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Unemployment as a constraint on labour supply and goods demand in Spain

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In this paper the implications of unemployment on labour supply and goods demand functions in Spain are analysed during the period 1964–91. To this end, the labour supply and goods demand is jointly modelled using a dynamic linear expenditure system under the condition that labour supply has been rationed due to the increasing number of unemployed in the last three decades. After proof that the model exhibits neither autocorrelation nor dynamic heteroscedasticity problems, it is found that food, beverages and tobacco, gross rent, fuel and power and miscellaneous goods are necessities, while other goods are luxuries. Labour has an expenditure effect below zero. The own-price Marshallian and Hicksian elasticities are negative for consumption goods and positive for labour, and indicate that all consumption goods are price inelastic. Finally, the cross-price values indicate that the goods are complementary.

I. INTRODUCTION

It is normally the case that the utility function of consumers is specified only in terms of goods and services that the agents buy in the markets. However, while it is evident the consumers are buyers of goods, they also demand leisure and supply labour. Therefore, this restrictive formulation of the utility function does not appear to be entirely correct. In this line, a very important number of empirical papers have specified utility functions that include leisure or labour and consumption goods, from which they derive different demand systems. The estimation of these systems has permitted us to jointly characterize leisure demand or labour supply and goods demand in several Western countries. Among these studies we can find Abbott and Ashenfelter (1976 and 1979), Barnett (1979), Dowd (1992), Joerding (1982), Kiefer (1977) and Phlips (1978) using US data; Darrough (1977) using Japanese data; Blundell and Walker (1982) and Ray (1982a and 1982b) using data from Great Britain and Kaiser (1993) using German data.

The objective of this paper is to analyse the implications of unemployment on labour supply and goods demand functions in Spain during the period 1964–91. In order to do this, we jointly model the labour supply and goods demand under the condition that the labour supply of some workers has been constrained due to the increasing number of unemployed in the Spanish economy in the last three decades. That is, unemployment causes restrictions in the theoretical modelling because, for this kind of consumer, the real labour supply and goods demand are not consistent with the predictions of their functions. Following Ashenfelter (1980) and Neary and Roberts (1980), we use the rationing theory to model unemployment, that is, we use a labour supply and goods demand system where the first is rationed. The chosen demand system is a dynamic version that incorporates habits of the linear expenditure system (LES) proposed by Stone (1954). This model is estimated using annual temporal series of expenditures on leisure, work time and consumption goods from 1964 to 1991. These data allow us to obtain expenditure and Marshallian and Hicksian price and wage elasticities.

Following the introduction, this paper is divided into four sections. In Section II the LES model is presented. In Section III the data and the estimation method are explained. The results are described in Section IV, and finally, Section V presents the conclusions of the paper in summarized form.

II. THE THEORETICAL MODEL

In estimating a labour supply and goods demand system in Spain, we must incorporate the existence of unemployment. To do this, we follow Ashenfelter (1980), who uses the rationing theory to incorporate it into the modelling, that is, to obtain the aggregate labour supply and goods demand functions. This method implies several steps. First, we should obtain the system for unconstrained agents. Thereafter, considering the rationed labour supply, we will obtain the system for

constrained consumers and, finally, we aggregate the functions using the unemployment rate as an approximation of this restricted population.

We consider rational employed and unemployed workers that decide both with respect to the purchase of consumption goods and with respect to the distribution of their total time between work and leisure. We assume a specific direct utility function that is common to both employed and unemployed workers; in particular, we use the simple augmented Stone–Geary utility function:

$$U = \beta_L \ln (\gamma_L - q_L) + \sum_{j=1}^{n} \beta_j \ln (q_j - \gamma_j) \qquad (1)$$

where q_L is the labour supplied by the agent, q_j is the consumption of the good j, and β_j, β_L, γ_j and γ_L are parameters. β_j are the proportions of every good in the supernumerary income, and coefficients γ_j and γ_L are usually interpreted as minimum subsistence. The parameters of the system must satisfy the following conditions: $\beta_j > 0$ and $\beta_L > 0$, $\beta_j + \beta_L = 1$, $q_j > \gamma_j > 0$ and $q_L < \gamma_L$.

The maximization of Equation 1 subject to the budget restriction leads to unconstrained goods demand and labour supply corresponding to Stone's (1954) the linear expenditure system (LES):

$$p_i q_i^U = p_i \gamma_i + \beta_i \left(y - \sum_{j=1}^{n} p_j \gamma_j + \omega \gamma_L\right) \qquad (i = 1,..., n) \qquad (2a)$$

$$\omega q_L^U = \omega \gamma_L - \beta_L \left(y - \sum_{j=1}^{n} p_j \gamma_j + \omega \gamma_L\right) \qquad (2b)$$

where ω and p_j are the nominal wage and the prices of goods, respectively, and y is the household's non-human income.

However, following Neary and Roberts (1980), when labour supply is rationed, the constrained goods demand and labour supply system is:

$$p_i q_i^C = p_i \gamma_i + \frac{\beta_i}{1-\beta_L} \left(y - \sum_{j=1}^{n} p_j \gamma_j = \omega \bar{q}_L\right) \qquad (i = 1,..., n) \qquad (3a)$$

$$\omega q_L^C = \omega \bar{q}_L \qquad (3b)$$

where $\bar{q}_L$ is the rationed labour supply. The aggregated behaviour includes both kind of agents, employed ($\bar{q}_L > 0$) and unemployed ($\bar{q}_L = 0$). We use the unemployment rate, u, to describe the proportion between workers and non-workers.

We then can aggregate the functions as follows:

$$p_i q_i = u(p_i q_i^C) + (1 - u)\ (p_i q_i^U) \qquad (i = 1,...,n) \qquad (4a)$$

$$\omega q_L = u(\omega q_L^C) + (1 - u)\ (\omega q_L^U) \qquad (4b)$$

The unemployment rate is an approximate indicator of the proportion of constrained consumers. It is not an exact measure for several reasons. First, some agents do not appear as unemployed, although in fact they are, because they do not appear as total labour force. In this case, we should use an indicator greater than the unemployment rate. Second, there will be agents that are considered unemployed, although they are actually workers. In this situation, we should use a measure that is lower than the unemployment rate.

To choose the best indicator of the proportion of rationed agents, Ashenfelter (1980) proposes two additional possibilities to approximate the proportion of constrained consumers: $u = \alpha u^*$ and $u = \alpha_0 u^* + \alpha_1 u^{*2}$, where u^* is the unemployment rate. Starting from the estimated parameters and their t-rates of both specifications, we can choose the best approximation. If α is significant and very close to unity or α_0 is significant and next to unity and α_1 is not significant or very close to zero, then the unemployment rate is a good indicator of the proportion of constrained consumers. Otherwise, we can use the specification whose parameters are significant.

III. DATA AND ESTIMATION

The data used in this paper are Spanish annual time series from 1964 to 1991. The personal consumption expenditures and prices are obtained from several issues of the national accounts, Vol. 2 (OECD); the nominal wage and labour supplied are obtained from the Year Book of Labour Statistics (OIT); and the unemployment rate is calculated from the Labour Force Statistics (OECD).

We have specified a model with six equations, five corresponding to consumption goods and the sixth to labour. As regards the first, we disaggregate the total expenditure in consumption goods into the following categories: (1) food, beverages and tobacco; (2) clothing and footwear; (3) gross rent, fuel and power; (4) durable goods; (5) miscellaneous goods and services. In order to obtain per capita values, consumption goods expenditure is divided by population and, as Philips (1978) said when unemployment exist, leisure expenditure is divided by the total labour force.

The nominal wage (ω) is the earnings of a production worker in non-agricultural activities. Non-human earnings (y) are taken as the difference between the personal available income and labour earnings. We then calculate full income (Y) by adding per capita non-human income to the value of an individual's time over the year, which is obtained by the product of the wage and the number of hours in each year.

Many of the papers within the empirical literature on LES have proved that one of the less satisfactory features of the LES model is its static character (for example, Howe *et al.* (1979), Phlips (1972), Pollak (1970), Pollak and Wales (1969) and Ray (1985)). Therefore, we dynamize our system following the formulation of Pollak (1970) that incorporates the effects of habits in the parameters γ_{it}:

$$\gamma_{it} = \gamma_i^* + \gamma_i^{**} q_{it-1} \qquad (i = 1,...,n,L) \qquad (5)$$

where γ_i^* and γ_i^{**} are new coefficients.

Under this dynamic specification, the budget share form of the LES model in its stochastic version is:

$$w_{it} = \gamma_{it}\frac{p_{it}}{Y_t} - \beta_{it}\left(\frac{y_t}{Y_t} - \sum_{j=1}^{n}\gamma_{jt}\frac{p_{jt}}{Y_t} + \gamma_{Lt}\frac{\omega_t}{Y_t}\right) - u_t\frac{\beta_{it}}{1-\beta_{Lt}}$$

$$\left[\gamma_{Lt}\frac{\omega_t}{Y_t} - \beta_{Lt}\left(\frac{y_t}{Y_t} - \sum_{j=1}^{n}\gamma_{jt}\frac{p_{jt}}{Y_t} + \gamma_{Lt}\frac{\omega_t}{Y_t}\right)\right] + \varepsilon_{it} \quad (i = 1, ...,n) \quad (6a)$$

$$w_{Lt} = (1-u_t)\left[\gamma_{Lt}\frac{\omega_t}{Y_t} - \beta_{Lt}\left(\frac{y_t}{Y_t} - \sum_{j=1}^{n}\gamma_{jt}\frac{P_{jt}}{Y_t} + \gamma_{Lt}\frac{\omega_t}{Y_t}\right)\right] + \varepsilon_{Lt} \quad (6b)$$

Due to the adding-up restriction, the covariance matrix is singular and the likelihood function undefined. The usual procedure followed in this study has been to drop one of the equations, estimate the remaining system and calculate the parameters in the omitted equation via the adding-up condition. The dropped equation corresponds to miscellaneous goods and services. The model (6a)-(6b) was estimated by Zellner's (1962) SURE method.

When estimating, an initial question is to determine how to incorporate the unemployment rate. To this end, we estimate both specifications of unemployment explained above and we choose the version according to the values of the parameters. We then test first-order autocorrelation and dynamic heteroscedasticity or ARCH errors Thereafter, we calculate the expenditure and Marshallian and Hicksian price and wage elasticities for the five consumption goods categories and labour.

IV. RESULTS

Table 1 *Parameters for choosing unemployment*

α	α_0	α_1
0.29	0.58	–1.51
(0.01)	(5.11)*	(–3.27)*

Note:* indicates significant at the 5% level. *t*-ratios at the 5% level: 1.96.

We estimate the LES model under both unemployment definitions. The value of parameters α, α_0 and α_1 and the *t*-ratio appear in Table 1. As we can see, α is not significant at the 5% level, whereas α_0 and α_1 are. Therefore, we choose the second form, $u = \alpha_0 u^* + \alpha_1 u^{*2}$, to incorporate the unemployment.

The values of α_0 and α_1 allow us to obtain a measure of real unemployment which is lower than the official indicator. This difference could be due to agents who, although classified as unemployed, actually are not, because they work in the hidden economy.

The statistic used to test first-order autocorrelation is obtained as follows. We start from the initial model and we suppose that the error term is specified as: $\varepsilon_{it} = \rho\varepsilon_{it-1} + \delta_{it}$, where δ_{it} is an error term which has an expected value of zero and a constant variance–covariance matrix. We estimate the system by substituting the error term by the above specification according to Berndt and Savin (1975) and Anderson and Blundell (1982). Finally, we test the hypothesis H_0: $\rho = 0$. Moreover, we test first-order dynamic heteroscedasticity or ARCH errors by means of the Engle (1982) test.

In Table 2 we show the results of the specification tests. The value of the *t*-rate of ρ appears in the first column. As the *t*-value is lower than the critical value, we accept that our model does not exhibit first-order autocorrelation problems. In the rest of the columns we can see the values for dynamic heteroscedasticity. As these values are lower than the critical value of χ^2, we reject ARCH problems in all equations. Thus, our model does not display either first-order autocorrelation or ARCH problems at the 5% level of significance.

Table 3 shows the estimated parameters and the degree of fit. As regards the individual significance of the coefficients, we observe that the majority are significant at the 5% level. As we can see, all parameters satisfy the initial conditions specified in the model. The parameter γ_i^{**}, which shows the effect of habits, is significant in all consumption goods but not in labour. With respect to consumption goods, we observe that this parameter displays the high influence of habits in the contemporaneous expenditures, because this parameter has a value close to one in all groups. With respect to the degree of fit and despite the fact that R^2 is only an approximate indicator in demand systems and thus has to be carefully interpreted, it is also true that the majority of empirical papers that have estimated the LES have included this coefficient in their results tables (for example, Abbott and Ashenfelter (1976 and 1979), Ashenfelter (1980) and Pollak and Wales (1969)). In our study, as usual, the model appears to fit very well as noted by the very high values, with the lower value corresponding to durable goods, specifically, 0.97.

Table 2. *Specification tests*

	ARCH					
Value of *t*-rate of ρ	Food, beverages and tobacco	Clothing and footwear	Gross rent, fuel and power	Durable goods	Miscellaneous goods	Labour
–0.01	2.43	0.55	1.49	0.002	0.30	0.13

t-ratios at the 5% level: 1.96. $\chi^2(1)_{0.05} = 3.84$.

Table 3 *Estimated parameters*

	β_i	γ_i^*	γ_i^{**}	$\bar{\gamma}_i$	R^2
Food, beverages and tobacco	0.04	7.59	0.93	113.53	0.99
	(1.78)	(2.67)*	(25.49)*	(60.63)*	
Clothing and footwear	0.04	2.82	0.89	42.88	0.99
	(2.16)*	(1.33)	(12.15)*	(21.43)*	
Gross rent, fuel and power	0.02	2.57	0.96	63.46	0.99
	(2.03)*	(3.71)*	(58.51)*	(97.18)*	
Durable goods	0.06	2.02	0.91	45.25	0.97
	(2.18)*	(1.61)	(16.13)*	(16.66)*	
Miscellaneous goods	0.06	3.59	0.99	173.26	–
	(1.96)*	(1.16)	(75.02)*	(53.59)*	
Labour	0.78	1060.99	0.27	1358.32	0.99
	(8.47)*	(2.37)*	(0.89)	(9.67)*	

Note: * indicates significant at the 5% level; *t*-ratios at the 5% level: 1.96.

In Table 4 we show aggregate elasticities evaluated at average sample values. With respect to the expenditure effects, we observe that all values are statistically significant at the 5% level except that relating to food, beverages and tobacco, although its *t*-value is very close to the critical value, 1.96. The figures indicate that all consumption goods are normal, with food, beverages and tobacco, gross rent, fuel and power and miscellaneous goods being necessities. Gross rent, fuel and power, and food, beverages and tobacco exhibit the lowest values and miscellaneous goods has a value of 0.84. This is due

Table 4 *Elasticities*

	Food, beverages and tobacco	Clothing and footwear	Gross rent, fuel and power	Durable goods	Miscellaneous goods	Labour
Expenditure	0.61	1.69	0.51	2.34	0.84	–1.74
	(1.93)	(2.42)*	(2.27)*	(2.46)*	(2.16)*	(–8.45)*
Marshallan						
Food, beverages and tobacco	–0.06	–0.02	–0.02	–0.02	–0.06	–0.011
	(–1.79)	(–1.90)	(–1.93)	(–1.87)	(–1.92)	(–2.35)*
Clothing and footwear	–0.11	–0.09	–0.06	–0.04	–0.15	–0.25
	(–2.43)*	(–1.81)	(–2.43)*	(–2.47)*	(–2.43)*	(–2.93)*
Gross rent, fuel and power	–0.03	–0.01	–0.02	–0.01	–0.05	–0.08
	(–2.25)*	(–2.18)*	(–1.85)	(–2.15)*	(–2.24)*	(–3.18)*
Durable goods	–0.16	–0.05	–0.08	–0.13	–0.22	–0.27
	(–2.45)*	(–2.46)*	(–2.45)*	(–2.08)*	(–2.46)*	(–2.35)*
Miscellaneous goods	–0.05	–0.02	–0.02	–0.02	–0.07	–0.11
	(–2.14)*	(–2.11)*	(–2.15)*	(–2.12)*	(–1.94)	(–2.93)*
Labour	0.09	0.03	0.04	0.03	0.12	1.32
	(8.37)*	(7.99)*	(8.45)*	(7.60)*	(8.30)*	(8.41)*
Hicksian						
Food, beverages and tobacco	–0.01	–0.02	–0.04	–0.01	–0.02	–0.87
	(–0.65)	(–1.43)	(–1.90)	(–0.86)	(–1.87)	(–7.49)*
Clothing and footwear	–0.02	–0.05	–0.009	–0.05	–0.02	–1.01
	(–2.33)*	(–1.15)	(–1.30)	(–1.37)	(–2.33)*	(–6.50)*
Gross rent, fuel and power	0.07	0.05	0.05	0.01	–0.06	–0.83
	(2.31)*	(0.95)	(–0.47)	(1.68)	(–2.00)*	(–7.87)*
Durable goods	0.02	0.007	–0.02	–0.06	–0.03	–1.12
	(2.44)*	(0.26)	(–1.61)	(–1.18)	(–2.41)*	(–6.29)*
Miscellaneous goods	0.02	0.03	0.04	0.05	–0.07	–0.87
	(2.18)*	(2.05)*	(2.16)*	(1.98)*	(–0.39)	(–7.87)*
Labour	–0.05	–0.01	–0.02	–0.02	–0.02	0.56
	(–8.21)*	(–5.82)*	(–8.09)*	(–5.70)*	(–6.32)*	(8.31)*

Note: * indicates significant at the 5% level. *t*-ratios at the 5% level: 1.96.

to the fact that this category is composed of several individual expenditures that are clearly necessities, for example medical care and health expenses, public transport or education. The remaining categories are luxuries; in particular, the durable goods group displays the greatest value. Finally, we obtain a negative expenditure elasticity for labour.

As regards Marshallian elasticities, we can see that of 36 price values, 28 are significant at the 5% level. On the other hand, all values corresponding to consumption goods are negative, whereas that relating to labour is positive according to demand theory. The consumption goods effects are, in absolute terms, very low, indeed close to zero; that is, their Marshallian demand is price inelastic. The value for labour is above one. With respect to Marshallian cross-price elasticities, our results are consistent with the theoretical properties of the LES model, that is, all consumption goods are complementary. According to Hicksian own-price effects, the conclusions are similar. The elasticities of consumption goods are negative and very close to zero, and the effect relating to labour is positive.

V. CONCLUSIONS

The purpose of this paper is to analyse the implications of the presence of unemployment on labour supply and goods demand functions in the Spanish economy during the period 1964–91. To do this, and knowing that labour supply has been rationed, we jointly specify labour supply and goods demand using a dynamic linear expenditure system.

As regards the results, having proved that the model exhibits neither autocorrelation nor dynamic heteroscedasticity problems, we obtain the estimated parameters, as well as expenditure and Marshallian and Hicksian price and wage effects. The *t*-rates of individual coefficients relating to habits show that our dynamic specification is adequate in order to reflect the behaviour of the Spanish agents.

With respect to elasticities, we find that food, beverages and tobacco, gross rent, fuel and power, and miscellaneous goods are necessities, while the rest of the goods are luxuries. Labour has an expenditure effect below zero. The own-price Marshallian and Hicksian elasticities display signs according to demand theory, that is, negative for consumption goods and positive for labour, and indicate that all consumption goods are price inelastic. Finally, the cross-price values indicate that the goods are complementary.

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