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ASSOCIATION HISPALINK GALICIA
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ECONOMIC DEVELOPMENT STUDIES
EE11**

**EDUCATION AND INTERNATIONAL
DEVELOPMENT, 1960-2000:
Economic Studies of OECD
Countries, Latin America, Europe,
Africa and Asia**

Guisan, M.C. · Aguayo, E. · Exposito, P.

EE11. 2023



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2023

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Web of the coordinator: <https://www.usc.gal/economet/guisan2.htm>

Book EE11 of the Series “Estudios Económicos/Economic Studies” of the Association Hispalink Galicia (AHG) hispalinkgalicia@gmail.com

With the collaboration of the Euro-American Association of Economic Development Studies

Available at <https://www.usc.gal/economet/ebooks.htm> and at [Ideas-Repec](#)
ISSN 2952-0738

Electronic edition, year 2023: <https://www.usc.gal/economet/ahg11.htm>

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**EDUCATION AND INTERNATIONAL DEVELOPMENT, 1960-2000:
ECONOMIC STUDIES OF OECD COUNTRIES, LATIN AMERICA,
EUROPE, AFRICA AND ASIA**

GUISAN, María-Carmen
AGUAYO, Eva
EXPOSITO, Pilar

Abstract: This book, EE11, presents a summary of several international studies published by the authors on international development for the period 1960-2000.. EE11 includes 5 chapters: 1) Evolution of Gross Domestic Product and Population in the World for the 20th century and indicators of Education and Production per capita by sector in 21 areas of America, Europe, Eurasia, Africa, Asia and Pacific. in years 1980 and 1999. The chapter also includes a summary of several international models of World development estimated by our research team for the period 1960-2000. 2) International panel models of OECD countries for the 20th century: Production, Employment, Wage and Consumption. 3) Production by sector in OECD countries: Agriculture, Industry, Building and Services. 4) Studies related with economic development of Latin American countries (Education, Trade and Production per capita) for the period 1960-2000. The analyzes highlight the positive impact of Education on international development. 5) A comparison of regional development in Europe and the United States for 1960-2000. This book is scheduled to be followed by another book, EE12, with contents of our research on international development for the period 2001-2023

JEL codes: C51, O5, O51, O52, O57

Keywords: Growth and Development, OECD countries in the 20th century, European Regions, Production and Employment by Sector, Latin America in the 20th century, Africa, Asia, Studies of the period 1960-2000.

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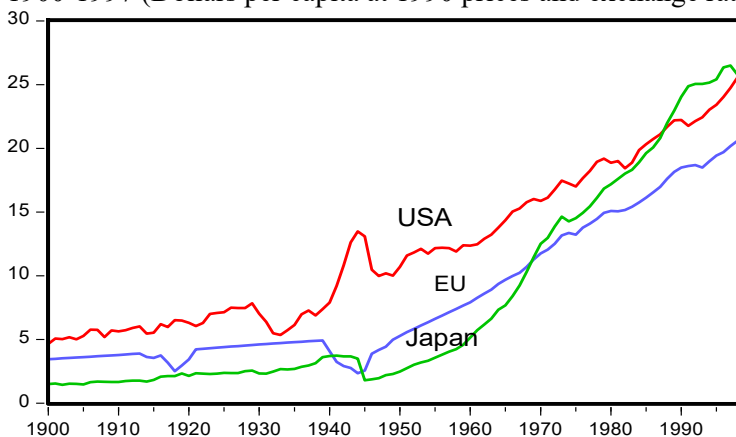
CHAPTER 2
DEVELOPMENT IN THE OECD, 1960-2000: ECONOMETRIC
MODELS AND INDICATORS
GUISAN, Maria-Carmen*

2.1. Evolution of OECD countries, 1900-1997: Production and Employment

This section is a supplement to the Economic Development paper n° 44, by Guisan, Exposito and Cancelo (2000), and includes references to DEA12 by Cancelo and Guisan (1998).

The evolution of production per head in 15 countries of the European Union, Japan and the United States is shown in graph 2.1 and table 2.1.

Graph 2.1. Production per capita in the European Union (EU15), USA and Japan, 1900-1997 (Dollars per capita at 1990 prices and exchange rates)



Sources: Elaborated by Guisan, in this book EE11 from the following sources: For the second half of the century, several statistics of the OECD (National Accounts, Labour Force and other ones) and for the first century from several historical statistics, published by Liesner(1985), Madrison(1989).A Nadal et al (1989), Landes(1998), and additional information from historical publications by Cipolla, Kendrick, Kuznets, Mitchell, Barioch, Paretto and other authors. Note: For the EU we have made some interpolations following the trend, with special effect of decay due to the 1st and the 2nd world wars). applying the percentage of France to the UE average in those years.

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We have analyzed the evolution of OECD countries for the 20th century. Thanks to improvements in education, health, sanitation, and scientific and technological advances, the more educated countries experienced a great advance in economic development, particularly during the second half of the century, after the second World war (ww2).

Tables 2.1 and 2.2 present a comparison of Production per capita, Productivity of Labour and Employment in the United States (USA), European Union (EU15). Besides, table 2.1 includes data of 4 European countries (France, Germany, Spain and the United Kingdom).

Table 2.1. Production per capita of France, Germany, Spain, UK, Japan, USA and EU15 (thousand Dollars at 1990 prices and exchange rates)

	USA	EU15	France	Germany	Spain	UK	Japan
1900	4.646	3.446	3.643	2.306	2.330	4.383	1.502
1910	5.639	3.779	3.743	2.595	2.709	4.499	1.662
1920	6.306	3.423	3.886	2.356	3.076	4.753	2.141
1930	7.010	4.607	5.506	3.466	3.587	5.309	2.333
1940	7.896	4.073	4.875	5.149	2.628	6.690	3.691
1950	10.687	5.279	6.318	4.849	3.119	6.970	2.476
1960	12.359	7.916	8.949	9.008	4.141	8.928	5.146
1970	15.871	11.751	13.842	13.001	7.634	11.120	12.505
1980	18.856	15.084	17.971	16.878	9.789	13.355	17.183
1990	22.224	18.495	21.199	20.665	12.662	16.947	24.042
1997	24.733	20.173	22.549	22.341	14.179	18.648	26.503

Source: Guisan, Exposito and Cancelo (2000) from historical statistics, cited in footnote of graph 2.1, for the first half of the 20th century and from OECD statistics for the second half. Note: Data of Germany include data of both West and East Germany, based on the sources of data and other indicators.

Productivity, Employment and Educational level, 1900-1997

Industrial development has had an important role in the increase of productivity, accordingly to Kaldor and to the empirical evidence. Thanks to industrial development the non agrarian sectors (Industry, Building and Services) experienced a great increase of Production, Employment and Productivity per worker. The technological modernization of Agriculture had the effects of diminution of Agrarian Employment but a positive effect of real production per worker.

Tables 2.2.1 to 2.2.2, show Mean Productivity of Labour (PM), Total Employment (LT) and Rate of Employment per one thousand inhabitants (LHT) in the USA, the European Union and Japan, for the period 1900-1997.

Table 2.2 1. Mean Productivity of Labour (PM) in USA, EU15 and Japan (thousand Dollars of 1990 prices and exchange rates),

Year	Mean Productivity of labor (PM)		
	USA	EU15	Japan
1900	13.094	7.657	2.658
1910	15.056	8.433	3.123
1920	17.127	7.672	4.395
1930	18.975	10.369	5.077
1940	21.959	9.208	8.173
1950	27.527	11.984	6.446
1960	33.936	17.996	10.867
1970	40.279	28.533	25.461
1980	42.559	37.094	36.253
1990	46.119	43.867	47.529
1997	50.784	49.674	50.998

Source: Guisan, Cancelo and Exposito(2000) from historical statistics, cited in footnote of graph 2.1, for the first half of the 20th century and from OECD statistics for the second half. Note: Data of Germany are estimations for the whole West and East Germany.

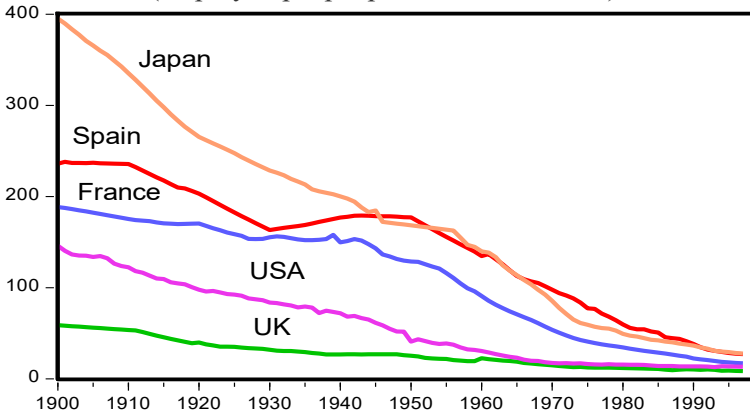
Table 2.2.2. Total Employment (thousand people) and Rate of Employment (per one thousand people), 1900-1997)

Year	Total Employment			Rate of Employment		
	USA	EU15	Japan	USA	EU15	Japan
1900	27000	105179	24770	355	450	565
1910	34600	113968	26170	374	448	532
1920	39200	114319	27260	368	446	487
1930	45500	120438	29620	370	444	460
1940	47500	125349	32480	360	442	452
1950	58900	126848	31954	388	440	382
1960	65800	138914	44165	364	440	470
1970	80796	140168	50940	394	412	488
1980	100907	144447	55360	443	407	474
1990	120430	153694	62490	481	422	506
1997	130543	151532	65566	478	406	520

Source: Elaborated by Guisan, Exposito and Cancelo(2000) from historical statistics, cited in footnote of graph 2.1, and table 2.2.1, and OECD statistics for the second half. Note: Data of Germany are estimations for the whole West and East Germany.

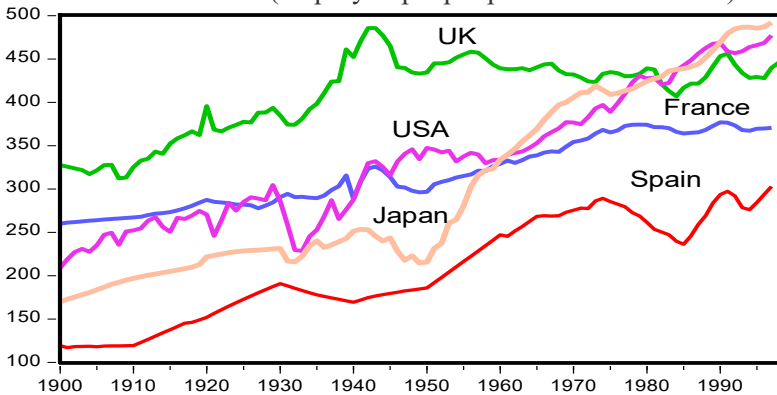
Graphs 2.2 and 2.3 show the evolution of the rate of Employment per 1000 inhabitants, in Agriculture and in Non-Agrarian sectors, and in section 1.3 we analyze the evolution of production and employment by sector in OECD countries.

Graph 2.2. Rate of Agrarian Employment in 5 OECD countries, 900-1997 (employed people per 1000 inhabitants)



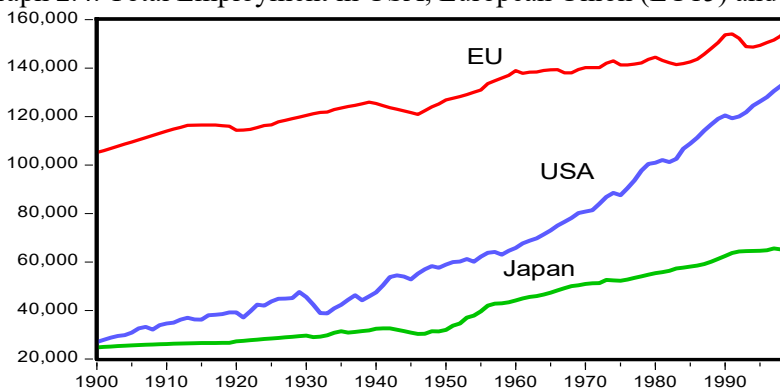
Source: Elaborated by M.C. Guisan, from OECD statistics and the historical sources cited in the footnote of graph 2.1. Note: Agrarian employment includes Agriculture and Fishing.

Graph 2.3. Rate of Non-Agrarian Employment in 5 OECD countries, 1900-1997 (employed people per 1000 inhabitants)



Source: Elaborated by M.C. Guisan from OECD statistics and the historical sources cited in the footnote of graph 2.1.

Graph 2.4. Total Employment in USA, European Union (EU15) and Japan



Source: Elaborated by M.C. Guisan, from OECD Labour Force statistics and the historical statistics cited in the footnote to graph 2.1.

OECD countries experienced a higher increase in real Gross Domestic Product per capita than the many areas of the World, thanks to a higher level of Education, with its positive effects on productivity, investment per capita and real production per capita. Table 2.3 shows a comparison of OECD with other areas of the World in the indicator of Education Attainment: Total years of Schooling (Tyr).

Table 2.3. Average School Years of Education of adult population

AREA	BARRO and LEE		NERUH et al.
	1970	1990	1987
Developing Countries	2.66	4.43	4.48
Middle East and North Afr.	2.05	4.47	4.79
Sub-Saharan Africa	2.06	2.93	2.54
Latin America	3.82	5.24	5.52
East Asia and South Pacific	3.80	6.08	5.13
South Asia	2.03	3.85	3.39
OECD	7.58	9.02	10.0

Source: Elaborated by Guisan(1997) from BARRO and LEE(1996), population over age 25. NERUH et al. (1995), population between the ages 15-64.

Table 2.4. shows real Gross Domestic Product and Population of USA, European Union and Japan in years 1900, 1925, 1950, 1975 and 1999, and table 2.4. the evolution of real GDP per capita.

Table 2.4. Real GDP (Billion dollars at 1990 prices and exchange rates)

	GDP at constant prices (Bn)			Population (thousand)		
	USA	EU15	Japan	USA	EU15	Japan
1900	353506	805377	65845	76094	233731	43850
1925	826561	1150271	142029	115829	261853	59740
1950	1621339	1520118	206868	151708	287965	83563
1975	3671500	4618390	1619510	215973	349247	111520
1999	7365056	7946800	3345011	279328	377067	126686

Source: Elaborated M.C. Guisan, from OECD and historical statistics. as cited in the foot note at graph 2.1.

Table 2.5. Real Production per capita (Dollar at 1990 prices and exchange rates) in the USA, EU15 and Japan, 1900-1999

	USA	EU15	Japan
1900	4646	3446	1502
1925	7136	4393	2377
1950	10687	5279	2476
1975	17000	13224	14522
1999	26367	21075	26404

Note: Elaborated by M.C. Guisan from table 2.4.

The rate of growth of real GDP was higher than the rate of growth of Population, and the rate of growth of real GDP per capita was positive and important in all the periods. The average rate of growth of the period 1900-1999 was 1.75% in the USA, 1.83% in the European countries of EU15, and 2.90% in Japan.

For the first half of the 20th century, the average annual rate of Population growth was 1.38% in the United States, 0.42% in the European Union and 1.29% in Japan.

For the second half, the annual rate of Population growth was 1.25% in the United States, 0.55% in the European Union and 0.85% in Japan. All of them were below the high value of World average of the annual rate for the period 1950-2000 (1.76%).

Expenditure on education and scientific research have also had a great impact on economic and social development, increasing life expectancy, productivity and production per inhabitant.

2.2. International Models of OECD countries: Pioneer studies until 1985.

For the period 1975-1985 our research team developed several pioneer empirical research with international samples in order to test and analyze demand side and supply side and its role in economic growth and development. There were also several interesting studies, published by other authors, calling attention to the great importance of Education to foster economic development in the World.

Studies with OECD countries were particularly interesting due to the availability of data and indicators for many important variables. The publications National Accounts and Labour Force Statistics by the OECD have been very useful in this regard.

Some of the pioneers approaches to the explanation from the supply side included not only the analysis of the effects of Primary Inputs (mainly Capital and Labour) but also the effects of the availability of Intermediate Inputs. The intermediate inputs include raw materials and more elaborated goods that are used as inputs in the production of other goods of services. It is important to have into account both the domestic production of Intermediate Inputs and the capacity to Import those inputs from the rest of the World.

Here we cite some pioneering research in this regard, developed by our research team in the period 1975-1985.

1) Guisan(1975):Dissertation on International Production Funcions

Title: Econometric Study of Aggregate Production Functions (with applications to 14 OECD countries)

This Doctoral dissertation was an empirical study of the role of the Production Function on economic growth of OECD countries and relationship between Imports and real Gross Domestic Product (GDP), and human capital and development.

The dissertations was prepared under the superivison of Professor Jesus-Bernardo Pena-Trapero, who was Professor and Dean of the Spanish Faculties of Santiago de Compostela (USC) and Alcala de Henares (UAH) at Madrid and Deputy Director of Demographic Statistics at the National Statistical Institute (INE).

The study was pioneer in the estimation of the relationships between GDP with primary inputs and intermediate inputs with an international panel, from

the Supply Side, and in the estimation of equations relating the Educational level of employed people with the Capital/labour ratio.

The summary of the dissertation was published in Spanish by the the University of Santiago de Composteloa in Spanish (Guisan(1975))

The index of the summary is as follows:

Section 1. A revision of the literature on aggregate production:

Specification forms: Approaches by Cobb and Douglas, Bridge, Valavanis, Klein and Goldberger, Bakony and other authors.

Analysis of problems: 1) Aggregation (Klein), 2) specification (Klein, Theil), 3) Identification in a multiequational system (Hoch, Mundlak and Hoch, Zellner, Kmenta and Dreze, Diamond and McFadden and Nerlove)

Estimation Methods of the CES function (Solow, Brown, Fhron, Kmenta)

Measure of technological change (Abramowitz), Tinbergen,

Section 2. Empirical results of several macroeconometric estimations:

Douglas in year 1948 for a cross-section of manufacturing in the United States in year 1919, with estimated elasticities of 0.76 (for Labour) and 0.25 for Capital. The sum of elasticities was slightly higher than unity (1.01).

Walters(1963) presents an interesting survey of 28 cross-section studies of industries in several countries, including the study by Douglas. The elasticity of Labour varied between 0.43 and 0.76 in those studies, and the elasticity of Capital between 0.13 and 0.58.

Aukrust(1965) compared its study for Norway 1900-1955 with the results of several studies that followed the approach suggested by Tinbergen. The comparison includes the study by Tinbergen, for Netherlands 1870-1915, Solow for USA in the period 1909-1949, Niitamo for Finland (1929-1992) and Gehrig and Khulo for West Germany 1925-1957.

The main conclusion from Aukrust is that the quantities of the primary factors (Labour and Capital) explain approximately the 50% of the rate of growth of real GDP, while the other 50% should be explained by other factors (tecnological change, education and other qualitative changes).

Section 3. Elaboration of a pool of data of OECD countries and estimations

Guisan(1975) elaborate a pool of data of 14 OECD countries (Belgium, Canada, Denmark, France, Germany West, Greece, Italy, Netherlands,


Norway, Portugal, Spain, Sweden, UK and the USA in years 1955 and 1964). and presents estimations for each year and for panel of both yearsta by Denison(1967) for the Stock of Capital in several OECD countries where highly appreciate.

In Guisan(1975), the estimated elasticities, for Labour and Capital, where 0.23 and 0.85 in the sample of 1955; 0.22 and 0.86 for the sample of 1964 and 0.22 and 0.86 for the pool of years 1955 and 1964. There was evidence of increasing returns to scale.

2) *Study by Guisan(1980). Panel model of 7 OECD countries, 1962-76.*

Guisan(1980) presented ta contribution to the Econometric Society World Congress, ESWC80, on Production Functions of OECD countries Forecasting Employment

Figure 2.1. Study by Guisan(1980) at ESWC80.

	<p>ESWC80. ECONOMETRIC SOCIETY WORLD CONGRESS 1980</p> <p>FORECASTING EMPLOYMENT THROUGH AN INTERNATIONAL COBB-DOUGLAS FUNCTION</p> <p>Maria-Carmen GUISAN Faculty of Economics University of Santiago de Compostela (USC, Spain)</p> <p>Session: Studies in Applied Econometrics II</p>
<p>AIX-EN-PROVENCE (FRANCE) 29th August 1980</p>	

Chairman: Teun Kloek. Erasmus University, Rotterdam (Netherlands).
Papers by: F.D.Arditt (Florida, US), G.S. Maddala (California, USA), James
Davies (W.Ontario, Canada), J.Van der Gaar&E. Smolenksy (Wisconsin,
USA), M.C. Guisan (USC, Spain)

The study by Guisan(1980) includes an anlysis of macroeconomic approaches from demand and supply and the role of the Production Function, and other equations, in the explanation of Gross Domestic Product and Employment. The study includes the following sections.

Some of the main contributions of the study are the following ones:

The estimation of an international Cobb-Douglas Function to relate real GDP (Q), Stock of Capital (KA=available capital) and Employment (L) in 7 OECD countries for the period 1962-1974 and to present a comparison of the dynamic forecasts of Q and L for year 1976 of 3 models.

The production function, estimated for the period 1962-1973 with a panel of 7 countries, showed increasing returns to scale and a high goodness of fit.. The existence of increasing returns to scale implies that the neoclassical approach must be reformulated as we mention in the book by Guisan(1983)

This is an important function relating Capital, GDP and Employment. but it does not explain Q when there is a high degree of underutilization of the available Capital Stock (KA). In that case, the production function may be utilized to estimate the value of utilized Capital (K).

For that period there were not important restrictions to full capacity utilization of the stock of capital in those countries, and the production function failed to forecast the value of Q for the period 1974-1976 due to other restrictions (diminution of stagnation of the capacity to increase real imports by consequence of the oil crisis of that period).

The explanation of Q corresponds to:

Model 1 from demand approach,

Model 2 from the supply of primary inputs (production function)

Model 3 as a function of intermediate inputs.

The explanation of L is based in equations that relate actual Employment L with the desired level of employment by enterprises (L^*) and supply of workers (LS) and the lagged value of L ($L(t-1)$).

L^* is explained as follows:

Equation 1: with the usual estimation in studies based on the demand approach, from the production function,

Equation 2 : with the usual estimation in studies of the supply of primary inputs, from the marginal productivity function, which usually leads to $L^*=f(K/W)$

Equation 3: we use our own approach for the situations, which holds when there are restrictions to the utilization of full capacity of the stock of capital

under the hypothesis that the enterprises would try to maintain at least an average return to available capital r^* .

In Equation 3 there is a relationship between L^* and the ratios Q/W (with positive effect) and KA/W (with negative effect). The total effect of the increase of KA on Employment depends on the effect of KA on Q . If there are not restrictions to full capacity the total effect usually will be positive.

The production function is an important function to explain the relationship between Q , L , and utilized capital (K). If there are not restrictions to full capacity K will be close to KA , Q would be explained by the production function and L by Model 2, with L^* depending on Q/W .

When there are restrictions to full capacity, K will be not close to KA and the production function may explain the utilized capital (K) given the values of Q (explained by demand or by intermediate inputs) and L (explained by the equation that we have formulated in Model 3 as a function of Q/W and KA/W).

Table 2.6 present dynamic forecasts for Q in 1976: Models 1 (Demand), 2 (Primary Inputs), 3 (Intermediate Inputs) and actual value of Q .

Table 2.6. Dynamic forecasts and actual value of real Production 1976 (Billion Dollars at 1970 prices and exchange rates)

Country	Q Forecasts			Q
	Model 1	Model 2	Model 3	Actual
France	181	195	184	182
Germany W	208	233	229	216
Italy	111	124	108	110
Japan	289	344	287	272
Spain	53	56	50	49
UK	140	147	134	137
USA	1136	1226	1159	1164

Source: Guisan(1980)

In all the countries, the forecasts of Model 2 overestimated the actual value. The best forecasts of Q corresponded to Model 1 in France, Germany West and Italy and to Model 3 in Spain and the USA. In the case of UK both Models. 1 and 3, showed a similar distance to actual value of Q .

Table 2.7 presents dynamic forecasts for Employment (L) in year 1976, based in equations 1, 2 and 3.

Table 2.7. Dynamic forecasts and Employment in 1976 (million people)

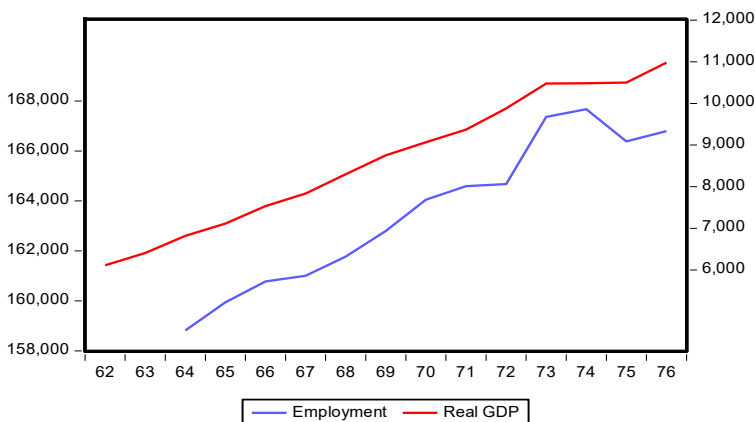
Country	L Forecasts			L
	Equation 1	Equation 2	Equation 3	
France	20.94	21.74	21.57	21.45
Germany W	24.72	25.85	25.24	25.09
Italy	18.57	19.38	19.37	19.29
Japan	53.83	53.21	53.05	52.70
Spain	13.10	13.01	12.99	12.65
UK	24.08	25.53	24.95	24.76
USA	88.46	92.15	89.19	89.63

Source: Guisan(1980).

Equation 3 provided the best forecasts in the 7 countries of this study.

Graph 2.5 presents in the lower line (blue colour) and left scale the total employment of these 7 OECD countries for the period 1962-1976, and in upper line (red colour) and right scale the total value of real GDP per capita (Q) in the 7 countries.

Graph 2.5. Employment (million) and real GDP (Billion Dollars at 1970 prices and exchange rates) in 7 OECD countries, 1962-1976



Sources: Guisan(1980) from OECD statistics.

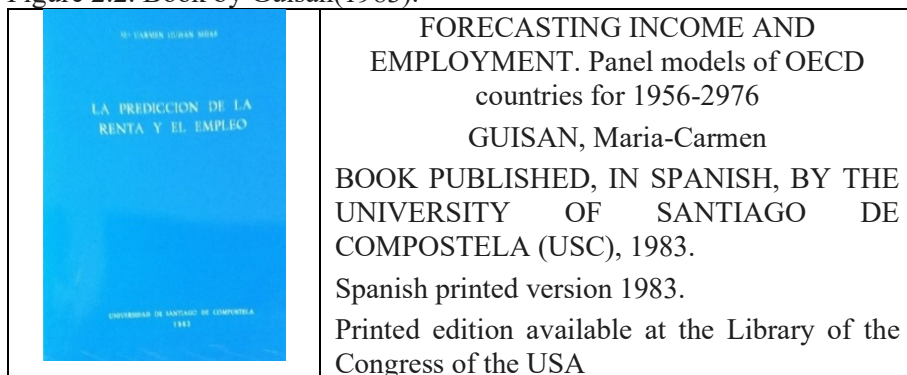
3) *Book by Guisan(1983) Forecasting Income and Employment*

In the book by Guisan(1983), published in Spanish by the USC, there is an analysis of macroeconomic models in OECD countries for 1956-1976.

The Index of that book includes the following chapters

- 1) Evolution of OECD countries for 1956-1975
- 2) Demand and Supply approaches to economic growth: Harrod-Domar, Keynes, Leontieff, Solow and Disequilibrium approaches.
- 3) Estimation of macroeconomic models of demand, supply and disequilibrium in 7 OECD countries for the period 1962-73 and forecasting capacity for 1974-76.
- 4) Macroeconomic models of Employment.
- 5) Wages, Prices and Employment
- 6) Economic development and Income distribution in the World
- 7) Energy crisis, intermediate inputs restrictions and foreign trade.

Figure 2.2. Book by Guisan(1983).



The book includes 7 Chapters, with some international estimations of econometric models and selected data of the period 1956-1976.

Table 2.8. shows the evolution of Population and real values of average Wage, Private Consumption per capita and Public Consumption per capita for the period 1956-1976 in the 7 more populated countries of the OECD.

The period 1956-1976 was positive for this group of 7 countries, with high increases of W), CH) and GH. Public Consumption includes individual and collective consumption of public goods, including many goods and services provided from Government to families, like health assistance and other ones

In year 1976 the highest wages corresponded to the United States followed by Germany West and France. Those countries also had the highest levels of Private and Public Consumption per capita.

Table 2.8. Evolution of Population (thousand), Wage, and Consumption per capita (Dollars at 1970 prices) in 7 OECD countries, 1956-1976).

Country	Pop 1956	Pop 1976	Wage 1956	Wage 1976	CH 1956	CH 1976	GH 1956	GH 1976
France	43843	52927	2490	5775	976	2120	271	441
Germany W	53008	61531	2096	5785	860	1956	263	631
Italy	48469	56156	1521	4528	565	1228	142	255
Japan	89980	112768	1133	3986	351	1284	88	208
Spain	29301	36240	835	3137	359	924	64	131
UK	51430	56001	2212	3937	1075	1499	260	474
USA	168903	215118	6751	8988	2208	3541	698	947

Note. Population in thousand people. Wage, Private and Public Consumption per capita (CH) and Public Consumption per capita GH), in Dollars at 1970 prices and exchange rates. Source: Elaborated by Guisan(1983) from OECD statistics.

Countries with the highest levels of education and investment per capita usually are those with the highest wages and highest values of consumption per capita (both private and public).

The highest level of Public Consumption per capita corresponded to the United States, with 947 in year 1976, followed by Germany West, the United Kingdom and France.

Tables 2.9 and 2.10 show values of real GDP (Q), real value of the available Stock of Capital (KA), Employment (L), the ratio KA/L the real average Wage (W) and the Mean Productivity of Labour (PM=Q/L).

There was an important increase of the variables for the period 1962-1976, particularly outstanding in the case of the two countries with PM lower than 2000 in year 1962 (Spain and Japan).

Productivity per worker (PM) is very much related with the ratio Capital/Labour (KA/L) and real Wage (W) is very much related with Productivity of Labour (PM).

Table 2.9. Producción, Stock of Capital, KA/L, PM and Wage in year 1962
(at 1970 prices and exchange rates)

Country	Q	KA	L	KA/L	W	PM=Q/L
Germany West	129	165.85	26690	6220	3110	4834
Spain	22.87	26.74	11767	1933	1117	1859
France	92.91	79.787	19.621	4066	3176	4735
UK	96.37	103.652	24.634	4208	2554	3912
Italy	61.91	53.00	20.261	2616	2179	3056
Japan	87.13	54.172	45.56	1189	1488	1912
USA	726.28	518.028	69.531	7450	7560	10445

Note: Q and KA in Billion \$ 1970, L thousand, KA/L, W and PM in \$1970.

Source: Tables of Guisan(1983), elaborated from OECD national accounts and labor force for Q, L, W, PM, and from Denison and other sources for KA.

Table 2.10. Producción, Stock of Capital, KA/L, PM and Wage in year 1976
(at 1970 prices and exchange rates)

Country	Q	KA	L	KA/L	W	PM=Q/L
Germany West	216.03	264.09	25088	10527	5785	8610
Spain	49.25	63.975	12650	5057	3137	3893
France	181.84	156.375	21447	7291	5775	8479
UK	136.82	150.218	24761	6067	3937	5530
Italy	109.62	94.548	19289	4902	4528	5683
Japan	272.93	231.665	52700	4396	3986	5179
USA	1164.47	966.130	89629	10779	8988	12992

Source: See footnote of table 2.7.

In the period 1962-1976 there were important increase of KA/L, PM and W in the 7 countries of the study. In year 1962 the lowest values of K/L corresponded to Japan and Spain, clearly below Italy, but both countries experienced an important investment process and an increase of K/L reaching in year 1976 a value close to that of Italy.

The highest values of KA/L corresponded to the USA and Germany (West), with values around 10000 Dollars in 1976.

Japan and Spain had low values of the Stock of Capital per capita in year 1962 (below 2000 Dollars), and both countries experienced a high increase for the period 1962-1976, reaching more than 4000 Dollars in year 1976.

2.3. Wages, Employment and GDP in the OECD, 1960-2000.

For the period 1985-2005, our research team of Econometrics, has contributed to several Congresses and published many articles, related with econometric models of the OECD countries with samples of 1960-2000.

Many of the articles has been published, in English and Spanish, in several academic journals, and we have published two books in Spanish in this series of books EE, on Economic Growth and Development in OECD countries.

In this section, we present: 1) a summary of the book OECD 1. 2) A summary of the book and OECD2. 3) the model by Guisan, in this book EE11, of year 2023, for GDP, Wages and Employment in 6 OECD countries for the period 1960-2000.

1) *Summary of Book OECD 1:* <https://www.usc.gal/economet/ahg4.htm>

OECD1 is the book EE4 of the series EE, written by Guisan et al (2001) t. It includes the estimation of panel models of the European Union, United States and Japan for the period 1960-1995, relating GDP per capita with the educational level of Population, as well as an analysis of Employment by sector in Germany, Spain, Japan and the USA.

It includes the estimation of a panel model relating Manufacturing and Non Manufacturing Production in 4 OECD countries for 1970-1992. and the impact of Manufacturing on the Employment of Private and Public Services.

It also analyses the evolution of development in France, Ireland and Spain, for the period 1965-1996, related with Non Agraria real Value-Added per capita, Educational level of Population (measured by the percentage of adults with upper secondary education), Rates of Non Agrarian Employment and level of industrialization.

2) *Summary of Book OECD2:* <https://www.usc.gal/economet/ahg8.htm>

OECD 2 is the book EE8 of the series EE, written by Guian et al(2004), including econometric models of OECD countries for the last decades of the 20th century.

Chapter 1, by Guisan, analyses the evolution in 25 OECD countries of the following variables, in per capita terms: Investment, Exports, Imports, GDP, Private and Public Consumption. It also includes an analysis of the evolution of GDP and Population for the periods 1964-1974, 1974-1984 and 1984-1999, as well as data of Education level (indicator Years of Schooling of adult Population) in years 1965 and 1999.

Chapter 2, by Guisan and Exposito, estimates multicuecacional models, with interdependence and recursives, applied to OECD countries, including a model on demand and supply of Agriculture in France, Japan, Spain and the United States, for the period 1964-1999, and an econometric models of demand, and supply of intermediate inputs, for the period 1966-1998 with data of the United States.

Chapter 3, by Guisan, analyses the relationships of causality and cointegration between Private Consumption and Gross Domestic Product and applies a test of Hausman, to test contemporaneous and bilateral causality with samples of Mexico and the United States for the period 1951-1997. Although there is some degree of bilateral relationship, the main address of causality is from Production to Consumption.

This chapter also includes data of Private and Public Expenditure per capita in Health and Education, of 24 OECD countries in year 1996, and highlights the importance of intermediate inputs to foster production from the supply side and the positive impact on Consumption, Health and Education.

Chapter 4, by Guisan and Cancelo, presents a panel model of OECD countries, with a sample of 176 observations, of 11 countries for the period 1975-1990, relating Production of Manufacturing from the demand and supply sides and applying several specification tests: Davidson and McKinnon and the method of the combined model. Both results indicate empirical evidence more favourable to the supply model. This chapter was published by Guisan and Cancelo(2006) in *EcoDev89*. The equation of supply is a production function that includes, besides Capital and Labour as explanatory variables, an indicator of innovation given by expenditure on research. This chapter also includes the estimation of equation of Exports of Manufacturing products, related positively with domestic industry, educational level and international demand, and negatively related with relative price of the domestic market and foreign markets.

That chapter includes an Annex with data of the main variables in years 1975, 1980, 1985 and 1990, in 11 OECD countries: Germany, Belgium, Denmark, Spain, France, UK, Netherlands, Italy Portugal, Japan and the USA.

Chapter 5, by Aguayo and Guisan, analyses econometric models of regional distribution of Population and Employment. It includes data and econometric models with a panel of Spanish regions for the period 1977-1997 an a summary of studies of the European Union, the United States, and Mexico.

Chapter 6, by Guisan and Neira. includes quinquennial data of the following variables, in 25 OECD countries for the period 1964-2000: Total Employment, Average real Wage in Purchasing Power Parities (PPPs), ratio Wage/Productivity.

It also includes annual data for 7 OECD countries for the period 1963-1976 of the following variables: Real Production, Real value of the Stock of Capital, Employment and real Wage.

The group of 7 OECD countries includes: Germany, Spain, France, Italy, Japan, UK and USA. A Production function was estimated with a panel of the 7 countries for the period 1962-1976, based in Guisan(1980) and (1983). It also includes the estimation of a production function, with a panel of quinquennial data of 19 OECD countries for the period 1965-1990.

3) A Panel model by Guisan (2023): 6 OECD countries for 1960-2000

Here, in section 2.3 of book EE11, we include the estimations, with annual data, for the period 1961-2000. We include the estimations as well as some tables of quinquennial data and graph 2.6 relating the values of real Production per capita of non industrial sectors (QHNI) with industrial production per capita (QHI).

Equation 2.1, by Guisan, 2023, for QHNI, 1960-2000

Table 2.11. Industrial production per head in 6 OECD countries, 1960-2000 (Thousand Dollars per inhabitant at 2000 Prices and Exchange Rates)

	QHI00 Germany	QHI00 Spain	QHI00 France	QHI00 Italy	QHI00 UK	QHI00 USA
1960	2.114	0.551	1.665	1.252	2.920	2.470
1970	3.458	1.270	2.534	2.292	3.503	3.511
1975	3.507	1.708	2.754	2.411	3.545	3.640
1980	4.124	1.803	3.167	3.086	3.759	4.234
1985	4.293	1.789	3.103	2.940	3.909	4.405
1990	4.909	2.167	3.522	3.423	4.412	4.787
1995	4.732	2.252	3.445	3.669	4.623	5.596
2000	5.218	2.712	3.809	3.926	4.884	6.282

Source: Elaborated by M.C. Guisan, from OECD National Accounts Statistics.

Note: Data of Germany for 1960-1990 has been calculated by adding to the West Germany data from the OECD statistics our estimations for East Germany.

Table 2.12. Non-Industrial Production per head in 6 OECD countries, 1960-2000
(Thousand Dollars per inhabitant at 2000 Prices and Exchange Rates)

	QHNI00 Germany	QHNI00 Spain	QHNI00 France	QHI00 Italy	QHI00 U K	QHI00 USA
1960	6.566	3.150	6.089	4.684	7.583	13.438
1965	7.894	4.479	7.624	5.678	8.536	15.357
1970	9.069	5.552	9.460	7.355	9.578	16.916
1975	10.269	6.722	10.883	8.308	10.848	18.241
1980	12.139	7.023	12.318	10.009	11.951	20.035
1985	13.345	7.415	13.295	11.238	13.368	21.746
1990	15.003	9.175	15.025	13.108	15.688	23.787
1995	16.215	9.817	15.936	13.900	16.883	24.311
2000	17.535	11.626	18.738	15.262	20.207	28.325

Source: Elaborated by M.C. Guisan, from OECD statistics. Note: Data of Germany for 1960-1990 calculated from OECD for West and own estimations for East.

Equation 2.1 is a function of *supply of intermediate inputs* from domestic and foreign markets.

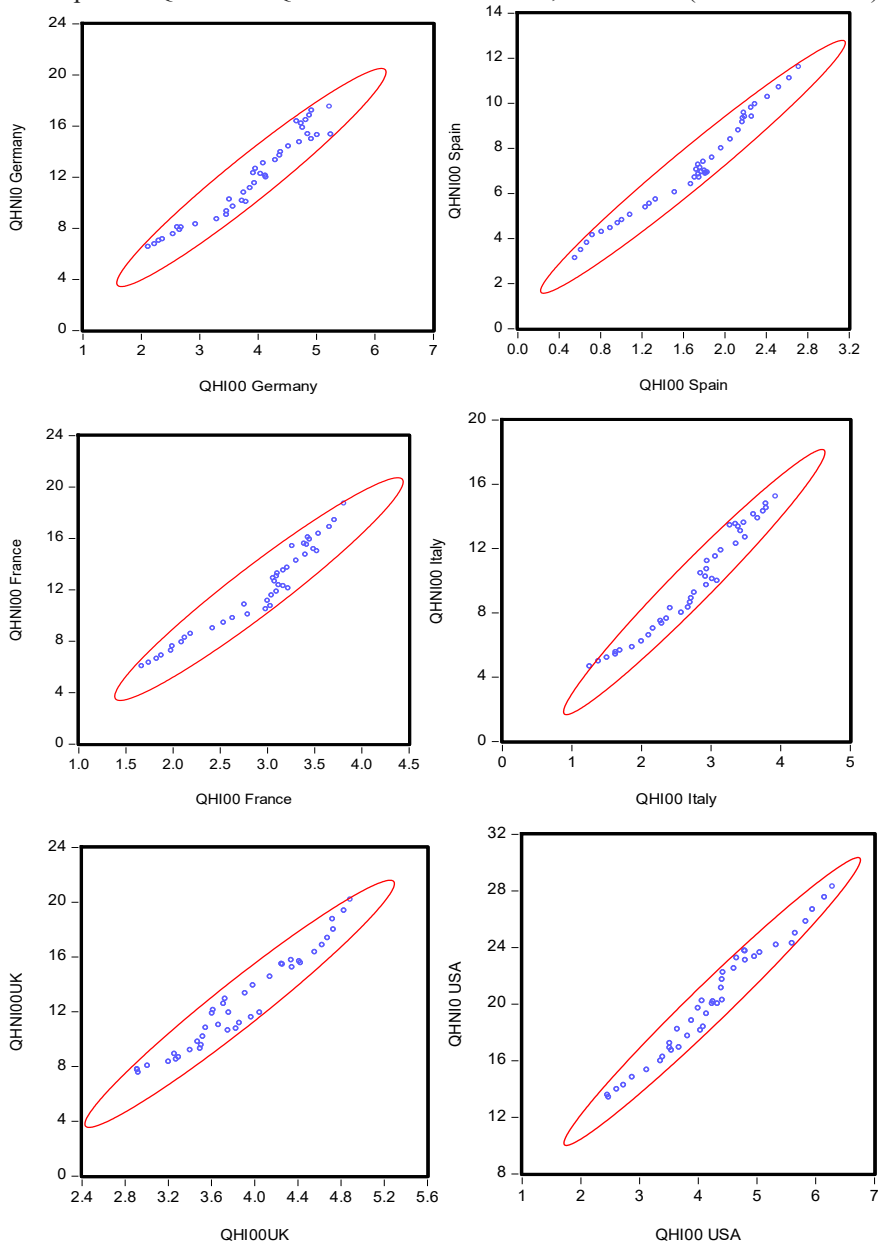
Equation 2.1. $QHNI = f(QHI(-1))$ and increase of QHI, MHG and XHGA.

Panel model of 6 OECD countries for the period 1965-2000

Dependent variable QHNI. Method: Pooled Least Squares				
Sample: 1965-2000. 36 obs. Cross-sections: 6. Total pool: 120				
White diagonal standard errors & covariance (d.f. corrected)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
QHNI00?(-1)	1.011842	0.002432	416.0210	0.0000
D(QHI00?)	0.565950	0.222643	2.541959	0.0123
D(MHG00?)	1.040119	0.175164	5.937978	0.0000
D(XHG00?)	-0.422826	0.162931	-2.595128	0.0107
R-squared	0.998988	Mean dependent var		14.41407
Adjusted R-squared	0.998961	S.D. dependent var		5.875765
S.E. of regression	0.189363	Akaike info criterion		-0.457539
Sum squared resid	4.159560	Schwarz criterion		-0.364622
Log likelihood	31.45232	Hannan-Quinn criter.		-0.419805
Durbin-Watson stat	1.405708			

Source: Estimated by Guisan, in this book EE11. Note: QHI and QHNI are Industrial and Non Industrial production per head. MHG and XHG are Imports and Exports of Goods per head. Thousand Dollars at 2000 Prices and Exchange Rates.

Graph 2.6. QHNI and QHI in 6 OECD countries, 1960-2000 (Th Dollars 2000):



Source: Elaborated by Guisan, in this book EE11, from OECD statistics

Equation 2.1. is the supply *equation of intermediate inputs*, which shows the average positive impact of Industry (QHI) on Non-Industrial sectors (QHNI), particularly in Services and Building, but also in Agriculture. It includes the direct effects of foreign trade. Imports of Goods per capita (MHG) has an average positive impact on QHNI, due to the increase of intermediate inputs from foreign origin available for domestic production of Services, and other other activities. Exports may have a direct negative effect on the availability of intermediate inputs but it usually has a total positive effect having into account its positive effect on the increase of inputs from abroad..

A simultaneous increase of 1 unity of MGH and XGH has a positive impact on QHNI (1.0401-0.4228=0.6173). Direct and Indirect effects of Foreign trade on economic development are analyzed in articles published by Guisan in journal IJAEQS

Guisan(2022), in chapter 3 of the book EE9 (in Spanish), includes interesting estimations of the period 1965-2019. and we are going to present an English version of that study in the book EE12 by Guisan(2023 b).

Equation 2.2 by Guisan, 2023, for real Wages 1960-2000

Table 2.13 includes quinquennial data of real Wage (W00) in 6 OECD countries for the period 1960-2000, and table 2.14. includes quinquennial data of the real value of the Mean Productivity of Labour (PM00).

Table 2.13. Real Wage in 6 OECD countries, 1960-2000
(Thousand Dollars at 2000 prices and exchange rates)

Year	W00 Germany	W00 Spain	W00 France	W00 Italy	W00 UK	W00 USA
1960	10.269	5.253	13.279	10.165	13.218	29.970
1965	13.000	8.519	16.988	13.185	14.857	31.586
1970	17.593	13.264	20.693	17.784	16.110	34.977
1975	21.494	17.634	25.104	21.403	19.702	36.383
1980	23.914	21.427	28.663	24.415	20.364	36.984
1985	24.711	21.595	29.792	25.717	22.694	38.292
1990	28.498	22.658	29.944	28.910	26.411	39.022
1995	31.514	24.019	30.771	27.685	27.267	40.044
2000	32.757	23.953	32.014	29.121	31.129	45.991

Note: Elaborated by Guisan, in this book EE11, from OECD statistics: National Accounts (for Compensations of Employees) and Labour Force Statistics (for number of Employees)

Table 2.14. Mean Productivity of Labour (PM00) in 6 OECD countries, 1960-2000
(Real value, in thousand Dollars at 2000 Prices and Exchange Rates)

Year	PM00 Germany	PM00 Spain	PM00 France	PM00 Italy	PM00 UK	PM00 USA
1960	10.269	5.253	13.279	10.165	13.218	29.970
1965	13.000	8.519	16.988	13.185	14.857	31.586
1970	17.593	13.264	20.693	17.784	16.110	34.977
1975	21.494	17.634	25.104	21.403	19.702	36.383
1980	23.914	21.427	28.663	24.415	20.364	36.984
1985	24.711	21.595	29.792	25.717	22.694	38.292
1990	28.498	22.658	29.944	28.910	26.411	39.022
1995	31.514	24.019	30.771	27.685	27.267	40.044
2000	32.757	23.953	32.014	29.121	31.129	45.991

Note: Elaborated by Guisan, in this book EE11, from OECD National Statistics.

Equation 2.2. relates real Wage, in Dollars at constant prices of year 2000, with a panel of 6 OECD countries of table 11, with a sample of annual data of the period 1962-2000, and a total of 226 observations.

Equation 2.2. $W00 = f(W00(-1), D(PM00), D(Unemployment), D(PH00(-1)))$

Dependent Variable: W00?. Method: Pooled Least Squares				
Sample (adjusted): 1962 2000				
Included observations: 39 after adjustments. Cross-sections included: 6				
Total pool (unbalanced) observations: 226				
White diagonal standard errors & covariance (d.f. corrected)				
Convergence achieved after 11 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
W00?(-1)	1.004372	0.002939	341.7766	0.0000
D(PM00?)	0.271045	0.053833	5.034891	0.0000
D((UR?)	-1.592835	3.165439	-0.503195	0.6153
D(PH00?(-1))	0.273829	0.105743	2.589580	0.0102
AR(1)	0.407660	0.068720	5.932207	0.0000
R-squared	0.997239	Mean dependent var		25.4585
Adjusted R-squared	0.997189	S.D. dependent var		7.8125
S.E. of regression	0.414198	Akaike info criterion		1.0969
Sum squared resid	37.91471	Schwarz criterion		1.1726
Log likelihood	-118.9530	Hannan-Quinn criter.		1.1274
Durbin-Watson stat	2.027456			

Source: Elaborated by M.C.Guisan for this book EE11. Note: We have included and autocorrelation term (AR(1)) to correct the possible effect of missing variables.

The equation relates W with its lagged value, PM , UR and $PH(-1)$.

$PM00$ = Mean Productivity of Labour

UR Unemployment Rate. Ratio Unemployment/Active Population

$PH00(-1)$: Lagged value of Production per head

The goodness of fit is very high, not only because the R-squared is close to unity, but also because the percentage of the Standard Error to the Mean of the dependent variable is very low ($0.414198 \times 100 / 25.4585 = 1.63\%$).

The model shows that the increase of Productivity (PM) and the increase of the lagged value of production per capita (PH) have a positive impact on real Wage, and that the increase of the Unemployment Rate may have a negative impact.

The coefficient of the Unemployment Rate is negative but not significantly different from zero, because there is some degree of uncertainty due to some degree of multicollinearity in the sample. Usually that coefficient is negative for each sector of Employment.

Equations 2.3 and 2.4, by Guisan, for Employment 1960-2000

Table 2.15 shows the quinquennial data of the Rate of Employment per 1000 inhabitants. in 6 OECD countries for 1960-2000.

Table 2.15. Rate of Employment (LHT) in 6 OECD countries, 1960-2000
(number of employed persons per one thousand inhabitants)

	LHT	LHTE	LHTF	LHTIT	LHTUK	LHTU
1960	NA	382	430	419	464	368
1965	476	356	413	383	464	376
1970	461	350	412	367	445	394
1975	447	351	407	361	446	405
1980	460	309	407	370	450	436
1985	457	276	388	373	431	449
1990	468	324	399	384	471	475
1995	452	306	387	349	449	469
2000	459	378	390	370	465	485

Note: Elaborated by Guisan, in the book EE11, from OECD Labour Force Statistics (for total Employment).

Equation 2.3 relates Total Employment (LT) with the ratios GDP/W and KD/W . and equation 2.4 relates the Rate of Total Employment (LHT) with the ratios of PH/W and KDH/W .

Equation 2.3. Total Employment (LT) related with its lagge value and the increasea fo GDP/W and KD/W

Dependent Variable: LT? Method: Pooled Least Squares				
Sample:1962 2000. Cross section: 4. Total pool observations 145				
White cross-section standard errors & covariance (d.f. corrected)				
Variable	Coefficient	Std. Error	t-Stat	Prob.
LT?(-1)	1.010795	0.002250	449.2998	0.0000
D(GDP00?/W00?)	359.6609	45.37004	7.927279	0.0000
D(KD00?/W00?)	-67.73817	16.90861	-4.006135	0.0001
AR(1)	0.357820	0.114462	3.126112	0.0022
R-squared	0.999844	Mean dependent var		42519.26
Adjusted R-squared	0.999840	S.D. dependent var		37096.11
S.E. of regression	468.8956	Akaike info criterion		15.16584
Sum squared resid	31000691	Schwarz criterion		15.24795
Log likelihood	-1095.523	Hannan-Quinn criter.		15.19920
Durbin-Watson stat	2.029313			

Source: Guisán in this book EE11, with OECD statistics

Equation 2.4. Rate of Employment per thousand people (LHT)

Dependent Variable: LHT?. Method: Pooled Least Squares				
Sample: 1962 2000. Included obs: 39. Cross-section: 4. Total 145				
White cross-section standard errors & covariance (d.f. corrected)				
Convergence achieved after 7 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LHT?(-1)	1.000916	0.001573	636.1295	0.0000
D(PH00?/W00?)	0.313658	0.054830	5.720585	0.0000
D((KDH00?/W00?)	-0.050105	0.010728	-4.670549	0.0000
AR(1)	0.338836	0.104392	3.245815	0.0015
R-squared	0.991456	Mean dependent var		0.403819
Adjusted R-squared	0.991274	S.D. dependent var		0.054812
S.E. of regression	0.005120	Akaike info criterion		-7.684067
Sum squared resid	0.003696	Schwarz criterion		-7.601950
Log likelihood	561.0948	Hannan-Quinn criter.		-7.650700
Durbin-Watson stat	2.091257			

Source:M.C. Guisán in this book EE11, with OECD statistics

Economic policies should be addressed to increase PH, without diminution of W, increasing the ratio PH/. The increase of PH allows simultaneous increases of W and the rate of Employment (LHT9. Increases of KDH are useful when they contribute to increase PH, but not in case of infratilization.

2.4. Consumption and Production in the OECD, 1960-2000

Causality tests by Guisan(2001) in 25 OECD countries, 1960-1995

Table 2.16 shows the evolution of Production per head (PH) and Private Consumption per head (CH).

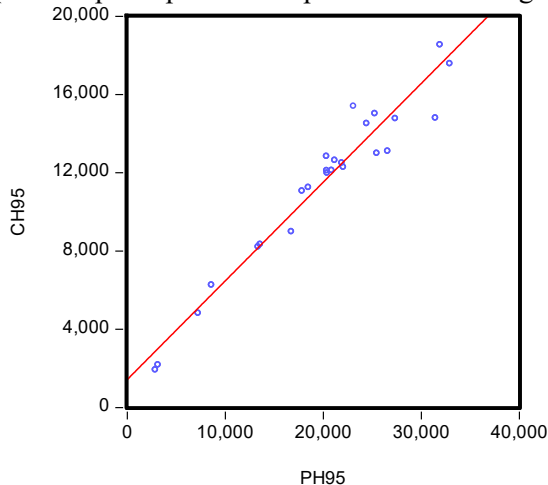
Table 2.16. Production and Private Consumption per capita in 25 OECD countries 1960-95. (Dollars per inhabitant at 1990 prices and Exchange Rates)

		PH60	PH75	PH95	CH60	CH75	CH95
1	Austria	8022	14334	22028	4495	7943	12294
2	Belgium	7844	14050	20316	5428	9038	12848
3	Denmark	11934	18445	27348	7407	10903	14784
4	Finland	9986	18336	25442	5086	9711	13011
5	France	8949	15738	21168	5341	9315	12645
6	Germany	9008	14297	21883	4427	7935	12510
7	Greece	2571	6311	8583	1909	4351	6270
8	Netherlands	9108	14685	20373	4884	8938	11996
9	Ireland	4700	8036	16740	3680	5477	9000
10	Italy	7047	12725	20345	3597	7258	12117
11	Luxembourg	11688	16657	32902	6497	11281	17585
12	Portugal	1992	4340	7214	1482	3464	4829
13	Spain	4141	9433	13351	2675	6115	8219
14	Sweden	13180	21519	26553	8044	11981	13118
15	UK	8928	12235	17818	5281	7058	11080
16	Australia	8785	13380	18463	5459	8123	11262
17	Canada	9244	15189	20857	5661	9043	12128
18	Iceland	9318	16147	24419	5284	9771	14532
19	Japan	5146	14522	25253	3425	8837	15036
20	Mexico	1741	2759	3132	1291	1963	2188
21	New Zealand	8742	11675	13561	6079	7875	8348
22	Norway	10485	17741	31425	6466	10070	14813
23	Switzerland	19099	26407	31905	10670	15468	18554
24	Turkey	1263	2015	2863	1039	1365	1932
25	USA	12259	16606	23068	7467	10811	15411
26	EU15	7908	13211	19397	4433	7713	11463
27	OECD25	8240	13181	18757	4903	8083	11613

Source: Elaborated by M.C. Guisan(2000) and (2002) in EcoDev67, from OECD National Accounts. Note: Countries 1 to 15 belonged to European Union (EU15). The Countries 16 to 25 include non European countries and some European countries that not belonged to EU15. The last two rows are total EU15 and total OECD25.

Graphs 2.7 presents the scatter diagram of the data of CH95 and PH95 in 25 OECD countries in year 1995, with data from table 2.16.

Graph 2.7. CH95 and PH95 in 25 OECD countries, 1995
(Dollars per capita a 1990 prices and Exchange Rates)



Source: Elaborated from data of table 2.16.

Guisan(2001), in AEID, presents an interesting analysis of causality and cointegration between real value of Private Consumption per Capita (CH) and real value of Gross Domestic Product per capita (PH), with a sample of 625 observations of 25 OECD countries in the 25 years of the period 1961-1995. Although it may be some degree of contemporaneous bilateral relation, we find that the main direction of causality is from Production to Consumption.

The main conclusion was to find empirical support to the importance of the supply side of macroeconomics to explain economic development. The supply side includes not only the availability of primary inputs but also the analysis of the impact of intermediate inputs.

Studies by Guisan and Arranz (2001) (2003) on Public Consumption

The studies by Guisan and Arranz (2001) and (2003) analyze the evolution of Consumption of Medical Care and Education for the period 1970-1996 in OECD countries, and present econometric models that take into account the difference between public and private consumption.

Table 2.17 presents data of Private and Public Consumption of 24 OECD countries on *Medical Care and Education and Culture* in year 1996.

Table 2.17. Private and Public Expenditure on Medical Care and Education in 1996
(dollars per inhabitant at 1996 prices and PPPs)

Country	Medical Care			Education and Culture		
	Total	Private	Public	Total	Private	Public
1. Austria	1895	418	1477	2352	1473	879
2. Belgium	2043	467	1576	2342	983	1359
3. Finland	1543	346	1197	2438	1159	1279
4. France	2674	434	2240	2211	1053	1158
5. Germany	2227	474	1753	2193	1216	977
6. Ireland	1611	279	1332	2322	881	1441
7. Italy	1779	400	1379	2063	1056	1007
8. Luxembourg ¹	1738	1734	34	2755	1473	1282
9. Netherlands	2055	439	1616	2525	1214	1311
10. Portugal	921	648	273	2117	679	1438
11. Spain	1013	327	686	1266	1016	250
12. Denmark	1552	288	1264	3758	1367	2391
13. Greece	1112	564	548	1136	672	464
14. Sweden	1470	219	1251	2371	1037	1334
15. UK	1627	155	1472	2487	1458	1029
16. Iceland	3213	323	2890	3046	1604	1442
17. Norway	1674	314	1360	2671	1336	1335
18. Switzerland ¹	2234	2144	90	2357	1460	897
19. Turkey ¹	179	125	54	462	137	325
20. Australia	2058	446	1612	3204	1642	1562
21. New Zealand	1491	819	672	2204	1066	1138
22. Japan	3747	386	3361	3093	1607	1486
23. Canada	2480	451	2029	3113	1413	1700
24. USA	3402	3298	104	3453	2190	1263

Source: Elaboration by Guisan and Arranz(2001), from OECD National Accounts, for Private Consumption, and from OECD Purchasing Power Parities and Real Expenditure, for Total Individual Consumption on Medical Care.

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