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ESTIMATION OF A DISEQUILIBRIUM AGGREGATE LABOR MARKET: SOME NEW EVIDENCE*

by

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Abstract:

This note presents some new evidence on estimation of a disequilibrium aggregate labor market. It is found that the earlier results of e.g. Rosen and Quandt are not robust in terms of computational aspects, the specification of the minimum condition, differencing and different data samples. Some sampling experiments suggest that these failures might results from incorrect assumptions on labor market disequilibrium.

1. INTRODUCTION

In the beginning of the 1970's there was a great deal of optimism with respect to the empirical applications of disequilibrium econometrics. This was true in spite of the fact that many important theoretical issues of disequilibrium models were - and are still - open to criticism.$^{1)}$ Along with time this optimism has diminished, however. It is difficult to say what are the reasons for this course of events. One reason can be the fact that there are only few empirical applications of disequilibrium econometrics which, moreover, do not appear to be indisputably superior to standard equilibrium models. The application which is perhaps most often mentioned as a promising example of the performance of disequilibrium econometrics is the study of Rosen and Quandt (1978) on the U.S. labor market. This study made use of annual time series data covering the period 1929-1973. Even though the parameter estimates were rather reasonable, there were some anomalous results in terms of the predicted excess demand and excess supply periods. The model predicted excess demand for labor during the Depresson years, and excess supply of labor from 1954 to 1973. Two "explanations" were afterwards given for this anomalies: Yatchew (1981) showed that the model performs better if the sample is restricted to post-World War data while Romer (1981) showed that dropping the asset variable from the supply equation produces much better excess demand predictions (the early 1930's became now an excess supply period and years 1965-1968 an excess demand period). Quandt (1981) and Eaton and Quandt (1983) have after that produced two sets of estimates with this same data using the Romer specification without any marked difference in the results.

Even though Quandt and others have thus succeeded in producing results which are altogether rather reasonable, this does not mean that the case with the U.S. labor market is settled. That is because we have no idea of how robust the results thus far obtained in fact are. The first thing one should check in this connection is the possibility of multiple local maxima, which is known to be a "standard" problem with disequilibrium models irrespective of the minimum condition.
Another thing is the question whether the results thus far obtained are robust with respect to the minimum condition itself. That is, whether the results change markedly if the Maddala-Nelson- minimum condition is replaced by the Ginsburgh-Tishler-Zang (stochastic) minimum condition.2)

Finally, one can ask whether the results of Rosen and Quandt et al pass "standard" checks of robustness in the sense that, for instance, the results can withhold differencing the data, splitting the data sample into, say, two segments, and estimating the model only with the central observations.3)

All these checks are, in fact, carried out in the subsequent piece of analysis. The result of this exercise will be that the results of Rosen and Quandt et al are far from robust. In order to find out the reason for this failure we will do a small exercise with experimental data; this analysis may give us some idea of the generality of our findings.

2. EMPIRICAL RESULTS WITH THE U.S. LABOR MARKET DATA

The model consists of the following equations:

$$\ln D_t = a_0 + a_1 \ln w_t + a_2 \ln Q_t + a_3 t + e_{1t} \qquad (1)$$

where labor demanded at time t is a function of real wages (w_t), the level of aggregate output (Q_t), and a time trend variable (t);

$$(2) \qquad \ln S_t = b_0 + b_1 \ln w_{nt} + b_2 \ln P_t + e_{2t}$$

where labor supplied is a function of real wages, net of taxes (w_{nt}), and the potential number of hours of work available in year t (P_t)[4];

$$(3) \qquad \ln E_t = \min(\ln D_t, \ln S_t)$$

where the quantity of labor traded in year t is the minimum of supply and demand. In this connection we do not use the wage adjustment equation (experimented in e.g. Rosen and Quandt (1978)). This is mainly motivated by our desire of simplifying the computations and of making possible the application of the GTZ-minimum condition. (Quandt (1981) argues that dropping the wage equation may also help in avoiding anomalous results due to the fact that the real wage rose in all but three years during the sample period 1930-1973).

Equation (3) represents the Maddala-Nelson-type (MN) minimum condition which has been systematically used in the context of the U.S. labor market model. An alternative way of specifying the minimum condition is to use the Ginsburg-Tishler-Zang-type (GTZ) condition (4) which is based on the assumption that the stochastic elements are connected with the transactions, not with the "planned" demands and supplies:

$$(4) \qquad \ln E_t = \min(\ln D_t^e, \ln S_t^e) + u_t$$

where the index e refers to the expected values of D_t and S_t, u_t being the composite error term of the model.[5)]

Now turn to the estimation results. Equations (1), (2) and (3) or (4) were estimated with annual U.S. data covering the period 1930-1973 (see Rosen and Quandt (1978) for details). The respective results are presented in Table 1.[6)]

Column (1) corresponds to the estimates obtained by Quandt (1981); those presented in column 1 of Table 1 below are obtained by us, there are only some minor differences between these and those presented in Quandt (1981), p. 60. What is important with this set of results is the fact that they represent only a local optimum. A set of results which corresponds to the global optimum with specification (1), (2) and (3) is presented in column (3), and one can find out that there are some very important differences between these results. According to the results in column (3) the supply equation does completely break down; the elasticity with respect to the scale variable goes up to 3.2. On the other hand, the negative slope of the demand schedule is steeper than the slope of the supply equation; thus one should increase wages in order to eliminate the excess supply of labor which sounds somewhat unreasonable. Far more serious is, however, the fact that the new estimates presented in column (3) indicate that only 1943-1945 and 1953 are excess demand periods; needless to say, these are just the last years of the World War II and the Korean War. All other periods are classified as excess supply periods (according to this crude classification system).

Table 1. Maximum Likelihood Estimates of the Aggregate U.S. Labor Market Model[1)]

Coefficient	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
a_0	-.316	.421	-.254		.238	2.618	.939	-.162
	(.399)	(.022)	(.357)		(.430)	(.609)	(.501)	(.731)
a_1	-.431	-.160	-.449	-.315	-.077	.031	-.011	-.828
	(.105)	(.014)	(.088)	(.292)	(.122)	(.189)	(.170)	(.171)
a_2	.925	.806	.911	.654	.852	.408	.716	1.159
	(.072)	(.004)	(.065)	(.139)	(.078)	(.109)	(.086)	(.142)
a_3	-.011	-.016	-.010	.007	-.021	-.012	-.016	-.009
	(.003)	(.001)	(.002)	(.009)	(.004)	(.006)	(.004)	(.006)
b_0	-1.859	-8.832	-12.417		-12.379	-11.531	-8.109	-2.531
	(.984)	(.390)	(.504)		(1.508)	(.243)	(2.064)	(.001)
b_1	-.215	-.464	-.473	.756	-.472	-.446	-.594	.125
	(.066)	(.018)	(.050)	(.208)	(.049)	(.023)	(.105)	(.000)
b_2	1.221	2.503	3.163	1.740	3.156	3.000	2.370	1.338
	(.182)	(.093)	(.286)	(.563)	(.277)	(.045)	(.379)	(.000)
lnL	108.804	-492.660	110.073	101.586	92.865	66.671	57.042	82.926

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1) Standard errors are inside parentheses, (1) corresponds to the set of estimates obtained by Quandt (1981), (2) estimates with GTZ minimum condition, (3) "new" estimates with MN minimum condition, (4) estimates with differenced data, (5) estimates with 36 central observations, (6) estimates with 23 central observations, (7) estimates with the data of 1930-1952, and (8) estimates with the data of 1953-1973. lnL is the value of the log likelihood function at the optimum.

How are the results changed when the GTZ specification is used? Column (2) in Table 1 indicates that the respective results are very similar to those with the MN specification in column (3). It is only that the wage elasticity in the demand equation becomes much smaller (and the "second" excess demand period includes also the years 1954-1957).

Next we can turn to the results obtained by making some perturbations with the data. Column (4) corresponds to the estimation results with differenced data, columns (5) and (6) correspond to the estimation results with data of some central observations, and finally (7) and (8) correspond to estimation results with data covering 1930-1952 and 1953-1973, respectively. The Maddala-Nelson specification is used in all these cases.7)

On the whole, these results display a great deal of sensitivity; in particular this is true with the coefficients of the wage variables. Moreover, the coefficient of the potential number of hours variable, P_t, has in all cases unreasonably high values - obviously compensating the high negative wage elasticity. Given this evidence one can, first of all, suspect that the structural equations (1) and (2) are misspecified, for instance, in terms of dynamics. It is only that handling the dynamic specification in the context of disequilibrium models is very difficult, in particular this is true with the MN-minimum condition.8)

On the other hand, one can, of course, ask whether these failures of the Rosen and Quandt model result from the incorrect assumption that the labor market does not clear. Even if distinguishing between these two alternative explanations seems impossible in this connection, we could try to do so by scrutinizing the effects of an incorrect equilibrium hypothesis by using some artical data.

3. A SAMPLING EXPERIMENT

The idea of the subsequent experiment is to generate data from an equilibrium model and then fit the disequilibrium model into this data so that one can possibly find out how the disequilibrium model alarms for this misspecification.

The model to be used comes from Eaton and Quandt (1983):

$$D_t = a_0 + a_1 x_{1t} + a_2 x_{2t} + u_{1t} \tag{5}$$

$$S_t = b_0 + b_1 x_{1t} + b_2 x_{3t} + u_{2t} \tag{6}$$

with $S_t = D_t$. The error terms u_{it} and u_{2t} were normally distributed, with mean zero and variances s_1^2 and s_2^2. The parameter values were $a_0 = 110$, $a_1 = -8$, $a_2 = 1$, $b_0 = 10$, $b_1 = 10$, $b_2 = 2$, $s_1^2 = 10$, $s_2^2 = 10$. The following uniform distributions were set to x_{2t} and x_{3t}: $x_{2t} = U(35,55)$, $x_{3t} = U(7.5,12.5)$. The sample size was 120 in all cases, 10 replications were made.

The estimation results of a disequilibrium model (5), (6) and (3) using these data are presented in Table 2.[9)]

Table 2. Maximum likelihood estimates with the Experimental Data[1]

Coefficient	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
a_0	73.294	75.540	74.814	71.757	68.377	72.321	72.004	71.548	72.146	67.517
	(2.351)	(2.696)	(2.677)	(2.970)	(1.774)	(3.053)	(2.674)	(2.784)	(2.579)	(3.504)
a_1	-.178	-.173	.124	-.088	.935	-.102	.278	-.088	.102	.222
	(.107)	(.097)	(.121)	(.127)	(.119)	(.095)	(.103)	(.103)	(.097)	(.125)
a_2	.568	.570	.525	.643	.684	.619	.567	.634	.596	.712
	(.053)	(.060)	(.057)	(.065)	(.038)	(.068)	(.057)	(.064)	(.054)	(.077)
b_0	78.880	36.270	25.610	29.323	39.697	33.318	53.525	20.639	26.872	63.627
	(8.237)	(3.183)	(1.694)	(1.902)	(.905)	(1.652)	(10.781)	(2.917)	(1.490)	(8.659)
b_1	-1.118	.012	.727	1.630	-1.288	4.542	-1.272	.832	3.801	-.065
	(.235)	(.270)	(.393)	(.427)	(.032)	(.307)	(.613)	(.777)	(.681)	(.426)
b_2	3.816	8.002	9.752	8.497	9.956	6.976	7.043	9.661	8.889	4.214
	(1.790)	(1.430)	(1.757)	(2.006)	(1.701)	(1.083)	(1.362)	(1.658)	(1.411)	(1.633)
lnL	-315	-306	-318	-326	-305	-310	-304	-315	-311	-310

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[1] Standard errors are inside parentheses. (1) - (10) correspond to a set of estimates obtained by using the data generated by model (5) and (6) with $S_t = D_t$.

According to these estimates both the demand and supply curves are almost vertical (with respect to x_{1t}); i.e. as a rule the null hypothesis that the respective coefficients are equal to zero cannot be rejected. Moreover, these coefficients display striking variability both in terms of signs and magnitudes. Otherwise there are not too many signs of failure: in most cases the model finds both excess demand and excess supply observations, even though the number of excess demand observations (outliers?) is rather small - on an average about 10.

Altogether, these results suggest that an incorrect equilibrium assumption produces very sensitive and inprecise parameter estimates, particularly for the price terms. Thus, one ought to take the robustness issue very seriously in the case an equilibrium or a disequilibrium hypothesis plays an important role for the estimation procedure. In this connection we cannot avoid recalling of the poor performance of the disequilibrium specification of Rosen and Quandt just in this respect. In the light of Table 1 above, in particular, the conclusions of Rosen and Quandt (1978) favouring the disequilibrium hypothesis do not seem to be completely warranted.10)

4. CONCLUDING REMARKS

The results of Rosen and Quandt have in some occasions been considered as "promising". The analyses performed above cast some doubts on this conclusion. In order to get a more affirmative result one should at least try to respecify the disequilibrium model and try to make a formal analysis on the relative performance of an equilibrium and a disequilibrium model.

FOOTNOTES

1) One can, for instance refer to the assumption of exogeneous prices, to the treatment of rationing schemes and to the problems of aggregation. Also the unability of disequilibrium models to produce unambiguous comparative statics results should be mentioned here (cf. Hildenbrand and Hildenbrand (1978)) to speak nothing about the problems with multimarket disequilibrium models (cf. eg. Kooiman and Kloek (1981)).

2) The pros and cons of these two specifications are discussed in Quandt (1982). The indisputable fact is that one cannot choose between these specifications only on theoretical grounds. Thus, one would expect that the empirical results do not differ to a great extent.

3) As it is well-known there are no formal specification tests for disequilibrium models. The procedures mentioned above are, in fact, only some kind of informal analogues for the Plosser-Schwert-White (1982) specification test, for the Utts (1982) Rainbow- test and for the Chow (1960) test. In the subsequent analysis we do not try to compute any test statistics but only scrutinize the behavior of the parameter estimates under these perturbations.

4) Notice that this specification of the scale variable P_t, in fact, leaves aside the supply-induced changes in average annual hours. Obviously this is a very strong a priori restriction for the estimation procedure.

5) Cf. Maddala and Nelson (1974), on the one hand, and Ginsburgh, Tishler and Zang (1980) on the other hand. Sneessens (1981) found in a Monte Carlo study that the GTZ specification is more robust and produces smaller mean square errors than the MN specification.

6) The likelihood function was maximized using first the Davidon-Fletcher-Powell (DFP) algorithm and then the Quadratic Hill Climbing (GRADX) algorithm. Derivatives were evaluated numerically. Accuracy was first set to 1.0E-04 and then increased to 1.0E-12.

7) The central observations were chosen so that the right hand side variables of (1) and (2) included only such observations that $\bar{x}_i - zSD_i \leq \bar{x}_i \leq \bar{x}_i + zSD_i$ for all i, $\bar{x}_i$ being the sample mean of x_i and SD_i the corresponding standard deviation. Columns (5) and (6) correspond to the following values of z: 1.5 and 1.0 (cf. Utts (1982)).

8) This is clearly pointed out by Richard (1982).

9) For details of the estimation, see footnote 6.

10) Both Rosen and Quandt (1978) and Yatchew (1981) present estimates for the equilibrium model, too. No formal testing procedure is not, however, carried out between these two classes of models.

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