Research Policy 56 (2027) 105656



Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol



Selective industrial policy for the EU open strategic autonomy: The role of products' relatedness☆

Filippo Bontadini *, Valentina Meliciani

LUISS Department of Economics and Financial Markets and LUISS Research Centre for European Analysis and Policy, Italy

ARTICLE INFO

JEL:
O25
O33
O38
P33

Keywords:
Industrial policy
Relatedness
Open strategic autonomy
Export specialisation

ABSTRACT

The European Union has adopted the concept of Open Strategic Autonomy (OSA) to reduce strategic dependencies while preserving openness to international trade. An important policy question is therefore which countries are best positioned to develop new trade advantages in strategic products. Building on the literature on relatedness and export diversification, we address this question by complementing the standard notion of product distance, measuring how close a country is to a product compared to other countries, and how close a product is to a country's productive structure compared to other products. We term these concepts absolute and relative distance advantages. We argue that relative distance advantages reflect countries' incentives to diversify into a product, whereas absolute distance advantages capture their ability to successfully develop new trade advantage in that product. Using trade data for EU countries, we show that both dimensions significantly predict the emergence of new export specializations in products identified by the EU as strategic.

1. Introduction

The continuous crises that started with the 2008 financial crisis, followed by the COVID-19 pandemic, the war in Ukraine, the ensuing energy crisis, the conflict in the Middle East and Trump's reinvigorated protectionist policies have brought into question the virtues of globalisation and led to a need for security in all domains including the economy (Evenett et al., 2024).

As a consequence, economic security has become a new policy goal to be achieved through strategic autonomy (Fontana and Vannuccini, 2024) and technological sovereignty (Edler et al., 2023; Crespi et al., 2021). This goes beyond the traditional arguments for technology and industrial policies such as the infant industry argument, inter-industry linkages or the existence of positive externalities and dynamic increasing returns, with industrial policy now aiming to sustain national competitiveness and building capacities for transformative policies to tackle major societal challenges (Mazzucato, 2021; Edler et al., 2023; Juhász et al., 2023).

In this new framework, the European Union faces additional challenges due to the nature of the Union, encompassing 27 national governments each pursuing specific policy goals. In fact, while competition policy is an exclusive competence of the Union, industrial policy is not and European industrial initiatives are still predominantly left to Member States by making use of the General Block Exemption Regulation (GBER) and declaring a priori certain categories of aid compatible with the internal market (Fontana and Vannuccini, 2024). Each Member State differs in terms of fiscal capacity to implement such policies and in terms of pre-existing productive structures and political economy features (Filippetti and Vezzani, 2022). This can trigger races to the bottom when it comes to policy interventions, with countries competing against each other, leading to redundant and suboptimal policy implementation undermining EU cohesion (Barbero et al., 2024). While providing European public goods and addressing externalities across industries at the EU level requires a supranational industrial policy, the EU initiatives rely on Member States' contribution, and the European level is left to focus mainly on supervision and coordination tasks (Kleimann et al., 2023).

In this context, the aim of this work is to propose a framework for analysing the role of products' distance for achieving new specializations in EU targeted areas. We use trade data to look at three product categories that have been identified by the EU as requiring special attention for economic security and for the green and digital transition (Arjona et al., 2023; European Commission, 2021): (i) products that the European Commission identifies as belonging to a sensitive ecosystem, i.e.

☆ This article is part of a Special issue entitled: 'Rethinking science & technology' published in Research Policy.

* Corresponding author.
E-mail address: fbontadini@luiss.it (F. Bontadini).

https://doi.org/10.1016/j.respol.2026.105656
Received 14 December 2024; Received in revised form 7 September 2026; Accepted 21 October 2026
Available online 5 November 2026
0048-7333/© 2026 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

being relevant for health, renewables, aerospace/defence, digital, electronics and energy intensive industries (see European Commission (2021) chapter 1.1) and in which the EU exhibits dependence, following the methodology in Arjona et al. (2023)[1]; (ii) Net Zero Industry Act (NZIA) products, which are strategic for the green transition; (iii) and semiconductors that are a general purpose technology at the core of the digital transition.[2]

Drawing on the structuralist and evolutionary literature on proximity and complexity (Hidalgo et al., 2007; Hidalgo, 2021; Balland et al., 2022) we identify strategic products that are closer to the EU production capabilities. Differently from previous studies on related diversification, we complement measures of distance as an absolute concept (Hidalgo et al., 2007; Boschma et al., 2013; Boschma, 2024; Hernández-Rodríguez et al., 2025) with measures of relative distance. As we describe more in detail in Sections 3 and 4, we use the former to identify which countries lie the closest to strategic products and the latter to identify which products are closest to countries' productive structure. We argue, and show, that relative distance plays an important role for achieving new specializations since countries will diversify towards products that are closer to their productive structure independently from the choices of firms in other countries. However, the likelihood of successful specialisation will also depend on absolute distance since countries may lack the basic capabilities to reach too distant products, or they would struggle to redeploy their capabilities compared to other countries that lie closer to the same product. The extent to which absolute and relative distance matter will depend on how much overlap exists among countries' specialisation patterns. If all countries have similar relative distances, they will likely compete for the same products, and absolute distance will determine the success of specialisation attempts; if there is no overlap instead countries' specialisation will be complementary to each other and they all move towards different products and relative distance will become relevant. We show empirically that complementarity is only partial and, as a consequence, both absolute and relative distance matter. This is important for policies too: if countries have incentives to pursue specialisation in the same products, coordination among EU countries becomes paramount to avoid duplication of efforts or, worse, races to the bottom.

Our findings support the importance of both absolute and relative distance for new trade advantages in strategic products.[3] We show that while large EU manufacturing countries, especially Germany and Italy, are closer in absolute terms to strategic products, some small Northern and Eastern European countries – namely Sweden, Finland and Czechia – are closer in relative terms.

We argue that if large manufacturing countries (and their firms) cannot simultaneously diversify into too many products, smaller Member States with limited relative distance may play a role if the European Union wants to develop extensive end-to-end value chains in critical areas. This points to the importance of coordinating EU and Member States' policies to acquire new trade advantages in strategic products and, therefore, reduce dependencies.

The paper is organised as follows: Section 2 reviews the methodological tools developed within the literature on geography and economics of innovation linking the acquisition of new trade advantages to proximity and briefly discusses the new European emphasis on strategic autonomy and economic security which informs the choice of strategic products investigated in this paper. Section 3 introduces the conceptual framework and the role of relative distance for achieving new trade advantages. Section 4 presents the methodology adopted to measure product proximity/distance in absolute and relative terms and the descriptive statistics. Section 5 discusses the results of the empirical analysis, while the last Section concludes and draws policy implications.

2. Distance and export specialisation: A literature review

The methodological toolbox developed within the literature on relatedness and export specialisation may prove very useful in mapping the position of EU countries with respect to strategic products and in identifying areas of opportunity by looking at those products that are closer to the actual set of countries' capabilities. This framework builds on the firm and country-level evolutionary theory (Dosi, 1982; Nelson and Winter, 1985; Lall, 1992) and in evolutionary economic geography (Boschma, 2005; Boschma and Frenken, 2011) and argues, in line with the structuralist tradition (Hirschman, 1958; Prebisch, 1962; Cimoli, 1994; Cimoli and Porcile, 2016), that the evolution of productive structures is path dependent and the structure of related activities determines countries' diversification opportunities and constraints. It puts forwards a data driven methodology inferring productive and technological capabilities through metrics of distance and relate them to the likelihood to achieve new specializations (Hausmann et al., 2007; Hidalgo and Hausmann, 2009; Tacchella et al., 2012; Boschma, 2017; Petralia et al., 2017; Perruchas et al., 2020; Mewes and Broekel, 2022).

For example, Hidalgo et al. (2007) measured the relatedness between exported products by examining their probability of being co-exported and found this measure to be significantly predictive of future export diversification. Recently this methodology has been applied to green capabilities, mainly using patent data (for a review see Caldarola et al., 2024), while few studies have focused on green productive capabilities using trade data (Huberty and Zachmann, 2011; Hamwey et al., 2013; Fraccascia et al., 2018; Sbardella et al., 2018; Perruchas et al., 2020; Mealy and Teytelboym, 2022; Müller and Eichhammer, 2023; Stojkoski et al., 2023).[4] Among these studies Fraccascia et al. (2018), using panel data regressions for 141 countries over the period 2005–2013, find support for the hypothesis that the green products with the highest potential for growth among all green products in a given country are those being in close proximity to the products a country produces with high Relative Comparative Advantage (RCA). Mealy and Teytelboym (2022) use a similar approach to explore countries' opportunities to increase their green production capabilities and find that "green complexity potential" which measures each country's average relatedness to green complex products positively affects changes in green production capabilities (measured by the green complexity index), the number and the share of exported green products. More recently, the complexity framework has been applied to study innovation paths and technological trajectories, especially in advanced materials (Albora et al., 2025). Stojkoski et al. (2023) add complexity metrics for technology and research to the traditional measure of complexity based on trade data and show that the new metric improves the ability of the regression models to explain variations in inclusive green growth.[5]

A key takeaway of this literature is that countries' productive structure evolves slowly over time and that "jumps" from one specialisation pattern to include products that are very dissimilar are unlikely to happen. This notion is also in line with firm level evidence looking at the importance of the coherence of firms' productive activities (Teece et al., 1994; Breschi et al., 2003; Goya and Zahler, 2019; Dosi et al., 2022; Duenas and Campi, 2024).

We contribute to this literature by complementing measures of absolute distance (which countries lie the closest to strategic products)

[1] While we refer the interested reader to the work of Arjona et al. (2023), in a nutshell the European Commission's methodology identifies products as exhibiting a dependence if the following conditions are met: high levels of concentration of imports, large shares of extra-EU imports and low EU domestic productive capacity.

[2] Although there is some limited overlap between this category and NZIA and semiconductors, we look separately at these categories due to their relevance for the green and digital transition.

[3] As we discuss explicitly in Section 4.2, products were selected on the basis of policy relevance, with no a priori hypotheses regarding the importance of proximity in achieving specialisation or reducing dependencies in these areas.

[4] For a review of the application of EC to sustainability, see Caldarola et al. (2024).

[5] For an extension to services see also Stojkoski et al. (2016).

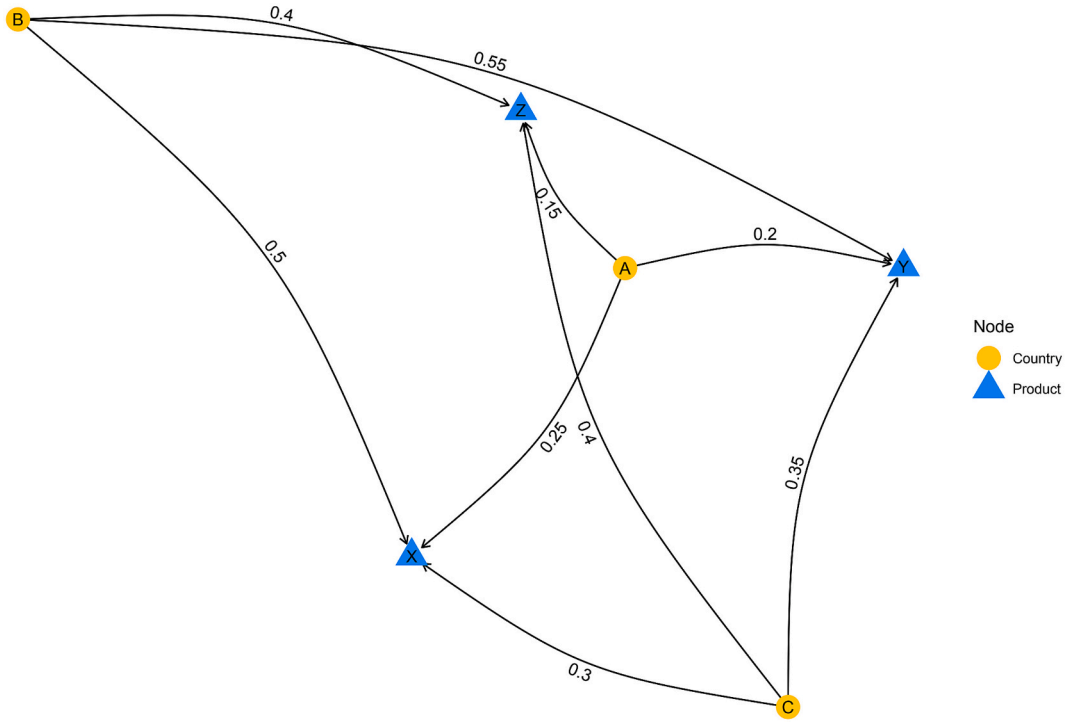


Fig. 1. Network example of three countries and three products. Note: the figure depicts a simplified example with three countries and three products, highlighting distance between each country-product pairs.

with measures of relative distance (which products are closest to countries' productive structure) and by testing their role for achieving new trade specializations in products that have been targeted by the EU for increasing strategic autonomy and economic security.

Disentangling how (absolute and relative) distance affects the capability of countries to specialise in these products and mapping the position of EU countries provides novel empirical evidence that can be used to inform industrial policies.

The methodological toolbox which we rely on in this work maps countries' position with respect to products and identifies possible diversification avenues, it remains however silent on how government can achieve specialisation (Uribe, 2025). Evaluating which policy instruments are better suited to enter strategic sectors goes beyond the scope of this paper; however, testing the role of product distance for specialisation and measuring the position of EU countries provides evidence on the opportunities and constraints of industrial policies. As we discuss in the concluding section, closer products may be easier to target, whereas distant products require transformative policies that broadly shift countries' productive structures (Chang and Andreoni, 2020; Juhász et al., 2023; Uribe, 2025). Moreover, insofar as EU countries display different levels of absolute and relative distance from targeted products, coordinated policies at the EU level may help effectively reduce EU dependencies.[6]

3. Distance and export specialisation: Conceptual framework

A key contribution of our research is to identify which products, in the three identified categories of strategic products, are closest to countries' productive capabilities and to relate product distance to the probability to develop new trade advantages over time. We do so by drawing on measures of relatedness density (Hidalgo et al., 2007; Boschma et al., 2013) developed within the structuralist literature of economic geography, technological capabilities and economic development. Relatedness density captures the overall proximity between a given product and all products that are in the current specialisation portfolio of a given country. Since diversified countries have more specializations, this measure is positively correlated to diversity (Hidalgo, 2021; Nomaler and Verspagen, 2024). Some recent papers have used different approaches to overcome this mechanical correlation: Pinheiro et al. (2022) standardize density within each country, Hidalgo (2021) divides by diversity, while Nomaler and Verspagen (2024) isolate the related variety component in density by using the residual of the regression of density on country and product dummies.

Building on Pinheiro et al. (2022) concept of relative relatedness, we introduce the concept (and measure) of relative distance. We argue that from a country's domestic perspective, what matters isn't just distance in absolute terms, but also in relative terms: i.e. what is the closest product to the country's productive structure among all the products the country could be producing. Firms in all countries will look for new advantages in products that are relatively closer to their capabilities.

In order to introduce the role of relative distance for achieving new specializations it is useful to start from Hidalgo et al. (2007) and from the example they use for explaining the role of (absolute) distance for firms' diversification trajectories. In their seminal contribution, they describe products as trees and firms as monkeys jumping from one tree to the next, that is redeploying their resources (physical and human capital, technology, institution) to reach new trees that are located at affordable distances (products that are close to firms' existing capabilities). The product space represents the forest, which turns out to be heterogenous with some areas being very sparse and others very dense. This implies that monkeys in trees located in dense parts of the forest will be closer to many other trees. If monkeys can jump only limited

[6] Evenett et al. (2024) raise questions around possible negative spillovers and tit-for-tat mechanisms in the use of industrial policies and point to the importance of strengthening multilateral surveillance. In the European context Archibugi and Mariella (2021) discuss how coordinated policies have been successful in the past, leading to the emergence of European champions such as Airbus.

distances, the structure of the forest and a country's position within it affects the opportunities of diversification into new products. We build on this example and assume that countries (and their firms) have limited resources so that they cannot jump on all surrounding trees.[7] They will therefore need to choose where to jump and they will choose the trees that are closest. For sake of simplicity, we also assume that firms cannot specialise in the same product (they cannot jump on the same tree) and if more than one firm attempt to jump on a tree, the firm that is located closer will succeed.[8]

The discussion thus far suggests that countries' specialisation patterns are driven by both absolute distance (distance across countries within a given product) and relative distance (distance across products within a given country). Combining these two distances we conceptualise specialisation dynamics in a two-fold endeavour:

1. The abundance of resources constraints the number of products in which a country's firms will attempt specialisation. Within this, firms will start from products closer, relatively to all other products they might choose to specialise in. Relative distance will therefore determine the incentives for a country to attempt to specialise in a given product.
2. The likelihood of whether firms (and countries) manage to specialise in a product also depends, however, on the absolute distance. In fact, firms won't be able to reach too distant products because they either lack the basic capabilities, or, even if they cleared this minimum threshold, they would struggle to redeploy their capabilities compared to other countries that lie comparatively closer to the same product. Therefore, absolute distance (compared to other countries) also matters as it shapes the likelihood of success of a country.

To illustrate this in more general terms, we provide a simplified example in Fig. 1 where we have three countries (A, B and C) and three products (X, Y and Z). Let's assume that countries can only produce two products due to a resource constraint.[9] In Fig. 1, Country A is the closest to all products (it is situated in the denser part of the forest), country B is the farthest from all products while country C is more distant than country A from all products but relatively closer to product X. Countries (i.e. their firms) would choose which products to target for specialisation starting from the closest product (they will attempt jumping on the closer tree).

It follows that:

– Country A will choose to specialise in products: Z and Y
– Country B will choose to specialise in products: Z and X
– Country C will choose to specialise in products: X and Y.

The success of each country will depend in contrast on which country is closest to which products compared to other countries. Therefore:

– Country A will produce products Z and Y.
– Country B won't succeed in any product
– Country C will produce X.

Countries' specialisation will depend both on absolute and relative distance. While products Z and Y are closer to country A both in absolute and relative terms, product X is closer to country C only in relative terms (in absolute terms it is closer to country A). Notice that the role of relative distance is the consequence of a resource constraint: country A cannot enter all the products that lie close to its productive capacity. Imperfect labour and capital mobility in Europe justify this assumption.[10]

Linking this framework to theories of trade specialisation, it is worth noting that Hidalgo et al. (2007), Hausmann et al. (2007), as well as the broader structuralist approach depart from the traditional theory of comparative advantage, which holds that countries specialise according to their relative factor endowments and benefit from trade regardless of the structure of their specialisation. Our notion of relative distance also follows the structuralist perspective and is not grounded in relative factor endowments; rather, it builds on the idea that firms diversify into products that are closer to their existing capabilities.

We extend this approach by acknowledging that, due to limited resources, countries cannot pursue all available diversification opportunities simultaneously. This implies that, while more diversified countries enjoy a larger set of opportunities to enter new products, countries that are (only) relatively close to specific products may still successfully specialise in some products.

In the example in Fig. 1, differently from traditional trade theory which assumes that all countries (firms) will find a product of "comparative advantage", and consistently with the structuralist approach relying on the non-fungibility of factors such as knowledge, country B that lies far from all products (in the more deserted areas of the forest) is unable to undergo structural transformation because its distances are too high. This is not the case for country C, which lies relatively close to product X and can therefore successfully diversify by exploiting opportunities that remain unexplored by country A, owing to constraints on its diversification trajectory. If large manufacturing countries (and their firms) face limits on the number of products into which they can diversify at any given time, this creates scope for smaller countries with sufficient diversification capabilities to develop trade advantages in related products.[11] Therefore, smaller Member States with limited relative distance may also play a role if the EU wants to develop extensive end-to-end value chains in critical areas.

The framework described above is particularly relevant for interpreting the diversification patterns of EU countries and for assessing the importance of a coordinated policy approach to avoid duplication of efforts and to maximize the likelihood of entering comprehensive end-to-end value chains in strategic products. In Appendix A.1 we show that coordinated industrial policies may serve this objective more effectively than uncoordinated national industrial policies.

In the following sections we operationalise measures of absolute and relative distance empirically and test their relationship with the

[7] By limited resources we refer to the fact that companies (and therefore countries) will have a limited amount of labour and capital, which cannot freely move among countries, and productive capabilities. We discuss this in more detail further down in this section.

[8] Admittedly this is a simplifying assumption, in reality more than one firm may be able to produce the same product, but the number of firms doing so is finite. Competition dynamics will prevent all firms to successfully specialise in the same product. So, to the extent that distance reflects lower costs of redeployment of resources to create new capabilities, firms (and countries) that lie closer to a product will have better chances to prevail in the market and achieve specialisation.

[9] Naturally, in our data there are many products (5199) and countries with very different resource constraints (e.g. think of Germany and Greece). So, it is entirely possible that some countries will be able to "jump" to different numbers of products. To go back to our metaphor, we can think of the resource constraint as the number of monkeys that belong to a country. The larger the size of the country the larger the number of monkeys it has and the more diversified the capabilities of these monkeys the shorter the distance will be separating the country from any given product. These aspects are fully reflected in our data; however, we simplify these to better illustrate the mechanisms at play, without loss of generality.

[10] This line of reasoning is similar to that of Camagni (2002) discussing the role of comparative and absolute advantages for the international competitiveness of countries and regions. He argues that in the case of regions what matters for trade is absolute advantages due to limited price-wage flexibility and high inter-regional migration of mobile factors, while low levels of factor mobility across countries give a role to competitiveness based on comparative advantage.

[11] In our setting even if a country is closer to producing a product in absolute terms, specialisation may not occur if the same country has a large number of diversification opportunities (is close to many products) and limited resources. At the same time all countries (firms) look for diversification opportunities in the neighbourhood of their capabilities and enter the closer products provided that they are not "too distant" (they have the capabilities). While we cannot quantify the threshold level of distance signalling the absence of capabilities, we can look at the predictive power of absolute and relative distance to achieve and maintain new trade advantages.

likelihood of countries' managing to specialise in new products through an econometric exercise. In the concluding section we discuss the results and cast them in light of the current policy challenges EU countries are facing.

4. Country-product distance, the evolution of comparative advantage: Data and methodology

In order to measure absolute and relative distance, we rely on what the literature has referred to as relatedness density (Hidalgo et al., 2007; Boschma et al., 2013) obtaining a measure of country-product distance. While we discuss the technical details in the Appendix A.2, it is important to convey the intuition of this measure. This starts from the notion of product-to-product proximity, i.e. products that are similar to one another will have a high probability of being exported by the same countries with an RCA. Building on this, the relatedness between a country and a product can be understood as average proximity between the product and the country's productive structure, proxied by the products the country exports with RCA. Our measure of distance is the complement of this measure of relatedness (for country i and product: $dist_{ik} = 1 - Relatedness_{ik}$). To give an example, a country that is specialised in chemical and electronic products will lie closer to lithium batteries than a country with a specialisation in textile or food and beverage.

This measure of country-product distance reflects differences in countries' productive structures and, in turn, their underlying technological capabilities and factor endowments. It is therefore reasonable that large, highly diversified economies such as Germany and Italy will be better placed to specialise successfully in strategic goods, than smaller service oriented economies such as Ireland and Luxembourg. These are relevant aspects that European policy makers would want to take into account when considering how to foster specialisation in strategic products without undermining EU cohesion. To the extent that more advanced industrialised countries (and regions) in the EU are in a more favourable position to specialise in strategic products, a high level of coordination between industrial and cohesion policies is needed to prevent increasing regional inequalities (Monastiriotis and Gamtkitsulashvili, 2024).

We have argued above, however, that countries' specialisation avenues do not simply depend on *levels* of distance. Under finite resources and limited mobility of labour and capital, larger and more diversified economies (and firms in these countries) will also need to identify which of the strategic products are closest and, importantly, which other non-strategic products might be closer still. This opens, in turn, opportunities for smaller, less diversified countries that would lie farther from most products in absolute terms but not in relative terms.

We, therefore, expect that both absolute and relative distance will matter for developing new export advantages. Since in our framework absolute distance matters compared among countries and relative distance compared among products, we perform a min-max normalisation on distance, taking countries and products as benchmarks, respectively.

$$Absolute\ Dist_{ik} = \frac{(Dist_{ik} - min_i(dist_{ik}))}{(max_i(dist_{ik}) - min_i(dist_{ik}))} \quad (1)$$

$$Relative\ Dist_{ik} = \frac{(Dist_{ik} - min_k(dist_{ik}))}{(max_k(dist_{ik}) - min_k(dist_{ik}))} \quad (2)$$

The formulas above imply that the absolute (relative) distance is computed by taking the difference between the distance between a country i and a product k and the minimum distance of all countries (products) with respect to the same product (country).[12] Intuitively, the absolute distance identifies for each product the country closest to it, while the relative distance identifies for each country the product closest to it.

Naturally, a country may have low distance vis-à-vis a product in both, neither or either of absolute or relative terms. To capture this, we construct a categorical variable taking four possible values for each country-product combination:

1. The country lies in the bottom two quintiles[13] of the distribution of the absolute distance. This means that, with respect to the product, the country is among the closest ones and enjoys what we refer to as an absolute distance advantage (absolute advantage henceforth).
2. The product lies in the bottom two quintiles of the distribution of the relative distance. This means, in specular way, that with respect to the country, the product is among the closest ones, i.e. the first one that the country's firms would be likely to choose to specialise in; it therefore enjoys what we refer to as a relative distance advantage (relative advantage henceforth).
3. Both the above statements are true, the country-product has therefore both kinds of advantages.
4. Neither is true, the country-product has no advantage.

4.1. Outcome variables of interest

The interest for industrial policy in the EU, and many other countries, has arisen from growing tensions in the geopolitical scenario we have discussed in the introduction, and it aims at reducing the EU dependence vis-à-vis its foreign partners. The EU has set out to pursue this goal through OSA, a key aim of which is to reduce the EU's dependence through the diversification of import and the building up of productive capacity to serve the EU domestic market. This cannot be achieved, in the long run, by simply implementing import substitution policies, but requires developing (or restoring) productive capabilities in strategic products. Consistently with this, the development of new specializations is at the core of the conceptual framework we discussed in Section 3. As it is standard in the literature, we measure specialisation with the revealed comparative advantage as a Balassa index:

[12] We term absolute distance a measure that is normalised, this is to be consistent with our conceptual framework which suggests that what matters is a country's distance from a product *compared* to other countries. This is what the normalisation achieves but the interpretation, and results, remain similar to the traditional measure of distance (Hidalgo et al., 2007). Our measure of relative distance follows what Pinheiro et al. (2022) refer to as "relative relatedness", except for the fact that we normalise with a min-max approach rather than a z-score. We however combine this measure with the notion of absolute distance discussed above and use these measures to obtain categorical variables mapping countries absolute and relative advantages across products as we discuss in the remainder of this section and in Section 5.2.

Finally, in the Appendix A.4 we also report correlation matrix (Table A.2) and scatterplots of these two normalised measures of relative and absolute distance (Figs. A.4 and A.5) and find the correlation to be significantly stronger when sampling individual countries rather than lumping all countries together.

[13] We chose the bottom two quintiles as a threshold to balance the need for a meaningful threshold and sufficient number of observations within each group. This is particularly important for the two smaller product categories, NZIA and semiconductors. We discuss these issues in our econometric analysis in Section 5.2.

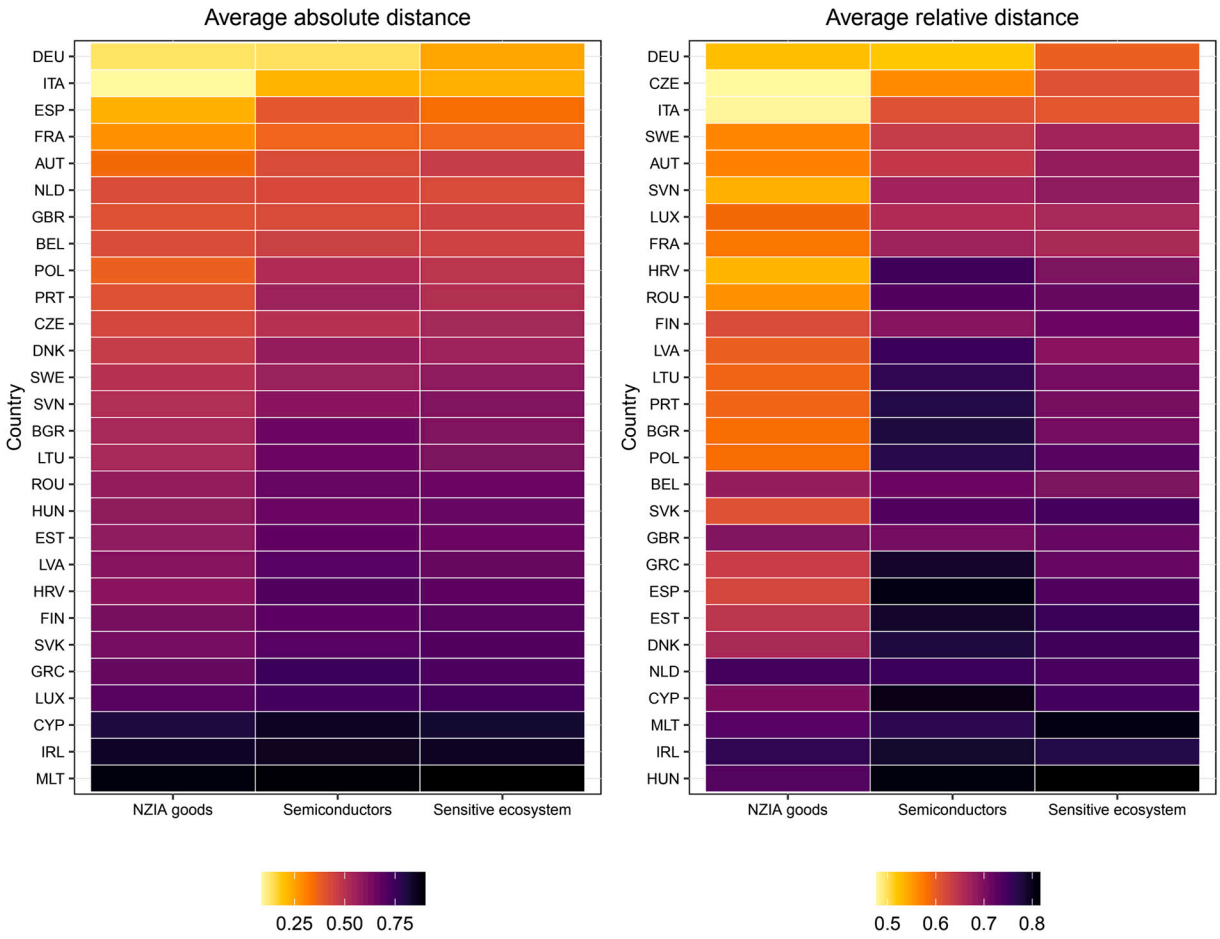


Fig. 2. Average absolute and relative distance across countries and strategic products. Note: Colours refer to unweighted average distance of country-product pairs over the 2012–21 period, for absolute and relative distance. Each panel has its own scale to facilitate comparisons across product categories. Source: authors' elaboration on BACI-CEPII data.

$$RCA_{ik} = \frac{x_{ik} / \sum_i x_{ik}}{\sum_k x_{ik} / \sum_i \sum_k x_{ik}} \quad (3)$$

When this measure takes values above unity, it captures a country's specialisation, relative to the rest of the World, in exports of a given good.

It is worth stressing that RCAs are measures of a country's specialisation in a product, based on the Ricardian idea of comparative advantage and opportunity costs. This means that RCAs identify products that have lower opportunity costs, relative to the other products a country could be producing. This is not equivalent to measures of absolute advantage drawn from the technology-gap theory that usually rely on market shares. We choose to focus on the former rather than the latter for a few key reasons.

First, our interest lies with a specific subset of products that are of strategic interest and for which global demand is likely to grow significantly in the coming years. Specialisation in these products allows countries to benefit from the growing demand and will likely improve economic outcomes (Thirlwall, 1979).

Second, EU countries greatly vary in size; this means that smaller economies have little chances to achieve large market shares simply because of their smaller economic size. The RCA is instead size-free and captures a countries' ability to export a product competitively in the global market relative to its other specialisation options.

Third, the use of the RCA has become dominant in the policy debate and is also at the basis of the complexity and relatedness approach on which our analysis rests, making this a theoretically consistent choice.

The RCA is a continuous variable with the economically meaningful threshold of one. Naturally, fluctuations around this threshold can occur for a variety of reason. To net out potential noise, we define RCA jumps whenever the RCA goes from below 0.8 to above 1.

4.2. Data sources and strategic products

To carry out our analysis we rely on bilateral trade data at the product level over the period 2012–2021 from the BACI-CEPII dataset (Gaullier and Zignago, 2010), for EU countries and the UK. This data is widely used in the trade literature and offers mirrored trade flows[14] at the product level with 6-digit HS12 codes. As we have discussed, the issue of what products are strategic is not straightforward to disentangle. A thorough discussion of this is beyond the scope of our analysis and we opt to simply take policy priorities identified by the European Commission, focussing on three key product groups.

First, relying on lists compiled by the European Commission, we look at products in which the EU has a dependence, identified as in Arjona et al. (2023), focussing on the subset of EU-dependence products that belong to a strategic ecosystem: health, renewables, aerospace/defence, digital, electronics and energy intensive industries. Targeting these products can be justified on the basis of "economic security" arguments.

[14] In standard trade statistics imports and exports do not fully match because of how transportation, freight and insurance costs are recorded. BACI-CEPII data provide a harmonised version of trade data where import between two countries is equal to export between the same pair of country.

Juhász et al. (2023) relate this argument to the more traditional concept of externalities: reducing dependencies makes a country more secure but this side-effect is not taken into account in the sourcing decisions of private firms leading to too little investment in these areas. Moreover, if these products belong to sectors/value chains related directly to security and safety, health or the green and digital transition too little investment increases the risk of not reaching social goals.

Second, we include in our analysis products that are relevant for the Net Zero Industry Act (NZIA), aiming to restore EU competitiveness in net zero technologies where Europe is currently a net importer in many products and at different stages of the value chain. Targeting these products may respond not only to the logic of increasing economic security, but also of favouring sustainable development goals (Mazzucato, 2021). Third, we look at semiconductors which have multiple uses and are at the core of the digital transition and where Europe aims to strengthen its leadership through the Chips Act. In the rest of the paper, we refer to the products included in these three categories as "strategic products". While we focus on these product categories for policy relevance (with no a priori hypothesis regarding whether distance is or isn't especially important in achieving specialisation in them) we also include empirical evidence for all products, to highlight the structural nature of our results.

We provide some additional details on strategic products in the Appendix[15] (Figs. A.1 to A.3). In particular, in Fig. A.3 we plot the distribution of product complexity for the three categories of strategic products.[16] We find that products in sensitive ecosystems are distributed in a rather similar way with respect to the total population of products. This may depend on the fact that we consider the whole value chain including also many raw materials with low levels of complexity and suggests that Europe exhibits dependence in the less complex portion of these value chains. NZIA and even more clearly semiconductors show a distribution of complexity significantly skewed towards higher values, reflecting the fact that semiconductors are high-tech products that require a vast array of capabilities, many of which are quite rare. This evidence suggests that policies aimed at strengthening Europe's capabilities in NZIA and semiconductors can contribute to long-term EU sustainable development.[17]

5. Empirical analysis

We now provide empirical evidence based on the conceptual and measurement framework we developed above. First, we map absolute and relative distance across strategic products categories and investigate the extent to which complementarities can exist among countries and, therefore, the relevance of relative distance. Second, we look at the interaction of absolute and relative distance in shaping countries' ability to develop new specializations. Third, we test this through an econometric exercise.

5.1. Absolute, relative distance, and coordination among countries

To highlight the differences that emerge between absolute and relative distance we look at the position of EU countries from each of the three lists of strategic products. In Fig. 2 we can see that it is large and diversified EU economies that lie the closest to products across our three groups. Notably, Italy and Germany – Europe's manufacturing leaders – have consistently lower distance than other countries. When looking at the countries farthest from strategic products we find small service-based economies, such as Luxembourg, Cyprus, Malta and Ireland. Interestingly, Eastern European countries despite their key role in manufacturing value chains also appear to be rather distant from strategic products, especially Slovakia, Croatia and Romania.

Comparing product categories, the NZIA goods stand out to be the ones with the lowest distance from EU countries. As we discuss further down these products consist of rather high-tech manufacturing, such as photovoltaic (PV) panels, engines, electric boards and converters.

Remarkably, things change quite starkly when we look at the relative distance. The distribution also appears to be more concentrated within each country, but much less so across them. The latter is of course the outcome of the normalisation we performed, while the former suggests that countries' productive structures lie significantly closer to few products with respect to others. The ranking of countries, based on the unweighted mean across all groups, also changes significantly: Czechia, for example, moves up from 11th to 2nd, Sweden goes from 13th to 4th, while Spain drops from 3rd to 21st, and France from 4th to 8th when comparing absolute with relative distance. So, despite Italy and Germany retaining their position, it appears that countries that lie in absolute terms rather far from most strategic goods may still find these to be among their closest possible alternatives, leaving therefore a possibility for firms in Czechia and Sweden to specialise in them.[18]

The opposite is also true: large, diversified countries such as Spain and France that lie close to most strategic goods in absolute terms may find other non-strategic goods to lie closer to their productive structure and therefore not even attempt specialising in strategic products. It is also worth noting that NZIA products are closest to EU specialisation pattern not only in absolute but also in relative terms.

Fig. 2 suggests that in absolute terms few large and diversified economies dominate across products. In relative terms, there is room for smaller economies, but ranking is stable across product categories. Considering the interplay between absolute and relative distance has consequences for coordinating industrial policies. In our setting countries, will benefit the most from coordination policies when they have different absolute advantages within the products in which they have similar relative advantages. Without coordination, countries will move towards the (relatively) closer products independently from the distance of other countries and this may result in a waste of overall resources as we discuss in our simplified example in the Appendix A.1. Through coordination policies each country could target the product that is closer in absolute term, resulting in non-overlapping specialisation trajectories and allowing to reach an overall larger number of strategic products. To look at this empirically we focus on country pairs and isolate products in which both countries have a relative advantage. For these products we look at the degree of overlap of absolute advantages. Both countries will

[15] The list of these products are not yet publicly available and the authors have gained access to them through a Fellowship sponsored by the Commission's Directorate General for the Internal Market, Industry, Entrepreneurship and SMEs (DG-GROW).

[16] We refer here to the concept of complexity as spelled out in the literature on economic complexity and proximity (Hausmann et al., 2007; Hidalgo and Hausmann, 2009; Tacchella et al., 2012). The intuition underlying the measurement of complexity is that complex products require a wide array of capabilities that are rare among countries. Therefore, complex products are those that are exported competitively (i.e. with a revealed comparative advantage) by few *and* highly-diversified countries.

[17] Economic complexity has been demonstrated to correlate with various features of economic development such as productivity, growth, reduction in inequality and sustainability (for a review see Uribe, 2025). While this further supports the policy relevance of strategic products, our analysis remains grounded in the concepts of relatedness, rather than complexity.

[18] To give some specific examples, we can identify for both Czechia and Sweden 4-digit products that have the lowest relative distance for each of the two countries.

For Czechia these are: Pumps; for liquids, whether or not fitted with measuring device, liquid elevators (8413); Machinery, plant (not domestic), or laboratory equipment; electrically heated or not, (excluding items in 85.14) for the treatment of materials by a process involving change of temperature; including instantaneous or non electric storage water heaters (8419); and Electric transformers, static converters (e.g. rectifiers) and inductors (8504).

For Sweden Works trucks, self-propelled, (not fitted with lifting or handling equipment), for factories, warehouses etc., for short distance transport of goods, tractors used on railway station platforms; parts thereof (8709) and Taps, cocks, valves and similar appliances for pipes, boiler shells, tanks, vats or the like, including pressure-reducing valves and thermostatically controlled valves (8481).

Remarkably, none of these products are among those in which large manufacturing countries like Italy and Germany have the lowest relative distance, suggesting these could be possible specialisation avenues. We discuss the rationales behind these ideas more at length in the remainder of this work.

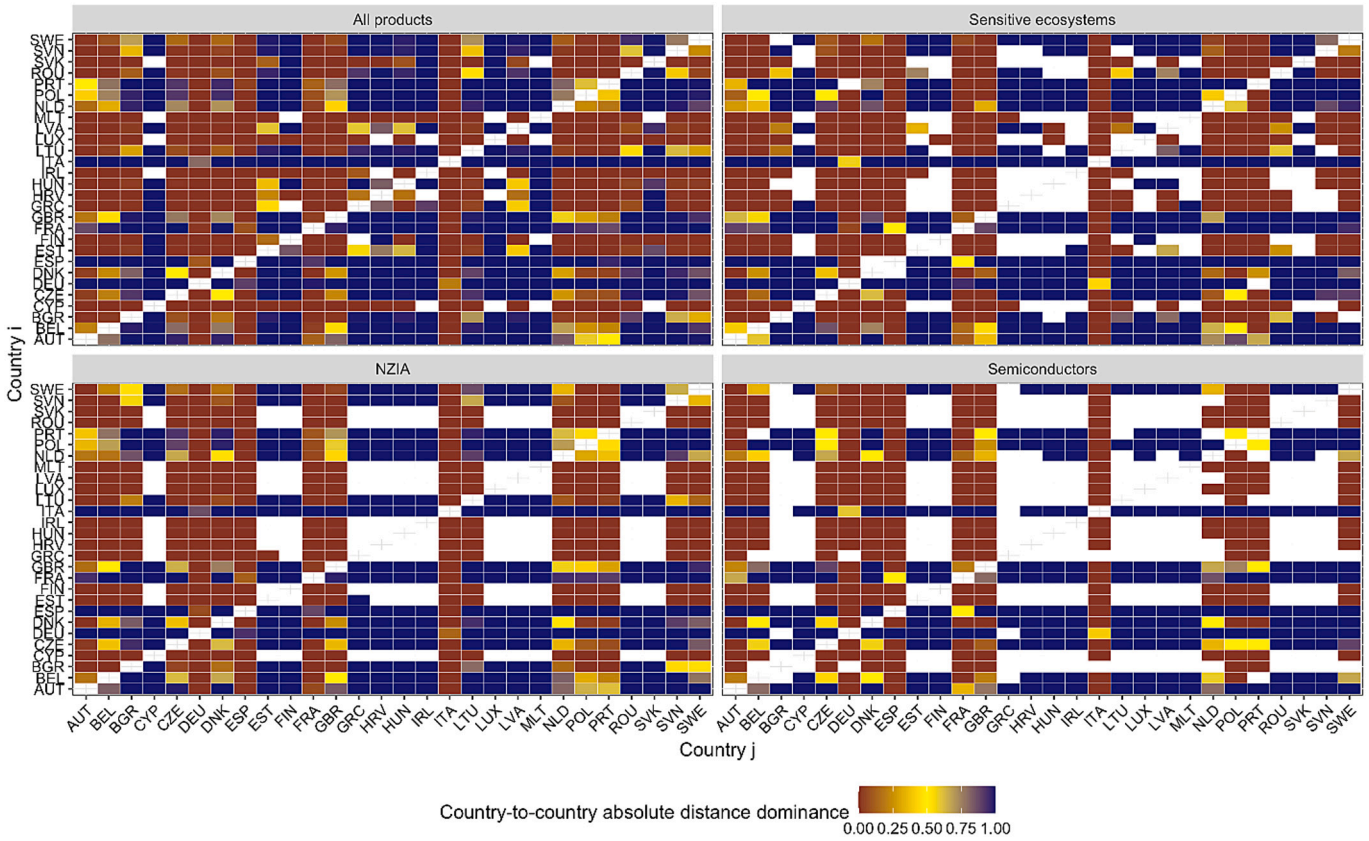


Fig. 3. Country-to-country dominance and cooperation potential across product categories. Note: The figure reports for country pairs the share of products in which country i on the vertical axis dominates country j on the horizontal axis. Values around 0.5 are marked in yellow as they identify country pairs that are well balanced and for which coordination would be particularly beneficial. Source: authors' elaboration on BACI-CEPII data. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

benefit the most from coordination policies when they have no overlap of absolute advantage within the products in which they both have a relative advantage. In this case countries should coordinate and divvy up products to pursue based on their absolute advantages. The opposite case would be when one country i, always dominates in terms of absolute distance country j. Still, coordination would be relevant so that j doesn't pursue products in which it has little chance of successfully specialising and identify those that are less contested by other bigger countries.

Formally, we can compute for each pair of countries:

$$\mathrm{Dom}_{i\longrightarrow j} = \frac{\sum_k D^k_{i\longrightarrow j}}{\sum_k D^k_{i\longrightarrow j} + \sum_k D^k_{j\longrightarrow i}} \tag{4}$$

Where $D^k_{i\longrightarrow j}$ takes value one to identify dominance of i over j in product k if both countries have a relative advantage, and either i has also an absolute advantage but j doesn't or, if both have an absolute advantage, i still has a lower absolute distance. $D^k_{i\longrightarrow j}$ will take value 0 otherwise, i.e. if both countries have a relative advantage but neither has an absolute advantage. When absolute advantages are well balanced $\mathrm{Dom}_{i\longrightarrow j}$ will take value 0.5.[19] Fig. 3 reports the country-to-country dominance in terms of absolute advantage, as described above. Shades of blue and red identify the dominating and dominated country, respectively. Shades of yellow identify values around 0.5, for country pairs that have different but balanced absolute advantages and for which coordination would be especially beneficial. White cells identify country pairs in which neither country has an absolute advantage in any product for which both countries have a relative advantage, and for which coordination remains a second order issue, while capabilities are the main hurdle to specialisation. The figure reports the same measure for all products and for each of the three strategic categories.

Overall, we see that country pairs are often dominated by one member of the pair, often Italy and Germany, in line with the evidence in Fig. 2 and that there is a growing number of country pairs that are lacking an absolute advantage as we zoom in on strategic products, especially semiconductors. Despite this, there are across all product categories, country pairs for which coordination can yield significant benefits, marked in yellow in Fig. 3. These include for example the Netherlands and Denmark, Belgium and the UK, Czechia and Denmark (especially in semiconductors) and Poland and Portugal (especially for NZIA strategic products). These are all pairs of smaller countries that while they might lack individually a broad range of absolute advantages, they can benefit considerably by coordinating efforts.

The evidence discussed so far paints a nuanced picture in which both absolute and relative distance matter and their overlap points to the importance of policies to coordinate national efforts, which is crucial for the European Union to gain economic competitiveness across as many strategic products as possible.

The framework discussed in Section 3 also points towards a second key aspect for diversification patterns. Countries pursue products based on relative distance, but absolute distance constrains the likelihood of their success. In the following two sections we turn to this issue in particular.

[19] To see this, let's take the example of a country pair with 10 products where both countries have a relative advantage. If country *i* dominates in 5 products and *j* in the other five $Dom_{i\longrightarrow j}$ will be the same as $Dom_{j\longrightarrow i}$, both equal to $\frac{5}{10} = 0.5$. This is where coordination becomes crucial, if *i* and *j* each pursue the products in which they have the absolute advantage they will cover all 10 products, if they don't they will waste resources and also cover a smaller number of products.

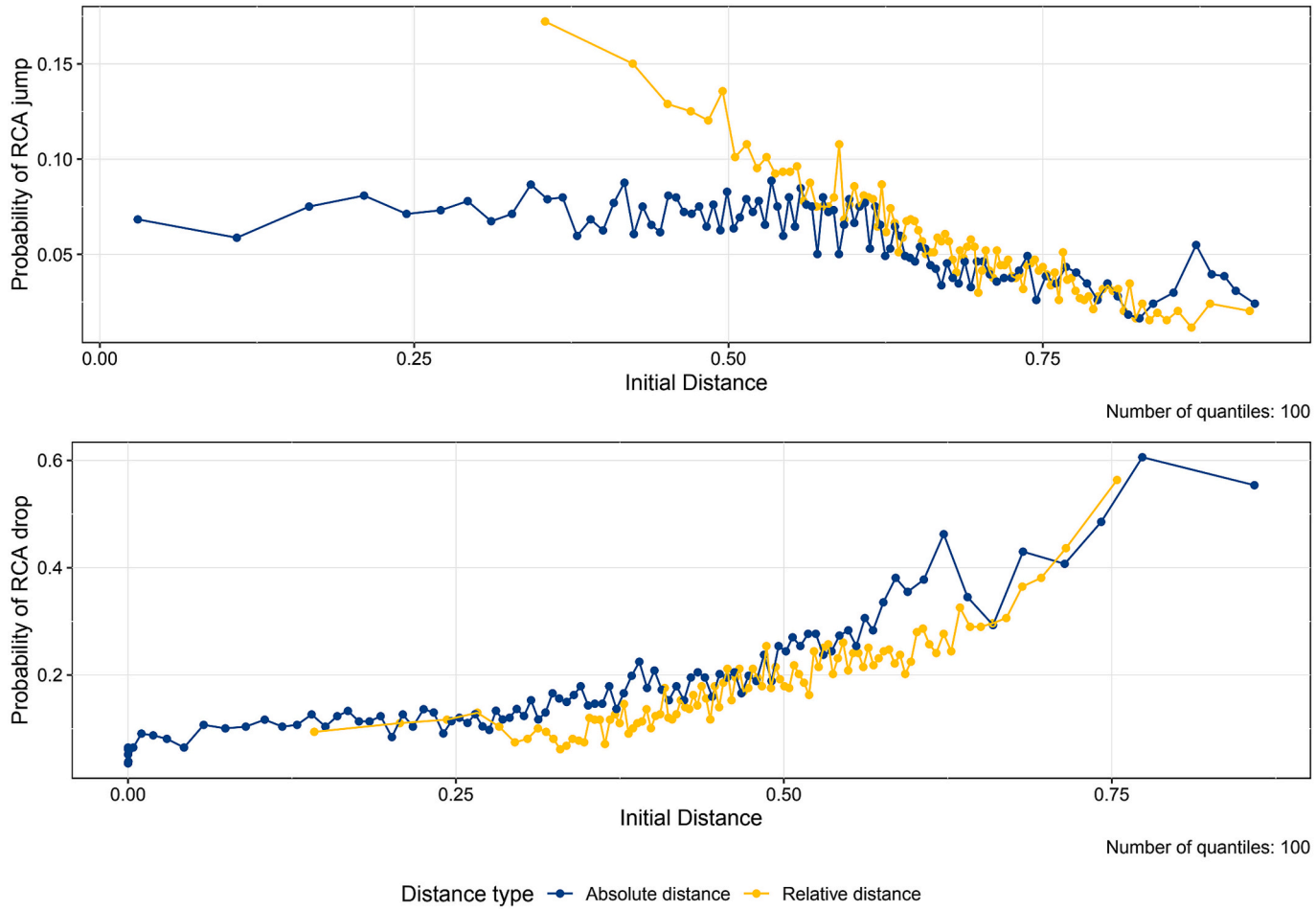


Fig. 4. Absolute and relative distance and RCA changes across all products. Note: The figure is a binned scatterplot, observations are grouped in 100 equally sized bins based on average distance over the 2012–15 period. Within each bin, the y-axis reports the likelihood of either a jump or drop in RCA to occur. An RCA jump occurs when a country-product with RCA below 0.8 in 2012–15 jumps to above 1 in 2018–21. An RCA drop occurs when RCA goes from above 1.2 to below 1 between 2012 and 15 and 2018–21. The figure is built including all products available to maximize the number observations.

5.2. *Absolute and relative advantages and specialisation patterns*

In the previous section we have mapped absolute and relative distance and the corresponding advantages across products. We now turn to how these variables vary across countries and how this is related to their ability to develop new specializations.

A first key implication of this framework is that countries try to diversify and choose the easiest product available, even if this is still quite hard in absolute terms. Absolute distance constrains the success of such experimentation by revealing the capabilities of a country and accounting for the fact that other countries' might be more productive in the same product in which a country is attempting specialisation. This is confirmed, descriptively, when we look at Fig. 4, which divides country-products in percentiles and looks at the likelihood of a specialisation jump and drop to occur.

A few key aspects emerge from this prima facie evidence. First, as expected, increases in relative distance are constantly associated with lower probability of jumps.[20] Second, absolute distance exhibits a threshold behaviour, around absolute distance 0.65, after which the probability of a jump decreases considerably. Third, in the bottom panel, looking at RCA drops, we find both distances to be associated to increasing likelihood of observing an RCA drop. The pattern is similar between the two, although absolute distance is consistently associated to higher probability of RCA drops, compared to relative distance. The main focus of our analysis lies with how distance affects the development of new RCAs rather than the loss thereof, we however provide some descriptive evidence on this in the Appendix A.6.

A second key implication of our model is that while relative distance matters for specialisation, absolute distance increases the chance of successful specialisation. It is therefore important to explore how these two measures of distance map against one another. Fig. 5 reports for a

[20] Interestingly, we also find that bottom percentiles of relative distance correspond to relatively high levels of distance (roughly 0.3): this is because there are no country-industry combinations with very low relative distance and an RCA below 0.8, which is required to define an RCA jump. This suggests that countries specialise in products that are very close (in relative terms) to them. It also means that when comparing absolute and relative distance it is important to account for the difference in span of the two measures. Devising our advantage dummies achieves this by looking where each country-product ranks relative to the distribution of relative and absolute distance

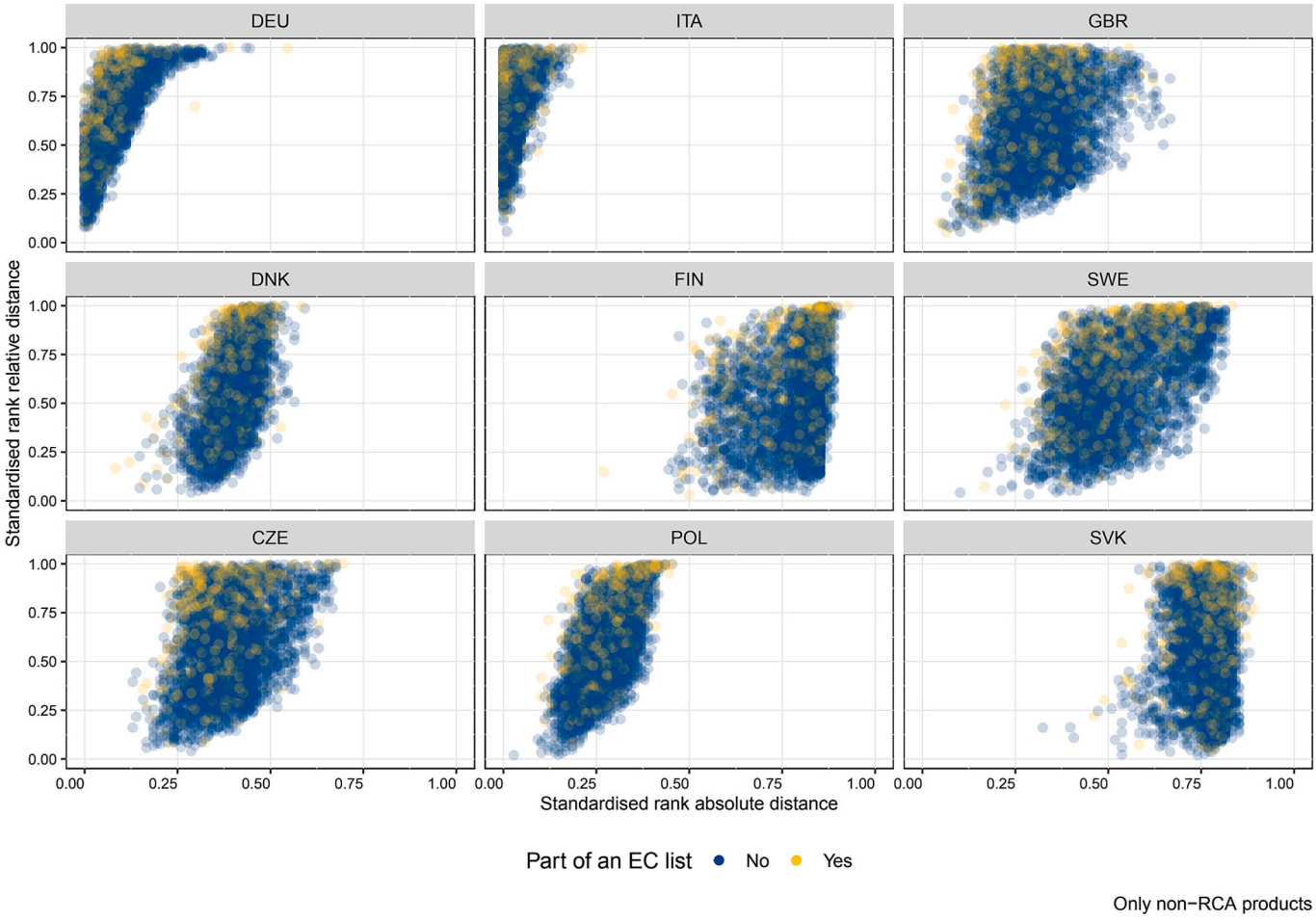


Fig. 5. Scatterplot of ranks of cross-country and cross-product distances. Note: The figure reports standardised ranks of absolute and relative distance across countries and products. Only product-country pairs without RCA have been included, although results are unchanged. We identify products belonging to an EC list, i.e. sensitive ecosystems, NZIA or semiconductor products. Measures are based on 2012–15 averages. Source: authors' elaboration on BACI-CEPII data.

selection of nine countries the standardised rank[21] of absolute and relative distance, offering a more granular view of the relationship between absolute and relative distance. Each dot in the figure is a product in which the country does not have an RCA at the beginning of the period 2012–15.

The figure shows that, for most countries, there is little correlation between absolute and relative distance rankings, suggesting that these two measures capture different aspects of countries and products positioning.

Germany and Italy rank among the closest countries in absolute terms for most products (these would correspond to country A in our framework in Fig. 1). Some products rank higher than others in terms of relative distance. If these countries have limited resources, they would be unable to specialise in too many strategic products and will first enter the relatively closer products. Other countries like Slovakia lie rather far from most products and may have difficulties also in entering the relatively closer products (in our framework these would resemble country B). This is for two reasons that emerge from our framework: (i) in line with the literature on relatedness, countries are unlikely to manage to specialise in products that lie too far from them (Hidalgo et al., 2007) (ii) competition dynamics will prevent countries that lie farther, compared to other countries, to achieve specialisation in a product.

Interestingly, however, we also observe some countries like Sweden, Czechia and, to some extent, the UK in which the scatterplots take more of a diagonal shape. For these countries (resembling country C in our framework), products that lie in the bottom-left quadrant would be prime candidates for specialisation. Firms are likely to diversify towards these products, and they are also likely to succeed. These are in fact products that lie close to the country's specialisation (compared to other products) and to which the country also lies quite close in absolute terms (although not as close as Germany and Italy).

Finally, it is also important to stress that products belonging to the EC lists of strategic products, tend to concentrate towards the top right across all nine countries, meaning they rank among the most distant products both in absolute and relative terms. So, overall, strategic products are among the hardest to specialise in for most countries, both in relative and absolute terms. Here too, however we find Czechia and Sweden to have some strategic products ranking low in both absolute and relative distance, which would suggest they would be strong candidates for specialisation.

We now offer further evidence in support of our contention that both relative and absolute distance matter for countries' specialisation. We start by looking descriptively at the likelihood of a country developing a new specialisation based on the presence of an absolute and/or relative distance advantage. Considering all products, the transition matrix in Fig. 6 reports the likelihood of a country-product transitioning between three states: no RCA (RCA $<$ 0.8), low RCA (0.8 $<$ RCA $<$ 1) and RCA

[21] Looking at ranks is the same approach with which we define the categories of absolute and relative advantage. We standardize, with same min-max approach as in Eqs. (1) and (2), the rank to ensure readability of the figure and, especially, to make results comparable across absolute distance and relative distance. The former varies in fact across 28 countries while the latter across 5199 products, without standardisation comparisons of ranks would not be straightforward.

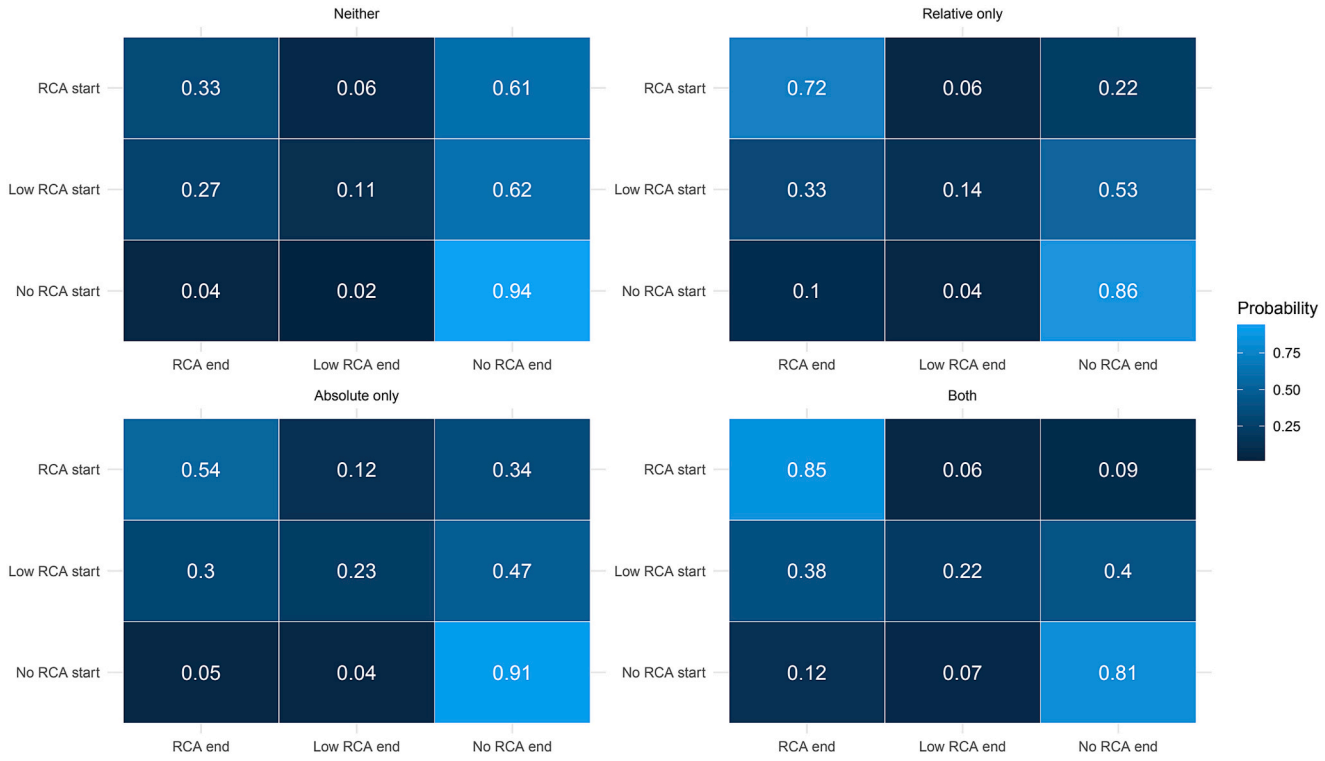


Fig. 6. Transition matrix based on absolute and relative distance advantage. Note: The figure reports transition matrices with probabilities of moving across three possible states: RCA above 1, between 0.8 and 1, and below 0.8, corresponding to RCA, low RCA and no RCA, respectively. Each matrix refers to four possible kinds of absolute and relative distance advantages: neither, only relative, only absolute and both. The matrices are built using all HS product codes. Source: authors' elaboration on BACI-CEPII data.

Table 1
Advantages and RCA jumps.

	(1)	(2)	(3)	(4)
Advantage = 0, None	−0.0462***	−0.0569***	−0.0386*	−0.0685***
	(0.00583)	(0.0118)	(0.0201)	(0.0157)
Advantage = 2, Abs. only	−0.0209***	−0.0248	−0.0202	−0.0190
	(0.00682)	(0.0163)	(0.0227)	(0.0247)
Advantage = 3, Both	0.0332***	0.0218	0.0907*	−0.0198
	(0.00820)	(0.0247)	(0.0461)	(0.0430)
Constant	0.0859***	0.0850***	0.0734***	0.0968***
	(0.00489)	(0.0114)	(0.0195)	(0.0138)
Observations	103,823	7431	4810	1878
R-squared	0.103	0.092	0.099	0.109
Advantage = 0, None	−0.0253***	−0.0321**	−0.0184	−0.0495**
	(0.00367)	(0.0118)	(0.0118)	(0.0193)
Advantage = 1, Rel. only	0.0209***	0.0248	0.0202	0.0190
	(0.00682)	(0.0163)	(0.0227)	(0.0247)
Advantage = 3, Both	0.0540***	0.0466**	0.111**	−0.000781
	(0.00789)	(0.0200)	(0.0413)	(0.0292)
Constant	0.0651***	0.0602***	0.0532***	0.0778***
	(0.00294)	(0.00791)	(0.00783)	(0.0136)
Observations	103,823	7431	4810	1878
R-squared	0.103	0.092	0.099	0.109
Country FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Category	All	Strategic products	Sensitive Ecosystems	NZIA

Note: the table reports regression coefficient for linear probability model; the benchmark category is Advantage = 1, Rel. advantage only in the upper panel, while it is Advantage = 2, Abs. only in the lower panel. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(RCA > 1), which are computed as averages of the initial (2012–15) and final period (2018–21). We create separate transition matrices, based on the categorical variable described in Section 4 identifying the presence of neither advantage, only relative, only absolute or both advantage.

We find values along the top left and bottom right parts the diagonal of all matrices to be large, suggesting that the majority of country-products with extreme RCA values do not change state. However, there is one notable exception: in the case of having neither advantage (first matrix) it is more likely to lose specialisation than to maintain it. Focussing on the bottom-left quadrant of each transition matrix, we can observe the likelihood of transitioning from no RCA (RCA < 0.8) to RCA (RCA > 1), which we have defined an RCA jump in Section 4.1, increases from 0.04 to 0.12 between having neither advantage to having them both; notably, the likelihood increases to 0.1 also with the relative distance advantage alone. This suggests, as we further test in the following section, that the relative distance advantage could be a stronger determinant of an RCA jump, than absolute distance advantage.

Going back to our framework, this distinction can be explained by the fact that absolute distance affects a firm's successful specialisation only after the product has been selected based on relative distance. In other words, firms wouldn't even attempt specialisation in products that may have an absolute distance advantage but not a relative distance one. However, once a product has been selected based on relative distance, absolute distance does matter in determining a firms' success against its competitors.

Bringing the conceptual discussion and the empirical patterns discussed so far together we are in the position to make a few key points.

First, we observe only a modest alignment of absolute and relative distance across countries (Figs. 3 to 5). This reflects a multifaceted reality: on the one hand, coordination issues may arise which are especially relevant in the case of policy intervention that target specific products. On the other hand, given the interplay of both relative and absolute distance it is possible for countries that lie far from most

Table A.3
Tabulations of advantage by country, all products and sensitive ecosystems.

All products						Sensitive ecosystems					
	None	Rel. Only	Abs. Only	Both	Total		None	Rel. Only	Abs. Only	Both	Total
AUT	46	0	3070	2083	5199	AUT	0	0	173	28	201
BEL	452	19	2666	2062	5199	BEL	8	0	139	54	201
BGR	3004	1265	123	807	5199	BGR	179	5	3	14	201
CYP	3135	2064	0	0	5199	CYP	170	31	0	0	201
CZE	1441	321	1651	1786	5199	CZE	52	0	122	27	201
DEU	3	0	3069	2127	5199	DEU	0	0	154	47	201
DNK	2037	230	1105	1827	5199	DNK	110	2	66	23	201
ESP	0	0	3107	2092	5199	ESP	0	0	186	15	201
EST	3104	2049	2	44	5199	EST	173	22	0	6	201
FIN	3109	2076	0	14	5199	FIN	166	32	0	3	201
FRA	0	0	3123	2076	5199	FRA	0	0	166	35	201
GBR	605	53	2509	2032	5199	GBR	10	0	123	68	201
GRC	3118	2031	0	50	5199	GRC	177	23	0	1	201
HRV	3133	2059	0	7	5199	HRV	184	17	0	0	201
HUN	3125	2031	1	42	5199	HUN	178	20	0	3	201
IRL	3135	2061	0	3	5199	IRL	138	63	0	0	201
ITA	0	0	3089	2110	5199	ITA	0	0	183	18	201
LTU	3111	1537	26	525	5199	LTU	183	11	2	5	201
LUX	3106	2092	0	1	5199	LUX	161	40	0	0	201
LVA	3137	2012	1	49	5199	LVA	171	27	0	3	201
MLT	3122	2077	0	0	5199	MLT	177	24	0	0	201
NLD	1117	73	2005	2004	5199	NLD	15	0	115	71	201
POL	48	0	3107	2044	5199	POL	9	0	172	20	201
PRT	843	0	2274	2082	5199	PRT	50	0	137	14	201
ROU	3086	1694	25	394	5199	ROU	179	14	2	6	201
SVK	3124	2070	0	5	5199	SVK	175	26	0	0	201
SVN	3108	1668	29	394	5199	SVN	171	13	2	15	201
SWE	2793	1143	317	946	5199	SWE	125	10	38	28	201
Total	56,042	30,625	31,299	27,606	145,572	Total	2961	380	1783	504	5628

Source: Authors' own elaboration based on BACI-CEPII data.

Table A.5
Tabulations of advantage by RCA jump state across product categories.

RCA jump	None	Rel. only	Abs. only	Both	Total
All products					
No	7481	725	4263	304	12,773
Yes	262	65	197	43	567
Total	7743	790	4460	347	13,340
Sensitive ecosystems					
No	2757	184	1556	93	4590
Yes	99	19	82	20	220
Total	2856	203	1638	113	4810
NZIA					
No	851	393	418	105	1767
Yes	26	46	29	10	111
Total	877	439	447	115	1878
Semiconductors					
No	565	36	324	25	950
Yes	8	4	9	0	21
Total	573	40	333	25	971

Source: Authors' own elaboration based on BACI-CEPII data.

product to still find specialisation opportunities in those products that lie the farthest from the more central countries. Second, strategic products are usually among the farthest from countries' productive structure, suggesting firms are unlikely to select them for specialisation and that policy intervention might be needed to provide the necessary incentives (Fig. 5).

Finally, we observe a stronger relationship between the likelihood of a country to perform an RCA jump and relative rather than absolute advantage, although having both advantages further increases RCA jump probabilities (Fig. 6). In what follows we test the relationship between absolute and relative advantage and the likelihood to obtain new specializations in an econometric setting.

Table A.7
Disadvantages and RCA jumps.

	(1)	(2)	(3)
disadvantage = 0, None	0.0453***	0.0507***	0.00105
	(0.00571)	(0.0130)	(0.0193)
disadvantage = 2, Abs. only	0.0268***	0.00973	−0.0129
	(0.00654)	(0.0147)	(0.0304)
disadvantage = 3, Both	−0.0137**	−0.00926	−0.0600**
	(0.00529)	(0.0107)	(0.0260)
Constant	0.0452***	0.0421***	0.0753***
	(0.00317)	(0.00472)	(0.0157)
Observations	103,823	4810	1878
R-squared	0.102	0.097	0.105
Country FE	Yes	Yes	Yes
Product FE	Yes	Yes	Yes
Category	All	Sensitive Ecosystems	NZIA

Note: the table reports regression coefficient for linear probability model; we use a measure of absolute and relative disadvantage computed in a specular way to that in the main text, i.e. whether a country-product pairs lies in the top two quintiles of absolute or relative distance. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.3. Econometric evidence

Our framework and the descriptive evidence discussed so far suggest that both relative and absolute advantages matter for countries to develop new specializations. While we confirm the positive relationship between each of the two kinds of distance and RCA jumps in the Appendix A.5, we are especially interested in the combination of the two kinds of advantage. Fig. 6, suggests that having neither advantage would lower the likelihood of performing an RCA jump and having both of them would increase it. It is also important to test econometrically whether having either of the two advantages is more important to perform an RCA jump. Concerning this specific issue, our framework has no a priori expectation: we have argued that low relative distance should

foster experimentation by countries, leading to RCA jumps, but having both advantages should further increase the likelihood of an RCA jump occurring. We exploit long-difference set up to test this, carrying out a forecasting exercise where our outcome variable is the likelihood that a country-product performs an RCA jump, going from an average RCA in 2012–15 below 0.8 to one above 1 over the 2018–21 period. Our explanatory variable is the categorical variable $Advantage_{ik}$ we use in Fig. 6, identifying whether a country-product has no advantage, only one of the two, or both:

$$y_{ik} = \alpha + \beta_1 Advantage_{ik} + \iota_i + \kappa_k \quad (5)$$

In order to simplify the comparison between having either kind of advantage we set the relative advantage as benchmark category. In the lower panel of Table 1, we also report the results with only absolute advantage as a benchmark, to assess the importance of absolute advantage in its own right.

This model relies on variation in the outcome state (the RCA jump) within each of the four groups identified by the $Advantage_{ik}$ variable, we report in the Appendix tabulations of this (Table A.5). Semiconductors rely on a very limited number of observations and exhibit perfect separation, among the country-product pairs with both advantages we observe no RCA jumps. For this reason, we exclude them from our analysis here, but they are included in the results for all strategic products, of course.

Table 1 reports the main results; starting by looking at all products, we find that not having either kind of advantage reduces the chances of performing an RCA jump while having them both increases it. Having only an absolute distance advantage is also associated with a lower chance of RCA jump, compared to having only a relative advantage; this is again consistent with both our framework and the empirical evidence shown in Fig. 6. When we take having only an absolute advantage as a benchmark in the bottom panel, we still find that this increases the likelihood of an RCA jump compared to having no advantage at all, and that when it's coupled with a relative advantage RCA jumps become even more likely.

When we look more closely at the strategic products, we find that the lack of both advantages retains a statistically significant and lower probability of RCA jumps for both sensitive ecosystems and NZIA products as well as for all strategic products taken as a whole. For the sensitive ecosystems, we also find that having both advantages increases the probability of performing an RCA jump compared to having only a relative distance advantage. In contrast, having only an absolute distance advantage doesn't show a statistically significant difference compared to having only a relative distance advantage. When we consider having only absolute advantage as benchmark category we find again that having both advantages further increases the likelihood of a jump, except for NZIA. For sensitive ecosystems, having only an absolute advantage is not statistically different from not having any advantage, suggesting that for these products it is relative distance that is especially important. This is consistent with fact that this is the product category with the lowest absolute and relative distance as shown in Fig. 2.[22]

In the Appendix A.5 we further test the robustness of our results by defining advantage based on the median, rather than the bottom two quintiles (Table A.6). We also identify a measure of disadvantage based on a country-product pair lying in the top two quintiles (Table A.7). In both instances results are consistent with Table 1.[23]

6. Conclusions

In the new geopolitical scenario, the European Union has increasingly emphasised the need to achieve strategic autonomy and economic security and has identified a set of strategic products to be monitored and targeted. In this context, the use of tools and methodologies to inform industrial policy may prove very useful as recently emphasised also in the Draghi report on the future of European Competitiveness.[24] Our work contributes to this objective by putting forward a conceptual framework in which countries specialise in new products based on both relative and absolute distance. We define these two concepts as the distance of a products from a countries' existing trade specialisation and the distance of a country from a product compared to other countries, respectively. In doing so we complement the work on relatedness and export specialisation and highlight some new crucial facts. This research, therefore, contributes to the well-established literature using proximity measures to study countries' diversification patterns from a structuralist and evolutionary perspective (Hausmann et al., 2007; Tacchella et al., 2012; Boschma, 2017; Petralia et al., 2017; Perruchas et al., 2020; Mewes and Broekel, 2022; Hidalgo, 2023); it bridges this literature with recent contributions that have looked at the emergence of economic security as industrial policy priorities (Filippetti and Vezzani, 2022; Kleimann et al., 2023; Fontana and Vannuccini, 2024).

While our analysis does not investigate industrial policies directly, it does offer evidence that is relevant when designing policy interventions aimed at targeting strategic products. In the context of limited resources, when large, diversified countries are unable to exploit all new diversification opportunities, specialisation opportunities for smaller countries arise. Countries in fact scan the product space around them and diversify towards products that lie closest to them irrespective of other countries' distances. This suggests, however, that two countries might move towards the same product and the country with the largest absolute distance may not succeed. Coordination becomes then necessary to avoid doubling up efforts and inefficient allocation of resources especially when countries have different and balanced absolute advantages.

We combine the implications of our framework with a granular analysis of country-product distances. The descriptive analysis shows that large and diversified manufacturing countries such as Germany and Italy tend to have a productive structure that is closer to most strategic products; this however changes when we look at distance in relative terms, i.e. looking at the product that is closest to a country, rather than the country that is closest to a product. Some small, specialised countries – notably Sweden and Czechia – see their prospects to steer their productive structure towards strategic products improve significantly. Our results also highlight pairs of smaller but diversified economies, such as Denmark and the Netherlands, Poland and Portugal that have different but balanced absolute advantages and would especially benefit from coordination.

Finally, we also find econometric evidence suggesting that both absolute and relative distance, and especially the latter, matter for new specializations. Having both advantages at the same time increases the

[22] Since country and product dummies can capture part of the variability of relative and absolute distance, we have also tested our results without country and product fixed effects. We find broadly consistent results, with an increase in the importance of relative distance with respect to absolute distance. For space's sake, we omit these results, but they remain available upon request.

[23] Our ability to run more extensive robustness checks is constrained by the number of observations across groups, when focussing on strategic products. This prevents us from looking at long RCA jumps as we do instead in our continuous model as well as to define advantages based on the bottom quintile, rather than the bottom two quintiles. Concerning this, it is important to point out that by identifying our advantages based on two rather than one quintile we expect to have more noise in our estimates. We therefore expect, if anything, that our results would be even neater if we were able to use only the bottom quintile to define advantages.

[24] https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en.

likelihood of RCA jumps even further, although this appears to be the case especially for sensitive ecosystems.

Relatedness tools provide positive descriptions of reality helping to identify diversification opportunities and "inertial forces" limiting structural change. However, they do not offer a clear mechanism for moving across product clusters, nor do they indicate which firms or products should be supported within a framework of policy feasibility (Hidalgo, 2023; Uribe, 2025).

Although assessing which specific policy instruments are best suited to foster entry into strategic sectors lies beyond the scope of this paper, our analysis of the role of absolute and relative distance in shaping specialisation patterns – and our measurement of the position of EU countries within the product space – provides empirical evidence on both the opportunities and the constraints faced by industrial policies. In this sense, our framework and results offer insights that can help inform the design of such policies.

They imply that different families of policies are necessary for different groups of products. When countries overlap with one another in terms of relative and absolute distance, coordination becomes relevant; when countries have low absolute distance but high relative distance policies should be focussed on the targeted products to change firms' incentive and spur them to move towards the strategic product specialisation; when in contrast absolute and relative distance are both very large, policies should be broader, expanding overall capabilities and facilitating their redeployment.

Leveraging our empirical analysis and looking at specific product categories, NZIA products exhibit the lowest absolute and relative distance, as well as few pairs of countries that would benefit from coordinated efforts (Figs. 2 and 3). To the contrary, semiconductors show high levels of distance from EU countries specialisation and also high levels of complexity suggesting that successfully entering and sustaining competitive advantages in these products requires a much broader transformation of EU countries' productive structures. So, NZIA products require coordination and policies targeted at specific products to ensure that firms' incentives are aligned with policy priorities. In contrast, successful specialisation in semiconductors involves the development of coherent technological and capability ecosystems, which in turn calls for investments in interlinked production activities (Hirschman, 1958; Chang and Andreoni, 2020), as well as sustained public support for R&D and complementary intangible assets – factors that have been shown to foster economic complexity (Uribe, 2025).

Looking ahead, while allowing to give significant amounts of public aid for industrial policies to Member States through GBER may be necessary to enter strategic products, coordinating this aid at the EU level is important not only to reach a sufficient scale but also to avoid duplication of efforts. In this respect, some policy initiatives, such as strategic alliances and IPCEI (Important Projects of Common European Interest), that pool together competencies of different countries, could be extended to strategic value chains, allowing the European Commission to select the best projects for a given industrial policy, to provide European co-funding (Di Carlo et al., 2024) and to coordinate the emergence of European champions (Archibugi and Mariella, 2021).

Finally, while this work contributes to the debate around countries' specialisation patterns in the context of the renewed interest for industrial policy, some weaknesses remain, and future work should include policies in the analysis more explicitly. This would be especially useful since relatedness measures have often been used in conjunction with complexity and economic growth; there is however little evidence on how policies can drive complexity while also achieving economic security goals and this should be a priority in future work. Moreover, while our work has focussed here on trade in manufactured goods, it could also be easily deployed to other data, ranging from patenting to employment, which would also include services into the analysis (Stojkoski et al., 2016). Further studies should also consider a dynamic framework in which countries can gain comparative advantages but also lose them and test the sensitivity of trade advantages to relative and absolute distances in the long run.

CRediT authorship contribution statement

Filippo Bontadini: Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization, Writing – original draft, Writing – review & editing. **Valentina Meliciani:** Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Valentina Meliciani reports financial support was provided by European Commission. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

Valentina Meliciani gratefully acknowledges support received from her DG GROW Fellowship, sponsored by the European Commission, as well as useful feedback from Román Arjona, Josefina Monteagudo and Frank Vandermeeren on earlier versions of this work. The opinions expressed here cannot be attributed to, nor considered as representing, the official views of the European Commission. Both authors wish to thank Maria Savona for insightful discussion on initial drafts of this work. We are indebted to participants to the Council of European Studies 2024 annual conference as well as to participants to the Research Conference on the Single Market 2025, to the conference on "European industrial policy in the new global context" organised at LEAP and LUHNIP from Luiss University, and Sapienza University in Rome on September 19 and 20 2024. We are also grateful to Bart Verspagen and participants to UNU-MERIT seminar series for useful comments. We also wish to thank participants to the Economic Fitness and Complexity Summer School held at the Enrico Fermi Research Centre (CREF, Rome) from 9 to 13 June 2025. Finally, we would also like to express our gratitude to three anonymous referees as well as the guest Editors of the Special Issue for valuable comments that have greatly improved this paper. All remaining mistakes are the authors' and the usual caveats apply.

Appendix A. Appendix

A.1. Coordinated and uncoordinated industrial policies

In order to show the advantage of coordinating industrial policies in our simple setting, Table A.1 reports the numbers of Fig. 1 focussing on country A and C and adds a new product W where country C has an absolute advantage. As in the example of Fig. 1, we assume that countries can specialise only in two new products and that products Y, Z and W are strategic (in bold in the table). Without policy intervention, country A will produce Z and Y and country C will attempt X and Y and produce X. No country will produce the strategic product W.

Countries' policy makers may thus decide to deploy industrial policies in the form of support to steer their firms towards strategic products.[25] Within the European Single Market such interventions can be uncoordinated, i.e. at the member state level, or coordinated, i.e. at the EU level. We depict these policies in the second and third column of Table A.1. For sake of simplicity, we assume that policies reduce the distance from strategic products.

Table A.1
Distance under policy scenarios.

Country	Product	No policy	Uncoordinated policies	Coordinated policies
A	X	0.25	0.25	0.25
A	**Y**	0.20	0.20	0.20
A	**Z**	0.15	0.15	0.15
A	**W**	0.40	**0.19**	0.40
C	X	0.30	0.30	0.30
C	**Y**	0.35	0.35	0.35
C	**Z**	0.40	0.40	0.40
C	**W**	0.37	**0.29**	**0.29**

Note: The table presents country-product distances, under different scenarios: no policy, uncoordinated, and coordinated policy. The no policy column reports the distances plotted in Fig. 1 and adds a new product W. In the second column, strategic products – i.e. policy targets – are in bold, in the policy columns products for which distance has changed are also in bold.

Because countries act irrespective of each other, policies alter the products' relative distances changing firms' choice of products to target but they overlook the existence of absolute (cross-country) distances that still play a role. Assuming that all countries target W after an uncoordinated policy intervention, Z and W will be produced by country A and X by country C but no country will produce Y. In the last column of Table A.1 we show that a coordinated policy intervention, concentrating on reducing the distance between country C and product W would have achieved production of all strategic products with a much lower outlay of public resources. In fact with coordinated policies, only country C would target product W successfully, thus producing products X and W with country A producing Z and Y. This example can also be used to show the advantages of coordinating policies when countries have similar relative advantages and different absolute advantages. If both countries have a relative advantage in all the four products, uncoordinated policies would lead to the production of only three products, while through coordination all products can be produced. This can be obtained by changing relative incentives (as in column 3) but also by sharing information in order not to compete for the same products (while this is possible in theory it is very difficult to be achieved in practice). The example is based on the simplifying assumption that each product can be produced only by one country. In reality more than one country may be able to produce the same strategic product. However, to the extent that distance reflects lower costs of redeployment of resources to create new capabilities, it would be more efficient to direct European resources towards countries that lie closer to a product. In this example the coordinated policy targets the country with the lowest absolute distance.

This very simplified conceptual framework allows us to make two key points that are relevant when considering industrial policies to target strategic products. First, uncoordinated policies may result in duplication of efforts and inefficient use of resources. Second, coordinated policies may allow for a better division of labour across European countries allowing to enter a larger number of strategic products with a more limited use of resources. However, such policies require a high degree of information on the distribution of relative and absolute distances across countries (countries' productive advantages). While it is not the purpose of this paper to discuss which policy instruments may fulfil these objectives, we refer to some EU policy tools in the conclusions.

A.2. From proximity to distance

Our starting point to obtain a measure of country-product distance is a measure of similarity across products, which we identify in line with Hausmann et al. (2007) as the conditional probability that two products have of being exported together, formally:

$$\Phi_{kk'} = \frac{\sum_i y_{ik} y_{ik'}}{\max\left(\sum_i y_k, \sum_i y_{k'}\right)} \tag{A.1}$$

Where y_{ik} is a vector populated with one for each country exporting product k with RCA, and $y_{ik'}$ is the same for product k'. Therefore, the numerator is the number of countries that export both k and k' with an RCA (i.e. a Balassa index above 1). We then look at the number of countries that export each product with RCA ($\sum_i y_k$ and $\sum_i y_{k'}$, respectively) and take the larger of the two to normalise our measure.

$\Phi_{kk'}$ is a product-by-product matrix populated with the proximity of each product pair. The proximity measure has become standard in the literature of regional studies and economic complexity. To provide the intuition of this measure, it aims at inferring capability requirements from trade patterns. The key idea is that two products (e.g. mobile phones and laptops) that have a high likelihood of being exported by the same country with RCA will share more requirements – and therefore be similar. In contrast two products that are unlikely to be exported with RCA by the same country (e.g. laptops and t-shirts) will share few capability requirements and will therefore have low proximity.

Once we have this measure, we can compute for each country-product pair a measure of relatedness:

$$dist = 1 - Relatedness_{ik} = 1 - \frac{\sum_{k'} \Phi_{kk'} * y_{ik'}}{\sum_{k'} \Phi_{kk'}} \tag{A.2}$$

We achieve this by computing the sum of the proximity between our product of interest k and those that the country exports with RCA – which we filter in the denominator with our vectors $y_{ik'}$. We then normalise this with a hypothetical country that would export all products with RCA, i.e. the sum of the column of $\Phi_{kk'}$ corresponding to k'. In doing so, we obtain what the literature has referred to as density relatedness (Hidalgo et al., 2007;

[25] Here too, countries can deploy a range of policy tools, from ex-ante subsidies to ex-post tax credits, to tariffs. Modelling these in detail would go beyond the scope of our work, we limit ourselves here to consider a generic form of support that will require a given amount of public resources. We provide a more detailed discussion of which policy tools and initiatives might be deployed in the conclusions.

Boschma et al., 2013), by computing $(1 - Relatedness_{ik})$ we obtain a measure of country-product distance.

To illustrate the logic underlying this measure, let us assume we wish to capture the distance between Germany and cars. This measure will depend on which products Germany exports, and how similar these products are with respect to cars. Therefore, exporting trucks will be more important than exporting t-shirts. So, the numerator of our measure is the weighted sum of products that Germany exports with RCA, using proximity with respect to cars as weights. This is compared with what the same weighted sum would be for a country that was exporting all products with RCA (the denominator). If Germany exports with RCA many products that are closely related to cars, it will have a high relatedness to cars (and therefore a low distance).

All told, this measure gives us for each product how unrelated it is with respect to each country's economic structure. Naturally, countries that are highly diversified – i.e. that export many products with RCA – and export many products with RCA will have lower distances to almost all products than smaller economies that export fewer products with RCA. As the number of countries increases, the vector $y_{ik'}$ approaches a vector populated only by 1, the numerator and denominator in Eq. (2) become increasingly closer to each other our measure of distance $= 1 - Relatedness = 0$. Countries' distance is therefore negatively correlated to export diversification, mechanically, while it integrates this with information on proximity of products.

A.3. Data and additional descriptive evidence

In this section of the Appendix we provide additional evidence on the three lists of products we consider in our study and then present additional descriptive evidence which is already discussed in the main text.

We rely for our analysis on lists provided by the European Commission, which are not yet publicly available, but we offer here some characterisation of them. The three lists have very little overlap, as they focus on three broad but granularly identified categories: (i) products in which the EU has a trade dependence and that are relevant for sensitive ecosystems: health, renewables, aerospace/defence, digital, electronics and energy intensive industries; (ii) products relevant for the Net Zero Industry Act (NZIA) and (iii) products related to the production of semiconductors. In Fig. A.1 we provide a mapping of the overlap of these products which shows how overall each identifies an independent group of products, justifying our choice of treating these separately throughout our empirical analysis.

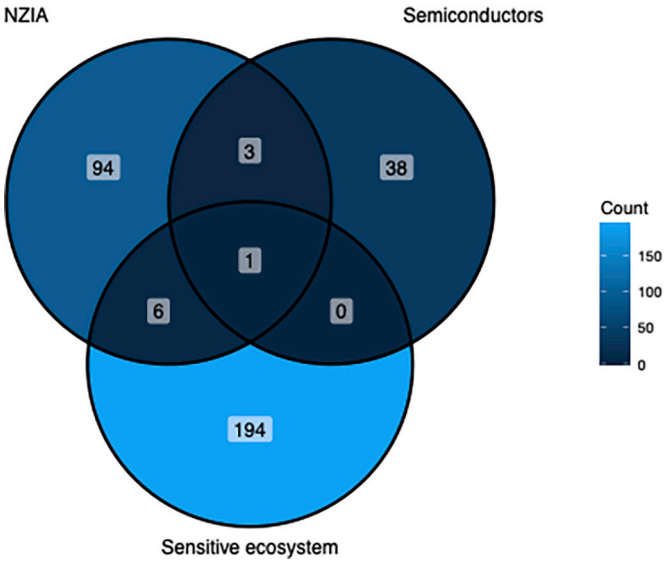


Fig. A.1. Product lists overlap. Note: Venn diagram reports the number of 6-digit HS codes appearing in each product list. Source: Authors' elaboration on BACI-CEPII data.

To provide a flavour of the kinds of products we include in our analysis we report in Fig. A.2 the number of 6-digit HS codes in each of the three product lists, divided by HS section. We can see that out of the 21 sections included the HS classification, only 13 include any strategic product at all. Among these, products are quite concentrated in some key macro-sectors, such as machinery, transportation and optical equipment as well as metals and chemicals. Sensitive ecosystems cover the broadest group of industries, also including metals and chemical components that are related to critical raw materials and their derivations. NZIA products are instead mostly machinery and high-tech equipment, while semiconductors are by far the narrowest subset of products, essentially included only in the machinery and optical equipment sections of the HS classification.

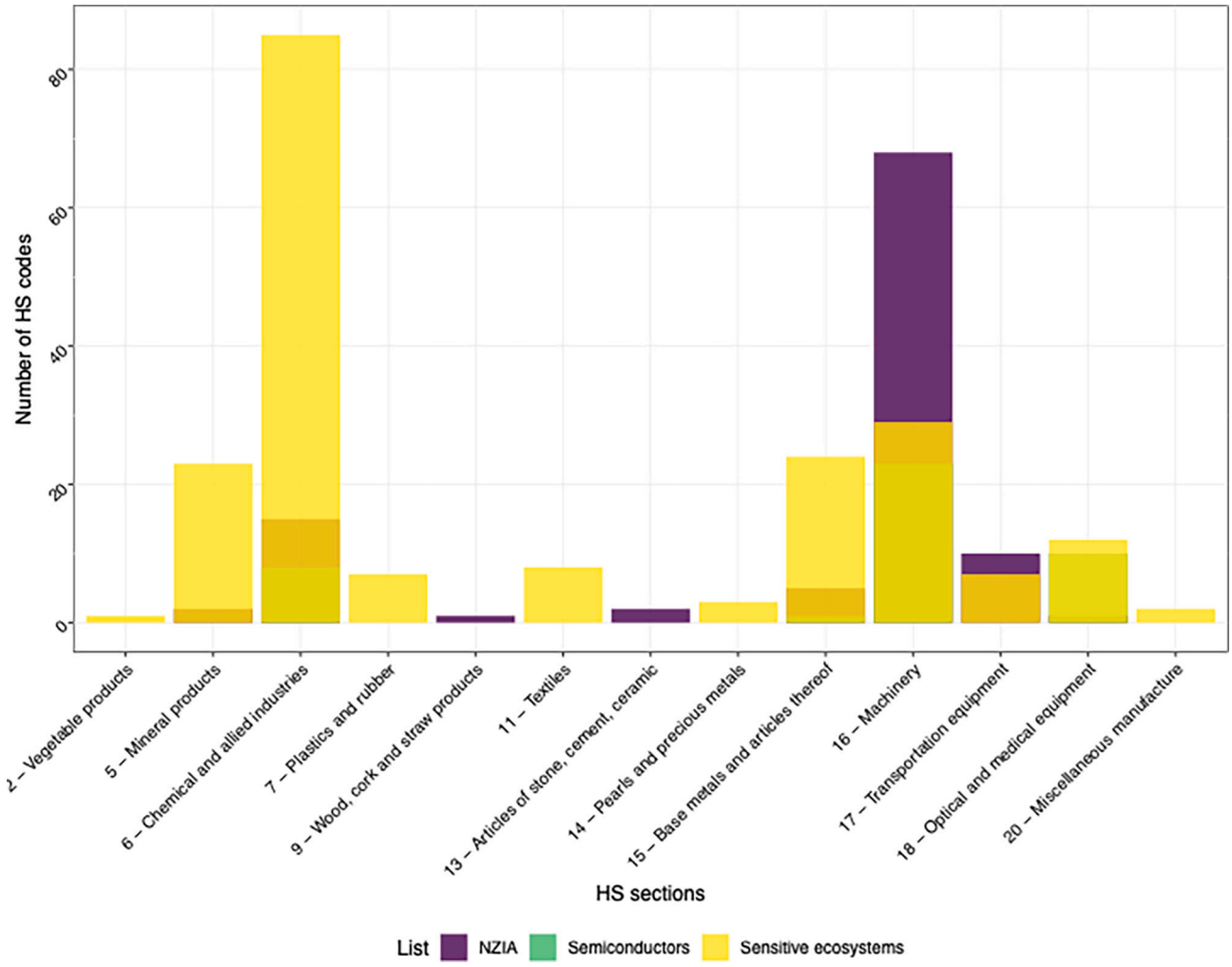


Fig. A.2. Product lists by HS sections. Note: Bar charts report the number of 6-digit HS codes appearing in each list by HS section. Source: Authors' elaboration on BACI-CEPII data.

To further characterise the possible heterogeneity among these products, we look at how complex products in our sample are. To do so we resort to the measure of product economic complexity, computed following the "reflection method" as described in Mariani et al. (2015). The intuition underpinning the concept of economic complexity is that complex products require many and rare capabilities. The rarity of capabilities required is understood as the inverse of a product's ubiquity in trade flows, – i.e. how many countries trade a given product with an RCA – while the number of capabilities required is captured by the diversification – i.e. the number of products exported with RCA – of countries exporting a given product. So, empirically speaking a product is complex if it is exported with RCA by very few countries who are highly diversified.

We rely on this measure as a general qualifier of capability requirement and technological features of products because it has been used widely in the literature (Hidalgo and Hausmann, 2009; Balland et al., 2022, 2019) and it is methodologically consistent with the measure of distance in its approach to capturing productive capabilities.

In Fig. A.3 we plot the distribution of the complexity of products, averaged over time, for all products in the BACI-CEPII database and for the three groups of products of interest. Products in sensitive ecosystems, are distributed in a rather similar way with respect to the total population of products. This may depend on the fact that we consider the whole value chain including also many raw materials with low levels of complexity. In addition, this result suggests that while sensitive ecosystem value chains certainly encompass complex technologies, Europe exhibits dependence in the less complex portion of these value chains too.

This is consistent with the fact that when we look at the other two groups which are identified based purely on technological aspects rather than dependence, we find a rather different picture. NZIA have a slighter higher average and are significantly more concentrated around the mean, suggesting higher prevalence of complexity among them. Semiconductor set themselves apart rather starkly, with a distribution of complexity significantly skewed towards higher values, reflecting the fact that semiconductors are high-tech products that require a vast array of capabilities, many of which are quite rare.

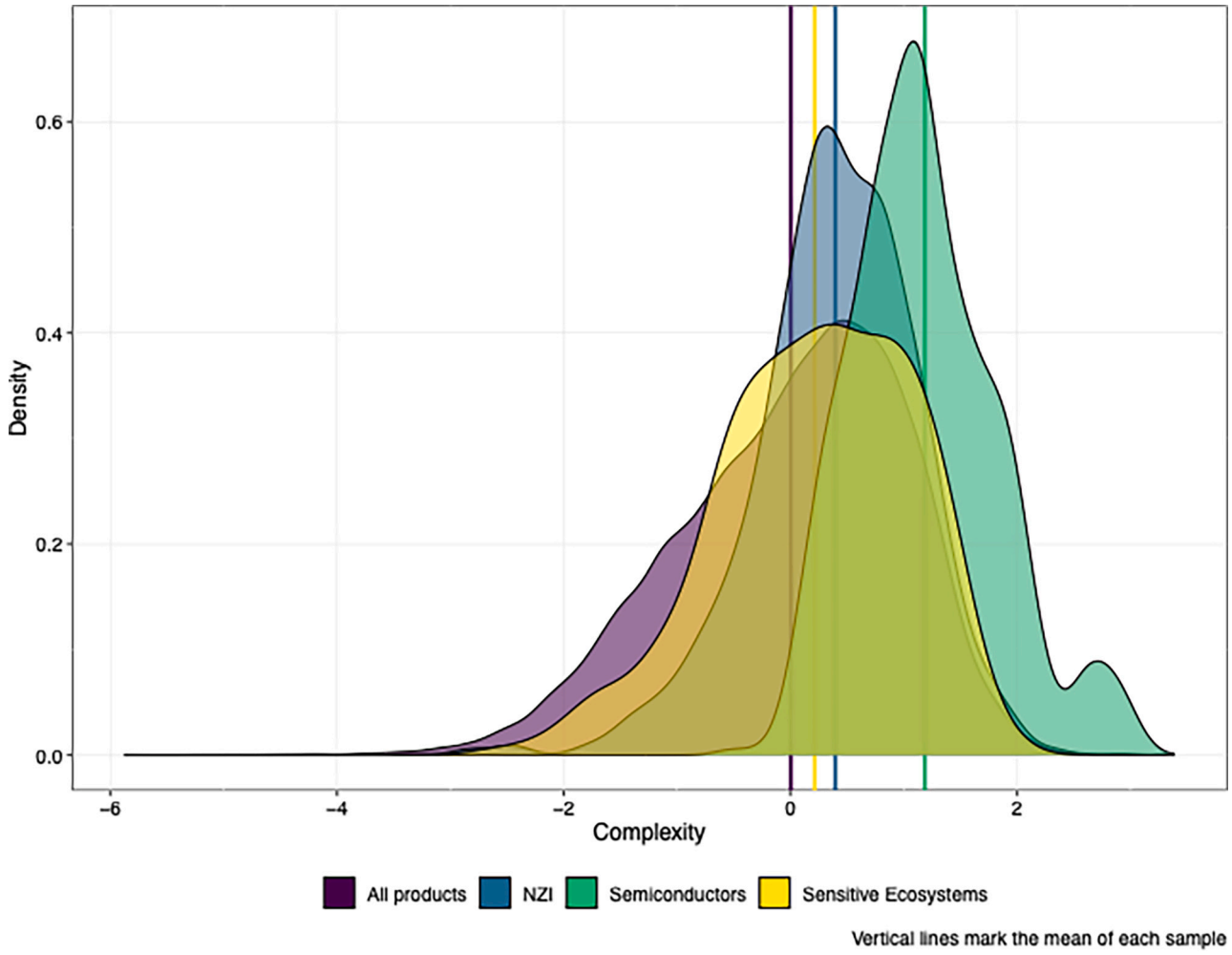


Fig. A.3. Products' complexity distribution. Note: Density plot of products' complexity. Complexity is averaged over time to only vary among products. Source: Authors' elaboration on BACI-CEPII data.

While this evidence provides us with preliminary insights on the technological features of strategic products, it is also important to stress that complexity is *not* mechanically linked to how we compute distance. Countries can be distant to highly complex products and lie far away from low-complexity ones, it is however likely that larger more diversified countries will also lie closer to many of the strategic products.

A.4. Absolute and relative distance

We report below some basic descriptive evidence on the relationship between absolute and relative distance as computed in Eqs. (1) and (2) in the main text. Table A.2 reports the pairwise correlation between the two measures across product groups.

Table A.2
Correlation between the two distances.

Product categories	
All products	0.571***
Ecosystems	0.632***
NZIA products	0.566***
Semiconductors	0.638***

Note: Table reports pairwise correlation coefficients, * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

Figs. A.4 and A.5 plot the same relationship highlighting products that are part of an EC list and distinguishing by country. We find a positive relationship, consistently with Table A.2, this relationship becomes even stronger when we look at individual countries.

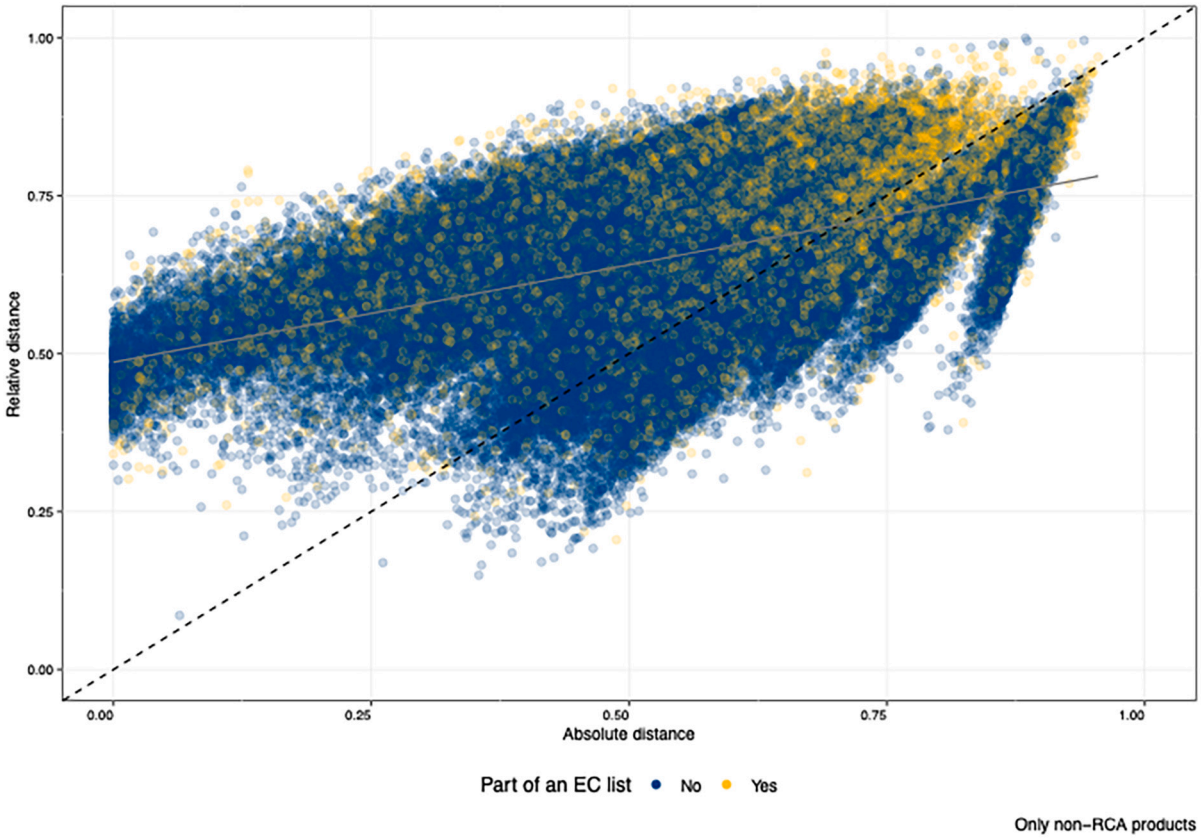


Fig. A.4. Absolute and relative distance, scatterplot. Note: Scatterplot of absolute and relative distance for all products, average over the 2012–15 period. EC list products are part of any of the three lists of strategic products: sensitive ecosystems, NZIA products or semiconductors. Source: Authors' elaboration on BACI-CEPII data.

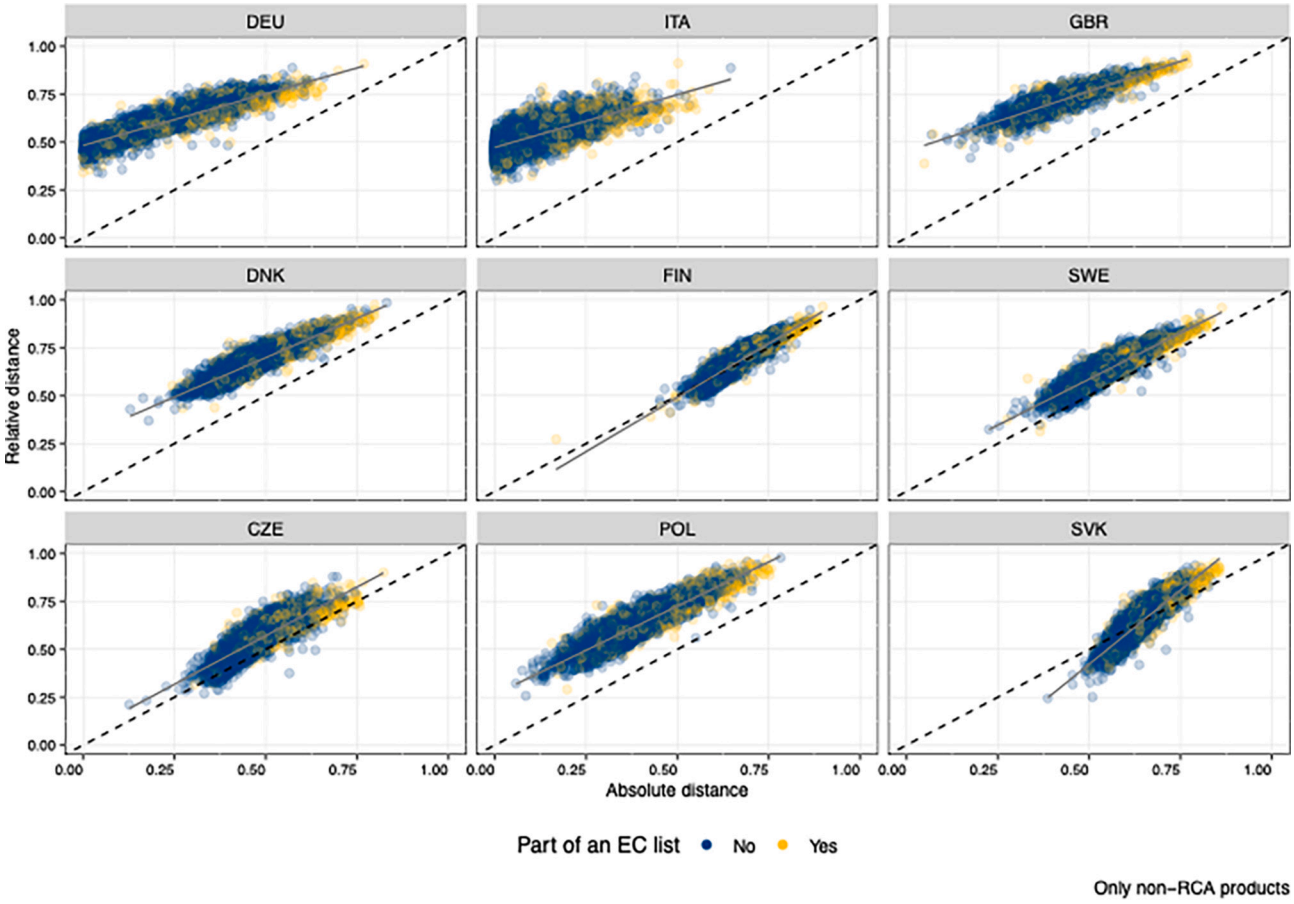


Fig. A.5. Absolute and relative distance, scatterplot across countries. Note: Scatterplot of absolute and relative distance for all products, average over the 2012–15 period, by selected countries. EC list products are part of any of the three lists of strategic products: sensitive ecosystems, NZIA products or semiconductors. Source: Authors' elaboration on BACI-CEPII data.

Finally, Tables A.3 and A.4 report the tabulations of distance (absolute and relative) advantages across countries for the different categories of products. Instead, Table A.5 tabulates our explanatory and outcome variable from Eq. (5) in the main text. We can see, as expected and discussed in the main text, that as we narrow down the number of products we consider in our analysis the variation across groups and outcome states also decreases, culminating with the perfect separation for semiconductors where none of the country-product pairs with both absolute and relative distance advantage performs an RCA jump.

Table A.4
Tabulations of advantage by country, NZIA products and semiconductors.

NZIA						Semiconductors					
	None	Rel. Only	Abs. Only	Both	Total		None	Rel. Only	Abs. Only	Both	Total
AUT	0	0	35	69	104	AUT	0	0	29	13	42
BEL	6	1	65	32	104	BEL	1	0	28	13	42
BGR	61	34	0	9	104	BGR	41	1	0	0	42
CYP	64	40	0	0	104	CYP	40	2	0	0	42
CZE	4	5	29	66	104	CZE	0	0	28	14	42
DEU	0	0	43	61	104	DEU	0	0	22	20	42
DNK	44	8	10	42	104	DNK	28	0	6	8	42
ESP	0	0	58	46	104	ESP	0	0	40	2	42
EST	45	58	0	1	104	EST	37	5	0	0	42
FIN	34	69	0	1	104	FIN	30	11	0	1	42
FRA	0	0	46	58	104	FRA	0	0	32	10	42
GBR	8	1	47	48	104	GBR	0	0	27	15	42
GRC	65	39	0	0	104	GRC	41	1	0	0	42
HRV	51	53	0	0	104	HRV	38	4	0	0	42
HUN	41	63	0	0	104	HUN	32	10	0	0	42
IRL	64	40	0	0	104	IRL	29	13	0	0	42
ITA	0	0	51	53	104	ITA	0	0	37	5	42
LTU	62	38	0	4	104	LTU	40	2	0	0	42
LUX	44	60	0	0	104	LUX	35	7	0	0	42
LVA	56	48	0	0	104	LVA	39	3	0	0	42

(*continued on next page*)

Table A.4 (*continued*)

NZIA						Semiconductors					
	None	Rel. Only	Abs. Only	Both	Total		None	Rel. Only	Abs. Only	Both	Total
MLT	55	49	0	0	104	MLT	27	15	0	0	42
NLD	40	4	38	22	104	NLD	2	2	25	13	42
POL	2	0	46	56	104	POL	8	0	30	4	42
PRT	15	0	45	44	104	PRT	16	0	24	2	42
ROU	53	51	0	0	104	ROU	36	6	0	0	42
SVK	42	62	0	0	104	SVK	35	7	0	0	42
SVN	35	51	0	18	104	SVN	33	6	3	0	42
SWE	29	36	7	32	104	SWE	13	0	18	11	42
Total	920	810	520	662	2912	Total	601	95	349	131	1176

Source: Authors' own elaboration based on BACI-CEPII data.

A.5. Robustness checks on econometric analysis

We present below the main robustness checks we discuss in the main text. We start by reporting here results taking the median as a threshold (Table A.6), for space's sake we report only the results taking as benchmark country-products with only a relative advantage. We also construct a disadvantage measure, specular to what we use in the main text. This is a measure based not on whether a country-product lies in the bottom two quintiles of distribution of absolute and relative distance but on whether it lies in the *top* two quintiles (Table A.7). Results using the median as threshold are essentially unchanged, while when we look at disadvantage we find, as expected, specular coefficient signs and very similar significance levels.

Table A.6
Advantages and RCA jumps, median as a threshold.

	(1)	(3)	(4)	(5)
advantage = 0, None	−0.0459***	−0.0433**	−0.0689***	−0.0501*
	(0.00577)	(0.0193)	(0.0234)	(0.0283)
advantage = 2, Abs. only	−0.0315***	−0.0337	−0.0396	0.0202
	(0.00844)	(0.0247)	(0.0409)	(0.0447)
advantage = 3, Both	0.0191**	0.0226	−0.0507	0.0237
	(0.00911)	(0.0340)	(0.0383)	(0.0514)
Constant	0.0822***	0.0786***	0.0984***	0.0359
	(0.00490)	(0.0187)	(0.0190)	(0.0310)
Observations	103,823	4810	1878	971
R-squared	0.103	0.096	0.109	0.090
Country FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
Category	All	Sensitive Ecosystems	NZIA	Semiconductors

Note: the table reports regression coefficient for linear probability model; The advantage variable is constructed like in the main text but based on the median rather than the two bottom quintile as threshold. We now no longer have a case of perfect separation in the semiconductor group of products for which we now report the coefficient. It should however be noted that variation across outcome states within country-products with both absolute and relative advantages in the semiconductor group remains very limited and the coefficients should be interpreted with the utmost caution; Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Looking at all products in column one of Table A.7, having neither an absolute or relative disadvantage improves the chances of performing an RCA jump, compared to having only a relative distance disadvantage. Having both disadvantages, in contrast, lowers the chances of an RCA jump. Finally, having only an absolute distance disadvantage improves the chances of an RCA jump, confirming that relative distance is more important in shaping a country's likelihood of success in developing a new RCA. When we focus on sensitive ecosystems, we find again consistent results, although only for the absence of both disadvantages. In contrast NZIA products show a statistically significant coefficient only for the case of both disadvantages, which is negative as expected.

The model we rely on in the main text rely on the categorical variable we build to map country and products advantages in absolute and relative terms. We report below the results using instead either relative or absolute distance. Our key contention is that both absolute and relative distance matter for countries' specialisation success in new products. The literature has already shown that distance in levels is positively associated to the likelihood of performing an RCA jump. We therefore provide evidence about our two normalised distances by testing a simple linear probability model previously used in the literature (Boschma et al., 2013, 2015; Hausmann and Klinger, 2007):

$$y_{ik} = \alpha + \beta_1 Distance_{ik} + e_{ik} \tag{6}$$

The equation focuses on the likelihood of country-product (*ik*) pair performing an RCA jump, as defined in Fig. 6. Our key explanatory variable is distance, absolute and relative as computed in Eqs. (1) and (2). The results in Table A.8 are consistent with evidence from the literature and what our framework would suggest. We find both kinds of distance to be significant, however coefficients for relative distance are much larger than for absolute distance. This is in line with the idea we discuss in our framework that relative distance drives firms (and countries) choice of products and that, therefore, high relative distance is likely to reduce the chance that a product be even selected as a specialisation avenue.

Table A.8
Probability of an RCA jump across product categories, absolute and relative distance.

	Absolute distance			
	(1)	(2)	(3)	(4)
Absolute distance	−0.0766***	−0.0672**	−0.0967***	−0.0401**
	(0.0248)	(0.0293)	(0.0316)	(0.0172)
Constant	0.102***	0.0865***	0.115***	0.0461***
	(0.0161)	(0.0198)	(0.0199)	(0.0116)
Observations	103,823	4810	1878	971
R-squared	0.003	0.003	0.005	0.002
Country FE	No	No	No	No
Product FE	No	No	No	No
Category	All	Sensitive Ecosystems	NZIA	Semiconductors
	Relative distance			
Relative distance	−0.271***	−0.196***	−0.252***	−0.154***
	(0.0281)	(0.0499)	(0.0516)	(0.0385)
Constant	0.242***	0.189***	0.228***	0.137***
	(0.0206)	(0.0378)	(0.0373)	(0.0310)
Observations	103,823	4810	1878	971
R-squared	0.016	0.008	0.015	0.012
Country FE	No	No	No	No
Product FE	No	No	No	No
Category	All	Sensitive Ecosystems	NZIA	Semiconductors

Note: the table reports regression coefficient for linear probability model. Distance is averaged over the period 2012–15, the outcome variable identifies RCA jumps. These occur when a country-product pair goes from an average RCA over 2012–15 below 0.8 to above 1 in the 2018–21 period. Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

A.6. Extension of results on risky jumps

Our main contribution, which we analyse in the main text, concerns the likelihood of performing an RCA jump in a two-period setting. In this extension we descriptively investigate however how distance relates to the likelihood of losing an RCA which was previously acquired, distinguishing between risky and non-risky jumps, which we define below.

We divide our data in three periods: t0 = 2012–14, t1 = 2015–17 and t2 = 2018–21. We then look at observations that have performed an RCA jump (going from 0.8 to above 1) between t0 and t1 and look at exit rates between t1 and t2.

In Fig. A.6 we identify two subsets of country-industry pairs: those that have performed the jump with at least a relative advantage and those that have done so with at least an absolute advantage. For each of these two subsets we then compare the different outcomes we observe between t1 and t2 based on distances at t0. We define risky jumps based only on relative advantage or on only absolute advantage, while non-risky jumps are those that benefit from both advantages. Our framework would suggest that risky jumps that have only a relative advantage should exhibit higher exit rates. That is, if a country manages to perform an RCA jump while experimenting based on its relative advantage alone, we would expect that there would be a higher likelihood of this RCA to be lost in subsequent periods. In contrast, RCA jumps performed with only an absolute advantage would still be riskier than those performed with both kinds of advantages, but to a lesser extent. In line with this, we find exit rates for country-products with only a relative advantage to be larger than for those having only an absolute advantage, although only slightly (0.36 vs 0.32, respectively). Having both advantages (i.e. non-risky jumps) has by far the lowest exit rate (0.24), as our framework suggests and the referee surmises.

When we replicate these results with strategic products, the differences are starker, and very much in line with the intuition above. The exit rate for country-products with only a relative advantage is 0.6, while having an absolute advantage only has an exit rate of "just" 0.37; having both advantages instead has an exit rate of 0.33. However, the number observations we can rely on is very limited (102), so we believe it's important to interpret these results with caution.

We leave a more formal testing of this notion to future research, which we discuss in the conclusions, although the descriptive evidence we present in this extension lends support to this conjecture.

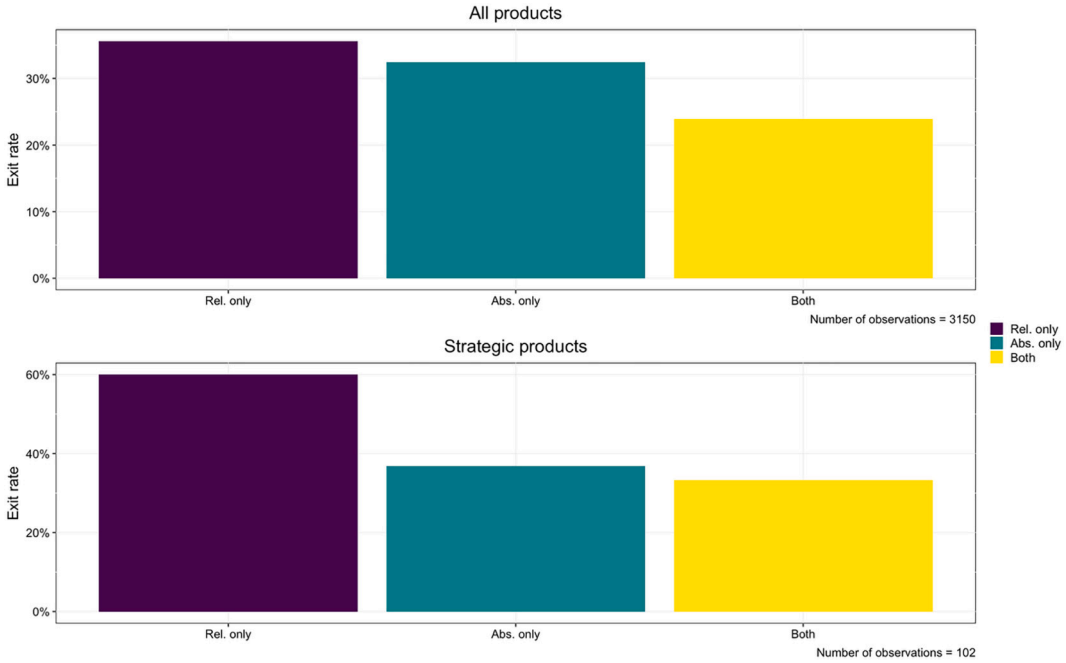


Fig. A.6. Exit rates of risky jumps with only relative or only absolute advantage. Note: The figure reports exit rates between t1 and t2 for country-products that have only a relative advantage, only an absolute advantage or both and that have performed an RCA jump between t0 and t1. Source: Authors' elaboration on BACI-CEPII data.

Data availability

The authors do not have permission to share data.

References

Albora, G., Benoit, F., Caldarola, B., Di Girolamo, V., Diodato, D., et al., 2025. Path to Innovation: an Economic Complexity Analysis of Technological Perspectives in the EU - Advanced Materials. Publications Office of the European Union, Luxembourg. https://data.europa.eu/doi/10.2760/6124424, JRC144431.

Archibugi, D., Mariella, V., 2021. Is a European recovery possible without high-tech public corporations? Intereconomics 56 (3), 160–166.

Arjona, R., Connell, W., Herghelegiu, C., 2023. An Enhanced Methodology to Monitor the EU's Strategic Dependencies and Vulnerabilities, No WP2023/14, Single Market Economics Papers, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (European Commission), Chief Economist Team.

Balland, P.A., Boschma, R., Crespo, J., Rigby, D.L., 2019. Smart specialization policy in the European Union: relatedness, knowledge complexity and regional diversification. Reg. Stud. 53 (9), 1252–1268.

Balland, P.A., Broekel, T., Diodato, D., Giuliani, E., Hausmann, R., O'Clery, N., Rigby, D., 2022. The new paradigm of economic complexity. Res. Policy 51 (3), 104450.

Barbero, J., Diukanova, O., Gianelle, C., Salotti, S., Pinheiro Hargreaves Santoalha, A., 2024. Technologically related diversification: one size does not fit all European regions. Res. Policy 53 (3), 104973.

Boschma, R., 2005. Proximity and innovation: a critical assessment. Reg. Stud. 39, 61–74.

Boschma, R., 2017. Relatedness as driver of regional diversification: a research agenda. Reg. Stud. 51 (3), 351–364.

Boschma, R., 2024. An evolutionary approach to regional studies on global value chains. Reg. Stud. 58 (7), 1492–1500.

Boschma, R., Balland, P.A., Kogler, D.F., 2015. Relatedness and technological change in cities: the rise and fall of technological knowledge in US metropolitan areas from 1981 to 2010. Ind. Corp. Change 24 (1), 223–250.

Boschma, R., Frenken, K., 2011. The emerging empirics of evolutionary economic geography. J. Econ. Geogr. 11, 295–307.

Boschma, R., Minondo, A., Navarro, M., 2013. The emergence of new industries at the regional level in Spain: a proximity approach based on product relatedness. Econ. Geogr. 89 (1), 29–51.

Breschi, S., Lissoni, F., Malerba, F., 2003. Knowledge-relatedness in firm technological diversification. Res. Policy 32, 69–87.

Caldarola, B., Mazzilli, D., Napolitano, L., Patelli, A., Sbardella, A., 2024. Economic complexity and the sustainability transition: a review of data, methods, and literature. J. Phys. Complex. 5, 022001.

Camagni, R., 2002. On the concept of territorial competitiveness: sound or misleading? Urban Stud. 39 (13), 2395–2411.

Chang, H.J., Andreoni, A., 2020. Industrial policy in the 21st century. Dev. Change 51 (2), 324–351.

Cimoli, M., 1994. Technological Gaps, Specialization and Growth: a Structuralist/ Evolutionary View, IIASA Working Paper. IIASA, Laxenburg, Austria: WP-94.

Cimoli, M., Porcile, G., 2016. Latin American structuralism: the co-evolution of technology, structural change and economic growth. In: Handbook of Alternative Theories of Economic Development, pp. 228–239.

Crespi, F., Caravella, S., Menghini, M., Salvatori, C., 2021. European technological sovereignty: an emerging framework for policy strategy. Intereconomics 56 (6), 348–354.

Di Carlo, D., Eisl, A., Zurstrassen, D., 2024. Together we trade, divided we aid: EU industrial policy, state aid and the loosening of EU competition regime. In: EU Industrial Policy Report 2024. Luiss Hub for New Industrial Policy and Economic Governance, Chapter 4. https://leap.luiss.it/wp-content/uploads/2024/09/20240919_Luiss_Rapporto-LUHNIP_v6.pdf.

Dosi, G., 1982. Technological paradigms and technological trajectories: a suggestive interpretations of the determinants and directions of technical change. Res. Policy 11, 147–162.

Dosi, G., Mathew, N., Pugliese, E., 2022. What a firm produces matters: processes of diversification, coherence and performances of Indian manufacturing firms. Res. Policy 51 (8), 104152.

Duenas, M., Campi, M., 2024. Regional resilience during COVID-19: evidence from Colombian exporting clusters. Reg. Stud. 58 (11), 2129–2145.

Edler, J., Blind, K., Kroll, H., Schubert, T., 2023. Technology sovereignty as an emerging frame for innovation policy. Defining rationales, ends and means. Res. Policy 52, 104765.

European Commission, 2021. Strategic dependencies and capacities, Brussels, Staff Working Document SWD(2021)352 final. https://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=SWD:2021:352:FIN.

Evenett, S., Jakubik, A., Martín, F., Ruta, M., 2024. The Return of Industrial Policy in Data. International Monetary Fund, WP/24/1.

Filippetti, A., Vezzani, A., 2022. The political economy of public research, or why some governments commit to research more than others. Technol. Forecast. Soc. Change 176, 121482.

Fontana, O., Vannuccini, S., 2024. How to Institutionalise European Industrial Policy (for Strategic Autonomy and the Green Transition), Centro Studi sul Federalismo Research Paper. February 2024.

Fraccascia, L., Giannoccaro, I., Albino, V., 2018. Green product development: what does the country product space imply? J. Clean. Prod. 170, 1076–1088.

Gaullier, G., Zignago, S., 2010. BACI: International Trade Database at the Product-Level. The 1994–2007 Version. CEPII Working Paper, N°2010-23.

Goya, D., Zahler, A., 2019. Distance from core competences and new export survival: evidence from multi-product exporters. World Econ. 42 (11), 3253–3286.

Hamwey, R., Pacini, H., Assunção, L., 2013. Mapping green product spaces of nations. J. Environ. Dev. 22 (2), 155–168.

Hausmann, R., Hwang, J., Rodrik, D., 2007. What you export matters. J. Econ. Growth 12, 1–25.

Hausmann, R., Klinger, B., 2007. The structure of the product space and the evolution of comparative advantage. In: Working Paper No. 146. Center for International Development, Harvard University, Cambridge, Mass.
Hernández-Rodríguez, E., Boschma, R., Morrison, A., Ye, X., 2025. Functional upgrading and downgrading in global value chains: Evidence from EU regions using a relatedness/complexity framework. Pap. Reg. Sci. 104 (1), 100072.
Hidalgo, C.A., 2021. Economic complexity theory and applications. Nat. Rev. Phys. 3, 92–113.
Hidalgo, C.A., 2023. The policy implications of economic complexity. Res. Policy 52 (9), 104863.
Hidalgo, C.A., Hausmann, R., 2009. The building blocks of economic complexity. Proc. Natl. Acad. Sci. 106 (26), 10570–10575.
Hidalgo, C.A., Klinger, B., Barabási, A.L., Hausmann, R., 2007. The product space conditions the development of nations. Science 317 (5837), 482–487.
Hirschman, A.O., 1958. The Strategy of Economic Development. Yale University Press.
Huberty, M., Zachmann, G., 2011. Green exports and the global product space: prospects for EU industrial policy (no. 2011/07). In: Bruegel Working Paper.
Juhász, R., Lane, N.J., Rodrik, D., 2023. The New Economics of Industrial Policy (No. w31538). National Bureau of Economic Research.
Kleimann, D., Poitiers, N., Sapir, A., Tagliapietra, S., Véron, N., Veugelers, R., Zettelmeyer, J., 2023. Green tech race? The US inflation reduction act and the EU net zero industry act. World Econ. 46 (12), 3420–3434.
Lall, S., 1992. Technological capabilities and industrialization. World Dev. 20 (2), 165–186.
Mariani, M., Vidmer, A., Medo, M., Zhang, Y., 2015. Measuring economic complexity of countries and products: which metric to use? Eur. Phys. J. B 88 (11), 293.
Mazzucato, M., 2021. Mission Economy: A Moonshot Guide to Changing Capitalism. Harper Business.
Mealy, P., Teytelboym, A., 2022. Economic complexity and the green economy. Res. Policy 51, 103948.
Mewes, L., Broekel, T., 2022. Technological complexity and economic growth of regions. Res. Policy 51 (8), 104156.
Monastiriotis, V., Gamtkitsulashvili, T., 2024. Taking the territorial dimension of industrial policy seriously: industrial and cohesion policy in the EU. In: EU Industrial Policy Report 2024, Luiss Hub for New Industrial Policy and Economic Governance, Chapter 7. https://leap.luiss.it/wp-content/uploads/2024/09/20240919_Luiss_Rapporto-LUHNIP_v6.pdf.
Müller, V.P., Eichhammer, W., 2023. Economic complexity of green hydrogen production technologies-a trade data-based analysis of country-specific industrial preconditions. Renew. Sustain. Energy Rev. 182, 113304.
Nelson, R.R., Winter, S.G., 1985. An Evolutionary Theory of Economic Change. Belknap Press: An Imprint of Harvard University Press, Cambridge, Mass.
Nomaler, O., Verspagen, B., 2024. Related or unrelated diversification. What is smart specialization? Struct. Change Econ. Dyn. 70, 503–515.
Perruchas, F., Consoli, D., Barbieri, N., 2020. Specialisation, diversification and the ladder of green technology development. Res. Policy 49 (3), 103922.
Petralia, S., Balland, P.A., Morrison, A., 2017. Climbing the ladder of technological development. Res. Policy 46 (5), 956–969.
Pinheiro, F.L., Hartmann, D., Boschma, R., Hidalgo, C.A., 2022. The time and frequency of unrelated diversification. Res. Policy 51, 104323.
Prebisch, R., 1962. The economic development of Latin America and its principal problems. Econ. Bull. Lat. Am. 7 (1), 1–22.
Sbardella, A., Perruchas, F., Napolitano, L., Barbieri, N., Consoli, D., 2018. Green technology fitness. Entropy 20 (10), 776.
Stojkoski, V., Koch, P., Hidalgo, C.A., 2023. Multidimensional economic complexity and inclusive green growth. Commun. Earth Environ. 4 (1), 130.
Stojkoski, V., Utkovski, Z., Kocarev, L., 2016. The impact of services on economic complexity: service sophistication as route for economic growth. PLoS One 11, e0161633.
Tacchella, A., Cristelli, M., Caldarelli, G., Gabrielli, A., Pietronero, L., 2012. A new metrics for countries' fitness and products' complexity. Sci. Rep. 2, 723.
Teece, D., Rumelt, R., Dosi, G., Winter, S., 1994. Understanding corporate coherence: Theory and evidence. J. Econ. Behav. Organ. 23 (1), 1–30.
Thirlwall, A.P., 1979. Balance of payments constraint as an explanation of international growth rate differences. Banca Naz. Lavoro Q. Rev. 128, 45–53.
Uribe, J.M., 2025. Investment in intangible assets and economic complexity. Res. Policy 54 (1), 105133.