KESKUSTELUALOITTEITA

DISCUSSION PAPERS

Suomen Pankin
kansantalouden osasto

Bank of Finland
Economics Department

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CONSUMPTION FUNCTION, LABOUR SUPPLY RATIONING AND BORROWING CONSTRAINTS

9.7.1984

KT 12/84

CONSUMPTION FUNCTION,
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BORROWING CONSTRAINTS*

by

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* We are indebted to two anonymous referees for helpful comments on an earlier version of this paper. Financial support from the Economic Research Council of the Nordic Countries, the Finnish Cultural Foundation and the Yrjö Jahnsson Foundation is gratefully acknowledged. This paper will appear in Oxford Economic Papers.

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Abstract:

The purpose of this paper is first to derive consumption functions in the presence of both endogenous and rationed labour supply by assuming neither contemporaneous nor intertemporal separability of the utility function in goods and leisure, second to show how the properties of consumption functions depend on the question of whether borrowing constraints are binding or not and finally, to subject these consumption functions to an empirical test concerning labour market assumption by using Finnish quarterly data over the period 1961.1-1980.3. Neither 'market clearing' nor 'labour supply rationing' model turns out to be clearly superior.

1. INTRODUCTION

Standard intertemporal models of household consumption and saving behaviour are characterized by among others the following assumptions: First, consumption of leisure is either ignored or it is assumed that hours of work are institutionally fixed so that a given wage path implies an exogenously determined income stream. If individuals, however, are free to set their hours of work, then consumption behaviour will depend on wage rates unless goods and leisure are independent of each other in utility. Second, capital markets are assumed to be perfect in the sense that individuals can dissave and borrow within the bounds of solvency at the same interest rate at which they can save and lend. For various reasons, however, individuals may be subject to borrowing constraints (see Stiglitz and Weiss (1981)).[1)] Binding borrowing constraints affect consumption and saving behaviour both directly and indirectly by changing the intertemporal allocation of resources.

In the light of long tradition of treating income as exogenously given and assuming perfect capital market when analyzing household consumption behaviour it is of some interest to compare the performance of consumption behaviour in the presence of labour supply rationing with the consumption behaviour predicted by the market-clearing view with endogenous goods-leisure choices and to look at the role of binding borrowing constraints in this connection.

The purpose of this paper is first, to derive consumption functions in the presence of both endogenous and rationed labour supply by assuming neither contemporaneous nor intertemporal separability of the utility function in goods and leisure[2], <u>second</u>, to show how the properties of consumption functions depend on the question of whether borrowing constraints are binding or not and <u>finally</u>, to subject these consumption functions to preliminary empirical tests concerning the labour market assumption by using Finnish quarterly data. In what follows we use the 'Lagrangian approach' by solving for the consumption as a function of all exogenous variables.[3] Consumption functions with and without labour supply rationing and borrowing constraints are derived and presented in section 2, while section 3 is devoted to preliminary empirical tests.

2. CONSUMPTION FUNCTION, LABOUR SUPPLY RATIONING AND BORROWING CONSTRAINTS

This section shows how the nature and properties of consumption function depend on the labour market and capital market assumptions.

Consider a T-period model of consumption and labour supply behaviour, where an individual chooses consumption and leisure for the present and future respectively. We assume for convenience that the intra-period elasticities of substitution between consumption and leisure can be described by the homothetic Cobb-Douglas (C-D) utility function so that $X_i = c_i^{\theta}\ell_i^{1-\theta}$ for $i = 1,\dots,T$, where c_i and ℓ_i refer to consumption and leisure for period i respectively.[4] On the other hand, at the level of intertemporal aggregates X_i preferences are specified to be of a constant elasticity (CES)-type so that we have a two-level utility function to describe preferences over consumption and leisure.

The individual's decision problem at $i = 1$ is to maximize the intertemporal utility function with respect to present and future consumption and leisure subject to the intertemporal budget constraint. In the presence of perfect capital markets it can be written as follows

$$(1) \qquad \underset{\begin{Bmatrix} c_1,\ldots,c_T \\ \ell_1,\ldots,\ell_T \end{Bmatrix}}{\text{maximize}} \;, \quad U = \sum_{i=1}^{T} \{\alpha_i (c_i^{\theta} \ell_i^{1-\theta})^{-x}\}^{-1/x}$$

$$\text{subject to: } A_0 + \sum_{i=1}^{T} R_i W_i (1-\ell_i) = \sum_{i=1}^{T} R_i P_i c_i$$

where for period $i = 1,\ldots,T$ α_i refers to the 'distribution parameters' of the CES-utility function, $(\sum_{i=1}^{T} \alpha_i = 1)$, P_i to the prices of consumption, W_i to the nominal wage rates, A_0 to the nominal amount of assets at the beginning of the current period 1 and R_i to the nominal interest rate factor in the capital markets so that $R_1 = 1$, $R_2 = (1+k_i)^{-1}$, etc. Finally, $(1-\ell_i)$ refers to labour supply, where time endowments have been normalized to unity. In what follows the intertemporal elasticity of substitution between $X_i = c_i^{\theta}\ell_i^{1-\theta}$ and $X_j = c_j^{\theta}\ell_j^{1-\theta}$, which we assume to be equal for any $i \neq j$, is denoted by $s = (1+x)^{-1}$ so that $x = (1-s)s^{-1}$.

In what follows we assume for simplicity that the time preference factor α_{i+1}/α_i is equal to the real rate of interest factor $R_{i+1}P_{i+1}(R_iP_i)^{-1} = (1+r_{i+1})^{-1}$ for $i = 1,\ldots,T-1$ r_{i+1} being the real interest rate. Straightforward manipulation leads to the general form of the consumption function without labour supply, which is presented in the top left-hand corner of Table 1. The general form of the consumption function is helpful in stressing the forward-looking aspect of intertemporal choice. Incomes are endogenous to the model because of endogenous goods-leisure choices.

Varying the intertemporal elasticity of substitution several variants of the 'market clearing'-consumption function with perfect capital markets can be directly obtained from this specification.

If labour supply is rationed individuals determine their intertemporal consumption conditional on expected future income streams rather than on wage rates. The individual's decision problem with perfect capital markets is still given by (1) with the additional constraints, however, that the $\ell_i^{\prime}$s are exogenous.[5)] The corresponding consumption function is presented in the top right-hand corner of Table 1.

Changes in wage rates and employment (labour supply rationing) will now have income effects. Notice moreover, that generally the $\ell_i^{\prime}$s appear as additional explanatory variables. Only in the case of C-D intertemporal preferences with unitary intertemporal elasticity of substitution all the effects of labour supply rationing go via incomes (see also Deaton and Muellbauer (1980), p. 313-314). The fact that prospective income growth affects consumption positively, implies, in a perfect foresight world, that household saving might well be negative in contrast to the basic proposition of a life-cycle model (as has been pointed out by Russell (1977)). A possibility to avoid this questionable result is to make use of the possibility of borrowing constraints facing individuals. Let us now turn to the implications of this possibility.

Consider an individual making consumption and labour supply decisions for period i. If he is currently subject to binding borrowing constraint, then his consumption is determined by his current income and the amount of (liquid) assets. The individual behaves as if his planning horizon would be one period. In what follows we consider the implications of a more interesting case where the individuals expects to be rationed in the future (see Koskela and Virén (1983a) for an analysis of the case where there is uncertainty about future credit rationing). More specifically, assume that in period i the individual expects to be subject to binding borrowing constraints in period i + 1. This means that the present value of consumption from the point of view of the beginning of period i cannot exceed the present value of 'wealth' by more than a certain amount. The additional constraint in period i can be written as follows

$$(2) \qquad A_{i-1} + \sum_{j=i}^{i+1} R_j W_j (1-\ell_j) - \sum_{j=i}^{i+1} R_j P_j c_j \geqq - R_{i+1} Z_{i+1}$$

where Z_{i+1} is the nominal amount of borrowing in period i+1.

The individual's decision problem with labour market clearing is now to maximize the intertemporal utility function with respect to present and future consumption and leisure subject both to the intertemporal budget constraint and to the constraint imposed by the borrowing limit (2). Straightforward manipulation leads to the consumption function without labour supply rationing, but with credit rationing to be expected in the next period. This presented in the bottom left-hand corner of Table 1. Expected credit rationing affects consumption both directly via the borrowing constraint and indirectly by changing the intertemporal allocation of resources towards future consumption. Under credit rationing individuals behave as if their planning horizons would be shorter than those without credit constraints.

TABLE 1: Consumption function with and without labour market clearing and with and without borrowing constraints.[1)]

	Labour market clearing:	Labour supply rationing:
Perfect capital markets:	$\log c_t = \log\theta + \log w_t + YP_t^{(1)} - WP_t^{(1)}$ where: $YP_t^{(1)} = \log[A_{t-1}/W_t + 1 + \sum_{i=1}^{T}(1+r_{t+i})^{-1}(\frac{w_{t+i}}{w_t})]$ $WP_t^{(1)} = \log[1 + \sum_{i=1}^{T}(1+r_{t+i})^{-i}(\frac{w_{t+i}}{w_t})^{\beta}]$ $\beta = (1-s)(1-\theta)$	$\log c_t = \log y_t + YP_t^{(2)} - HP_t^{(2)}$ where: $YP_t^{(2)} = \log[A_{t-1}/Y_t + 1 + \sum_{i=1}^{T}(1+r_{t+i})^{-i}(\frac{y_{t+i}}{y_t})]$ $HP_t^{(2)} = \log[1 + \sum_{i=1}^{T}(1+r_{t+i})^{-i}(\frac{h_{t+i}}{h_t})^{\gamma}]$ $\gamma = -((1-s)(1-\theta))[s+(1-s)\theta]^{-1}$
Borrowing constraints:	$\log c_t = \log\theta + \log w_t + \hat{YP}_t^{(1)} - \hat{WP}_t^{(1)}$ where: $\hat{YP}_t^{(1)} = \log[A_{t-1}/W_t + 1 + (1+r_{t+1})^{-1}(\frac{w_{t+1}}{w_t} - \frac{Z_{t+1}}{W_t})]$ $\hat{WP}_t^{(1)} = \log[1 + (1+r_{t+1})^{-1}(\frac{w_{t+1}}{w_t})^{\beta}]$	$\log c_t = \log y_t + \hat{YP}_t^{(2)} - \hat{HP}_t^{(2)}$ where: $\hat{YP}_t^{(2)} = \log[1 + (1+r_{t+1})^{-1}(\frac{y_{t+1}}{y_t} - \frac{Z_{t+1}}{Y_t})]$ $\hat{HP}_t^{(2)} = \log[1 + (1+r_{t+1})^{-1}(\frac{h_{t+1}}{h_t})^{\gamma}]$

1) w_t denotes real wage rate, W_t/P_t, h_t employment, $1-\hat{\ell}_t$, Y_t labor income, $W_t h_t$, y_t real income, Y_t/P_t, and r_t real interest rate.

Finally, consider the case where, labour supply is rationed and the borrowing constraint (2) is binding. In this case we end up with the consumption function, presented in the bottom right-hand corner of Table 1. Again credit rationing operates both directly and indirectly through the length of 'effective' planning horizon. Labour supply rationing - as in the perfect capital market case - affects both via income concept and directly as an additional explanatory variable. The latter effect disappears with C-D intertemporal preferences, and under these rather special circumstances the consumption function is similar to 'Keynesian' liquidity-oriented consumption function into which credit rationing variable has been included as the additional explanatory variable.[6)]

Finally, it might be worthwhile to point out that the approach presented above eliminates the Hendry et al (1981) inflation effect, while not the Deaton (1977) 'misperception of inflation' effect.

3. SOME EMPIRICAL RESULTS

In what follows our purpose is not to try to find out the 'best' consumption function specification, but rather to carry out some preliminary empirical tests with the "market clearing" and "labour supply rationing" consumption function specifications by using Finnish quarterly data over the period 1961.1.-1980.3.[7)] These data are seasonally adjusted and expressed in per capita terms; total consumption expenditure has been used for c, total man hours for employment h (= $1-\hat{\ell}$) and the wage rate per man hour, adjusted for taxes, for W (for other details, see Koskela and Virén (1983b)). The estimation results which were obtained when fitting the linearized "market clearing" and "labour supply rationing" consumption function specifications to these data are presented in Table 2, where $w = W/P$, Y denotes households´ disposable income and $y = Y/P$ and variables with superscript e refer to expected values.[8,9] The equations were estimated both in a level and difference form and with and without the lagged dependent variable as an additional explanatory variable.

The results can be briefly summarized as follows: First, the coefficient estimates of explanatory variables are of expected sign, while the significance of some of them is slightly sensitive to the question of whether the level or difference form is used and whether the lagged dependent variable is introduced or not as an additional explanatory variable. It is of some interest to note that the coefficient estimates of the expected employment term are not incompatible with unitary inter-temporal elasticity of substitution.[10] Second, applying the Davidson-MacKinnon (1981) J-test for non-nested models and the F-test for the non-overlapping variables of the competing hypotheses - following the suggestion of Mizon and Richard (1983)[11] - suggests that the evidence concerning the relative performance of "market clearing" and "labour supply rationing" specifications is conflicting. As far as the level form equations C1 and R1 are concerned, their residuals are highly autocorrelated. Furthermore, the parameters are unstable, which makes their comparison rather meaningless. Introducing the lagged dependent variable increases the performance of both specifications. In this case the "labour supply rationing" model outperforms the "market clearing" model in terms of both J- and F-statistics.

TABLE 2: Estimation results with Finnish quarterly data

	Constant	$\log w_t$	(A_{t-1}/W_t)	r^e_{t+1}	$\Delta \log w^e_{t+1}$	$\log c_{t-1}$	R^2	SEE	D-W	Q(6)	LM(4)	J	F	Chow
(C1)	7.018	.923	.005	-1.064	.864		.993	.0186	.995	35.16*	25.81*	.512	5.990*	3.117*
	(.055)	(.011)	(.001)	(.286)	(.198)							(.154)		
(C2)	3.672	.483	.004	-.417	.274	.474	.995	.0160	1.999	9.67	8.23	.782	3.154*	1.477
	(.639)	(.084)	(.001)	(.274)	(.203)	(.090)						(.272)		
(C3)		.745	.011	-.673	.128		.422	.0168	2.639	11.40	11.28*	.578	1.768	0.774
		(.121)	(.004)	(.317)	(.188)							(.367)		
(C4)		.829	.014	-.641	.213	-.216	.461	.0163	2.251	6.43	6.33	.590	1.754	1.424
		(.094)	(.004)	(.309)	(.187)	(.094)						(.353)		

	Constant	$\log y_t$	(A_{t-1}/Y_t)	r^e_{t+1}	$\Delta \log y^e_{t+1}$	$\Delta \log h^e_{t+1}$	$\log c_{t-1}$	R^2	SEE	D-W	Q(6)	LM(4)	J	F	Chow
(R1)	.317	.949	.046	-.699	.436	.760		.993	.0187	1.202	26.00*	16.53*	.557	8.918*	2.664*
	(.120)	(.011)	(.016)	(.274)	(.083)	(.464)							(.160)		
(R2)	.189	.448	.023	-.272	.133	.483	.524	.996	.0153	2.221	4.74	5.95	.366	1.751	1.540
	(.100)	(.083)	(.014)	(.235)	(.084)	(.431)	(.086)						(.334)		
(R3)		.729	.145	-.306	.198	.586		.419	.0170	2.631	11.18	12.95*	.925	2.214	2.487*
		(.123)	(.044)	(.346)	(.093)	(.406)							(.444)		
(R4)		.836	.177	-.278	.240	.317	-.229	.459	.0165	2.239	6.89	7.41	.818	2.418	1.946
		(.129)	(.045)	(.337)	(.092)	(.411)	(.099)						(.226)		

Equations (C1)-(C4) correspond to the "market clearing" specification and (R1)-(R4) to the "labor supply rationing" specification. Equations (C1), (C2), (R1) and (R2) have been estimated in a level form while equations (C3), (C4), (R3) and (R4) have been fitten into a differenced data. Standard deviations are in parentheses, Q(6) denotes the Box-Pierce autocorrelation statistic with 6 lags, LM(4) the Breusch (1978) LM-autocorrelation statistic with 4 lags, J the Davidson-MacKinnon J-statistic for nonnested models, F the standard F-statistic for the non-overlapping variables of the competing hypothesis, and finally Chow the Chow F-statistics for parameter stability. Starred values of χ^2 and F-statistics are significant at 5 percent level of significance.

If the data are differenced, however, these tests statistics fail to discriminate between "labour supply rationing" and "market clearing" consumption function specifications, even though the "market clearing" consumption function specification works slightly better.

As noted earlier, in the case of C-D intertemporal preferences all the effects of labour supply rationing go via incomes so that the difference between them is essentially a matter of testing for the exogeneity of incomes in the consumption equation.[12)] But the Davidson-MacKinnon J-test (reported in Table 2) can also be viewed as a test of misspecification by Hausman (1978) in the sense that both tests are asymptotically equivalent under standard assumptions (see Hausman and Pesaran (1983) for details). Anyway, we also tried to check the exogeneity of y by carrying out Granger causality tests. The results were indecisive.[13)]

All the equations were also estimated by using the non-durable private consumption expenditure - instead of total private consumption expenditure - as the dependent variable and by introducing gross transfer income as an additional explanatory variable into the "market clearing" consumption function specifications. Results with non-durable consumption expenditure were almost identical to those with total consumption expenditure - only the significance of the real rate of interest slightly diminished - while, on the other hand, the gross transfer income did not turn out to be significant in any of the equations.[14)]

In this connection one can finally ask whether this result that neither model is clearly superior is sensitive with respect to different specifications of expectations formation, or with respect to different ways of treating the approximations. This does not, however, seem to be the case; even though the test statistics display some variability, no clear superiority is detected.[15)]

Concludingly, the preliminary testing procedures reported above suggest that the question of whether the "market clearing" or "labour supply rationing" assumption provides a better approximation for Finnish consumption behaviour remains moot. Our results leave open the possibility of some kind of regime switching between equilibrium and disequilibrium periods in the labour market. Moreover, one can still question the derivation of both models; for example introducing uncertainty into the intertemporal choice problem might change the overall stochastic structure of both specifications.

FOOTNOTES:

1) Quantity rationing at a given interest rate is only one form of capital market imperfections. For an analysis of the implications of borrowing/lending interest rate differentials for consumer intertemporal behaviour with exogenous income profile, see Shah (1981).

2) Koopmans (1972) has shown that the intertemporal separability is implied by certain assumptions like stationarity and independence of preferences. Hicks (1965) has identified independence of preferences as the key assumption arguing that it is counter-intuitive. Instead he claims that there is normally a strong complementarity between consumption at successive moments. The assumption that consumption and leisure may be substitutes or complements within periods, but independents over time is made in Heckman (1974) and Barro and Grossman (1976). In Lucas and Rapping (1969) the intertemporal substitution is allowed in a general form, which leaves most of the signs ambiguous a priori.

3) Instead of solving as usual for the complete consumption profile as a function of all the exogenous variables consumption behaviour of households could also be analyzed by using the (stochastic) Euler equation along the lines suggested by Hall (1978), who, under certain simplifying assumptions, ended up with the reduced form specification $C_t = a_0 + a_1 C_{t-1} + e_t$ where C_t is the real volume of consumption and e_t the (possibly heteroscedastic) error term. Several empirical studies have tried to test the Hall specification with exogenous labour income either in a reduced form context by looking at the relevant information sets for households (see e.g. Hall (1978)) or by modelling structurally the underlying consumption behaviour (see e.g. Flavin (1981)). In the context of endogenous goods-leisure choices Altonji (1982) has used the observed consumption in the labour supply function the idea being that the consumption variable would capture expectations of future wages and real interest rates on labour supply. Naturally, the same idea could be applied the other way round when analyzing the consumption behaviour. Clearly the 'Euler approach' seems to be helpful by looking at observed behaviour instead of unobservables. Unfortunately, relaxing certain simplifying assumptions like independence of goods and leisure in the utility functions and constant real rate of interest imply that the Hall specification no longer holds; it is not only the case that the coefficient of lagged consumption becomes varying and the error term serially correlated, but also additional variables have to be included (see King (1983)). Thus we end up with varying parameter regressions.

4) The evidence about intra-period preferences is not compelling and seems to be a bit sensitive to the specification of an expenditure system (see Abbott and Ashenfelter (1976)).

5) In order to concentrate on extreme cases we consider only the case where household is subject to permanent labour supply rationing.

6) As indicated earlier, when deriving consumption behaviour in in the presence of labour market clearing on the one hand and labour supply rationing on the other hand, we have assumed that households are permanently on either regime. Households can be presently subject to labour supply rationing, while not in the future and vice versa. Allowing for switching regimes in the labour market, however, makes the consumption functions intractable with CES-intertemporal preferences. With C-D intertemporal preferences explicit solutions for the consumption behaviour can be derived; the regime switching now gives rise to unstable regression coefficients over time. Of course, the same argument holds with respect to regime switching in the capital market (see Koskela and Virén (1983b) for details).

7) As it is evident from Table 1, borrowing constraints affect both directly and indirectly by changing the intertemporal allocation of resources. The qualitative properties of the consumption function with and without labour supply rationing are not, however, sensitive to the assumption about capital market. We hope to analyze the role of capital markets for consumption behaviour in another occasion.

8) These specifications result from the following linear approximations:

(i) $YP_t^{(1)} = a_0(A_{t-1}/W_t) + a_1 r_{t+1}^e + a_2 \Delta \log w_{t+1}^e$

(ii) $WP_t^{(1)} = b_0 r_{t+1}^e + b_1 \Delta \log w_{t+1}^e$

(iii) $YP_t^{(2)} = c_0(A_{t-1}/Y_t) + c_1 r_{t+1}^e + c_2 \Delta \log y_{t+1}^e$

(v) $HP_t^{(2)} = d_0 r_{t+1}^e + d_1 \Delta \log h_{t+1}^e$

9) Estimates are OLS estimates. The expected values for period t+1 were obtained by regressing w_{t+1}, p_{t+1}, y_{t+1} and h_{t+1} against the following set of variables; w_t, p_t, y_t, h_t, R_t, A_t (besides values for period t, also values for t-1, t-2 and t-3 were used for all of these variables). A_t denotes the stock of liquid assets and $r_{t+1}^e = k_t - \Delta \log p_{t+1}^e$.

It should be noted, however, that this (rather usual) way of generating expected values may invalidate standard errors given in various model specifications so that results should be considered with due care (see e.g. Pagan and Hall and Trivedi (1983)).

10) As far as the coefficient of (A_{t-1}/W_t) is concerned, it should be interpreted as the initial net assets relative to the "full income" (wage rate times the time endowment, which is unobservable) of households. We have assumed that our proxy, liquid assets of households relative to wage rate, is proportionately related to its theoretical counterpart. In this context it may be useful to point out that the (A_{t-1}/W_t)- and (A_{t-1}/Y_t)-terms do make it possible an inflation effect on consumption as a sort of the real balance effect via the deterioration of the real value of liquid assets. In the light of the fact that inflation also affects consumption via the real rate of interest in our specifications it is of no surprise that the inflation variable - used here as an ad hoc additional variable - did not turn out to be significant in any of the equations estimated (its t-values never exceeded .5).

11) The use of the F-statistic (proposed also by Dastoor (1983)) is based on the encompassing principle forcefully advocated by Mizon and Richard (1983).

12) In the context of static consumer expenditure system extended by allowing for goods-leisure choices Deaton (1982) has looked at the question of whether the market clearing or labour supply rationing provides a better approximation in the special case of separability between goods and leisure, in which case testing for rationing is essentially a matter of testing for exogeneity of income in the commodity demands. The results, by using the 1973 British Family Expenditure Survey, although slightly in favour of the market clearing hypothesis, are basically unable to distinguish between that and the constrainted hours.

13) We computed the Granger test statistics for $\Delta \log c_t$, $\Delta \log w_t$, $\Delta \log y_t$ and $\Delta \log h_t$. The following F-statistics were obtained by using 4 lags with both the dependent and the independent variables:

	'Causal' candidates			
	$\Delta \log c_t$	$\Delta \log w_t$	$\Delta \log y_t$	$\Delta \log h_t$
$\Delta \log c_t$	-	1.863	2.729	.096
$\Delta \log w_t$	1.938	-	1.720	4.371
$\Delta \log y_t$	1.409	3.003	-	.841
$\Delta \log h_t$	2.750	.822	2.586	-

$$F_{.05,4.65} = 2.51, \; F_{.01,4,65} = 3.62.$$

Results are not totally unambiguous; however they are slightly more in line with the labour supply rationing hypothesis than with the market clearing hypothesis. In particular, one can notice that the real wage fails to "Granger cause" consumption and employment, while the opposite is true with the real income at the 5 per cent, but not at the 1 per cent significance level.

14) We also experimented a bit with the role of taxes by allowing for the separate potential effect of "tax income" (taxes minus transfers) on consumption. In both the "labour supply rationing" and "market clearing" specifications the propensity to consume out of "tax income" was clearly positive, although significantly smaller than the one out of gross income. This is not inconsistent with the notion that households are unable to distinguish between pre- and post-tax income in the short run. In the presence of progressive taxation, however, the net wage rate becomes endogenous in the "market clearing" specification. By taking progressive taxation into account in a proper way is a separate issue and lies beyond the scope of our preliminary testing. A complete set of results reported above is available from the authors upon request.

15) On the one hand, the equations were estimated by using, the actual values of the respective variables for period t+1. On the other hand, the multiplicative terms

$r^e_{t+1}\ \Delta \log w^e_{t+1}$ for" market clearing" equation and $r^e_{t+1}\ \Delta \log y^e_{t+1}$ and

$r^e_{t+1}\ \Delta \log h^e_{t+1}$ for "labour supply rationing" equation were used.
In all cases the results were practically identical with those presented above (see Koskela and Virén (1983b) for details).

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