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# How do countries shift their export specialization? The role of technological capabilities and industrial policy in Ireland, Spain and Sweden (1995–2018)

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## Abstract

This article contributes to the Comparative Political Economy discourse on countries' export specialization transitions. While current growth model literature often highlights producer coalitions' influence, we present a complementary perspective emphasizing industrial policies. These policies, we argue, are not solely shaped by politics but are also deeply influenced by sectoral technological capabilities. By strategically engaging in both demand and supply-side sectoral innovation processes, industrial policies deepen existing technological capabilities with spillover effects into new sectors or foster new sector-specific capabilities. Our empirical analysis comprises two main steps. First, we create export profiles for eight European nations, using OECD TiVA data from 1995 to 2018. These profiles are categorized based on their technological and innovation content. Second, we identify significant shifts in export structures within Ireland, Sweden and Spain. Through thorough case studies, we illustrate the role of industrial policies in cultivating sector-specific technological capabilities.

**Key words:** growth models, exports, industrial policy

**JEL classification:** O57 comparative studies of countries, P51 comparative analysis of economic systems

## 1. Introduction

In the past three decades, European countries have experienced increased economic specialization due to the effects of global market integration and European integration, which contributed to the emergence of new peripheries and new challenges in the core of Europe

(Celi *et al.*, 2018). Those nations that have developed a comparative advantage in high-value-added service and product markets tend to perform better in export markets (Gräbner *et al.*, 2020*a*; Botta and Tippet, 2022; Kohler and Stockhammer, 2022). Specialization in less price-sensitive markets also promotes a more equitable and balanced growth model because it reduces pressure on labor costs, thereby maintaining consumer spending levels (Baccaro and Pontusson, 2022). Therefore, the adaptation and enhancement of export strategies are essential for the growth of European countries and have garnered increased attention in the literature on growth models (Gräbner *et al.*, 2020*a*; Baccaro and Pontusson, 2022; Kohler and Stockhammer, 2022).

This literature proposes a political approach to study change in productive structures by examining the sectoral coalitions between collective actors such as business and labor, which coordinate among themselves and advocate for institutional reforms that serve their producers' interest (Baccaro and Pontusson, 2019; Thelen, 2019); in more recent contributions, these coalitions also influence industrial policies (Calvo, 2014*a*; Brazys and Regan, 2017; Baccaro and Bulfone, 2022). Two recent papers by Gräbner *et al.* (2020*a*,*b*) have contributed to the growth model literature by emphasizing the role of past technological capabilities in explaining current national export trajectories. However, these articles measure capabilities at the national level rather than the sectoral level, and therefore, they do not identify shifts in export structures. Additionally, while acknowledging the importance of capabilities, they do not explain how industrial policies can help foster these capabilities.

Drawing on the literature in innovation and development studies (Rosenberg, 1972; Nelson and Winter, 1982; Dosi, 2000; Dosi *et al.*, 2015), we aim to advance the perspective on export specialization in the growth model literature by illustrating the connection between shifts in export structures, industrial policies and sectoral-level capabilities. Our analysis begins by examining the export structures of eight European countries using recent data on domestic value-added (DVA) content of gross exports from 1995 to 2018. We have reclassified the export data using the Eurostat categorization based on the technological and innovation content of different sectors to proxy the sectoral technological capabilities of each country. This approach reveals that the sectoral trajectories of Ireland, Spain and Sweden have experienced the most significant changes in terms of export success and quality. As a result, we present in-depth case studies that illustrate how industrial policies intervene on both the supply and demand sides of sectoral innovation processes to deepen or develop new capabilities.

Our article offers a complementary perspective rather than an alternative explanation to the coalition-based explanation in the growth model literature regarding the shift in export structures. While we acknowledge the critical influence of politics and power relations on industrial policies, we argue that technological capabilities embedded within organizations and sectors (or the lack thereof) shape the choice of industrial policies. Therefore, we expand upon the analysis of Gräbner *et al.* (2020*a*,*b*) on the path dependency of export structures because we analyze shifts in export structures at the sectoral level and demonstrate the important role of industrial policies that develop by stimulating the demand and supply side of sectoral processes of innovation.

## 2. Explaining shifts in export specialization

This section begins by presenting the debate in the Comparative Political Economy (CPE) literature on national trajectories of export specialization, with a particular focus on recent

contributions to the growth model literature that emphasize the role of industrial policies. To advance this line of research further, we then illustrate how industrial policies can either develop new sectoral technological capabilities or build upon existing capabilities to create new sectors, drawing insights from the literature in the fields of development and innovation studies.

### 2.1 CPE debate on export specialization

The Varieties of Capitalism (VofC) literature explains national economic specialization trajectories through the complementarities between institutional arenas, such as industrial relations, vocational education and training (VET) systems and corporate governance structures. These institutional factors create a framework of opportunities and constraints that influence firms' strategic choices. This, in turn, provides firms in specific sectors with a comparative advantage over similar firms in other countries but also 'locks' the country into a specific specialization path, leading to divergent trajectories in different high-value-added manufacturing sectors (Whitley, 1999; Hall and Soskice, 2001*a*). In liberal market economies, companies in industries requiring flexibility and radical innovation, such as pharmaceuticals and software development, benefit from a comparative advantage due to weak industrial relations, flexible labor markets and corporate governance and financial systems that are open to outsiders. In contrast, in coordinated market economies, companies specialize successfully in high-value-added segments of metal and machine-tool building because the VET system provides a skilled workforce, encompassing collective agreements that establish high and uniform wage levels, and workplace representation that fosters labor-management cooperation at the company level (Hall and Soskice, 2001*b*).

The VofC framework, which places significant emphasis on institutionally determined specialization trajectories, faces limitations in explaining shifts in productive structures unless prompted by external shocks (Amable and Palombarini, 2008). In contrast, the growth model literature offers a more dynamic perspective on national political economies, focusing on the role of various supply and demand components in a country's growth (Baccaro and Pontusson, 2016; Kohler and Stockhammer, 2022). It also explores how the relative importance of these components affects power dynamics among interest groups (Blyth *et al.*, 2022). This body of work primarily investigates the contribution of exports to national growth as opposed to domestic consumption. The relative significance of either of these growth drivers is used to distinguish between different growth models, primarily export-led and wage-led models (Baccaro and Pontusson, 2016; Morlin *et al.*, 2022).

Nevertheless, scholars have also examined the quality of exports, contingent on the segment of product and service markets. The type of exports a country specializes in and their price competitiveness have implications not only for export performance but also for the relative importance of other growth drivers. For instance, if exports are price-competitive, this can exert downward pressure on labor costs, potentially leading to reduced internal consumption (Baccaro and Benassi, 2016; Gräbner *et al.*, 2020*a*; Kohler and Stockhammer, 2022).

Changes in export specialization, encompassing goods and services across various price market segments, have been attributed to sector-based coalitions among collective actors that support institutions and advocate for policies or significant institutional reforms conducive to specific growth and export trajectories (Baccaro and Pontusson, 2019). The Swedish case provides a noteworthy illustration of this mechanism. Since the 1990s,

Sweden's exports and productive structures have shifted from advanced manufacturing to high-end services, a transformation explained by the altered political dynamics between organized labor and employers. Large Swedish employers had diverse interests in the country's economy, allowing them to invest in high-end services. Simultaneously, unions, with a broad membership base across sectors, prevented the cost-cutting strategies responsible for the success of German manufacturing; they also supported increased investments in services due to the growing significance of white-collar workers in union membership (Thelen, 2014, 2019; Erixon and Pontusson, 2022).

Recent contributions have also demonstrated how these sectoral coalitions can influence industrial policies, bringing the state back as a political actor in CPE (Hassel and Palier, 2021; Baccaro *et al.*, 2022). These studies have shown that the composition and influence of these coalitions explain which sectors benefit from state policies (Calvo, 2014*a*; Bohle and Regan, 2021; Sierra, 2022). For instance, Bohle and Regan (2021) explained the FDI-led growth strategy in their case studies of Hungary and Ireland. This strategy was driven by state-led industrial and enterprise policies that targeted the capital investment of foreign-owned multinational firms. These policies were the result of agreements between corporate business elites and state elites. Conversely, Sierra (2022) argued that Latin American governments cannot promote the development of manufacturing and services due to the political influence of landed elites, whose power relies on a commodity-based export strategy for growth.

While the primary focus of the growth model literature remains on the politics that shape industrial policy, influencing national export and economic specialization trajectories, this expanding body of work has also discussed how specific policy instruments can affect these trajectories by facilitating entry into new sectors or nurturing existing sectoral strengths (Bulfone, 2020; Iversen and Soskice, 2020; Mertens *et al.*, 2021; Reurink and Garcia-Bernardo, 2021). For example, tax policies, alongside infrastructure development and economic diplomacy, have been used to attract new businesses and expand into new sectors (Reurink and Garcia-Bernardo, 2021). On the contrary, this literature has shown how governments can maintain continuity in productive structures, especially by nurturing national monopolies, using various policy instruments, including National Development Banks (Mertens *et al.*, 2021) and monetary compensation during the transition from monopoly to market actors or through economic diplomacy (Bulfone, 2020). However, there is still a need for a systematic mapping of specific policy instruments and their contribution to successful shifts in productive structures.

This article advances the literature on the role of industrial policies in economic specialization, especially in driving shifts in productive structures, on two main fronts. First, while acknowledging the pivotal role of politics in shaping industrial policy decisions, we argue that the presence or absence of sector-based technological capabilities developed in the past also influences these choices. Technological capabilities, whether deepened or newly developed, are central to sectoral innovation processes, which are vital for export performance. Second, we categorize policy instruments based on whether they stimulate the demand or supply side of sectoral innovation processes and illustrate how they impact the trajectory of export specialization.

The concept of technological capabilities, as defined in the following section, was recently introduced into the debate on export specialization in the growth model by Gräbner *et al.* (2020*a*). They measure the presence of these capabilities using the Production

Complexity Index, an index at the national level that excludes services. Consequently, their approach does not allow for the observation of shifts in the overall export structures; they argue that countries with a high PCI score in the past have further increased their product complexity while countries traditionally characterized by low product complexity have lost further ground, leading to divergent trajectories of specialization. Building upon their analysis, we advance it in two significant ways: first, we consider the presence of technological capabilities at the sector level rather than focusing solely on countries. By doing so, we align with the sectoral approach of the growth model literature and can identify shifts in export structures. Second, while Gräbner *et al.* (2020*a*,*b*) emphasize the path-dependent nature of export specialization, we delve into these trajectories at the sectoral level and offer insights into the role of industrial policies in developing both new and pre-existing capabilities within a specific sector and in promoting innovation processes in adjacent sectors.

### 2.2 Technological capabilities and the role of industrial policy

In the field of innovation studies and development economics, technological capabilities are seen as the driving force behind technological change and innovation processes (Rosenberg, 1972; Dosi, 2000; Dosi *et al.*, 2015; Chang and Andreoni, 2020). These capabilities are conceptualized as learning and innovation abilities that are deeply embedded in the routines and expertise of workers, as well as in organizations (Nelson and Winter, 1982; Teece *et al.*, 1997). They encompass both codifiable knowledge, such as engineering blueprints and generic scientific knowledge, and tacit knowledge embedded within firms' organizational structures, their workforce and their routines (Dosi *et al.*, 2000). As technological opportunities vary across sectors, so do the technological capabilities of firms within specific sectors, as they are closely tied to the actual processes of innovation and production in those areas (Cimoli *et al.*, 2009, p. 31).

Because capabilities necessitate time, financial, technological and organizational resources, their development tends to be path-dependent, contingent on a pre-existing set of capabilities (Winter and Nelson, 1982; Silverberg, 1991; Dosi *et al.*, 2000; Andreoni, 2014). However, this does not imply that capabilities inevitably 'lock' countries into specific sectors. Indeed, their successful reconfiguration depends on tapping into positive spillovers and interdependence mechanisms. For example, certain manufacturing sectors (e.g. automotive, metal, plastic and machinery) are believed to foster capabilities that act as a catalyst for the development of the entire economy, including other sectors (Penrose, 1959; Lall, 2001; Amsden, 2004; Rodrik, 2013). These sectors are referred to as 'elevator' sectors because they create deeper linkages across the broader economy, contributing to the development of capabilities across various sectors and transforming the economy through interdependence mechanisms (Rodrik, 2013; Andreoni and Chang, 2019). Interdependence mechanisms rely on the existence of complementarities and indivisibilities. Complementarities induce cascade effects; for example, a new material innovation in a particular manufacturing product may necessitate new machine tools for its production, leading to changes in the machine tool industry. Indivisibility of production processes means that in certain sectors, certain production processes and specific techniques cannot be implemented below a certain volume, compelling technological and organizational innovations within adjacent sectors (Lissoni, 2005).

These symbiotic relationships between sectors, which support learning and innovation, are considered by policymakers when designing industrial policies (Chang and Andreoni, 2020).

While capabilities are indeed embedded in firms, the type of sectors that firms operate in holds significance because sectors are associated with specific technologies, knowledge and demand elasticities that industrial policies need to consider (Malerba, 2005; Cimoli *et al.*, 2009). Therefore, individuals and organizations embedded in sectors exhibit different knowledge and learning, which underpin innovation processes (Adams *et al.*, 2011). To promote sectoral innovation by developing capabilities, both the demand side and the supply side are important. On the supply side, the formal competences and skills of workers, as well as the characteristics of the labor market, which influence the ability to hire and retain skilled workers, are crucial. Firms also gain access to knowledge through participation in formal and informal networks of other public or private organizations, such as universities, research centers and public agencies (Adams *et al.*, 2011, p. 169). On the demand side, the public sector (through e.g. public agencies and state-owned enterprises) can stimulate the production of advanced products. Additionally, the size of the demand determines the ability to achieve economies of scale, which are essential for investments in innovation (Malerba, 2002; Adams *et al.*, 2011, p. 170).

Industrial policies aiming to promote capabilities should address both the demand and supply sides. In the field of innovation studies, industrial policies are categorized based on this distinction (Rodrik, 2004; Andreoni, 2016*a*), whereas the traditional classification of vertical (or selective) policies and horizontal (or general) policies is more commonly seen in CPE literature. Vertical policies involve the selective support of specific sectors and firms through grants, subsidies and capital investment, essentially 'picking winners' (Bulfone, 2022). Horizontal policies, however, are designed to benefit all industries equally through measures like corporate tax reductions and investments in education and training (Crespi and Dutrénit, 2014; Robinson and Mazzucato, 2019). However, the distinction between horizontal and vertical policies was criticized in innovation and development studies because, in a world of limited resources, every policy choice inherently involves implicit targeting (Chang *et al.*, 2013). For example, higher investment in research and development (R&D) benefits sectors with a strong reliance on patents, such as pharmaceuticals and chemicals, while potentially neglecting sectors like mining, where innovation primarily occurs beyond the R&D phase.

Therefore, in our perspective, industrial policies either target or favor specific sectors over others (Bailey *et al.*, 2019) by influencing sectoral processes of knowledge and learning from both the demand and supply sides. This categorization is valuable for the growth model literature because it enables the study of industrial policies at the meso-level, aligning with the sector-based approach of the growth model literature. Furthermore, the detailed examination of how these policies target technological capabilities reveals the mechanisms through which they contribute to changes in national export structure trajectories.

Table 1 provides a non-exhaustive list of supply and demand-side policies that scholars found being used in combination across different policy packages (Geroski, 1990; Chang and Andreoni, 2020; Anzolin, 2021). Examples of supply-side policies include low-cost loans to firms, grants for R&D and technology adoption, R&D subsidies and investments in infrastructure. These instruments facilitate the accumulation of knowledge, practice and capital, which in turn promotes processes of learning-by-doing and the development of technological capabilities. Demand-side policies, instead, aim to create stable and growing demand to facilitate productivity growth and economies of scale. These policies include measures such as public procurement, local content requirements, tariffs, import quotas and preferential agreements that favor domestic firms. A strategic mission-oriented

**Table 1** Supply and demand policies. Examples and main objectives.

| | Supply-side industrial policies | Demand-side industrial policies |
|---|---|---|
| Examples | • Tax exemptions (e.g. for R&D)<br>• Subsidies for technology purchasing<br>• Policies for skills/education improvement<br>• Access to venture capital<br>• Grants to overcome the 'valley of death' | • Public procurement<br>• Local content policies<br>• Incentives to export<br>• Public companies support/action<br>• Import quotas |
| Main objectives | • Upgrade capabilities through the provision of cheaper goods, pools of skills, R&D incentives into specific sectors. | • Fostering the formation of capabilities through the provision of stable demand that can allow increases in productivity, economies of scale, scope and learning mechanisms. |

*Source*: Authors.

approach, involving state-owned enterprises, such as public procurement, can also be a part of demand-side policies (Edquist and Zabala-Iturriagagoitia, 2012; Gasperin, 2022).

## 3. Data

This article uses the most recent release of the OECD TiVA database, published in November 2021, which tracks the origins of value-added in exports, imports and final demand from 1995 to 2018. The primary indicator employed for this analysis is the DVA content of gross exports (*EXGR DVA*), encompassing all countries to which goods and services are exported. Agriculture and mining were not considered in the analysis due to their minor and negligible role in the examination of structural changes. These data provide a detailed industry classification at the three-digit level (ISIC rev. 4). Sectoral profiles for different countries were constructed based on the Eurostat classification of manufacturing and services, which categorizes sectors based on their technological intensity (Eurostat, 2020). This intensity is measured as the ratio between R&D expenditure in a sector and its output (value added). This classification allows for the proxying of technological capabilities embedded in different sectors, with high R&D intensity sectors typically experiencing faster accumulation of capabilities, which then spread more effectively to other sectors of the economy (Archibugi *et al.*, 2009; Lin *et al.*, 2012).

The Eurostat classification is based on NACE rev. 2, which has a one-to-one relation with ISIC rev. 4 used in the TiVA data. The classification of manufacturing industries groups them into categories related to high-technology, medium/high-technology, medium/low-technology and low-technology. These classes were aggregated into two groups: high-technology manufacturing sectors (high-tech and medium/high-tech) and low-technology manufacturing sectors (low-tech and medium/low-tech). All manufacturing classes with

reported data were considered for analysis. Services were grouped based on their knowledge intensity and whether they are market-based or not. Only more tradable business services were considered, with their exports divided into Knowledge-Intensive Services (KIS) and Less KIS (LKIS) sectors. All available information regarding business services was used, except for highly aggregated classes, such as Administrative and Support Service activities (77–82) that were excluded. Table 2 presents our adapted classifications as discussed.

This classification derived from Eurostat is superior in capturing the quality composition of exports compared to other widely used indexes, such as Unit Labor Cost (ULC) and PCI. ULC, often used in CPE literature, including by Gräbner *et al.* (2020*a*,*b*), indicates how much workers are paid per level of output and does not capture the quality of exports per se, while PCI primarily measures trade variety in goods at the national level rather than sectoral specialization (Baccaro and Tober, 2022; Kohler and Stockhammer, 2022). Although the PCI provides interesting insights and is widely used (Gräbner *et al.*, 2020*a*; Lee and Lee, 2021), it overlooks two crucial aspects of our research, which focuses on export specialization in different sectors. It excludes services, which are critical, especially in advanced political economies' structural change, and measures trade variety in goods at the national level rather than sector specialization.

## 4. Shifts in export structures: descriptive evidence

We conducted an analysis of export data for eight Western European countries spanning the years 1995–2018. These countries exhibit considerable variation in terms of their growth models, be it export-led or consumption-led, their traditional areas of specialization, and the political coalitions supporting them. Over this period, exports, both in terms of gross exports and DVA exports as a share of GDP, have increased (Appendix Figure A1). This expansion in exports has coincided with significant changes in export structures, as depicted in Figure 1. To assess the extent and quality of these changes across countries, our analysis distinguishes between manufacturing and service industries, categorizing them as low/high quality based on technology and knowledge intensity. We define structural change in the export structure as a shift in (or out) of economic activities, which we aggregate using our four-sector classification. In Figure 1, we plot the ratio of high-technology manufacturing to low-technology manufacturing on the x-axis and the ratio of KIS to LKIS on the y-axis at two distinct points in time, 1995 and 2018. The graph incorporates three key dimensions: (a) the quality of change, signifying the direction of the line toward high-tech/low-tech manufacturing and KIS-LKIS; (b) the intensity of change, indicating the length of the line; and (c) the temporal aspect.

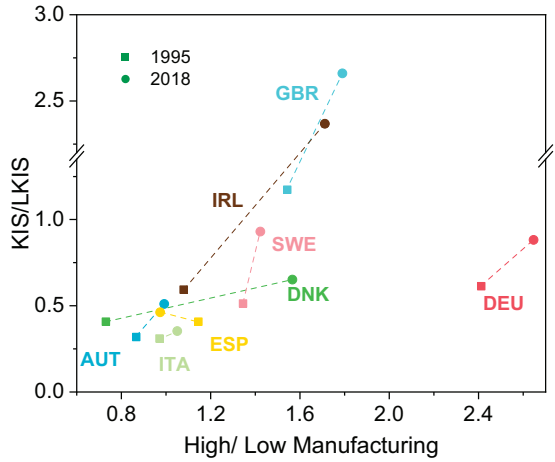
Across all eight European countries, there has been an increase in the share of KIS, although to varying degrees. The shifts along the other axis demonstrate that several countries have witnessed an increase in high-tech manufacturing exports relative to low-tech manufacturing. Germany, Austria and Denmark have maintained strong continuity with their traditional specialization (Campbell and Pedersen, 2007; Witt and Jackson, 2016), deepening their capabilities in the manufacturing sector, particularly high-technology manufacturing, while also investing in KIS. In contrast, Italy's lack of relevant change reflects a stagnant economy, whereas the UK continued deepening its specialization in KIS, although the structural change occurred before 1995. The three countries that have shown the most significant shifts—both quantitatively (i.e. the length of the line) and qualitatively

**Table 2** Data used in our analysis classified by technology intensity.

| Sectoral classification | | Nace rev 2 codes |
|---|---|---|
| Manufacturing | High and Medium-High Technology | 20–21 Chemical and pharmaceutical products<br>26 Manufacture of computer, electronic and optical products.<br>27–30 Manufacture of electrical equipment; Manufacture of machinery and equipment nec; Manufacture of motor vehicles, trailers and semi-trailers Manufacture of other transport equipment. |
| | Low and Medium-Low Technology | 22–25 Manufacture of rubber and plastic products; Manufacture of other non-metallic mineral products; Manufacture of basic metals; Manufacture of fabricated metals products, excepts machinery and equipment.<br>10–12 Food products, beverages, and tobacco.<br>13–15 Textiles, wearing apparel, leather and related products.<br>16–18 Wood and paper products and printing.<br>19 Manufacture of coke and refined petroleum products.<br>31–33 Manufacture of nec; repair and installation of machinery and equipment |
| Services | KIS | 50–51: Water transport and Air transport.<br>58–63 Publishing activities; Motion picture, video and television program production, sound recording and music publish activities; Programming and broadcasting activities; Telecommunications; computer programming, consultancy and related activities; Information service activities (section J).<br>64–66 Financial and insurance activities.<br>69–75 Professional, scientific and technical activities.[†] |
| | LKIS | 45–47 Wholesale and retail trade; Repair of motor vehicles and motorcycles.<br>49 Land transport and transport via pipelines.<br>52–53 Warehousing and support activities for transportation; Postal and courier activities.<br>55–56 Accommodation and food service activities.<br>68 Real Estate Activities |

[†]Legal and accounting activities; activities of head offices, management consultancy activities; architectural and engineering activities, technical testing and analysis; scientific R&D; advertising and market research; other professional, scientific and technical activities; veterinary activities (section M).
*Source*: authors adapted from Eurostat Indicators, see https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf.

(i.e. the direction of the line)—in their export structures from 1995 to 2018 are Sweden, Spain and Ireland. Sweden increasingly focused on KIS at the expense of manufacturing, showing a stronger shift toward services than other North European countries. Spain




Source: Authors based on elaboration of OECD TiVA data on domestic value-added content of gross exports.

**Figure 1.** Changes in the quality of export (1995 and 2018).

exports did not increase dramatically (i.e. the length of the line) yet they did in terms of the quality of the change (i.e. the direction of the line). Indeed, Spain is the only country with a backward bending line, suggesting that there was a shift from high-tech manufacturing to low-tech manufacturing alongside an increase in KIS exports. Ireland experienced the most substantial increase in KIS exports. After the global financial crisis, Ireland also saw a strong resurgence in high-tech manufacturing, reaching 31% of its exports in 2018 after dropping to 23% in 2010 [refer to Appendix Figure B4(a)].

We have selected these three countries to provide a 'parallel demonstration of theory' (Skocpol and Somers, 1980). Our three case studies, which are not compared in our analysis, aim to persuade the reader that our argument regarding the role of industrial policy and technological capabilities is valuable in explaining shifts in export specialization across a variety of cases. As shown, Ireland, Sweden and Spain have changed the sectoral composition of their exports between 1995 and 2018, although the quality of change differs. These distinctions in export trajectories are central to our analysis as they result from differing starting points. Indeed, the three countries had different productive structures (and hence different sectoral-level capabilities) at the beginning of our analysis period. This is shown in Table 3, which reports how our countries' Revealed Comparative Advantage (RCA, see Appendix for calculations) changed respectively between 1995 and 2018. For example, Ireland had a comparative advantage in chemical and pharmaceutical products that increased substantially over time, similarly to information and communication technology (ICT) services; conversely, its comparative advantage of 1.7 in 1995 in Computer, electronic and electrical equipment disappeared in 2018. Spain did not have a RCA in wholesale and retail trade and repair of motor vehicles in 1995, but it emerged in 2018. Finally, Sweden did not have a comparative advantage in information and communication services in 1995 (RCA = 0.9) yet by 2018 the sector became very relevant for the country (with RCA = 1.9 in 2018).

**Table 3** RCA for Ireland, Spain and Sweden between 1995 and 2018.

| | RCA_Ireland | | RCA_Spain | | RCA_Sweden | |
|---|---|---|---|---|---|---|
| | 1995 | 2018 | 1995 | 2018 | 1995 | 2018 |
| D10T33: Manufacturing | 1.148 | 0.907 | 0.905 | 0.909 | 1.143 | 0.992 |
| D20T21: Chemicals and pharmaceutical products | 1.756 | 3.377 | 0.834 | 0.938 | 0.864 | 0.768 |
| D26T27: Computer, electronic and electrical equipment | 1.705 | 0.559 | 0.314 | 0.253 | 0.744 | 0.320 |
| D29T30: Transport equipment | 0.210 | 0.053 | 1.752 | 1.322 | 1.462 | 1.468 |
| D45T47: Wholesale and retail trade; repair of motor vehicles | 0.784 | 0.699 | 0.844 | 1.168 | 0.784 | 0.994 |
| D58T63: Information and communication | 1.029 | 4.537 | 1.128 | 1.379 | 0.922 | 1.968 |
| D64T66: Financial and insurance activities | 1.298 | 3.018 | 0.441 | 0.443 | 0.384 | 0.595 |

*Source*: Authors based on elaboration of OECD TiVA data on DVA content of gross exports.

We explain such changes through the capabilities that governments either deepened or developed by the end of our analysis period through the utilization of industrial policies (see the next section for further details). Our analysis provides a complementary explanation to the perspective offered by the growth model literature, which focuses on the political aspects underlying the shift in export trajectories, even when discussing the role of industrial policy. For instance, the FDI-led growth of ICT services in Ireland was explained through coalitions of businesses and state elites influencing industrial policies (Brazys and Regan, 2017). Simultaneously, the weakened position of labor following the collapse of social pacts made Ireland an attractive destination (Teague and Donaghey, 2015). Sweden's transition from high-end manufacturing to high-end services is attributed to strong unions and collective agreements preventing labor cost compression in industrial services, alongside the presence of business elites in manufacturing with interests extending into the ICT sector (Erixon and Pontusson, 2022; Thelen, 2019). In Spain, the expansion of ICT services was attributed to peer coordination among private and public actors supporting industrial policies aimed at developing the former national monopoly, Telefonica (Calvo, 2014*a*,*b*).

We will show that the role of industrial policies and technological capabilities is critical to the shift in export structures of all three countries because technological capabilities (or the lack thereof) are vital for a better understanding of strategic industrial policy choices. This includes explaining why specific sectors were targeted by industrial policies while some sectors were neglected, despite the presence of national champions, such as the case of the Spanish automotive company SEAT. Additionally, we will explore why other sectors experienced resurgence, as seen in the Irish manufacturing sector after the global financial crisis [refer to Appendix Figure B4(a)].

## 5. Role of industrial policies in developing capabilities

In the following section, we will delve into three case studies on Ireland, Spain and Sweden, illustrating how industrial policies can influence the sectoral composition of export trajectories by building on former capabilities or developing new ones. Each case study will focus

on sectors that, according to our data, have been at the core of these countries' structural changes.

### 5.1 Ireland

Ireland is an export-oriented economy. Since 1995, the structural change in Irish exports has been marked by two significant trends (Figure 2a and b): First, there has been a steady and impressive increase in the export of KIS, particularly information and communication services (NACE 2 - class 58–63). These services accounted for 2% of total DVA exports in 1995 and surged to 19% in 2018. The second-largest growing KIS category has been financial and insurance activities. On the contrary, the share of high-tech manufacturing saw growth in the late 1990s but declined after 2001, going from 50% in 1995 to 29% in 2010, only to increase again after the global financial crisis. Some argue that these numbers are merely a result of the Irish statistical mirage (Kirby, 2004; Honohan, 2021; Pogatcnik SHAWN, 2021), mainly attributed to American firms operating within the Irish low-tax regime. This argument certainly holds true, especially considering the sharp increase in high-manufacturing exports between 2014 and 2015 [see Appendix Figure B4(b)], which is associated to the tax transfers of pre-existing intangible assets by American multinational companies (Khder *et al.*, 2020). Yet, we posit that this view overlooks important elements of the Irish experience of 'growth within the bubble' (O'Riain, 2004), which is a direct consequence of a path-dependent state-led development strategy aimed at attracting inward Foreign Direct Investment (FDI) in high-value sectors (Brazys and Regan, 2021). Recent data from the annual employment survey support this, confirming rapid job expansion in the ICT service sector and a considerable increase in full-time jobs (Regan, 2016). Even in the pharmaceutical industry, which is often criticized for the statistical mirage due to processing abroad, factory-less production and contract manufacturing (Polyak, 2023),

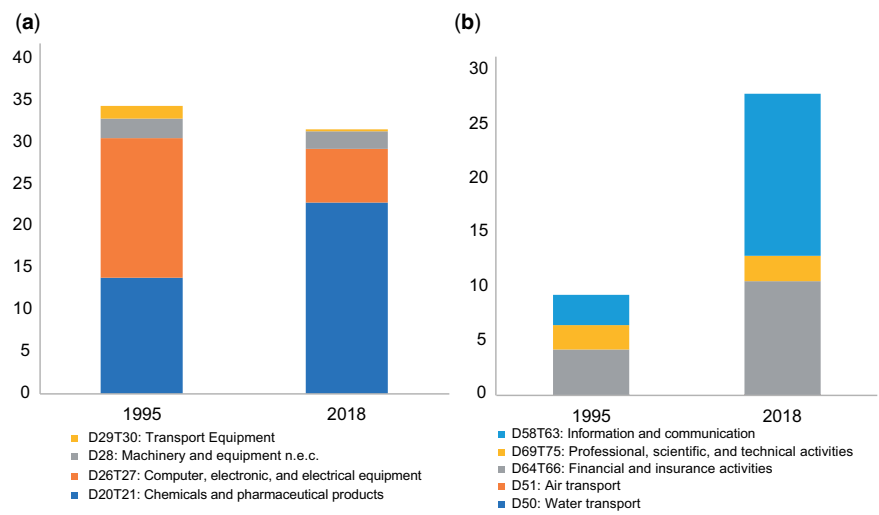



**Figure 2.** Ireland changes in export structure (1995 and 2018). a) High Tech Manufacturing. b) Knowledge Intensive Services

employment data reveal a resurgence in employment levels after 2013, reaching early-2000s levels (refer to Appendix Figure B5).

Returning to Figure 1, and particularly examining Figure 2a and b for Ireland, the two trends observed can be attributed to a long-term capability-building strategy by the government. Both the chemical, pharmaceutical, and ICT manufacturing sectors were central to the initial Technology Foresight Exercise initiated in March 1998 (ICSTI, 1999). This exercise played a pivotal role in Ireland's industrial policy process. It involved collaboration between scientists, engineers, industrialists, government officials and other stakeholders to identify areas of strategic research and emerging technologies that would yield the greatest economic and social benefit and sustain industrial competitiveness (Martin, 1996).

The first technological upgrade of the Irish economy emerged in the 1980s within the Irish 'Silicon Dock', a state-led cluster created around various ICT products (Regan and Brazys, 2018). This endeavor was significantly supported by Enterprise Ireland, a state agency responsible for developing Irish-owned industries through targeted funding, and the Irish Industrial Development Authority (IDA), a key player in an embedded development project that evolved over time (Regan, 2016). Specifically, IDA also played a central role in the government's five-year national development plans. The first five-year plan ran from 1988 to 1993, the second was a six-year plan from 1994 to 1999 and the third ran as a seven-year plan from 2000 to 2006. Such plans bring together different stakeholders (union, employment, chambers of commerce, etc.) to agree on the future strengths to be built in Ireland. Since the 1970s, IDA aimed to establish a high-wage technology cluster by attracting Silicon Valley firms to Ireland: North-American Multinational Corporations (MNCs) were drawn to Ireland due to the presence of specific skills that had been developed through Irish industrial policies, essential for both ICT manufacturing in the 1970s and 1980s and ICT services from the 1990s (O'Riain, 2014).

Although active in targeting the microcomputer industry since the 1960s, IDA's first major success was in 1971 when the Digital Equipment Corporation decided to establish a large-scale mini-computer manufacturing plant in Ireland (van Egeraat and Jacobson, 2004). Three main waves of development ensued (Brazys and Regan, 2017): The first significant achievement was the establishment of Intel's micro-processing plant in Ireland in 1989, which attracted firms like IBM, Apple and Dell. Big MNCs operating in a relatively small ecosystem created positive effects in terms of deepening existing capabilities in both R&D and ICT product manufacturing. The second wave occurred in the 1990s as hardware producers sought countries with lower labor costs. The IDA successfully transitioned from high-tech manufacturing to KIS by targeting new software companies, moving to complementary software and other ICT services where pre-existing capabilities could be leveraged. These MNC-attraction policies, which ensured a stable and growing demand for products, were complemented by supply-side policies promoting R&D investments, such as favorable corporate taxes, R&D grants, access to a young and increasingly skilled workforce, and advantageous banking channels that attracted FDIs (O'Riain, 2014). Among OECD countries, Ireland, along with South Korea, exhibited the fastest rates of increase in R&D spending in the 1990s (O'Riain, 2004). The third wave occurred in the mid-2000s, with well-established capabilities in ICT manufacturing and services showcasing successful transformation and adaptation. While IDA kept targeting firms in the Silicon Valley, other state-led investments took place in setting up very expensive data storage labs, which became a

crucial factor in attracting tech giants like Google, which moved its headquarters to Ireland in 2004, followed by Facebook in 2008 (Brazys and Regan, 2017).

The second major driver of export growth was the pharmaceutical sector (Hilliard and Jacobson, 2011; Barry and Bergin, 2012). Similar to the computer industry, the pharmaceutical sector became a target for FDI attraction by Ireland's IDA in the 1970s. This initial focus was specifically on the fine chemical sector, which benefited from favorable FDI policies, including low taxes, coupled with the availability of reasonably skilled labor at relatively low costs. The plants established in Ireland during this period were primarily subsidiaries of multinational corporations (MNCs) that outsourced lower value-adding segments of the industry by setting up high-volume production facilities, often specializing in the manufacturing of specific active ingredients used in drugs and products.

Starting in the 2000s, recognizing the growing importance of international R&D in the pharmaceutical sector and the increasing reliance on external sources of knowledge, particularly from biotechnology firms, the Irish government implemented a series of supply-side policies. These initiatives were aimed at bolstering national science and technology infrastructure, with a particular emphasis on promoting basic research, notably in the field of biotechnology. This strategic investment was intended to elevate the capabilities within the pharmaceutical sector, facilitating its transition toward more advanced stages of R&D and higher value-adding segments (van Egeraat and Barry, 2009).

For instance, the establishment of Science Foundation Ireland in 2000 marked a significant milestone in this effort, as it was allocated 1.4 billion euros for research in biotechnology, ICT and sustainable energy between 2006 and 2013 (Hannon *et al.*, 2011). Complementing this, Ireland's education policies ensured a steady supply of skilled workers. Public expenditure on third-level education saw dramatic growth from the mid-1960s, and vocationally oriented colleges offered a range of degrees and diplomas in coordination with the needs of the pharmaceutical industries (EGOFS, 2010). Moreover, universities increased the number of PhD students in science and engineering and fostered collaboration with international pharmaceutical companies on basic research projects. This cooperation led to the growth of indigenous campuses and startup firms specializing in pharmaceuticals and biotechnology (O'Riain, 2004). While it is not possible to segregate the exact allocation by sector, the OECD's indicator for government budget allocation for R&D in industrial production and technology reported a substantial 46% increase between 1995 and 2017 (OECD dataset: Government Budget Allocation for R&D). These combined policies empowered Ireland to assume a more prominent role in launching activities, with a growing focus on higher value-adding segments within the chemical synthesis cycles. This expansion encompassed activities related to discovery, product development, clinical trials and active ingredient manufacturing.

### 5.2 Spain

Between 1995 and 2018, and especially before the global financial crisis, Spain experienced substantial growth compared to countries like Italy, France and Germany (Baccaro and Bulfone, 2022). Three significant trends emerge from the Spanish graphs (Figure 3a–c): First, a notable decline in manufacturing exports, particularly in transport equipment and computer, electrical and electronic manufacturing. Second, significant growth in KIS exports, with a strong focus on ICT services (dark blue bar in Figure 3b). Third, the 'servification' of the economy, accompanied by an increase in LKIS (Figure 3c), particularly

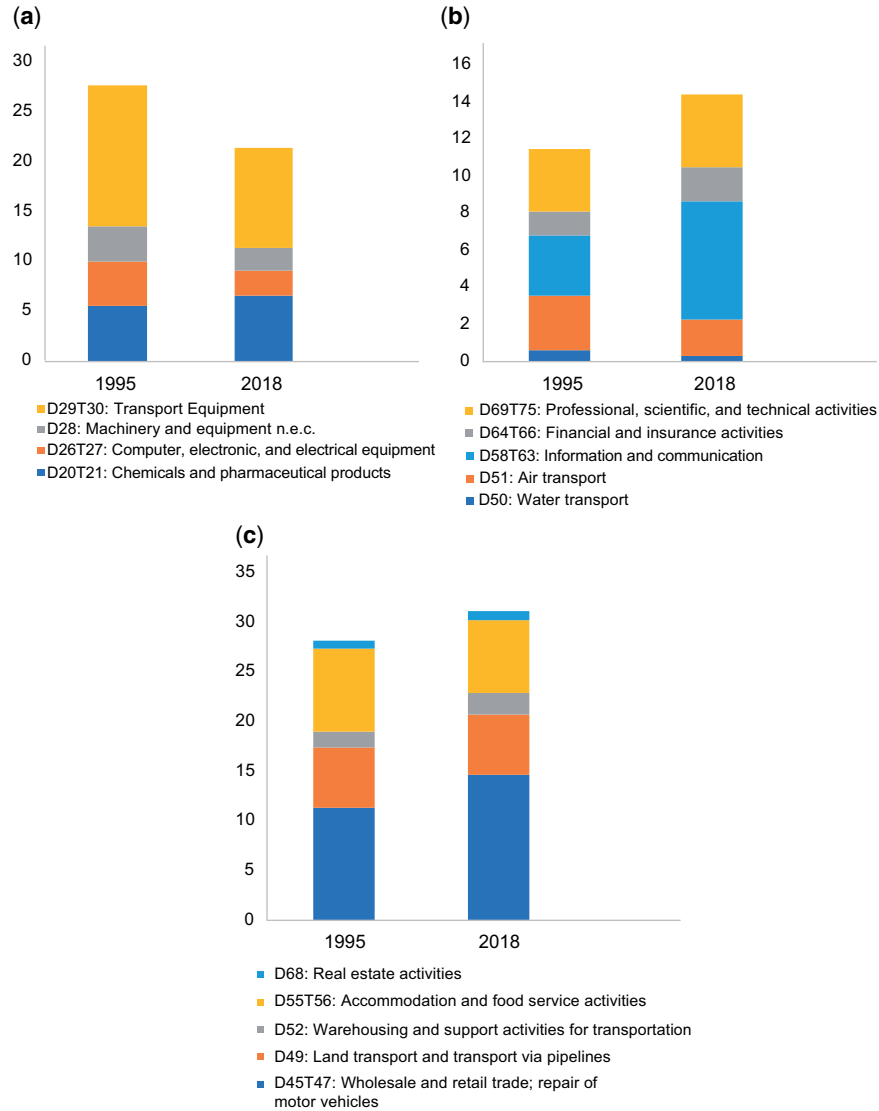



**Figure 3.** Spain changes in export structure (1995 and 2018). a) High Tech Manufacturing. b) Knowledge Intensive Services. c) Less Knowledge Intensive Services.

in Wholesale and retail trade, repair of motor vehicles (D45–D47), and Warehousing and support activities for transportation (D52).

The shift of the Spanish economy toward services was attributed to a form of peer coordination between its public and private institutions (Calvo, 2014*a*,*b*). This non-hierarchical configuration was based on complementarities between the public and private sectors, which aimed to sustain and expand the service sector, particularly through the strategic role

of Telefonica. However, this political coalition was unable to protect the manufacturing sector from increasing foreign competition due to its inherent lack of productivity growth and stable capital. European integration further exacerbated the challenges faced by Spanish manufacturing as new member countries, characterized by lower labor costs and sufficient technological capabilities, quickly engaged in medium-high manufacturing activities. Given its strong specialization in supplier-dominated sectors, which were characterized by small and labor-intensive firms, the Spanish economy was highly vulnerable to price-based competitiveness (Di Berardino and Onesti, 2021), contributing to a significant drop in manufacturing output (Calvo, 2014*a*,*b*). In the production of more sophisticated goods, such as ICT manufacturing goods, Spanish firms operated behind the efficiency frontier and had not developed strong capabilities, as indicated by their high reliance on imported input technologies, which hindered the sector's full development (Rico González, 2006).

In the 1980s, the Spanish government decided to transfer significant portions of manufacturing firms to foreign ownership. One of the most notable examples of this was the automotive and component industry, including the transfer of SEAT to Volkswagen in 1986 (Šćepanović, 2020). By relinquishing these sectors rather than investing in their potential as 'elevator sectors', such as automotive and ICT, the government effectively 'locked' Spain into low-technology manufacturing, thereby preventing positive spillovers to local firms and other sectors.

Nevertheless, various state-led activities aimed to counterbalance this approach, particularly by focusing on national champions in banking, construction and utilities. The building of a leadership role in global telecommunication services is closely linked to the Spanish government's support for Telefonica through a range of supply-side and demand-side policies. On the demand side, the government acquired golden shares in the company and retained them until 2005. It also delayed the domestic liberalization process in the telecom sector, thus postponing privatization, while promoting internationalization in Latin America (Abraha *et al.*, 2016). On the supply side, the government exerted significant pressure on domestic banks to support Telefonica financially (Bulfone, 2020), adding to the company's already strong investment capacity based on monopolistic capital accumulation (López, 2003). These demand-side and supply-side policies greatly contributed to its market expansion (Calvo, 2014*a*,*b*).

Furthermore, the government also stimulated the demand side through public procurement, favoring local firms by extensively allocating telecommunication licenses (Calvo, 2014*b*). The positive results of these policies are reflected in the composition of KIS exports. The information and communication class (NACE 58-63) nearly doubled in size, driven by the growth of telecommunication services (D61) and computer programming, consultancy and information services activities (D62–D63). These segments received consistent R&D investments from major operators like Telefonica (Perez, 1997). To confirm the effectiveness of these policies, the OECD indicator for government budget allocation for R&D in transport, telecommunication and other infrastructure increased by 88% between 1995 and 2017 (data from the Government budget allocations for R&D, OECD indicator).

However, unlike Ireland and Sweden, Spain did not successfully transform into a KIS-led export economy. In 2018, the share of DVA in KIS exports accounted for 14% of the total export, compared to 20% in Sweden and 29% in Ireland. Conversely, LKIS in 2018 represented 31% of Spain's total exports, in contrast to 21% in Sweden and 12% in Ireland [Appendix Figures B2(a)–B4 (b)]. The historical significance of the ICT manufacturing

sector in Spain did not facilitate a full reorientation of its export strategy toward ICT service exports due to the lack of pre-existing capabilities.

Instead, the Spanish government pursued an alternative development path through the State-Owned Enterprise Telefonica, which became a leader in international and domestic telecommunication services. Thus, Spain reconfigured its position within transnational value chains: While capturing the highest value-adding segment of telecom services, especially through Telefonica, the government also contributed to the repositioning of manufacturing industries lower down the value chain. For example, the automotive sector shifted toward lower value-adding segments of production, including LKIS such as motor vehicle repair and warehousing and support activities for transportation.

### 5.3 Sweden

Sweden embarked on a rapid shift away from the manufacturing sector and toward ICT services starting in the early 2000s, driven by strong global market demand. Swedish manufacturing production for telephones, radios, television and other electronics increased from 11% of total exports in 1990 to 24.7% in 2000 (Erixon, 2011). Figure 4a illustrates that the decline in the manufacturing sector is correlated with a decrease in computer, electronic and electrical equipment production. Figure 4b reveals a greater reliance on services, with increased financial and insurance activities, professional services and ICT services. ICT and telecommunication industries, both products and services, were pivotal to Swedish growth in the 1990s and 2000s (Erixon, 2011). They made substantial contributions to the growth of R&D and labor productivity (Edquist and Henrekson, 2017).

Indeed, ICT manufacturing served as an elevator sector, contributing to rapid capabilities accumulation that, in turn, fostered labor productivity growth in related sectors such as software development, telecommunication services and logistics. This was achieved through

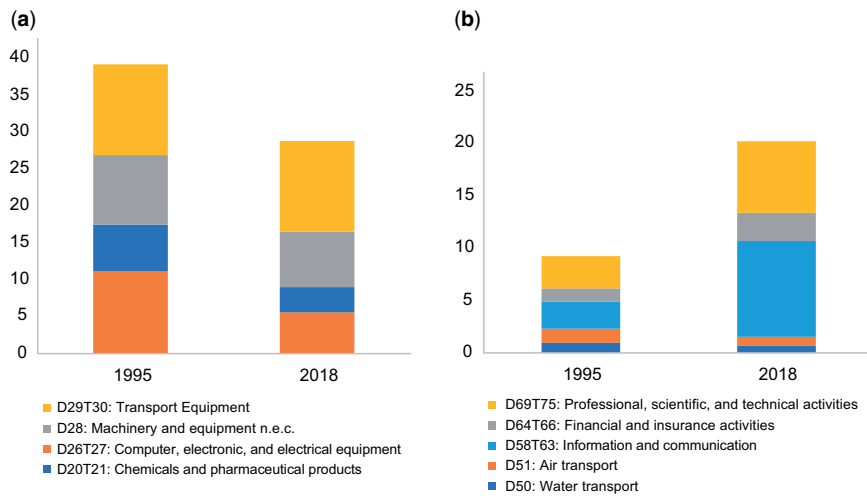



**Figure 4.** Sweden changes in export structure (1995 and 2018). a) High Tech Manufacturing. b) Knowledge Intensive Services.

the substitution of ICT inputs for labor and the dissemination of ICT knowledge (Erixon, 2001).

In driving this transformation, both business elites and policymakers played significant roles. Swedish business groups responded to market pressures by reorganizing their portfolios and leveraging their capabilities developed in the computer and electronic sectors to enter high-end services, particularly in ICT and professional services (Thelen, 2019). Among these, Ericsson played a central role in facilitating this transition, functioning as an organizational and technological hub within the ICT sector and between new and traditional industries. Behind Sweden's impressive recovery from the crisis of the early 1990s lay an interventionist state that was instrumental in promoting structural change (Schnyder, 2012).

Education supply-side policies were central to Sweden's industrial strategy. The 'knowledge lift program' implemented between 1997 and 2002 was highly successful, involving 10% of Sweden's workforce (Albrecht *et al.*, 2005). This program aimed to enhance the skills of the lowest strata of the workforce through measures such as upper-secondary courses, vocational training and work placements (Schnyder, 2012). Government expenditure on higher education saw substantial growth. In 1990, Sweden allocated 5.3% of its GDP to education, which increased to 7.4% by 2000. This expansion was most pronounced in higher education, where the ratio doubled from 1% to 2% (Steinmo, 2010).

Sweden also revamped its VET systems in the 1990s to provide more firm-specific skills (Gibbons-Wood and Lange, 2000). Complementing investments in education, the government significantly increased gross expenditure on R&D from 2.8% in 1981 to 3.75% in 2008. This made Sweden the only European country to allocate more than 3% of its GDP to R&D (Schnyder, 2012).

Other supply-side policies included providing temporary financial aid and administrative support to encourage the formation and growth of SMEs. The venture capital market adapted rapidly to accommodate SMEs, with the government directly providing public funds to venture capital firms. Additionally, the government established various channels to provide start-ups with capital and services (Månsson and Landström, 2006). Although most of the policies were on the supply side, demand for ICT services was never a problem for Sweden, whether from the private or public sectors, for two main reasons. First, Sweden was able to access the export market for ICT services due to the enduring presence of Swedish MNCs engaged in ICT equipment production, which positions Swedish ICT manufacturing at the forefront of R&D investments. As an example of the R&D activities at the university level, there has been an increase of 10% in R&D in engineering and technology between 2010 and 2018 (OECD dataset: Government Budget Allocation for R&D) (Edquist and Henrekson, 2017). Second, Sweden has a long tradition of public procurement for innovation, particularly in ICT services. For instance, the successful computerized switching telephone network developed by AXE, a semi-public company, resulted from the collaboration between the Swedish Telecommunication Administration as a user and the private manufacturer LM Ericsson as a producer (Edquist and Zabala-Iturriagagoitia, 2012).

By targeting pre-existing capabilities, the Swedish government was also able to foster the creation of niche markets. For instance, through supply-side policies like the establishment of innovation centers and grants for knowledge creation, the city of Malmo emerged as a central hub for new media industries, encompassing a broad range of activities at the intersection of ICT, media content, video games, apps and music (Power and Jansson, 2004; Martin and Martin, 2017). Similarly, local and regional governments recognized

opportunities for expanding capabilities in the music and ICT industry in Stockholm (Power and Jansson, 2004) and in the new media and ICT industry in Scania (Martin and Martin, 2017).

Like the case in Ireland, although with the notable difference that Sweden historically had successful domestic companies such as Ericsson, Swedish ICT services benefited from investments, expertise, and capabilities accumulated in ICT manufacturing. This 'new' path of development resulted from an endogenous branching process within existing firms, which possessed high-tech capabilities across the entire production spectrum (R&D and manufacturing) and gradually diversified into technologically related fields (Martin and Martin, 2017).

## 6. Conclusion

This article elucidates the role of industrial policies in developing and deepening technological capabilities within and across sectors to explain shifts in national export structures. The descriptive analysis presents the export trajectories of eight selected Western European countries between 1995 and 2018, particularly focusing on how they transitioned to new, higher value-adding sectors (Figure 1). Based on the extent and quality of these changes, we selected Ireland, Spain and Sweden for an in-depth analysis of how supply-side and demand-side industrial policies contribute to export structural change. These case studies illustrate that the state is, to some extent, constrained by the presence or absence of technological capabilities when implementing industrial policies.

In our case studies of Ireland and Sweden, we demonstrate that structural changes toward specific high-value adding sectors were encouraged by the state following a continuity with pre-existing capabilities. In Ireland, long-term policies paved the way for the development of the ICT sector since the 1970s. Favorable tax policies were complemented by a mix of policies led by the IDA, which ensured a stable demand for labor, production and innovation activities due to US multinational companies, while also providing a skilled labor force and an innovative ecosystem through supply-side policies. In Sweden, the strong core of capabilities in the manufacturing of computer and electrical equipment, built in the 20th century and constituting the Swedish 'elevator sector', as well as the critical complementarities between state and business actions, proved essential to foster endogenous branching processes, where existing firms slowly diversified into technologically related sectors. The transition from high-technology manufacturing to ICT services was accompanied by industrial policies supporting the transition. Although big domestic companies provided an endless source of demand for ICT products, often complemented by public procurement, the Swedish government engaged more heavily in supply-side policies with a specific focus on labor force and R&D promotion.

In Spain, the government led a substantial change in the productive structure, moving away from existing capabilities in the manufacturing sector, which were not sophisticated enough to sustain an upgrade. Leveraging the infrastructure and market power of the former state monopoly Telefonica, the government employed a series of policies, mainly on the demand side with public procurement and a strong international expansion in Latin America, to transition toward ICT services, especially in telecommunications. Simultaneously, it contributed to the expansion of low-value-adding industrial services as a result of the 'downgrading' of manufacturing along the transitional value chain.

Our findings make a valuable contribution to the ongoing academic debate within the CPE literature regarding the sectoral specialization of various growth models, as discussed by Baccaro and Pontusson (2019) and Thelen (2019). Additionally, our work enriches the emerging discourse on the significance of industrial policy in shaping changes in productive structures, as explored by Brazys and Regan (2017), Bulfone (2022) and Garcia Calvo (2021). Specifically, our research builds upon recent studies by Gräbner *et al.* (2020*a*,*b*) that highlighted the role of capabilities in influencing export performance. However, Gräbner *et al.* primarily measured these capabilities at the national level and utilized them to support a path-dependent argument regarding export trajectories. Our article extends these insights by demonstrating how technological capabilities, or their absence, impact the selection and design of industrial policies, drawing on concepts from the innovation literature (Mazzucato, 2011; Chang and Andreoni, 2020). Furthermore, our work illustrates how such policies can contribute to the deepening of existing capabilities or the development of new ones by intervening on either the demand side or the supply side of the sectoral innovation process, as discussed by Adams *et al.* (2011) and Malerba (2005).

Importantly, our article proposes a complementary perspective, rather than an alternative one, to existing explanations within the CPE framework regarding shifts in productive structures. While coalitional politics involving business, state elites and labor undeniably influence industrial policies (Brazys and Regan, 2017; Garcia Calvo, 2021) or give rise to new production alliances (Thelen, 2019; Baccaro and Pontusson, 2022), our findings reveal that technological path-dependence can both constrain state actions and create opportunities for policies that alter a country's trajectory of export specialization. The nature of state actions varies across countries, influenced by numerous factors beyond the scope of this article, including the type and role of business elites, fiscal and monetary constraints, cultural and institutional history. These factors can impact the selection and implementation of specific policy tools. Future research should delve deeper into these variations in the role of the state, potentially identifying clusters of countries with similar patterns, and explore how these align with different types of growth models.

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## Appendix A

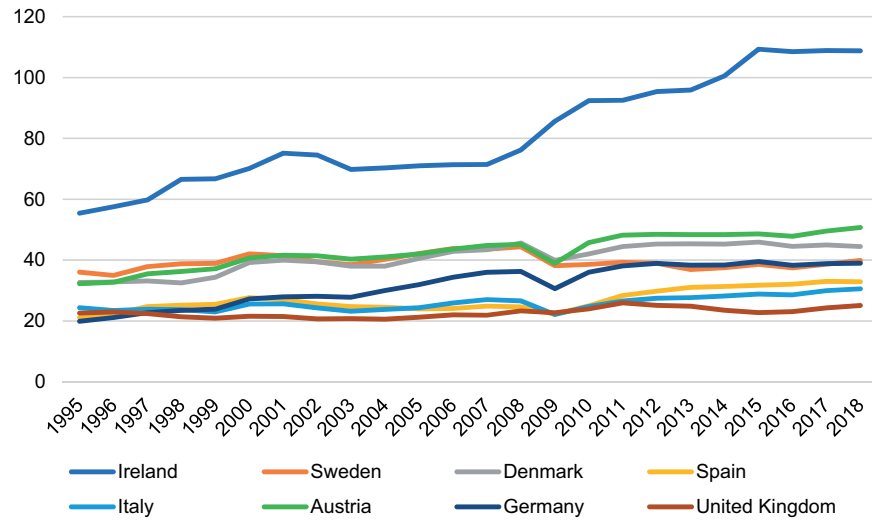


**Figure A1** Total export as % GDP.

*Source*: Authors based on OECD and World Bank for GDP. Data for GDP are taken for all countries from the World Bank indicator GDP (current prices).

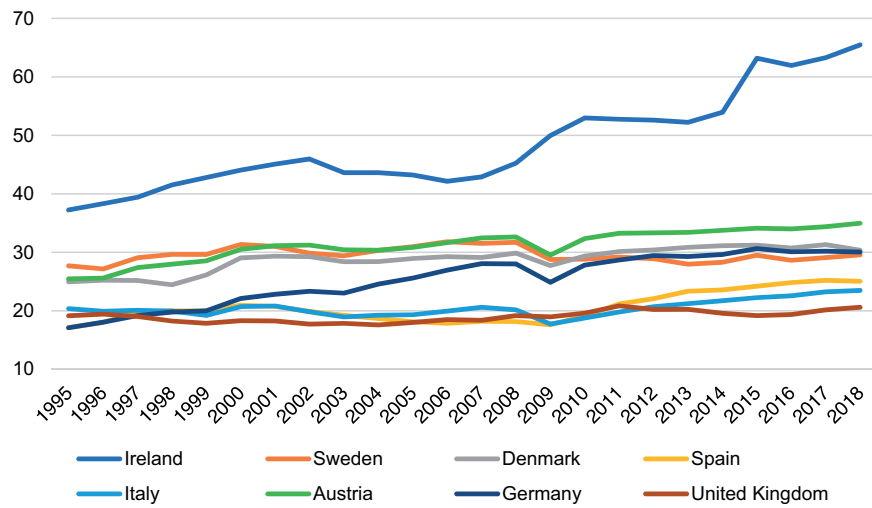


**Figure A2** DVA export as a % of GDP.

*Source*: Authors based on OECD and World Bank for GDP. Data for GDP are taken for all countries from the World Bank indicator GDP (current prices).

## Appendix B

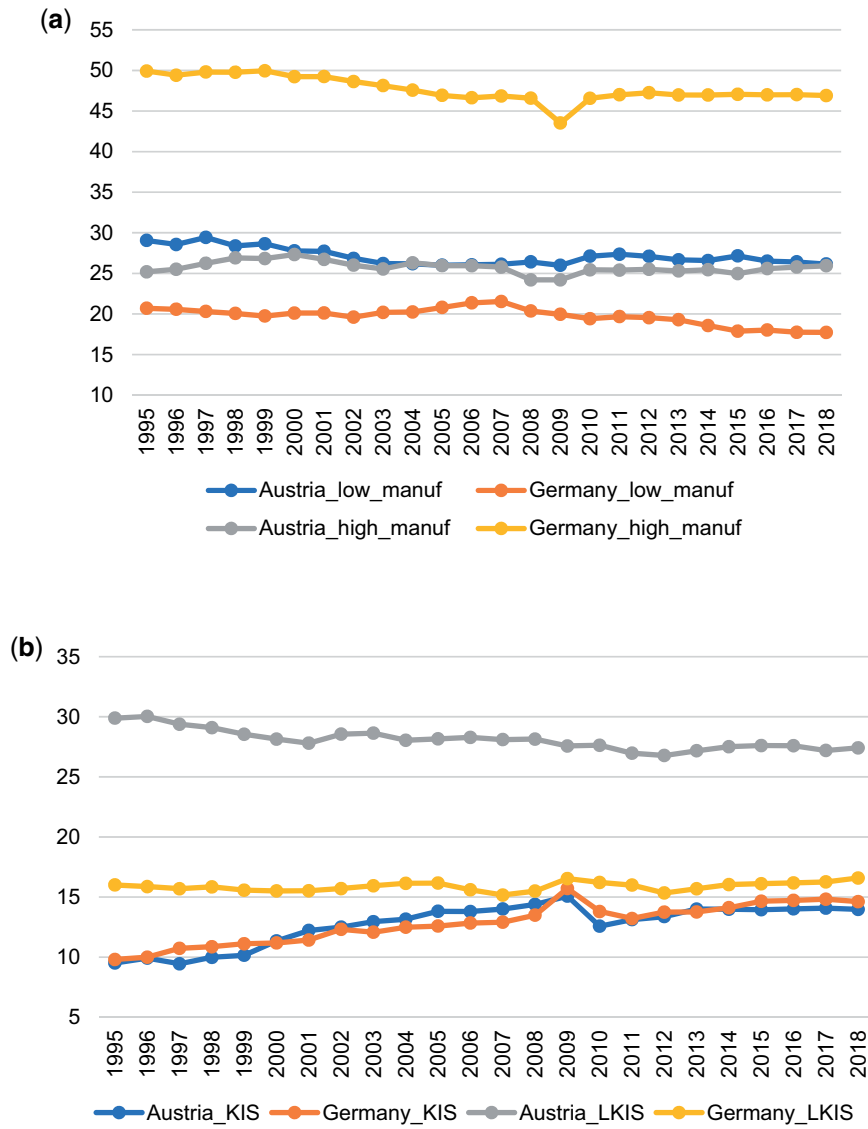


**Figure B1** Austria and Germany manuf/services export as % total export. (a) Manufacturing. (b) Services.

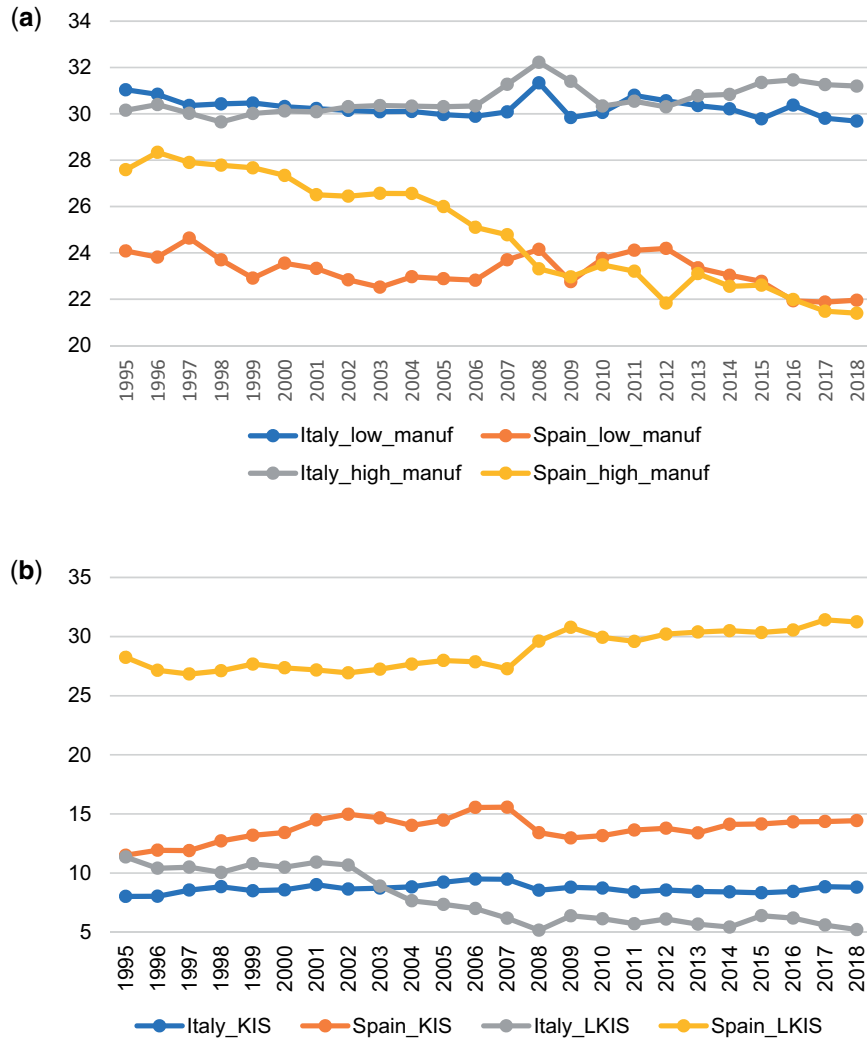


**Figure B2** Italy and Spain manuf/services export as % total export. (a) Manufacturing. (b) Services.

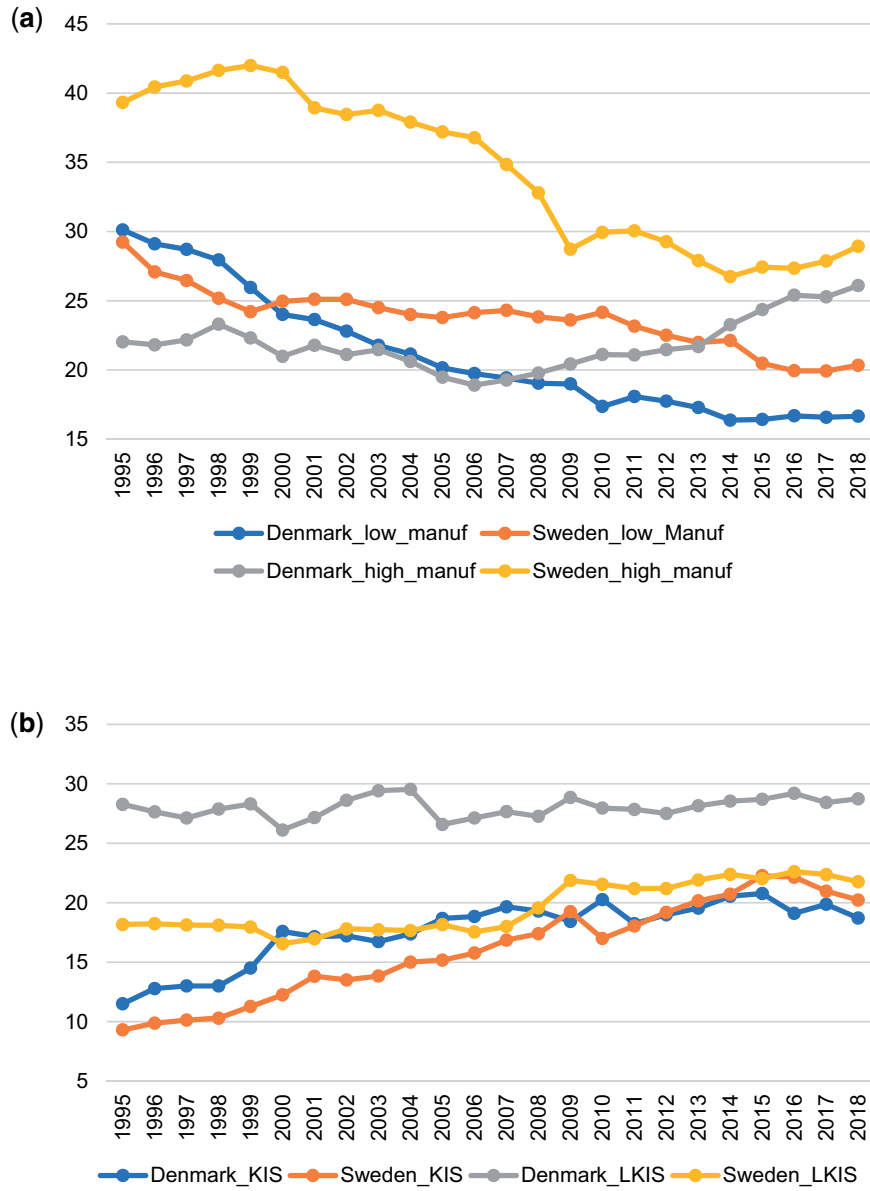


**Figure B3** Denmark and Sweden manuf/services export as % total export. (a) Manufacturing. (b) Services.

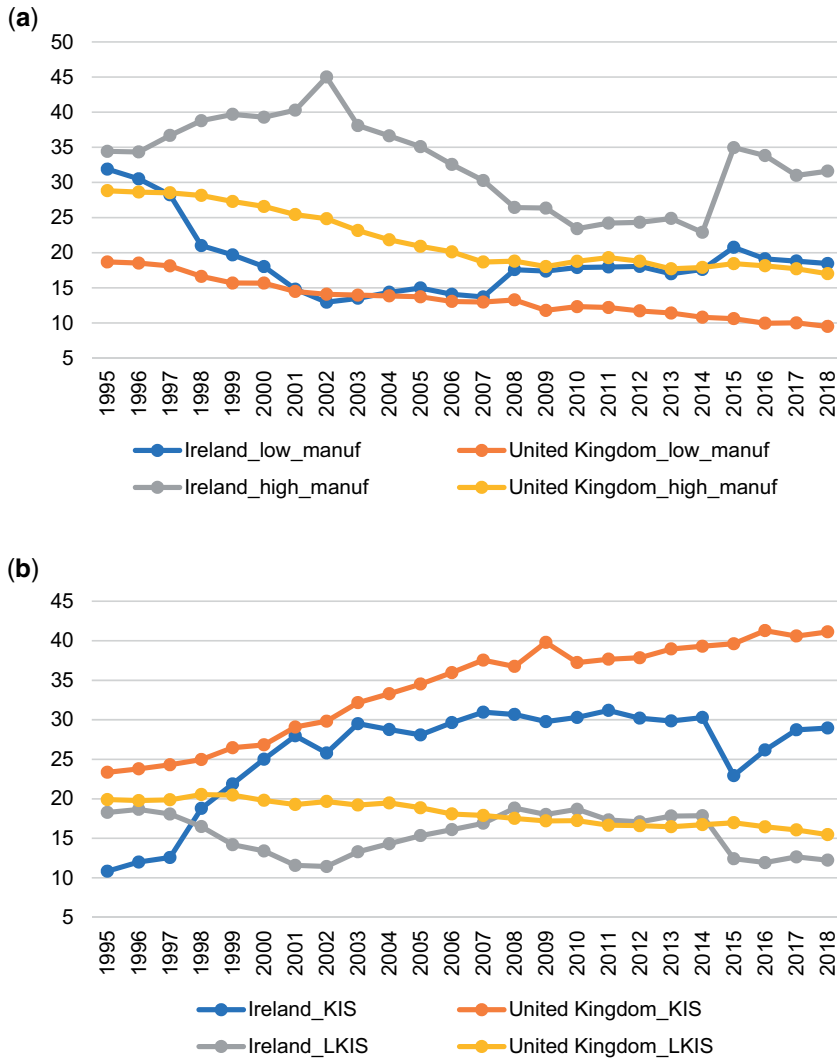


**Figure B4** UK and Ireland manuf/services export as % total export. (a) Manufacturing. (b) Services.

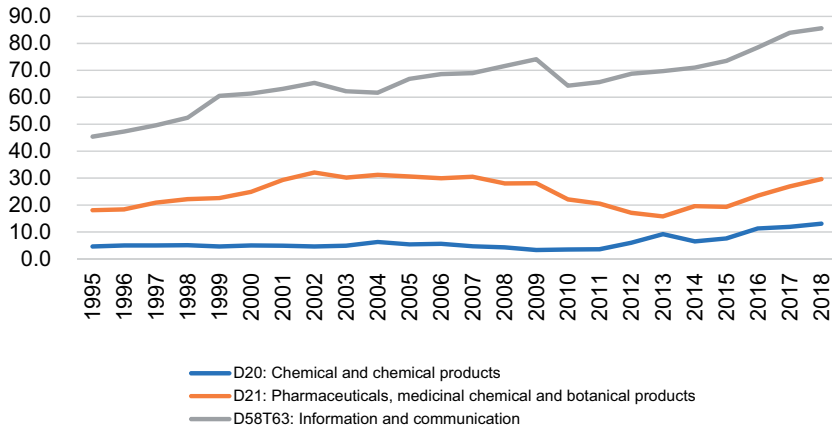


**Figure B5** Evolution of the employment by sector (persons, thousands).
*Source*: TIM data OECD, 2021 ed.

## RCA

In order to provide a quantitative check of our analysis, we calculated the RCA of the three countries at the core of our analysis (Ireland, Sweden and Spain) in selected sectors where our case studies point to important shifts. Table 3 presents the RCA in 1995 and in 2018. The index is calculated as follows:

$$\mathrm{RCA} = \frac{\mathrm{Xij}/\Sigma \mathrm{k}\ \mathrm{Xkj}}{\Sigma \mathrm{l}\ \mathrm{Xil}/\Sigma \mathrm{kl}\ \mathrm{Xkl}}$$

where the numerator measures the export in country j in the commodity i by the sum of all exports by country j, divided by the result of the sum of all exports in commodity j divided by all world export. Since we are using OECD data, our sample intends the world as made by 66 countries (including all major economies: OECD countries, EU and G20 countries and most East and Southeast Asian economies).