

CONTRIBUTIONS TO ECONOMICS

Pablo Coto-Millán
Editor

Essays on Microeconomics and Industrial Organisation

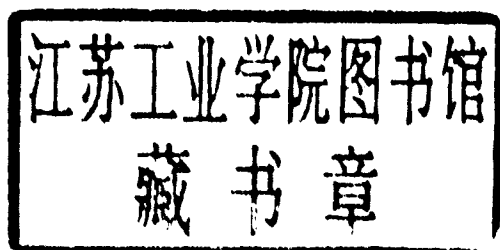


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Essays on Microeconomics and Industrial Organisation

With 19 Figures and 36 Tables



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continued on page 192

Table of Contents

Introduction	1
PART I. Demand	3
1 Modeling Seasonal Integrated Time Series: the Spanish Industrial Production Index	
J. L. Gallego-Gómez	5
1.1 Seasonal Time Series Models	5
1.2 Forecasting	9
1.3 Unobservable Components	11
1.4 Empirical Analysis	12
References	17
2 Passenger's Choice of Air Transport under Road Competition: the Use of Cointegration Techniques	
J. Baños-Pino, P. Coto-Millán, V. Inglada-López de Sabando	19
2.1 Introduction	19
2.2 The Model	21
2.3 The Data	22
2.4 Marshallian or Non Compensated Demands of Interurban Passenger Transport: Air and Road Transport	23
2.4.1 Air Transport Demand	23
2.4.2 Road Transport Demand	25
2.5 Conclusions	27
References	27
3 Introduction of an Innovative Product: the High Speed Train (AVE)	
V. Inglada-López de Sabando, P. Coto-Millán	29
3.1 AVE: Characterisation	29
3.2 Qualitative Analysis	31

3.3	The Concept of Generalised Cost	33
3.4	Comparison Among Different Competing Products	35
3.5	Induction and Substitution Effects	38
3.5.1	Induction Effect	38
3.5.2	Substitution Effect	39
3.5.3	The Demand for the New Product	39
3.6	Impact on Demand	40
	References	40

PART II. Production and Costs (Supply) **41**

4 Technical and Allocative Inefficiency in Spanish Public Hospitals

C. García-Prieto	43
4.1 The Model	44
4.2 Definition of Variables and Functional Specification	48
4.2.1 Outputs	49
4.2.2 Input Prices	49
4.2.3 Fixed Input	50
4.2.4 Functional Form	50
4.3 Estimation and Results	51
4.4 Conclusions	54
References	55

5 Technical Efficiency of Road Haulage Firms

J. Baños-Pino, P. Coto-Millán, A. Rodríguez-Álvarez, V. Inglada-López de Sabando	57
5.1 Introduction	57
5.2 Efficiency	58
5.3 Classification of Efficiency Frontiers	60
5.4 A Theoretical Application to Goods Haulage Companies on Spanish Roads Using Panel Data	62
References and Further Reading	70

6 Technological Innovation and Employment: Intersectoral Appraisals of Structural Change in the Service Economy

D. Díaz-Fuentes	71
6.1 Introduction	71
6.2 Extent of Structural Change in Service Employment	74
6.3 Innovation and Employment Trends in Structural Change	76
6.4 Embodied Technology and Technology Diffusion in Services	78
6.5 Compositional Structural Change in Employment (Final and Intermediate Demand for Services)	82

6.6	Conclusions	84
	References	85
PART III.	Market and Industrial Structure	89
7	The Measurement of Intra-industry Trade and Specialisation: a Review	
	G. Carrera-Gómez	91
7.1	Measures of Intra-industry Trade and Specialisation	91
7.1.1	Intra-industry Trade Indices	92
7.1.2	Intra-industry Specialisation Indices	99
7.1.3	Comparison of Measures	102
7.1.4	Later Developments	105
7.2	Trade Imbalance Adjustment	108
7.2.1	Grubel and Lloyd (1975)	108
7.2.2	Aquino (1978)	110
7.2.3	Balassa (1979)	113
7.2.4	Loertscher and Wolter (1980)	114
7.2.5	Bergstrand (1983)	114
7.2.6	Comments and Conclusions	115
7.3	Categorical Aggregation	117
7.3.1	Definition of the Problem	117
7.3.2	Categorical Aggregation Tests	118
7.3.3	Critics and Conclusions	119
7.4	Summary and Conclusions	120
	References	122
8	The Determinants of Intra-industry Trade in Spanish Manufacturing Sectors: a Cross-section Analysis	
	G. Carrera-Gómez	125
8.1	Spanish Intra-industry Trade Measurement	126
8.2	Analysis of the Determinants of Intra-industry Trade in Spain	127
8.2.1	Hypotheses	127
8.2.2	Data, Variables and Econometric Model	129
8.2.3	Results	131
8.3	Summary and Conclusions	133
	References	133
9	Economic Integration, Vertical and Horizontal Intra-industry Trade and Structural Adjustment: the Spanish Experience	
	G. Carrera-Gómez	135
9.1	Data and Methodology	136
9.2	Results	139

9.3 Summary and Conclusions	144
References	144
PART IV. Failures of Market and Industrial Regulation	147
10 Structure, Functioning and Regulation of the Spanish Electricity Sector. The Legal Framework and the New Proposals for Reform	
F. J. Ramos-Real, E. Martínez-Budría, S. Jara-Díaz	149
10.1 Introduction	149
10.2 Structure, Functioning and Regulation of the Spanish Electricity Sector between 1983-1996	150
10.2.1 The Reform Process and the Basic Principles Regulating the System's Operation (1983-1996)	152
10.2.2 Unified Management and Central Planning	153
10.2.3 The Rates and Financial Return Policy of the Legal and Stable Framework (MLE)	154
10.3 Regulation Reform in the Spanish Electricity Sector from 1997	161
10.4 Conclusions	165
References	166
11 Effects of a Reduction of Standard Working Hours on Labour Market Performance	
C. Pérez-Domínguez	167
11.1 Effects on Employment	168
11.1.1 The Basic Model	168
11.1.2 The Role of Fixed Labour Costs	169
11.1.3 Effort Effect and Organisational Effect	171
11.2 Effects on Labour Market Participation	174
11.2.1 Labour Market Participation with Compulsory Working Hours	174
11.2.2 Effects of a Reduction of the Working Hours on Aggregate Labour Supply	176
11.3 Effects on the Unemployment Rate	177
11.3.1 The Basic Case	177
11.3.2 Effects on the Unemployment Rate under a More General Model	179
11.4 Conclusions	180
References	181
12 Dynamic Adjustments in a Two-Sector Model	
F. Galera, P. Coto-Millán	183
12.1 The Formal Model	183
12.2 Basic Results	185

12.3 Conclusions	187
Annex	187
Basic References	190
Other References	190

Introduction

The aim of *Essays on Microeconomics and Industrial Organisation* is to serve as a source and work or reference and consultation for the field of Microeconomics in general and of Industrial Organisation in particular.

Traditionally, Microeconomics is essentially taught as theory and, although handbooks illustrate the various microeconomic theories with examples and practical cases, they hardly ever offer an estimation of a demand, production and cost function. In fact, Microeconomics is explained with self-contained theories without empirical tests. The editor of these Essays has taught Microeconomics for ten years in the traditional way; for the last eight years –in advanced courses and doctorates- he has offered a selection of empirical applications, which have complemented the traditional theoretical teaching. These applications have emerged from various research projects managed by the author during the last ten years with the financial support of several institutions (DGICYT, DGESIT, CICYT, and R&D National Plan). The success in this type of teaching and the availability of recent original applications from authors usually collaborating with the editor has led the later to compose this text.

This text combines microeconomic theories with appropriate empirical tests. The standardised microeconomic analysis of demand, production and costs (supply) is set forth along with appropriate econometric techniques. Moreover, it should be pointed out that over the last two decades Microeconomics has greatly broadened its field of application. On the one hand, this has been due to the fact that the conditions required for existence, unicity and stability of the general competitive equilibrium have been met. This was the prevailing focus of Microeconomics in the Sixties and part of the Seventies. On the other hand, as big samples of inter- and intra-industrial data were increasingly available, a neo-classical Microeconomics branch emerged in the mid Seventies traditionally called in Britain New Microeconomics or Industrial Organisation, which on the structure-behaviour-results paradigm, binds together the earlier and new works on structural change and technical progress and applies new techniques -mainly panel data- which enable us to observe how the behaviour of the new agents affects industrial structure.

Demand, production and costs are parts of Microeconomics which are greatly active at present. Industrial structure and regulation, markets and failures of market constitute central nuclei of Industrial Organisation. Therefore, the second part of the title of these essays records this expression. Although I dare not give it a Roman numeral, a new volume will foreseeably emerge in the future recording new advances both in the expression of ideas and in the econometric cointegration and panel data techniques used here.

The text consists of four parts: Demand, Production and Costs (Supply), Market and Industrial Structure and Failures of Market and Industrial Regulation. Each part has three chapters.

Section I deals with demand and starts with a paper that studies industrial demand. Chapter 2 offers a study on air transport demand with respect to the remaining modes of transport. To conclude, this section presents the behaviour of the consumer's with respect to the introduction of a new product.

Section II deals with supply. In Chapter 4 a production function is estimated with panel data for the hospital industry and the results corresponding to assignative efficiency are presented. In Chapter 5 economic efficiency is analysed for the case of road transport firms. Finally, Chapter 6 offers the producer's behaviour with technological innovation and structural change.

Section III studies the market and industrial structure. Chapter 7 covers the problems of measurement of inter- and intra-industry trade. The following chapter presents a typical model of Industrial Organisation in which intra-industry activity is explained by industrial structure and the behaviour of the agents. To conclude, this section presents a paper on economic integration in which the link between structural adjustment and horizontal and vertical intra-industry trade is analysed.

Section IV starts with a chapter on structure and regulation in electrical industry. In Chapter 11 the effects of a regulation of working time on labour market are studied. The last chapter includes a theoretical model which explains how the lack of co-ordination in the input and output of agents in industry may generate complex situations and presents an application.

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PART I. DEMAND

1 Modeling Seasonal Integrated Time Series: the Spanish Industrial Production Index

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In this paper the Box-Jenkins approach to the building of seasonal time series model is extended so that it is adequate to model seasonally integrated time series. To this end, the class of multiplicative ARIMA models is broadened in such a way that it allows to describe time series integrated at a few of the seasonal frequencies. Thus, tests for seasonal unit roots are not considered as a rival modeling approach, but can be used in the identification stage to decide the transformation inducing stationarity. The fit model is used to generate forecasts and to estimate unobservable components. The enhanced Box-Jenkins approach is illustrated modeling the Spanish Industrial Production Index.

1.1 Seasonal Time Series Models

The Box and Jenkins approach to the seasonal time series analysis can be sketched as follows. Firstly, the non-seasonal $1 - B$ and seasonal $1 - B^s$ differencing operators are used to convert a non-stationary series z_t into a stationary series w_t . It is usually necessary to use d -order non-seasonal and D -order seasonal differencing, that is,

$$w_t = (1 - B)^d (1 - B^s)^D$$

Then, the stationary series w_t is expressed, according the Wold decomposition theorem, as a weighted sum of current and past values of a white noise process

$$w_t = a_t + \sum_{j=1}^{\infty} \psi_j a_{t-j} = \psi(B)a_t$$

where

$$\psi(B) = 1 + \sum_{j=1}^{\infty} \psi_j B^j$$

Finally, to achieve parsimonious models the polynomial $\psi(B)$ is approximated by the rational polynomial

$$\psi(B) = \frac{\theta(B)\Theta(B^s)}{\phi(B)\Phi(B^s)}$$

where $\phi(B) = 1 - \phi_1 B - \dots - \phi_p B^p$ and $\theta(B) = 1 - \theta_1 B - \dots - \theta_q B^q$ are the non-seasonal autoregressive and moving-average polynomials which describe the dependence between consecutive data, and $\Phi(B) = 1 - \Phi_1 B - \dots - \Phi_p B^p$ and $\Theta(B) = 1 - \Theta_1 B - \dots - \Theta_q B^q$ are the seasonal autoregressive and moving-average polynomials describing the dependence between data which are s periods apart. Therefore, the nonstationary seasonal time series z_t is described by the general multiplicative model

$$\phi(B)\Phi(B^s)\nabla^d \nabla_s^D z_t = \theta(B)\Theta(B^s)a_t \quad (1.1)$$

The choice of the seasonal differencing to induce stationarity is based on the fact that seasonal time series show a cyclical behaviour with period s ($s = 4$ for quarterly data and $s = 12$ for monthly data). In the extreme case $z_t = z_{t-s}$, we have a homogeneous difference equation whose general solution is a linear combination of the s roots, $e^{i2\pi j/s}$ ($j = 0, 1, \dots, s-1$ and $i = \sqrt{-1}$), of the characteristic equation $1 - B^s = 0$,

$$z_t = \sum_{j=0}^{s-1} a_j e^{i2\pi j/s} = \alpha_0 + \sum_{k=1}^{[s/2]} (\alpha_k \cos(\frac{2\pi k}{s}t) + \beta_k \sin(\frac{2\pi k}{s}t))$$

where $\alpha_k \cos(\frac{2\pi k}{s}t) + \beta_k \sin(\frac{2\pi k}{s}t)$ is a harmonic oscillation with period $p_k = s/2\pi k$ and constant amplitude $A_k = (\alpha^2 + \beta^2)^{1/2}$, generated by the pair of conjugate complex roots $e^{-i2\pi k/s}$ and $e^{-i2\pi (k-s)/s}$; the harmonic with frequency $s/2$, $\alpha_{s/2}\cos(\pi t)$, only arises when s is even and is generated by the negative unit real root; $[s/2] = s/2$ if s is even and $[s/2] = (s-1)/2$ if s is odd. Hence, it is seen the key role played by the seasonal difference in representing the seasonal pattern.

Although the $1 - B^s$ filter has been commonly used in the Box-Jenkins approach, Abraham and Box (1978) pointed out that sometimes some of its factors could be sufficient to handle the seasonality. Such factors are found by expressing $1 - B^s$ in terms of its roots

$$1 - B^s = \prod_{j=0}^{s-1} (1 - e^{i2\pi j/s} B)$$

and joining each pair of complex roots into a second-order factor

$$(1 - e^{i2\pi k/s} B)(1 - e^{i2\pi(s-k)/s} B) = 1 - 2\cos(2\pi k/s)B + B^2$$

Thus, the seasonal difference can be factored as follows

$$1 - B^s = \prod_{k=0}^{[s/2]} S_k(B) \quad (1.2)$$

where

$$S_k(B) = \begin{cases} 1 - B & k = 0 \\ 1 - 2\cos(2\pi k/s)B + B^2 & k = 1, \dots, [(s-1)/2] \\ 1 + B & k = [s/2] = s/2 \end{cases} \quad (1.3)$$

Hylleberg, Engle, Granger and Yoo [HEGY] (1990) developed unit root tests to identify the simplifying operators $S_k(B)$ in the underlying time series model. These authors extend the notion of integration to cover the seasonal frequencies. Thus, a time series z_t is integrated of order d at the frequency k , denoted by $z_t \sim I_k(d)$, if its autoregressive representation contains the factor $S_k(B)^d$. Empirical evidence based on the HEGY test reveals that most of the monthly and quarterly economic time series are integrated of order one at a few seasonal frequencies (see, e. g., Osborn 1990, Beaulieu and Miron 1993, Hylleberg, Jorgensen and Sorensen 1993).

In contrast, the empirical evidence found using the Box-Jenkins methodology has revealed that most of the monthly and quarterly seasonal time series can be adequately described by the IMA(0,1,1)(0,1,1)_s model,

$$(1 - B)(1 - B^s)z_t = (1 - \theta B)(1 - \Theta B^s)a_t$$

implying that z_t is $I_0(2)$ and $I_k(1)$ for $k = 1, \dots, [s/2]$.

Gallego and Treadway (1995) have shown why the empirical results obtained with the HEGY test cannot be found with the conventional multiplicative ARIMA class, and how to broaden such a family to allow for unit roots at a few seasonal frequencies. Consider for example the seasonal IMA(1,1)₄ model for quarterly time series

$$(1 - B^4)z_t = (1 - \Theta B^4)a_t \quad (1.4)$$

It is interesting to write (1.4) as

$$(1 - B)(1 + B^2)(1 + B)z_t = (1 - \Theta^{1/4}B)(1 + \Theta^{1/2}B^2)(1 + \Theta^{1/4}B)a_t \quad (1.5)$$

The three nonstationary factors on the left-hand side of (1.5) contribute to "spectral peaks" at the frequencies 0, 1 and 2, respectively. So, under the condition of invertibility $\Theta < 1$, z_t is integrated of order one, $z_t \sim I_k(1)$, at $k = 0, 1$ and 2. However, if the MA parameter Θ is positive and strictly noninvertible, $\Theta = 1$, then the model contains three common factors whose cancellation implies that z_t is integrated of order zero, $z_t \sim I_k(0)$, at $k = 0, 1$ and 2. In contrants, let the seasonal MA(1)₄ polynomial in model (1.4) be replaced with a nonseasonal MA(4) polynomial. Then, the resulting IMA(1,4)(1,0)₄ model