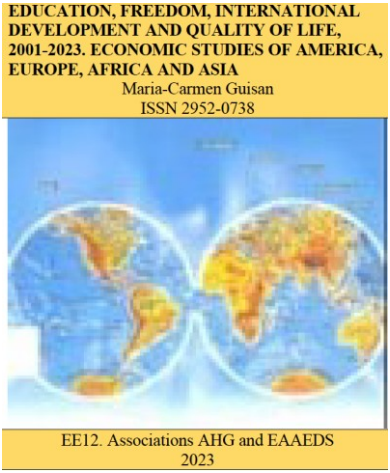

BOOK EE12
EDUCATION, FREEDOM, INTERNATIONAL DEVELOPMENT AND QUALITY OF LIFE, 2001-2023: INTERNATIONAL. ECONOMIC STUDIES OF AMERICA, EUROPE, AFRICA AND ASIA

Maria-Carmen GUISAN

Chapter 2. Econometric Models of OECD Countries and Regions, 2001-2023. Maria-Carmen Guisan

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CHAPTER 2
ECONOMETRIC MODELS OF OECD COUNTRIES AND REGIONS, 2001-2023

GUISAN, Maria-Carmen*

2.1. Econometric models of 6 OECD countries: Inputs and Production

The studies by Guisan(2011 a,b) and (2013) present an econometric analysis of macroeconomic relationships with a panel of OECD countries for the periods 2000-2010 and 2000-2012.

The estimations included in this section are based on the approach by Guisan, having into account, Demand and Supply of Primary Inputs (Production Function) and the Supply of Intermediate Inputs (from domestic and foreign origin).

International studies of OECD countries have several advantages for Econometrics applications of panel data, thanks to the availability of data from OECD statistics for important variables, and to the variability of many variables, both through time and countries, which contributes to diminish multicollinearity and to increase precision of estimations.

Macroeconometric approach in the studies by Guisan(2011) and (2013):

Demand, Supply Primary Inputs and Supply of Intermediate Inputs

$$Q = \min (Q^d , Q^{s1}, Q^{s2}) \quad (1)$$

$$Q^d = C + G + GFCF + EXP - IMP \quad (2)$$

$$Q^{s1} = F(K^*, L, ti) \quad (3)$$

$$Q^{s2} = QA+QI+QB+QS = QI + QNI \quad (4)$$

$$QNI = f(QNI(-1). D(QI), D(IMPG) \text{ y } D(EXPG) \quad (5)$$

The system may include more equations, where Imports of Goods depend on other variables and Exports of Goods depend on QI

Maria-Carmen Guisan, Honorary Professor of Econometrics, Editor of the journals AEID and RSES, https://www.usc.gal/economet/guisan2.htm

Main variables are expressed at constant prices:

Q = Gross domestic Product

C = Private Consumption

G = Government Consumption (Public Consumption)

GFCF = Gross Fixed Capital Formation

EXPG = Exports of Goods

IMPG = Imports of Goods

QA = Agriculture Value-Added

QI = Industrial Value-Added

QB = Building Value-Added

QS = Services Value-Added

Following our approach to the impact of intermediate inputs (from domestic and foreign origin) to domestic development, Guisan(2013) estimated the following relationship with a panel of 6 OECD countries of table 2.1 for the period 1993-2010

QHNI = f (QHNI(-1), D(QHI); D(MHG) D(XHG)

where

QHNI is Non-Industrial Production per capita= real value-Added of Non Industrial Sectors (Agriculture, Building and Services) per inhabitant.

QHNI(-1) is the value of QHNI lagged one year.

D(QHI) is the annual increase of industrial production per capita

D(MHG) is the annual increase of Imports of Goods per capita

D(XHG) is the annual increase of Exports of Goods per capita

Data was elaborated by Guisan(2013) from the OECD National Accounts Statistics. The variables are expressed in Dollars per inhabitant at 2000 prices and exchange rates.

Notice that Imports and Exports have several direct and indirect effect on economic development. Exports usually has a direct positive effect on the

Demand Side and an indirect positive effect on the supply side when the Exports contribute to increase the Imports of intermediate inputs or stock of capital necessary to increase domestic production.

Equation 2.1. shows is a mixed dynamic model that relates non industrial production (QHNI) with its lagged value and with the increases of industrial production (QHI), imports of goods (MHG) and exports of goods (XHG). The direct effect is expected positive for MHG and negative for XHG, although the final effect of XHG may be positive when contributes to increase MHG, QHI and QHNI.

Equation 2.1. QHNI= F(QHNI(-1), D(QHI), D(MHB), D(XHB)

Dependent Variable: QHNI00? Method: Pooled Least Squares				
Sample (adjusted): 1993 2010. Included observations: 18 after adjustments				
Cross-sections included: 6. Total pool (unbalanced) observations: 86				
White cross-section standard errors & covariance (d.f. corrected)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
QHNI00?(-1)	1.015261	0.001539	659.6649	0.0000
D(QHI00?)	0.388669	0.210720	1.844478	0.0687
D(MHG00?)	0.670343	0.160444	4.178048	0.0001
D(XHG00?)	-0.405141	0.155843	-2.599669	0.0111
R-squared	0.998371	Mean dependent var		17.64640
Adjusted R-squared	0.998312	S.D. dependent var		5.198703
S.E. of regression	0.213596	Akaike info criterion		-0.204067
Sum squared resid	3.741100	Schwarz criterion		-0.089911
Log likelihood	12.77489	Hannan-Quinn criter.		-0.158125
Durbin-Watson stat	1.252632			

Source:Guisán(2013) in AEID 13-2. Data in thousand Dollars per capita at 2000 prices and exchange rates, elaborated from OECD statistics

The coefficient of the lagged value of QHNI is significantly higher than 1 with the test of the t de Student: t=(1.015261-1)/0.001539=9.92.

All the coefficients are significantly different from zero at the 7% level of significance, and several of them at the 1% level of significance. The signs of the estimated coefficients are as expected: positive for the parameters of QHNI, D(QHI), D(MHG), and negative for D(XHG).

The coefficients measure the direct effect on QHNI of changes in the explanatory variables. The total effect of the variables should have into account other relationships.

For example, an increase of QHI has an estimated direct effect of 0.388689, but the total effect is higher because an increase of one unity in QHI may be have effects on foreign trade. Usually the increase of XHG implies an increase of MHG with a positive effect on QHNI. The increase of MHG may have also a positive impact on QHI with an additional impact on QHNI.

The following tables present a comparison of data of 6 OECD countries: France, Germany, Italy, Spain the United Kingdom and the United States, for the period 1993-2010.

Table 2.1 includes data of real Value-Added per inhabitant in Industrial activities (including Energy, Mining and Manufacturing) at constant prices of year 2000.

Table 2.1. QHI00 in 6 OECD countries, 1993-2010

	Spain	Germany	France	UK	Italy	USA
1993	2.173	4.848	3.260	4.337	3.269	5.047
1994	2.181	4.760	3.386	4.555	3.469	5.325
1995	2.252	4.732	3.445	4.623	3.669	5.596
1996	2.288	4.657	3.427	4.674	3.608	5.647
1997	2.411	4.815	3.540	4.728	3.746	5.829
1998	2.519	4.878	3.656	4.720	3.790	5.945
1999	2.622	4.915	3.708	4.825	3.786	6.148
2000	2.712	5.218	3.809	4.884	3.926	6.282
2001	2.760	5.264	3.824	4.800	3.866	5.880
2002	2.712	5.181	3.756	4.699	3.805	5.907
2003	2.693	5.211	3.701	4.653	3.779	6.095
2004	2.680	5.390	3.738	4.691	3.766	6.286
2005	2.644	5.551	3.716	4.583	3.703	6.398
2006	2.684	5.851	3.701	4.565	3.816	6.380
2007	2.702	6.163	3.731	4.563	3.853	6.378
2008	2.600	6.196	3.618	4.377	3.689	6.082
2009	2.161	5.210	3.151	3.910	2.994	5.350
2010	2.166	5.818	3.321	4.031	3.130	5.584

Source: Elaborated by Guisan(2013) from OECD National Accounts. Note: Data in thousand Dollars at constant prices and Exchange rates of year 2000.

We may notice an increase of QHI until year 2007 and a decrease for the period 2007-2010, as consequence of the financial crisis of year 2007.

Development in 6 OECD countries for 1965-2012

Tabla 2.2. Consumption per capita: CH00 in 6 OECD countries, 1965-2012 (thousand Dollars per inhabitant at 2000 prices and purchasing parities)

obs	Spain	Germany	France	Italy	UK	USA
1965	3.434	5.807	5.842	4.191	7.284	11.335
1970	4.361	7.144	7.105	5.633	7.890	13.055
1975	5.459	8.228	8.124	6.414	8.718	14.397
1980	5.788	9.823	9.232	7.730	9.190	15.944
1985	5.652	10.610	10.001	8.304	10.287	17.880
1990	7.004	11.515	11.019	9.477	12.505	19.680
1995	7.278	12.093	11.219	10.262	13.648	20.697
2000	8.554	13.400	12.566	11.497	16.447	23.862
2005	8.932	13.800	13.501	11.647	18.039	26.277
2010	8.724	14.571	13.916	11.206	18.077	27.204
2012	8.459	15.152	13.802	10.611	17.681	28.235

Source: Elaborated by Guisan(2013) from OECD National Accounts

Tabla 2.3. Industry per capita: QHI in 6 OECD countries, 1965-2012 (thousand Dollars per inhabitant at 2000 prices and purchasing parities)

Year	Spain	Germany	France	Italy	UK	USA
1965	0.893	2.656	1.990	1.689	3.270	3.119
1970	1.270	3.458	2.534	2.292	3.503	3.511
1975	1.708	3.507	2.754	2.411	3.545	3.640
1980	1.803	4.124	3.167	3.086	3.759	4.234
1985	1.789	4.293	3.103	2.940	3.909	4.405
1990	2.167	4.909	3.522	3.423	4.412	4.787
1995	2.252	4.732	3.445	3.669	4.623	5.596
2000	2.712	5.218	3.809	3.926	4.884	6.282
2005	2.644	5.551	3.716	3.703	4.583	6.398
2010	2.067	5.818	3.321	3.130	4.029	5.584
2012	1.948	6.205	3.219	2.965	3.950	5.780

Source: Elaborated by Guisan(2013) from OECD National Accounts

There was an important increase of Private Consumption per capita in the countries of table 2.2 for the period 1965-2010. There was a diminution for the period 2010-2012 in Spain, France, Italy and the United Kingdom.

There was an increase of QHI in Spain, France, Italy and the United States for the period 1965-2000 and a diminution for 2000-2012.

Model by Guisan(2013) with a panel of 6 OECD countries for 1991-2012

The study by Guisan(2013), in AEID 13-2, includes the estimation of a non linear system to explain Total Employment (LT) and real Wage (W). with a panel of 6 OECD countries for the period 1991-2012.

Figure 2.1 presents the equations and figure 2.2 shows the estimations.

Figure 2.1. Non linear system between LT and W

Dependent variable	Equation
(2.2) Employment	NLS: LT=C(11)*LTR+C(12)*((Q/W)- QR/WR) + C(13)*DPA
(2.3) Real Wage	NLS: W=C(21)*WR+C(22)*((PM)-(QR/LTR))

Source: Guisan(2013), in AEID 13-2.

Where:

LT= Total Employment of country i in year t (i=1.---6) (t=1991,…,2012)
Q = Real Gross Domestic Product
W = Real Wage (Compensation of Employees/Number of Employees)
DPA is the annual increase of Active Population
PM=Q/LT es Mean Labor Productivity
Lagged variables, with 1 retard: LTR=LT(-1); QR=Q(-1); WR=W(-1)

The model was estimated by Non Linear 2 Stages Least Squares (NL2LS), with significant coefficients, high goodness of fit and the following results.

Figure 2.2. NLS of estimation of Employment and Wage model with a panel of 6 countries, for the period 1965-2012.

C(11) = 0.9916; C(12)=0.3747; C(13)=0.9994; R^2=0.9998	(2.2)
C(21) = 1.0012; C(22) = 0.4869; R^2 = 0.9973	(2.3)

Source: Guisan(2013), in AEID 13-2.

The estimated equations show a positive impact of the increases of Q/W and Population Activa (PA) on Employment, and the positive impact of the increase of Labor Productivity (PM) on real Wage (W).

The increase of PA only has a positive impact on real Wage when it is compatible with an increase of PM (Q/LT).

In the case of Spain the immigration policy for the period 1995-2023, addressed to increase PA but without policies addressed to increase real Production per capita and Labor Productivity, has led to an increase of Employment but to an stagnation of real Wage.

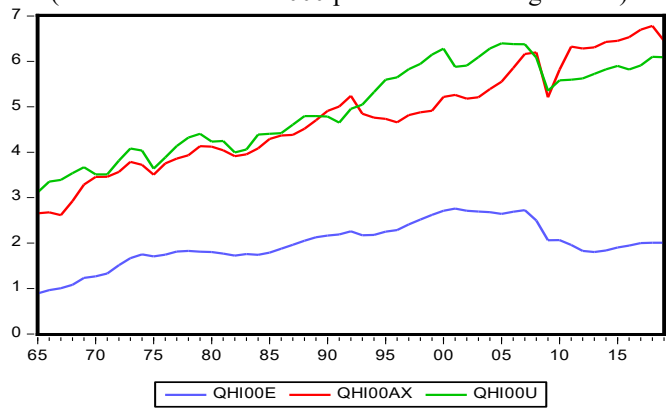
2.2. Econometric models of 3 OECD countries: Wages and Employment in Germany, Spain and the United States, 1965-2019.

In this section we present the estimations of equations of Employment, real Wage and Productivity with a sample of 3 OECD countries for the period 1965-2019. Before the presentation of the estimation we present several graphs and data and analyze the evolution of development in those countries.

A version in Spanish of these model has been included in Guisan((2022), in the book EE9 of this series.

Evolution for 1965-2019: Germany, Spain and the United States

Graph 2.1. Industrial Production per inhabitant (QHI), 1965-2019
(thousand Dollars at 2000 prices and Exchange Rates)

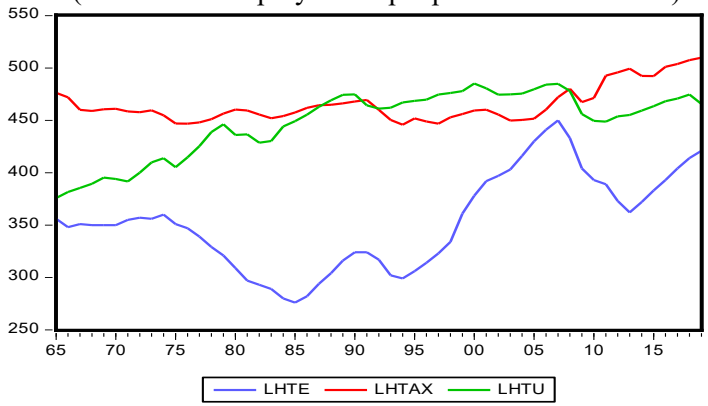


Source: Elaborated by Guisan(2022), in the book EE9, from OECD data. Notes: The blue colour (QHI00E) corresponds to Spain, the red color (QHI00AX) to Germany and the red color (QHI00U) to the Unitet States

We may notice a general trend of increase for the period 1965-2007. a negative impact of the crisis of year 2008 and an important recovery in the lasts years of the sample in Germany, a moderate recovery in the United States and a stagnation in Spain after several years of decrease.

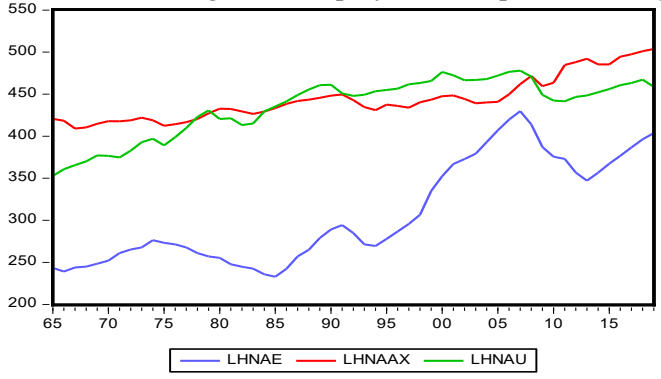
Graphs 2.2 and 2.3 show the evolution of the rates of Employment per thousand people (LHT for total employment and LHNA for non Agrarian Employment, for the period 1965-2019.

Graph 2.2. Employment rate in Spain, Germany and the USA, 1965-2019
(Number of Employed People per 1000 inhabitants)



Source: Elaborated by Guisan(2022), in the book EE9, from OECD statistics. Blue color corresponds to Spain, red color to Germany and green color to the United States.

Graph 2.3. Rate of Non-Agrarian Employment in Spain, Germany and USA



Source: Elaborated by Guisan(2022a) from OECD Labour Force Statistics (LFS)

The comparison of Spain with Germany and the United States in graph 2 shows that there was a lower distance in year 2019 than in year 1965. For the period 1965-1985, in Spain, there was an strong diminution of the Rates of Agrarian Employment (LHA) and Total Employment (LHT) and an increase of the Rate of Non Agrarian Employment (LHNA).

The highest rate of Employment, at the beginning and at the end of the period 1960-2019, corresponded to Germany. There was a high increase of Employment in the United States for the period 1965-2000 and a moderate increase for 1990-2007, followed by a decrease for 2007-2011 and a slight recovery afterwards.

Table 2.4 shows the evolution of real ·Wage, Mean Productivity of Labor and real Production per inhabitant, for the period 1996-2019.

Table 2.4. Wage, Mean Labor Productivity and Production per capita (thousand Dollars at 2000 prices and exchange rates)

	Real Watge (W)			Productividad Media (PM)			Producción per cápita (PH)		
	Es	De	USA	Es	De	USA	Es	De	USA
1996	24.3	31.9	40.6	38.5	47.3	65.3	12.3	21.0	30.7
2008	24.6	33.5	49.8	36.8	53.0	80.1	15.9	25.0	38.5
2012	24.7	35.0	51.2	40.3	52.8	85.7	14.8	25.7	38.7
2019	24.5	38.8	55.4	40.6	54.1	90.6	16.9	27.6	41.8

Source: Elaborated by Guisan(2022a), in the book EE9, from OECD statistics.

We may notice that there was stagnation of W in Spain for the period 1996-2019, an increase of 6.9 thousand Dollars in Germany and an increase of 14.8 thousand Dollars in the United States.

Mean Productivity of Labor increased 2.1 thousand Dollars in Spain, 6.8 in Germany and 25.3 in the USA.

A high level of Industrial production per capita, like in Germany and The United States, increases real production of Services and generate many Employment in Services sectors, compatible with high levels of real Wage. Other factors like Tourism, social services and foreign trade also contribute to increase production and employment in Services, but without enough Industrial development it is difficult to get a general increase of productivity and real Wages.

In the case of Spain there has not been enough increase of Industrial production per capita, and even there has been diminution for the period 2007-2019. This evolution has led to stagnation of real average Wage.

Table 2.5 show the rates of Employment in Services for the period 1970-2019. In Spain the rate has increased from 122 to 318 in the period 1970-2019, while in Germany the evolution has been from 203 to 365 and in the United

States from 234 to 385. Population, in that period has increased by 39% in Spain, 7% in Germany and 65$ in the United States.Table 2.6 shows rates of Employment in 10 Services sectors in year 2005.

Table 2.5 Employment Rate in Services and Population 1970-2019
(Employeed persons per 1000 people, and Population in thousand)

	Employment Rate in Services			Population (thousand people)		
	Spain	Germany	USA	Spain	Germany	USA
1970	122	203	234	33876	77709	205052
1980	138	235	287	37386	78275	227757
1990	178	260	337	38851	79364	250181
2000	239	310	372	40500	82212	282162
2015	291	349	369	46624	81687	321040
2019	318	365	385	47026	83167	338353

Sourc: Elaborated from Guisán(2023a) and OECD data.

Tabla 2.6. Employed people per thousand inhabitants in year 2005

Services sectors	Spain	Germany	USA
Commerce	63	71	71
Hotels and Restaurants	28	22	33
Transports and Communication	24	26	27
Financial Services	8	15	24
Business Services	35	65	61
Public Administration	30	32	29
Education	21	28	42
Health	25	50	58
Other Social and Personal Serv.	18	26	33
Domestic Services	11	8	3
Total Services	**263**	**343**	**381**

Source: Guisán, Aguayo and Expósito(2018) (Ecodev119), based on Guisán et al 2011) (book EE10) and OECD statistics.

We may notice that the highest differences of Spain, in comparison with Germany and the United States, corresponds to Financial Services, Business Services, Education and Health Services. The sum of "Other Social and personal services" and "Domestic Service" reaches a rate of 29 in Spain, 34 in Germany and 36 in the United States.

Equation of Employment in 3 OECD countries, 1965-2019

Equation 2.4 shows the estimation of the Employment equation with a panel of 3 OECD countries (Spain, Germany and the United States), for 1965-2019.

Equation 2.4. Employment Equation. Panel of Spain, Germany and the USA, 1965-2019

Dependent Variable: LT?				
Method: Pooled Least Squares. Sample: 1965 2019				
Included observations: 55. Cross-sections included: 3. Total panel: 165				
White cross-section standard errors & covariance (d.f. corrected)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LT?(-1)	1.001994	0.001957	512.1318	0.0000
D(GDP00?/W00?)	362.8020	50.11164	7.239875	0.0000
D(KD3?/W00?)	-54.66922	9.984645	-5.475330	0.0000
D(PA?)	0.562920	0.120658	4.665425	0.0000
R-squared	0.999869	Mean dependent var		56352.93
Adjusted R-squared	0.999867	S.D. dependent var		46788.99
S.E. of regression	539.9176	Akaike info criterion		15.44465
Sum squared resid	46933270	Schwarz criterion		15.51995
Log likelihood	-1270.184	Hannan-Quinn criter.		15.47522
Durbin-Watson stat	1.432179			

Source Elaborated by Guisan(2022 a). Book EE9. Data from OECD statistics for LT, GDP00, W00, and Active Population (PA) and from FMI for KD3 (being KD3 the stock of capital public and private). Data of GDP and W are expressed in Dollars at 2000 prices and exchange rates, and data of KD3 in Dollars at 2017 prices.

Equation 2.4 is a mixed dynamic model where LT depends on its lagged valued and the increases of the explanatory variables: Q/W, KD/W and PA. The Effect of KD/W is negative when the increase of investment does not lead to an increase of Q/W, in case of a high underutilization of the stock of capital.

Generally, the most convenient economic policy is to increase both Q and W, compatible with an increase of Employment. Increase of Q must have into account the demand side, the supply of primary inputs and the supply of intermediate inputs.

Economic policies addressed to stagnation of real Production per capita, real Productivity per worker and real Wage, as it has happened in Spain for the period 1995-2023, present several problems, increasing public debt, and leading to scarcity of resources in many social services (health, education, research and other ones) and for the payments of social assistance.

Equation of real Wage in 3 OECD countries 1965-2019

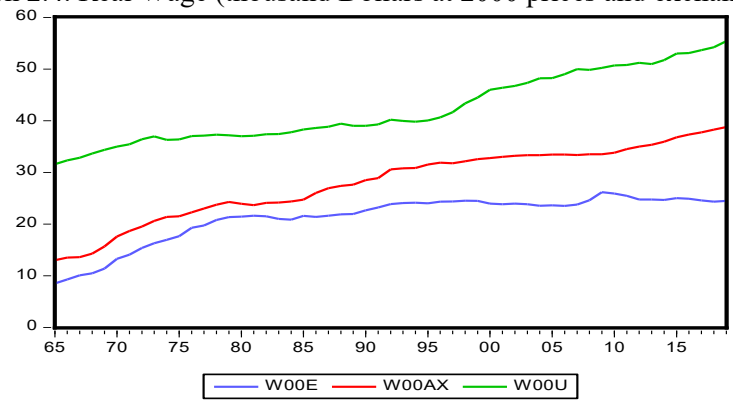
Equation 2.5. Wage related with D(PM) and D(PH) in 3 OCDE countries

Dependent Variable: W00?				
Method: Pooled Least Squares. Sample: 1965 2019				
Included observations: 55. Cross-sections included: 3. Total 165				
White cross-section standard errors & covariance (d.f. corrected)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
W00?(-1)	0.999715	0.001622	616.3371	0.0000
D(PM00?)	0.399385	0.054731	7.297218	0.0000
D(PH00?(-1))	0.418295	0.093717	4.463398	0.0000
R-squared	0.998315	Mean dependent var		30.51630
Adjusted R-squared	0.998294	S.D. dependent var		10.75658
S.E. of regression	0.444316	Akaike info criterion		1.233454
Sum squared resid	31.98155	Schwarz criterion		1.289926
Log likelihood	-98.75998	Hannan-Quinn criter.		1.256378
Durbin-Watson stat	1.528145			

Fuente: Guisan(2022) in the book EE9. Data from the OCDE.

Graphs 2.4 shows the evolution of real Wage for 1965-2019

Graph 2.4. Real Wage (thousand Dollars at 2000 prices and exchange rates)



Source: Elaborated by Guisan(2022a) from OCDE statistics. Blue color (Spain), Red color (Germany), Green color (United States).

Both DPM and DPH show a positive and significant effect on the real Gross Wage. The Net Wage (Wage after deduction of social security contributions and taxes) usually increase with the Gross Wage.

2.3. Development and Quality of Life in 372 OECD Regions

In the studies by Guisan(2022a) in AEID 22-2 and (2022 b) in RSES 22-2, we analyze indicators of development and quality of life in 372 regions of 38 OECD countries in year 2016 and estimate a model relating Quality of Life with seve4ral indicators.

Studies by Guisan(2022 am b) on Quality of Life in OECD regions

The study presents de estimation of an econometric model of 372 regions of 36 OECD countries in year 2016, relating Life Satisfaction, with Income, Security and Quality of Environment, among other indicators. The initial number of regions was 402 but only 372 had availability of all the indicators.

The study includes an interesting review of the literature on econometric models and quantitative studies of Quality of Life, well based in samples of individuals, samples of countries or samples of regions.

That study includes an Annex with data of the indicators in each region. The indicators analyzed are listed in figure 2.3.

Figure 2.3. Indicators of regional development in this stuty.

R13= Satisfaction with Life

R3 = Unemployment rate (% of Active Population).

R4X = Income per capita (thousand Dollars) at Purchasing Power Parities

R5 = Homicides rate (per 100 thousand people)

R7 = Life Expectancy (years)

R8 = PM2.5. Indicator of concentration of particles with 2.5 microns of diameter, or less, by cubic meter o air. The tables of risk indicate low until 12, moderate between 12.1 and 35.5. Highest levels have graduation frm 35.5 to the maximum value of 500.

Table 2.7 presents the values of the indicators at country level in 46 OECD countries. Data for 372 regions are included in the Annex of Guisan(2022a). Guisan(2022 b) found that R4 seems to undervalue income at purchasing power parities, in some cases, in comparison with the United States, while R4X seem to avoid the undervaluation.

Tables 2.8 and 2.9 show the interval of values of R13 in the regions of each country and the names, and values of R13, of the top regions of its country.

Table 2.10 shows the average values of the Indicators in the groups of region with the lowest and the highest values of R13.

Table 2.7. Country data, from OECD statistics, for Quality of Life in year 2016

Country	R13	R4	R4X	R4*	R7	R3	R5	R8
Australia	7.3	27698	32136	38939	82.2	5.7	0.9	5.1
Austria	7.3	23770	29898	36228	81.8	5.6	0.5	16.7
Belgium	7.1	19547	27914	33824	81.5	7.2	1.5	14.5
Canada	7.4	22499	27725	33594	81.9	6.3	1.7	7.3
Chile	6.4	6871	13796	16717	79.2	6.8	8.9	16.3
Czech R	6.5	13997	19529	23664	79.1	3.0	1.3	19.8
Denmark	7.7	18064	26368	31951	80.9	5.9	0.9	9.6
Estonia	5.4	12073	16063	19464	78.0	6.1	3.3	7.6
Finland	7.5	18688	26634	32273	81.5	8.9	0.4	6.2
France	6.7	20480	27689	33551	82.7	9.6	1.4	13.3
Germany	6.7	23887	31273	37894	81.0	3.9	0.8	14.1
Greece	5.6	12958	16741	20286	81.5	21.8	0.8	18.4
Hungary	5.0	11000	15625	18933	76.2	4.2	1.0	20.3
Iceland	7.4	16290	36970	NA	82.2	3.1	0.9	1.8
Ireland	7.1	17630	22389	27129	81.8	6.9	0.8	7.2
Israel	7.3	11391	26160	NA	82.2	4.9	1.5	21.9
Italy	6.3	19552	24325	29475	83.4	11.5	1.4	19.2
Japan	6.1	19322	24173	29290	83.9	3.5	0.7	15.1
Korea R	5.9	16909	19964	24191	81.4	3.8	1.5	31.1
Latvia	5.9	10434	15421	18686	74.9	9.0	4.4	10.4
Lithuania	..	13889	19221	23290	74.9	7.3	5.2	13.3
Luxembourg	7.0	29279	36730	44506	82.7	5.6	0.9	12.3
Mexico	7.0	3415	13933	16882	75.2	4.1	19.6	15.1
Netherlands	7.5	18631	27447	33258	81.7	5.0	0.9	13.8
New Zealand	7.3	17564	22599	27383	81.4	5.3	0.9	5.0
Norway	7.5	24549	30477	36929	82.5	4.3	0.5	4.5
Poland	5.8	13011	17264	20919	78.0	5.0	1.2	22.1
Portugal	5.3	14495	19762	23946	81.3	9.3	0.6	7.1
Slovak R	5.9	12999	16435	19914	77.3	8.2	1.1	21.3
Slovenia	5.9	14772	19301	23388	81.2	6.7	1.9	17.0
Spain	6.6	16065	21472	26018	83.5	17.4	0.6	11.5
Sweden	7.4	21276	27160	32911	82.4	7.0	0.9	6.5
Switzerland	7.6	24113	33904	41081	83.7	5.0	0.5	13.9
Turkey	5.3	5946	17035	20641	78.1	11.1	2.3	21.2
UK	6.9	20610	26642	32282	81.2	4.5	1.2	9.2
USA	7.2	40002	40002	48471	78.6	4.4	5.3	10.3

Sources: Elaborated by Guisan(2022a,b) from OECD Regional Statistics. In the case of income at purchasing power parities, we have calculated R4X, having into account the ratio of each country to the USA in R4*, from OECD National Accounts at PPPs (including Disposal income in kind) or from World Bank in a few cases.

Table 2.8. R13 (Life Satisfaction) in regions of 35 OECD countries, 2016

Country	Regional values: (interval) and highest values
Australia	(7.0 to 7.7): Tasmania(7.7), Canberra (7.7).
Austria	(7.1 to 7.5): Tyrol (7.5).
Belgium	(6.8 to 7.2): Flemish region (7.2).
Canada	(7.3 to 8.1): Newfoundland-L. (8.1), Prince Edward (8.0).
Chile	(5.6 to 7.9):Aysen (7.9),Magallanes-A.(7.3), Valparaiso (7.1).
Czech R	(6.2 to 6.8): Prague (6.8).
Denmark	(7.5 to 7.7): Copehagen region (7.7), Northern Jutland (7.7).
Finland	(7.5 in all: Western, Eastern and Northern, Southern, Helsinki.
France	(6.3 to 7.3): Corsica (7.3), Brittany (6.9) and Nouvelle-Aquitain (6.9).
Germany	(6.1 to 7.0): Hamburg (7.0), (6.9 in: Baden-Wurttenberg, Bavaria, Bremen, Lower Saxony and Schleswig-Holstein).
Greece	(4.8 to 5.9): East Macedonia-Thrace (5.9), West Greece (5.9) Peloponeso (5.9).
Hungary	(4.5 to 5.3): Western Transdanubia (5.3).
Iceland	(7.1 to 7.3): Other regions 7.3, Reykjavik (7.1).
Ireland	(7 to 7.2): Border, Midland and Western (7.2).
Israel	(7.0 to 7.5): Tel Aviv (7.5), Central (7.4), South (7.4).
Italy	(5.4 to 6.8):Aosta V. (6.8), Bolzano-Bozen (6.7),Trento (6.7).
Japan	(5.7 to 6.1): (6.1 in Northern Kanto, Southern Kanto, Toukai)
Korea R	(5.7 to 6.1): Chngcheong (6.1), Seoul (6.0), Gyeongnam(6.0).
Luxembourg	(6.9).
Mexico	(6.2 to 8.6): Campeche (8.6), Tamaulips (8.2), Yucatan (8.2), Quintana Roo (8.1), Sinaloa (8.1), Sonora (8.1).
Netherlands	(7.1 to 7.8): Zeeland (7.8). Groningen (7.6), Friesland (7.6).
New Zealand	(7.1 to 7.7): Otago (7.7), West Coast (7.6).
Norway	(7.4 to 7.7): 7.7 Trondelag, 7.6 (Oslo, SE Norway, Agder&R)
Poland	(5.4 to 6.6). Zachodniopomorskie Pomerania (6.6)
Portugal	(5.1 to 5.4): Lisbon (5.4), Alentejo (5.4), Azores (5.4).
Slovakia	(6.0 to 6.5): Bratislava (6.5).
Slovenia	(5.9 to 6.2): Western Slovenia (6.2).
Spain	(6.1 to 7.0): Cantabria (7.0), Navarra (7.0).
Sweden	(7.3 to 7.6): Smaland & Islands (7.6), South Sweden (7.5).
Switzerland	(7.3 to 7.8): Eastern (7.8), Central (7.8), Zurich (7.7).
Turkey	(4.4 to 6.3): Eastern Marmara-South(6.3)(
UK	6.7 to 7.1): Scotland (7.1), SW England (7.0), N.Ireland (7.0)
USA	(6.6 to 8.1): Delaware (8.1), Vermont (8.0), North Dakota (7.9), Nebraska (7.8), Wyoming (7.8), South Carolina (7.7)

Source: Elaborated by M.C.Guisan from OECD regional statistics 2016.

Table 2.9 shows the average values of the indicators in the groups of OECD regions with lowest and highest values of R13 in comparison with the non weighted average of 372 OECD regions. Group 1 is the group of regions with lowest levels of Life Satisfaction (R13 lower than 5.1). Group 7 correspons to the OECD regions with the highest levels of Life Satisfaction (R13 higher than 7.4).

Table 2.9. Non weighted averages in groups of 372 OECD regions, 2016

Group	R13	Nb regions	xr13 satisfaction	xr3 unemployment.	rx4 income per capita(th)	xr5 homicide	xr7 life expectancy	xr8 Pollution Pm2.5
1	<5.1	13	4.77	13.72	8.10	1.54	77.94	22.08
7	>7.4	62	7.69	5.11	20.93	4.42	80.44	**9.23**
All	4.4-8.6	372	6.69	6.99	18.63	3.75	80.21	13.29

Source: Elaborated by Guisan (2022a,b) from regional statistics OECD(2022). Notes: xRi is the non weighted average of indicator Ri in the regions of each group. Nb regions is the number of regions of each group. Guisan(2022 b) includes the values of R13, R4 and R4X in the regions of OECD countries of Europe and America. Guisan(2022a) includes data of R13 and other indicators in 372 regions.

Group 1 has lowest average values of R13 (4.77) and has several objective indicators worse than OECD regional average and than the average of the group 7, which has the highest average value of R13 (7.69).

Unemployment rate is 13.72% in group 1 and only 5.11 in group 7. Income per capita is 8.10 thousand Dollars in group 1 and 20.93 in group 5. Pollution is worse in group 1 (22.08 for the indicator of PM2.5) than average (13.29) while it is better (lower pollution) in group 7 (9.23).

Quality of life is higher than 6 in the majority of the OECD regions (77% of 372 regions). The lowest value is 4.4 and the highest 8.6. Only 10 OECD regions have a value of R13 below World average(5)

Table 2.10 shows the correlation of R13 with the indicators R4, R4X, R7, R3 and R8 with data of 372 OECD regions in year 2016.

Table 2.10. Correlation of R13 with other Indicators in OECD regions

R4	R4X	R7	R3	R8
0.4021	0.7024	0.0904	-0.4050	-0.5692

Source. Elaborated by Guisan(2022 b) from OECD statistics 2016

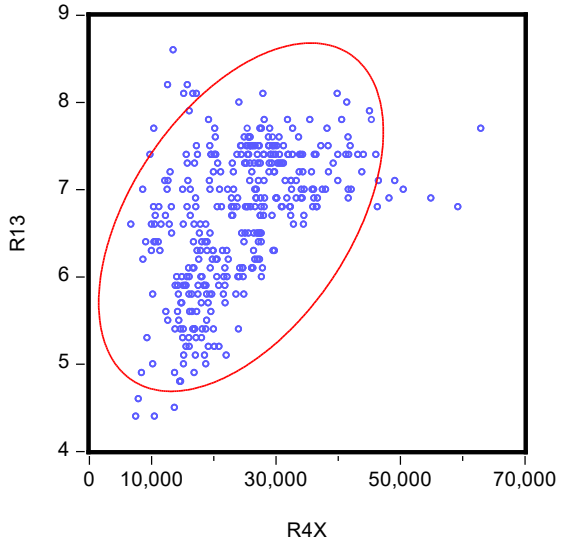
Correlation of R13 (Life Satisfaction is positive with Income per capita (R4 and R4X) and R7 (Life Expectancy). It is negative with R3 (Homicides rate) and R8 (Pollution PM2.5). Correlation with R7 is higher when the sample includes countries with a great variability in the values of R7.

We may notice that R4X (our best estimation of Income per capita at purchasing power parities, using both regional and national OECD statistics) shows a higher correlation with R13 (Life Satisfaction).

Graph 2.5 shows the general positive relationship between both variables.

We may notice that for very high levels of income per capita, income is not always the most relevant variable and other factors may have more importance (quality of working conditions, environment, quality of government, individual freedom, peace and other ones).

Graph 2.5. Life Satisfaction (R13) and Income per capita (R4X) in 372 OECD regions, year 2016



Source: Guisan(2022b). Data of 372 OECD regions. R4X of each regions was calculated from R4 of regional statistics multiplied by the ratio R4X/R4 of the country.

Equation 2.6 relate Life Satisfaction (R13) with the indicators R4x, R7, R3 and R8, in 373 regions with available data among 402 regions of OECD regional statistics of year 2016.

Equation 2.6. R13 related with R4x, R7, R3 and R8, in OECD regions 2016

Dependent Variable: REG13=Satisfacion with Life				
Method: Least Squares. Sample 1 402. Included observations 373				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.324142	0.480086	13.17294	0.0000
R4X/1000	0.010873	0.001827	5.950027	0.0000
R7	0.013371	0.006110	2.188318	0.0293
R3	-0.054189	0.002861	-18.93944	0.0000
R8	-0.008485	0.002309	-3.675177	0.0003
DN1	-1.403584	0.045363	-30.94089	0.0000
DN2	-0.723809	0.037652	-19.22368	0.0000
DN3	-0.443126	0.043025	-10.29916	0.0000
DP1	0.255658	0.058914	4.339497	0.0000
DP2	0.100590	0.049686	2.024509	0.0437
DNREG	-0.693724	0.052808	-13.13670	0.0000
DPREG	0.633684	0.046325	13.67914	0.0000
R-squared	0.923177	Mean dependent var		6.687668
Adjusted R-squared	0.920836	S.D. dependent var		0.810687
S.E. of regression	0.228096	Akaike info criterion		-0.086459
Sum squared resid	18.78201	Schwarz criterion		0.039705
Log likelihood	28.12454	Hannan-Quinn criter.		-0.036361
F-statistic	394.3723	Durbin-Watson stat		1.604569
Prob(F-statistic)	0.000000			

Source: Elaborated by M.C. Guisan in this book EE12 from the indicators included in Guisan(2022a,b) from OECD statistics. Notes: Names of variables in Figure 2.3: R4X income, R7=Life Expectancy, R3=Unemployment Rate, R8=Pollution.

Equation 2.6 shows a positive and significant effect of R4X (Income per capita at purchasing parities), and R7 (Life Expectancy). It shows a negative and significant effect of R3 (Unemployment rate) and R8 (Pollution PM2.5).

Dummies for some groups of countries: We includes several dummy variables, to have into account the effects of missing variables in several countries. We include 5 country dummies: 3 for negative effects (DN1, DN2 and DN3) and 2 for positive effects (DP1, DP2). (See Guisan(2022a).

Dummies for groups of regions: Two groups of regions seem to have a value of R13 below or over the value expected accordingly to the model. We have created a dummy variable for negative effects (DNREG) and a dummy variable for positive effects (DPREG). (See Guisan(2022 a).

2.4. Regional development in the United States and 5 European countries

Comparison of 5 European countries and 8 BEA regions of the USA

In chapter 5 of the Book EE11 of this series, Guisan(2023) presents a comparison of regional development in 8 BEA regions of the United States and 5 big economies of Europe for the period 1950-2000, and in the article by Guisan(2023) we analyze regional development of those regions for 2000-2021.

Here, we present a comparison of indicators of regional development in the United States and the group EU5, of 5 big European economies, in year 2016, based on OECD regional statistics.

Table 2.11 presents a comparison of indicators of development and quality of Life in the 8 BEA regions of the United States and 5 European countries .

Table 2.11. Indicators of Income per capita and Quality of Life, year 2016

	R13 Satisfaction	R4X Income pc	R7 Life Exp.	R3 Unemployment Rate	R5 Homicides Rate	R8 Pollution
France	6.7	27689	82.7	9.6	1.4	13.3
Germany	6.7	31273	81.0	3.9	0.8	14.1
Italy	6.3	24325	83.4	11.5	1.4	19.2
Spain	6.6	21472	83.5	17.4	0.6	11.5
UK	6.9	26642	81.2	4.5	1.2	9.2
Av. EU5	**6.6**	**26280**	**82.4**	**9.4**	**1.1**	**13.5**
New England	7.2	45595	80.2	3.7	2.0	8.0
Mideast	7.3	47099	78.8	4.8	7.8	10.6
Great Lakes	7.0	37765	78.5	4.3	6.1	11.6
Plains	7.5	40168	79.4	3.3	3.5	9.0
Southeast	7.2	34479	76.7	4.5	7.1	9.4
Southwest	7.1	35758	78.1	4.9	5.9	8.7
Rocky Mountain	7.1	37453	79.3	3.5	3.2	6.8
Far West	7.1	41332	79.7	4.7	4.6	7.6
USA	**7.2**	**40002**	**78.6**	**4.4**	**5.3**	**10.3**

Source: Elaborated by Guisan(2023), based on OECD regional data and other sources. Notes: R4X are estimations of Income per capita, in Purchasing Power Parities of year 2016, elaborated by Guisan(2023), with information from national and regional statistics. Life satisfaction is measured in decimal scale. Life Expectancy is in years. Unemployment rate is in percentage of Active Population. Homicides is number of homicides per 100 thousand people. Pollution is measures as Particles PM2.5 concentration per cubic meter of air. The BEA regions values in this table were calculated as non-weighted averages of the values at state level from OECD data.

Tables 12.1 to 12.8 show the values at state level of each BEA region, as well the average of the region and the value of the United States. Tables 13 to 17 present the indicators of regional development of EU5 countries (France, Germany, Italy, Spain and the United Kingdom).

Besides the indicators of development and quality of life we include the evolution of population for the fists 2 decades of the 21st century. There may be small discrepancies between the sum of Population of the regions of a country if the total includes also Population in other territories.

The footnote of table 12.1 also holds for tables 12.2 to 12.8 and 13 to 17.

Each table includes the values of indicators defined in Figure 2.3, with data around year 2016:

Positive Indicators R13 Life Satisfaction, R4 (Income per capita) and R7 (Life Expectancy).

Negative Indicators: R3 (Unemployment rate), R5 (Homicides rate) and R8 (Pollution PM2.5).

Population in the United States increase by 17.77% for the period 2000-2020, and this increase was compatible with an important increase of real production and real income per capita in the country and in each of the 8 BEA regions, as seen in the study by Guisan(2023) in Volume 23-2 of RSES.

Regional development in the United States

Table 12.1. BEA region 1 by state: New England

States and BEA region	Pop 2000	Pop 2020	R13	R4X	R7	R3	R5	R8
Connecticut	3405	3605	6.9	54925	80.8	4.7	2.2	9.2
Maine	1274	1362	6.8	36549	79.2	3.3	1.5	6.7
Massachusetts	6349	7029	7.0	50499	80.5	3.7	2.0	8.5
New Hampshire	1235	1377	6.9	48205	80.3	2.7	1.3	7.7
Rhode Island	1048	1097	7.5	41969	79.9	4.5	2.7	8.8
Vermont	608	643	8.0	41425	80.5	3.0	2.2	7.0
New England	13919	15113	7.2	45595	80.2	3.7	2.0	8.0
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

Source: Elaborated by M.C. Guisan from OECD regional data and Guisan(2022).
Note: Pop is Population in thousand people. Indicators, around year 2015 are: R13 Life Satisfaction, R4=Income per capita, R7=Life Expectancy, R3=Unemployment rate), R5=Homicides rate and R8=Pollution PM2.5. They are defined in Figure 2.3. The values of the BEA region were calculated as non-weighted average of state data.

Table 12.2. BEA region 2, by state: Mideast

States and BEA region	Pop 2000	Pop 2020	R13	R4x	R7	R3	R5	R8
Delaware	783	990	8.1	39885	78.4	4.6	5.9	11.0
Wastington DC	572	689	6.8	59267	76.5	6.0	20.4	11.5
Maryland	5296	6177	7.4	46107	78.8	4.1	8.0	10.8
New Jersey	8414	9289	7.1	49152	80.3	4.6	4.2	10.2
New York	18976	20201	7.1	46512	80.5	4.7	3.2	10.0
Pennsylvania	12281	13002	7.0	41673	78.5	4.9	5.2	10.3
Mideast	46322	50348	7.3	47099	78.8	4.8	7.8	10.6
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

Source: See footnote of table 12.1. This region includes 5 states and Washington DC

Table 12.3. BEA region 3, by state: Great Lakes

States and BEA region	Pop 2000	Pop 2020	R13	R4x	R7	R3	R5	R8
Illinois	12419	12812	6.9	41661	79.0	5.0	8.2	12.1
Indiana	6080	6785	7.0	35874	77.6	3.5	6.6	12.2
Michigan	9938	10077	6.9	36150	78.2	4.6	6.0	11.0
Ohio	11353	11799	6.8	36638	77.8	5.0	5.6	12.4
Wisconsin	5363	5893	7.2	38502	80.0	3.3	4.0	10.1
Great Lakes	45153	47366	7.0	37765	78.5	4.3	6.1	11.6
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

Source. See footnote of table 12.1

Table 12.4. BEA regions 4, by state: Plains

State and BEA region	Pop 2000	Pop 2020	R13	R4x	R7	R3	R5	R8
Iowa	2926	3190	7.5	38438	79.7	3.1	2.3	10.6
Kansas	2688	2937	7.4	40002	78.7	3.6	3.8	8.8
Minnesota	4919	5706	7.4	41291	81.1	3.5	1.8	9.6
Missouri	5595	6154	7.2	35767	77.5	3.8	8.8	9.8
Nebraska	1711	1961	7.8	40618	79.8	2.9	2.6	9.4
North Dakota	642	779	7.9	45071	79.5	2.6	2.0	6.8
South Dakota	754	886	7.1	39992	79.5	3.3	3.1	8.0
Plains	19235	21613	7.5	40168	79.4	3.3	3.5	9.0
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

Source. See footnote of table 12.1

Table 12.5. BEA region 5, by state: Southeast

	Pop 2000	Pop 2020	R13	R4x	R7	R3	R5	R8
Alabama	4447	5024	7.4	32686	75.4	4.4	8.4	10.1
Arkansas	2673	3011	7.0	32574	76.0	3.7	7.2	10.3
Florida	15982	21538	7.0	37510	79.4	4.2	5.4	8.3
Georgia	8186	10712	7.0	34116	77.2	4.7	6.6	10.0
Kentucky	4041	4505	7.1	32509	76.0	4.9	5.9	9.7
Louisiana	4468	4657	7.4	36214	75.7	5.0	11.8	9.7
Mississippi	2844	2961	7.3	30303	75.0	5.0	8.0	9.6
North Carolina	8049	10439	7.4	34334	77.8	4.6	6.7	8.7
South Carolina	4012	5118	7.7	32729	77.0	4.3	7.4	9.4
Tennessee	5689	6910	7.4	36500	76.3	3.7	7.3	9.4
Virginia	7078	8631	7.4	43221	79.0	3.8	5.8	9.2
West Virginia	1808	1793	6.8	31055	75.4	5.1	4.4	8.9
Southeast	69277	85299	7.2	34479	76.7	4.5	7.1	9.4
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

Source. See footnote of table 12.1

Table 12.6. BEA region 6, by state: Southwest

State	Pop 2000	Pop 2020	R13	R4x	R7	R3	R5	R8
Arizona	5130	7151	6.9	33304	79.6	4.9	5.5	10.6
New Mexico	1819	2117	7.1	32463	78.4	6.1	6.7	6.0
Oklahoma	3450	3959	7.0	38008	75.9	4.3	6.2	9.2
Texas	20851	29145	7.3	39256	78.5	4.3	5.3	9.1
Southwest	31250	42372	7.1	35758	78.1	4.9	5.9	8.7
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

Source. See footnote of table 12.1

BEA region 7, by state: Rocky Mountain

	Pop 2000	Pop 2020	R13	R4x	R7	R3	R5	R8
Colorado	4301	5773	7.4	41740	80.0	2.8	3.7	7.4
Idaho	1293	1839	6.8	32368	79.5	3.2	2.9	7.3
Montana	902	1084	6.6	34462	78.5	4.0	3.5	5.8
Utah	2233	3271	7.1	33302	80.2	3.2	2.4	7.9
Wyoming	493	576	7.8	45393	78.3	4.2	3.4	5.4
Rocky Mountain	9222	12543	7.1	37453	79.3	3.5	3.2	6.8
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

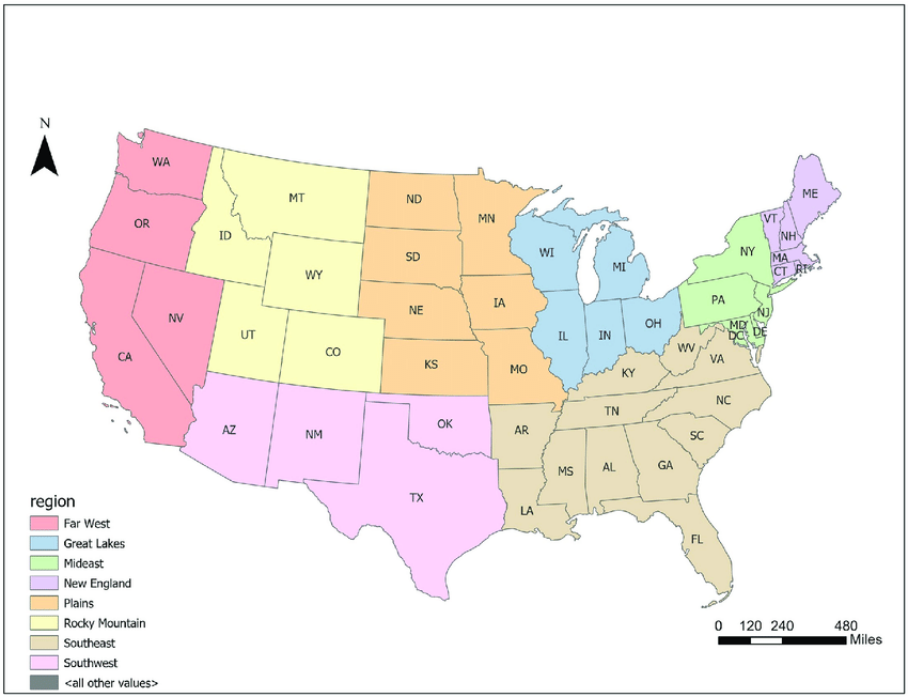
Source. See footnote of table 12.1

Table 12.8. BEA region 8, by state: Far West

	Pop 2000	Pop 2020	R13	R4x	R7	R3	R5	R8
Alaska	627	733	6.8	46338	78.3	7.1	7.0	6.7
California	33871	39538	7.4	44093	80.8	4.8	4.9	13.7
Hawaii	1211	1455	7.6	41620	81.3	2.4	2.5	5.1
Nevada	1998	3104	6.8	35987	78.1	5.0	7.6	7.3
Oregon	3421	4237	7.0	36093	79.5	4.1	2.8	5.9
Washington	5894	7705	7.2	43860	79.9	4.8	2.7	6.8
Far West	47022	56772	7.1	41332	79.7	4.7	4.6	7.6
United States	281422	331449	7.2	40002	78.6	4.4	5.3	10.3

Source. See footnote of table 12.1

Map 1. States and BEA regions of the USA.



The eight U.S. economic regions defined by the Department of Commerce Bureau of Economic Analysis: New England, Mideast, Southeast, Great Lakes, Plains, Rocky Mountains, Southwest, and Far West. Source: https://doi.org/10.1371/journal.pone.0256407.g001

Regional development in 5 European countries

Tables 13 to 17 show the values of regional indicators in France, Germany, Italy, Spain and the United Kindomg in year 2016. We also include the evolution of population in each region in years 2000 and 2021.

Table 13. France: Population (thousands) and regional indicators 2016

Regions	Pop 2000	Pop 2021	R13	R4x	R7	R3	R5	R8
Île-de-France	11020	12329	6.6	32856	84.2	8.8	1.2	16.0
Centre - Val de Loire	2450	2573	6.5	27690	82.5	8.7	0.9	12.3
Bourgogne-Franche-Comté	2793	2791	6.7	27498	82.3	9.2	0.7	13.4
Normandy	3212	3320	6.5	26997	81.9	10.1	1.0	13.0
Hauts-de-France	5941	5986	6.5	24559	80.7	12.1	1.2	15.2
Grand Est	5563	5561	6.5	26490	82.1	10.1	1.1	13.7
Pays de la Loire	3719	3883	6.8	26697	83.1	7.1	0.7	10.9
Brittany	3294	3412	6.9	26848	82.0	7.4	0.4	9.9
Nouvelle-Aquitaine	5912	6087	6.9	26849	82.9	9.5	1.2	11.2
Occitanie	5775	6060	6.8	25972	83.1	9.7	1.4	10.8
Auvergne-Rhône-Alpes	7877	8156	6.8	28161	83.6	7.5	1.2	13.9
Provence-Alpes-C.A.	5008	5140	6.7	27569	83.1	10.4	1.7	13.0
Corsica	327	349		25242	83.9	7.9	3.6	11.3
France	60913	67750	6.7	27689	82.7	9.6	1.4	13.3
EU5	331894	324799	6.6	26280	82.4	9.4	1.1	13.5

Source:See footnote of table 12.1. Porvence-Alps-C.A. is Provence-Alpes-Côte d'Azur

Map 2. French regions

Table 14. Germany: Population, in thousands, and regional indicators 2016

Regions	Pop 2000	Pop 2021	R13	R4x	R7	R3	R5	R8
Baden-Württemberg	10500	11125	6.9	34107	82.0	3.0	0.7	14.1
Bavaria	12193	13177	6.9	34279	81.7	2.4	0.9	15.9
Berlin	3384	3677	6.4	27667	80.9	7.1	1.2	14.9
Brandenburg	2602	2538	6.2	27396	80.7	4.6	1.1	14.5
Bremen	662	676	6.9	30034	80.1	4.5	1.3	12.9
Hamburg	1710	1854	7.0	34574	81.2	4.3	1.1	12.6
Hesse	6060	6295	6.8	32323	81.6	3.4	1.2	14.3
Mecklenburg-Vorpom.	1782	1611	6.5	25646	80.1	5.2	0.7	12.7
Lower Saxony	7912	8027	6.9	30171	80.5	3.9	1.2	12.5
North Rhine-Westphalia	18005	17925	6.8	30914	80.6	4.2	0.5	13.9
Rhineland-Palatinate	4033	4106	6.8	32298	81.1	3.4	0.5	13.6
Saarland	1070	982	6.7	29417	80.2	4.6	1.0	13.2
Saxony	4443	4843	6.2	27081	81.1	4.5	0.9	15.7
Saxony-Anhalt	2632	2169	6.1	26344	79.8	7.0	1.1	14.2
Schleswig-Holstein	2783	2922	6.9	31824	80.6	3.7	0.6	11.6
Thuringia	2440	2109	6.2	26657	80.4	4.5	1.0	14.1
Germany	82212	83196	6.7	31273	81.0	3.9	0.8	14.1
EU5	331894	324799	6.6	26280	82.4	9.4	1.1	13.5

Source: See footnote of table 12.1

Map 3 : German regions

Table 15. Italy: Population (thousands) and regional indicators 2016

Region	2000	2021	R13	R4x	R7	R3	R5	R8
Piedmont	4225	4256	6.5	20398	83.3	9.3	0.6	28.0
Aosta Valley	119	123	6.8	27466	83.0	7.9	0.0	21.1
Liguria	1588	1509	6.0	27692	83.6	9.7	0.5	26.2
Lombardy	8971	9943	6.3	27731	84.0	6.5	0.6	38.2
Abruzzo	1261	1276	6.1	29809	83.5	12.0	0.8	18.3
Molise	323	292	5.6	21859	83.4	14.9	0.3	15.6
Campania	5717	5624	5.6	19606	81.7	21.3	1.3	17.6
Apulia	4035	3923	5.9	17309	83.5	19.3	1.1	13.4
Basilicata	601	541	6.4	18483	83.1	13.1	0.3	11.2
Calabria	2029	1855	5.4	18139	82.9	22.0	2.4	11.4
Sicily	4994	4833	5.9	16931	82.4	21.9	8.5	12.5
Sardinia	1639	1587	6.2	17536	83.3	17.6	1.1	12.9
Trentino-Alto Adige	929	1074	6.7	31051	84.2	5.5	0.7	14.6
Veneto	4485	4848	6.3	28062	83.9	6.5	0.2	33.5
Friuli-Venezia Giulia	1178	1195	6.5	26464	83.5	6.9	0.7	22.2
Emilia-Romagna	4003	4425	6.3	27285	83.7	6.7	0.6	33.1
Tuscany	3492	3663	6.1	29586	83.9	8.8	0.7	23.6
Umbria	821	859	6.1	26182	84.1	10.8	0.9	18.6
Marche	1447	1487	6.0	24235	84.0	11.0	0.5	20.7
Lazio	5119	5715	6.1	24795	83.2	10.9	0.9	17.6
Italy	56929	59030	6.3	24325	83.4	11.5	1.4	19.2
EU5	331894	324799	6.6	26280	82.4	9.4	1.1	13.5

Source: See footnote of table 12.1.

Map 4. Italian regions

Map 4, from Wikipedia: 1. Abruzzo, 2. Valle d´Aosta,Cal 3. Puglia (Apulia), 4. Basilicata, 5. Calabria, 6. Campania, 7. Emilia-Romagna, 8. Friuli-Venezia Giulia. 9. Lazio, 10. Liguria, 11. Lombardia, 12. Marche, 13. Molise, 14. Piemonte (Piedmont), 15. Sardegna, 16. Sicilia, 17. Trentino-Alto Adige (it includes Trento and Bolzano), 18. Toscana, 19. Umbria, 20. Veneto.

Table 16. Spain: Population (thousands) and regiona indicators 2016

Regions	Pop 2000	Pop 2021	R13	R4x	R7	R3	R5	R8
Galicia	2702	2698	6.3	19895	83.0	15.8	0.4	8.1
Asturias	1068	1012	6.3	22142	82.6	13.9	0.6	8.3
Cantabria	533	585	7.0	20995	83.5	13.6	0.0	9.0
Basque Country	2085	2213	6.9	28227	83.9	11.4	0.3	10.0
Navarra	548	662	7.0	26909	84.1	10.3	0.2	10.3
La Rioja	274	319	6.2	22382	84.3	12.1	0.0	9.3
Aragon	1200	1332	6.7	23112	83.8	11.7	0.6	8.7
Madrid	5330	6727	6.4	27229	85.2	13.5	0.5	11.2
Castile and León	2473	2385	6.3	21465	84.3	14.2	0.4	8.2
Castile-La Mancha	2473	2053	6.3	17931	83.6	20.9	0.5	10.1
Extremadura	1060	1061	6.7	16297	82.6	26.4	0.6	9.3
Catalonia	6283	7750	6.4	24903	83.9	13.5	0.7	13.3
Valencia	4104	5068	6.3	18982	83.0	18.3	0.6	12.4
Balearic Islands	817	1183	6.8	21296	83.4	12.6	0.8	11.7
Andalusia	7286	8485	6.4	16813	82.2	25.7	0.8	12.7
Murcia	1169	1518	6.9	17155	82.9	18.1	0.8	12.4
Canary Islands	1659	2179	6.5	17759	82.7	23.7	1.0	14.1
Spain	40500	47416	6.6	21472	83.5	17.4	0.6	11.5
EU5	331894	324799	6.6	26280	82.4	9.4	1.1	13.5

Map 5. Spanish regions (*Comunidades Autónomas*)

Table 17. United Kingdom: Population (thousands) and regional indicators

Regions	Pop 2000	Pop 2021	R13	R4x	R7	R3	R5	R8
North East England	2544	2647	6.7	22929	79.9	5.7	1.0	6.7
North West England	6774	7422	6.8	23810	80.0	4.2	1.3	10.3
Yorkshire&The Humber	4963	5481	6.9	22901	80.7	5.0	3.0	7.8
East Midlands	4170	4880	6.9	23883	81.3	4.1	1.1	7.4
West Midlands	5273	5954	6.8	23281	80.9	5.7	1.1	7.8
East of England	5372	6348	6.9	27623	82.2	4.1	0.8	12.1
Greater London	7237	8797	6.7	34549	82.8	5.4	1.2	11.3
South East England	7989	9294	6.9	30183	82.5	3.4	0.7	10.1
South West England	4915	5713	7.0	26658	82.0	3.8	0.7	9.9
Wales	2906	3105	6.8	22923	80.4	4.7	1.1	10.5
Scotland	5066	5480	7.1	25846	79.3	4.2	1.2	7.6
Northern Ireland	1684	1905	7.0	22277	81.1	4.7	0.9	7.0
United Kingdom	58893	67327	6.9	26642	81.2	4.5	1.2	9.2
EU5	331894	324799	6.6	26280	82.4	9.4	1.1	13.5

Source: See footnote of table 12.1.

Map 6, Regions of the United Kingdom

Comparison of regional indicators in year 2016

R13. Satisfaction with Life: Only 7 European regions of this group of countries, out of 77 (less than 10%) had a value of the indicator R13 equal to 7 or higher: Corsica in France, Hamburg in Germany, Cantabria and Navarra in Spain, and S.W England, Scotland and Northern Ireland in the United Kingdom. In the United States 38 regions of tables 12.1 to 12.8, out of 51 (almost 75%) reached a value of 7 or higher.

R4. Income per capita at purchasing power parities, was below 40 thousand Dollars in the 77 European regions of the group of EU5 and only in 11 regions reached a value between 30 a 40 thousand Dollars. In the United States the 51 regions of tables 12.1 to 12.8 reached 30 thousand Dollars or more (22 regions with more than 40 and 29 regions between 30 and 40).

In comparison with the United States, EU5 shows an average value of R7 (Life Expctancy) higher, an average value of R3 (Unemployment rate) higher, a value of R5 (Homicides rate) lower, and a value of R8 (Pollution PM2.5) higher.

Other studies Besides, the studies by Guisan(2023) (chapter 5 in EEbook 11, and article in Volume 23-2 of RSES, we have published the study by Guisan and Aguayo(2022) with links to 16 interregional models for the period 1994-2004 and 8 studies published for the period 2004-2022, with international comparisons of European and American regions.

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