User Cost of Capital & Cost Function : Does the Margin of Freedom in the Modellig Yield Robust Results?

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Abstract

In this paper we report results of a rather successful attempt to provide evidence on the substitution possibilities between capital, labor, and energy in French manufacturing industry. In order to assess the sensitivity of results to the choice of the functional form and to data construction procedures, alternative specifications of the cost function are estimated, based on three flexible functional forms (i) the Translog, (ii) the Generalized Leontief, and (iii) the Symmetric Generalized McFadden while two different series of the user cost of capital are constructed (i) the implicit *ex ante* price (which includes fiscality parameters), obtained by extending the theoretical model of Jorgenson and (ii) the *ex post* price computed as the residual rate of return to capital, when zero profits are imposed at full equilibrium position. We show that the choice of the regressor is even important in the context of the choice of the functional form. We also consider the validity of the *ex post* approximation of the user cost of capital, frequently used in studies of production and investement behaviour, and find that our data do not support it. In cases where we can precisely estimate an elasticity, our results seems robust to the choice of the functional form and the method of calculating the user cost of capital. This explain the fact that regressions with the *ex post* price of capital yield elasticities that can diverge from the true values of elasticities and discrepancies between the estimates suggests that care should be taken during the economic interpretation of results. The issues analysed in the present paper are therefore not merely of theoretical interest, but are also of practical concern.

Keywords : user cost of capital, flexible cost functions, technical change, variability of the regressors, precision of fits, substitution possibilities, capital-energy elasticity.

JEL Classification : C51, D24, E22, H32.

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References

[1] Baccar, S. (1995) : Reliability of the Translog Cost Function : Some Theory & an Application to the Demand of Energy in French Manufacturing, CREST Working Paper N^0 9547, INSEE-Paris (France).

[2] Berndt, E.R (1976) : Reconciling Alternative Estimates of the Elasticity of Substitution, *Review of Economics and Statistics*, 58, 59 68.

[3] Berndt, E.R. et N.E. Savin (1975) : Estimation and Hypothesis Testing in Singular Equation Systems with Autoregressive Disturbances, *Econometrica*, 43, 937 957.

[4] Berndt, E.R. et D.O. Wood (1975) : Technology, Prices and the Demand of Energy, *Review of Economics and Statistics*, 62, 259 268.

[5] Berndt, E.R. et D.O. Wood (1979) : Engineering and Econometric Interpretations of Energy-Capital Complementarity, *American Economic Review*, 69, 342 354.

[6] Binswager, H.P. (1974) : The Measurement of Technological Change Biases with Many Factors of Production, *American Economic Review*, 64, 964 976.

[7] Burgess, D.F. (1975) : Duality Theory and Pitfalls in the Specification of Technologies, *Journal of Econometrics*, 3, 105-121.

[8] Chambers, R. (1988) : Applied Production Analysis : A Dual Approach. Cambridge, Mass : Cambridge University Press.

[9] Christensen, L.R., D.W. Jorgenson et L.J. Lau (1971) : Conjugate Duality and the Transcendental Logarithmic Production Function, *Econometrica*, 39, 255 256.

[10] Christensen, L.R., D.W. Jorgenson et L.J. Lau (1973) : Transcendental Logarithmic Production Frontiers, *Review of Economics and Statistics*, 55, 28 45.

[11] Diewert, W.E. (1971) : An Application of the Shephard Duality Theorem : A Generalized Leontief Production Function, *Journal of Political Economy*, 79, 481 507.

[12] Diewert, W.E. (1974) : Application of the Duality Theory *in Frontiers of Quantitative Economics*, Vol. II, ed. par M. D. Intriligator et D. A. Kendrik. Amsterdam : North-Holland, 106 171.

[13] Diewert, W.E., M. Avriel et I. Zang (1977) : Nine Kinds of Quasiconcavity and Concavity, *Journal of Economic Theory*, 25, 397 420.

[14] Diewert, W.E. et T.J. Wales (1987) : Flexible Functional Forms and Global Curvature Conditions, *Econometrica*, 55, 43 68.

[15] Gallant, A.R. et E.H. Golub (1984) : Imposing Curvature Restrictions on Flexible Functional Forms, *Journal of Econometrics*, 26, 295 321.

[16] Hayashi, F. (1982) : Tobin s Average q and Marginal q : A Neoclassical Interpretation, *Econometrica*, 50, 213 224.

[17] Jorgenson, D. W. (1963) : Capital Theory and Investment Behavior, *American Economic Review*, 53, 247 259.

[18] Jorgenson D. W. et P. J. Wilcoxen (1990) : Energy, the Environnement and Economic Growth, *in Handbook of Natural Resources and Energy Economics*, Vol. III, ed. par A.V. Knesse et J. L. Sweeney. Amsterdam : North-Holland, 1267 1349.

[19] Lau, L.J. (1986) : Functional Forms in Econometric Model Building, *in Handbook of Econometrics*, Vol. III, ed. par Z. Griliches et M. D. Intriligator. Amsterdam : North-Holland, 1516 1566.

[20] Malinvaud, E. (1971) : Peut-on mesurer l evolution du cout d usage du capital productif?, *Economie et Statistique*, 22, 5 25.

[21] Malinvaud, E. (1983) : Profitability and Investment Facing Uncertain Demand, *Document de Travail*, INSEE (Paris), 8303.

[22] McFadden, D. (1978) : The General Linear Profit Function, *in Production Economics : A Dual Approach to Theory and Applications*, Vol. I, ed. par M.A. Fuss et D.L. McFadden. Amsterdam : North-Holland, 269 286.

[23] Moroney, J. R. et J. M. Trapani (1981) : Alternative Models of Substitution and Technical Change in Natural Resource Intensive Industries, *in Modeling and Measuring Natural Resources Substitution*, ed. par E.R. Berndt et B.C. Fields. M.I.T. Press, 209 229.

[24] Muet, P. A. et S. Avouyi-Dovi (1987) : L effet des incitations fiscales sur l investissement, *Observations et Diagnostics Economiques*, Revue de l OFCE, 18, 149 174.

[25] Solow, J. (1987) : The Capital-Energy Complementarity Debate Revised, *American Economic Review*, 77, 605 614.

[26] Wales, T.J. (1977) : On the Flexibility of Flexible Functional Forms, *Journal of Econometrics*, 5, 183 193.

ANNEXE I
Theoretical Consistency Properties of the Cost Function

1. Domain. $C(p, y, t)$ is a non-negative real-valued function.

$$C(p, y, t) \geq 0, \quad p, y > 0 \qquad \text{and} \qquad C(p, 0, t) = 0$$

1. Monotonicity. $C(p, y, t)$ is non-decreasing in p and y.

$$\frac{\partial C}{\partial p_i} \geq 0 \ \text{ or } \ x_i \geq 0, \quad i \qquad \text{and} \qquad \frac{\partial C}{\partial y} \geq 0$$

2. Homogeneity. $C(p, y, t)$ is linear homogeneous in p. Hence Euler Theorem yields

$$\sum_{i=1}^{n} p_i \frac{\partial C}{\partial p_i} = C \qquad (2.a), \qquad \sum_{i=1}^{n} p_i \frac{\partial^2 C}{\partial p_i \partial p_j} = 0, \quad j \quad (2.b)$$

$$\sum_{i=1}^{n} p_i \frac{\partial^2 C}{\partial p_i \partial y} = \frac{\partial C}{\partial y} \quad (2.c), \qquad \sum_{i=1}^{n} p_i \frac{\partial^2 C}{\partial p_i \partial t} = \frac{\partial C}{\partial t} \qquad (2.d)$$

3. Symmetry. $C(p, y, t)$ is twice continuous differentiable, young theorem implies

$$\frac{\partial^2 C}{\partial p_i \partial p_j} = \frac{\partial^2 C}{\partial p_j \partial p_i} \qquad \text{or} \qquad \frac{\partial x_i}{\partial p_j} = \frac{\partial x_j}{\partial p_i}, \quad i, j$$

i.e. that the Hessian matrix must be symmetric.

4. Concavity. $C(p, y, t)$ is concave in p if

$$\left[\frac{\partial^2 C}{\partial p_i \partial p_j} \right]_{i,j} \text{ is a negative semidefinite matrix,}$$

i. e. that the Hessian matrix must be negative semidefinite.

Note : The homogeneity restrictions 2.a, 2.b, 2.c are known us the adding-up condition, the Cournot aggregation conditions, and the Engel aggregation condition, respectively.

Functional Forms	Unit Cost Function	Input Demand System	
translog	$\log C^{TL}(p,t)^a \equiv \alpha_0 + \alpha_t t + \sum_{i=1}^{n}\alpha_i \log p_i + \sum_{i=1}^{n}\alpha_{it} t \log p_i$ $+0.5\sum_{i=1}^{n}\sum_{j=1}^{n}\alpha_{ij}\log p_i \log p_j + 0.5\alpha_{tt}t^2, \qquad \alpha_{ij} = \alpha_{ji} \quad i,j$	$S_i^{TL}(p,t) = \alpha_i + \sum_{j=1}^{n}\alpha_{ij}\log p_j + \alpha_{it}t$ were $\quad \sum_{i=1}^{n} S_i^{TL}(p,t) = 1$	ϵ^{T}_{ij} où δ
Generalized Leontief	$C^{GL}(p,t) \equiv \sum_{i=1}^{n}\sum_{j=1}^{n}\beta_{ij}\ \overline{p_i p_j} + \sum_{i=1}^{n}\beta_{it}p_i t, \qquad \beta_{ij} = \beta_{ji} \quad i,j$	$a_i^{GL}(p,t) = \sum_{j=1}^{n}\beta_{ij}\sqrt{p_j/p_i} + \beta_{it}t$	ϵ^{G}_{ij} ϵ^{G}_{ii}
Symmetric Gneralized McFadden	$C^{MF}(p,t)^b \equiv \sum_{i=1}^{n}\gamma_i p_i + 0.5\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\gamma_{ij}p_i p_j}{p} + \sum_{i=1}^{n}\gamma_{it}p_i t, \quad \gamma_{ij} = \gamma_{ji}$ where $\quad p^c = \sum_{i=1}^{n}\theta_i p_i, \qquad 0 < \theta_i < 1 \quad i$	$a_i^{MF}(p,t) = \gamma_i - 0.5\theta_i \sum_{k=1}^{n}\sum_{j=1}^{n}\frac{\gamma_{kj}p_k p_j}{p^2}$ $+\sum_{j=1}^{n}\frac{\gamma_{ij}p_j}{p} + \gamma_{it}t$	$C_{ij}^{MF}(p,t$

Notations : $S_i(p,t) = p_i x_i / \sum_{i=1}^{n} p_i x_i = \partial \log C(p,t)/\partial \log p_i$, $\qquad a_i = x_i/y = \partial C(p,t)/\partial p_i$, $\qquad C_{ij}(p,t) = \partial^2 C(p,t)/\partial p_i p_j$, $\qquad \epsilon_{ij} = (\partial \log x_i \cdot \partial \log p_i) = (p_j C_{ij}(p,t))/a_i(p,t) = (p_i p_j C_{ij}(p,t))/(C(p,t)S_i(p,t))$, where x_i, for $i = 1, ldots, n$ are input demands, S_i are cost shares, a_i are input-output ratios and ϵ_{ij} are price elasticities.

ANNEXE III : Tables and Figures

TABLE I
Sample summary statistics : french manufacturing 1970 1989

Branch		y	p_K^A	p_K^P	p_L	p_E	a_K^A	a_K^P	a_L	a_E	S_K^A	S_K^P	S_L^A	S_L^P	S_E^A	S_E^P	CU^A	CU^A
	Mean	229881	1.271	1.165	1.070	0.912	0.150	0.234	0.592	0.217	0.194	0.269	0.605	0.547	0.201	0.183	0.944	1.025
Intermediate	Std.	17416	0.802	0.639	0.652	0.516	0.005	0.008	0.133	0.006	0.042	0.050	0.040	0.026	0.036	0.040	0.466	0.482
Goods	Min.	189446	0.403	0.516	0.249	0.237	0.140	0.218	0.409	0.206	0.127	0.194	0.538	0.498	0.150	0.130	0.348	0.393
	Max.	257505	2.581	2.564	2.133	1.739	0.164	0.255	0.854	0.226	0.260	0.349	0.681	0.594	0.258	0.246	1.543	1.733
	Mean	205760	1.262	1.188	1.093	0.964	0.098	0.188	0.837	0.042	0.125	0.223	0.835	0.741	0.040	0.035	0.948	1.047
Equipement	Std.	29111	0.814	0.469	0.694	0.550	0.010	0.019	0.225	0.004	0.037	0.037	0.038	0.033	0.004	0.005	0.456	0467
Goods	Min.	141406	0.387	0.674	0.246	0.272	0.086	0.165	0.539	0.036	0.071	0.150	0.772	0.685	0.034	0.028	0.377	0.443
	Max.	244236	2.651	2.303	2.283	1.754	0.115	0.220	1.284	0.051	0.190	0.281	0.891	0.808	0.045	0.043	1.596	1.795
	Mean	147219	1.277	1.043	1.106	0.958	0.097	0.267	0.717	0.054	0.137	0.281	0.808	0.673	0.055	0.046	0.856	1.012
Consumer	Std.	12078	0.817	0.453	0.708	0.556	0.005	0.013	0.176	0.009	0.032	0.019	0.029	0.016	0.005	0.005	0.419	0.468
Goods	Min.	115010	0.399	0.478	0.251	0.255	0.090	0.247	0.496	0.041	0.084	0.251	0.764	0.645	0.045	0.039	0.340	0.409
	Max.	161662	2.602	1.807	2.325	1.765	0.107	0.294	1.076	0.070	0.188	0.311	0.858	0.697	0.063	0.053	1.495	1.703

Note : All input prices are normalized to unity for 1980. All input and output quantities are expressed in 1980 French francs. y is the output quantity index, p_i is the price index of input i ($i = K, L,\ E$ which stands for capital, labour and energy respectively), a_i is the ith input-output ratios, S_i is the ith input cost share.
CU^A means the unit cost of production evaluated with the ex ante price of capital (p_K^A). The same criterion is applied for other entries.
CU^P means the unit cost of production evaluated with the ex post price of capital (p_K^P). The same criterion is applied for the other entries.

TABLE II
ANNUAL PERCENTAGE CHANGES IN INPUT PRICES AND IN THE UNIT COST OF PRODUCTION, FRENCH MANUFACTURING, 1970-1989

Branch		Δp_K^A	Δp_K^P	Δp_L	Δp_E	ΔCU^A	ΔCU^P
	Mean	0.093	0.095	0.120	0.104	0.084	0.083
Intermediate	Std.	0.166	0.160	0.053	0.184	0.089	0.070
Goods	Min.	−0.253	−0.345	0.036	−0.234	−0.046	0.007
	Max.	0.540	0.354	0.213	0.651	0.274	0.320
	Mean	0.093	0.073	0.125	0.102	0.079	0.077
Equipement	Std.	0.169	0.139	0.048	0.114	0.051	0.033
Goods	Min.	−0.261	−0.200	0.041	−0.099	−0.014	0.024
	Max.	0.539	0.365	0.213	0.366	0.154	0.155
	Mean	0.093	0.069	0.125	0.107	0.082	0.079
Consumer	Std.	0.161	0.073	0.051	0.139	0.046	0.039
Goods	Min.	−0.238	−0.083	0.051	−0.114	0.010	−0.004
	Max.	0.516	0.201	0.256	0.508	0.159	0.158

TABLE III
Concavity Violations

	ex ante price of capital (p_k^A)			ex post price of capital (p_k^P)		
Branch	Translog	Generalized Leontief	Generalized McFadden	Translog	Generalized Leontief	Generalized McFadden
Intermediate Goods	16	20	20	20	5	0
Equipement Goods	4	0	0	6	0	0
Consumer Goods	5	0	0	0	0	0

Note : Concavity violations are sample points at which the estimated cost function is not concave. The sapmle size is 20.

TABLE IV
PRICE ELASTICITIES AND ALLEN PARTIAL ELASTICITIES OF SUBSTITUTION FOR INTERMEDIATE GOODS, FRENCH MANUFACTURING, 1970-1989

	ex ante price of capital (p_k^A)			ex post price of capital (p_k^P)		
Elasticity	Translog	Generalized Leontief	Generalized McFadden	Translog	Generalized Leontief	Generalized McFadden
ϵ_{KK}	-0.074^a	-0.107^a	-0.106^a	-0.038^a	-0.105^a	-0.100^a
	(0.008)	(0.014)	(0.012)	(0.012)	(0.015)	(0.013)
ϵ_{KL}	0.116^a	0.102^a	0.103^a	0.044^a	0.136^a	0.130^a
	(0.012)	(0.019)	(0.019)	(0.017)	(0.027)	(0.024)
ϵ_{KE}	-0.042^a	0.005	0.003	−0.006	-0.031^a	-0.030^a
	(0.011)	(0.013)	(0.013)	(0.011)	(0.015)	(0.014)
ϵ_{LK}	0.037^a	0.032^a	0.031^a	0.022^a	0.064^a	0.057^a
	(0.004)	(0.006)	(0.006)	(0.009)	(0.013)	(0.011)
ϵ_{LL}	-0.055^a	−0.020	−0.020	−0.021	-0.084^a	-0.077^a
	(0.008)	(0.012)	(0.014)	(0.018)	(0.026)	(0.024)
ϵ_{LE}	0.018^a	−0.012	−0.011	0.001	0.020	0.020
	(0.007)	(0.008)	(0.009)	(0.011)	(0.015)	(0.014)
ϵ_{EK}	-0.040^a	0.004	0.003	−0.009	-0.042^a	-0.042^a
	(0.010)	(0.012)	(0.013)	(0.016)	(0.020)	(0.020)
ϵ_{EL}	0.054^a	−0.036	−0.037	−0.002	0.063	0.064
	(0.020)	(0.027)	(0.027)	(0.032)	(0.047)	(0.045)
ϵ_{EE}	−0.014	0.031	0.034	0.011	−0.021	−0.022
	(0.022)	(0.024)	(0.025)	(0.022)	(0.031)	(0.030)
σ_{KL}	0.191^a	0.165^a	0.166^a	0.080^a	0.236^a	0.227^a
	(0.020)	(0.032)	(0.030)	(0.032)	(0.047)	(0.043)
σ_{KE}	-0.206^a	0.026	0.015	−0.033	-0.174^a	-0.166^a
	(0.053)	(0.070)	(0.066)	(0.060)	(0.083)	(0.078)
σ_{LE}	0.090^a	−0.059	−0.059	−0.004	0.112	0.111
	(0.032)	(0.044)	(0.044)	(0.058)	(0.083)	(0.079)

Note : Elasticities are evaluated at means of exogeneous variables. Standard errors are in parentheses. ϵ_{ii} $(i = K, L, E)$ means the own price elasticity of demand for input i, ϵ_{ij} $(i, j = K, L, E)$ means the elasticity of demand for input i with respect to price of input j , σ_{ij} means the Allen elasticity of substitution between inputs i and j.
[a] Significant at the 95 % level.

TABLE V
PRICE ELASTICITIES AND ALLEN PARTIAL ELASTICITIES OF SUBSTITUTION FOR EQUIPEMENT GOODS, FRENCH MANUFACTURING, 1970-1989

	ex ante price of capital (p_k^A)			ex post price of capital (p_k^P)		
Elasticity	Translog	Generalized Leontief	Generalized McFadden	Translog	Generalized Leontief	Generalized McFadden
ϵ_{KK}	-0.187^a	-0.054^a	-0.052^a	-0.065^a	-0.069^a	-0.050^a
	(0.018)	(0.010)	(0.009)	(0.015)	(0.009)	(0.008)
ϵ_{KL}	0.177^a	0.032^a	0.039^a	0.050^a	0.052^a	0.035^a
	(0.015)	(0.013)	(0.010)	(0.015)	(0.012)	(0.012)
ϵ_{KE}	0.010	0.022^a	0.013^a	0.015^a	0.017^a	0.015^a
	(0.007)	(0.007)	(0.006)	(0.005)	(0.005)	(0.005)
ϵ_{LK}	0.026^a	0.005^a	0.005^a	0.015^a	0.015^a	0.009^a
	(0.002)	(0.002)	(0.002)	(0.005)	(0.003)	(0.003)
ϵ_{LL}	-0.043^a	-0.016^a	-0.017^a	-0.020^a	-0.014^a	-0.012^a
	(0.003)	(0.004)	(0.003)	(0.007)	(0.006)	(0.006)
ϵ_{LE}	0.017^a	0.011^a	0.012^a	0.005	-0.001	0.003
	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)	(0.004)
ϵ_{EK}	0.032	0.061^a	0.038^a	0.098^a	0.093^a	0.084^a
	(0.022)	(0.021)	(0.019)	(0.032)	(0.030)	(0.031)
ϵ_{EL}	0.360^a	0.225^a	0.247^a	0.100	-0.023	0.064
	(0.042)	(0.057)	(0.052)	(0.095)	(0.092)	(0.094)
ϵ_{EE}	-0.392^a	-0.286^a	-0.285^a	-0.198^a	-0.070	-0.148^a
	(0.038)	(0.052)	(0.050)	(0.068)	(0.067)	(0.070)
σ_{KL}	0.212^a	0.038^a	0.046^a	0.067^a	0.067^a	0.045^a
	(0.018)	(0.016)	(0.012)	(0.020)	(0.015)	(0.015)
σ_{KE}	0.257	0.580^a	0.324^a	0.440^a	0.498^a	0.432^a
	(0.172)	(0.196)	(0.160)	(0.143)	(0.158)	(0.157)
σ_{LE}	0.430^a	0.276^a	0.292^a	0.134	-0.030	0.083
	(0.051)	(0.070)	(0.062)	(0.128)	(0.123)	(0.124)

Note : Elasticities are evaluated at means of exogeneous variables. Standard errors are in parentheses. ϵ_{ii} $(i = K, L, E)$ means the own price elasticity of demand for input i, ϵ_{ij} $(i, j = K, L, E)$ means the elasticity of demand for input i with respect to price of input j , σ_{ij} means the Allen elasticity of substitution between inputs i and j.

[a] Significant at the 95 % level.

TABLE VI
PRICE ELASTICITIES AND ALLEN PARTIAL ELASTICITIES OF SUBSTITUTION FOR CONSUMER GOODS, FRENCH MANUFACTURING, 1970-1989

	ex ante price of capital (p_k^A)			ex post price of capital (p_k^P)		
Elasticity	Translog	Generalized Leontief	Generalized McFadden	Translog	Generalized Leontief	Generalized McFadden
ϵ_{KK}	-0.109^a	-0.072^a	-0.069^a	-0.095^a	-0.101^a	-0.125^a
	(0.023)	(0.013)	(0.010)	(0.021)	(0.033)	(0.025)
ϵ_{KL}	0.139^a	0.084^a	0.085^a	0.103^a	0.080^a	0.119^a
	(0.024)	(0.019)	(0.015)	(0.029)	(0.041)	(0.035)
ϵ_{KE}	-0.030^a	−0.012	−0.016	−0.008	0.021	0.007
	(0.014)	(0.012)	(0.011)	(0.013)	(0.013)	(0.013)
ϵ_{LK}	0.024^a	0.014^a	0.013^a	0.043^a	0.032^a	0.043^a
	(0.004)	(0.003)	(0.002)	(0.012)	(0.016)	(0.012)
ϵ_{LL}	-0.052^a	-0.036^a	-0.034^a	-0.075^a	−0.038	−0.057
	(0.007)	(0.006)	(0.006)	(0.019)	(0.023)	(0.020)
ϵ_{LE}	0.028^a	0.022^a	0.021^a	0.032^a	0.006	0.014
	(0.005)	(0.005)	(0.005)	(0.009)	(0.009)	(0.009)
ϵ_{EK}	-0.074^a	−0.027	−0.040	−0.050	0.125	0.036
	(0.035)	(0.027)	(0.027)	(0.079)	(0.078)	(0.080)
ϵ_{EL}	0.416^a	0.330^a	0.322^a	0.471^a	0.095	0.216
	(0.076)	(0.072)	(0.067)	(0.134)	(0.134)	(0.140)
ϵ_{EE}	-0.342^a	-0.303^a	-0.282^a	-0.422^a	-0.220^a	-0.253^a
	(0.064)	(0.064)	(0.062)	(0.081)	(0.074)	(0.079)
σ_{KL}	0.171^a	0.102^a	0.104^a	0.154^a	0.116^a	0.169^a
	(0.030)	(0.023)	(0.018)	(0.043)	(0.058)	(0.050)
σ_{KE}	-0.541^a	−0.220	−0.310	−0.177	0.473	0.144
	(0.257)	(0.231)	(0.208)	(0.282)	(0.296)	(0.315)
σ_{LE}	0.516^a	0.414^a	0.394^a	0.700^a	0.138	0.308
	(0.094)	(0.091)	(0.084)	(0.200)	(0.193)	(0.206)

Note : Elasticities are evaluated at means of exogeneous variables. Standard errors are in parentheses. ϵ_{ii} $(i = K, L, E)$ means the own price elasticity of demand for input i, ϵ_{ij} $(i, j = K, L, E)$ means the elasticity of demand for input i with respect to price of input j , σ_{ij} means the Allen elasticity of substitution between inputs i and j.
[a] Significant at the 95 % level.

TABLE VII
DERIVATIVES OF PRICE ELASTICITIES FOR CONSUMER GOODS,
FRENCH MANUFACTURING, 1980

	ex ante price of capital (p_k^A)			ex post price of capital (p_k^P)		
Elasticity	Translog	Generalized Leontief	Generalized McFadden	Translog	Generalized Leontief	Generalized McFadden
ϵ_{KE}	−0.036	−0.013	−0.017	−0.007	0.023	0.025
	(0.016)	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)
$\partial\epsilon_{KE}/\partial_{p_K}$	0.071[a]	0.006	0.005[a]	0.022[a]	−0.009	0.003
	(0.014)	(0.006)	(0.001)	(0.005)	(0.006)	(0.004)
$\partial\epsilon_{KE}/\partial_{p_L}$	−0.096[a]	0.001	−0.026[a]	−0.043[a]	−0.002[a]	−0.009
	(0.011)	(0.001)	(0.005)	(0.004)	(0.001)	(0.008)
$\partial\epsilon_{KE}/\partial_{p_E}$	0.024[a]	−0.008	0.004	0.021[a]	−0.011	0.031[a]
	(0.005)	(0.007)	(0.014)	(0.005)	(0.006)	(0.011)

Note : Standard errors are reported in parenthesis. $\partial\epsilon_{KE}/\partial p_K$ means the partial derivative of ϵ_{KE} with respect to the price of capital (p_K). The same criterion is applied for other entries.
[a] Significant at the 95 % level.

TABLE VIII

Sensitvity of the Results to the Choice of the Functional Form and to the Data Construction Procedure

Branche	User cost of capital	Translog (TL)	Gneralized Leontief (GL)	Symmetric Generalized McFadden (MF)
Intermediate Goods	ex ante price (p^A_K)	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon_{EE} \leq 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} < 0$ $\sigma^a_{LE} > 0$ concavity violated in 80% of cases	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon_{EE} \geq 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} \geq 0$ $\sigma_{LE} \leq 0$ concavity violated in 100% of cases Separability between E and (K, L)	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon_{EE} \geq 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} \geq 0$ $\sigma_{LE} \geq 0$ concavity globally violated Separability between E and (K, L)
	ex post price (p^P_K)	$\epsilon^a_{KK} < 0$ $\epsilon_{LL} \leq 0$ $\epsilon_{EE} \geq 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} \leq 0$ $\sigma_{LE} \leq 0$ concavity violated in 100% of cases Separability between E and (K, L)	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon_{EE} \leq 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} < 0$ $\sigma_{LE} > 0$ concavity violated in 25% of cases K and E are independents	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon_{EE} \leq 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} < 0$ $\sigma_{LE} > 0$ concavity globally respected L and E are independents
Equipement Goods	ex ante price (p^A_K)	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} > 0$ $\sigma^a_{LE} > 0$ concavity violated in 20% of cases K and E are independents	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} > 0$ $\sigma^a_{LE} > 0$ concavity respected at each sample point	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} > 0$ $\sigma^a_{LE} > 0$ concavity globally respected
	ex post price (p^P_K)	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} > 0$ $\sigma_{LE} > 0$ concavity violated in 33% of cases L and E are independents	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} > 0$ $\sigma_{LE} < 0$ concavity respected at each sample point L and E are independents	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} > 0$ $\sigma_{LE} > 0$ concavity globally respected L and E are independents
Consumer Goods	ex ante price (p^A_K)	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma^a_{KE} < 0$ $\sigma^a_{LE} > 0$ concavity violated in 25% of cases	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} < 0$ $\sigma^a_{LE} > 0$ concavity respected at each sample point K and E are independents	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} < 0$ $\sigma^a_{LE} > 0$ concavity globally respected and E are independents
	ex post price (p^P_K)	$\epsilon^a_{KK} < 0$ $\epsilon^a_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} < 0$ $\sigma^a_{LE} > 0$ concavity respected at each sample point K and E are independents	$\epsilon^a_{KK} < 0$ $\epsilon_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} > 0$ $\sigma^a_{LE} > 0$ concavity respected at each sample point Separability between K and (L, E)	$\epsilon^a_{KK} < 0$ $\epsilon_{LL} < 0$ $\epsilon^a_{EE} < 0$ $\sigma^a_{KL} > 0$ $\sigma_{KE} > 0$ $\sigma_{LE} > 0$ concavity globally respected Separability between E and (K, L)

Notes : Inputs i and j $(i, j = K, L, E)$ are Allen substitutes (complements) if $\epsilon_{ij} > 0$ $(\epsilon_{ij} < 0)$. There are independents if $\epsilon_{ij} = 0$.

[a] Significant at the 95% level.