Specialization or diversification of local production systems - Size matters?

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Abstract

Specialization or diversification? The theoretical and empirical literature on the economic growth of regions and local production systems has studied the links between a region's economic development and the structural characteristics of its specialization pattern. Several analyses have shown how gradual diversification of a region's economic structure can sustain its growth and reduce its vulnerability to external shocks. Others continue to emphasize the importance of specialization consistent with the region's comparative advantages. This study aims to contribute to this empirical literature by exploring the idea that the choice between diversification and specialization may depend on the economic size of the production system. The underlying hypothesis is that an effective diversification process requires a minimum endowment of productive resources, which makes the "critical mass" necessary to expand the region's basket of comparative advantages. Our results show that provinces that have concentrated their production structure in specific areas of comparative advantage over the years have improved their export performance. The same results also appear when controlling for the economic size of the provinces, with some difference in the significance of the results for the class of larger provinces.

Keywords: *Export specialization, export diversification, economic size, export performance, local development.*

JEL classification: C23, F14, R11, R12

[Advanced draft]

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Introduction

The latest wave of globalization and the phase of instability, which began with the great economic crisis of 2008, have shown how local economies are vulnerable to external shocks, mainly if their production structure is concentrated in sectors more exposed to the risk of significant fluctuations in world demand. On the other hand, under certain conditions, international economic integration has reinforced the resilience of local economies to exogenous disturbances by improving their industrial systems and spreading knowledge across firms. Therefore, a better understanding of the complex relationships between the structure of local economies and their performance in external markets is essential to explain the wide divergence between their growth rates and to devise appropriate regional development policies.

In recent decades, there has been substantial debate in the economic literature about the pattern of economic development that is most effective in coping with the remarkable dynamism of the world economy. On the one hand, we find advocates of the need for high specialization in a few areas of comparative advantage; on the other, there are those oriented towards promoting a broadly diversified economic structure. Contributions on the subject are very numerous and often with conflicting results. With this paper, we intend to contribute to the literature on the subject by focussing on the impact of diversification on the growth of local economies. To pursue this objective, we first observe how different specialization patterns affect the export performance of the areas examined and then test their effects on labour productivity. We analyzed a relatively large balanced panel of 103 Italian provinces (NUTS-3 level) from 1995 to 2021.

In the first section, we provide a broad literature overview. In the second section, divided into three parts, we present the paper's empirical strategy, its econometric specification's main features, an in-depth review of the sectoral specialization indices considered and a description of the large dataset used. In the third section, after showing the main trends of sectoral specialization indices of Italian provinces in recent decades, we present and discuss the results of the econometric estimates. Finally, in the last section, we focus on the main insights from the analysis, with an eye towards possible policy implications.

1. Literature review

The literature on regional economic resilience has flourished in the last few years. Although the heuristic power of the concept and its empirical specification is still controversial, increasing interest surrounds the idea that the structural features of local economic systems may exert a significant influence on their ability to resist and overcome external shocks (Christopherson, Michie and Tyler, 2010; Fingleton, Garretsen and Martin, 2012; OECD, 2013; Augustine et al., 2016; Martin & Sunley, 2015; Brown & Greenbaum, 2017). The quality of economic structures can be assessed from different perspectives. One influential strand of literature aims to illuminate why and under what conditions regions characterized by a diversified portfolio of productions tend to perform better than more specialized regions. On the one hand, the territorial concentration of different firms belonging to the same sector can activate various forms of intra-industry externalities, as described by Marshall (1890), Becattini (1979, 1990) and Porter (1990), which can explain the success of specialized industrial districts. On the other hand, knowledge spillovers among proximate firms belonging to different industries, as Jacobs (1969) highlighted, can be conceived as diversification externalities, which can favour more complex economic systems.

Following the former approach, the transmission of knowledge would be significantly more effective among companies in the same sector, allowing specialized production systems to progress much faster. However, the evidence in the literature on productivity increases in the presence of specialization is different and sometimes conflicting. In their review of the empirical research, De Groot et al. (2009) show that only a fraction of the studies confirm that specialization spillovers significantly impact productivity.

Following the other approach, the main advantages of a diversified sectoral structure of a region identified by the literature are three. The first refers to the presence of relations between different sectors, allowing a process of cross-fertilization that favours radical product innovations (Glaeser et al., 1992) and contributes significantly to the economic growth of a region (Fujita, Krugman and Venables, 1999). Scherer (1982) confirms this relationship and finds that around 70% of innovations in an industry come from inputs outside the industry. The second mechanism concerns the ability of a diversified economy to better respond to the needs of the labour market, favouring an increase in employment (Boschma & Iammarino, 2009). The need for many complex and diversified skills characterizes modern economies. A relatively diversified industrial structure

can facilitate the search for these skills. Along the same lines, the extensive review of empirical work proposed by De Groot et al. (2009) frequently finds a positive relationship between the trend in the employment rate of a region and the presence of a diversified industrial structure. The third reason to prefer a diversified economic structure is based on those advantages typically discussed by economists dealing with business portfolio theory. Sector diversification reduces the vulnerability of an economic area to economic fluctuations and, above all, to asymmetric shocks (Attaran, 1986; Koren & Tenreyro, 2003).

Empirical studies on the diversity of countries' productive structures and their relationship to economic development flourished after the seminal paper by Imbs and Wacziarg (2003). In this study, they use value-added data from 99 economies at various stages of development to measure the concentration of their productive structures. As a result of their non-parametric estimation, the authors obtained a U-Shaped diversification curve that reflects a two-stage economic development path related to the maturity and ability to use production factors efficiently. In the early stage, economic development is associated with an increase in the diversity of economic structures, while at a later stage, the opposite relationship prevails.

Since then, given the greater detail of trade statistics, the focus has shifted towards analyzing the variety observed in trade specialization patterns and their relationship with economic growth. These papers expanded the set of the analyzed countries and either added more explanatory variables or modified the methodology of measuring and estimating diversification (Basile et al., 2018; Cadot et al., 2011; Parteka, 2010; De Benedictis et al., 2009).

However, the economic literature on diversification highlighted that the possible, resulting advantages occur only in some conditions. The contribution of Frenken et al. (2007) enters the debate by distinguishing between a 'related' and 'unrelated' variety of regional economic structures. The first case refers to a region with a diversified economic structure but in interconnected and complementary sectors. According to the authors, only in this case can the advantages of innovation and employment materialize. Conversely, the region diversified into disconnected and unrelated sectors might better prevent the risk associated with asymmetric shocks and thus preserve employment in the area. The approach adopted by Frenken et al. (2007) has been followed by most of the subsequent theoretical and empirical contributions (e.g. Boschma and Iammarino, 2009; Kemeny & Storper, 2015).

Another strand of research starts from the seminal contributions by Hausmann and Rodrik (2003), Hausmann, Hwang and Rodrik (2007) and Tacchella et al. (2013). Countries that can upgrade the 'complexity' or the 'fitness' of their exports tend to have a better performance than countries remaining stuck to the specialization dictated by their initial comparative advantages.

In this context, some studies have investigated, at the Italian province level, both the evolution of product variety and the importance of the degree of 'complexity' of the local production bundles for subsequent economic growth (Boschma & Iammarino, 2009; Coniglio et al., 2016). These papers show that provinces that can upgrade the variety or complexity of their exports tend to have better economic growth performance than areas highly specialized in their initial comparative advantages.

Assessing the relative importance of specialization and diversification externalities is difficult, as these mechanisms can work in the same economic system as intra- and inter-industry spillovers. A crucial variable affecting their relevance is the size of the economic system in which they are generated. Other things being equal, larger economic systems can easily accommodate a diversified productive structure, allowing for significant inter-industry externalities. In contrast, smaller territorial systems may need more room for diversification.

This contribution enters the literature to focus attention on this problem. Specialization and diversification will not be put in opposition; on the contrary, we will try to identify the territorial characteristics, mainly in terms of economic dimension, most suitable for a specialized or diversified industrial structure.

We hypothesize that an effective diversification process requires a minimum endowment of productive resources, making the "critical mass" necessary to expand the region's comparative advantages basket.

To test our hypothesis, we will use the data on merchandise exports of the 103 Italian provinces (NUTS-3), disaggregated according to the statistical classification of economic activities in the European Community (3 digits NACE Rev.2) from 1995 to 2021.

We will study how the diversification of the sector structure of provincial exports affects several aggregate variables, such as export performance (Iapadre, 2018), labour productivity growth (Serrano & Cabrer, 2004; Lee et al., 2005; Boschma & Iammarino, 2009); employment rate (Cainelli & Leoncini, 1999; Combes, 2000; Boschma & Iammarino, 2009) and value-added growth rate (Boschma & Iammarino, 2009; Coniglio et al., 2016).

The relationship between diversification and economic performance will be checked against the economic size of the provinces, controlling for other variables such as human capital, capital-labour ratio, and institutional quality.

2. Empirical analysis

We study how the structural characteristics of the specialization patterns of Italian provinces affect their export performance from 1995 to 2021, controlling for the economic size of the provinces. Our empirical strategy involves measuring export performance through the absolute change in the export share of Italian provinces, adjusted for the composition effects highlighted by the constant-market-shares (CMS) statistical technique. Changes in the structural features of their specialization patterns are measured through the absolute variations of several indicators proposed in the literature, allowing for a more robust and statistically significant analysis. The estimate is conducted initially without controlling for the economic size of the provinces. Later, the study considers the heterogeneity of the different economic dimensions of the territories. We organize the section as follows: the first subsection explains the specifics of the model and the econometric estimation techniques; the second part describes the dataset; and the third shows an in-depth methodological discussion of the variables used for the analysis.

2.1 Econometric strategy

Our empirical strategy aims to estimate the effect of the diversification of Italian provinces' specialization pattern on their export performance. To this end, we operate the analysis in two parts: the first in which we test the effect of specialization patterns on export performance without controlling for the economic size of provinces, and the second in which we account for the heterogeneous effects of economic size. To disentangle the effect of economic size, we divided provinces according to the quartiles of the distribution of their average export value logs between 1995 and 2021 (Table 1)[5].

The specification of the equation that we use in the analysis without controlling for the economic size of provinces is as follows:

[5] The log-transformation is widely used to deal with skewed distribution as in the case of the value of export. For further information see Lee K. D., 2020.

$$Y_{it} - Y_{it-1} = \beta_0 + \beta_1(X_{it} - X_{it-1}) + \mu_i + \eta_t + \epsilon_{it} \quad (1)$$

Where i is the subscript for Italian provinces and t indicates time. $Y_{it} - Y_{it-1}$ represents the change in the export share of Italian provinces relative to the national share adjusted for composition effects (the competitiveness effect of the CMS analysis), $X_{it} - X_{it-1}$ measures the change in diversification indicators, μ_i indicates province fixed effects, η_t indicates year fixed effects, and ϵ_{it} represents the robust standard error. The specification that accounts for size differs only in the subscript representing the four groups of provinces divided by economic size:

$$Y_{ikt} - Y_{ikt-1} = \beta_0 + \beta_1(X_{ikt} - X_{ikt-1}) + \mu_{ik} + \eta_{it} + \epsilon_{ikt} \quad (2)$$

In this case, the subscript k indicates the four different groups into which the provinces are divided according to their economic size. For each group, there will be a different equation and econometric estimate. Following the primary references in the literature (Boschma & Iammarino, 2009; Kemeny & Storper, 2015; Frenken et al., 2007) to estimate both equations, we use both the standard OLS model in the absence of fixed effects and the Two-Way Fixed Effect (TWFE) model by adding fixed effects by year and by province. Unlike the OLS estimator, the TWFE allows us to control for unobserved variables and provides robustness to the variance explained by the model.

2.2 Data

In this paper, we conduct the empirical analysis using data on export value for 103[6] Italian provinces (NUTS3) from 1995 to 2021 at the highest available level of commodity disaggregation (3-digit NACE Rev. 2, 2008). The Italian Institute of Statistics (ISTAT) makes foreign trade statistics available on the Coeweb platform.

[6] Currently, the number of Italian provinces is 107. To obviate the various administrative changes that have occurred throughout the historical series, we have aggregated the data of the provinces to make their numbers homogeneous throughout the period analyzed. In particular, the province of Olbia-Tempio are included in that of Sassari; the province of Ogliastra in that of Nuoro; the provinces of Medio-Campidano, Carbonia-Iglesias and Sud-Sardegna in that of Cagliari; the province of Monza and Brianza in that of Milan; the province of Barletta-Andria-Trani in that of Bari; and the province of Fermo in that of Ascoli-Piceno.

Table 2 shows the main descriptive statistics of the variables used in our empirical analysis. Specifically, our dependent variable is the CMS Competitiveness Effect, which measures the weighted average of changes recorded by each province in each Italian export market sector, net of compositions effects[7].

2.3 Measures of diversification of export specialization patterns

In this subsection, we present the indices of sectoral diversification used as explanatory variables in the analysis.

The most intuitive indicator of sectoral diversification is the number of sectors with revealed comparative advantage, expressed as a percentage of the total number of sectors:

$$RCAN_i = m_i/n$$

where m is the number of sectors in which the specialization indices of the province i are positive, while n is the total number of sectors.[8]

Small local economies tend to concentrate their comparative advantages in a few sectors, as available resources limit their ability to differentiate production. The extreme case in which a province is fully specialized in only one sector represents the maximum concentration level. On the other hand, a geographical area cannot specialize in all sectors since, by definition, any comparative advantage in one production implies a comparative disadvantage in at least one of the other sectors considered. Therefore, the number of sectors of comparative advantage cannot grow up to the total number of sectors. The maximum level of diversification is reached if the economy does not show specialization, that is, if the SXP index is equal to zero in each sector or, in other words, if the market shares of provincial exports are equal across sectors. The RCAN index's main limitation is its inability to discriminate between sectors based on size. Thus, a local economy that reveals a comparative advantage in a given number of large sectors would show the same concentration level as a region specializing in an equal number of small productions.

The second measure considered in our analysis is the sectoral concentration index of Herfindahl-Hirschman (Hi), often used in the empirical literature on international trade:

[7] The specification used for CMS analysis is described in Memedovic and Iapadre (2010).

[8] The measure of revealed comparative advantages used in this index ranges between -1 and 1 (see Iapadre, 2018).

$$H_i = \sqrt{\sum_k \left(x_{ik} / \sum_k x_{ik} \right)^2}$$

where x is the value of exports of province *i* in sector *k*.

The range of variation of this index depends on the number of sectors considered in the distribution. More precisely, it equals 1/n when all n sectors have the same weight in export value, reaching a maximum level of 1 if exports are concentrated in only one sector. To make the range of variation of the indicator homogeneous (between 0 and 1), we will consider the normalized version, which is the following:

$$NH_i = (H_i - 1/n)/(1 - 1/n)$$

However, we must stress that both H-H index variants are based on a comparison between the actual distribution of the data and an abstract benchmark of equidistribution between the observed statistical units. This benchmark may be reasonable when the index is applied to individual households or firms. However, it is much less so when the index is used to study the concentration of distribution between statistical units that are inherently very different in size, such as sectors or partner countries. The sectoral boundaries used in trade classifications are not aimed at identifying units of comparable size. Indeed, there is no reason to expect the exports of a large sector to have the same weight as those of a small sector (i.e. consider the automotive and the musical instrument sectors).

An alternative approach, which does not refer to the equidistribution benchmark, is based on comparing each province's sectoral distribution and the national average. Local economies tend to concentrate their productive resources in comparative advantage sectors, so their export structure differs from the average of other localities.

This view can also be related to the debate on optimal currency areas, particularly Kenen's criterion (Kenen, 1969). The vulnerability of an economy to external shocks can be related not to the absolute degree of concentration of its productive structure but its degree of dissimilarity concerning partner economies. For any given concentration level, a sector shock will mainly affect local economies specializing in the sector affected by the shock. Hence, if production structures are similar across regions, any sector shock will not be asymmetrical, as it will similarly

harm all local economies. Conversely, a substantial dissimilarity to the rest of the country exposes the local economy to more significant risks of idiosyncratic shocks.

The Finger-Kreinin Dissimilarity Index (FK) offers a simple way to measure the diversity of export structures between provinces, which is as follows:

$$FK_i = 1/2 \sum_k |(x_{ik}/x_{i.}) - [(x_{.k} - x_{ik})/(x_{..} - x_{i.})]|$$

where x_{ik} indicates the value of province *i*'s exports of sector *k,* $x_{i.}$ indicates the value of total exports of province *i*, $x_{.k}$ the value of Italian exports of the sector *k* and $x_{..}$ the value of total Italian exports. FK_i compares a province's sectoral distribution of exports with that of the other Italian provinces. This index is null if the structure of exports by sectors of a province is precisely equal to the average of the others and varies up to a maximum of one, which is reached when a given sector represents the only export item of a single province of the country (perfect concentration and dissimilarity).

Frenken et al. (2007) have explored the concept of diversification of the productive structure of an economy, distinguishing between two different forms of variety, called "related variety" and "unrelated variety". According to their approach, ceteris paribus, an economy characterized by a relatively large presence of related sectors, grows faster than a highly specialized economy and a diversified economy oriented towards mutually unrelated sectors. In principle, assessing the links between sectors would require detailed information on their production functions. Even input-output tables would not be sufficient to ascertain the presence of cognitive spillovers, which often go beyond the supply chain links. A widely used indicator is based on Theil's concept of entropy and has been applied to the study of specialization models by Frenken et al. (2007). The driving idea is that Jacobs's externalities emerge more easily between related productions within each sector than between different and unrelated sectors. Hence, the authors measure the unrelated variety by the Theil entropy index between different sectors:

$$UV_i = \sum_k w_k \, log_2(1/w_k)$$

where $w_k = x_{ik}/x_{i.}$

On the other hand, related variety is measured by a similar index calculated between different products (p) within each sector and its aggregate measure for each economy is given by the weighted average of the related variety indicators of the different sectors:

$$RV_i = \sum_k w_k V_k$$

where $V_k = \sum_p w_{pk}\, log_2(1/w_{pk})$ e $w_{pk} = x_{ip}/x_{ik}$

The properties of the Theil entropy index ensure that the total variety between sectors is equal to the sum of the related and unrelated variety. The problem with these indicators is that their heuristic power is strongly influenced by the quality of the statistical classification available, particularly by the reliability of the distinction between sectors and products.

However, even ignoring this problem, it should be emphasized that the entropy index is also a measure of diversification. Hence it is an inverse function of the degree of concentration. Its maximum corresponds to the case where all statistical units (sectors or products) have the same weight (equidistribution). As already stated in our discussion of the Herfindahl-Hirschman index, the equidistribution benchmark appears unreasonable when the size of the statistical units of observation is inherently different. Thus, even in this case, a helpful approach could be to measure the dissimilarity between the different provinces' related (unrelated) variety and the national average. If the intra-sectoral entropy differs from the national average, this gap can be used to measure *relative* related (unrelated) variety. Hence, our relative measures of related and unrelated variety are as follows:

$$RUV_i = (UV_i - UV_i^*)/(UV_i + UV_i^*)$$

$$RRV_i = (RV_i - RV_i^*)/(RV_i + RV_i^*)$$

where * refers to the arithmetic mean of the two indicators in the other provinces (Italy net of province *i*). This exclusion ensures that both indicators can vary between 1 and -1.

3. Results

In this section, we present preliminary results of our econometric estimates about the effect of the diversification of specialization patterns of Italian provinces on their export performance, as measured by the competitiveness effect identified by constant market share analysis. The latter allows controlling changes in export market shares for the underlying composition effects. By doing so, our analysis cannot be affected by differences across provinces in the 'dynamic' efficiency of the export specialization patterns, that is, the correlation between the sector distribution of their comparative advantages and changes in the structure of foreign demand. In addition, our measure of export performance net of composition effects makes it possible to reduce endogeneity problems in our estimates.

Table 3 shows the results of OLS estimates of Equation 1 without fixed effects and not controlling for the economic size of the provinces. Models 1-5 represent univariate regressions of the export performance of Italian provinces on each indicator of diversification. The results show that provinces that have concentrated their production structure in specific sectors of comparative advantage over the years have improved their export performance. The regression coefficients of all indicators are statistically significant, and their sign converges toward a positive effect of specialization on the competitiveness effect. Notably, indicators measuring the diversification of specialization patterns, such as the RCAN, RRV, and RUV, have negative coefficients.

Similar results also appear in table 4, which shows the estimates of Equation 1 using the TWFE methodology. Again, for all indicators, we find that the provinces that have increased the degree of specialization of their economic structures have improved their export performance. The regression coefficients are statistically significant for all indicators, and their sign is identical to the estimates made with the OLS model.

These results are confirmed by analyzing the different groups of provinces divided according to their economic size. In particular, for all groups of provinces, it is confirmed that an increase in specialization tends to translate into an improvement in export performance. These results suggest that size differences across provinces do not significantly alter the relationship between the diversification of their economic structures and export performance. The only exception is the regression coefficients in the TWFE estimate for the group of larger provinces, which are not statistically significant. However, their sign is identical to that of the other groups of provinces. .

4. Final remarks

[Forthcoming]

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Figures and tables

First group	Log export	**Second group**	Log export	**Third group**	Log export	**Fourth group**	Log export
Enna	2,40	Aosta	6,5	Pesaro e Urbino	7,8	Siracusa	8,6
Crotone	3,19	Sondrio	6,5	Prato	7,9	Udine	8,6
Vibo Valentia	3,67	Foggia	6,6	Perugia	7,9	Como	8,6
Oristano	4,02	La Spezia	6,7	Pisa	8,0	Napoli	8,6
Caltanissetta	4,03	Brindisi	6,8	Trieste	8,0	Chieti	8,7
Catanzaro	4,33	Messina	6,9	Lodi	8,1	Alessandria	8,7
Isernia	4,35	Caserta	7,0	Potenza	8,2	Frosinone	8,7
Cosenza	4,43	Terni	7,1	Forlì-Cesena	8,2	Mantova	8,8
Nuoro	4,52	Avellino	7,1	Pavia	8,2	Parma	8,8
Agrigento	5,16	Taranto	7,2	Trento	8,2	Latina	8,8
Sassari	5,25	Teramo	7,2	Ascoli Piceno	8,2	Arezzo	8,9
Benevento	5,30	Catania	7,2	Pordenone	8,2	Cuneo	8,9
Reggio di Calabria	5,33	Pistoia	7,3	Ancona	8,3	Roma	9,1
Trapani	5,56	Rovigo	7,3	Belluno	8,3	Padova	9,2
Matera	5,76	Siena	7,4	Lucca	8,3	Varese	9,2
Rieti	5,80	Savona	7,4	Ravenna	8,3	Reggio nell'Emilia	9,2
Palermo	5,82	Macerata	7,4	Cremona	8,3	Verona	9,3
Ragusa	5,84	Livorno	7,5	Genova	8,3	Modena	9,4
Grosseto	5,87	Biella	7,5	Lecco	8,4	Firenze	9,4
Viterbo	5,96	Gorizia	7,5	Venezia	8,4	Treviso	9,5
Imperia	6,07	Massa-Carrara	7,5	Bolzano	8,4	Bologna	9,5
Campobasso	6,20	Asti	7,7	Bari	8,4	Bergamo	9,6
Lecce	6,33	Vercelli	7,7	Piacenza	8,5	Brescia	9,6
Pescara	6,34	Rimini	7,7	Cagliari	8,5	Vicenza	9,8
L'Aquila	6,36	Ferrara	7,8	Novara	8,5	Torino	9,9
Verbano-Cusio-Ossola	6,46	Salerno	7,8			Milano	10,8

Table 1 – Italian provinces' groups classified by export value – data source ISTAT.

Variable	N	Mean	SD	Max	Min
Competitiveness Effect	2678	1.93e-06	0.000851	0.00699	-0.00754
HH Index	2678	-0.000486	0.0611	0.473	-0.502
RCAN Index	2678	0.000330	0.0321	0.298	-0.288
FK Index	2678	-0.000774	0.0507	0.482	-0.509
RRV Index	2678	-0.000313	0.0903	0.867	-0.884
RUV Index	2678	-0.000140	0.0588	0.588	-0.532

Table 2 – Descriptive statistics – data source ISTAT.

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
HHIndex	0.00231***				
	(0.000331)				
RCAN Index		-0.00363***			
		(0.000708)			
FKIndex			0.00229***		
			(0.000507)		
RRVIndex				-0.00120***	
				(0.000215)	
RUVIndex					-0.00239***
					(0.000385)
Constant	3.05e-06	3.13e-06	3.70e-06	1.55e-06	1.59e-06
	(1.62e-05)	(1.63e-05)	(1.63e-05)	(1.63e-05)	(1.62e-05)
Observations	2,678	2,678	2,678	2,678	2,678
R-squared	0.028	0.019	0.019	0.016	0.027

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 – OLS estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the total sample.

VARIABLES	(1) Fixed Effects	(2) Fixed Effects	(3) Fixed Effects	(4) Fixed Effects	(5) Fixed Effects
HHIndex	0.00229*** (0.000542)				
RCAN Index		-0.00357*** (0.000897)			
FKIndex			0.00222*** (0.000664)		
RRVIndex				-0.00118*** (0.000342)	
RUVIndex					-0.00236*** (0.000563)
Constant	3.04e-06*** (2.63e-07)	3.11e-06*** (2.96e-07)	3.64e-06*** (5.14e-07)	1.56e-06*** (1.07e-07)	1.60e-06*** (7.86e-08)
Observations	2,678	2,678	2,678	2,678	2,678
R-squared	0.029	0.020	0.019	0.017	0.029
Number of ID	103	103	103	103	103
Province FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 – TWFE estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the total sample.

VARIABLES	(1) OLS group 1	(2) OLS group 1	(3) OLS group 1	(4) OLS group 1	(5) OLS group 1
HHIndex	0.000673*** (0.000129)				
RCAN Index		-0.00150*** (0.000286)			
FKIndex			0.000832*** (0.000182)		
RRVIndex				-0.000247*** (7.42e-05)	
RUVIndex					-0.000758*** (0.000149)
Constant	-1.03e-05 (7.28e-06)	-9.71e-06 (7.30e-06)	-1.09e-05 (7.32e-06)	-1.14e-05 (7.40e-06)	-1.05e-05 (7.20e-06)
Observations	676	676	676	676	676
R-squared	0.076	0.058	0.053	0.024	0.088

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 5 – OLS estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the first group.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fixed Effects group 1	Fixed Effects group 1	Fixed Effects group 1	Fixed Effects group 1	Fixed Effects group 1
HHIndex	0.000669***				
	(0.000183)				
RCAN Index		-0.00149***			
		(0.000492)			
FKIndex			0.000817***		
			(0.000288)		
RRVIndex				-0.000247**	
				(9.21e-05)	
RUVIndex					-0.000750***
					(0.000217)
Constant	-1.03e-05***	-9.72e-06***	-1.09e-05***	-1.14e-05***	-1.06e-05***
	(5.14e-07)	(8.18e-07)	(4.57e-07)	(3.15e-07)	(4.78e-07)
Observations	676	676	676	676	676
R-squared	0.077	0.059	0.052	0.024	0.089
Number of ID	26	26	26	26	26
Province FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 6 – TWFE estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the first group.

VARIABLES	(1) OLS group 2	(2) OLS group 2	(3) OLS group 2	(4) OLS group 2	(5) OLS group 2
HHIndex	0.00355*** (0.000512)				
RCAN Index		-0.00519*** (0.000898)			
FKIndex			0.00321*** (0.000603)		
RRVIndex				-0.00190*** (0.000368)	
RUVIndex					-0.00444*** (0.000702)
Constant	-1.08e-06 (1.74e-05)	-2.84e-06 (1.81e-05)	-1.53e-07 (1.80e-05)	-4.05e-06 (1.81e-05)	-3.19e-06 (1.72e-05)
Observations	676	676	676	676	676
R-squared	0.161	0.095	0.103	0.094	0.180

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 7 – OLS estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the second group.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fixed Effects group 2	Fixed Effects group 2	Fixed Effects group 2	Fixed Effects group 2	Fixed Effects group 2
HHIndex	0.00356***				
	(0.00115)				
RCAN		-0.00517**			
		(0.00197)			
FKIndex			0.00321**		
			(0.00119)		
RVIndex				-0.00192***	
				(0.000665)	
UVIndex					-0.00443***
					(0.00135)
Constant	-1.07e-06	-2.84e-06***	-1.56e-07	-4.06e-06***	-3.19e-06***
	(8.10e-07)	(2.80e-07)	(1.27e-06)	(1.66e-07)	(1.19e-07)
Observations	676	676	676	676	676
R-squared	0.163	0.095	0.104	0.096	0.182
Number of ID	26	26	26	26	26
Province FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 8 – TWFE estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the second group.

VARIABLES	(1) OLS group 3	(2) OLS group 3	(3) OLS group 3	(4) OLS group 3	(5) OLS group 3
HHIndex	0.00265*** (0.000797)				
RCAN Index		-0.00364*** (0.000959)			
FKIndex			0.00291*** (0.000770)		
RRVIndex				-0.00170*** (0.000582)	
RUVIndex					-0.00259*** (0.000864)
Constant	4.27e-05 (2.73e-05)	4.21e-05 (2.75e-05)	4.49e-05 (2.74e-05)	4.00e-05 (2.73e-05)	4.06e-05 (2.72e-05)
Observations	650	650	650	650	650
R-squared	0.046	0.030	0.037	0.042	0.048

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 9 – OLS estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the third group.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fixed Effects group 3	Fixed Effects group 3	Fixed Effects group 3	Fixed Effects group 3	Fixed Effects group 3
HHIndex	0.00262**				
	(0.000943)				
RCAN Index		-0.00367**			
		(0.00132)			
FKIndex			0.00282***		
			(0.000975)		
RRVIndex				-0.00169**	
				(0.000734)	
RUVIndex					-0.00256***
					(0.000853)
Constant	4.27e-05***	4.20e-05***	4.49e-05***	4.00e-05***	4.07e-05***
	(5.06e-07)	(7.41e-07)	(2.83e-07)	(1.78e-06)	(1.14e-06)
Observations	650	650	650	650	650
R-squared	0.046	0.031	0.036	0.042	0.048
Number of ID	25	25	25	25	25
Province FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 10 – TWFE estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the third group.

VARIABLES	(1) OLS group 4	(2) OLS group 4	(3) OLS group 4	(4) OLS group 4	(5) OLS group 4
HHIndex	0.00483**				
	(0.00193)				
RCAN Index		-0.00422*			
		(0.00227)			
FKIndex			0.00252		
			(0.00174)		
RRVIndex				-0.00266*	
				(0.00151)	
RUVIndex					-0.00431**
					(0.00197)
Constant	-2.42e-05	-1.88e-05	-1.87e-05	-2.45e-05	-2.57e-05
	(5.52e-05)	(5.55e-05)	(5.56e-05)	(5.56e-05)	(5.53e-05)
Observations	676	676	676	676	676
R-squared	0.024	0.010	0.008	0.014	0.019

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 11 – OLS estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the fourth group.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fixed Effects group 4	Fixed Effects group 4	Fixed Effects group 4	Fixed Effects group 4	Fixed Effects group 4
HHIndex	0.00474				
	(0.00283)				
RCAN Index		-0.00406			
		(0.00254)			
FKIndex			0.00234		
			(0.00212)		
RRVIndex				-0.00258	
				(0.00226)	
RUVIndex					-0.00422
					(0.00284)
Constant	-2.41e-05***	-1.88e-05***	-1.87e-05***	-2.43e-05***	-2.55e-05***
	(3.03e-06)	(1.08e-07)	(2.81e-07)	(4.70e-06)	(4.40e-06)
Observations	676	676	676	676	676
R-squared	0.025	0.010	0.008	0.014	0.020
Number of ID	26	26	26	26	26
Province FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tab. 12 – TWFE estimates of the relationship between the diversification of specialization patterns and export performance of Italian provinces over the period 1996-2021 for the fourth group.