TERRITORI APERTI

The quality of specialization and export performance of local economies: methodological issues

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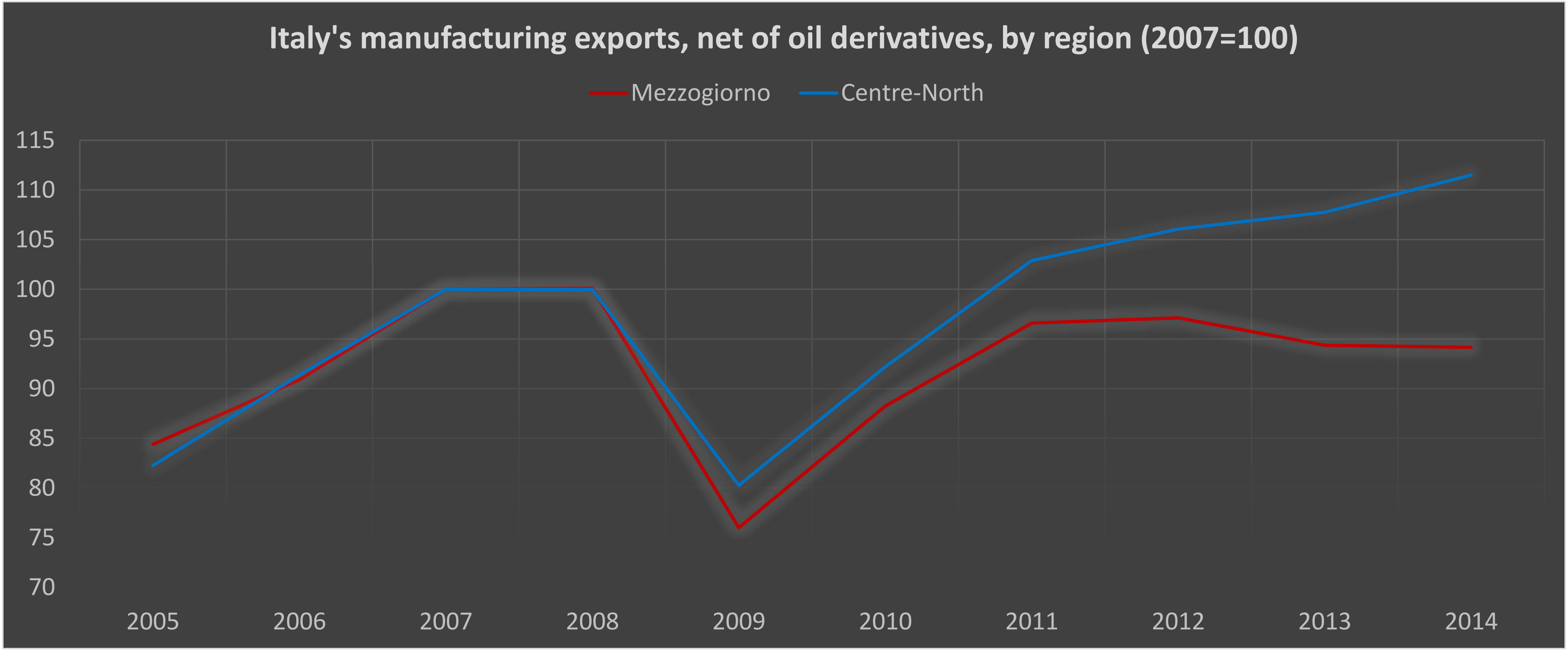
Outline

- Introduction: export resilience in Italy after the global crisis
- The quality of export specialization: «what you export matters…»
  - The ‘dynamic efficiency’ of specialization patterns: Constant-market-share analysis
  - Concentration or diversification of local economic systems? A survey of indicators
- Concluding questions

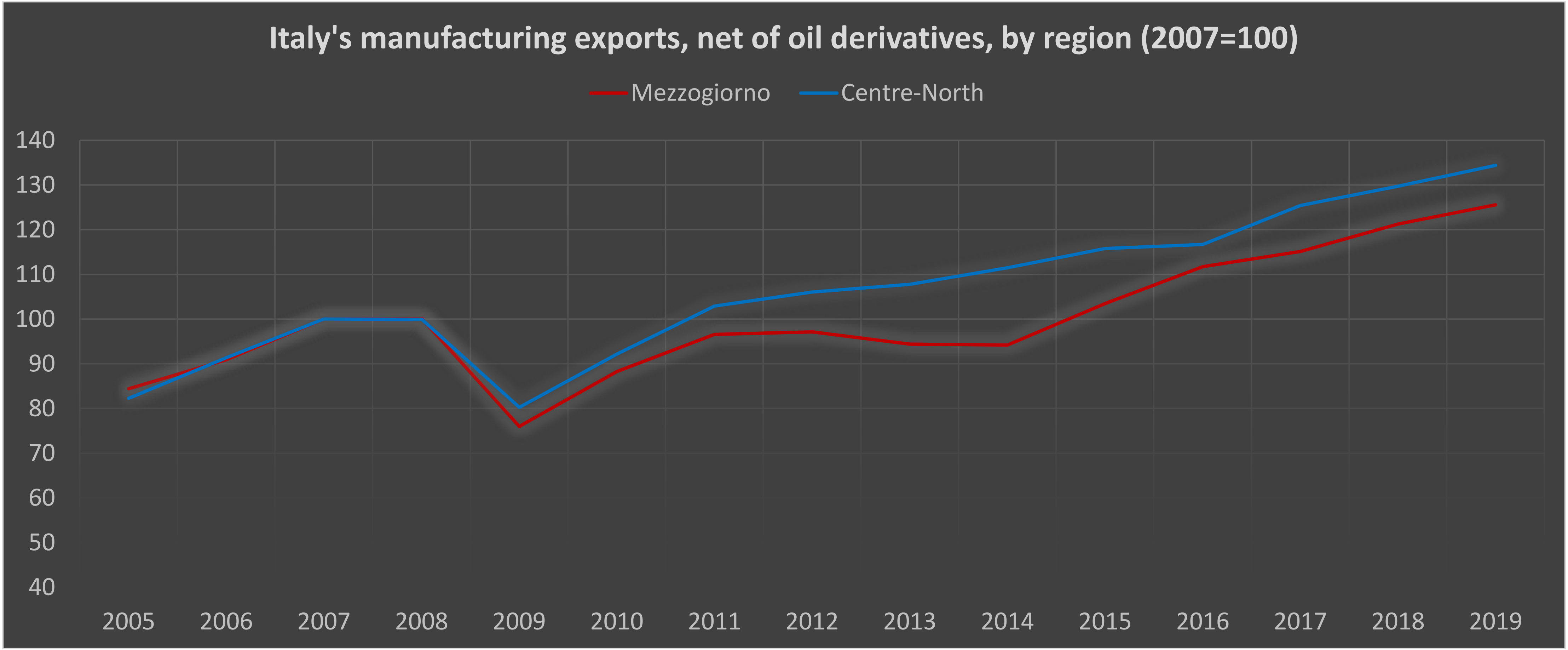
Export resilience in Italy after the global crisis

- Better understanding the relationship between international economic integration, risk and resilience at the local level
- Initial assumptions
  - Open local economies are exposed to higher risks of external shocks
  - Under certain conditions, international economic integration reinforces the resilience of local economies, by spreading knowledge and improving their productive structure
- The global crisis initiated in 2008 offers an important benchmark to assess the different resilience of local economies to a common external shock
- Export performance after the 2009 trade collapse can be used to gauge the dynamic resilience of open local economies

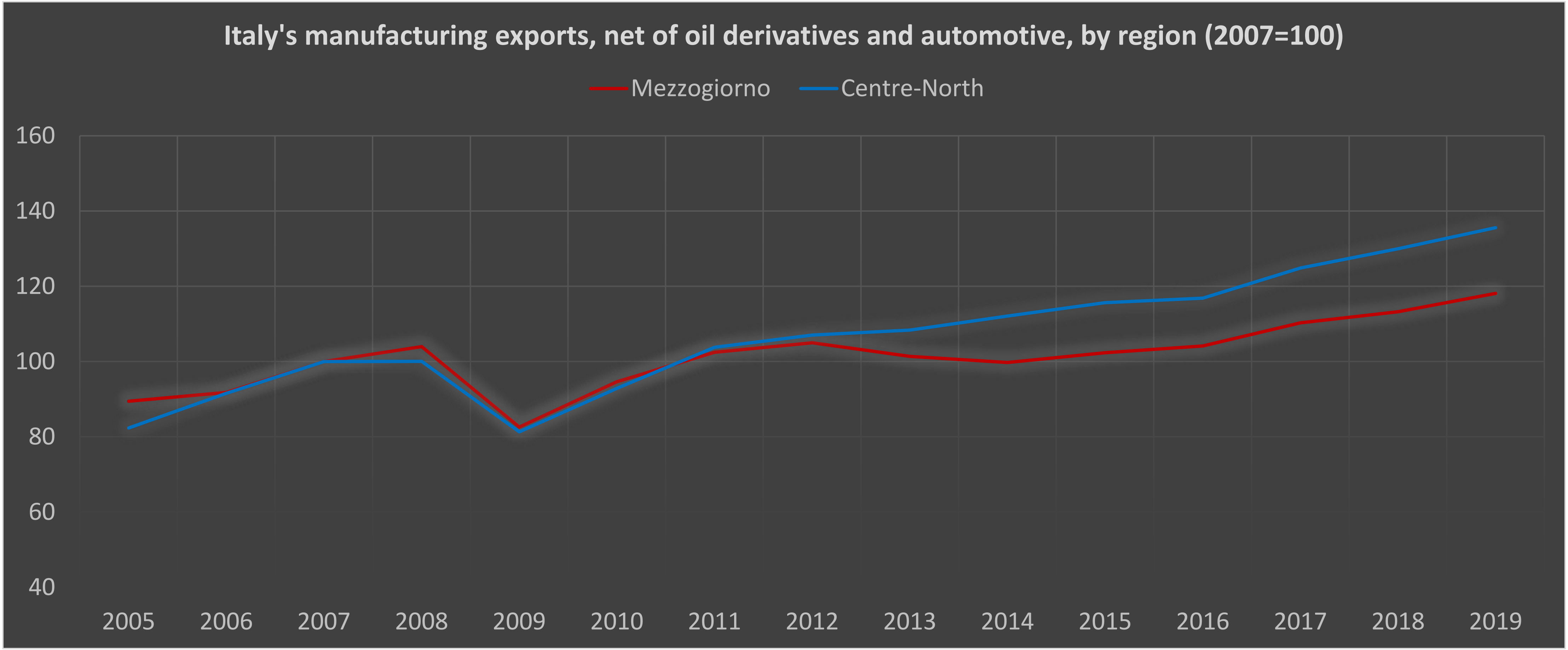
Export resilience in Italy during the global crisis



Convergence resumed in 2015-16…



…but mostly as a result of the upsurge in automotive exports from a couple of plants in the Mezzogiorno



The quality of export specialization: “What you export matters”…

- Several criteria can be used to assess the quality of export specialization patterns:
  - Technological intensity
  - Market structure and knowledge diffusion (the Pavitt taxonomy)
  - Labour intensity
  - ‘Dynamic efficiency’ and the income elasticity of trade
  - Diversification, resilience and growth
    - Traditional measures of concentration
    - Related and unrelated variety
    - Product complexity and economic fitness

Relevant literature

- Dynamic efficiency of international specialization patterns (Krugman, 1989; Thirlwall, 2011)
- Trade performance and specialization (Fagerberg and Sollie, 1987; Coughlin and Pollard, 2001; Memedovic and Iapadre, 2010)
- Structural diversification and regional growth (Frenken et al., 2007; Boschma and Iammarino, 2009; Kemeny and Storper, 2015)
- Regional economic resilience (Fingleton et al., 2012; Augustin et al., 2013; Martin and Sunley, 2015; Brown and Greenbaum, 2016)
- Product complexity and economic fitness (Hausmann and Rodrik, 2003; Hausmann et al., 2007; Hidalgo and Hausmann, 2009; Tacchella et al., 2012; Coniglio et al., 2016; Sbardella et al. (2018); Basile and Cicerone, 2022)

Dynamic efficiency of export specialization patterns

A GAME OF NUMBERS

	Italian exports		*World exports*			*Market shares*	
	Period 1	*Period 2*	*Period 1*	*Period 2*		*Period 1*	*Period 2*
Sector A	4	9	40	80			
Sector B	8	9	40	44			
Total	12	18	80	124			

CMS analysis

- Constant-market-shares (CMS) analysis is a particular application to international trade of a more general statistical decomposition technique, aimed at measuring the contribution of ‘structural factors’ (composition effects) to the growth of an aggregate variable (Memedovic and Iapadre, 2010)
- In regional economics this technique is known as shift-and-share analysis.
- CMS analysis can usefully be integrated into an econometric model of trade flows, where it helps improve the specification of the dependent variable by filtering out composition effects.

CMS Analysis: Methodological Issues

- Base accounting identity
  - Decomposition object
  - Disaggregation criteria
- Decomposition formula
  - Weighting method
  - Interdependence of the effects
  - Path-dependence of the effects

Decomposition object

- The economic variable to be analyzed
- Growth rates versus market shares
- Exports versus imports
- Data at current versus constant prices

Disaggregation criteria

- When more than one disaggregation criterion is used, the decomposition results are affected by the order in which the disaggregation is made
- This problem cannot be solved, contrary to what some authors argue.
- What can (and must) be done is write a formula where the two disaggregation criteria are used independently upon each other.
- ‘Structural diversification indices’ can help solve this problem

In the case of a unique disaggregation criterion

$$S^t \equiv \frac{\sum_k m_k^t}{\sum_k M_k^t} \qquad [1]$$

in which:

S^t: the target country's aggregate market share;

m_k^t: imports of the market from the target country in the k^th^ product (k = 1 ... p);

M_k^t: imports of the market from the world in the k^th^ product;

the base accounting identity is the following:

$$S^t \equiv \sum_k s_k^t w_k^t \qquad [2]$$

in which:

$s_k^t \equiv \frac{m_k^t}{M_k^t}$: the target country's share of the market's imports in the k^th^ product;

$w_k^t \equiv \frac{M_k^t}{\sum_k M_k^t}$: weight of the k^th^ product over the market's total imports from the world.

If there are two criteria of data classification (for example by product and importing country) the aggregate share of an exporting country on the imports of the market may be expressed as:

$$S^t \equiv \frac{\sum_i \sum_j m_{ij}^t}{\sum_i \sum_j M_{ij}^t} \qquad [3]$$

in which:

m_{ij}^t: imports of the j[th] country (j = 1…m) from the target country in the i[th] product (i = 1…n);

M_{ij}^t: imports of the j[th] country from the world in the i[th] product.

Five alternative specifications of the base accounting identity can be derived:

$$S^t \equiv \sum_i \sum_j s_{ij}^t w_{ij}^t \qquad [4]$$

$$S^t \equiv \sum_i \sum_j s_{ij}^t g_{ij}^t p_{i.}^t \qquad [5]$$

$$S^t \equiv \sum_i \sum_j s_{ij}^t g_{.j}^t p_{ij}^t \qquad [6]$$

$$S^t \equiv \sum_i \sum_j s_{ij}^t g_{.j}^t p_{i.}^t d_{ij}^t \qquad [7]$$

$$S^t \equiv \sum_i \sum_j s_{ij}^t g_{ij}^t p_{ij}^t \frac{1}{d_{ij}^t} \qquad [8]$$

Structural Diversification Indices

$$d_{ij}^{t} \equiv \frac{M_{ij}^{t} \cdot \sum_i \sum_j M_{ij}^{t}}{\left(\sum_i M_{ij}^{t}\right)\left(\sum_j M_{ij}^{t}\right)} \equiv \frac{w_{ij}^{t}}{p_{i.}^{t} g_{.j}^{t}}:$$

Structural diversification indices (SDIs): ratios between the weight of the j^{th} country (of the i^{th} product) over the market's imports in the i^{th} product (over the j^{th} country's total imports) and the weight of that country (of that product) over the market's total imports from the world.

- These indices show to what degree the commodity structure of a market's imports is differentiated by passing from one importing country to another, or to what degree their distribution by importing country varies from one product to another.

- There is a precise relationship between these indices and Pearson's quadratic average contingency coefficient (**f**), calculated on the double-entry table showing the distribution of the market's imports by product and by importing country. In particular:

$$\left(f^{t}\right)^{2} = \sum_{ij} d_{ij}^{t} w_{ij}^{t} - 1$$

The index-number problem of CMS analysis

The continuous-time decomposition of changes in the aggregate market share:

$$\frac{dS^t}{dt} = \sum_k \frac{ds_k^t}{dt} w_k^t + \sum_k \frac{dw_k^t}{dt} s_k^t \qquad [14]$$

two terms:

- the *competitiveness effect* (CE) mirroring *ex-post* the effects of changes in relative prices and in the other factors of competitiveness.
- the *structure effect* (SE) represents the variation that the aggregate market share would in any case have, because of the effect of changes in the structure of the market's imports, even if the elementary market shares do not change (*constant-market-shares*). It mirrors the conformity of a country's specialization pattern to changes in the structure of demand.

The index-number problem of CMS analysis

The "index-number problem" of CMS analysis concerns the variety of possible solutions to adapt identity [14] to the discrete-time data available for empirical analysis.

$$S^t - S^0 = \sum_k \left(s_k^t - s_k^0\right) w_k^0 + \sum_k \left(w_k^t - w_k^0\right) s_k^t \qquad [\ 15\ ]$$

$$S^t - S^0 = \sum_k \left(s_k^t - s_k^0\right) w_k^t + \sum_k \left(w_k^t - w_k^0\right) s_k^0 \qquad [\ 16\ ]$$

$$S^t - S^0 = \sum_k \left(s_k^t - s_k^0\right)\left[\alpha\, w_k^t + (1-\alpha)\, w_k^0\right] + \sum_k \left(w_k^t - w_k^0\right)\left[(1-\alpha)\, s_k^t + \alpha\, s_k^0\right] \qquad [\ 17\ ]$$

$$S^t - S^0 = \sum_k \left(s_k^t - s_k^0\right) w_k^0 + \sum_k \left(w_k^t - w_k^0\right) s_k^0 + \sum_k \left(w_k^t - w_k^0\right)\left(s_k^t - s_k^0\right) \qquad [\ 18\ ]$$

$$S^t - S^0 = \sum_k \left(s_k^t - s_k^0\right) w_k^t + \sum_k \left(w_k^t - w_k^0\right) s_k^t - \sum_k \left(w_k^t - w_k^0\right)\left(s_k^t - s_k^0\right) \qquad [\ 19\ ]$$

The index number problem of CMS analysis

- Traditional specifications (with interaction terms) are to be preferred to Tornqvist-type formulas
  - In CMS analysis there is no precise and theoretically founded functional relationship between the two elementary components (market shares and weights) and we consequently lack the continuous-time aggregation function on which we could select the best discrete-time approximations.
  - From a purely descriptive point of view, using the averages between the initial and final periods as weights does not allow to neatly disentangle the competitiveness effect from the structure effect.
  - By doing this the structure effect ends up by englobing a part of the changes of the elementary market shares, which should instead be captured by the competitiveness effect and vice versa.

The complete specification (Memedovic and Iapadre, 2010)

$$S^t - S^0 = \sum_i \sum_j \left(s_{ij}^t - s_{ij}^0\right) w_{ij}^0 +$$

[CE]

$$\sum_i \left(p_{i.}^t - p_{i.}^0\right) s_{i.}^0 +$$

[CSE]

$$\sum_j \left(g_{.j}^t - g_{.j}^0\right) s_{.j}^0 +$$

[GSE]

$$\sum_i \sum_j \begin{bmatrix} \left(d_{ij}^t - d_{ij}^0\right) s_{ij}^0 p_{i.}^0 g_{.j}^0 + \\ \left(p_{i.}^t - p_{i.}^0\right)\left(g_{.j}^t - g_{.j}^0\right) s_{ij}^0 d_{ij}^0 + \\ \left(p_{i.}^t - p_{i.}^0\right)\left(d_{ij}^t - d_{ij}^0\right) s_{ij}^0 g_{.j}^0 + \\ \left(g_{.j}^t - g_{.j}^0\right)\left(d_{ij}^t - d_{ij}^0\right) s_{ij}^0 p_{i.}^0 + \\ \left(p_{i.}^t - p_{i.}^0\right)\left(g_{.j}^t - g_{.j}^0\right)\left(d_{ij}^t - d_{ij}^0\right) s_{ij}^0 \end{bmatrix} +$$

[SIE]

$$\sum_i \sum_j \left(s_{ij}^t - s_{ij}^0\right)\left(p_{i.}^t - p_{i.}^0\right) g_{.j}^0 d_{ij}^0 +$$

[CAE]

$$\sum_i \sum_j \left(s_{ij}^t - s_{ij}^0\right)\left(g_{.j}^t - g_{.j}^0\right) p_{i.}^0 d_{ij}^0 +$$

[GAE]

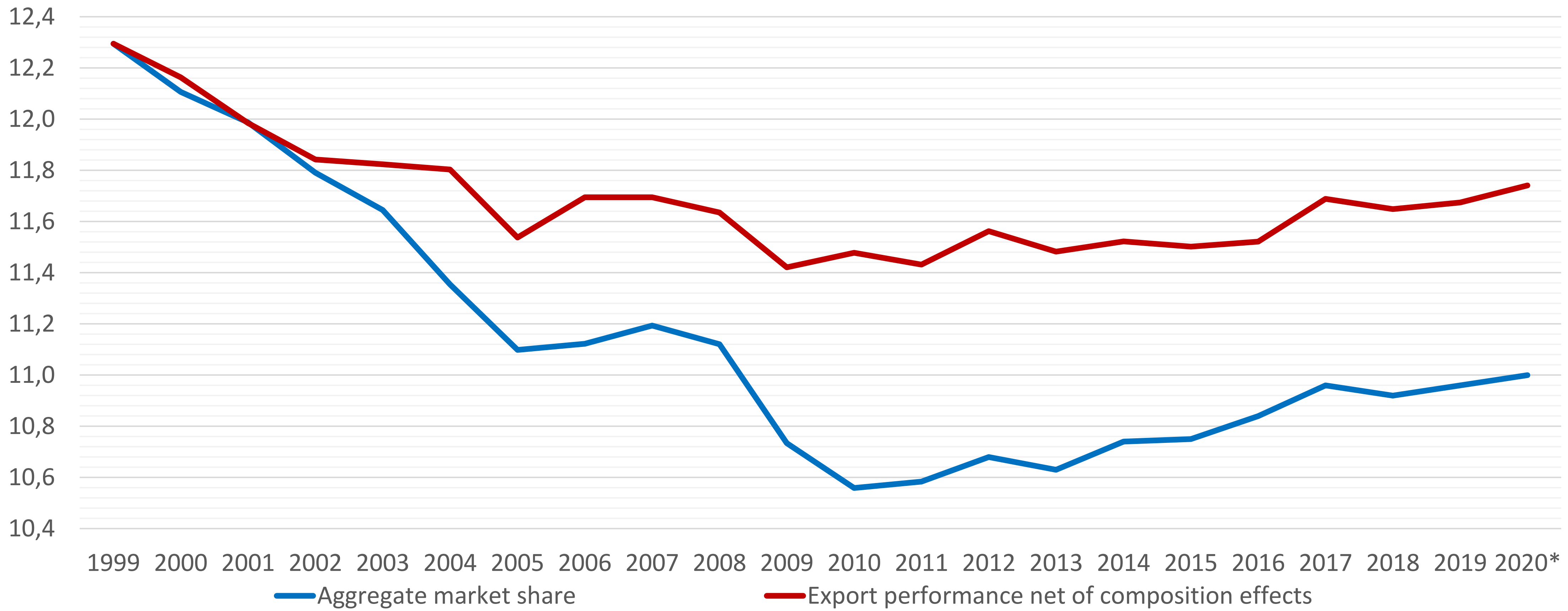
$$\sum_i \sum_j \begin{bmatrix} \left(s_{ij}^t - s_{ij}^0\right)\left(d_{ij}^t - d_{ij}^0\right) p_{i.}^0 g_{.j}^0 + \\ \left(s_{ij}^t - s_{ij}^0\right)\left(p_{i.}^t - p_{i.}^0\right)\left(g_{.j}^t - g_{.j}^0\right) d_{ij}^0 + \\ \left(s_{ij}^t - s_{ij}^0\right)\left(p_{i.}^t - p_{i.}^0\right)\left(d_{ij}^t - d_{ij}^0\right) g_{.j}^0 + \\ \left(s_{ij}^t - s_{ij}^0\right)\left(g_{.j}^t - g_{.j}^0\right)\left(d_{ij}^t - d_{ij}^0\right) p_{i.}^0 + \\ \left(s_{ij}^t - s_{ij}^0\right)\left(p_{i.}^t - p_{i.}^0\right)\left(g_{.j}^t - g_{.j}^0\right)\left(d_{ij}^t - d_{ij}^0\right) \end{bmatrix}$$

[RAE]

Structural factors are important to understand the export performance of the Italian economy

Italy's share of Eurozone exports: constant-market-share analysis			
	1999	2010	2020*
Market share	**12,29**	**10,56**	**11,00**
change		-1,74	0,44
Competitiveness effect		**-0,82**	**0,26**
Structure effect		**-1,07**	**0,46**
commodity		-1,09	0,27
geographic		0,27	0,04
interaction		-0,25	0,14
Adaptation effect		**0,15**	**-0,27**
Source: based on Italian Trade Agency data.			
* Estimate based on January-November data.			

Italy's share of Eurozone exports: CMS analysis



Source: Italian Trade Agency.

*Estimate based on January-November data..

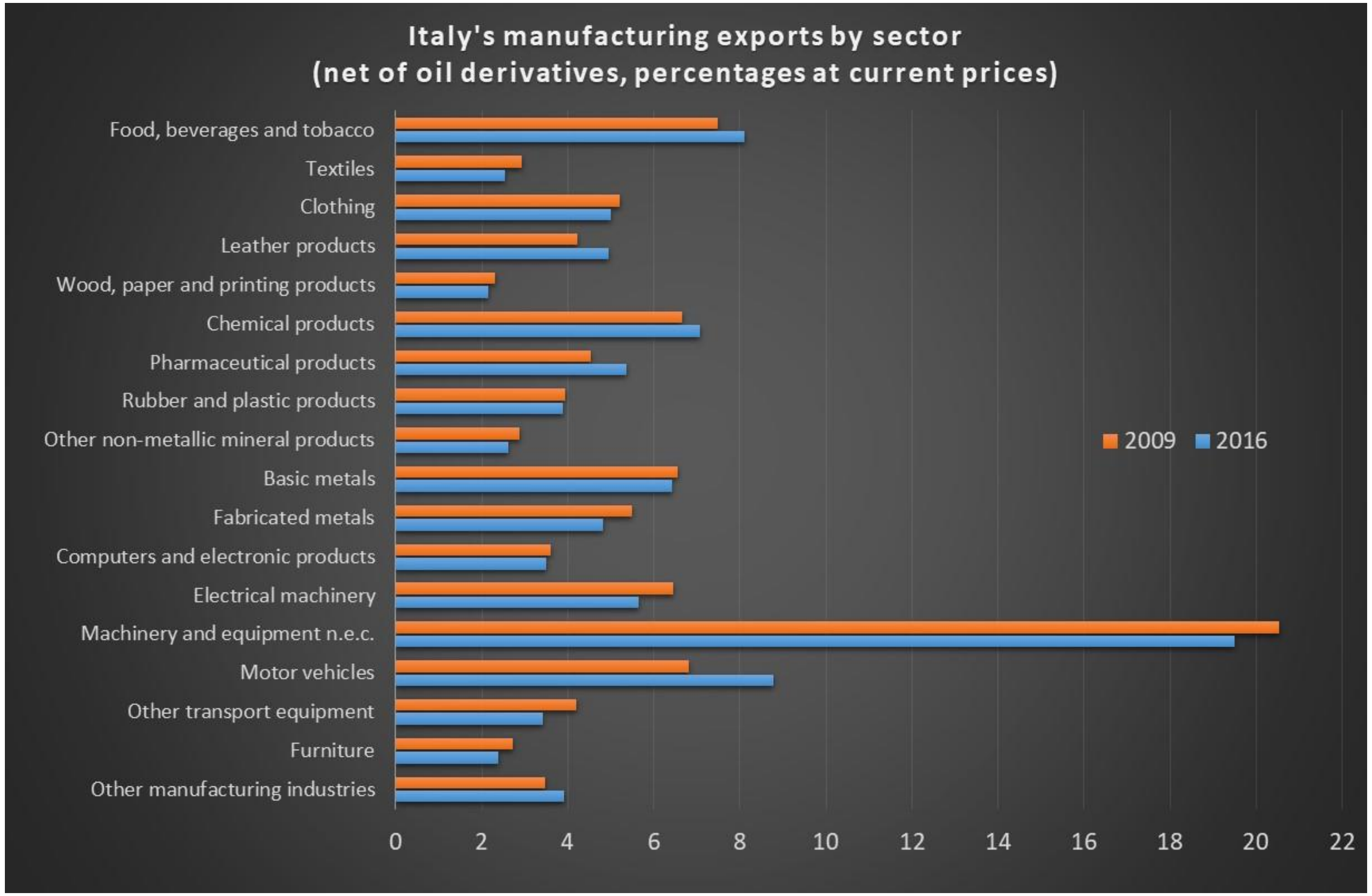
Constant-market-share analysis of export performance of Italian provinces

- Splitting the change in aggregate export market shares into three components:
  - Competitiveness effect (CE): export performance, net of composition effects, reflecting ex post the role of relative prices and other competitiveness factors
  - Structure effect (SE): measuring how changes in the composition of export demand interact with the exporting economy’s specialization pattern
  - Adaptation effect (AE): measuring how changes in the exporting economy’s specialization pattern interact with changes in the composition of export demand

Constant-market-share analysis of export performance of Italian provinces

- The decomposition formula:
- St – S0 = CE + SE + AE $= \sum_k (s_k^t - s_k^0) w_k^0 + \sum_k (w_k^t - w_k^0) s_k^0 + \sum_k (w_k^t - w_k^0)(s_k^t - s_k^0)$
- where:
  - S: province i's market share of total Italian exports;
  - sk: province i's market share of Italian exports in sector k;
  - wk: sector k's weight on Italian exports;

Changes in the structure of foreign demand for Italian exports



The top 15 exporting provinces in Italy

Constant-market-share analysis of export performance (percentages at current prices)						
Provinces	Market shares		Changes	Competitiveness	Sector structure	Adaptation (AE)
	2009	2016	2016-2009	(CE)	(SE)	
Milano - Monza	13,20	11,89	-9,95	-9,88	-0,66	0,59
Torino	5,28	5,39	2,18	-2,70	5,63	-0,76
Vicenza	4,14	4,25	2,72	2,23	1,69	-1,19
Bergamo	3,61	3,62	0,43	4,08	-4,22	0,57
Brescia	3,59	3,65	1,73	4,58	-1,85	-1,01
Treviso	3,32	3,10	-6,66	-0,28	-5,00	-1,38
Bologna	3,06	3,26	6,37	6,38	0,10	-0,10
Modena	2,99	3,03	1,37	-4,32	6,37	-0,69
Varese	2,87	2,42	-15,46	-11,37	-4,80	0,71
Firenze	2,55	2,78	9,09	3,99	3,19	1,91
Verona	2,44	2,47	1,31	1,73	1,49	-1,91
Reggio Emilia	2,39	2,44	1,78	8,35	-4,52	-2,05
Padova	2,09	2,28	9,43	11,82	-1,85	-0,54
Cuneo	1,84	1,68	-8,86	-11,60	1,98	0,76
Roma	1,67	1,91	13,87	9,26	6,70	-2,09
	55,03	54,17				

The top 15 exporting provinces in the Mezzogiorno

Constant-market-share analysis of export performance (percentages at current prices)						
Provinces	Market shares		Changes	Competitiveness	Sector structure	Adaptation (AE)
	2009	2016	2016-2009	(CE)	(SE)	
Napoli	1,50	1,30	-13,42	-12,00	3,27	-4,70
Chieti	1,21	1,49	22,91	0,98	15,74	6,19
bari foggia bat	1,06	1,15	8,44	3,33	4,34	0,77
Salerno	0,66	0,55	-17,35	-13,31	-3,98	-0,05
Taranto	0,50	0,28	-44,74	-42,03	-8,32	5,62
Potenza	0,46	1,04	125,19	59,72	42,27	23,19
Caserta	0,33	0,27	-18,46	-17,12	-5,21	3,87
Teramo	0,31	0,31	-1,52	1,07	-2,68	0,09
sardegna	0,29	0,18	-40,16	-39,99	-1,12	0,94
Avellino	0,29	0,26	-8,86	-8,22	11,72	-12,36
L'Aquila	0,26	0,14	-47,82	-44,91	0,07	-2,98
Brindisi	0,24	0,24	-0,92	1,30	-2,05	-0,16
Catania	0,17	0,23	32,35	35,60	-4,85	1,60
Siracusa	0,16	0,15	-9,89	-10,42	-0,26	0,79
Pescara	0,15	0,14	-5,14	-6,89	-0,11	1,86
	7,60	7,71				

The ‘dynamic efficiency’ of specialization patterns

- The CMS sector structure effect measures the dynamic efficiency of specialization, that is its concordance with structural changes in export demand
- This is related to the foreign income elasticity of export demand
- At the national level, the income elasticity of exports affects the intensity of the external constraint to growth
- At the local level, it is an important determinant of export performance and growth

Decomposing the sector structure effect

- The sector structure effect is the product of three factors:
  - The degree of correlation between the sector structure of a province's market shares, which defines its specialization pattern, and the changes in the sector structure of Italian export demand.
  - An indicator of the variability of sector market shares around their mean or, in other terms, of the degree of polarization of the specialization pattern.
  - An indicator of the intensity of change in the structure of demand, as measured by the variation of sector weights in Italian exports.

Decomposing the sector structure effect

$$SE = r_{SC}\sqrt{\sum_k \left(s_k^0 - \mu_s^0\right)^2}\sqrt{\sum_k \left(w_k^t - w_k^0\right)^2}$$

- in which:
  - rSC : linear correlation coefficient between a province’s initial export market shares in each sector and the changes of sector weights in Italian exports;
  - sk0 : a province’s initial export market share in sector k;
  - µs0 : unweighted arithmetic mean of a province’s initial sector market shares;
  - Wk0,t : product k's weight on Italian exports.

Dynamic efficiency of specialization patterns in the top 15 exporting provinces in Italy

Determinants of the sector structure effect, 2009-2016 (percentages at current prices)				
Provinces	**Average market share 2009**	**Relative structure effect**	**Correlation between specialization and structural change**	**Relative polarization**
Milano - Monza	13,20	-0,66	-3,74	6,91
Torino	5,28	5,63	23,58	9,33
Vicenza	4,14	1,69	5,91	11,14
Bergamo	3,61	-4,22	-13,12	12,58
Brescia	3,59	-1,85	-7,05	10,23
Treviso	3,32	-5,00	-14,19	13,76
Bologna	3,06	0,10	0,50	7,46
Modena	2,99	6,37	12,78	19,49
Varese	2,87	-4,80	-10,48	17,92
Firenze	2,55	3,19	8,87	14,07
Verona	2,44	1,49	2,58	22,60
Reggio Emilia	2,39	-4,52	-13,61	13,00
Padova	2,09	-1,85	-10,19	7,10
Cuneo	1,84	1,98	3,55	21,82
Roma	1,67	6,70	14,20	18,46

Dynamic efficiency of specialization patterns in the top 15 exporting provinces in Mezzogiorno

Determinants of the sector structure effect, 2009-2016 (percentages at current prices)				
Provinces	**Average market share 2009**	**Relative structure effect**	**Correlation between specialization and structural change**	**Relative polarization**
Napoli	1,50	3,27	9,53	13,42
Chieti	1,21	15,74	37,03	16,62
Bari-Foggia-BAT	1,06	4,22	16,00	10,60
Salerno	0,66	-3,98	-2,74	56,89
Taranto	0,50	-8,32	-12,00	27,11
Potenza	0,46	42,27	69,82	23,67
Caserta	0,33	-5,21	-6,23	32,68
Teramo	0,31	-2,68	-4,72	22,22
Sardegna	0,29	-1,12	-1,45	29,96
Avellino	0,29	11,72	16,29	28,13
L'Aquila	0,26	0,07	0,05	55,51
Brindisi	0,24	-2,05	-4,19	19,16
Catania	0,17	-4,85	-2,58	73,44
Siracusa	0,16	-0,26	-0,20	49,59
Pescara	0,15	-0,11	-0,38	10,97

Concentration or diversification?

Measuring specialization

The Balassa index of revealed comparative advantage (1965)

- $RCA_{ik} = S_{ik}/W_{ik} = (x_{ik}/x_{i.})/(x_{.k}/x_{..})$
- where:
- x_{ik} : province *i*'s exports of product k.
- $x_{i.}$: province *i*'s total exports.
- $x_{.k}$: Italian exports of product k.
- $x_{..}$: Italian total exports

Statistical problems:

- The maximum value of the index is not homogeneous across provinces and products.
- Its range is not symmetrical around the critical threshold of one.
- Its changes across time can be misleading: under certain circumstances, Balassa indices can increase (or decrease) for all products simultaneously, which would be a non-sense.

A new index of revealed comparative advantages

- Relative export specialization (RXSik)
- RXSik = (HRCAik - HRCAi(-k))/ (HRCAik + HRCAi(-k))
- where:
- HRCAik = Sik/Vik = (xik/xi.)/[(x.k - xik)/ (x.. - xi.)]
- and HRCAi(-k) refers to the aggregate of all products except k

- -1 ≤ RXSik ≤ 1 (size-invariant and symmetric range)
- RXSik = - RXSi(-k) (no dynamic ambiguity)

Concentration and polarization

- If the structure of a local economy relies heavily on a limited number of products, this concentration can increase its vulnerability to external shocks.
- The debate on international monetary integration (Kenen, 1969): the costs of monetary integration, as highlighted by the theory of optimum currency areas, are lower for countries characterised by a more diversified export structure, because this reduces the probability of an adverse asymmetric shock and dampens its impact.

Measuring the concentration of local specialization patterns

- Relative number of comparative advantage sectors, i.e. the share of m sectors in which province i's RXS index is positive (ni):
- RCANi = ni/m
- Herfindahl-Hirschmann concentration index (Hi):
- Hi = $\sqrt{\sum_k \left(x_{ik} / \sum_k x_{ik}\right)^2}$
  - This index is dependent on the number of products considered in the distribution More precisely, Hi is equal to 1/n when all the n products have the same weight in terms of export value, reaching a maximum level of 1 if exports are concentrated in only one product.
  - So, we prefer its normalised version, which is as follows:
  - NHi = (Hi i – 1/n)/(1 – 1/n)
  - $0 \leq NHi \leq 1$

Measuring the concentration of local specialization patterns

- Export dissimilarity
  - Both variants of the Herfindahl-Hirschmann index are based on a comparison between the actual distribution of data and an abstract benchmark of equi-distribution across the statistical units of observation.
  - This benchmark can be reasonable, when the index is applied to individual families or firms, but may be questioned when the index is used to study the concentration of a distribution across statistical units that are inherently different in terms of size, such as sectors or partner countries.
  - An alternative approach, which does not refer to the equi-distribution benchmark, is based on the linkage between the concepts of concentration and specialization. Local economies tend to concentrate their productive resources in their sectors of comparative advantage, so that their export structure tends to differentiate from the average of other localities (an alternative interpretation of Kenen's criterion)

Measuring the concentration of local specialization patterns

- A simple way to measure the dissimilarity of export structures across provinces is offered by the Finger-Kreinin index (FKi), which is as follows:
- $FKi = \frac{1}{2} \Sigma k \, |(xik / xi.) - [(x.k - xik)/(x.. - xi.)]|$
- $0 \leq FKi \leq 1$

Measuring the concentration of local specialization patterns

- An index of polarization of export specialization patterns:
- POLi = Σk |RXSik (xik / xi.)|
  - Polarization is measured as the weighted average of RCA indices, taken in their absolute value.
- This index should not be confused with a measure of concentration. Rather, it can be seen as a measure of the average intensity of comparative advantages and disadvantages.
- However, the two concepts are interrelated and the corresponding indicators tend to be strongly correlated between each other.

Related and unrelated variety

- Underlying idea: innovation and growth can be favoured by technological and cognitive externalities among sectors (so-called Jacobs externalities).
- So, other things being equal, an economy characterized by a relatively large presence of related sectors grows more rapidly than a strongly specialised economy, as well as than a diversified economy, which however is oriented towards reciprocally unrelated sectors.
- This concept is difficult to operationalize:
  - Assessing linkages among sectors would require detailed information about their production functions
  - Even the use of input-output tables would not be enough to ascertain the presence of cognitive spillovers, which often go beyond supply-and-use linkages

Related and unrelated variety

- A widely used indicator is based on the concept of entropy (Theil, 1972), and has been applied to the study of specialization patterns by Frenken et al. (2007).
- The driving idea is that Jacobs externalities emerge more easily among related productions within each sector, rather than between different and unrelated sectors.
- So, unrelated variety is measured by the Theil entropy index between different sectors (k):
- $UV = \Sigma_k w_k \log_2(1/w_k)$
- Related variety is measured by a similar index computed between different products (p) within each sector, and its aggregate measure for each economy is given by the weighted average of the sector indicators:
- $RV = \Sigma_k w_k V_k$
  - where: $V_k = \Sigma_p w_{pk} \log_2(1/w_{pk})$
- $w_{pk} = x_{ip}/x_{ik}$
- $w_k = x_{ik}/x_i$.

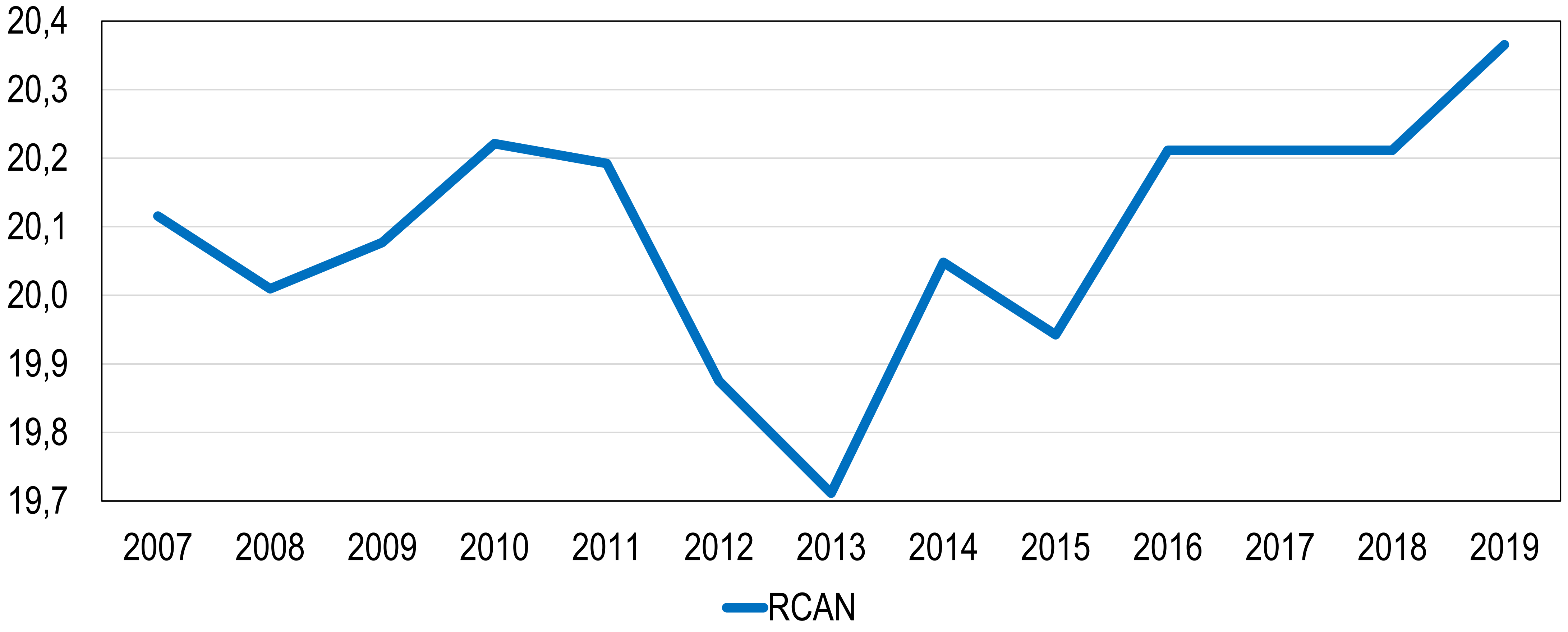
Related and unrelated variety

- The properties of the Theil entropy index ensure that total variety across products is equal to the sum of related and unrelated variety.
- The heuristic power of these indices is strongly affected by the quality of the available statistical classification, and particularly by the reliability of the distinction between products and sectors.
- Leaving this problem aside, it should be stressed that, by construction, the entropy index is a measure of diversification. So, it is an inverse function of the degree of concentration and its maximum corresponds to the case in which all the statistical units (products or sectors) have the same weight (equi-distribution).
- The equi-distribution benchmark appears as unreasonable when the size of the statistical units of observation is intrinsically different.

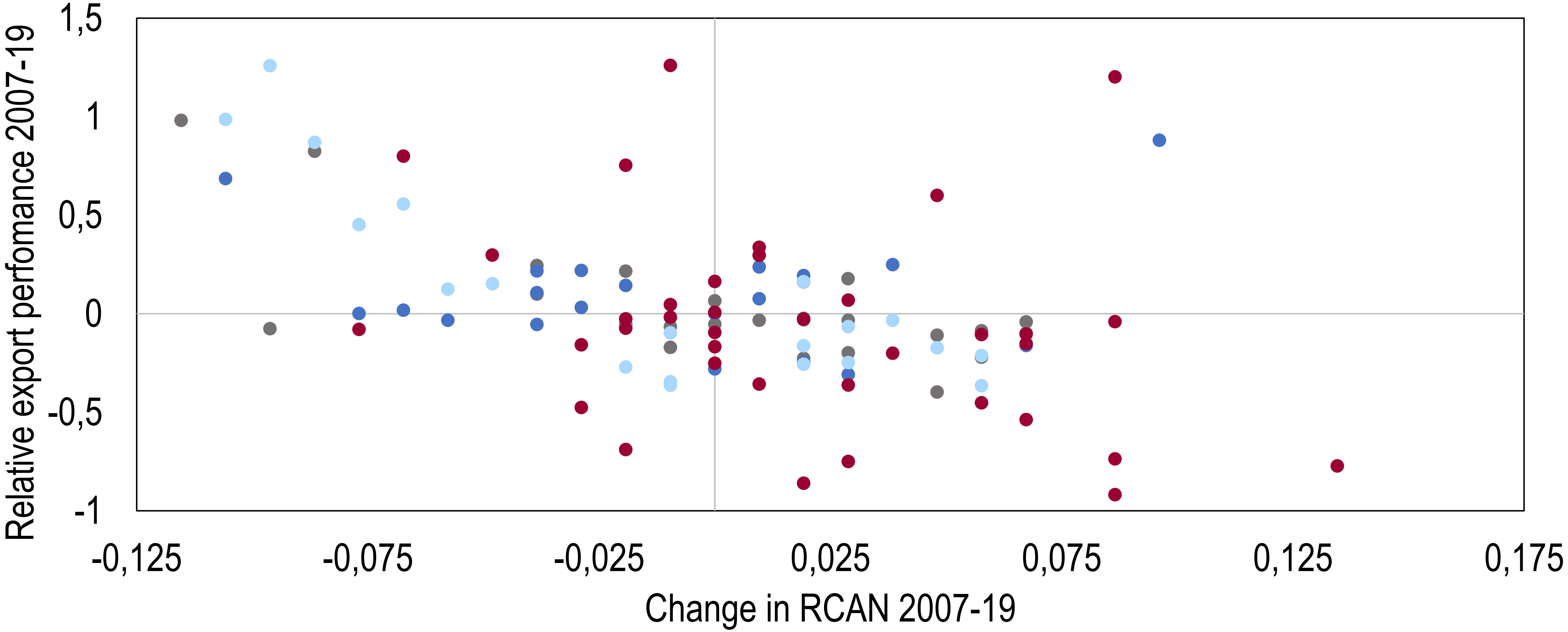
Relative related and unrelated variety

- A possible solution could be, even in this case, a comparison between each province's export distribution and their average.
- If a province's within-sector entropy is higher than the national average, this gap can be used to detect and measure related variety. So, our relative measures of related and unrelated variety are as follows:
- $RUVi = (UVi – UV^*)/(UVi + UV^*)$
- $RRVi = (RVi – RV^*)/(RVi + RV^*)$
- where the * refers to the arithmetic mean of the two indicators across provinces.

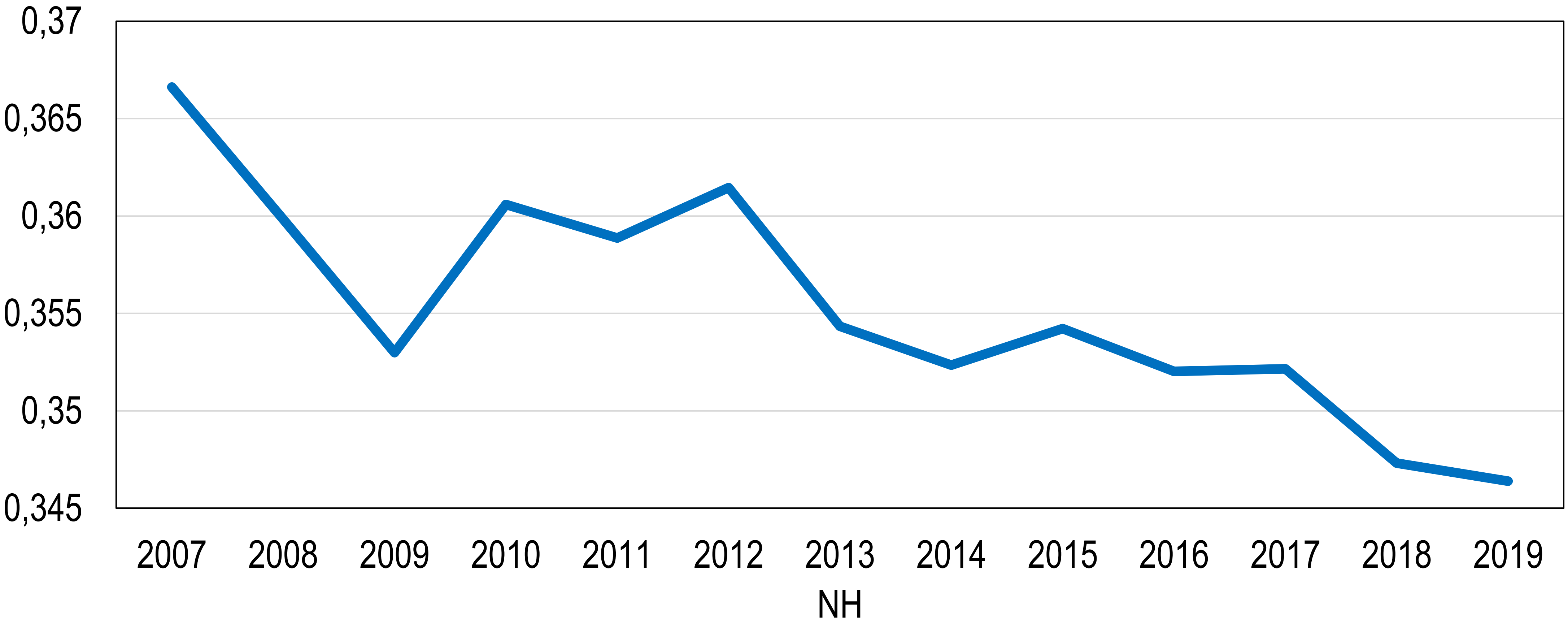
Relative number of comparative advantage sectors (average of Italian provinces)



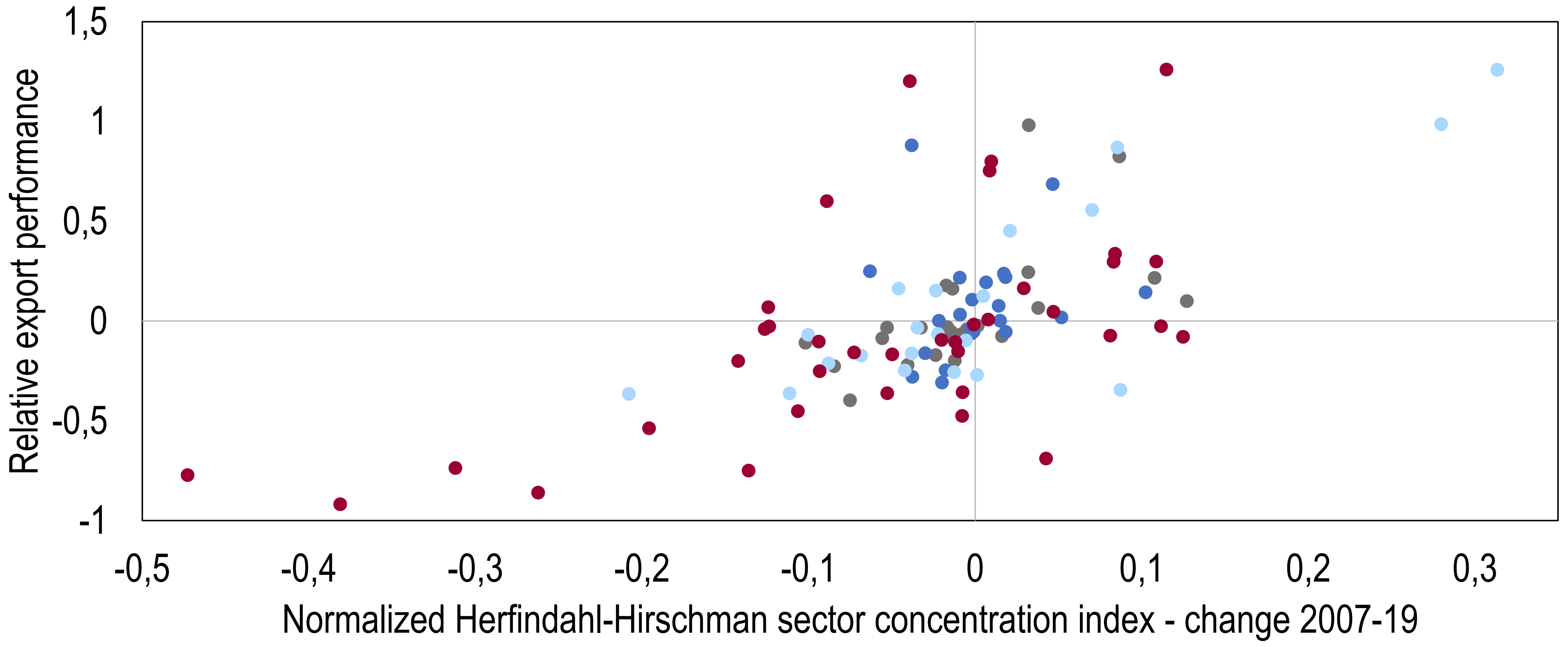
Correlation between change in the relative number of comparative advantage sectors and relative export performance



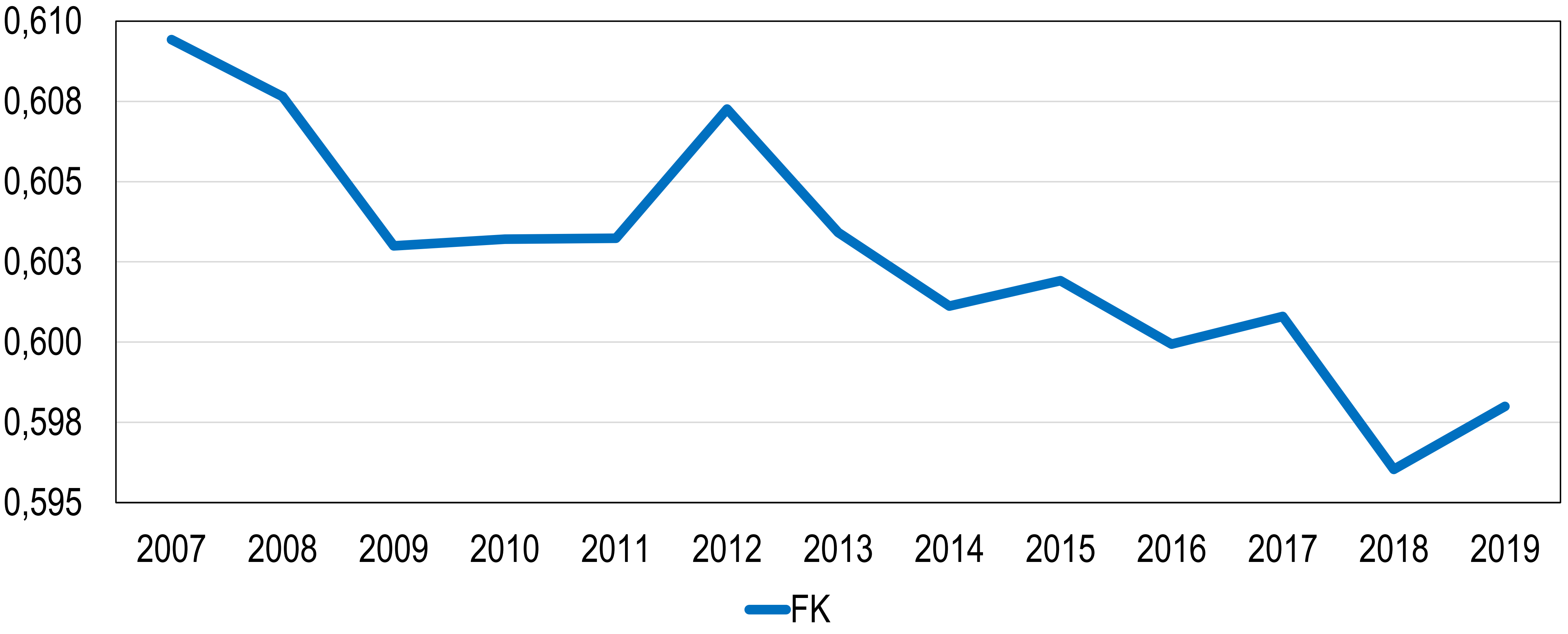
Normalized Herfindahl-Hirschmann sector concentration index (average of Italian provinces)



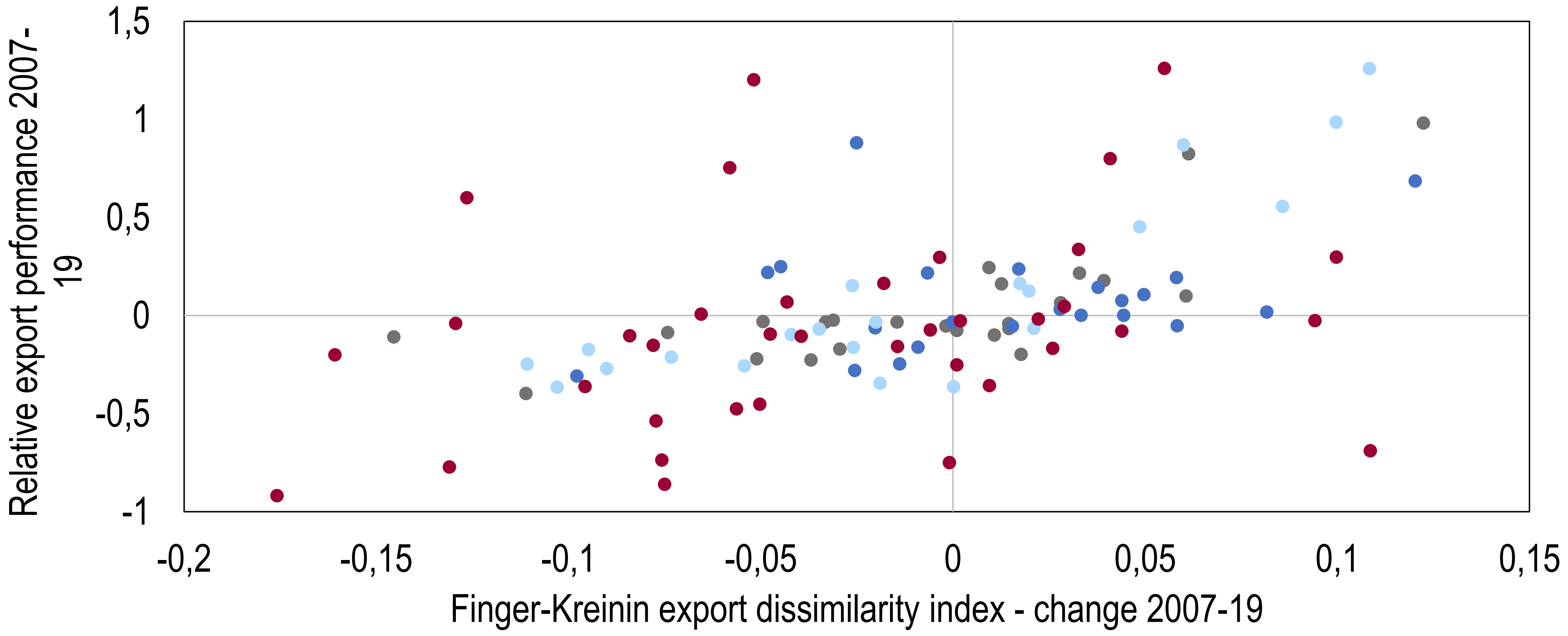
Correlation between the change in sector concentration and relative export performance



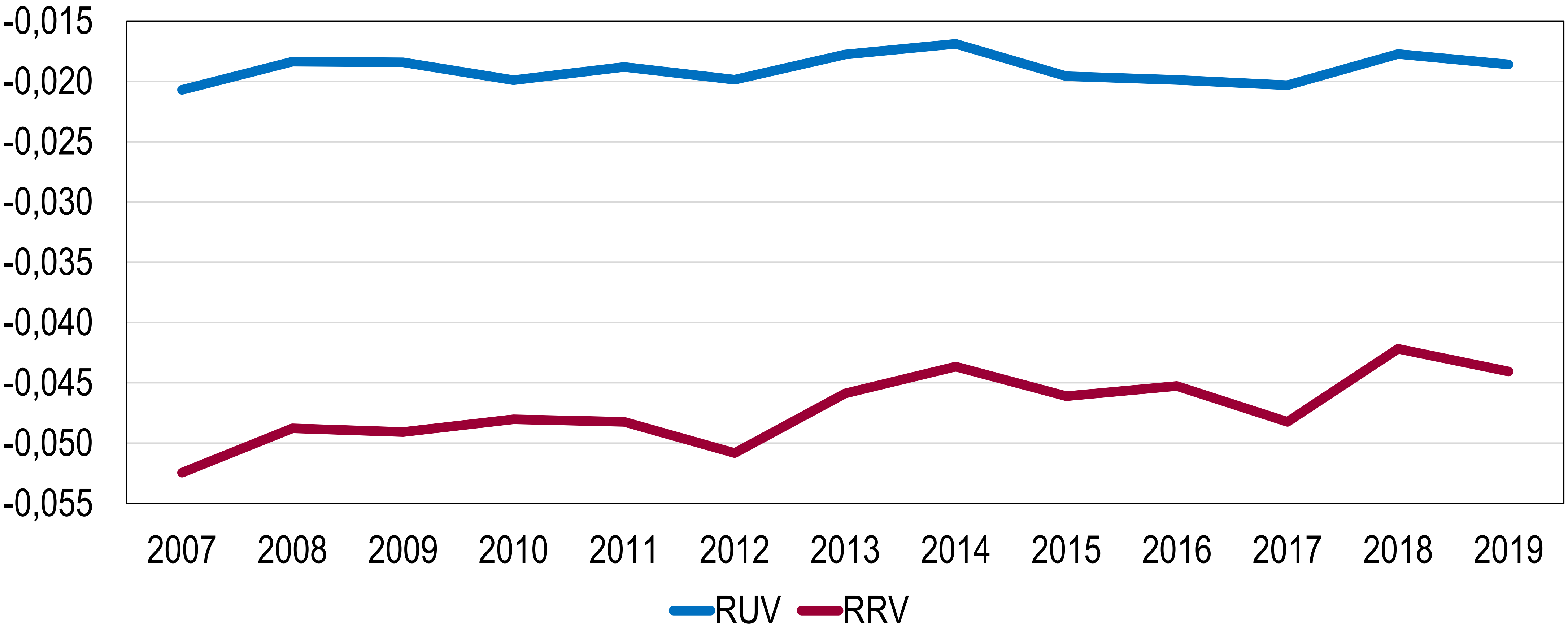
Finger-Kreinin export dissimilarity index (average of Italian provinces)



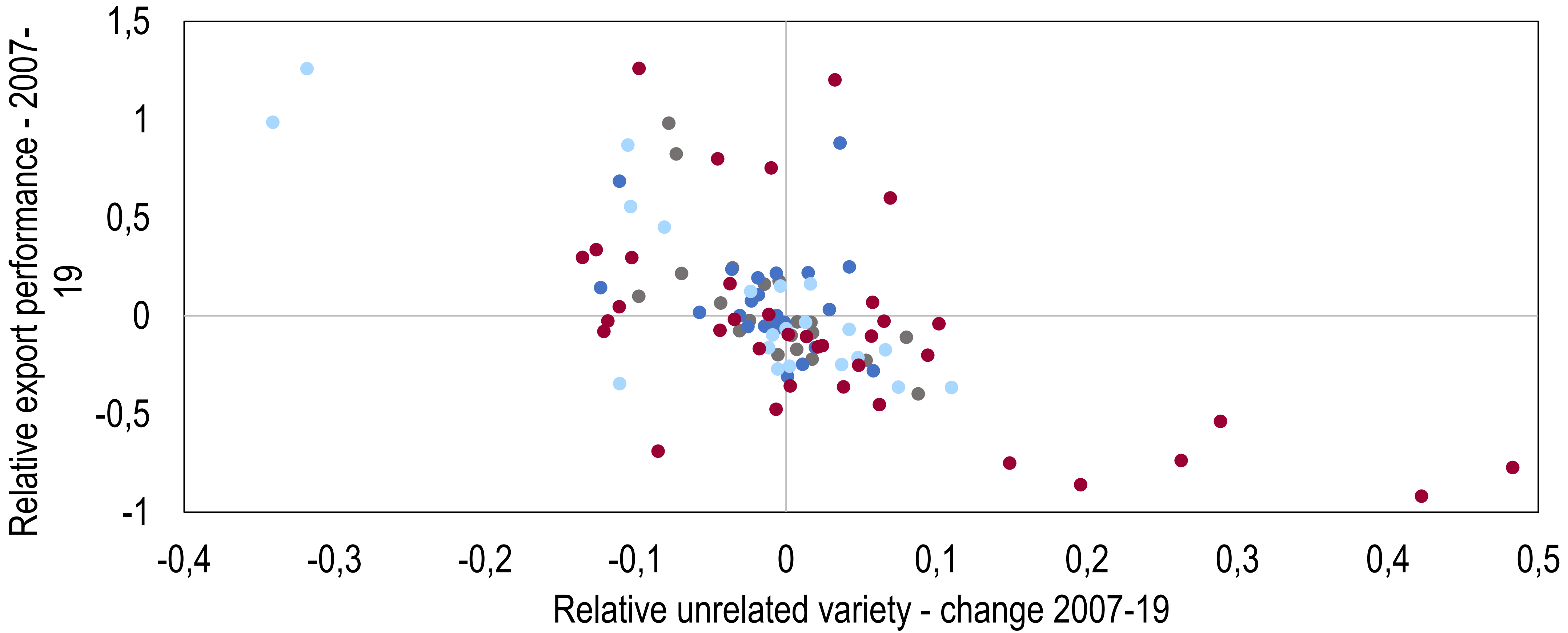
Correlation between changes in export dissimilarity and relative export performance



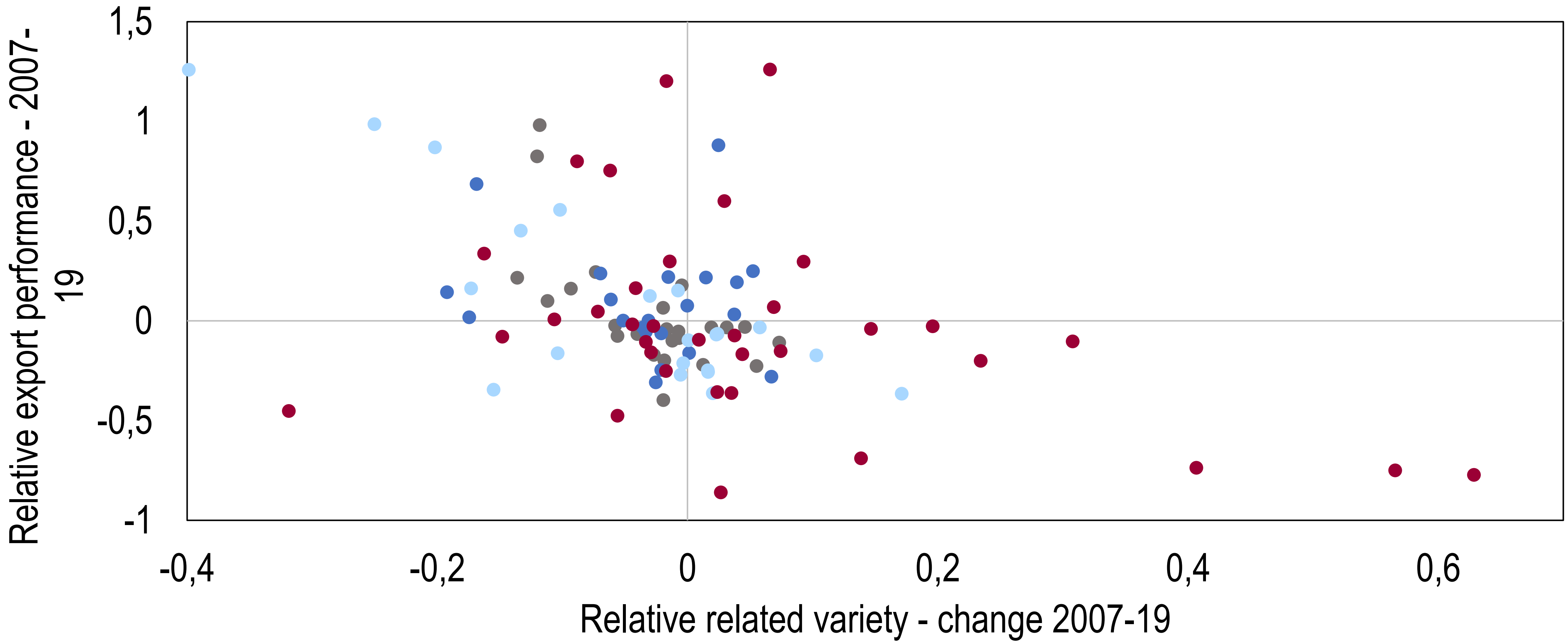
Relative unrelated and related variety (average of Italian provinces)



Correlation between changes in relative unrelated variety and relative export performance



Correlation between changes in relative related variety and relative export performance



Preliminary econometric estimates: diversification and export competitive success

VARIABLES	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS
HHIndex	0.00231***				
	(0.000331)				
RCAN		-0.00363***			
		(0.000708)			
FKIndex			0.00229***		
			(0.000507)		
RVIndex				-0.00120***	
				(0.000215)	
UVIndex					-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

Preliminary econometric estimates: diversification and export competitive success

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
HHIndex	0.00229***				
	(0.000542)				
RCAN		-0.00357***			
		(0.000897)			
FKIndex			0.00222***		
			(0.000664)		
RVIndex				-0.00118***	
				(0.000342)	
UVIndex					-0.00236***
					(0.000563)
Constant	3.04e-06***	3.11e-06***	3.64e-06***	1.56e-06***	1.60e-06***
	(2.63e-07)	(2.96e-07)	(5.14e-07)	(1.07e-07)	(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

Diversification and export competitive success: first quartile

VARIABLES	(1) OLS group 1	(2) OLS group 1	(3) OLS group 1	(4) OLS group 1	(5) OLS group
HHIndex	0.000673***				
	(0.000129)				
RCAN		-0.00150***			
		(0.000286)			
FKIndex			0.000832***		
			(0.000182)		
RVIndex				-0.000247***	
				(7.42e-05)	
UVIndex					-0.000758**
					(0.000149)
Constant	-1.03e-05	-9.71e-06	-1.09e-05	-1.14e-05	-1.05e-05
	(7.28e-06)	(7.30e-06)	(7.32e-06)	(7.40e-06)	(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

Diversification and export competitive success: second quartile

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		-0.00519***			
		(0.000898)			
FKIndex			0.00321***		
			(0.000603)		
RVIndex				-0.00190***	
				(0.000368)	
UVIndex					-0.00444***
					(0.000702)
Constant	-1.08e-06	-2.84e-06	-1.53e-07	-4.05e-06	-3.19e-06
	(1.74e-05)	(1.81e-05)	(1.80e-05)	(1.81e-05)	(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

Diversification and export competitive success: third quartile

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		-0.00364***			
		(0.000959)			
FKIndex			0.00291***		
			(0.000770)		
RVIndex				-0.00170***	
				(0.000582)	
UVIndex					-0.00259***
					(0.000864)
Constant	4.27e-05	4.21e-05	4.49e-05	4.00e-05	4.06e-05
	(2.73e-05)	(2.75e-05)	(2.74e-05)	(2.73e-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

Diversification and export competitive success: fourth quartile

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		-0.00422*			
		(0.00227)			
FKIndex			0.00252		
			(0.00174)		
RVIndex				-0.00266*	
				(0.00151)	
UVIndex					-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

Diversification and export competitive success: fourth quartile

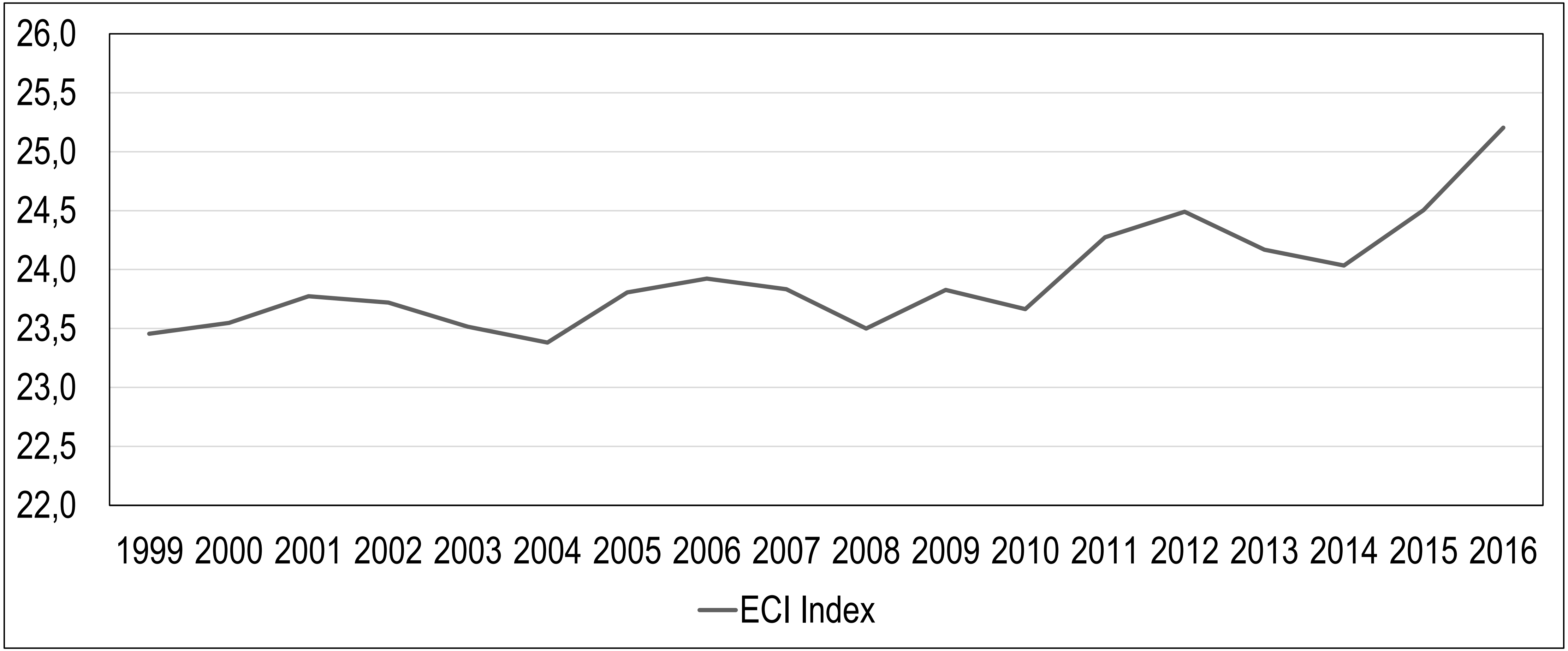
	(1)	(2)	(3)	(4)	(5)
VARIABLES	Fixed Effects group 4	Fixed Effects group 4	Fixed Effects group 4	Fixed Effects group 4	Fixed Effects group 4
HHIndex	0.00474				
	(0.00283)				
RCAN		-0.00406			
		(0.00254)			
FKIndex			0.00234		
			(0.00212)		
RVIndex				-0.00258	
				(0.00226)	
UVIndex					-0.00422
					(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

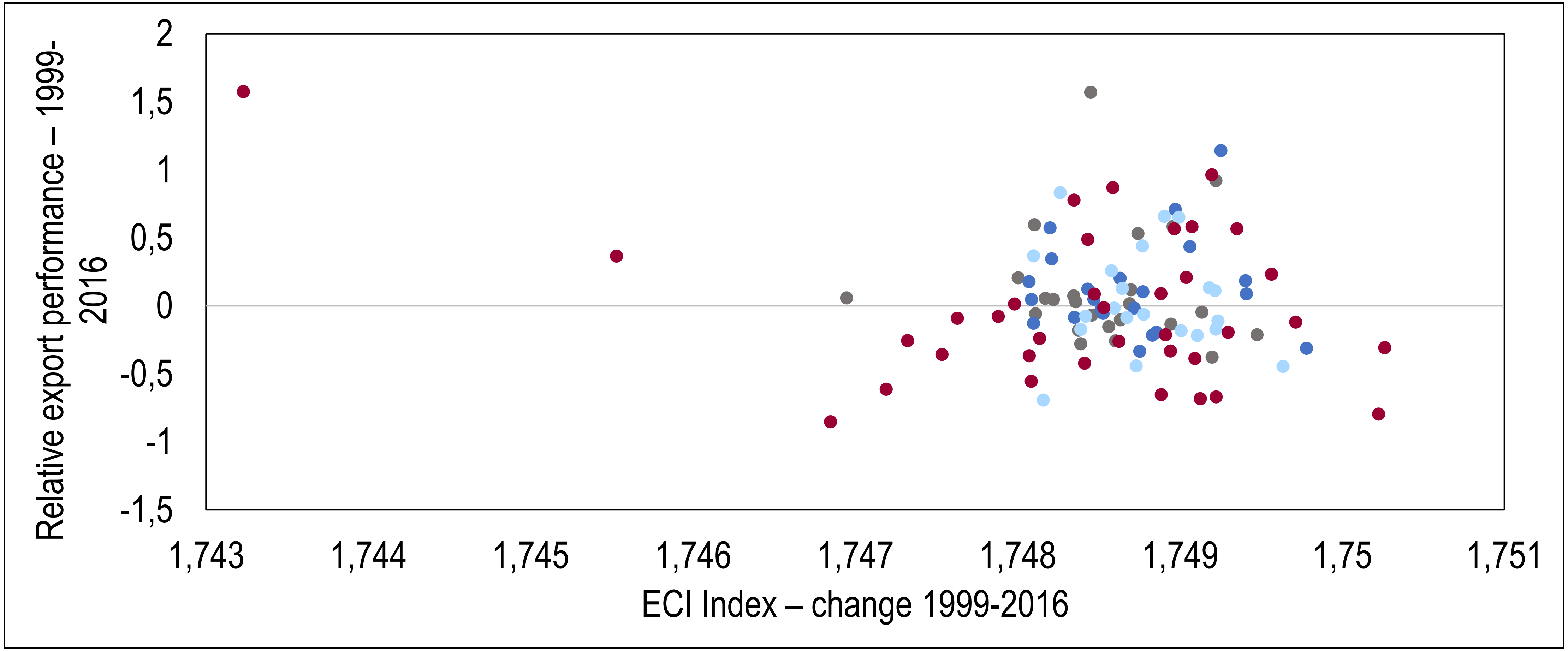
Economic complexity indicators

- Distinguishing between relatedness and complexity (Hidalgo, 2021)
  - Relatedeness concerns the evolution of specialization patterns, or how close is an economy to a desired economic structure
  - Complexity uses data on the geography of economic activities to extract information on the endowment and quality of production assets and capabilities
- The driving idea: an economic system is complex if its pattern of specialization includes a wide range of 'non-ubiquitous' products, revealing specific capabilities
- The Economic Fitness-Complexity algorithm (Sbardella et al. 2018): a complex-network metrics using revealed comparative advantages to extract information about the underlying skills and capabilities

Economic complexity index (average of Italian provinces)



Correlation between changes in economic complexity and relative export performance



Future research

- Controlling for other local conditions, e.g.:
  - Innovation and productivity
  - Multinational presence
  - Industrial districtse
  - Urban systems
  - Social capital
  - Infrastructures
- Controlling for inter-regional effects

Economic complexity indicators: some questions and a possible cooperation proposal

- Limitations of the binary approach to the measurement of comparative advantages
- Sensitivity to the size of the province: larger provinces reach more easily higher levels of diversification; for small economies, the advantages of specialization still appear relevant.
- Non-ubiquitous products are not necessarily complex products
- Interdipendence between diversification of provinces and ubiquity of products: other things being equal, any increase in a province's diversification brings about a rise in a product's ubiquity
- However, new products are non-ubiquitous by definition, which reveals an interesting link between economic complexity and dynamic efficiency of specialization patterns
- Exploring the link between economic fitness and dynamic efficiency of specialization patterns: to what extent an economy's endowment of skills and capabilities is favourable to product innovation

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