of certain groups of elements for n elements with m variations of random variables.
For our problem the n elements are the 30 time periods from 1952 - 81. The m variations of the elements are random variables, for example unemployment or employees. The Schierjott analysis uses as information all the variables contained in the model. To describe the relations between the elements by means of the m variations of the random variables it is necessecary to compute in a first step a similarity- or a distance-matrix.

A value is associated with two elements each (e_i, e_j) that show the similarity s_{ij} or the distance d_{ij} between them. Thus metric distance measures are assumed.
The present analysis uses as distance function the quadratic euklidian distance

$$(21) \quad d_{ij}^2 = |\underline{x}_i - \underline{x}_j|^2$$

with the vectors

$$\underline{x}_i' = (x_{i1},\dots,x_{im})$$

$$\underline{x}_j' = (x_{j1},\dots,x_{jm})$$

As a measure of distance of the two elements i and j we obtain the sum of the quadratic distances between the variations of the m random variables

$$(22) \quad d_E^2 = \sum_{h=1}^{m} (x_{ih} - x_{jh})^2$$

For the practical use of such a distance measure the units of the m variables must be comparable, which can be reached through standardisation.
The given n elements should be grouped in such a way that the resulting clusters can be clearly separated and therefore show the largest possible distance. There are numerous algorithms for clustering. The Schierjott-analysis uses the agglomerative Ward-method (Ward (1963)). At first every element is exactly one cluster, thereafter successive other elements are summarized until one single cluster is created. Those groups are united that show the smallest increase according to the variance criterion as a measure of heterogeneity.
The variance criterion

$$(23) \quad Z_V = \sum_{l=1}^{k} \sum_{i \in g_l} |x_i - \bar{x}_{g_l}|^2$$

measures the quadratic euklidian distance of all variables of elements in one group from the corresponding values of group averages. With each fusion of two groups there is an increase of heterogeneity (ΔZ_v). One starts with the fusion of those clusters (elements) that show the smallest increase of heterogeneity. Then follows the computation of the measures of the heterogeneity between the finally obtained cluster and the remaining ones. In the new distance matrix the measures for the two single elements must be substituted by the computed measures of the new group. Then follows the fusion of the two clusters with the smallest increase of heterogeneity and the new distance computation between this new cluster and the remaining ones. This can be continued until one single cluster is formed.

The increase in heterogeneity that is produced by the fusion of clusters can be used for the evaluation of the formed clusters. A large increase indicates that the clusters obtained so far are homogenous within themselves and the next fusion would lead to a rather heterogenous new cluster.

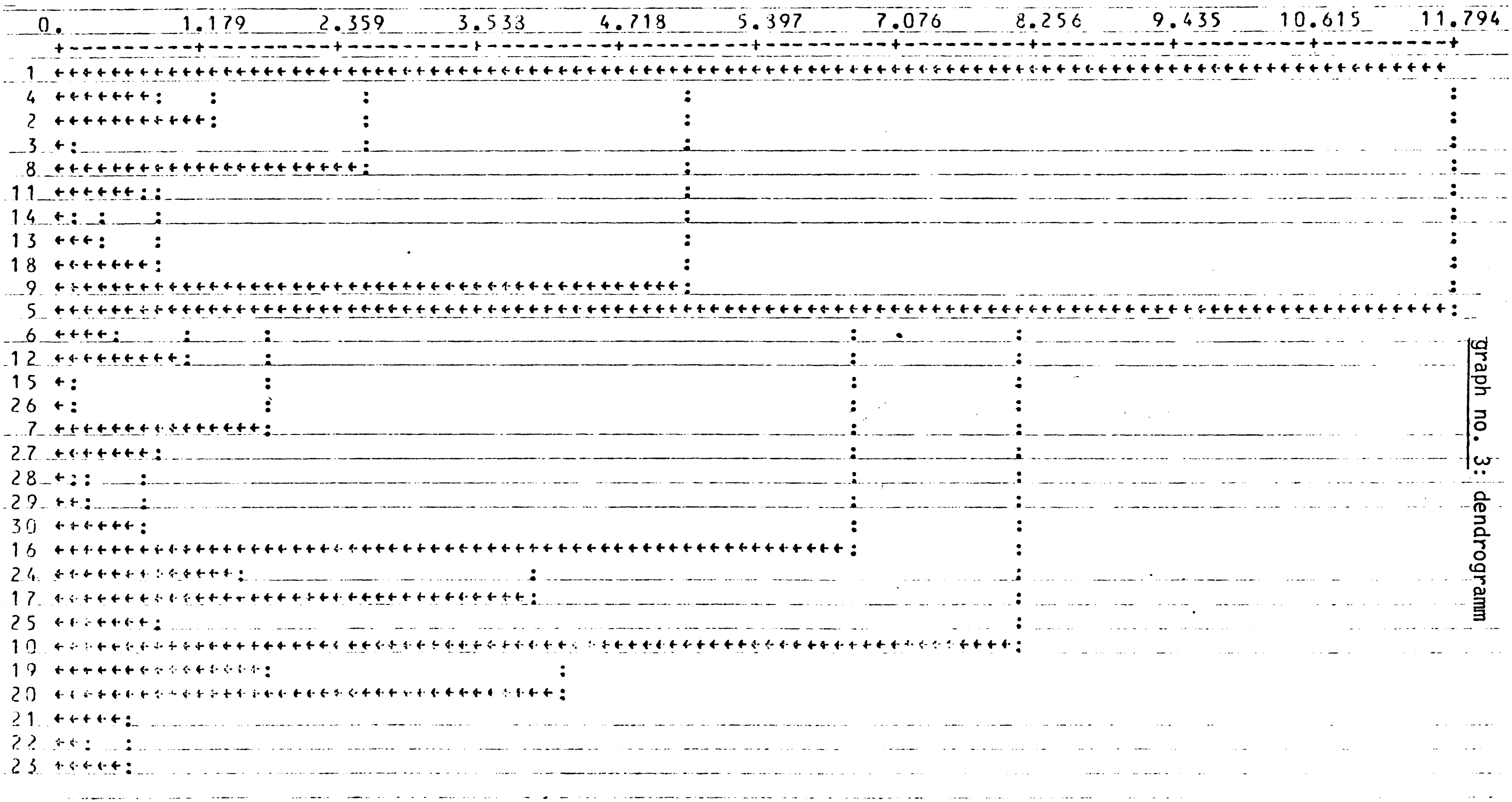
The Schierjott-analysis uses all variables within the labour market model as information for grouping. The model consists of 10 variables for a time-span of 30 years.

Pre-test using absolute values of the variables resulted in a simple time attached clustering. This fact suggested the use of growth rates of the variables.

The principle of the hierachical Ward-method may be well illustrated by a dendrogramm (see graph no. 3).

The vertical axis shows the elements that are united, where 1 corresponds to the year 1952, 2 to the year 1953 et cetera. The horizontal axis indicates the increasing heterogeneity through the fusion of the different groups.

The increase reaches its maximum in the fusion of all elements in one single group; in the present case, this means a value of 11.794. The increase is a criterion for the judgement of the clusters: a relatively small increase following the fusion of



graph no. 3: dendrogramm

two clusters indicates a small error according to the criterion of variance. For that, the present analysis leads to 8 clusters as can also be seen in graph no. 3.
This leads to the following association of time periods to clusters:

Cluster	Time periods
(1)	1,2,3,4
(2)	5,6,7,12,15,26,27,28,29,30
(3)	8,11,13,14,18
(4)	9
(5)	10,19
(6)	16,24
(7)	17,25
(8)	20,21,22,23

Furthermore the association of the time periods to the supply and the demand régimes is necessary. Whether the clusters put together time periods of positive or negative labour market development is dependent on this association. Clusters indicating a positive economic development will be attached to régime A and clusters indicating a negative economic development will be attached to régime B.
A positive development is for example indicated by an increase in employment, an increase in labour volume or a decrease in unemployment.
According to this interpretation the clusters (1), (3), (4) and (5) can be associated with the time periods of the labour supply and the clusters (2), (6), (7) and (8) to the time periods of the labour demand. Therefore we have 12 years as time periods of labour supply and 18 years as time period of labour demand.

Here the problem arises, whether the cluster analysis is able to give a right association to the supply and the demand régimes. This question cannot be answered in general but depends on the concrete labour market informations.

The minimum condition of the rationing model can be fulfilled only approximately. Thus, in every time period, there are unemployed people that cannot be classified as "voluntary unemployed". Furthermore structural and frictional aspects of the unemployment situation are neglected due to the high aggregation level of the data presented here.

After separation of the data in supply and demand régimes in the first stage of estimation, one of the possible estimation methods for interdependent multi-equation models can be used in the second stage.

In the investigation presented here, this is the 2 SLS method.

The wage equation (16) was estimated both under the demand régime (ΔBRU_t^D) as well as under the supply régime (ΔBRU_t^S) and led to the following results:

		DW*
(14') $\ln VL_t^D$	$= 5{,}83 + \underset{(4{,}68)}{0{,}63} \ln EMP_t - \underset{(-4{,}79)}{0{,}16} \ln RW_t$	1,77
(15') EMP_t^S	$= -\,1262{,}58 + \underset{(4{,}64)}{0{,}56}\, POT_t + \underset{(4{,}45)}{0{,}12}\, RW_t - \underset{(-2{,}62)}{1{,}18}\, UN_{t-1}$	2,66
(16 a') ΔBRU_t^D	$= -\,0{,}01 + \underset{(2{,}03)}{3{,}58} \frac{1}{UN_t} + \underset{(7{,}74)}{1{,}30}\, \Delta P_t + \underset{(3{,}42)}{0{,}67}\, \Delta PROD_t$	2,07
(16 b') ΔBRU_t^S	$= 0{,}04 + \underset{(1{,}62)}{3{,}55} \frac{1}{UN_t} + \underset{(3{,}27)}{0{,}77}\, \Delta P_t + \underset{(0{,}35)}{0{,}10}\, \Delta PROD_t$	2,37

(t-values in brackets, DW* = modified Durbin-Watson test)

While in the equations for the labour supply and the labour demand the coefficients could be estimated significantly different from zero, this is not true for all coefficients in the two wage equations. Apparently the wage development has to be regarded as independent from the régime present at a particular time period.

Under theoretical and statistical aspects we come to the conclusion, that the estimation lead to plausible results. Furthermore a comparison with estimations from a corresponding Walras-equilibrium model shows, that the rationing model should be preferred.

4. Conclusion

When estimating a rationing labour market model for the Federal Republic of Germany, switching regressions as well as the sequential estimation method lead to plausible results under both theoretical and statistical aspects.
Compared with equilibrium models, rationing models are to be preferred.
The switching regression assigns the data to demand and supply régimes by a wage equation or by indicator variables. The use of a wage equation implies theoretical aspects of the market stability and the market mechanism.
The sequential estimation uses different information for data separation, information rated as important for the question at hand.
The advantage of using the cluster analysis compared with the wage adjustment equation lies in the possibility of exhausting all informations contained in the model and possibly also those externally given. The cluster analysis has also subjective elements. Thus, for example, the assignment including all model variables is based on the subjective estimate.

In the second stage the sequential estimation can be done by means of approved estimation methods (e.g. 2SLS) whose properties are well-known. This does not hold equally true for the non-linear estimations of the switching regressions. Also for ML-methods there are still some unsolved numerical problems in this respect.
Using the sequential estimation method, the problem might arise, that in the first stage only a small number of time periods can be assigned to one of the régimes, so that a reliable estimate of the matching equation can become difficult in the second stage.
The analysis of Hujer and Bauer uses price changes to indicate the ruling market régime. In this case the underlying reaction hypothesis determines the estimation method and its properties. The price equation from a Walras-hypothesis of the market behaviour gives the necessary information about the régime. Such a hypothesis implies

that in principle a market equilibrium and an equilibrium price exist, but cannot be reached.
When accepting the assumption that the price variable really describes the market conditions, one has to realize, that there exist interdependent relations between demand and supply on the one hand and the price variable on the other hand.
To take this into account, the price variable has to be endogenous. Other informations, e.g. traded quantities, might illustrate the market situation but they are not considered in the price equation. Another important information within the framework of this model is the unemployment. Its computation in terms of difference between supply and demand is only possible within the model (endogenously), if the demand function is valid for the whole time interval, that is, also for those time periods showing a demand rationing. Stability for the supply function must be assumed under supply as well as under demand régimes. This implies, that the reaction of the agents are the same under quantity rationing as under non-rationing.

A further development of the models needs improvements in the model specifications. For example the terms $(D_{t-1}-Q_{t-1})$ and $(S_{t-1}-Q_{t-1})$ may be considered to imply the rationing situation of the pre-period [Orsi (1982)]. It should be mentioned, that the analyses discussed so far only deal with rigid -price models although other rationing schemes may be assumed [Spatz (1979)], for example as well quantity- as price-tâtonnement simultaneously.
A further reaching modification would be the development and estimation of multi-market models that include the mutual rationings explicitly by spill over-effects. Furthermore an economy has not only one single homogeneous national labour market but regionally separated labour markets connected to each other and showing regional specialities. Socio-economic consequences in the development of disequilibrium between labour demand and labour supply should also be emphasized in the specification of labour market models, if such social dimensions

can be quantified in principles. Socio-economic phenomena, which have no directly observable equivalents, should be completed by adequate soft modelling and adequate estimation methods (Cremer/ Hujer (1979)).

The solution of such complex questions not only needs improved model specifications, but also the development of efficient estimation methods to come closer to the solution of the problems of disequilibrium processes by analyses based on empirical data.

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