LABOR USE AND ITS ADJUSTMENT IN THE SPANISH FISHING INDUSTRY

Joaquín A. Millán, Technical University of Madrid UPM, joaquin.millan@upm.es
Natalia Aldaz, University of Lleida, natalia@aegern.udl.es

ABSTRACT

This study investigates the adjustment process of labor in the fishing industry of the Spanish regions (Autonomous Communities). The analysis is based on a dynamic model applied to a panel of the 10 coastal regions in Spain for the period covering 1965 to 2001. A translog labor demand equation is estimated with flexible adjustment parameter which is both region and time variable. The results indicate that the long run labor demand exhibit increasing price elasticity, increasing output elasticity and decreasing capital elasticity, although still close to unitary in the final years. The fishing industry has shown considerable dynamics in adjusting its workforce, with different patterns for regions and years. In general, the speed of adjustment is modest except for some particular years in mid-90s. The speed of adjustment is low in Galicia, Andalusia, and in the Basque Country but very high in the Canary Islands. The average equilibrium labor to actual labor (optimality ratio) ratio is on average below unity, but there are important regional differences in evolution patterns.

Keywords: Dynamic Labor Adjustment, Fishing Industry, Spanish Regions

INTRODUCTION

The fishing sector has experienced very important changes in Spain in the last four decades. Structural changes and policy reforms have impacted strongly labor use in the fishing industry, decreasing at a rate close to 2% per year. The evolution of labor is particularly important in Spain, because of the high unemployment rates the Spanish economy has suffered, and mainly in some important fishing regions. The impact of changes in the fishing industry on labor has not been studied in Spain.

In this paper, we analyze the evolution of labor in the fishing industry in the Spanish regions (Autonomous Communities) for the period covering 1965 to 2001. We study regions for three reasons. First, the study at a national level hides the differing evolution patterns of labor use. Second, with regions data rather than national data we have the advantages of panel data, with more degrees of freedom in estimating determinants of labor changes. Third, these estimates may provide different suggestions about the types of policy that a region might adopt to adjust fishing structures.

The theoretic approach defines the equilibrium labor as the long-run desired level of labor given output, capital stock and input prices. Industries undertake adjustment in its resource use, including labor, with an objective to improve efficiency and profitability. A possibility is to analyze deviations from the desired long-run labor level as inefficiency in a frontier framework (Kumbhakar and Lovell, 2000). We follow an alternative approach incorporating dynamic adjustment process in the analysis of labor use. A number of studies attempt to analyze the dynamic labor demand and its adjustment procedure (Nickell, 1986; Hamermesh, 1993). A firm faced with adjustment costs may choose to operate in the short run with a quantity of labor that differs from the long-run desired level.

Recent contribution on dynamic adjustment of labor has been made by Kumbhakar et al. (2002), where the ratio of actual to desired labor demand is termed ‘catch-up’ factor, and Bhandari and Heshmati (2005). Using regional panel data, a flexible adjustment model is used incorporating a speed of adjustment model which is both region and time variant. In addition, the study also provides an insight into labor demand elasticity with respect to wages, output and capital, both over time and across regions.

The paper proceeds as follows. In the next section the basic model of our empirical analysis is developed. This is followed by the description of data and variables and the presentation of the empirical results. The major findings of the paper are summarized in the concluding section.

THE MODEL

The demand for labor is a derived demand which, assuming a variable cost minimization problem, depends on the changes in production, quasi-fixed capital, input prices and the level and utilization of technology. First, assume that labor market is adjusted instantaneously. In the present study, we employ a translog labor demand function because of its flexibility, with homogeneity of degree zero in prices:

$$\begin{aligned}\ln L_{it}^{*} = {} & \sum\nolimits_i b_i R_i + b_w \ln\left(\frac{w_{it}}{p_{it}}\right) + b_y \ln y_{it} + b_k \ln k_{it} + b_t t + \frac{1}{2} b_{ww}\left(\ln\left(\frac{w_{it}}{p_{it}}\right)\right)^2 + \\ & b_{wy} \ln\left(\frac{w_{it}}{p_{it}}\right)\ln y_{it} + b_{wk} \ln\left(\frac{w_{it}}{p_{it}}\right)\ln k_{it} + b_{wt} \ln\left(\frac{w_{it}}{p_{it}}\right) t + \frac{1}{2} b_{yy}\left(\ln y_{it}\right)^2 + \\ & b_{yk} \ln y_{it} \ln k_{it} + b_{yt} \ln y_{it} t + \frac{1}{2} b_{kk}\left(\ln k_{it}\right)^2 + b_{kt} \ln k_{it} t + \frac{1}{2} b_{tt} t^2 \end{aligned} \qquad \text{(Eq. 1)}$$

In (Eq. 1), L_{it} is the equilibrium labor used by region i in period t, w_{it} is wage, p_{it} is intermediate consumption price, y_{it} is output, and k_{it} is capital stock. The parameters $\{b_j\}$ do not have direct interpretation, but they are use to estimate labor demand elasticity with respect to price, output capital and exogenous technical change, taking derivatives with respect to $\ln(w_{it}/p_{it})$, $\ln y_t$, $\ln k_t$ and t, respectively.

Under the equilibrium condition, the observed level of labor (L_{it}) should be equal to the optimal level of labor (L_{it}^{*}) for region i in period t . In reality, the process of adjustment is costly and we adopt partial adjustment model of actual and desired level of employment. This is the equation of non-full adjustment of labor where d_{it} denotes the adjustment parameter.

$$\frac{L_{it}}{L_{it-1}} = \left(\frac{L_{it}^{*}}{L_{it-1}}\right)^{d_{it}} \qquad \text{(Eq. 2)}$$

Higher the value of d_{it} means higher the speed of adjustment: $d_{\text{it}} = 0$ implies that there is not any adjustment, $d_{\text{it}} <1$ implies that there is only partial adjustment, and $d_{\text{it}} =1$ implies immediate full adjustment. Taking log of both sides of (Eq. 2) and rearranging we get:

$$\ln L_{it} = (1 - d_{it}) \ln L_{it-1} + d_{it} \ln L_{it}^{*} \qquad \text{(Eq. 3)}$$

The flexible speed of adjustment d_{it} is expressed as a flexible function of time (not time dummies), region dummies *Ri* and other determinants: the share of wage employment in total employment *Eit*, and the share of intermediate consumption in production *Mit*. We impose that d_{it} lies between 0 and 1, using the following transformation, where $\{a_j\}$ are parameters to estimate:

$$d_{it} = \exp\left\{-\left(\sum\nolimits_i a_i R_i + a_t t + \frac{1}{2} a_{tt} t^2 + a_s \sin(t) + a_c \cos(t) + a_E E_{it} + a_M M_{it}\right)^2\right\} \qquad \text{(Eq. 4)}$$

The speed of adjustment is flexible, ranges between 0 and 1, and varies with both across regions and over time.

Substituting (Eq. 1) and (Eq. 4) in (Eq. 3), and adding an error term, we get a non linear model, which we estimate using maximum likelihood. A particular problem with our data is worth of being noted here. Our panel consists of data every two years. It means that the one-period partial adjustment model using (Eq. 1), (Eq. 3) and (Eq. 4), cannot be estimated. The model with biannual data can result from other combinations of adjustments and speed, or under very restrictive assumptions: a) labor growth in the period from the previous to the missing year and labor growth from the missing year to the actual year are equal, for both actual and equilibrium labor; b) the adjustment coefficient dit is the same for both periods concerning the missing year. Anyway, we can expect a loss in the goodness-of-fit parameters. Put simply, it is the cost of the lost information, due to the missing years.

DATA AND VARIABLE DEFINITIONS

Total production, value added, total and salaried employment, cost of wage labor, output deflator is obtained from Alcaide-Inchausti (1999) and Alcaide-Inchausti and Alcaide-Guindo (2004), for every two years for the period 1955 to 2003. Employment (L_{it}) is defined as the total number of workers engaged in fishing. The wage (w_{it}) is calculated as the ratio of labor cost to salaried employment. Capital series from 1994 is taken from Mas-Ivars et al. (2004) as capital stock at 1990 prices. Time is scaled linearly as (Year-1990)/2. National deflators for intermediate inputs (p_{it}, here p_t) are calculated in a Laspeyres-like price index using weights calculated from the 4th column (Fishing) of the Spanish Input Output Table for 1980 (TIO80). All price indices are rescaled taking 1990 as the base year. Output (y_{it}) is measured as total production divided by output deflator.

A summary statistics of the regional data is presented in Table I. Mean annual rates of growth (g.) follow the average values for labor, output and capital. We observe that the main important regions are Galicia (38% of employment, 36% of production) and Andalusia (21% *L*, 25% *y*) and the Basque Country (10% *L*, 12% *y*). Andalusia and the Basque Country are the regions with higher share of salaried labor. For the whole period 1965 to 2001, labor and output decrease and capital increases. Exceptions are Canary Islands (output increases) and the Basque Country (capital decreases, in a very important structural reform).

Table I: Descriptive Summary of the Regional Fishing Industry in Spain, by Region

	Labor		*Output*		*Capital*		*% Salaried Labor (E)*	*% Intermed Consum. (M)*
REGION	*L*	g_L	*y*	g_y	*k*	g_k		
Andalusia	23.570	-2.3	81.301	-2.6	409.401	0.1	81.3	30.1
Asturias	3.830	-3.3	8.365	-2.3	47.036	1.5	73.1	28.7
Balearic Islands	2.099	-1.9	4.152	-0.6	28.930	5.3	65.3	20.9
Canary Island	8.134	-0.4	26.658	1.0	181.575	0.8	80.8	28.9
Cantabria	3.109	-1.9	7.741	-0.8	35.212	1.9	74.5	29.1
Catalonia	7.740	-1.0	17.844	-0.3	117.377	5.4	71.4	23.3
C. Valencia	7.997	-1.5	20.866	-0.6	115.686	2.7	80.0	26.3
Galicia	42.283	-1.5	116.726	-0.3	712.501	0.8	73.0	31.8
Murcia	1.589	-1.7	3.711	-0.6	14.040	4.8	75.0	24.4
Basque Country	11.350	-2.2	38.402	-2.1	254.920	-2.5	82.9	29.7

A statistical summary of the regional variables by year, weighted by share in total employment, is in Table II. We observe the decline in total employment (*L*), being more important the loss of salaried workers as the decline of the share of salaried to total employment (*E*) illustrates. Production (*y*) increases first, but the decrease is very strong. Capital (*k*) increases until 1977, and declines following this year, with net increase in the period, contrary to output. The share of intermediate inputs (M) increases in the 90s.

Table II: Descriptive Summary of the Regional Fishing Industry in Spain, by Year Weighted by Total Labor

YEAR	*Labor (L)*	*Output (y)*	*Capital (k)*	*% Salaried Labor (E)*	*% Intermediate Consumpt. (M)*
1965	14.147	34.560	122.536	78.0	24.6
1967	14.113	35.194	145.384	77.8	24.6
1969	14.015	34.498	158.491	77.8	24.2
1971	13.849	37.616	180.739	77.7	24.3
1973	13.026	36.607	215.671	78.4	23.9
1975	12.373	34.588	224.053	79.1	23.2
1977	12.084	37.430	259.451	79.1	23.8
1979	12.291	35.815	236.362	81.1	24.9
1981	12.032	36.693	222.973	81.5	25.8
1983	10.451	33.571	226.877	76.6	27.0
1985	9.885	35.005	227.513	75.2	27.3
1987	10.034	31.984	210.257	74.1	27.3
1989	9.782	29.871	193.215	72.8	27.2
1991	9.754	28.494	202.765	73.2	27.3
1993	9.603	31.050	193.282	73.4	27.4
1995	9.250	27.167	174.272	71.2	34.2
1997	9.210	28.461	155.005	70.6	34.0
1999	8.677	26.684	148.311	70.7	34.1
2001	7.658	23.668	144.530	70.3	34.1

EMPIRICAL RESULTS

We estimate a dynamic model in equation (3) with the flexible adjustment component shown in equation (4) and assuming the long term structure in equation (1). Both the long term and the adjustment components are time and region variant. Contrary to other papers, as Bhandari and Heshmati (2005), we do not use time dummies, due to econometric problems given the nature of the data used, and a parsimonious but flexible time function is estimated.

The advantages of using translog function are that it is flexible and that it nests several other functional forms. The Generalized Cobb-Douglas functional form is obtained by setting the interaction terms equal to zero and also Cobb-Douglas by restricting both the squared terms, too.

Table III: Labor Demand Parameter Estimates

Long Run Translog			*Speed of Adjustment*		
Parameter	Estimate	Std. Error	Parameter	Estimate	Std. Error
b_1	0.471	0.351	d_1	-7.000	1.324
b_2	-0.132	0.179	d_2	0.683	0.295
b_3	-0.146	0.190	d_3	2.704	0.508
b_4	-0.165	0.117	d_4	0.948	0.265
b_5	-0.294	0.179	d_5	0.798	0.284
b_6	0.230	0.150	d_6	0.562	0.350
b_7	-0.038	0.133	d_7	0.797	0.257
b_8	0.475	0.123	d_8	-0.254	0.301
b_9	-0.574	0.205	d_9	1.136	0.299
b_{10}	-0.269	0.112	d_{10}	-0.125	0.199
b_w	-1.563	0.611	d_c	0.147	0.090
b_y	1.026	0.309	d_s	-0.019	0.078
b_k	-0.060	0.238	d_t	-0.048	0.030
b_t	0.096	0.026	d_{tt}	0.002	0.003
b_{ww}	0.390	0.752	d_E	2.325	0.896
b_{yy}	-0.143	0.294	d_M	12.955	3.595
b_{kk}	-0.172	0.208			
b_{tt}	0.004	0.002			
b_{wy}	-0.758	0.287	Observations	18 * 10 = 180	
b_{wk}	0.558	0.257	Goodness of fit		
b_{yk}	0.137	0.240		R^2 = 0.77	
b_{wt}	-0.112	0.031		LM-HET= 0.09	
b_{yt}	0.063	0.011			
b_{kt}	-0.049	0.010			

In Table III, we show the parameter estimates. We do not report the test results, but the Cobb-Douglas and Generalized Cobb-Douglas are rejected against the translog specification. We can observe that several squared and interaction terms are significant. The results show that some region specific effects are significant in the long run structure and in the adjustment model.

Table IV shows the total employment-weighted average values for the speed of adjustment, the optimality of labor estimate, and the long-run elasticity with respect to wage, to output, and to capital and the exogenous technical change labor-using rate. The short run elasticity can be calculated by multiplying with the adjustment component. Wage elasticity and output elasticity are increasing, meanwhile capital elasticity is decreasing. However, capital elasticity is the more important determinant of long-run labor demand in the first half, and is still close to unity in the final years of the period analyzed. Concerning exogenous changes, the beginning and final years are labor using and mid years are labor saving.

The average of the optimality ratio is below unity except in the 60s and in a few years since 1989 and 1997. This means that optimal labor is less than actual labor commonly. We cannot term this ratio an efficiency ratio because it can be higher than one. In a smooth trend, the optimality ratio is declining in the 70s, low in the 80s, fairly good in the 90s, and deteriorates in the last years.

The overall mean speed of adjustment is relatively low, and only in the second half of the 90s is above 50%. This means that regional fishing sectors adjust its labor towards optimal level at low rates, in general.

Table IV: Mean Long-Run Elasticities, Optimality and Speed of Adjustment, by Year Weighted by Total Labor

YEAR	*Adjustment Speed $d._t$*	*Optimality Ratio*	*Elasticities respect to*			*Technical Change E_t*
			Wage E_w	*Output E_y*	*Capital E_K*	
1967	0.47	1.07	-0.73	0.71	1.62	0.05
1969	0.46	1.02	-0.72	0.71	1.60	0.04
1971	0.40	0.94	-0.71	0.56	1.74	0.01
1973	0.26	0.84	-0.57	0.44	1.79	-0.03
1975	0.14	0.92	-0.67	0.64	1.62	-0.02
1977	0.14	0.88	-0.71	0.61	1.65	-0.03
1979	0.22	0.86	-0.86	0.70	1.57	-0.02
1981	0.30	0.86	-1.01	0.71	1.58	-0.01
1983	0.34	0.87	-1.04	0.76	1.52	-0.02
1985	0.25	0.91	-1.18	0.80	1.51	-0.02
1987	0.15	0.93	-1.31	0.93	1.39	0.00
1989	0.11	1.00	-1.45	1.05	1.28	0.01
1991	0.12	0.97	-1.50	1.13	1.19	0.01
1993	0.14	1.06	-1.69	1.14	1.23	0.02
1995	0.66	0.92	-1.73	1.19	1.10	0.01
1997	0.62	1.00	-1.93	1.21	1.11	0.03
1999	0.49	0.93	-1.99	1.24	1.05	0.02
2001	0.42	0.88	-2.01	1.30	0.94	0.02

Figure 1 illustrates the evolution of the speed of adjustment for Galicia, Andalusia, the Basque Country and the Canary Islands. We can observe large similarities in the continental regions, and a very different picture with quick adjustment for the Canary Islands.

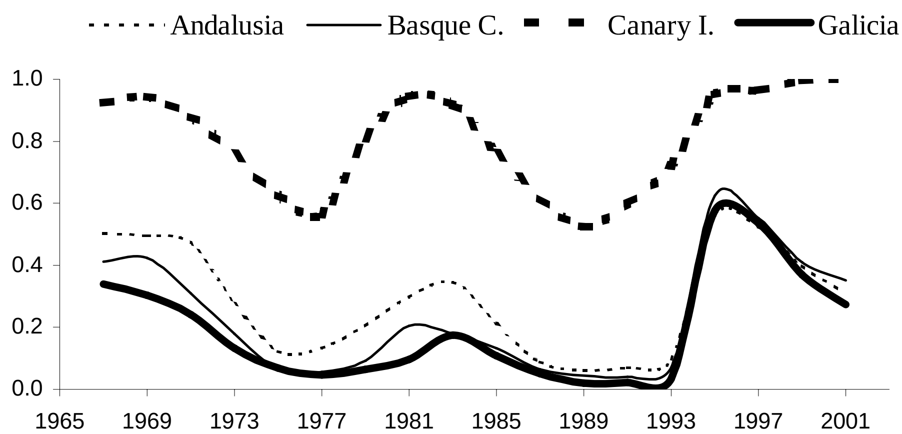

Figure 1. Speed of Adjustment for the Four Main Fishing Regions in Spain

Table V shows the results for the regions. We present the mean, the minimum and the maximum value for the speed of adjustment, the optimality ratio, the elasticities and the exogenous technical change.

Table V: Long-Run Elasticities, Optimality and Speed of Adjustment, by Region

YEAR	*Adjustment Speed $d._t$*	*Optimality Ratio*	*Elasticities respect to* Wage E_w	Output E_y	Capital E_K	*Technical Change E_t*
			Mean			
Andalusia	0.29	0.91	-1.39	0.90	1.57	0.02
Asturias	0.50	0.97	-0.84	0.89	0.70	-0.02
Balearic Islands	0.77	0.99	-0.65	0.90	0.44	-0.04
Canary Island	0.81	1.00	-1.01	0.93	1.12	-0.01
Cantabria	0.59	0.98	-0.94	0.82	0.75	-0.02
Catalonia	0.13	1.08	-0.95	0.87	1.02	-0.02
C. Valencia	0.48	0.97	-1.05	0.87	1.08	-0.01
Galicia	0.19	0.91	-1.35	0.88	1.74	0.01
Murcia	0.47	0.92	-0.93	0.87	0.45	-0.01
Basque Country	0.23	0.78	-1.05	0.84	1.30	-0.01
			Minimum			
Andalusia	0.06	0.77	-2.11	0.45	0.87	-0.01
Asturias	0.14	0.86	-1.43	0.40	0.05	-0.05
Balearic Islands	0.16	0.88	-1.38	0.43	-0.15	-0.10
Canary Island	0.52	0.88	-2.08	0.53	0.81	-0.05
Cantabria	0.26	0.83	-1.73	0.39	0.33	-0.05
Catalonia	0.00	0.86	-1.63	0.41	0.45	-0.05
C. Valencia	0.15	0.85	-1.87	0.40	0.60	-0.04
Galicia	0.02	0.71	-2.19	0.47	1.41	-0.02
Murcia	0.13	0.84	-1.88	0.43	0.01	-0.04
Basque Country	0.04	0.60	-2.10	0.38	0.89	-0.05
			Maximum			
Andalusia	0.56	1.04	-0.78	1.41	2.06	0.07
Asturias	0.82	1.11	-0.30	1.44	1.17	0.04
Balearic Islands	1.00	1.07	-0.07	1.48	0.83	0.05
Canary Island	1.00	1.22	-0.23	1.29	1.47	0.03
Cantabria	0.98	1.15	-0.30	1.27	1.13	0.04
Catalonia	0.58	1.29	-0.36	1.43	1.35	0.06
C. Valencia	0.97	1.07	-0.52	1.37	1.54	0.05
Galicia	0.58	1.16	-0.68	1.20	2.04	0.06
Murcia	0.95	1.07	-0.35	1.33	0.83	0.05
Basque Country	0.63	1.07	-0.43	1.28	1.82	0.03

Some important regions exhibit moderate speed of adjustment, Catalonia in addition to Andalusia, Galicia, and the Basque country. On the other hand, sometimes the speed of adjustment is virtually zero. On the contrary, the Balearic and the Canary Islands adjust quickly. For all regions but Galicia technical change is labor saving on average. We can observe the wide range of labor elasticity values concerning wages, output and capital, all of them with the correct sign.

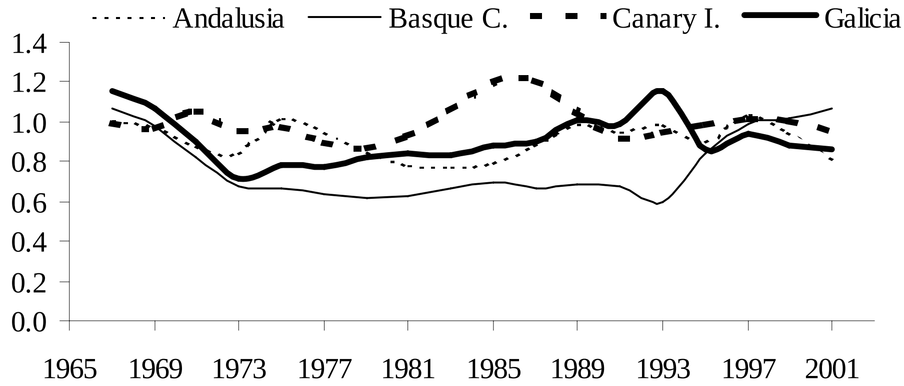

Figure 2. Optimality Ratio for the Four Main Fishing Regions in Spain

Although the average optimality ratio is below one, the desired labor is sometimes higher than actual labor for all regions. In Figure 2 we observe the optimality ratio for the four main regions. It is worth noting the adjustment in the Basque Country and in the Canary Island in the last years of the period.

CONCLUSION

This study estimates a dynamic labor demand with flexible adjustment parameter for the fishing industry of the Spanish regions. Long run labor demand is represented by a translog demand function, which is a function of wages, output, capital stock and exogenous technical change. The adjustment parameter is modeled to be region and time variant, and restricted to lie in the zero-one range. The period of study, 1965-2001, covers large variation in economic and environmental conditions in Spain.

The results show that the mean labor demand elasticity is greatest with respect to capital and least by wages and by output in the first half of the period. Own price labor demand and output demand are increasingly more elastic and capital demand less elastic. In the last years, the mean labor demand elasticity is greatest with respect to price, followed by output and least capital. However, labor elasticity to capital is still close to one. The results indicate the increasing sensitivity of labor demand to main economic variables.

On the contrary, there is no evidence of higher speed of adjustment over time, in general. Perhaps the very sensitive long term structure and the slow speed of adjustment are responsible for the deterioration of the optimality ratio, indicating labor over utilization in the last years of the period analyzed. Finally, the regions are far from homogeneous. In particular, there are huge differences concerning the evolution of the optimality ratio.

REFERENCES

Alcaide-Inchausti, J., 1999, *La Renta Nacional de España y su Distribución Provincial. Series Homogéneas. Tomo 1*. Fundación BBV. Bilbao

Alcaide-Inchausti, J., and P. Alcaide-Guindo, 2005, *Balance Económico Regional. Años 1995 a 2003.* Funcas. Madrid

Bhandari, A. K. and A.Heshmati, 2005, Labour Use and Its Adjustment in Indian Manufacturing Industries, *Global Economic Review* 34(3), pp. 261-290

Hamermesh, D. S., 1993, *Labour Demand.* Princeton University Press

Kumbhakar S.C., Hjalmarsson L. and A. Heshmati, 2002, How Fast Do Banks Adjust? A Dynamic Model of Labour-Use with an Application to Swedish Banks, *Journal of Productivity Analysis* 18(1), pp. 79-102.

Kumbhakar, S. C. and C. A. K. Lovell. (2000). *Stochastic Frontier Analysis*. Cambridge University Press.

Mas-Ivars, M., Pérez-García F., and E. Uriel-Jiménez, 2004, *El Stock de Capital en España y su Distribución Territorial, 1964-2000. Volumen II. Series de Capital Total.* Fundación BBVA. Bilbao

Nickell, S. J., 1986, Dynamic Models of Labour Demand. In *Handbook of Labour Economics*, vol. 1, edited by O. C. Ashenfelter and R. Layard. North-Holland.

ENDNOTES

We acknowledge funding from Project ALG04-7303 of the National Plan for Research of the Spanish Government.