
Business Size, Numbers, Production Value and Productivity Trends in Manufacture and Mining-Quarrying across the EU, 2008-2017

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Abstract:

Purpose: The objective of the paper is to empirically estimate and contrast the long-run trends of four business development and performance measures (number, average size, production value, and labor productivity of companies) observed annually across the EU in the manufacturing and mining-quarrying sectors from 2008 to 2017.

Design/Methodology/Approach: The paper econometrically isolates the long-run trends from both the autonomous components and the principle medium-term deviations from the trend in the 28 EU member-states by achieving a high level of model fitness while preserving degrees of freedom.

Findings: Despite operating in the same legal-competition-funding-export framework, on average, EU businesses exhibit diverse development and performance trends from one member-state to another (within sectors) and from one sector to the other (in the same state), especially in terms of numbers and sizes. However, in most member-states, on average, they exhibit upward productivity in manufacture; and in a good number of states (not necessarily the same states) they exhibit upward labor productivity trends in mining-quarrying and upward (downward) production value trends in manufacture (mining-quarrying).

Practical Implications: Business decisions and policy interventions may have to vary from one sector to another across the EU, and from one place to another within the two sectors. In addition, by empirically pinpointing in time, space and sector the switches in the trends and the mid-term deviations from the trends, the paper enables future research to identify what caused the said changes, and, thus, draw useful lessons for businesses and for territorial development policy in manufacture or mining-quarrying.

Originality/value: A broad, unified view of business life and performance complements the individual sectoral or subsectoral analyses on such matters usually carried out for single member-states or groups of member-states.

Keywords: Time trend, manufacturing and mining-quarrying sectors, number of businesses and average company size, product value and labor productivity, European enterprises.

JEL classification: C23, J24, L70, M20.

Paper Type: Research study.

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1. Introduction

The article studies the evolution of four business measures in the manufacturing and mining-quarrying sectors across the 28 EU member-states (EU-28) on the basis of Eurostat's structural business statistics running from 2008 to 2017. That is, from the time the international financial and economic crisis reached Europe triggering the European sovereign debt crisis, to the last year Eurostat supplies the said statistics. Thus, it provides a broad, unified view of business life and performance that complements the individual sectoral or subsectoral analyses on such matters carried out for single member-states or groups of member-states (e.g., Traù, 1997; O'Sullivan, 2000; Serrasqueiro and Maças Nunes, 2008; Zeli and Mariani, 2009; Mahlberg *et al.*, 2013; Voulgaris *et al.*, 2015; Vavřina and Lacina, 2018; the sources sited therein).

The four measures consist of: (a) the number of companies, N , (b) the average business size in terms of persons employed, L/N , (c) labor productivity, Q/L , and (d) production value, \bar{P} . Both separately and collectively these measures sketch crucial aspects of the sectoral structure and business performance;¹ and in the pages that follow they are analyzed over time via econometrics in order to: (a) Identify and isolate the long-run trends from the autonomous components and the principal medium-term deviations in each member-state. (b) Examine whether the long-run trends varied from one *common market* country to another and compare the patterns. (c) Facilitate further research into the features and operation of businesses in the said sectors across the EU member-states. (A list of the member-states is provided in Table 1.)

The activities included in each sector are defined in a uniform manner across the EU (Eurostat, 2008). The data employed hereinafter were collected annually in the context of EU Council Regulation 58/97 (Eurostat, 2015), and were drawn by the authors from the Eurostat site in the summer of 2019.² Since the data are regularly updated and, consequently, change, in the following pages the conclusions are formulated based on the frequency of the findings rather than on individual findings.

Table 1. *The country codes of the EU-28 considered in the analysis*

AT	Austria	FR	France	NL	Netherlands
BE	Belgium	GR	Greece	PL	Poland
BG	Bulgaria	HR	Croatia	PT	Portugal
CY	Cyprus	HU	Hungary	RO	Romania
CZ	Czechia	IE	Rep. of Ireland	SE	Sweden
DE	Germany	IT	Italy	SI	Slovenia
DK	Denmark	LT	Lithuania	SK	Slovakia
EE	Estonia	LU	Luxembourg	UK	United Kingdom of Great Britain & Northern Ireland (hereinafter: United Kingdom). Withdrew from the EU in 2020.
ES	Spain	LV	Latvia		
FI	Finland	MT	Malta		

The article is structured as follows: Section 2 provides a context. Section 3 describes the empirical approach. Section 4 discusses the findings, and Section 5 supplies the conclusions.

2. Context

Of the four measures considered, P is the most intricate. It is equal to turnover (i.e., the sum of all sales of goods and services carried out by a business in a year, without value-added taxes):

- plus or minus changes in stocks of finished products, work in progress, and goods and services purchased for resale,
 - minus purchases of goods and services for resale,
 - plus capitalized production, and other operating income (excluding subsidies),
- associated with the ordinary —not the financial or extra-ordinary— accounts of the business (company). So, for the sake of simplicity, P is treated as the sum of each company's $P_i \times O_i$, where O_i stands for the output of a certain good or service provided by the company, and P_i stands for the price of the said good or service. By contrast, Q_i captures the gross value added to the product by the company's workforce, L , and by the other production factors, all measured in terms of their (factor) prices.

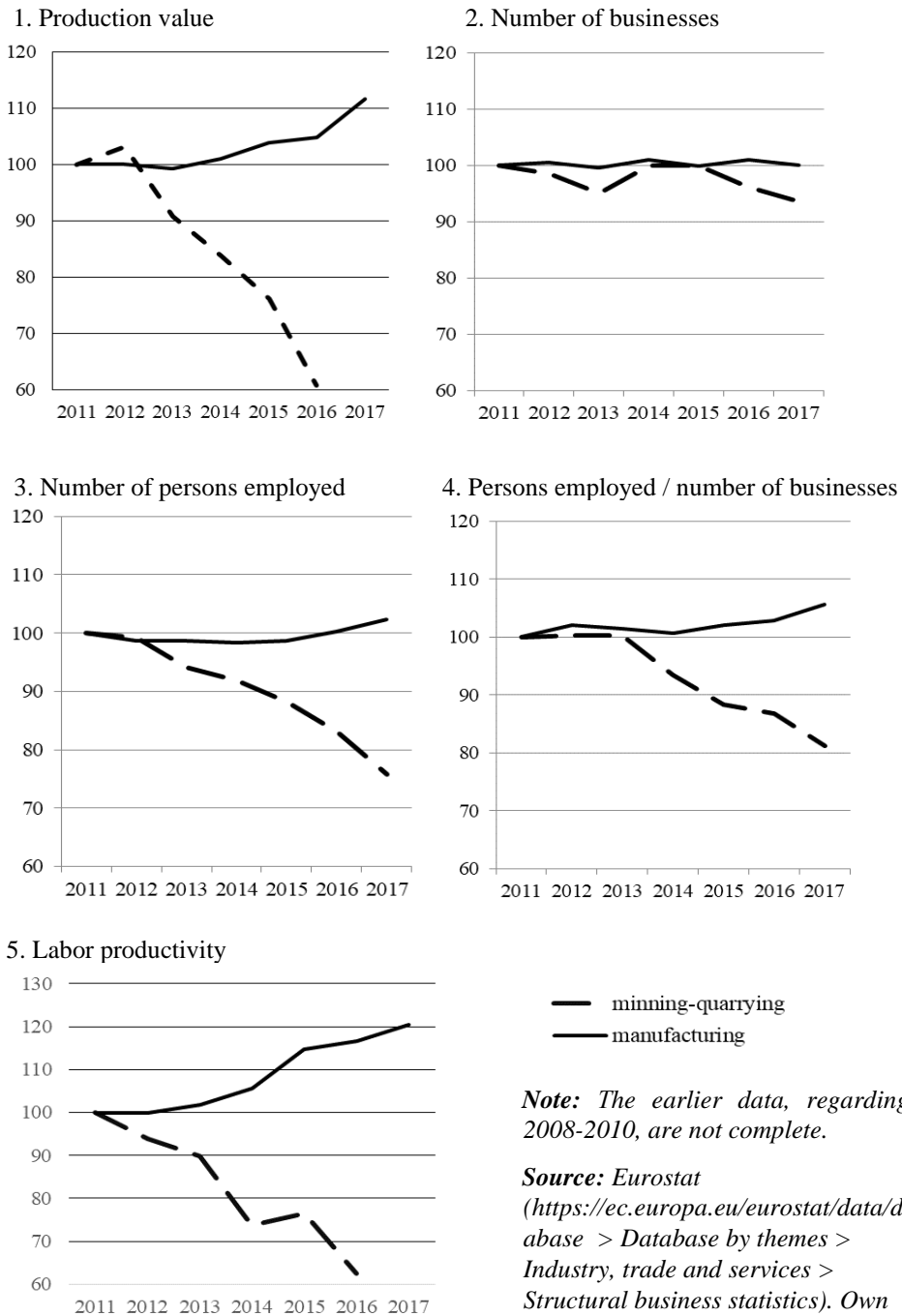
At the EU level, P increased in manufacture from 6,450 in 2011 to 7,200 billion euro in 2017. At the same time, L increased from 30.4 to 31.1 million people, N increased from 2,100 to 2,101.7 thousand businesses, overall L/N inched up from an average of 14 to an average of 14.8 people per business —this corresponds to a small-sized (almost a micro) business by EU-28 standards (see Table 2)— and Q/L increased from 54 to 65 thousand euro. In mining-quarrying, P decreased considerably from 228.0 million euro in 2011 to 138.5 million euro in 2016, L decreased from 6.2 to 4.7 million people, N decreased from 20 to 18.7 thousand businesses, L/N decreased from an average of 30.9 to an average of 25.1 people per business, and Q/L decreased considerably from 149 to 93 thousand euro (even so, above manufacture). See also Graphs 1-5.

Table 2. *Classification of businesses, EE-28*

	Staff headcount	and (a) Turnover	or (b) Balance sheet total (in million euro)
Micro	< 10	≤ 2	≤ 2
Small	< 50	≤ 10	≤ 10
Medium-sized	< 250	≤ 50	≤ 43
Large	≥ 250	> 50	> 43

Source: *EU recommendation 2003/361(2003).*

Graphs 1-5. Business developments in the manufacturing and mining-quarrying sectors at the EU-28 level, 2011-17 (2011=100%)



Overall, L/N moved in the same direction as both its numerator, L , and its denominator, N ; Q/L moved in the same direction as its denominator, L ; and so did P . The movement of N and L in the same direction is consistent with the argument that a rise (drop) in N and, seemingly, in competition, affects the production of more (less) Q , thus requiring more (less) staff, L ; and/or (b) that the presence in the industry of a larger (smaller) workforce of self-employed, and of employees who learn or have learned the business, and others, affects the formation of more (fewer) businesses in the said industry (e.g., Begg *et al.*, 2008). However, the other measures could have moved in different directions.³ Indeed, as we shall see, in most EU member-states the said trends by and large differed from one another, with one exception: the Q/L trend in manufacture.

In the pages that follow we look at the trends (as opposed to incidental or mid-term deviations) of P , N , L/N , and Q/L across the EU member-states, keeping in mind that the producers operated in a *common market* and the same legal, competition, funding and export framework. As we are interested in the cross-sectional (country-level) aspect, and as the time-series (especially, in the early years) were not always complete, we turn to a pooled –rather than a panel– type of data analysis.

3. Methodological Approach

The patterns of each measure are econometrically analyzed via Stata on the basis of a close variant of the well-established functional form described by Smith and Duncan (1944), Fox (1968), Franzini and Harvey (1983), Black (1992), Cameron (2005), Lee *et al.* (2019) and others:

$$y_{itc} = \beta_{0c} + \beta_{1c} t_i + \beta_{2c} t_i^2 + \sum_{i=0}^3 \beta_{3ic} m_{itc}, \quad (1)$$

where ‘ y ’ stands for the regressand, i.e., for each of the four measures considered in each sector. Each equation is regressed separately, i.e., not as a system, and each regression relies on annual data from the EU member-states. ‘ t ’ stands for time ($t = 1, \dots, 10$) and enters the expression both as an index and as the long-run trend variable in each member-state. The trend may be linear; however, the inclusion of its square allows for the consideration of non-linear features (including a peak or a trough). ‘ c ’ stands for the number of member-states. ‘ m ’ is in binary form and stands for an exceptionally high medium-term deviation or fluctuation from the trend observed in a member-state.⁴ The ‘ i ’s denote the number of these medium-term deviations in a member-state ($i \in [0,3]$ in the sense that in the end, the maximum number of such fluctuations in any one state is three; however, in most states it is equal to 0). The ‘ β ’s stand for the regressors’ coefficients.

To produce a short expression with a high level of fitness, the estimation procedure runs as follows: (a) A preliminary OLS regression is performed using the autonomous components and the trends. As a rule, Germany is set as reference, and in order to deal with heteroscedastic residuals both the preliminary regression and all

subsequent regressions (iterations) are conducted with robust standard errors. (b) The β_{2i} s associated with p -values in excess of 10% and/or with β_{1i} s featuring p -values in excess of 10% (i.e., t 's for which the rate of change in many analyses might be seen as trivial) are removed so as to preserve degrees of freedom. (It turns out that the impact on the model's fitness is negligible, if any.) (c) The expression is simplified further via successive regressions and post-estimation analyses through which pairs of β_{0i} s, β_{1i} s, and β_{2i} s with similar values are grouped together (and, thus, their respective impacts are maintained). In particular, after each regression: (i) the recovered autonomous effects are grouped with the reference if the relevant p -values exceed a certain threshold, and (ii) all recovered coefficients—ordered by type—are tested in pairs of successive size *for equality* and grouped together if the probability of error exceeds the threshold mentioned under item (i). This threshold is initially set at 99%, falls in each iteration, and eventually reaches 10%. If the regressors-to-observations ratio is over 9.9%, the procedure continues until the ratio is reached. (In these cases, the threshold decreases from 0.10 to 0.05 or less.) (d) An additional regression is carried out, on the basis of which residual values are estimated for each and every observation.

The top 5%, highest positive (HP) and highest negative (HN) residual values are identified, and all successive HP or all successive HN observations in any one EU member-state are taken to denote a possibly exceptional (medium-term) deviation. Other successions of HP observations or successions of HN observations in the same or in another member-state are taken to denote additional such deviations. Binary (dummy) variables are constructed for each such succession, and a regression, akin to expression (1), is estimated. Each and every *one* in each and every such binary variable is experimentally replaced with a *zero*, and a regression is run for each modification. If the R^2 improves the modification is kept, otherwise it is replaced with the original value. More or longer such binary variables, involving observations with immediately lower HP or HN residual values, are considered until the regressor-to-observations ratio reaches 11.5%.⁵ The results are provided in Tables 3-10, and their high goodness-of-fitness (the R^2 s range from 97.4 to 99.8) cannot be overlooked. As we shall see, the medium-terms fluctuations that emerge in the case of Greece (with which the author are familiar) match the findings of other analysts, so the authors believe that they probably marked out some very interesting periods.

4. Empirical Findings

Table 3 provides the findings about the evolution of \bar{P} in manufacture, and suggests that at the outset the largest economies, Germany (line 1), Italy (line 13), France (line 12), Spain and the United Kingdom (line 11) featured the highest levels, while the smallest economies, Cyprus, Estonia, Latvia, Malta (line 2) featured the lowest levels. Over time, \bar{P} :

- Increased in Bulgaria, Portugal (line 18), Austria, Czechia, Denmark, Hungary, Romania, Slovakia (line 19), Netherlands, Poland (line 20), France, the Republic

Table 3. The evolution of the production value (*P*) in manufacture across the EU, 2008-17 (analyzed with robust standard errors) (in million euro)

Regressors	Coefficients	P-values
<i>Autonomous components</i>		
1 DE (reference area)	1,665,334.0	0.000
2 CY, EE, LV, MT	-1,659,465.0	0.000
3 BG, HR, LT, LU, SI	-1,647,117.0	0.000
4 RO, SK	-1,622,152.0	0.000
5 DK, GR, HU, IE, PT	-1,594,588.0	0.000
6 CZ, FI	-1,543,202.0	0.000
7 AT	-1,521,371.0	0.000
8 SE	-1,483,192.0	0.000
9 PL	-1,462,365.0	0.000
10 BE, NL	-1,424,522.0	0.000
11 ES, UK	-1,139,636.0	0.000
12 FR	-937,626.4	0.000
13 IT	-783,222.2	0.000
<i>Time trend</i>		
14 ES	-39,244.6	0.000
15 CY, FI, GR, HR, LU	-2,757.0	0.000
16 BE, IT, MT, SE	-568.0	0.511
17 EE, LV, LT, SI	384.6	0.119
18 BG, PT	1,132.8	0.000
19 AT, CZ, DK, HU, RO, SK	3,222.6	0.000
20 NL, PL	7,230.5	0.000
21 FR, IE, UK	11,408.3	0.000
22 DE	17,922.4	0.000
<i>Time trend squared (captures the rate of change)</i>		
23 CY, HR, LU	267.5	0.000
24 ES	3,508.1	0.000
<i>Time trend squared (captures the rate of change)</i>		
25 DE 2009-2010	-235,833.4	0.000
26 UK 2009-2010	-58,884.8	0.013
27 IT 2009-2010	-89,328.6	0.022
28 FR 2009-2010	-53,754.2	0.020
29 IE 2012-2014	-29,568.7	0.002
Observations	251	
Model fitness (R ²)	99.80%	

Note: Regressions are estimated with robust standard errors so as to address issues of heteroscedasticity and lack of normality.

Source: Eurostat (see Graphs 1-5). Own calculations.

of Ireland, the United Kingdom (line 21), Germany (line 22), and, probably, Estonia, Latvia, Lithuania, and Slovenia (line 17: the *p-value* is modest).

- Decreased in Finland, Greece (line 15)⁶ and, maybe, Belgium, Italy, Malta and Sweden (line 16: the *p-value* is quite high).
- First decreased then increased, thus forming a V-shaped pattern in Spain (lines 14, 24), Croatia, Cyprus, and Luxembourg (lines 15, 23), as per the first and second order conditions of expression (1) with respect to time.
- Dropped below the trend in France, Germany, Italy, and the United Kingdom during 2009-2010, in the wake of the international financial and economic crisis (lines 25-28), and in the Republic of Ireland in 2012-2014, during the Irish bailout (line 29).

Table 4 provides the findings about the evolution of \bar{P} in mining-quarrying, and suggests that at the outset Italy, the United Kingdom (line 11), Germany, the Netherlands, and Poland (line 1) featured the highest levels, while Belgium, Croatia, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta, and Slovenia (line 2) featured the lowest. Over time, \bar{P} :

- Increased in Bulgaria, Estonia and Sweden (line 17).
- Decreased in Italy, the United Kingdom (line 12), Denmark, Romania (line 14), Czechia, France, Germany (line 15), and, maybe, Cyprus, Finland, Greece, Latvia, Lithuania Luxembourg, Malta, Hungary, Poland, Portugal, Slovakia, and Slovenia (line 16, the *p-value* is very high).
- Formed a V-shaped pattern in the Republic of Ireland (lines 15, 24) and Spain (lines 13, 25).
- First increased then decreased, thus forming a Λ -shaped pattern in Austria, Belgium (lines 18, 23), Croatia (lines 19, 22), and the Netherlands (lines 20-21).
- Rose above the trend during 2011-2012 in Poland (line 28), dropped below the trend during 2016-2017 in the United Kingdom (line 29), and both dropped below the trend during 2008-2010 and rose above the trend during 2011-2012 in Italy (lines 26-27).

Table 5 provides the findings about the evolution of N in manufacture, and suggests that at the outset France, Spain, Poland (line 12) and Italy (lines 10, 26), featured the most businesses, while Estonia, Cyprus and Latvia featured the least (lines 2-3). Over time, N :

- Increased in Cyprus, Sweden (line 17), Estonia, Latvia, Lithuania, Slovenia (line 18), Czechia, the Netherlands (line 19), and Slovakia (lines 20-21, at a decreasing rate as per the first and second order conditions of expression (1) with respect to time).
- Decreased in Italy (line 13), Greece, Spain (lines 13, 22), Bulgaria, Luxembourg, Malta, Finland (line 15), Belgium, and Croatia (Line 16).

Table 4. The evolution of the production value (\hat{P}) in mining-quarrying across the EU, 2008-17 (analyzed with robust standard errors) (in million euro)

Regressors	Coefficients	P-values
<i>Autonomous components</i>		
1 DE, NL, PL (reference areas)	12,709.1	0.000
2 BE, CY, EE, HR, LV, LT, LU, MT, SI	-12,588.7	0.000
3 HU, SI	-12,245.3	0.000
4 BG, GR	-11,819.4	0.000
5 PT	-11,614.0	0.000
6 AT, IE, FI	-10,981.4	0.000
7 CZ, SE	-8,578.6	0.000
8 ES	-6,210.1	0.000
9 FR, RO	-4,833.9	0.000
10 DK	-2,991.0	0.000
11 IT, UK	54,907.0	0.000
<i>Time trend</i>		
12 IT, UK	-2,816.5	0.004
13 ES	-770.6	0.000
14 DK, RO	-460.1	0.000
15 CZ, DE, FR, IE	-202.6	0.000
16 CY, GR, FI, HU, LT, LV, LU, MT, PL, PT, SI, SK,	-0.1	0.996
17 BG, EE, SE	55.1	0.001
18 AT, BE	245.2	0.000
<i>Time trend squared (captures the rate of change)</i>		
21 NL	-471.5	0.000
22 HR	-160.4	0.000
23 AT, BE	-20.5	0.000
24 IE	16.1	0.000
25 ES	52.1	0.000
<i>Time trend squared (captures the rate of change)</i>		
26 IT 2008-2010	-15,295.8	0.026
27 IT 2011-2012	13,591.5	0.004
28 PL 2011-2012	2,514.2	0.000
29 UK 2016-2017	-7,447.9	0.038
Observations	251	
Model fitness (R ²)	98,07%	

Note and Source: As in Table 3.

- Formed a V-shaped pattern in Austria, Denmark, the Republic of Ireland (lines 15, 22), Hungary, Portugal, Romania, the United Kingdom (lines 14, 22), and Poland (lines 13, 23).
- Formed a Λ -shaped pattern in France and Germany (lines 19, 21).

- Rose above the trend during 2010-2011 in Slovakia (line 27), and during 2013-2017 in Spain (line 28), and dropped below the trend during 2008-2010 in Poland (line 24), during 2008-2012 in Greece (line 25), and during 2016-2017 in Austria (line 29). (The finding regarding Greece is consistent with the position expressed

Table 5. *The evolution of the number of businesses (N) in manufacture across the EU, 2008-17 (analyzed with robust standard errors)*

Regressors	Coefficients	P-values
<i>Autonomous components</i>		
1 DE (reference area)	193,989.9	0.000
2 EE	-193,263.2	0.000
3 CY, LV	-189,832.8	0.000
4 DK, IE, LT, LU, MT, SI, SK	-184,281.7	0.000
5 AT, HR, FI	-169,089.0	0.000
6 BE, BG, NL	-158,189.4	0.000
7 SE	-140,432.6	0.000
8 HU, RO	-135,150.8	0.000
9 PT	-114,998.7	0.000
10 IT	-92,291.7	0.000
11 CZ, GR, UK	-54,302.4	0.000
12 ES, FR, PL	15,617.0	0.000
<i>Time trend</i>		
13 GR, ES, IT, PL	-10,169.8	0.000
14 HU, PT, RO, UK	-2,987.0	0.000
15 AT, BG, DK, FI, IE, LU, MT	-911.9	0.000
16 BE, HR	-335.9	0.020
17 CY, SE	99.4	0.024
18 EE, LT, LV, SI	1,007.9	0.000
19 CZ, DE, FR, NL	4,019.9	0.000
20 SK	10,125.8	0.000
<i>Time trend squared (captures the rate of change)</i>		
21 DE, FR, SK	-369.4	0.000
22 AT, DK, GR, ES, HU, IE, PT, RO, UK	198.4	0.000
23 PL	901.5	0.000
<i>Time trend squared (captures the rate of change)</i>		
24 PL 2008-2010	-12,881.8	0.000
25 GR 2008-2012	-34,049.5	0.000
26 IT 2008-2016	365,745.8	0.000
27 SK 2010-2011	29,750.9	0.000
28 ES 2013-2017	26,285.3	0.000
29 AT 2016-2017	-8,926.0	0.000
Observations	251	
Model fitness (R ²)	99.66%	

Note and Source: As in Table 3.

by Giannakis and Bruggeman (2017) that the manufacturing sector suffered the brunt of the country's economic recession).

Table 6 provides the findings about the evolution of N in mining-quarrying, and suggests that at the outset Italy, Spain (line 12), and Germany (line 1) featured the most businesses, while Belgium, Estonia, Lithuania, Luxembourg, Malta and Slovakia featured the least (line 2). Over time, N :

- Increased in Greece, Lithuania, Netherlands, Poland, the Republic of Ireland, Slovakia, and the United Kingdom (lines 15-18).
- Decreased in, Italy, Spain (lines 13, 22), Croatia, Cyprus, France, Hungary, Romania, and Slovenia (line 14).
- Formed a V-shaped pattern in Czechia, Portugal (lines 13, 23-24), Denmark, Finland, and Malta (lines 14, 22).
- Formed a Λ -shaped pattern in Austria, Luxembourg (lines 15, 21), Belgium, Germany (lines 18-19), Bulgaria, Estonia, Latvia, and Sweden (lines 17, 20).
- Rose above the trend during 2011-2012 in Poland (line 26), during 2012-2016 in Italy (line 28), during 2015-2017 in Spain (line 29), and dropped below the trend during 2008-2009 in Spain (line 25), and during 2012-2013 in Greece (line 27). (The finding regarding Greece is attributed by Tzeferis (2014): (a) to the country's sovereign debt crisis and deepening of the economic recession which adversely affected domestic demand for steel, cement and other materials, (b) to volatility in the international markets for raw materials, (c) to the reduction in international metal prices, and (d) to rising energy prices. In other countries the coefficients and periods vary so the explanations may vary as well).

Table 7 provides the findings about the evolution of L/N in manufacture, and suggest that at the outset Slovakia (line 11), Luxembourg (line 10) and Germany (line 1), on average, featured the largest businesses in terms of staff, while France (line 1), Malta (line 2), and Greece (line 3) featured the smallest. Over time, L/N :

- Increased in Austria, Belgium, Croatia, Cyprus, Denmark, Finland, Greece, Hungary, Lithuania, Poland, Portugal, Romania, Sweden, and the United Kingdom (line 14).
- Decreased in Estonia (line 13), Bulgaria, the Netherlands, the Republic of Ireland, (lines 13, 19), Czechia, Latvia, Slovenia, and Spain (lines 13, 20).
- Formed a V-shaped pattern in Slovakia (lines 12, 24), Germany, Luxembourg, and Malta (lines 13, 21-23).
- Formed a Λ -shaped pattern in France and Italy (lines 15-18).
- Rose above the trend during 2011-2015 in Denmark (line 26), and during 2016-2017 in the Republic of Ireland (line 29), and dropped below the trend during 2010-2011 in Slovakia (line 25), during 2012-2015 in Cyprus (line 27), and during 2015-2017 in Lithuania (line 28).

Table 6. *The evolution of the number of businesses (N) in mining-quarrying across the EU, 2008-17 (analyzed with robust standard errors)*

Regressors	Coefficients	P-values
<i>Autonomous components</i>		
1 DE (reference area)	1,618.5	0.000
2 BE, EE, LT, LU, MT, SK	-1,585.1	0.000
3 CY, DK, LV, NL, SI	-1,411.7	0.000
4 AT, BG, GR, HR, IE	-1,237.4	0.000
5 HU	-1,065.9	0.000
6 CZ, SE	-857.1	0.000
7 FI	-721.7	0.000
8 RO, UK	-403.6	0.000
9 PL	-212.9	0.000
10 PT	233.5	0.091
11 FR	292.4	0.000
12 ES, IT	1,504.5	0.000
<i>Time trend</i>		
13 CZ, ES, IT, PT	-220.7	0.000
14 CY, DK, FI, FR, HR, HU, MT, RO, SI	-19.8	0.000
15 AT, IE, LU, UK	3.0	0.023
16 LT	10.8	0.000
17 BG, GR, EE, LV, NL, SE, SK	27.0	0.000
18 BE, DE, PL	68.9	0.000
<i>Time trend squared (captures the rate of change)</i>		
19 BE, DE	-5.6	0.000
20 BG, EE, LV, SE	-2.8	0.000
21 AT, LU	-0.8	0.000
22 DK, ES, FI, MT	2.7	0.000
23 PT	14.8	0.004
24 CZ	20.6	0.002
<i>Time trend squared (captures the rate of change)</i>		
25 ES 2008-2009	-178.7	0.068
26 PL 2011-2012	263.6	0.000
27 GR 2012-2013	-153.7	0.000
28 IT 2012-2016	696.0	0.011
29 ES 2015-2017	753.3	0.022
Observations	251	
Model fitness (R ²)	98,17%	

Note and Source: As in Table 3.

Table 8 provides the findings about the evolution of L/N in mining-quarrying, and suggests that at the outset Poland (line 9), Bulgaria, Romania and Slovakia (line 8), on average, featured the largest businesses in terms of staff, while Belgium, Croatia,

Table 7. *The evolution of the average size of businesses in terms of staff (L/N) in manufacture across the EU, 2008-17 (analyzed with robust standard errors)*

	Regressors	Coefficients	P-values
	<i>Autonomous components</i>		
1	DE (reference area)	36.4	0.000
2	MT	-36.8	0.000
3	FR	-35.6	0.000
4	GR	-31.4	0.000
5	IT, CY PT, CZ	-27.4	0.000
6	BE, IE, ES, HR, LT, HU, PL, SI, SE	-22.8	0.000
7	LV, NL, FI	-20.5	0.000
8	BG, DK, EE, UK	-16.1	0.000
9	AT, RO	-11.8	0.000
10	LU	3.8	0.000
11	SK	35.7	0.000
	<i>Time trend</i>		
12	SK	-17.3	0.000
13	BG, CZ, DE, IE, EE, ES, LV, LU, MT, NL, SI, CZ	-0.6	0.000
14	AT, BE, CY, DK, FI, GR, HR, HU, LT, PL, PT, RO, SE, UK	0.0	0.036
15	IT	0.9	0.050
16	FR	8.5	0.000
	<i>Time trend squared (captures the rate of change)</i>		
17	FR	-0.7	0.000
18	IT	-0.1	0.050
19	BG, IE, NL	0.0	0.001
20	ES, LV, SI, CZ	0.0	0.000
21	DE	0.1	0.000
22	LU	0.1	0.000
23	MT	0.2	0.000
24	SK	1.1	0.000
	<i>Time trend squared (captures the rate of change)</i>		
25	SK 2010-2011	-18.8	0.000
26	DK 2011-2015	3.7	0.000
27	CY 2012-2015	-3.1	0.000
28	LT 2015-2017	-2.5	0.000
29	IE 2016-2017	3.5	0.000
	Observations	251	
	Model fitness (R ²)	97,36%	

Note and Source: *As in Table 3.*

Finland, France, and Malta (line 2), on average, featured the smallest. Over time, L/N:

- Increased in Belgium (line 16), Malta, Portugal, and Sweden (line 15).
- Decreased in Romania (lines 10, 25), Poland, Slovakia (line 11), Germany (line 12), and Luxembourg (line 14).
- Formed a V-shaped pattern in Bulgaria, Estonia, Lithuania, Slovenia (lines 11, 25), Cyprus, Hungary, Latvia, the Republic of Ireland, Spain (lines 13, 24), and Austria (lines 14, 24).
- Formed a Λ -shaped pattern in Greece, Italy, the Netherlands (lines 16, 22), Finland (lines 16, 23), the United Kingdom (lines, 17, 22), Denmark, France (line 18, 21), Croatia, and Czechia (lines 19-20).
- Rose above the trend during 2009-2010 in Croatia (line 27), rose above the trend during 2008-2009 and dropped below the trend during 2010-2011 in Poland (lines 26, 28), and dropped below the trend during in 2013-2014 in Czechia (line 29).

Table 9 provides the findings about the evolution of Q/L in manufacturing, and suggests that at the outset Belgium, the Republic of Ireland (line 13), and the Netherlands (line 12) featured the highest levels, while France (line 2), Malta (line 3), Bulgaria, and Romania (line 4) featured the lowest. Over time, Q/L :

- Increased in Austria, Bulgaria, Czechia, Finland, Germany, Hungary, Italy, Latvia, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, the United Kingdom (line 15), Belgium, Denmark, the Netherlands (line 16), Estonia (lines 16, 23), Sweden (lines 17, 22), and the Republic of Ireland (line 18).
- Formed a V-shaped pattern in Croatia and Cyprus (lines 14, 24-25).
- Formed a Λ -shaped pattern in France (lines 19-20), Greece (lines 17, 21), and Lithuania (lines 16, 22).
- Rose above the trend during 2011-2013 in Belgium (line 26) and during 2015-2016 in France (line 29); and dropped below the trend during 2012-2014 but rose above the trend during 2015-2016 in the Republic of Ireland (lines 27-28).

Table 10 provides the findings about the evolution of Q/L in mining-quarrying, and suggests that at the outset Denmark (line 10), the Netherlands (line 9), Italy, and the United Kingdom (line 8) featured the highest levels, while France (line 2), Belgium, and Croatia (line 3) featured the lowest. Over time, Q/L :

- Increased in Bulgaria, Cyprus, Czechia, Estonia, Finland, Germany, Greece, Hungary, Latvia, Lithuania, Luxembourg, Poland, Portugal, the Republic of Ireland, Slovakia, Slovenia, Spain, and Sweden (line 13).
- Decreased in the United Kingdom (line 12).
- Formed a V-shaped pattern in Denmark (line 11, 24), and Malta (line 12, 23).

- Formed a Λ -shaped pattern in Austria, Romania (lines 14, 22), Belgium (lined 15, 21), Croatia (lines 15, 20), France (lines 16, 19), Italy (lines 16, 18), and the Netherlands (lines 16-17).

Table 8. *The evolution the average size of businesses in terms of staff (L/N) in mining-quarrying across the EU, 2008-17 (analyzed with robust standard errors)*

Regressors	Coefficients	P-values
<i>Autonomous components</i>		
1 CZ, DE, LT, SI, UK (reference area)	45.6	0.000
2 BE, FI, FR, HR, MT	-45.7	0.000
3 CY, DK, GR, IT, PT	-35.7	0.000
4 AT, ES, HU, IE, LV, SE	-30.8	0.000
5 NL	-22.8	0.000
6 LU	-17.4	0.000
7 EE	11.3	0.000
8 BG, RO, SK	40.3	0.000
9 PL	83.5	0.000
<i>Time trend</i>		
10 RO	-9.0	0.000
11 BG, EE, LT, PL, SI, SK	-6.2	0.000
12 DE	-2.3	0.000
13 CY, ES, HU, IE, LV	-1.1	0.000
14 AT, LU	-0.2	0.095
15 MT, PT, SE	0.0	0.076
16 BE, FI, GR, IT, NL	1.9	0.000
17 UK	2.6	0.000
18 DK, FR	5.2	0.000
19 CZ, HR	20.1	0.000
<i>Time trend squared (captures the rate of change)</i>		
20 CZ, HR	-1.9	0.000
21 DK, FR	-0.5	0.000
22 GR, IT, NL, UK	-0.2	0.000
23 FI	-0.1	0.000
24 AT, CY, DE, ES, HU, IE, LV	0.1	0.000
25 BG, EE, LT, RO, SI	0.4	0.000
<i>Time trend squared (captures the rate of change)</i>		
26 PL 2008-2009	8.8	0.028
27 HR 2009-2010	14.4	0.006
28 PL 2010-2011	-14.8	0.000
29 CZ 2013-2014	-10.8	0.005
Observations	251	
Model fitness (R ²)	98.13%	

Note and Source: *As in Table 3.*

Table 9. The evolution of labor productivity (Q/L) in manufacture across the EU, 2008-17 (analyzed with robust standard errors) (in thousand euro)

Regressors	Coefficients	P-values
<i>Autonomous components</i>		
1 DE (reference area)	0.2209	0.000
2 FR	-0.3888	0.000
3 MT	-0.2290	0.000
4 BG, RO	-0.1905	0.000
5 EE, LT, LV	-0.1746	0.000
6 HR	-0.1564	0.000
7 PL, PT	-0.1351	0.000
8 CY, CZ, GR, HU, SI, SK	-0.1195	0.000
9 DK, ES, IT, SE, UK	-0.0118	0.004
10 AT	0.0213	0.000
11 FI, LU	0.0535	0.000
12 NL	0.1168	0.000
13 BE, IE	0.1682	0.000
<i>Time trend</i>		
14 CY, HR	-0.0036	0.001
15 AT, BG, CZ, DE, ES, FI, HU, IT, LU, LV, MT, PL, PT, RO, SI, SK, UK,	0.0034	0.000
16 BE, DK, EE, LT, NL	0.0114	0.000
17 GR, SE	0.0179	0.000
18 IE	0.0495	0.000
19 FR	0.1542	0.000
<i>Time trend squared (captures the rate of change)</i>		
20 FR	-0.0136	0.000
21 GR	-0.0014	0.000
22 LT, SE	-0.0008	0.000
23 EE	-0.0005	0.000
24 CY	0.0003	0.000
25 HR	0.0004	0.000
<i>Time trend squared (captures the rate of change)</i>		
26 BE 2011-2013	0.0391	0.000
27 IE 2012-2014	-0.0881	0.000
28 IE 2015-2016	0.1213	0.004
29 FR 2015-2016	0.1223	0.001
Observations	251	
Model fitness (R^2)	98.66%	

Note and Source: As in Table 3.

Table 10. *The evolution of labor productivity (Q/L) in mining-quarrying across the EU, 2008-17 (analyzed with robust standard errors) (in thousand euro)*

Regressors	Coefficients	P-values
<i>Autonomous components</i>		
1 CY, DE, ES (reference areas)	0.161	0.000
2 FR	-0.458	0.000
3 BE, HR	-0.259	0.000
4 RO	-0.160	0.000
5 BG, CZ, GR, EE, HU, LT, LV, MT, PL, PT, SI, SK	-0.087	0.000
6 AT, FI, IE, LU	0.109	0.000
7 SE	0.248	0.000
8 IT, UK	0.948	0.000
9 NL	1.923	0.000
10 DK	2.703	0.000
<i>Time trend</i>		
11 DK	-0.377	0.001
12 MT, UK	-0.051	0.000
13 BG, CY, CZ, DE, EE, ES, FI, GR, HU, IE, LT, LU, LV, PL, PT, SE, SI, SK	0.002	0.001
14 AT, RO	0.047	0.000
15 BE, HR	0.132	0.000
16 FR, IT, NL	0.226	0.000
<i>Time trend squared (captures the rate of change)</i>		
17 NL	-0.031	0.000
18 IT	-0.022	0.000
19 FR	-0.019	0.000
20 HR	-0.012	0.000
21 BE	-0.010	0.000
22 AT, RO	-0.004	0.000
23 MT	0.006	0.000
24 DK	0.026	0.002
<i>Time trend squared (captures the rate of change)</i>		
25 IT 2009-2010	-0.276	0.004
26 IT 2011-2012	0.404	0.000
27 NL 2012-2013	0.319	0.000
28 NL 2014-2016	-0.318	0.000
29 IT 2014-2016	-0.129	0.007
Observations	251	
Model fitness (R ²)	98.76%	

Note and Source: As in Table 3.

- Dropped below the trend during 2009-2010, rose above the trend during 2011-2012 and again dropped below during 2014-2016 in Italy (lines 25-26, 29); rose

above the trend during 2012-2013, and dropped below during 2014-2020 in the Netherlands (lines 27-28).

Table 11 brings together all long-run trend components estimated above,⁷ and suggest that there existed both considerable heterogeneity in the evolution of the four business measures across the EU member-states –especially the measures about N and L/N – and, also, some similarities. Indeed, of the 28 countries:

- In manufacture, 23 countries (82%) exhibited an upward Q/L trend,⁸ 18 countries (64%) exhibited an upward P trend,⁹ 16 countries (57%) exhibited both,¹⁰ two more countries exhibited very similar V-shaped Q/L and P patterns,¹¹ so, overall, 18 countries (64%) exhibited similar Q/L and P long-run patterns. (The latter is also illustrated in the first two columns of Table 12.) Of the 16 countries, 13 countries (46%) exhibited upward trends in Q/L , P and a third business measure.¹² In addition, 14 countries (50%) exhibited an upward L/N trend,¹³ while the desirable (employment-wise) situation of upward L/N and N trends was observed only in Sweden, Lithuania, and Cyprus: countries with an initially modest or small number of (typically, small or micro) businesses. By contrast, only two countries (Spain and Bulgaria) exhibited downward N and L/N trends.
- 15 countries (54%) exhibited upward Q/L trends in both manufacture and mining-quarrying,¹⁴ and another country (France) exhibited very similar V-shaped Q/L patterns in both sectors, so, overall, 16 countries (57%) exhibited similar Q/L long-run patterns in the two sectors. 15 countries exhibited opposite (upward, downward, mixed or switching) P trends in the two sectors,¹⁵ and very few countries exhibited opposite L/N trends (Poland, Romania) or Q/L trends (Croatia, the United Kingdom)¹⁶ in the two sectors.

To illustrate the heterogeneity and similarities in terms of trends, Table 12 reorganizes the information regarding manufacture that is provided in Table 11, and Table 13 reorganizes the information regarding mining-quarrying that is provided in Table 11. Insofar as the:

- P and Q/L trends in Austrian, Danish, Hungarian, Polish, Portuguese, Romanian, British and Irish, Bulgarian, Czech, Dutch, Estonian, Latvian, Slovenian, Croatian, Cypriot, German, Slovak manufacture (18 countries, see Table 12, columns 1-3), and in Croatian, Dutch, Swedish, Austrian, Belgian, British, Bulgarian, Estonian mining-quarrying (eight countries, see Table 13, columns 1-2) were in the same direction, we may conclude that that circumstances there differed from other countries. Along the same lines as the P and Q/L trends in Belgian, Finnish, Swedish, Italian, Maltese manufacture (five countries, see Table 12, columns 4-5), and in Portuguese, German, Luxembourgian, Polish, Slovak, Czech, Cypriot, Finnish, Greek, Hungarian, Latvian, Lithuanian, Slovenian mining-quarrying (13 countries, see Table 13, columns 3-5) were in opposite directions, we may conclude that circumstances there were also differed from other countries.

Table 11. An overview of the trends of the four business measures observed in manufacture and mining-quarrying across the EU, 2008-17

	Manufacturing				Mining-quarrying			
	p	N	L/N	Q/L	p	N	L/N	Q/L
AT	/	V	/	/	Λ	Λ	V	Λ
BE	-	\	/	/	Λ	Λ	/	Λ
BG	/	\	\	/	/	Λ	V	/
CY	V	/	/	V	-	\	V	/
CZ	/	/	\	/	\	V	Λ	/
DE	/	Λ	V	/	\	Λ	\	/
DK	/	V	/	/	\	V	Λ	V
EE	+	/	\	/	/	Λ	V	/
ES	V	\	\	/	V	\	V	/
FI	\	\	/	/	-	V	Λ	/
FR	/	Λ	Λ	Λ	\	\	Λ	Λ
GR	\	\	/	Λ	-	/	Λ	/
HR	V	\	/	V	Λ	\	Λ	Λ
HU	/	V	/	/	-	\	V	/
IE	/	V	\	/	V	/	V	/
IT	-	\	Λ	/	\	\	Λ	Λ
LT	+	/	/	Λ	-	/	V	/
LU	V	\	V	/	-	Λ	\	/
LV	+	/	\	/	-	Λ	V	/
MT	-	\	V	/	-	V	/	V
NL	/	/	\	/	Λ	/	Λ	Λ
PL	/	V	/	/	-	/	\	/
PT	/	V	/	/	-	V	/	/
RO	/	V	/	/	\	\	\	Λ
SE	-	/	/	/	/	Λ	/	/
SI	+	/	\	/	-	\	V	/
SK	/	/	V	/	-	/	\	/
UK	/	V	/	/	\	/	Λ	\

Key for symbols

Results associated with $p\text{-value} \leq 10\%$

Upward trend: /

Downward trend: \

Peak followed by recession: Λ

Trough followed by recovery: V

Results associated with $p\text{-value} > 10\%$

Upward trend: +

Downward trend: -

Source: Tables 3-10.

- Q/L and L/N trends in Austrian, British, Danish, Hungarian, Polish, Portuguese, Romanian, Belgian, Finnish, Swedish, French manufacture (eleven countries, see Table 12, columns 1, 4 and 6), and in Croatian, Dutch, Swedish, Portuguese, French, Italian mining-quarrying (six countries, see Table 13, columns 1, 3 and 6) were in the same direction, we may conclude that conditions and circumstances

there differed from other countries. Along the same lines, as the Q/L and L/N trends in Bulgarian, Czech, Dutch, Estonian, southern Irish, Latvian, Slovenian, Spanish manufacture (eight countries, see Table 12, columns 2 and 7), and in German, Luxembourgian, Polish, Slovak, Danish mining-quarrying (five countries, see Table 13, columns 4 and 7) were in opposite directions, we may conclude that conditions and circumstances there differed from other countries.

Table 12. Another view of the trends of the four business measures observed in manufacture across the EU, 2008-17

Q/L and L/N trends		P and Q/L trends							P	N	L/N	Q/L
		similar			opposite		other					
similar	opposite	other	similar	other	similar	opposite	other					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)					
AT, DK, HU, PL, PT, RO, UK								/	V	/	/	
	BG							/	\	\	/	
	CZ, NL							/	/	\	/	
	EE, LV, SI							+	/	\	/	
	IE							/	V	\	/	
		DE						/	Λ	V	/	
		SK						/	/	V	/	
		CY						V	/	/	V	
		HR						V	\	/	V	
			FI					\	\	/	/	
			BE					-	\	/	/	
			SE					-	/	/	/	
				IT				-	\	Λ	/	
				MT				-	\	V	/	
					FR			/	Λ	Λ	Λ	
						ES		V	\	\	/	
							GR	\	\	/	Λ	
							LT	+	/	/	Λ	
							LU	V	\	V	/	

Key for symbols

Results associated with $p\text{-value} \leq 10\%$	Results associated with $p\text{-value} > 10\%$
Upward trend: /	Upward trend: +
Downward trend: \	Downward trend: -
Peak followed by recession: Λ	
Trough followed by recovery: V	

Source: Table 11.

Table 13. Another view of the trends of the four business measures observed in mining-quarrying across the EU, 2008-17

similar		P and Q/L trends opposite			other			P	N	L/N	Q/L
similar	other	similar	opposite	other	similar	opposite	other				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)				
SE								/	Λ	/	/
HR								Λ	\	Λ	Λ
NL								Λ	/	Λ	Λ
	BG, EE							/	Λ	V	/
	UK							\	/	Λ	\
	AT							Λ	Λ	V	Λ
	BE							Λ	Λ	/	Λ
		PT						-	V	/	/
			DE					\	Λ	\	/
			LU					-	Λ	\	/
			PL, SK					-	/	\	/
				CZ				\	V	Λ	/
				CY, HU, SI				-	\	V	/
				GR				-	/	Λ	/
				LT				-	/	V	/
				FI				-	V	Λ	/
				LV				-	Λ	V	/
					FR, IT			\	\	Λ	Λ
						DK		\	V	Λ	V
							RO	\	\	\	Λ
							MT	-	V	/	V
							ES	V	\	V	/
							IE	V	/	V	/

Key for symbols

Results associated with $p\text{-value} \leq 10\%$

Upward trend: /

Downward trend: \

Peak followed by recession: Λ

Trough followed by recovery: V

Results associated with $p\text{-value} > 10\%$

Downward trend: -

Source: Table 11.

5. Conclusions

The paper empirically estimates and contrasts the long-run trends regarding (a) the number of businesses, (b) the average size of business, (c) labor productivity, and

(d) production value in the manufacturing and in mining-quarrying sectors across the EU-28, from 2008-2017.

It finds that 23 (82%) of the member-states exhibited an upward labor productivity trend in manufacture; and over 17 (60%) of the member-states (not necessarily the same member-states) exhibited: (i) an upward labor productivity trend in mining-quarrying, (ii) an upward production value trend in manufacture, (iii) a downward production value trend in mining-quarrying, and (iv) production value and productivity trends in manufacture that were similar to each other (either upward or V-shaped). These suggest that while production value and productivity by and large seemed to go hand-in-hand in manufacture, the same was not as widespread in mining-quarrying. In addition, if it is true that an economy's ability to improve its standard of living over time depends on its ability to raise its output per worker (Krugman, 1994), then the upward labor productivity trends exhibited by the majority of the EU member-states in both sectors provides (a) an encouraging sign for the block's broad economic social policy objectives, as well as (b) useful paradigms for the other member-states.

The long-run patterns of the other business measures considered, namely the trends regarding business sizes and numbers in manufacture and mining-quarrying, were more diverse and evenly split across the EU. Accordingly, very few countries exhibited (a) both upward business number and business size trends in manufacture, (b) both downward business number and business size trends in manufacture, (c) both downward business number and business size trends in mining-quarrying (even though the pattern was observed at the aggregate (EU) level), and (d) no country exhibited both rising business number and size trends in mining-quarrying.

Overall, the findings suggest the presence of considerable diversity in the trends and the mid-term deviations from one country to another (within sectors) and from one sector to the other (in the same country), as well as similarities. These are interesting for both business decisions and sectoral policy making. It is conceivable that the differences in all four measures are more pronounced at the subsectoral (activity) or subnational (regional) level; however, the production value and productivity figures are not available at the subnational level in the Eurostat dataset.

The switches in the trends and mid-term deviations from the trends, which are empirically pinpointed in time, sectors, and space, deserve a closer look. Their discovery facilitates: (a) Future research on the causes behind the said switches and deviations for they may help narrow down (from the multitude of events and announcements that occur over time) the likely causes: a change in the policy mix or in circumstances, some government announcement, and so on. Following that: (b) The refinement of business, sectoral or territorial development policy, the repetition/replication of what affected the upward trends or mid-term deviations, and the avoidance in the same or other countries of what affected downward trends or mid-term deviations.

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Notes:

¹ Another obvious measure is profitability. However, in the data it is proxied via the ratio of gross operating surplus over turnover, which may make sense in a macroeconomic (national account) context, but differs from the microeconomic notion or company account figure and, hence, may not well capture the factors shaping business behavior and performance. Other datasets may provide more appropriate measures of profitability but less appropriate measures of productivity or feature other limitations (e.g., Madaleno and Bărbuță-Mișu, 2019).

² <https://ec.europa.eu/eurostat/data/database>, under the heading "Industry, trade and services", and sub-headings "Structural business statistics", and "Main indicators".

³ For instance, if L/N and Q/L were largely influenced by L . On the other hand, the movement of L/N and Q/L in the same direction: (a) may be attributed to the movements of Q and N , (b) recalls the findings of Bento and Restuccia (2017) about business size and GDP per capita, (c) is consistent with rising (falling) labor productivity driving business expansion (contraction), and/or with the relative ability (inability) of larger (smaller) businesses to acquire factors that allow their workforce to be more productive.

⁴ The *short-term* is usually taken to denote an interval *smaller than or up to a year*, so the *medium term* is viewed as a somewhat lengthier interval of time. In this case, it turns out to span two to five years as suggested by Begg et al. (2008), Carnot et al. (2011), and others. Its algorithmic identification/derivation process is outlined in the second half of Section 3 and, hence, the overall number of 'm's depends on the regressors-to-observations ratio. See also next note.

⁵ Their number ranges between 4 and 6; and adds pertinent information that would otherwise be missing. There are no changes in the other coefficients or their *p-values*.

⁶ Though Greece was the EU member-state affected the longest by the sovereign debt crisis, the downward P trend in manufacture was about the same as in Finland, the downward N trend was about the same as in Italy (in other member-states the downward trend was milder), while the slightly upward L/N trend in manufacture was similar to the that of many other member-states. The above suggest that to some or considerable extent, the Greek sectoral patterns and shifts were not idiosyncratic but in line with broader developments in the sector. In addition, the rise in L/N in manufacture was more in line with producer activity aiming to maintain or bring up individual production and compete for a market share rather than collude by reducing individual production. Obviously, the country's mining-quarrying sector was affected differently.

⁷ These are the best estimates we have: all obtained from the empirical analysis.

⁸ Belgium, Finland, Italy, Luxembourg, Malta, Spain, Sweden, plus the countries listed in note 10.

⁹ France, Lithuania, plus the countries listed in note 10

¹⁰ Austria, Bulgaria, Czechia, Denmark, Estonia, Germany, Hungary, Latvia, the Netherlands, Poland, Portugal, Republic of Ireland, Romania, Slovakia, Slovenia, United Kingdom.

¹¹ Croatia and Cyprus (each) with the extrema occurring within a year according to the first order conditions of expression (1) regarding Q/L and P , with respect to time. Interestingly, the notable 2013-2014 (medium-term) fluctuations of Q/L and P in the Republic of Ireland were in the same direction (both dropped).

¹² Seven (Austria, Denmark, Hungary, Poland, Portugal, Romania, the United Kingdom) in P , Q/L , and L/N , and six (Czechia, Estonia, Latvia, the Netherlands, Slovenia, Slovakia) in P , Q/L , and N .

¹³ Austria, Belgium, Croatia, Cyprus, Denmark, Finland, Greece, Hungary, Lithuania, Poland, Portugal, Romania, Sweden, United Kingdom. Of these, Lithuania exhibited upward trends in all P , L/N and N .

¹⁴ Bulgaria, Chechia, Estonia, Finland, Germany, Hungary, Latvia, Luxembourg, Poland, Portugal, the Republic of Ireland, Spain, Sweden, Slovakia, Slovenia.

¹⁵ Czechia, Denmark, France, Germany, Hungary, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, the United Kingdom exhibited upward trends in manufacture and downward trends in mining-quarrying. Sweden exhibited a downward trend in the former sector and an upward trend in the latter sector, while Croatia exhibited a V-shaped pattern in the former and a Λ -shaped pattern in the latter with the extrema occurring within a year.

¹⁶ The two Croatian patterns were opposite with the extrema occurring within a year.