PRODUCTION BY SECTOR IN THE EUROPEAN UNION: ANALISYS OF FRANCE, GERMANY, ITALY, SPAIN, POLAND AND THE UNITED KINGDOM, 2000-2005

GUISAN, M.C.[*]

AGUAYO, E.

Abstract:

We analyze the evolution of sectoral production per inhabitant in EU countries during the period 2000-2005 with special focus in the 6 more populated countries, but also with reference to other European countries. The main aim of the study is to analyze the evolution of industrial development in this period, and to estimate the inter-sectoral effects of industrial real-valued-added on services and other sectors. Besides we present some econometric models and focus in the main causes that explain the lower levels of industrial real value-added per inhabitant in Spain and Poland, in comparison with the other major economies of the European Union, having into account human capital, social capital and other factors that explain the evolution of industry by the demand and supply sides.

JEL classification: C51, L6, L7, L8, O52

Keywords: Production Sectors, Industry, European Economy, France, Germany, Italy, Spain, Poland, United Kingdom

1. Introduction

The purpose of this study is to analyze the evolution of production by sector in the European with special focus on the six more populated EU countries for the period 2000-2005, and to analyze the inter-sector relationships that explain the differences in real Gross Domestic Product per inhabitant among these countries.

Section 2 presents a general view of real Gdp per inhabitant and rates of employment of EU15 countries together with the four Central European Countries which belonged to the OECD for this period (Czech Republic, Hungary, Poland and Slovakia), in

[*] Maria-Carmen Guisan is Professor of Econometrics, eccgs@usc.es, and Eva Aguayo is Associate Professor of Econometrics, eaguayo@usc.es. Faculty of Economics. University of Santiago de Compostela (Spain)

comparison with two high income per head countries: Switzerland and the United States.

   Section 3 presents real value-added by sector and per inhabitant in the following sectors: Agriculture, Industry, Building, Commercial Services, Business and Financial Services, and Social Services, and analyzes the evolution of each of the six more populated countries of the European Union: France, Germany, Great Britain, Italy, Poland and Spain, during the period 2000-2005.

   Section 4 present the estimation of econometric models which have into account some inter-sector relationships and analyze the main causes of the differences among countries, particularly focused to suggest policy measures aimed to increase real income per inhabitant in the countries with the lower levels of development and to avoid stagnation in other ones. Finally section 5 presents the main conclusions.

2. A general view of Gdp per inhabitant and employment rates.

   Table 1 shows the rates of employment by sector of 20 European countries and the United States, for the following sectors: Agriculture (including Farming, Fishing and Forestry), Industry and Building, Services. The rates of employment are the number of employed people per one thousand inhabitants.

   The rate of employment in Agriculture has diminished in EU15 countries from 18 to 16. It has also diminished in the other countries of the table: from 52 to 46 in CC4, from 26 to 22 in Switzerland and from 13 to 11 in the United States. As seen in Guisan and Exposito(2004) employment in Agriculture diminish when real income of this sector does not increase and/or when workers may find much better paid jobs in another sectors, what happened with non-agrarian real income and employment experience high increases. The real income of the sector does not only depend of the increase of real production but also of the evolution of relative prices of the sector in comparison with a general price index such the private consumption price index. The rate of employment in Industry and Building has experienced a diminution in EU15: from 122 to 116, in CC4: from 131 to 127, in Switzerland: from 146 to 133, and in the

USA: from 112 to 95. Diminution of employment in industry and building may happen in spite of an increase of real production in those sectors, due to some technical change or to the general trend to outsourcing services.

Table 1. Rates of Employment by Sector in EU15, CC4, Switzerland and the United States

Country	Agriculture		Industry and Building		Services	
	2000	2005	2000	2005	2000	2005
Austria	27	26	143	128	297	310
Belgium	8	10	93	88	282	291
Denmark	17	15	133	121	354	363
Finland	27	22	124	118	298	316
France	16	13	97	93	290	283
Germany	12	10	148	132	281	289
Greece	68	55	81	89	216	252
Ireland	34	28	125	127	278	308
Italy	19	16	117	121	225	251
Luxembourg	11	9	139	144	456	535
Netherlands	16	14	104	97	367	373
Portugal	62	58	170	149	257	277
Spain	25	22	118	127	234	274
Sweden	11	10	115	104	342	357
UK	7	6	120	112	345	371
EU15	18	16	122	116	283	300
Czech Rep.	23	19	182	184	250	231
Hungary	25	19	128	125	221	238
Poland	71	64	116	108	189	198
Slovakia	26	19	145	159	218	232
CC4	52	46	131	127	206	212
Switzerland	26	22	146	133	397	409
USA	13	11	112	95	361	371

Notes: Rate of employment is the number of employed per one thousand people. Agriculture includes farm activities, fisheries and forestry. Note: Here Industry includes Building, Manufacturing and Energy. Source: Elaboration from OECD Statistics.

The rate of employment in Services has increased in EU15: from 283 to 300, in CC4: from 206 to 212, in Switzerland: from 397 to 409 and in the United States: from 361 to 371. This is a good indicator of increase of production per inhabitant in industry and foreign trade, as seen in Guisan (2006).

Table 2 presents the total rate of employment and the evolution of real Gross Domestic Product per inhabitant (Gdph) in the same group of countries of table 1. The total rate of employment has increased in EU15: from 427 to 439. This rate shows an stagnation with a very small decrease in CC4: from 389 to 386, in Switzerland: from 569 to 564 and in the USA: from 489 to 482. As some figures for year 2005 are provisional estimates, the final figures may be slightly different to those here presented. Switzerland has an outstanding total rate of employment, even above the USA. Both countries have also levels of real Gdp per inhabitant and real wages above European Union Average. Other EU countries with very high rates of total employment (450 or higher) and high real Gdp per inhabitant (30 thousand dollars or higher) are Austria, Ireland, Luxembourg, Denmark, Sweden. We may notice that the high values of Luxembourg seem to be due to the important share of employees from neighboring countries, which count for the employment and real Gross Domestic Product but do not count for population because their residence is outside this small country. Real income per inhabitant in Luxembourg is similar to values of its neighboring countries.

 CC4 countries have experienced a positive evolution during the period 2000-2005, with percentage increases of real Gdp per inhabitant of 20% in the Czech Republic, 25% in Hungary, 16% in Poland and 26% in Slovakia. EU15 countries and Switzerland have experienced percentages of increase in real Gdph, respectively, of 5.6% and 1.3%, while the United States has reached a 7.2%.

Among EU15 countries the most outstanding percentages of increase of real Gdp per inhabitant correspond to 11.5% in Finland, 22% in Greece, 17.6% in Ireland, 11.4% in Luxembourg, 10.3% in Sweden and 10.2% in the United Kingdom.

**Table 2. Total rates of employment and real Gross Domestic
Product per inhabitant (Gdph)**

Country	Employment rate		Gdph		
	2000	2005	2000	2005	%
Austria	472	469	28.7	30.0	4.5
Belgium	387	393	26.7	28.0	4.9
Denmark	510	504	28.8	30.3	5.2
Finland	455	463	26.1	29.1	11.5
France	409	412	25.9	27.0	4.2
Germany	444	441	25.6	26.3	2.7
Greece	365	395	20.9	25.5	22.0
Ireland	440	464	28.9	34.0	17.6
Italy	368	393	25.9	26.0	0.4
Luxembourg	604	688	50.8	56.6	11.4
Netherlands	490	487	28.4	29.3	3.17
Portugal	493	488	18.4	18.4	0
Spain	382	426	21.1	22.9	8.5
Sweden	469	471	27.2	30.0	10.3
UK	474	491	25.6	28.2	10.2
EU15	427	439	25.2	26.6	5.6
Czech Rep.	455	434	14.8	17.8	20.3
Hungary	373	382	12.3	15.4	25.2
Poland	376	370	10.7	12.4	15.9
Slovakia	389	411	10.8	13.6	25.9
CC4	389	386	11.3	13.9	23.0
Switzerland	569	564	30.4	30.8	1.3
USA	489	482	34.6	37.1	7.2

Notes: Total rate of employment is the number of employed people per one
thousand inhabitants. Gdph is real Gdp per inhabitant in thousand dollars at
2000 prices and Purchasing Power Parities. In Luxembourg the values are
due to the effect of workers from neighbouring countries. Source:
Elaboration from OECD statistics. Provisional estimations in some
countries for year 2005. The last column is the percentage of increase of
real Gdph for the period 2000-2005

EU countries with real Gdp per inhabitant below EU15 average in year 2000 (25.2 thousand dollars) and percentage of increase below 10% for the period 2000-2005 are: Portugal (18 Gdph in year 2000 and 0% of increase), and Spain (21.1 Gdph in year 2000 and 8.5% of increase). EU countries with real Gdp per inhabitant above EU15 average and below 28 thousand dollars in year 2000 and with percentage of increase below 5% in the period 2000-2005 are: Belgium (26.7 Gdph in year 2000 and 4.9% of increase), France (25.9 Gdph and 4.2% of increase), Germany (25.6 Gdph and 2.7% of increase) and Italy (25.9 Gdph and 0.4% of increase).

As seen in Guisan and Aguayo(2006) EU15 countries are below the United States in rates of employment and real wages due to a lower effort in financing and supporting human capital, with average values of expenditure in education and RD (Research and Development) per inhabitant clearly lower in the European Union average than in the United States. Usually the countries with highest levels of human capital reach also the highest levels in industry and services as well as high real wages and income per inhabitant. In the next section we present comparative of real value-added by sector and per inhabitant in the six more populated countries belonging to the European Union, and analyze some inter-sector relationships.

3. Real Value added by sector in six EU countries, 2000-2005.

Tables 3 to 6 present the evolution of real value-added per inhabitant and by sector in the six more populated EU countries: France, Germany, Great Britain, Italy, Poland and Spain, expressed in dollars at 2000 prices and exchange rates ($2000 ER). These countries accounted for the 89% of EU15 population in year 2005. Data have been elaborated from OECD National Accounts Statistics.

The values may be expressed in purchasing power parities by applying the particular PPPs corresponding to each sector or by multiplying by the general factor between values at PPPs and Exchange rates, which are as follows: France 1.19, Germany 1.11, Great Britain 1.05, Italy 1.34, Poland 2.39, and Spain 1.46.

Table 3. Real Value-Added per capita: Agriculture ($2000 ER)

Country	2000	2001	2002	2003	2004	2005
France	573	554	579	488	582	545
Germany	263	273	256	260	267	267
Great Britain	227	204	229	223	219	223
Italy	475	463	449	428	484	464
Poland	195	210	213	219	234	229
Spain	568	549	542	527	531	468
EU6	376	369	371	351	381	363
USA	397	364	354	379	371	368

Table 4. Real Value-Added per capita: Industry ($2000 ER)

Country	2000	2001	2002	2003	2004	2005
France	3583	3641	3642	3692	3695	3716
Germany	5218	5264	5181	5211	5390	5551
Great Britain	4940	4836	4727	4684	4698	4585
Italy	3980	3951	3921	3835	3808	3745
Poland	945	948	944	1019	1121	1171
Spain	2712	2760	2712	2693	2680	2644
EU6	3879	3886	3834	3833	3883	3893
USA	6289	5891	5922	6093	6279	6396

We may notice a general stagnation in the real value-added of Agriculture, and even some diminutions. There are also diminutions in Industry in Great Britain Italy and Spain. The value of Industry in Poland is very low although the difference with other countries should be lower in PPPs: 2799 dollars in Poland and 3860 in Spain in year 2005. Even so the value of Poland is low in comparison with Spain and both are low in comparison with Germany and Great Britain. EU average is very far below the USA in real value-added of Industry per inhabitant. The difference is also important if we do the comparison at PPPs instead of using exchange rates (see table 9). The lower values of industrial real value-added per inhabitant in European Union in comparison with the United States have an important role to explain the gap between EU6 and the USA regarding the development of Building and Services.

Table 5. Real Value-Added per capita: Building ($2000 ER)

Country	2000	2001	2002	2003	2004	2005
France	1041	1072	1053	1039	1045	1074
Germany	1079	1016	977	934	891	861
Great Britain	1186	1205	1245	1296	1341	1353
Italy	850	914	936	963	973	982
Poland	305	285	260	252	257	276
Spain	1082	1158	1209	1244	1294	1335
EU6	963	976	978	983	991	1001
USA	1527	1516	1472	1422	1429	1473

Table 6. Real Value-Added per capita: Services ($2000 ER)

Country	2000	2001	2002	2003	2004	2005
France	14995	15180	15267	15426	15640	15829
Germany	14253	14526	14686	14686	14854	14977
Great Britain	16209	16676	17070	17585	18266	18728
Italy	11687	11968	12085	12130	12281	12424
Poland	2499	2589	2669	2746	2843	2934
Spain	8617	8790	8894	8968	9186	9390
EU6	12256	12529	12691	12833	13098	13301
USA	24067	24470	24598	24978	25599	26192

Table 7 present three groups of Services at 2000 prices and exchange rates ($2000 ER) and table 8 presents the same groups of Services valued at Purchasing Power Parities ($2000 PPP): 1) Commercial services includes trade, restaurants and hotel, transport and repairs). 2) Business and Financial services includes those services and also real state and renting. 3) Social services includes community services mainly addressed to education, research, social services and public administration both those provided by private sector and those provided by public institutions.   These tables show that the six EU countries are below the USA in real value-added of the three groups of Services, being Great Britain the most outstanding among these group of EU countries in Commercial Services, France and Great Britain in Business and Financial Services, and France in Social and Community Services

Table 7. Real Value-Added per capita: Services groups
(dollars at 2000 prices and exchange rates)

	Commercial		Business & Fin.		Social	
Country	2000	2005	2000	2005	2000	2005
France	3809	4029	6195	6645	4991	5155
Germany	3782	4012	5729	6124	4743	4841
Great Britain	5140	5901	6208	7535	4861	5292
Italy	4067	4310	4203	4474	3417	3640
Poland	1075	1293	714	839	710	802
Spain	3392	3546	2526	2908	2698	2936
EU6	3714	4034	4671	5186	3870	4080
USA	6364	7049	10205	11189	7498	7954

Table 8. Real Value-Added per capita: Services groups
(dollars at 2000 prices and PPPs)

Country	Commercial		Business & Fin.		Social	
	2000	2005	2000	2005	2000	2005
France	4518	4779	7348	7883	5921	6115
Germany	4184	4439	6338	6776	5247	5356
Great Britain	5375	6171	6492	7879	5083	5534
Italy	5463	5790	5647	6009	4589	4889
Poland	2568	3088	1705	2004	1694	1914
Spain	4962	5187	3695	4254	3947	4295
EU6	4577	4975	5573	6182	4659	4924
USA	6364	7049	10205	11189	7498	7954

Finally table 9 present a summary of real value-added per inhabitant at purchasing power parities in years 2000 and 2005. The gap of EU6 in comparison with the United States is outstanding in Industry, Building and Services. As seen in Guisan(2006), Guisan and Cancelo(2006), and Guisan and Aguayo(2007), among other studies, the industrial gap is partly due to the lower levels of expenditure and support to human capital and has as consequence lower levels of development in Building and Services.

Table 9. Real Value-Added per capita: 4 sectors at $2000 PP

	EU6 2000	EU6 2005	USA 2000	USA 2005
Agriculture	494	479	397	368
Industry	4706	4748	6289	6396
Building	1194	1248	1527	1473
Services	14810	16081	24067	26192

4. Econometric models of inter-sector relationships

The following equations show that real value-added of Services (QS) and Exports of Services (EXPS), including Tourism, have a positive and significant effect on Building, and that Industry (QI) and foreign trade of goods have a positive and significant effect on QS (if we increase both real imports of goods (IMPG) and exports of goods (EXPG) in the same amount the effect on QS is positive). In the Annex we include the complete results.

$$qb_{it} = 0.95 \ qb_{i,t-1} + 0.11 \ d(qs_{it}) + 0.17 \ d(exps_{i,t-1}) \qquad (1)$$
$$\quad (93.1) \qquad\qquad (6.6) \qquad\qquad (2.2)$$

$$qs_{it} = 1.02 \ qs_{i,t-1} + 0.88 \ d(qi_{it}) + 0.88 \ d(impg_{it}) - 0.64 \ d(expg_{it}) \qquad (2a)$$
$$\quad (580.6) \qquad (6.0) \qquad\quad (4.2) \qquad\qquad (2.1)$$

$$qs_{it} = 0.98 \ qs_{i,t-1} + 0.63 \ d(qi_{it}) + 0.60 \ d(impg_{it}) - 0.27 \ d(expg_{it}) \qquad (2b)$$
$$\quad (62.6) \qquad\quad (3.5) \qquad\qquad (2.60) \qquad\qquad (-0.8)$$

Terms within parentheses are t-student ratios. The difference between (2a) and (2b) is that the latter includes fixed effects. Goodness of fit is very high with adj-R^2 equal to 0.999 in the three equations. The percentage of S.E. on the mean of dependent variable amounts to 3.25% in (1), 1.16% in (2a) and 0.86% in (2b).

Graph 1 shows the important relationship that usually exists between the sum of real value-added of Building and Services and the sum of real value-added of Agriculture and Industry.

Graph 1. Real Value-Added per capita, 1994-2005 (thousand $2000 ER)

France

Germany

Great Britain

Italy

Poland

Spain
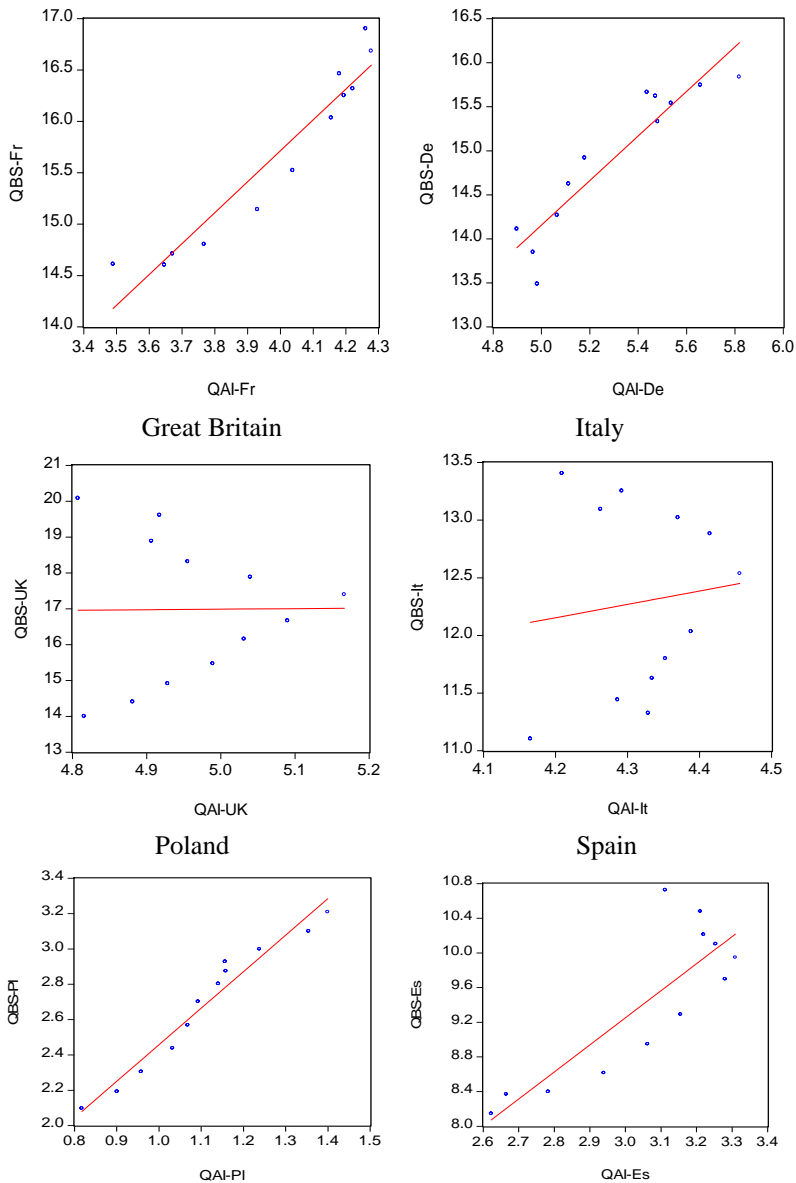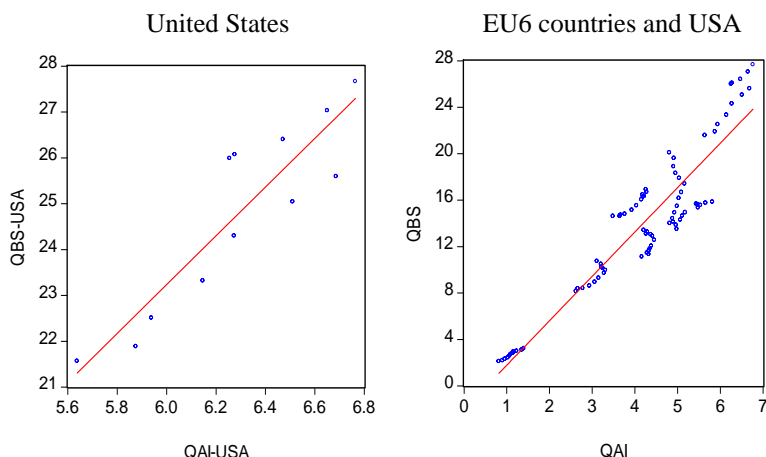
Note: Elaboration from OECD. Data in thousand dollars per inhabitant at 2000 prices and exchange rates. Q is real value-added, AI is Agriculture and Industry, BS is Building and Services. In the joint graph of EU6 and the US, the lowest levels correspond to Poland the highest to the United States.

Given that Agriculture has generally tight limits for expansion (both due to physical and market limits), then Industry is usually the main source to provide, from the supply side, intermediate goods to the building and services sectors (both directly or indirectly through foreign trade). As seen in Guisan(2006), and other studies, industry has also a positive effect on foreign trade and thus it has also positive indirect effects on QS and QB. Income from industrial production also have an important role from the demand side to foster the development of building and services.

It is important to notice that, accordingly to Kuh(1967), productivity per worker and production per inhabitant explain the higher levels of real wages in the United States in comparison with EU average. European economic policies addressed to increase productivity per worker should have into account not only technical changes in industrial activities but also the convenience to increase real value-added per inhabitant in Industry and other sectors, which

implies better policies to finance Education and Research in Europe at the same level than in the United States.

5. Conclusions

The main cause of the European average gap with the United States in economic development is the lower level of industrial production per capita in the European Union (EU). This lower level is partly to the lower support to education, and Research and Development (RD) in many European countries, and to a system of higher taxation and rigidities in the EU which discourage many initiatives addressed to increase production of goods and services. Here we have focused in the analysis of inter-sector relationships from the supply side, although both sides, demand and supply, are important as Klein(1983) has pointed out.

The econometric models here presented, and other cited in the bibliography, show the important positive effect that Industry has, directly and indirectly, on Services and also the positive impact of development of Services on Building. Real income per capita is lower in the European Union (EU) in comparison with the USA mainly due to its lower levels of industrial development. As industrial development is positively related with human capital, social capital and RD policies, we suggest an improvement on EU policies addressed to reach a higher level of convergence with the USA in this regard, which would be highly positive for EU citizens.

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Annex

Econometric models of inter-sector relationships. Pool of the 6 most populated EU countries and the United States.

EU6 countries: France, Germany, Great Britain, Italy, Poland, Spain.

Variables: Data of real value-added in billion dollars at 2000 prices and PPPs. Data of foreign trade in billion dollars at 2000 prices and exchange rates. Source of data: Elaboration from OECD statistics.

QB = real value-added of building

QI = real value-added of industry

QS = real value-added of services

IMPG = Imports of goods

EXPG = Exports of goods

EXPS = Export of services

Note: Billion dollars = thousand million dollars.

Estimation of equations 1 and 2:

Equation 1 relates QB with QS and EXPS.

Equation 2 relates QS with QI and foreign trade. We present two estimations of this equation without fixed effects and with those fixed effects.

Equation 1. Real Value-added of Building
Dependent Variable: QB00?PP. Method: Pooled Least Squares
Sample: 1995 2005   Number of cross-sections used: 7
Included observations: 11   Total panel (balanced) observations: 77
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
(QB00?PP(-1))	0.955607	0.010269	93.06187	0.0000
D(QS00?PP)	0.106926	0.023159	4.617129	0.0000
D(EXPS00?(-1))	0.170132	0.077711	2.189281	0.0317
R-squared	0.999085	Mean dependent var		116.4699
Adjusted R-squared	0.999060	S.D. dependent var		123.4827
S.E. of regression	3.785821	Sum squared resid		1060.601
Log likelihood	-210.2355	F-statistic		40390.36
Durbin-Watson stat	1.588939	Prob(F-statistic)		0.000000

Equation 2a. Real Value-Added of Services:
Dependent Variable: QS00?PP. Method: Pooled Least Squares
Sample: 1995 2005   Number of cross-sections used: 7
Included observations: 10   Total panel (balanced) observations: 70
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
(QS00?PP(-1))	1.019708	0.001756	580.6430	0.0000
D(QI00?PP(-1))	0.878906	0.145306	6.048645	0.0000
D(IMPG00?)	0.880095	0.210852	4.173993	0.0001
D(EXPG00?)	-0.640870	0.308895	-2.074715	0.0419
R-squared	0.999921	Mean dependent var		1681.640
Adjusted R-squared	0.999918	S.D. dependent var		2140.458
S.E. of regression	19.43693	Sum squared resid		24934.42
Log likelihood	-304.9685	F-statistic		278901.9
Durbin-Watson stat	1.253914	Prob(F-statistic)		0.000000

Equation 2b. Real Value-Added of Services: Pool with fixed effects
Dependent Variable: QS00?PP. Pooled Least Squares with fixed effects
Sample: 1995 2005   Number of cross-sections used: 7
Included observations: 10   Total panel (balanced) observations: 70
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
(QS00?PP(-1))	0.976982	0.015596	62.64243	0.0000
D(QI00?PP(-1))	0.629574	0.177766	3.541583	0.0008
D(IMPG00?)	0.601055	0.233779	2.571033	0.0127
D(EXPG00?)	-0.268594	0.337904	-0.794883	0.4299
R-squared	0.999961	Mean dependent var		1681.640
Adjusted R-squared	0.999954	S.D. dependent var		2140.458
S.E. of regression	14.47536	Sum squared resid		12362.63
Log likelihood	-280.4135	F-statistic		150864.3
Durbin-Watson stat	1.839943	Prob(F-statistic)		0.000000

Note: Fixed effects: France 42.0, Germany, 34.6, Great Britain 48.9, Italy
31.6, Poland 9.7, Spain 20.9, United States 309.7

Equation 2b improves the results of equation 2a regarding autocorrelation. The effects of Industry and Imports of goods are positive and significant. Exports of goods seems to have a direct negative effect, but its total effect is positive because Exports allow to increase the Imports capacity of a country. Industrial development contributes usually to expand foreign trade.

The overall effect of foreign trade is usually positive for the increase of industrial and non industrial sectors, as seen in Guisan(2006) and (2007) and other studies. The main conclusion is that, accordingly to Klein(1983), and other studies, it is usually very important to analyze demand and supply for economic development, and particularly the inter-sector relationships from the supply side if we wish to explain the main differences among countries in this regard.