Chapter 4
The Performance of Manufacturing in the European Union in the Context of Agricultural Economics

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1 Introduction

In this current context of crisis across many European countries, it is pertinent to analyze the economic performance for present members of the European Union. In economic literature there are many authors that defend the manufacturing sector as the determinant segment for economic growth, namely those related with the Keynesian theory and with the New Economic Geography, but in different ways. The Keynesian theory in terms of increasing returns to scale which derives from the dimension of the industrial firms and the New Economic Geography in terms of the number of firms. In both cases spillover effects are generated which are able to induce circular and cumulative processes with advantages for the more developed regions and sectors.

In this process the Keynesian theory, namely by Kaldor (1966, 1967, 1970, 1975, 1981) through its three laws, defends that the manufacturing sector is the engine of the economy, because the growth rate of the manufacturing output induces: the growth rate of the economy, the growth rate of manufacturing labor productivity, and the growth rate of nonmanufacturing productivity (Mamgain 1999).

The relationship between the growth rates of labor productivity in manufacturing as dependent upon the growth rate of the output in that sector is known as the Verdoorn (1949) law or second Kaldor law. The Verdoorn law captures increasing returns to scale derived from learning by doing effects and from the endogeneity of the factors. This relation can be mathematically formalized in a linear equation between the two variables and the coefficient, regression being the Verdoorn coefficient. Following the studies of Kaldor for the UK, it is expected that a value for the coefficient of Verdoorn positive and less than the unity is around 0.5. Values

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above 0.5 signify larger increasing returns to scale and values below reflect lower scale economies.

In this context the aim of the study presented here is to analyze the performance of manufacturing, namely its capacity to capture the economic dynamics related to the spillover effects, the endogeneity and with the increasing returns to scale, and other factors which can affect this evolution, through the Verdoorn law extended (with new variables based on the Keynesian theory), over the period 1996–2008, using data from Eurostat (European Union statistics) and for the first 27 European Union countries. Relevance was given to the manufacture of food, beverages, and tobacco, mainly because this sector has much potential for growth, and actually presents interesting signs of growth in many countries, being a sector that has its importance for the upstream sector (agriculture) and represented in production value, in 2007, 13.54 % of the total manufacturing and 13.61 % in terms of share of employment. We cannot forget the importance of agriculture, the food industry, and tourism for many regions in several countries of the European Union, mainly those which are more disadvantaged. Therefore, this original study is an important contribution towards European Union economic understanding.

2 Literature Review

The Verdoorn law has been applied in many countries and in many different ways: with more aggregated/disaggregated data; for the manufacturing sector/all economic sectors; original simple equation/extended equation with other variables (considering in some cases other theories). For example, Fase and Van Den Heuvel (1988) analyzed the Verdoorn law in the manufacturing sector. Leon-Ledesma (1999) tested this law, in 17 Spanish regions, over the period 1962–1991, for the manufacturing sector and confirmed the presence of increasing returns to scale. Some years later León-Ledesma (2002) tested the Verdoorn law again for a set of OECD countries over the period 1965–1994, considering effects from innovation and catching up. On the other hand, Harris and Liu (1999) studied this law and the increasing returns for 62 countries, in the period 1965–1990, based on the co-integration approach. The results also support the hypothesis of increasing returns to scale in the majority of countries. Later, based on this law Dall'Erba et al. (2008) applied a model, considering spatial autocorrelation effects, on the manufacturing sector of the 244 European Union regions, of 25 countries, from 1991 to 2003, and found four different clubs of convergence. These authors considered a Verdoorn equation augmented with variables according to the regional population density, the technological gap, labor productivity, the spatial autocorrelation effects, the urbanization rate, and the geographical distance from Luxembourg (the central location for Europe). In the same line, yet for the European regions, in the period from 1991 to 2002, Angeriz et al. (2009) estimated, also, the Verdoorn law, with spatial autocorrelation effects, for the manufacturing sector. They considered other variables in the Verdoorn equation, such as the density of industrial output, the degree of specialization of the industries, and spatial variables, and confirmed the presence of the dynamic Verdoorn law. This author, one year before Angeriz et al. (2008), had already analyzed this law for the European regional manufacturing, in the period 1986–2002, considering spatial autocorrelation effects, and found, again, robust conclusions about this law. More recently, Alexiadis and Tsagdis (2010) tested the Verdoon law, with several specifications, accounting for variables such as the manufacturing agglomeration and the spatial interaction, in 109 regions of 12 European Union countries, across the period 1977–2005. The results confirm the existence of circular and cumulative processes. Some years before, Alexiadis and Tsagdis (2006) analyzed this law in the Greek regions, with different specifications, namely to capture spatial effects, and found results that support the Verdoorn relationship.

In another perspective, considering the Verdoorn law with other regularities, in the context of the Kaldor laws, there are, also many studies. Drakopoulos and Theodossiou (1991) analyzed the Kaldor theory in the Greek economy, from 1967 to 1988, and the results are consistent with the theory. Pons-Novell and Viladecans-Marsal (1999), considering the Kaldor laws, tested the Verdoorn law in the European regions over the period 1984–1992, accounting for the spatial autocorrelation aspects. The results are consistent with the previsions of these laws. Considering cross-country data for developing countries, in the period 1960–1994, Necmi (1999) analyzed the Kaldor laws with supporting results. In a similar way, Pieper (2003) found several results for 30 developing countries that support the Kaldor interpretation of the growth processes, using time series data disaggregated at a sectorial level. In another economy and context, Wells and Thirlwall (2003) tested these laws across 45 African countries, during the period 1980–1996 and concluded the presence of these laws. Juarez and Leobardo (2011) applied the Kaldor theory in the Mexican regions, namely from 1993 to 2010, and concluded about the importance of the manufacturing sector. McCausland and Theodossiou (2012) testing the Kaldor laws found that the increasing returns appear more in the manufacturing sector and less in the services sector. Recently, Katrakilidis et al. (2013) analyzed these laws in the Greek economy over the period 1970–2006 and their conclusions validated the three laws.

Other studies aim to find relationships between the Verdoorn law and other theories. For example, Erixon (2005) analyzed the relationship between Schumpeterian and Keynesian economics. Ryzhenkov (2009) studied the relation between the Verdoorn law and the Ricardian relationship between employment and returns. Kosfeld and Dreger (2006) analyzed the Verdoorn and the Okun laws for Unified Germany, considering spatial autocorrelation aspects, during the 1990s. Fase and Winder (1999) analyzed the Verdoorm and Baumol laws for the manufacturing and services sectors of the Netherlands, in the period 1956–1993, considering other variables such as employment, the wage rate, and the unit labor cost. The results are more consistent with the Baumol law than with the Verdoorn law.

Finally, some studies, such as that of McCombie and Roberts (2007), investigated the static (constant returns to scale)-dynamic (increasing returns to scale)

Table 4.1 Literature review summarized about the Verdoorn law

Authors	Sectors considered	Countries	Relationships	New variables
Fase and Van Den Heuvel (1988)	Manufacturing		Verdoorn law	
Leon-Ledesma (1999)	Manufacturing	Spanish regions		
León-Ledesma (2002)		OECD countries		Innovation and catching-up
Harris and Liu (1999)		62 countries		Cointegration approach
Dall'Erba et al. (2008)	Manufacturing	244 regions, 25 EU countries		Regional population density, the technological gap, in terms of labor productivity, the spatial autocorrelation effects, the urbanization rate, and the geographical distance from the Luxembourg (the central location of the Europe)
Angeriz et al. (2009)	Manufacturing	European Union regions		Density of industrial output, the degree of specialization of the industries and spatial variables
Angeriz et al. (2008)	Manufacturing	European regions		Spatial autocorrelation effects
Alexiadis and Tsagdis (2010)		109 regions of 12 - European Union countries		Manufacturing agglomeration and the spatial interaction
Alexiadis and Tsagdis (2006)		Greek regions		Spatial effects
McCombie and Roberts (2007)	Manufacturing			
Drakopoulos and Theodossiou (1991)		Greek economy	Kaldor laws	
Pons-Novell and		European regions		Spatial autocorrelation aspects

(continued)

Table 4.1 (continued)

Authors	Sectors considered	Countries	Relationships	New variables
Viladecans-Marsal (1999)				
Necmi (1999)		Developing countries		Instrumental variables techniques
Pieper (2003)	All sectors	30 developing countries		Employment and value added
Wells and Thirlwall (2003)		45 African countries		
Juarez and Leobardo (2011)		Mexican regions		
McCausland and Theodossiou (2012)				
Katrakilidis et al. (2013)		Greek economy		
Erixon (2005)			Schumpeterian and Keynesian economics	
Ryzhenkov (2009)		Italy	Verdoorn law and the Ricardian relationship between the employment and returns	Capital–output ratio, employment ratio, relative labor compensation and the profit rate
Kosfeld and Dreger (2006)		Unified Germany	Verdoorn and the Okun laws	Spatial autocorrelation aspects
Fase and Winder (1999)	Manufacturing and services sectors	Netherland	Verdoorm and Baumol laws	Employment, the rate wage and the unit labor cost

Verdoorn law paradox and demonstrated the preference for the dynamic relationship, because of the existence of the spatial aggregation bias in the static analysis.

This review of literature about the Verdoorn law made before is summarized in Table 4.1, in order to better understand the following sections, namely that related with the model built and the options for the new variables considered in the Verdoorn equation.

3 The Model

The model considered in this study is based on the Verdoorn relationship extended with new variables considering the Keynesian theory and the literature review carried out beforehand and summarized in Table 4.1. Usually the related studies try to develop a model considering variables from other theories, from a perspective of linking different approaches. However, in this study variables are taken into account, related to the Keynesian theory that captures the endogeneity of the factors, effects of learning by doing and increasing returns to scale. It is considered that variables such as the wages and salaries [endogeneity of the factors and salary of efficiency—Fase and Winder (1999) and Ryzhenkov (2009)], number of persons employed per enterprise [endogeneity of the factors—Pieper (2003)], share of employment in manufacturing total [endogeneity of the factors—Alexiadis and Tsagdis (2010) and Angeriz et al. (2009)], investment per person employed [investment, capital, and learning by doing—León-Ledesma (2002)], and the share of R&D employment in the number of persons [capital and learning by doing—León-Ledesma (2002)] can capture these effects. If everything goes as expected by theory and these variables pick increasing returns to scale, a positive effect from everyone is expected. The model is presented as follows:

$$p_{it} = a + bq_{it} + c\mathrm{WS}_{it} + d\mathrm{PEE}_{it} + e\mathrm{SEM}_{it} + f\mathrm{IPE}_{it} + g\mathrm{SRE}_{it}$$

where p is the growth rate of labor productivity and q is the growth rate of the product. The variables WS, PEE, SEM, IPE, and SRE are, respectively, the wages and salaries, number of people employed per enterprise, share of employment in manufacturing total, investment per person employed, and the share of R&D employment in the number of people. The indexes i and t represent the countries and the years and a, b, c, d, e, f, and g are coefficients of estimation.

4 The Data

The data is relative to the output, to the number of people employed and to the wages and salaries, number of people employed per enterprise, share of employment in manufacturing total, investment per person employed, and the share of R&D employment in the number of people. This data was obtained from Eurostat (2013) and are disaggregated for the current 27 European Union countries and for the period from 1996 to 2008.

Figure 4.1 presents the productivity of the labor growth rate (%) in averages (for the period considered and for the several forms of manufacturing sectors) for the current several countries of the European Union.

From Fig. 4.1 it is possible to observe that countries such as France, Luxembourg, and Slovenia present a negative average labor productivity growth rate.

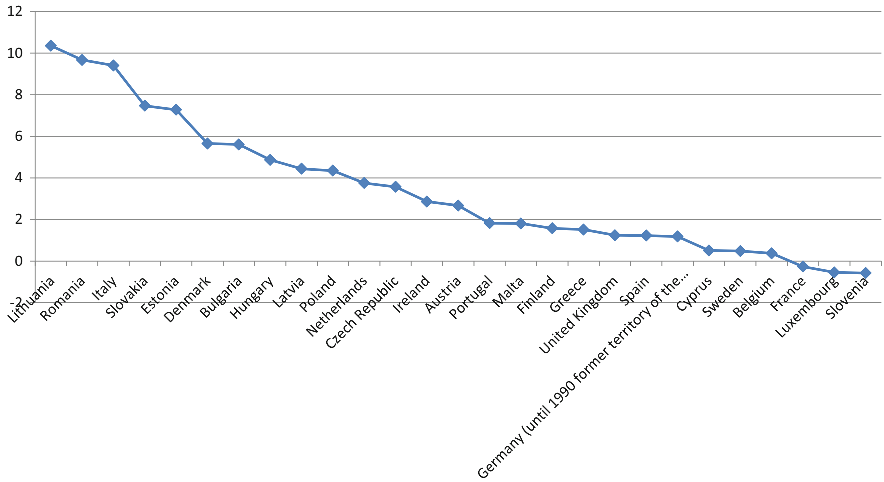

Fig. 4.1 Productivity of labor (Production value/number of persons employed) growth rate (%) in averages (over the period 1996–2008 and over the different forms of the manufacturing sector considered) for the current several countries of the European Union

Lithuania, Romania, Italy, and Slovakia are the countries with the greatest average labor productivity growth rate.

The figure shows the productivity of labor growth rate (%), also, in averages for the several forms of the manufacturing sector considered.

Observing Fig. 4.2, the manufacture of tobacco products (between the manufacture of food products, beverages and tobacco) possesses the greatest average labor productivity growth rate. On the other hand, the processing and preserving of fish and fish products show negative values for this variable.

5 Results

Table 4.2 presents the results obtained with the estimations made with panel data (27 European Union countries and the period 1996–2008) in the Stata software program. The econometric estimations are realized first with fixed and random effects methods and after, if necessary, taking into account some statistic tests, with the ordinary least square. The options for each one of these econometric methods are effectuated considering the several statistic tests presented in Table 4.2 and are the most used in these models.

From Table 4.2 it is possible to conclude that the manufacturing sector across the current 27 European Union countries presents strong increasing returns to scale, considering the value of the Verdoorn coefficient (0.945) for the fixed effects econometric method (considering that the Hausman test (13.310) reject the random effects). On the other hand, the coefficient of the constant does not present statistic

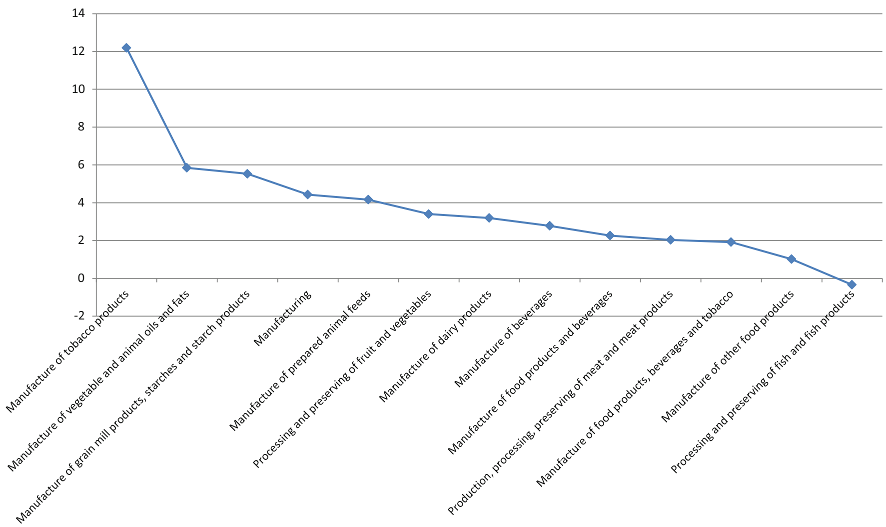

Fig. 4.2 Productivity of labor (Production value/number of persons employed) growth rate (%) in averages (over the period 1996–2008 and over the differing current countries of the European Union) for the several forms of the manufacturing sector considered

significance. Relative to the other variables, only the coefficient associated with the share of R&D employment in the number of people presents a positive statistic significance, although residual (0.018). For the entire manufacturing sector, considering what was mentioned before and the R^2 value, it would seem that the original Verdoorn relationship is the more robust.

The manufacture of food products, beverages, and tobacco is not affected by fixed or random effects (the ordinary least square is the more adjusted method), considering the F tests for these effects. The Verdoorn coefficient is relatively lower (0.896) than that of the whole manufacturing sector and the constant coefficient has statistical significance, but presents a residual value (0.052). In this sector the new variables, number of people employed per enterprise, share of employment in manufacturing total, investment per person employed, all show statistical significance, but the coefficients are close to zero. The first new variable presents a positive effect and the last two, negative effects. This means that the share of employment in the manufacturing total and the investment per person employed did not have, in the period considered, for the current 27 countries of the European Union, an endogenous positive effect upon the labor productivity growth rate and consequently did not help in the improvement of the increasing returns to scale in this sector.

The manufacture of food products and beverages shows a Verdoorn coefficient which is excessively high, because it is close to 1, but higher than 1, because values lower than 1 are expected. This happens in some cases and is explained as a sign of strong increasing returns to scale.

Table 4.2 Estimations results of the Verdoorn equation extended, with panel data, for the several forms of the manufacturing sector considered, over the period 1996–2008 and over the differing current countries of the European Union

	Const.[a]	Coef.[b]	Coef.[c]	Coef.[d]	Coef.[e]	Coef.[f]	Coef.[g]	F/Wald (mod.)[h]	F (Fe_OLS)[i]	Corr (u_i)[j]	F (Re_OLS)[k]	Hausman[l]	R^2 [m]	N. O.[n]
Manufacturing														
FE[o]	−0.055 (−1.590)	0.945* (23.250)	0.000 (0.050)	0.001 (1.060)	–	0.000 (0.680)	0.018* (1.990)	117.540*	2.040*	−0.389	–	–	0.846	136
RE[p]	0.008 (0.770)	0.913* (24.600)	0.000 (0.800)	0.000 (0.580)	–	−0.000 (−0.270)	−0.001 (−0.440)	–	–	–	5.310*	13.310*	0.888	136
OLS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manufacture of food products, beverages, and tobacco														
FE[o]	−0.052 (−0.570)	0.870* (14.000)	−0.000 (−0.080)	0.002** (1.700)	0.003 (0.550)	−0.000** (−1.780)	0.035 (1.440)	37.350*	0.790	−0.418	–	–	0.711	120
RE[p]	0.052* (3.180)	0.896* (16.280)	−0.000 (−0.490)	0.001* (2.270)	−0.002* (−2.930)	−0.000* (−2.540)	0.008 (0.940)	–	–	–	0.000	3.430	0.896	120
OLS	0.052* (3.180)	0.896* (16.280)	−0.000 (−0.490)	0.001* (2.270)	−0.002* (−2.930)	−0.000* (−2.540)	0.008 (0.940)	61.560*	–	–	–	–	0.753	120
Manufacture of food products and beverages														
FE[o]	0.454* (3.300)	1.221* (12.230)	−0.000 (−1.410)	−0.001 (−0.720)	−0.015** (−1.930)	−0.000 (−1.620)	−0.034 (−0.560)	32.660*	1.980*	−0.966	–	–	0.827	63
RE[p]	0.027 (0.890)	1.066* (12.490)	−0.000 (−0.230)	0.001 (0.950)	−0.000 (−0.140)	−0.000** (−1.730)	0.015 (0.910)	–	–	–	0.030	1.550	0.796	63
OLS	0.026 (0.970)	1.059* (12.320)	−0.000 (−0.390)	0.001 (1.330)	−0.001 (−0.450)	−0.000 (−1.460)	0.010 (0.680)	36.590*	–	–	–	–	0.775	63
Production, processing, preserving of meat and meat products														
FE[o]	0.279* (2.630)	0.999* (16.970)	−0.000 (1.040)	0.000 (0.340)	−0.107* (−2.040)	−0.000* (−2.450)	0.026 (1.540)	51.700*	0.890	−0.605	–	–	0.760	128
RE[p]	0.059* (2.370)	0.959* (18.000)	0.000 (0.250)	0.000 (0.370)	−0.009 (−1.240)	−0.000* (−2.900)	0.016 (1.080)	–	–	–	0.000	7.410	0.850	128
OLS	0.059* (2.370)	0.959* (18.000)	0.000 (0.250)	0.000 (0.370)	−0.009 (−1.240)	−0.000* (−2.900)	0.016 (1.080)	60.150*	–	–	–	–	0.736	128

(continued)

Table 4.2 (continued)

	Const.[a]	Coef.[b]	Coef.[c]	Coef.[d]	Coef.[e]	Coef.[f]	Coef.[g]	F/Wald (mod.)[h]	F (Fe_OLS)[i]	Corr (u_i)[j]	F (Re_OLS)[k]	Hausman[l]	R^2 [m]	N. O.[n]
Processing and preserving of fish and fish products														
FE[o]	0.020 (0.260)	0.519* (7.310)	0.000 (0.990)	−0.000 (−0.310)	−0.043 (−1.350)	0.000 (0.190)	−0.014 (−0.260)	9.660*	0.980	−0.731	–	–	0.475	88
RE[p]	−0.003 (−0.100)	0.499* (9.440)	0.000 (0.150)	0.000 (0.670)	0.012 (1.520)	0.000 (0.120)	−0.019 (−0.660)	–	–	–	0.000	5.660	0.818	88
OLS	−0.003 (−0.100)	0.499* (9.440)	0.000 (0.150)	0.000 (0.670)	0.012 (1.520)	0.000 (0.120)	−0.019 (−0.660)	16.150*	–	–	–	–	0.511	88
Processing and preserving of fruit and vegetables														
FE[o]	0.184* (2.630)	0.618* (13.750)	0.000 (1.180)	0.004* (4.160)	−0.421* (−5.080)	−0.000 (−0.210)	0.034 (1.280)	40.410*	2.730*	−0.923	–	–	0.725	122
RE[p]	0.058* (2.680)	0.600* (13.230)	−0.000 (−1.450)	0.000 (0.450)	−0.012 (−0.900)	−0.000** (−1.940)	−0.008 (−0.500)	–	–	–	0.000	36.770*	0.708	122
OLS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manufacture of vegetable and animal oils and fats														
FE[o]	0.447* (2.660)	0.711* (6.120)	−0.000 (−1.570)	−0.006* (−4.070)	−0.565 (−1.140)	0.000* (2.570)	−0.004 (−0.170)	10.840*	2.300*	−0.894	–	–	0.516	86
RE[p]	0.071 (1.430)	0.473* (4.250)	−0.000 (−0.290)	−0.001 (−1.190)	−0.074 (−0.960)	0.000** (1.780)	−0.017 (−1.090)	–	–	–	0.000	20.200*	0.303	86
OLS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manufacture of dairy products														
FE[o]	0.223** (1.970)	0.794* (7.800)	−0.000 (−0.020)	−0.000 (−0.880)	−0.124** (−1.900)	−0.000 (0.750)	−0.021 (−0.590)	12.210*	0.760	−0.824	–	–	0.430	126
RE[p]	0.069* (3.160)	0.833* (9.210)	−0.000 (−1.630)	0.000 (1.580)	−0.020* (−2.480)	−0.000 (−1.440)	0.010 (0.430)	–	–	–	0.000	5.550	0.828	126
OLS	0.069* (3.160)	0.833* (9.210)	−0.000 (−1.630)	0.000 (1.580)	−0.020* (−2.480)	−0.000 (−1.440)	0.010 (0.430)	18.500*	–	–	–	–	0.457	126
Manufacture of grain mill products, starches, and starch products														
FE[o]	0.085 (0.990)	0.685* (11.780)	0.000** (1.730)	−0.002 (−0.850)	−0.285* (−2.100)	0.000 (1.060)	−0.001 (−0.080)	32.630*	2.280*	−0.748	–	–	0.718	106
RE[p]	0.038 (1.030)	0.697* (12.290)	−0.000* (−3.290)	0.001* (2.050)	−0.044 (−0.820)	0.000* (2.930)	−0.041* (−4.170)	–	–	–	1.130	16.960*	0.660	106

OLS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manufacture of prepared animal feeds														
FE[o]	0.181* (2.390)	0.771* (16.180)	0.000 (1.330)	0.005* (2.570)	−0.749* (−4.380)	−0.000* (−2.270)	0.032 (1.540)	46.230*	2.400*	−0.763	–	–	0.770	112
RE[p]	0.062* (1.960)	0.748* (15.870)	−0.000 (−0.710)	0.001 (1.470)	−0.089** (−1.750)	−0.000 (−1.630)	0.014 (0.840)	–	–	–	0.540	17.230*	0.726	112
OLS	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Manufacture of other food products														
FE[o]	−0.113 (−1.510)	0.644* (9.340)	−0.000 (−0.210)	0.003** (1.900)	0.000 (0.020)	0.000* (2.450)	0.018 (0.860)	17.740*	1.050	−0.632	–	–	0.526	126
RE[p]	0.008 (0.510)	0.660* (10.680)	−0.000 (−1.570)	0.001* (2.540)	−0.004* (−2.460)	0.000 (1.170)	−0.002 (−0.160)	–	–	–	0.000	5.580	0.758	126
OLS	0.008 (0.510)	0.660* (10.680)	−0.000 (−1.570)	0.001* (2.540)	−0.004* (−2.460)	0.000 (1.170)	−0.002 (−0.160)	25.590*	–	–	–	–	0.541	126
Manufacture of beverages														
FE[o]	0.089 (1.190)	0.758* (11.200)	0.000 (1.220)	−0.001 (−0.420)	−0.043 (−1.090)	−0.000 (−1.290)	−0.008 (−0.360)	21.720*	1.440	−0.677	–	–	0.584	123
RE[p]	0.087* (4.270)	0.792* (12.660)	−0.000 (−0.050)	−0.000 (−0.290)	−0.023* (−3.710)	−0.000* (−2.000)	−0.010 (−0.700)	–	–	–	1.850	4.690	0.809	123
OLS	0.085* (4.340)	0.798* (12.690)	−0.000 (−0.050)	−0.000 (−0.200)	−0.022* (−3.750)	−0.000* (−1.990)	−0.012 (−0.830)	35.590*	–	–	–	–	0.630	123
Manufacture of tobacco products														
FE[o]	0.592* (2.170)	0.531* (4.850)	−0.000 (−1.190)	−0.001** (−1.880)	−0.053 (−0.440)	−0.000 (−0.210)	−0.047* (−3.000)	5.230*	2.950*	−0.964	–	–	0.487	52
RE[p]	0.230* (3.140)	0.502* (4.960)	−0.000 (−0.290)	−0.000** (−1.720)	−0.060 (−0.750)	−0.000 (−0.130)	−0.026* (−2.160)	–	–	–	3.830*	5.270	0.451	52
OLS	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Note: [a]Constant; [b]Verdoorn coefficient; [c]Wages and Salaries coefficient; [d]Number of persons employed per enterprise coefficient; [e]Share of employment in manufacturing total coefficient; [f]Investment per person employed coefficient; [g]Share of R&D employment in the number of persons employed (%) coefficient; [h]Test F for fixed effects model and test Wald for random effects; [i]Test F for fixed effects or OLS (Ho is OLS); [j]Correlation between errors and regressors in fixed effects; [k]Test F for random effects or OLS (Ho is OLS); [l]Hausman test (Ho is GLS); [m]R square; [n]Number of observations; [o]Fixed effects model; [p]Random effects model

*Statistically significant at 5 %; **Statistically significant at 10 %

The decreasing order of increasing returns to scale, considering the Verdoorn coefficient, for the several forms of manufacturing, within the manufacture of food products, is the following: Production, processing, preserving of meat and meat products (0.959), manufacture of dairy products (0.833), manufacture of prepared animal feeds (0.771), manufacture of vegetable and animal oils and fats (0.711), manufacture of grain mill products, starches, and starch products (0.685), processing and preserving of fruit and vegetables (0.618), manufacture of other food products (0.660), and processing and preserving of fish and fish products (0.499). In these industries many times the fixed and random effects are rejected and when they are not rejected the fixed effects are more acceptable. The new variables either do not have statistical significance or do have, but the coefficient values are close to zero or many times negative.

The manufacture of tobacco products has the lower Verdoorn coefficient, but in the data analysis presented the greatest average in labor productivity growth rate. This signifies that the growth rate of this variable is not picked by the Verdoorn law and does not come from increasing returns to scale, but instead comes from other variables not considered in the study, as can be confirmed by the value of the constant coefficient and by the R^2 values being around 0.451.

In general, relative to the new variables, the variable wages and salaries do not show any case for statistic significance. The variables, number of people employed per enterprise, investment per person employed, and the share of R&D employment in the number of people, present values or insignificant statistics, or close to zero, or in some cases negatives. The total share of employment in manufacturing reflects strong negative effects upon the processing and preserving of fruit and vegetable sectors (−0.421), in the manufacture of grain mill products, starches, and starch products (−0.285), and in the manufacture of prepared animal feeds (−0.749). This signifies that in these sectors the total share of employment in manufacturing is not a consequence of the enterprise number or dimension, but rather a consequence of the dependency of the labor resources, with lower increasing returns.

Conclusions

The Verdoorn relationship has been studied by many authors for different periods of time, for several countries and regions, and for different sectors. Sometimes with the original relationship and at other times with extensions considering the Keynesian theories or other theories, as for example, the New Economic Geography (this theory along with the Keynesian theory defends the existence of increasing returns to scale as the base of circular and cumulative processes).

In this study, from the data analysis and from the results obtained with the several methods of econometric estimations, it was possible to conclude that in reality, in the differing countries that actually are members of the European Union, the economy is strongly diverse. The differences in the labor

(continued)

productivity growth rate between the 27 countries are significant, with countries such as France and Luxembourg with negative average productivity growth rates and countries such as Italy and Slovakia with the greatest growth rates.

The same happens with the different forms of manufacturing considered, namely those related with the manufacture of food products, beverages, and tobacco. The manufacture of tobacco products presents the greatest average labor productivity growth rate. Curiously this sector is that which possesses the lower Verdoorn coefficient. This needs further research in the future despite the explanation presented. The processing and preserving of fish and fish products showed the lower average productivity growth rate and the lower Verdoorn coefficient, sign of a weak increase in return for this sector.

The new variables, with exception to the total share of employment in manufacturing (which presents strong negative effects in some industries), have a residual effect and in some cases, also, negative. This means that the manufacturing sector is not enough, in the existing European Union countries, developed to catch opportunities that come from the spillover effects, externalities, endogeneity of the factors, and learning by doing effects. Consequently, these variables have a negative effect, when they were expected to have a positive effect.

In general, all the manufacturing sectors considered have significant increasing returns to scale, taking into account the Verdoorn coefficient. But these results could be better if the effects represented in the new variables were potentiated. In this line, it is important to promote strategies to make this possible.

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