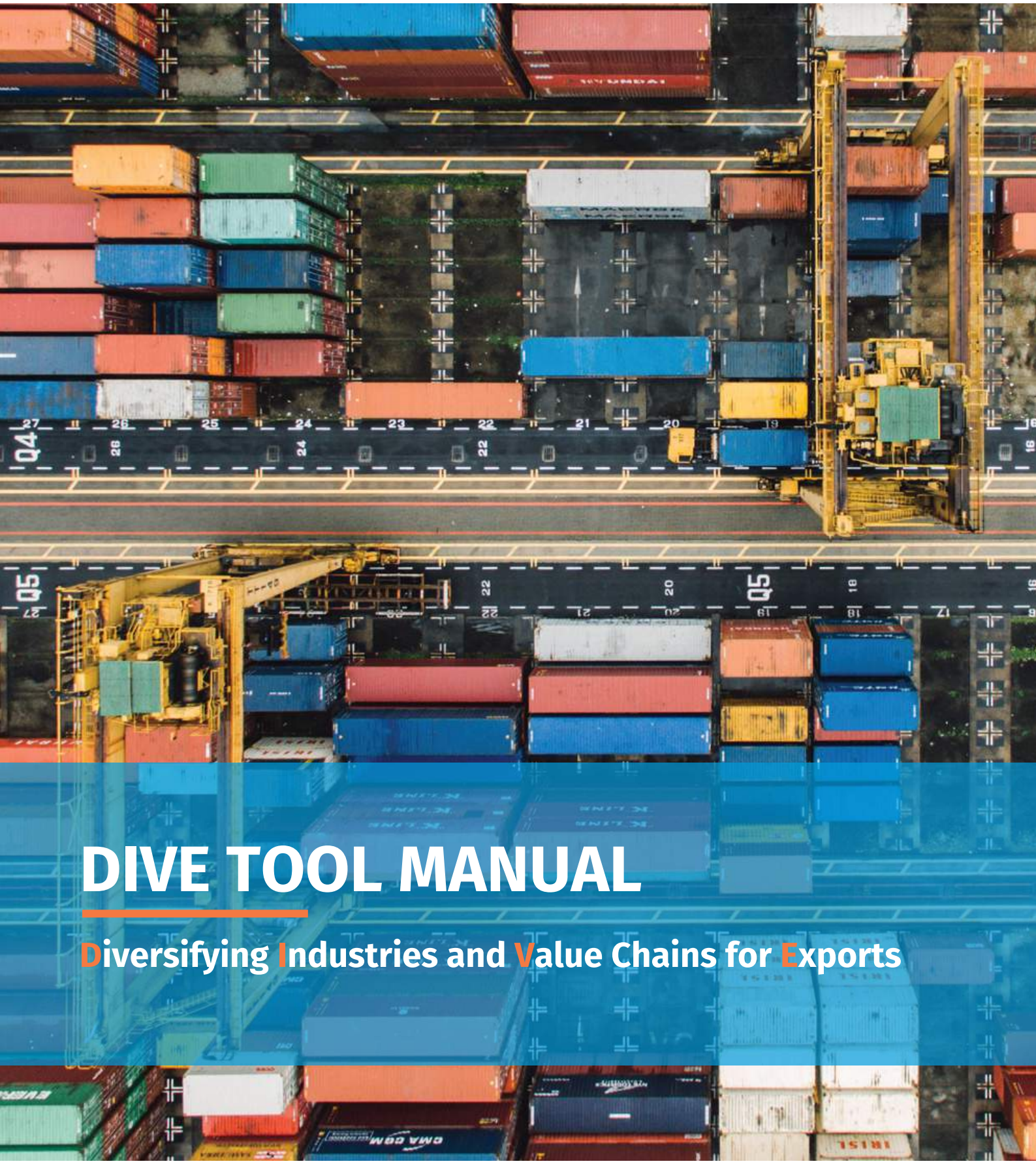
UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

SUSTAINABLE DEVELOPMENT GOALS



DIVE TOOL MANUAL

Diversifying Industries and Value Chains for Exports

Acknowledgements

This manual summarizes the findings of an industrial policy research project funded by UNIDO and led by Nicola Cantore in collaboration with Michele Clara. It was prepared by Nicola Coniglio and Davide Vurchio of the University of Bari (Italy) and edited by Niki Rodousakis (UNIDO). The layout was designed by Ahmed Osman (UNIDO and University of Bari). This work would not have been possible without the invaluable feedback and comments of UNIDO colleagues.

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FOREWORD

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The importance of economic diversification

The set of products an economy specializes in reflects its production capabilities and more importantly, influences the success of its development pattern. Low-income countries tend to specialize in a limited bundle of products, primarily in the agricultural or natural resources sector, which are produced in—and exported to—many other competing countries (ubiquitous products). Advanced economies, on the other hand, are usually specialized in the production of a highly diversified set of products, namely high value-added products, which are usually present in the export bundle of a relatively small number of countries. Economic diversification assumes a central role in developing countries' policy agenda in their effort to address the challenges of globalization and improve their economy's resilience. It is widely accepted that diversification reduces countries' vulnerability to internal and external shocks. A more diversified economy—in particular the manufacturing sector—is also more conducive to structural change. A broader and differentiated set of productive capabilities can be recombined to develop new or improved products, thereby contributing to enhanced long-term economic performance.

The manufacturing sector plays a decisive role in shaping the economic development of low- and lower middle-income countries as endorsed by the United Nations Sustainable Development Goal 9 (SDG 9) "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". The Lima Declaration identifies industrialization as the driver of development - it increases productivity, creates jobs and generates income, thereby contributing to poverty reduction and the achievement of other development goals. In addition to supporting the economic *take-off* of Least Developed Countries (LDCs), strong and diversified manufacturing capabilities proved decisive for mitigating the pandemic's economic impacts: according to the SDG Report 2022, global manufacturing has rebounded from the pandemic, but this does not hold true for LDCs, which continue to struggle at levels far below their pre-crisis levels.

The UNIDO DIVE tool (Diversifying Industries and Value Chains for Exports): A novel approach to informing diversification policies

While there is strong consensus on the need to promote diversification, there is far less agreement on how to design and implement diversification and industrial strategies. One fundamental requirement for a successful policy is an analysis of the current productive landscape, in particular the features of the country's existing export and production basket and its dynamism. Such an analysis is a prerequisite for outlining potential paths for industrial development. The main objective of UNIDO's DIVE tool, which is presented and described here, is to provide strategic guidance that will contribute to the design of production and export diversification policies.
The key question we address is which direction an economy should take and specifically, whether it is desirable to exclusively diversify into new products that rely on the set of capabilities that are already available and linked to existing endowments (*related products*) or whether on the contrary, it is feasible to develop new specializations in products that have limited similarity with the country's existing production structure (*unrelated products*). Whether to aim for '*short jumps*' by pursuing specializations in related products or '*long jumps*' by promoting the development of a comparative advantage in unrelated and more 'distant' products, is a fundamental component in policy design, which has often been explored but with little empirical guidance and rigour.

Our novel approach is based on a comprehensive analysis of the degree to which potential new specializations, i.e. products that are not part of the country's export or specialization basket, could be developed in the near future, even in countries that currently do not possess the necessary set of productive capabilities (as proxied by the existence of related products in their export basket that use similar capabilities). We define products as '*path-dependent*' if—based on an analysis of world trade data of the last 25 years—the development of a new specialization in that product is only likely to occur if the country is already specialized in related products that 'share' similar production capabilities. The main implication from a policy perspective is that a diversification policy is unlikely to be successful if an economy's products are highly path-dependent, unless that country is also specialized in related products. In other words, what a country currently produces and exports matters when defining feasible paths towards future diversification based on path-dependent target products.

On the other hand, a large number of potential products is '*path-departing*' or '*path-defying*', i.e. specialization in these products is possible, even in countries with an initially unrelated export basket. Contrary to recent approaches, which a priori define 'unrelated diversification' as unfeasible—hence discouraging ambitious policies that target 'long jumps'—our approach suggests that countries could successfully pursue unrelated, path-departing products; in fact, these new specializations might be desirable to broaden the country's set of capabilities, thereby boosting economic performance. Long jumps over the production space are not rare events and in most cases create new opportunities for subsequent structural transformation (see Coniglio et al., 2021).

Key elements of the DIVE tool

A. Current specialization: how diversified is the economy? How vulnerable is the economy's current specialization?

The first component of the DIVE tool provides detailed and novel information on a country's current export basket, i.e. the products in which the country has a revealed comparative advantage (i.e. 'specialization'). The analysis of 'where we are at' is fundamental for assessing 'where can we possibly go' in terms of the country's diversification strategies. One fundamental concept in this first component is 'vulnerability'. We develop a product-level index of vulnerability that measures how 'easy' the development of a specialization in a given product is, i.e. the product's (revealed) entry barrier or contestability. We use data on the product's level of path dependence and the frequency of new export specializations in the world economy in the given product over the last 25 years. The index of vulnerability is computed at the country level to provide a synthetic assessment of how contestable the country's export basket is in terms of its specialization. The higher a country's level of specialization in products with a low entry barrier, the more vulnerable its export basket is to international competition. Such information provides useful guidance for policymakers and a rationale for introducing diversification policies.

B. New entries in the export basket: How dynamic are countries in the global economy?

The second component of the DIVE tool assesses a country's diversification performance by exploring 'new entries' in the country's export basket over the last 20 years. New entries are defined as products characterized by a (non-temporary) export surge or as a new specialization in products that were not exported with a revealed comparative advantage in the preceding five years.

We provide both quantitative (type, number and size of new exports) and qualitative data (level of path dependence, vulnerability, level of sophistication of new exports) on new entries in the export basket. This information is condensed in a country-level measure of the country's ability to perform 'long jumps' or to develop specializations in products that are unrelated with its initial export basket. This represents an index of structural dynamism.

C. Directions for future diversification

The policy actions of a country that decides to actively promote diversification policies and prioritize specific products/sectors should target all potential options (i.e. all products that are not in the export basket). Different criteria and strategies will likely inform and guide these policy strategies. The DIVE tool identifies diversification options that consider the level of 'capability similarity' with the country's current economic structure; the potential dynamic of new specializations; the extent to which the development of a product is constrained by the set of available capabilities; the relative advantage compared with other countries that are at the same stage of development, and the degree of vulnerability (i.e. the extent to which a new specialization is contestable once developed). Such information, which varies from country to country, serves as input for the diversification decision process which cannot be implemented in an automated way.

The third component of the tool helps identify alternative targets with heterogeneous degrees of desirability and feasibility for 'short jumps' (products that require capabilities that are likely already available) or for 'long jumps' (products that are unrelated with the country's current export structure and that require capabilities not yet available). The selection criteria can be used flexibly in accordance with the country's specific strategies. The tool adds a new dimension of analysis for diversification strategies as a broad set of products exists that have a high propensity to enter a country's export basket, are unrelated to it but still feasible policy targets.

The structure of the manual

This manual introduces the DIVE diversification tool in a simple and straightforward way and presents the preparatory information as well as the main metrics 6 provided to policymakers seeking advice. It also provides an example of all the information that can be collected, new metrics to evaluate the country's propensity to diversify into path-departing products and the degree of vulnerability of its current set of specializations.

The manual is structured as follows. *Chapter 1* introduces the framework; *Chapter 2* presents the methodological aspect of our analysis; *Chapter 3* provides an example country (Morocco) and lastly, we present final remarks.

CHAPTER 1

THE ROAD TO DIVERSIFICATION: THE CURRENT DEBATE

1.1 Comparative advantage, diversification and structural change

The concept of comparative advantage, which drives a country's specialization, was initially developed by economist David Ricardo in his renowned work of 1817 "On the Principles of Political Economy and Taxation". It has since become a cornerstone of international trade theory. The concept of comparative advantage has been linked to the cost of production of goods that are traded internationally, reflecting the relative efficiency of trading economies in producing and selling a specific good or service to the rest of the world. The concept of comparative advantage is crucial for identifying the set of goods a country is specialized in, i.e. its export basket. In his seminal contribution published in 1965, Bela Balassa introduced the concept of *Revealed Comparative Advantage (RCA)*, namely an index based on which an economy's relative advantage in producing a certain product or class of products can be computed using international trade data.

In its most widely used formulation, the Balassa index of RCA of economy c in the production of good i is given by the ratio between the relative value of exports of good i over country c's total exports (the country's export share of product i) and the relative value of exports of good i over global total exports (world export share of product i). Values lower than 1 reflect a country's disadvantage in the production of the product while values higher than unity reflect a country's relative advantage in the production of that product. The index is capable of proxying an economy's underlying structure since it allows us to identify which products the economy is specialized in. We refer to this as its 'export basket'.

In line with previous studies, we define an export basket, i.e. the set of products in which a country has a specialization in as reflected[1] in the country's RCA. Moreover, using export data, we analyse how export baskets change over time or[2] rather we identify 'new entries' in the export baskets of all countries in recent decades. One of the major novelties of the DIVE tool is the assessment of the level of "path dependence" of these new product specializations. Path dependence, in line with the literature on economic diversification, refers here to the existence of a pattern that is strongly influenced by the set of pre-existing endowments/skills/technologies (more generally, a country's capabilities).

In a path-dependent diversification strategy, newly introduced activities are inherent to the existing production specialization. By contrast, path departure (or path defiance) refers to cases in which a new economic specialization is characterized by the presence of production capabilities that are not strictly related to those already available in the country.

1.2 The pattern of diversification: Short or long jumps?

Production and export diversification have always been desired objectives endorsed by both policymakers and scholars around the globe, since a lack of economic diversification is often associated with higher long-term economic vulnerability (OECD/WTO, 2019). Diversification is not only about reducing vulnerability; existing evidence demonstrates that an expansion of the set of products a country is specialized in triggers a structural change process, and more importantly, induces sustained growth and development (UNIDO, 2016).

It is widely agreed that economies need to diversify, but which specific diversification pattern developing economies should follow has been the object of study for decades by both economists and historians. The debate has been inspired since the 1960s with contributions by Rostow and Gerschenkron, with the former introducing the *Stages of Economic Growth* model[3] and the latter theorizing about the existence of advantages in countries' relative 'backwardness'. [4] More recently, industrial policy has gained new significance in policymakers' agendas, and several schools of thought propose different models and theories. Among others, the approach of New Structural Economics (NSE) emphasizes the significance of the market in resource allocation and recommends governments to play a facilitating role in supporting firms in the process of industrial upgrading by addressing externality and coordination issues. By proposing a framework to conceptualize governments' facilitator role in industrial upgrading and economic diversification, NSE rejects conventional import substitution strategies that aim to distort a country's economic structure by promoting high-cost, advanced capital-intensive industries that are inconsistent with the country's manifest or latent comparative advantage.

1. We identify products according to the Harmonized System (HS) nomenclature, Rev. 1992.
2. We adopt the BACI dataset provided by CEPII.
3. According to Rostow's 1960 model, all countries must complete a 5-step process to become developed. These stages are: i) traditional society; ii) society with pre-conditions to grow; iii) society in take-off mode; iv) maturity of society, and v) mass-consumption society.
4. Gerschenkron's theory postulates that the more 'backward' a country is, the higher the alternative options of missing "unrewarding preconditions" for industrialization.

This view of the evolution of the economic structure contributed to the pivotal debate of two development experts, Justin Yifu Lin and Ha-Joon Chang, namely their 2009 Development Policy Debate entitled "*Should Industrial Policy in Developing Countries Conform to Comparative Advantage or Defy it?*". According to Lin, one of the main promoters of the NSE approach, an optimal industrial structure is endogenous to a country's endowment structure; the State plays a facilitating role to (gradually) encourage the emergence of industries which, once launched, will effectively use the economy's current comparative advantage by reinvesting the economic surplus (which is expected to be higher because the industrial structure is now optimal for the given endowment structure). On the other hand, while agreeing with the positive role State intervention can play in promoting industrial upgrading, Chang asserts that a country's comparative advantage, although important, is no more than a baseline for understanding how much a country is sacrificing by protecting its infant industries. Accordingly, a country should defy its comparative advantage if it is to upgrade its industry. The concept of industry upgrading—which does not always mean economic diversification—as an engine of growth is rooted in the idea that sustained growth necessarily implies a structural transformation of the economy (Kuznets, 1966). For years, such upgrading, consisting of vertical innovations, has been interpreted as a non-immediate process.

It is widely accepted that a push of the economy towards a specialization in goods with a higher level of productivity generates a dynamic process of growth; gains from globalization are higher in countries that specialize in goods that are more *sophisticated*.[5] In this context, what you produce and export matters for subsequent growth, and if a country is not able to specialize in goods associated with a higher level of productivity, it is because entrepreneurship activity is suboptimal, and policymakers are failing to push the economy towards more productive and sophisticated products. Hence, if efforts are required to 'push' the economy towards the production of increasingly sophisticated goods, a crucial question arises: should policies be aimed at engineering the production of goods that are 'similar' but slightly more sophisticated (i.e. associated with a higher level of productivity) than what is already being produced? Or should policies be aimed at more ambitious targets, i.e. products that have less in common with the country's current production and export basket? In other words, should diversification and industrial policies be aimed at 'short or gradual jumps' or at 'long jumps'?

5. Hausmann and Rodrik (2003); Hausmann et al. (2007).

To address these important and policy-relevant questions, several studies focus on the role of relatedness and local capabilities as drivers of economic diversification—both at the regional and country level—and many have found inspiration in the concept of the network representation of relatedness between goods (*the Product Space*). They therefore advocate the desirability of short distance or path-dependent jumps within the production network.

1.3 The Product Space approach

The work of Hidalgo et al. (2007) "The Product Space Conditions the Development of Nations" is a seminal and influential contribution to the debate on industrial policy. Building on network analysis, the authors highlight the role of path dependence in the process of quality upgrading and place the product space and the relatedness between products at the centre of their analysis.

The product space is a network representation of all goods traded worldwide in which every product is linked to others according to its "*relatedness*". Goods that are closely 'related' to each other within the network have a high probability of being co-exported (and hence co-produced) with a significant comparative advantage. According to Hidalgo et al. (2007), a high relatedness between products implies that the set of capabilities required to produce them largely overlap. This set of shared capabilities might be rooted in the intensity of labour, land or capital required, in the level of technological sophistication, in the inputs or outputs involved in the product's value chain or in the institutions required to produce specific goods.

This logic infers that if an economy has the necessary institutions, labour, land and capital together with a sufficient level of human capital and technology to specialize in a certain good, it should be relatively easy for the economy to produce and export related goods. The policy-relevant result is that related products that are not yet being produced or exported are expected (with a high probability) to enter the export basket in the future. All of these aspects can be synthetically represented by the concept of local capabilities, with capacity literally meaning "power or ability to do something". In this context, however, it includes all non-tradable (and not easily measurable) characteristics that allow a firm rooted in a region or country to be able to produce a certain good. Changes in a country's specialization over time are associated with the pattern of relatedness across products. As the export mix of an economy changes, there is a strong tendency to move towards related goods rather than to goods that are less related.

The 'relatedness map' thereby obtained can be used to analyse the development of a productive structure together with an international specialization. Interestingly, developing economies tend to be located in the periphery of the network while advanced countries usually export goods that are highly connected and represented in the product space's core (where there are typically also more sophisticated products). Important policy considerations can be derived from this map. It is quite difficult for producers to acquire comparative advantages in products located far away in the product space. Accordingly, policies aimed at promoting long jumps in the production space are quite challenging and have a higher probability of being unsuccessful or failing.

Studies that are strictly related to the key concept developed by the product space (PS) analyse the role of economic complexity[6] according to which a country's position in the PS reflects the locally available capabilities. World economies can be interpreted as "buckets of building blocks". Productivity is intrinsic in the diversity of localized capabilities such as property rights, regulations, infrastructure or specific labour skills. Differences in income can be explained by economies' ability to position themselves in the PS. Empirical results indicate that the measures of complexity are positively correlated with level of income, and deviations from this relationship are predictive of future growth.

The key message of the "capability approach" for policymakers is to set modest goals - *long jumps* across the PS have been very rare in the past and may prove difficult to achieve. This theoretical approach calls on policymakers to favour "quick wins", leveraging available production capacities that have largely determined the country's comparative advantage considering that "[i]t is quite difficult for production to shift to products far away in the space, and therefore policies to promote large jumps are more challenging" (Hidalgo et al. 2007, p. 487). This rather mechanical approach to industrial and diversification policy inspired by the PS framework has recently been challenged by new evidence, in particular by studies which—rather than simply assuming it—measure the actual degree of path dependence in the development of countries' comparative advantages. This new evidence is discussed below.

1.4 A critical view of the product space approach: Long jumps are not rare events!

Several studies adopted the PS framework to investigate whether new entries are more closely connected to the economy's pre-existing structure; whether a nexus exists between path dependence and economic performance; and which sectors to select to outperform in the mid- to long run. In a recent article published in the *Journal of International Economics*, Coniglio et al. (2021) test the validity of the framework at the global level for the period 1995–2015. Their study generally confirms the hypothesis of path dependence, but also finds that a non-negligible number of new specializations developed in the world economy are unrelated to pre-existing export baskets.

The share of new products in a country's export basket that defy its initial comparative advantage amounts to at least 39 per cent of total export baskets. Although this finding generally supports the PS approach according to which countries diversify by building on their existing capabilities, the flip side of the coin is that unrelated diversification is far from being an unlikely event. The share of long jumps is higher for relatively more developed economies because they are less constrained by their initial export baskets owing to their broader sets of capabilities, skills and know-how, all of which favour path-defying diversification. Notable examples have been widely discussed among policymakers and include the cases of Brazil's aeronautical industry and the Republic of Korea's high-tech and capital-intensive industries. The analysis confirms that the emergence of unrelated specialization is more widespread than commonly believed.

As mentioned at the beginning of this chapter, the main reason why economic diversification is advocated in both academic and policy circles is that it can lead to economic growth and hence, human development. Coniglio et al. (2021) suggest that countries that are able to diversify their economies towards unrelated products achieve better economic performance. On the other hand, a high degree of path dependence is associated with lower growth rates. This relationship is particularly marked in low-income countries. One final conclusion is that adhering to the PS's main policy suggestion to promote 'short jumps' might not only overlook the fact that 'long jumps' frequently occur even in developing economies (in other words, are feasible diversification targets), but might also be conducive to weaker economic performance.

6. Research stream pioneered by Hidalgo and Hausmann (2009) and Hausmann and Hidalgo (2011).

CHAPTER 2

MEASURING STRUCTURAL VULNERABILITY, DYNAMISM AND IDENTIFYING DIVERSIFICATION TARGETS

2.1 How do we measure country specialization? Identifying export baskets and new specializations

In line with the majority of literature on export specialization, we rely on export data to identify the economic structure of countries engaged in trade. To define the set of products that belongs to each country's export basket, we use the BACI trade database (CEPII) at the HS 4-digit 13 disaggregation to determine which products are exported with a Revealed Comparative Advantage (RCA) higher than unity.[7]

As trade data are characterized by high volatility, we only include products that are exported with an RCA larger than unity over a longer period. More precisely, the product must have been part of the country's export basket for at least two years since its initial entry. Using export data from 1995 to 2019, we identify the set of products economies are specialized in and track their dynamism from 1995 to 2017. [8]
The country-year export baskets are used as a baseline to investigate whether new specializations are related (or not) to the country's pre-existing comparative advantage five years earlier. Following Hidalgo et al. (2007), we compute the degree of relatedness between each pair of products (the PS) – a measure of how often pairs of goods are co-exported.[9]

We adopt a series of criteria to avoid labelling sporadic and irrelevant episodes of export booms as "new entries" (both in absolute and relative terms) . Specifically, we aim to identify products as new specializations for which i) the average export value increased in absolute terms; ii) the Balassa index is consistently above unity; iii) the country had a relatively low degree of specialization in the product (i.e. low RCA) prior to the product's entry in the export basket. Additional details on the criteria adopted are available in Appendix A. Based on these criteria, we identify approximately 7,000 new entries—or export surges—in countries' export baskets for the period 2000–2019.

2.2 The diversification space or option set

The diversification space, labelled as the *option set* (OS), is the country-time-specific bundle of products that represent potential specializations that have not yet been developed. The OS represents the bundle of potential new entries for each country and year of analysis. In the tool, these products are also used to i) measure product-level path dependence – from the OS, we compute counterfactual relatedness upon which the path dependence threshold is computed (see methodological details in Coniglio et al. (2021)); ii) create a set of potential diversification strategies reported in the last part of the manual.

2.3 Measuring relatedness, path dependence, path departure and vulnerability

As reported in Section 2.1 and in Appendix A, our concept of relatedness relies on the definition developed by Hidalgo et al. (2007), i.e. the probability that a country is specialized in the export of a product usually implies that it is simultaneously also specialized in the export of another good. The higher this probability, the higher the degree of similarity in the knowledge/skill/factor endowments required to produce the two different products. In our approach, we compute the relatedness between a new entry (and all potential new entries, i.e. products in the OS) and the pre-existing export basket.[10] We consider the most related product in the export basket, which in our opinion captures the essence of similarity in local capabilities and path dependence as a measure of relatedness.[11]

2.3.1 The product-level index of path dependence (or path departure)

The product-level index of path dependence (or the opposite index of path departure) provides information on the degree to which products classified under the HS 4-digit trade classification (1241 products in total) are related (or unrelated in the case of path departure) to the set of products a country is already specialized in at the time they enter the export basket. This information is crucial from a policy perspective, as strong path dependence implies that it is unlikely that the country can develop a new specialization in that product, unless it is already specialized in related products; in other words, what a country produces today strongly influences how feasible it is to develop a new specialization.

7. For details, see Appendix A.
8. The time interval ends in 2017 as more information for the period 2017–2019 is needed to classify stable export specializations.
9. The measure is given by the minimum of the pairwise conditional probability of being in an export basket at the same time. We compute year-specific networks of relatedness, i.e. a non-static PS that represents the dynamics in the degree of similarity between products' capabilities.
10. We define relatedness as the maximum value derived from all possible pairwise proximities between the new entry (or product in the OS) and products included in the export basket.
11. For the robustness of the analysis, Coniglio et al. (2021) apply alternative measures of relatedness – for instance, average proximity between a new entry and ALL products in the export basket. Their analysis reveals that the results are qualitatively similar. The use of the maximum level of proximity is preferred as being more consistent with the theoretical idea of 'shared productive capabilities' between products.

On the other hand, if a product is characterized by low path dependence (or high path departure), the current set of capabilities—as expressed by the country's current export basket—does not really affect the development of a specialization in that product. We measure product-level path dependence (or departure) in a highly intuitive way. Suppose a given product, say "Electrical boards" (HS 8537), entered the export basket of countries a given number of times over the last two decades; how can we determine whether these entries are path-dependent or not? We compute the actual proximities between electrical boards (HS 8537) and the export baskets of those countries where this particular product developed as a new specialization, and compare the resulting average proximities with a counterfactual one, which represents the proximities we would find if those countries had developed a specialization in products drawn at random from their individual option sets. Based on this strategy, we can assess the extent to which the entry in export baskets of each of the 1241 products traded in the world (HS 4-digit classification) is related to countries' pre-existing export baskets compared to a counterfactual that includes all products that might in principle enter their option sets. In line with the choice of counterfactual relatedness, we develop three different measures of product path dependence (or path departure). Details are reported in the following box and in an accompanying technical paper.

2.3.2 Frequency of new export specializations

Is specialization in the production of 'Motor vehicles; parts and accessories' (HS8708) as frequent as in 'Articles of apparel and clothing accessories, of leather or of composition leather' (HS4203) or 17 'Petroleum gases and other gaseous hydrocarbons' (HS2711)? There are good reasons to believe that the answer is 'no', as the production of certain goods is likely to be largely constrained in the short- and medium term by the set of existing capabilities (capital, skilled labour, knowledge, institutions, etc.), and sometimes even in the long term (e.g. for mineral resources that need to be available within the country's borders). The direct implication of this consideration is that products enter a country's export basket with an RCA (new trade specializations or 'export discoveries') with highly heterogeneous frequency. The emergence of new trade specializations depends on two factors: i) geographical diffusion of the capabilities necessary to produce those products (ubiquity/ scarcity), and ii) 'ease' in obtaining or generating the required capabilities.

Some products are more likely to enter countries' export baskets, either because the necessary production capabilities are 'ubiquitous' (i.e. available in most countries around the world) or/and because the production of these goods is not severely constrained by currently existing capabilities. Some goods are likely to be produced using 'rare' production capabilities or are constrained by the requirement of a highly specific ecosystem of capabilities. We complement our analysis by measuring how frequently countries develop a new trade specialization in a specific product. We thereby identify products for which a new trade specialization is a 'rare' or 'frequent' event. The frequency of new trade specializations delivers valuable insights that are policy-relevant as products that many countries develop a comparative advantage in are likely to have a low 'entry' threshold in terms of required productive capabilities – especially when combined with a high index of path departure. By contrast, 'rare' specializations—especially when combined with a low index of path departure—are difficult targets of diversification policies because the required set of production capabilities is rare and not easily reproducible. The frequency of new entries is computed by first identifying them in the global economy for the period 2000–2019 (see Section 2.1) and aggregating them at the product level. Each product in the HS 4-digit classification entered different countries' export baskets 8.8 times on average during the period analysed (standard deviation 5.5). We find that no country developed a new comparative advantage in the 58 products that entered countries' export baskets between 2000 and 2019. The maximum number of new entries was 32 for HS4 7801 *Lead refined unwrought.*

2.3.3 Product-level index of vulnerability

To understand the extent to which specialization in a product is associated with a high degree of vulnerability due to new potential competitors—and consequently, to better understand a country's degree of vulnerability—we combine three different elements:

BOX 1

Three alternative measures of product-level path departure

To measure the degree of path departure associated with the entry of the 1241 products in countries' export baskets that were traded in the world between 1995-2019, we develop three alternative metrics that differ from the OS on the basis of the 'counterfactual' distribution of relatedness. Two of these are computed using the degree of the relatedness of new entries with the OS's average proximity while the third considers the entire distribution of products in the OS. We compute the average proximity of products in the OS for each country and year to the pre-existing export basket in three alternative ways:

A. Relative distance from threshold

a) This figure determines how distant (or unrelated) the entry of a product generally is from the threshold representing the average relatedness of all products that might enter the export basket ex-ante (i.e. those belonging to the OS). To determine the extent to which each of the products traded globally is path-defiant, we develop an index based on the relative distance between new entry relatedness and the country-time-specific threshold computed from the products in the OS. More specifically, the index of path departure of product *i* in country *k* at time *t*(ipd_{ikt}) has a positive value if the product is unrelated to the pre-existing capabilities. The higher the value, the higher the degree of path departure. We generalize such product-country-time-specific indices by averaging them across countries and obtain a product-time-specific index of path departure (IPD_{it}). For example, the most path-dependent product in the most recent years is HS 6110 "Sweaters, pullovers, sweatshirts etc., knit" while HS 9013 "Liquid crystal devices" is the least path-dependent product.

B. Share of path-defying new entries

This alternative metric provides an alternative quantitative dimension of product-level path dependence and labels the share of products as either path-departing or -defying. A new entry is path-departing if its relatedness to the pre-existing export basket is lower than the threshold. This provides us with the qualitative information of path defiance (or path dependence) that can be measured in a dichotomic manner. We generalize the product-country-time-specific dichotomic information by computing a product-time index that determines how often a product enters in a path-breaking way(d_IPD_{it}).

C. Average percentile

This metric offers a comparative perspective on path departure, indicating in which percentile of the unrelatedness distribution of all potential products (computed from the OS) the new entry apears. The closer the index is to 1, the higher the new entry's level of path-departure (the highest compared to all products belonging to the OS). To obtain an overall value for each product *i* in each time *t*, we compute product-time averages $av\_perc\_dep_{it}$.

1. ***The frequency with which countries acquire a comparative advantage in the given product (see previous section***). We take the distribution of the frequency of new entries and assign the relative percentile within this distribution to each product and normalize the percentile in the interval [0,1]. This information allows us to measure the degree of contestability of a product specialization;
2. ***The degree of new entries' product-level path departure (the opposite of path dependence) is a proxy for the relevance of previously acquired production capabilities for the development of a comparative advantage.*** The degree of path departure, with values in the interval [0,1], is computed as introduced at the end of Section 2.3.1, and measures the average position of products with respect to the OS relatedness distribution.
3. ***The number of countries with a comparative advantage in the given product (a measure of the ubiquity of specialization in the product).*** We take the distribution of these values and assign the relative percentile within this distribution to each product and normalize the percentile in the interval [0,1]. This information allows us to measure a different but complementary dimension of the degree of competition for a product specialization.

Methodological details on how the three dimensions are accounted for are provided in Appendix A.

2.4 Country index of structural vulnerability

We define and measure country-level structural vulnerability by relating it to the country's current export basket with a product-level index of vulnerability as described above, weighted by the relative importance of the products (i.e. the share of product *i* in total trade of country *k*). A high level of structural vulnerability suggests that a country is specialized in highly vulnerable products, i.e. in products that are likely easily contested by competitors. A low level of structural vulnerability, on the other hand, suggests that a country is specialized in products that rarely enter other countries' export baskets and when they do, their high level of relatedness plays a fundamental role in limiting the number of countries with a latent comparative advantage in those products. Among developed countries, Japan, Ireland, the Republic of Korea and Singapore show particularly low levels of structural vulnerability. This also applies to countries such as China, Malaysia, the Philippines and Madagascar. Not surprisingly, countries that rely heavily on the export of a few products—such as Algeria, Nigeria, Qatar and Venezuela—have a high index of structural vulnerability.

2.5 Country index of path departure

We measure the degree to which countries diversify away from their initial export basket by employing a weighted average of the product-level indexes of path departure as described above. A high level of path departure suggests that a country's new entries are largely unrelated products, i.e. long jumps over the PS (see Appendix A for additional details).

2.6 Country index of structural dynamism

The degree of an economy's dynamism over a given time interval can be quantified by looking at how many new products were added to its export basket as well as at the extent to which such new entries diverge from the path. Our tool provides metrics that take these two dimensions into consideration. The country index of path departure is computed as a weighted average of the products' degree of path departure (using the percentile method) while the number of new entries in an economy's export basket is normalized by ranking all countries' frequency of entry. Details are provided in Appendix A.

2.7 Identifying country-specific opportunities for diversification: A new tool

The ultimate goal of diversification policies is to broaden the country's PS, i.e. to increase the number of products a country is specialized in. Countries in the world are, on average, specialized in 129 products of a total of 1241 products contained in the HS4 trade classification; in other words, the potential set of diversification is equivalent to 90 per cent of the products that are traded in the world economy. Some countries have a highly diversified economy (e.g. China, Italy, Germany and Spain), while others have an export basket that is concentrated in a few products only (e.g. Angola, Chad and Equatorial Guinea), but the choice set of target products is relatively broad for all countries. Which products should policies target? The answer to this question depends on the country's specific goals as well as on the feasibility of alternative strategies. The traditional approach developed by Hausmann et al. (2007) suggests that countries should give priority to 'related' products; in other words, they should focus on 'short distance jumps' over the PS since these are feasible and realistic diversification opportunities.

Our approach suggests that this strategy is not necessarily the most desirable one from a growth perspective. Our analysis shows that 'relatedness' only matters for products with a high index of path dependence, i.e. products for which the initial set of capabilities is fundamental for acquiring a comparative advantage. Countries also specialize in long distance jumps over the PS as well. In fact, the initial relatedness—as discussed above—does not matter less for a relatively large set of products. The capabilities required to develop a comparative advantage in these products are likely to be ubiquitous and relatively 'easy' to generate or acquire in countries that do not initially possess them. In the case study on Morocco reported below—and more generally using the DIVE tool—we identify four sets of country-specific opportunities for diversification:

Short jumps with high path dependence and many competitors

- These are products that belong to the country's potential diversification space (OS), which have a *high degree of path dependence*, i.e. for which initial capabilities do matter and which are characterized by a high degree of relatedness with the country's export basket. In addition, we apply two criteria: i) a positive *relatedness gain* (or advantage), a condition that ensures that the country has a higher level of relatedness to the product than other countries at a similar level of development, and ii) *a large number of countries that already have a specialization in the product* (above the median).

Short jumps with high path dependence and few competitors

- These are products that have the *same features as those described above but have a limited number of competitors* or countries with a comparative advantage in that product.

Long jumps with high path dependence, low relatedness and relatedness advantage

- These are products in the country's potential diversification space that have a *low degree of path dependence*, i.e. for which initial capabilities matter less, and that are characterized by a low degree of relatedness with the country's export basket. In other words, these are products that are located far away from the country's export basket. Such products are of particular interest in terms of diversifying away from the current comparative advantage (but are typically excluded from the standard PS approach).

In this case, we also use the existence of a *positive relatedness* gain as an additional criterion, which suggests that the country has a higher relatedness to the product than other countries at a similar level of development.

Long jumps with low path dependence, high frequency of new entries and few competitors

- These are products in the country's potential diversification space that have a *low degree of path dependence* and a *high observed frequency of entry*. The combination of these two features suggests that low initial relatedness is not a constraint for the development of a specialization in the product. In fact, we find that many countries —even those with an unrelated initial specialization—acquired a comparative advantage in the product. Such products might be of high interest as a policy target, provided that they possess other characteristics (e.g. complexity, positive spillovers, strategic sectors) which make them desirable for the country.

CHAPTER 3

APPLICATION OF THE DIVERSIFICATION TOOL: THE CASE OF MOROCCO

3. The case of Morocco

In this chapter, we provide a concrete example and apply the DIVE tool to a developing country, Morocco. We selected this lower middle-income country because of the interesting features of its specialization pattern. Morocco has experienced robust export growth in recent decades, which has involved different sectors and products. Between 1995 and 2021, which saw Morocco double its per capita income (from USD 3,820 to USD 7,413 at constant 2017 international dollars), the country's export value of goods and services quadrupled (from USD 11.09 billion to USD 42.49 billion at constant 2015 dollars, reaching a pre-COVID peak of USD 46.68 billion). These developments, which accompanied the structural change of Morocco's economy, resulted in the addition of 57 new specializations to the country's export basket from 1995–2019. Morocco's economy is characterized by a diversity of products ranging from agriculture, textile, electronics, chemicals to vehicles. In 2019, agricultural products represented 21.35 per cent of Morocco's exports; textiles accounted for 17.61 per cent. Moroccan exports in electronics, chemicals and vehicles accounted for 17.42 per cent, 16.20 per cent and 16.17 per cent, respectively. This reflects the evolution of the country's economic structure towards more sophisticated and complex products.

Our analysis informs the formulation of policies aimed at igniting the process of structural change. In Section 3.1, we present Morocco's specialization/diversification trends in recent decades to highlight the country's main trends and policies and assess the country's current export basket with a specific focus on its structural vulnerability indicators. In our analysis, the country is benchmarked against other countries at a similar level of development. In Section 3.2., using the product-level metrics developed and discussed in Chapter 2, we analyse Morocco's diversification opportunities. We focus on different sets of products the country has the potential of developing a specialization in. In line with Section 2.7 above, we define 'short jumps' as products that are not yet part of Morocco's export basket but which are related to its current specialization and for which it possesses a latent as well as a relative advantage compared to countries at a similar level of development. We consider the potential of new export products for which relatedness matters, namely those products for which countries rarely acquire a comparative advantage, unless they possess the necessary set of capabilities.

We also define a set of target products for Morocco that represent 'long jumps' over the PS for which—based on the methodology developed by Coniglio et al. (2022)—we observe that relatedness plays only a limited role in explaining new entries in the world economy. Although these products are less related to Morocco's current export basket, they might still provide interesting and feasible patterns for future diversification.

3.1 Recent patterns of specialization in Morocco: An overview

Level of income: Low middle-income

Morocco has a diversified export basket, reflecting two and a half decades of structural change. The economy was initially specialized in agriculture and textile products (accounting for 31 per cent and 29.1 per cent of exports in 1995, respectively), which evolved into an example of a dynamic developing country. By 2019, the bundle of exported products ranged from agriculture, textile, electronics, vehicles to chemicals, with shares ranging from 16.17 per cent to 21.3 per cent. The export of vehicles is a case in point: export shares skyrocketed from 0.46 per cent in 1995 to 16.20 per cent in 2019, with the initial value of the country's exports increasing by 175, while the value of total exports rose threefold compared to 1995. To gain a better understanding of Morocco's export basket, we look at its level of sophistication using the methodology developed by Hausmann et al. (2007). This metric, which can be computed for individual products as well as for countries' export bundles as a weighted average, provides a measure of the level of productivity/complexity associated with the country's exports. High values for product sophistication (**ProdY**) are found for goods that are usually exported by high-income countries. High values for export sophistication (**ExpY**) are attained by countries specialized in products that are usually exported by high-income countries (or products with a high **ProdY**). In the period 2017–2019, Morocco registered an index of product sophistication equal to USD 12,830.88, a value that was higher than 43 per cent of world economies. While still far from the world's average value of USD 15,063.60, Morocco's level of export sophistication is 16.7 per cent higher than the average of lower middle-income countries (USD 10,991.15).

Table 1: Top 10 products in the export basket – selected indicators

HS code	HS description	Product sector	Exports in 2019 (thous. $)	Balassa Index	ProdY (2017-19)	countries with product in EB (2017-19)	LMI countries with product in EB (2017-19)	nr NEs (1995-2019)	nr Nes in LMI countries (1995-2019)	% of Pdep new entries	Index of vuln.
8703	Cars	Vehicles	$ 3,914,639	2.77	$ 22,141.82	26	2	8	2	100	0.590
8544	Insulated electrical wire	Electronics	$ 3,752,545	15.93	$ 9,091.47	40	11	13	6	100	0.749
3105	Mixed fertilizers	Chemicals	$ 2,706,330	62.28	$ 11,248.56	37	6	14	5	93	0.758
2809	Phosphoric acid etc.	Chemicals	$ 1,482,250	198.85	$ 4,134.68	11	3	2	1	0	0.420
6204	Women's suits and pants	Textiles	$ 1,390,826	11.72	$ 7,715.08	48	18	6	4	100	0.640
2510	Natural calcium phosphates	Minerals	$ 1,174,763	202.60	$ 6,684.34	18	5	3	1	0	0.489
702	Tomatoes	Agriculture	$ 827,730	50.13	$ 6,216.08	33	10	11	2	64	0.722
8803	Parts of other aircraft	Vehicles	$ 750,643	4.40	$ 23,266.07	22	3	11	4	18	0.744
1604	Prepared or preserved fish	Agriculture	$ 723,630	22.18	$ 8,630.45	44	16	10	4	90	0.738
810	Other fresh fruit	Agriculture	$ 575,083	17.67	$ 12,239.29	42	12	12	5	100	0.755

Notes: EB = export basket; NEs = new entries in the export basket; LMI = Low middle-income countries (World Bank classification); Pdep = Path dependence

Table 1 presents the top 10 products in Morocco's export basket in the most recent years of our analysis. The list above includes products from six different industries (vehicles, electronics, chemicals, textiles, minerals and agriculture), highlighting an extraordinary level of diversification for a country at Morocco's level of development. 'Cars' (HS 8703) are the country's main export, with an export value slightly below USD 4 billion in 2019, followed by 'Insulated electrical wire' (HS 8544) and 'mixed fertilizers' (3105), amounting to USD 3.7 billion and USD 2.7 billion, respectively. Taking the extent of product specialization (Balassa index) and the product level of sophistication (ProdY) into consideration, Morocco demonstrates very high levels of specialization in products with a relatively low degree of sophistication—the highest levels for the Balassa index are recorded for two of the least complex goods in the list, namely 'Phosphoric acid' (HS 2809) and 'Natural calcium phosphates' (HS 2510) —and weaker specializations in sophisticated products—Balassa indices equal to 2.77 and 4.40 for 'Cars' and 'Parts of other aircraft' (HS 8803), respectively. These results show that Morocco's export basket has been consolidated while it has increased its level of sophistication on account of relatively new specializations in the automotive industry. Among the top 10 products in Morocco's export basket, the least vulnerable (see Section 2.3.3) are 'Phosphoric acid' and 'Natural calcium phosphates'—despite their high level of path departure (% of path-dependent new entries equal to 0)—with an index of vulnerability equal to 0.42 and 0.49, respectively.

Despite a high level of path dependence, 'Cars' have a significant degree of vulnerability since their index of 0.59 is higher than the value of 65 per cent of products. Six out of the first ten products in Morocco's export basket are relatively vulnerable specializations: values higher than 0.72 are associated with the products in the tenth decile of the vulnerability indices' distribution. Table 1 also presents information on the degree of competition (number of countries with the given product in their export baskets and the number of new entries in the period considered) for each product in both the global and in lower middle-income economies, which, together with the degree of path dependence, contribute to the computation of our vulnerability metrics.

Indivdual products' indices of vulnerability can be aggregated by computing a weighted average to obtain Morocco's structural vulnerability measure. The value assigned to Morocco is 0.641, corresponding to the 42.79th percentile of countries' distribution. This level is lower than both the world average, equal to 0.646, and the average for lower middle-income countries. These results mean Morocco's current specialization is only slightly less contestable than that of other peer countries.

As already reported at the beginning of this chapter, Morocco's performance was very dynamic in the period 1995–2019. Fifty-seven new products entered the country's export basket, most of which were still part of its export basket in 2019. Some of the products reported in Table 1 were temporary specializations, yet represented stable new entries for several years.

For instance, the export of 'Mechanical woodpulp' (HS 4701)—with the highest level of sophistication among Morocco's new entries—has experienced a downward trend in recent years (-7.5 per cent at the global level), and it is found in the export basket of only nine countries, none of which are lower middle-income countries. Other sophisticated products that have entered Morocco's export basket are 'Fishing vessels' (HS 8902) and 'Vehicle bodies' (HS 8707), both of which have a ProdY above USD 28,000. They continued to represent a specialization in 2019 and showed increasing trade values at the global level between 2017–19 (+18.6 per cent and +5.7 per cent, respectively).

Interestingly, the specializations related to the country's current export basket entered it in 2006 and 2014, respectively, and are exported in a few lower middle-income countries: from 2017–2019, 'Fishing vessels' were found in the export baskets of only three lower middle-income economies while only Morocco was specialized in 'Vehicles bodies'. Two of the top 10 products in the country's export basket (reported in Table 1), namely 'Cars' and 'Parts of other aircraft', were new entries in 2009 and 2012, but were exported with an RCA as a result of different paths. While 'Cars' were related to Morocco's pre-existing export basket (level of relatedness: 0.423) and entered in a path-dependent way (index of path dependence 0.103, higher than 0), 'Parts of other aircraft' were unrelated to the country's existing economic structure (relatedness equal to 0.289) and entered the export basket in a path-departing way (-0.241).

Other examples of products that entered Morocco's export basket in an unrelated way and which are still being exported with an RCA are 'Kaolin' (HS 2507) and 'Manganese oxides' (HS 2820), both of which are characterized by a level of sophistication that is higher than Morocco's average and whose values have increased over the three-year period between 2017 and 2019. As a result of Morocco's structural change, recent new entries in the electronics industry (in 2013–2014), such as 'Insulating fittings for electrical machines' (HS 8547) and 'Electrical boards' (HS 8537), have been characterized by path dependence. This differs from 'Parts for electrical apparatus' (HS 8538), which entered Morocco's export basket in a path-defying way in 2002 and was still part of the export basket in 2019, with Morocco being one of only two lower middle-income countries specialized in the production of this good.

The development of Morocco's export specializations has followed a path-dependent process, with two-thirds of new entries linked to its set of existing capabilities at the beginning of the period (product index of path dependence higher than zero). This is evident, in particular, for the automotive industry in which only the recent entry of 'Parts for electrical apparatus' has "defied the path". Most of the chemical industry's new entries were unrelated with the initial structure of Morocco's economy and continued to represent a specialization in 2019. New entries in 'Textiles' and 'Electronics' were mainly driven by the country's pre-existing set of capabilities.

Morocco's mostly path-dependent development has been accompanied by a high level of structural dynamism. By looking at the number of new entries in the period 1995–2019 and at the degree of path departure of the new entries, we find that Morocco's index of structural dynamism was equal to 0.638, a value that was higher than 81 per cent of world economies. The country's outstanding dynamic performance is evident when we compare its value with the world's and with lower middle-income countries' average indices. These groups of countries show a level of dynamism equal to 0.446 and 0.456, respectively, with the former value mainly driven by the relative low number of new entries among developed countries.

By adopting the metrics introduced in the previous chapter, we analyse the Moroccan economy's overall ability to defy its pre-existing comparative advantage, i.e. its tendency to diversify into unrelated products. Morocco's path departure computed as the new entries' relative distance from the threshold (equal to the opposite of the path dependence metric) is equal to -0.142, denoting that the majority of new specializations are the result of a capabilities-led diversification. This pattern is also confirmed when looking at the share of path-defying new entries, which is slightly below 28 per cent, and at the average percentile metric, which is equal to 33.146. All three metrics for path departure rank Morocco in the median of countries' distribution, which is reflected in a non-univocal ranking with respect to the world average level of path departure: by considering the relative distance from the threshold, we determine that Morocco is more path-departing than the average country (-0.203), but when we consider the share of its path-departing new entries (0.283) and its average percentile position (33.384), Morocco's results are more path-dependent. On the other hand, the three metrics for path departure unanimously show that Morocco has diversified in a less capabilities-constrained way than the average lower middle-income country.[12]

12. The average path departure metrics for LMI countries are -0.203 (relative distance from threshold), 0.283 (share of path-defying new entries) and 33.384 (average percentile).

Table 2

New entries in Morocco's export basket (1995-2019)

YEAR*	HS CODE	HS DESCRIPTION	PRODUCT SECTOR	PRODY (2017-19)	GROWTH IN GLOBAL TRADE (%,2017-19)	COUNTRIES WITH PRODUCT IN EB (2017-19)	LMI COUNTRIES WITH PRODUCT IN EB (2017-19)	PROD. RELATEDNESS (1)	PRODUCT INDEX OF PATH DEPEND. (2)	PATH DEPENDENCY (PERCENTILE)
2000	5209	Woven fabrics of cotton of <85% weighing >200g/m2	Textiles	6987.99	-9.001	24	10	0.586	0.516	98.379
2001	2501	Salt	Minerals	14840.94	17.918	47	9	0.385	0.020	54.490
2001	2811	Other inorganic acids	Chemicals	16388.51	9.960	29	4	0.370	-0.019	47.326
2002	2707	Oils etc. from high temperature coal tar	Minerals	19534.38	2.435	29	3	0.256	-0.329	6.162
2002	5514	Woven fabrics of <85% synthetic staple fibers weighing >170g/m2	Textiles	10396.74	35.811	23	5	0.590	0.545	98.990
2002	6117	Other clothing accesories, knit	Textiles	15361.54	2.743	32	7	0.448	0.172	78.889
2002	8538	Parts for electrical apparatus	Electronics	21797.67	0.671	29	2	0.377	-0.012	49.798
2003	806	Grapes	Agriculture	5122.40	9.071	28	8	0.578	0.526	98.281
2003	2817	Zinc oxide or peroxide	Chemicals	18537.40	-12.409	21	6	0.394	0.040	57.634
2004	5608	Nets	Textiles	11089.11	2.181	34	8	0.427	0.158	77.823
2005	3303	Perfumes	Chemicals	23198.41	11.564	32	4	0.306	-0.167	21.699
2005	3917	Plastic tubes and fittings	Chemicals	19027.02	8.475	44	5	0.418	0.136	75.230
2005	4107	Bovine leather further prepared	Agriculture	15318.70	-25.505	37	8	0.346	-0.059	40.635
2005	4302	Other tanned furskins	Agriculture	14937.06	-9.821	30	2	0.420	0.143	76.459
2005	5911	Textile articles for technical use	Textiles	28239.89	3.624	25	0	0.352	-0.042	42.989
2005	6601	Umbrellas	Textiles	9387.24	5.439	7	1	0.227	-0.382	3.582
2005	7802	Lead waste or scrap	Metals	14889.45	-12.789	75	13	0.558	0.518	98.567
2005	8535	Electrical apparatus for >1k volts	Electronics	22503.97	0.915	25	4	0.389	0.060	62.538
2006	704	Cabbages, cauliflowers, broccoli	Agriculture	7814.52	16.855	31	11	0.389	0.054	61.065
2006	1515	Other vegetable fats and oils	Agriculture	7683.08	-3.890	46	12	0.386	0.047	60.125
2006	1704	Confectionery sugar	Agriculture	12501.22	2.205	53	14	0.490	0.327	93.111
2006	8902	Fishing vessels	Vehicles	29858.02	18.624	19	3	0.448	0.214	85.908
2007	601	Flower bulbs	Agriculture	24598.62	0.532	11	2	0.222	-0.417	2.321
2007	705	Lettuce	Agriculture	13796.12	7.278	18	5	0.410	0.078	65.190
2007	706	Carrots & turnips	Agriculture	10767.34	14.462	38	12	0.442	0.160	77.954
2007	2507	Kaolin	Minerals	15901.27	5.041	20	6	0.290	-0.239	12.236
2007	5206	Cotton yarn of <85%	Textiles	15589.59	-4.529	20	10	0.610	0.602	99.262
2007	5212	Other woven cotton fabrics	Textiles	7818.08	-27.421	22	5	0.468	0.229	85.443
2007	6309	Used clothes and textiles	Textiles	10855.94	3.751	46	6	0.327	-0.141	26.266

2008	2904	Sulfonated, nitrated derivatives of hydrocarbons	Chemicals	21599.11	73.806	12	5	0.473	0.247	87.076
2009	813	Fruits, dried	Agriculture	4542.80	-10.463	44	17	0.557	0.463	98.298
2009	4701	Mechanical woodpulp	Agriculture	36773.88	-7.516	9	0	0.342	-0.101	33.298
2009	6310	Used or new rags textile scraps	Textiles	7927.22	-18.872	46	15	0.536	0.408	96.809
2009	8803	Parts of other aircraft	Vehicles	23266.07	7.876	22	3	0.289	-0.241	15.000
2010	1507	Soybean oil	Agriculture	9210.41	-7.997	24	5	0.313	-0.187	19.979
2010	3602	Prepared explosives, except gunpowder	Chemicals	11155.17	0.972	39	9	0.374	-0.030	46.154
2010	4016	Other articles of vulcanized rubber	Chemicals	21251.70	3.854	28	3	0.533	0.382	95.513
2010	8530	Electric signal and traffic controls	Electronics	28050.18	-1.542	27	0	0.569	0.476	97.863
2011	4104	Tanned hides of bovines or equines	Agriculture	13370.11	-26.450	51	14	0.473	0.239	85.363
2011	7612	Aluminum containers, <300liters	Metals	15636.48	4.349	44	7	0.471	0.233	84.829
2012	407	Eggs, in shell	Agriculture	14019.85	0.968	43	10	0.459	0.197	82.303
2012	2523	Cements	Minerals	9268.51	7.603	71	20	0.516	0.346	92.431
2012	2619	Iron or steel slag	Minerals	21776.18	-8.176	20	7	0.372	-0.030	45.842
2012	2713	Petroleum coke	Minerals	17054.98	20.555	35	3	0.357	-0.070	38.380
2012	4808	Corrugated paper and paperboard	Agriculture	14905.19	1.826	29	6	0.531	0.386	94.670
2012	8703	Cars	Vehicles	22141.82	2.770	26	2	0.423	0.103	69.296
2013	2403	Other manufactured tobacco	Agriculture	11327.81	25.187	42	12	0.414	0.068	62.420
2013	2820	Manganese oxides	Chemicals	14072.86	3.127	19	6	0.295	-0.238	14.437
2013	4102	Raw skins of sheep or lambs	Agriculture	11644.36	-31.745	40	6	0.524	0.351	92.994
2013	4803	Tissue	Agriculture	12394.34	10.243	32	5	0.419	0.081	64.756
2013	5101	Wool	Textiles	14853.74	-18.555	18	5	0.293	-0.244	12.951
2013	8547	Insulating fittings for electrical machines	Electronics	17951.46	-1.245	22	2	0.477	0.231	85.669
2013	8704	Motor vehicles for transporting goods	Vehicles	16118.73	3.977	24	1	0.425	0.097	68.259
2014	2835	Phosphates	Chemicals	15324.11	3.980	26	2	0.368	-0.052	43.024
2014	5508	Synthetic staple fibers sewing thread	Textiles	10054.05	4.590	23	7	0.423	0.088	66.241
2014	8537	Electrical boards	Electronics	20896.56	10.688	24	2	0.565	0.454	96.379
2014	8707	Vehicle Bodies	Vehicles	28394.57	5.743	18	1	0.418	0.076	65.389

(1) **Product relatedness** captures the proximity between the new entry and the country's export basket in the preceding five years. It is measured by the maximum pairwise relatedness between a new entrant product and all products in the pre-existing export basket; (2) **Product index of path dependence** is computed for each new entry and corresponds to the relative difference between product relatedness as defined in (1) and the average relatedness of all products in the OS (i.e. all products in which the country can potentially diversify in the considered period). Positive values imply that the relatedness of the new entry is higher than the relatedness of a representative product belonging to the country's OS; (3) **Path dependence (percentile)** is a metric for computing a product's path dependence based on the distribution of relatedness of products in the OS. The value of this metric represents the position (percentile) of a product's relatedness in such a distribution. For instance, a value of 95 for product *i* in country *j* means that this product's relatedness is equivalent to the 95th percentile of the distribution of relatedness of all products in the OS of country *j*; such products with a relatedness that is higher than 95 per cent of the products that belong to the OS. * New entries are identified over an 11-year interval. The year reported is the median one of such a time interval.

Notes: EB = export basket; NEs = new entries in the export basket; LMI = Low middle-income countries (World Bank classification).

3.2. Jumping near or far? An analysis of diversification opportunities

We review four sets of potential targets for diversification policies selected from Morocco's OS on the basis of different selection criteria (see below). The tables report several of the products' characteristics, which might be useful for informing policymakers' decisions.

- ***Complexity gain***, measured as the difference between the product's sophistication reported in each row of the table and the average sophistication of the country's export basket. A positive figure implies that specialization in the product will lead to an increase in the average level of the country's sophistication/complexity.
- ***Export growth 2017-19***[13] represents the growth rate of world exports in the specific product over the last three years. This signals how dynamic international trade has been in recent years, but there is no guarantee that future trends will be similar to past ones.
- ***Number of countries specialized in the product*** measures the number of countries that have had an RCA in the product in the last year for which data are available (2019).
- ***Number of countries belonging to the benchmark group (low middle-income countries, LMI) specialized in the product.***
- ***Relatedness***. The degree of relatedness between the potential new entry and the country's export basket. A high degree of relatedness suggests that the set of capabilities required to produce the potential diversification option might already be available in the country.
- ***Relatedness advantage***. This measures Morocco's proximity advantage to the potential product compared to countries in the same income group (LMI countries). This country advantage is particularly important for products with a high level of path dependence.
- ***Number of countries that developed a new specialization in the product in the period analysed (2000–2019).*** This metric indicates countries' general ability to acquire a comparative advantage in the product and is likely to be related with the degree of entry barriers/ difficulty of acquisition of the required production capabilities.

Set 1: Short jumps with a high path dependence and many competitors

The Moroccan economy has largely diversified—with some notable exceptions reported above—into new related products in recent decades. This includes vehicles and textile products which have contributed to a gradual upgrading of the country's level of complexity. Future strategies could continue to target related products with a high level of path dependence. In this first OS, we focus on products that require common capabilities, with some of the goods already being produced and exported with an RCA by Morocco. Fourteen out of 20 options represent an upgrade in terms of level of sophistication and are thus preferable in a strategy that aims to increase productivity associated with the export basket. The list reported in the table below is ranked according to the products' level of relatedness advantage, i.e. how much closer the product is related to Morocco's export basket than to other LMI countries' export baskets.

Morocco has the highest relatedness advantage in 'Volcanized rubber tubes' (HS 4009). This might be attributable to the presence of products in its export basket such as 'Other articles of vulcanized rubber' (HS 4016), which entered the country's export basket in 2010. This new entry is characterized by a relatively high level of sophistication. One interesting feature of this product is that no other LMI country includes it among its exports with an RCA, while the number of countries already exporting it—given that the subsample only considers products with many competitors—is not very high (26), at least compared to other options on the list. Moreover, Morocco already exports—albeit marginally—such a product (RCA 0.13, with an export value of USD 3.6 million). When we consider recent trends on international markets, Morocco shows a relatedness advantage in some of its short jumps, such as 'Mattresses and bedding' (HS 9404) and 'Electrical transformers' (HS 8504), which witnessed an increase in global trade of 14.67 per cent and 8.05 per cent, respectively. Both represent an upgrade in terms of sophistication, in particular the latter, which represents a complexity gain of USD 7,550.

13. Note that although 2020 data are available, given the COVID-19-induced shocks to international trade, we prefer to employ previous data which reflect the structure of the global economy and the pattern of comparative advantage in a more reliable way.

Table 3: Short jumps with a high path dependence and many competitors (projections)

HS CODE	HS DESCRIPTION	PRODUCT SECTOR	COMPLEXITY GAIN ($)	GROWTH IN GLOBAL TRADE (%, 2017-19)	COUNTRIES WITH PRODUCT IN EB (2017-19)	LMI COUNTRIES WITH PRODUCT IN EB (2017-19)	PROD. RELATEDNESS	RELAT. ADVANTAGE	NR NES (1995-2019)
4009	Vulcanized rubber tubes	Chemicals	6529.73	2.816	25	0	0.680	0.249	8
5208	Woven fabrics of cotton of > 85% weighing < 200 g/m2	Textiles	-5133.93	-3.094	25	8	0.560	0.210	4
7204	Ferrous waste and scrap	Metals	5917.60	-0.876	95	9	0.720	0.201	31
3603	Detonators	Chemicals	394.63	5.585	26	7	0.538	0.186	4
8504	Electrical transformers	Electronics	7550.64	8.054	25	4	0.577	0.179	2
9404	Mattresses and bedding	Textiles	903.21	14.675	32	9	0.606	0.165	10
7117	Imitation jewellery	Stone	11821.83	-0.483	25	3	0.500	0.153	9
105	Fowl	Agriculture	7771.48	6.337	32	6	0.581	0.152	11
2007	Jams, jellies and marmalades	Agriculture	-2957.42	2.016	45	10	0.622	0.148	3
8533	Electrical resistors	Electronics	9284.60	0.854	25	3	0.500	0.143	5
4821	Paper labels	Agriculture	5582.23	1.355	48	7	0.647	0.138	8
4011	New pneumatic tires of rubber	Chemicals	9108.46	4.921	31	4	0.516	0.137	10
8702	Buses	Vehicles	1891.47	13.422	26	2	0.500	0.135	9
401	Milk	Agriculture	9976.65	-5.821	40	5	0.625	0.133	19
5202	Cotton waste	Textiles	-7791.87	-36.371	30	15	0.484	0.130	2
2105	Ice cream	Agriculture	2929.30	11.896	45	8	0.622	0.130	6
4817	Letterstock	Agriculture	10438.44	6.269	39	5	0.568	0.130	5
6302	House linen	Textiles	-6527.08	1.150	28	10	0.484	0.127	9
2009	Fruit juices	Agriculture	-2751.08	-6.022	59	16	0.567	0.124	7
3923	Packing lids	Chemicals	3956.19	7.983	61	8	0.590	0.120	18

Notes: EB = export basket; NEs = new entries in the export basket; LMI = Low middle-income countries (World Bank classification).

The development of such new export specializations, which Morocco was already exporting in 2019 but with a low RCA (0.32 and 0.1, respectively), could be pursued by redeploying capabilities already being used in the production of 'Electrical boards' (HS 8537), 'Semiconductor devices' (HS 8541) and 'Parts for electrical apparatus' (HS 8538), as well as those being used in the production of 'Seats' (HS 9401). Only four LMI countries are already specialized in the production of 'Electrical transformers' while only two countries succeeded in developing these products during the period analysed. 'Electrical resistors' (HS 8533) could play a similar role in terms of relatedness advantage, complexity gain, similarity of capabilities required with those needed for products already in the export basket, competition (three LMI countries specialized in their production), and contestability (five new entries between 1995 and 2019). Other interesting diversification options for Morocco are 'New pneumatic tires of rubber' (HS 4011) and 'Buses' (HS 8702). Both have witnessed an increasing trend in global exports and might share capabilities with some of the vehicles and chemical products already being produced in Morocco, considering that such products were being exported in 2019 for a total value of slightly below USD 2 million and USD 20 million, respectively.

Set 2: Short jumps with a high path dependence and few competitors

The selection of this second OS is driven by the need to identify products that, in line with the previous list, have a set of required capabilities that do not differ much from the initial export basket and that entered countries' export baskets in a path-dependent way during the period analysed. The only difference with the previous list is that this OS is composed of products that are exported with an RCA by a smaller number of countries. All products but one represent a sophistication upgrade while three of 20 products did not enter any export basket between 1995 and 2019, revealing a very sticky dynamic (probably associated with a very high entry barrier). The list reported in the table below is ranked according to the products' level of relatedness advantage, i.e. how much closer the product is related to Morocco's export basket than to other LMI countries'.

Morocco has an outstanding relatedness advantage (0.400) in the production of 'Parts and accessories for video or sound equipment' (HS 8522), a product that is only found in the export basket of three LMI countries and which represents a new entry for only two countries. However, the global downward trend (-23.89 per cent between 2017 and 2019) raises some doubts about the feasibility of properly developing it, although the presence of many specializations in electronics products represents a springboard for Morocco.

No LMI country is specialized in the production of 'Parts of motor vehicles' (HS 8708), which Morocco possesses a remarkable relatedness advantage in: such products represent a desirable complexity gain opportunity, even though the number of new entries in this industry was very low from 1995–2019 (one). The option 'Clock movements, complete, unassembled' (HS 9110) represents a complexity gain of nearly USD 25,000, but did not register a single new entry. This product is exported by only eight countries (none of which are lower middle-income countries) and used to be exported by Morocco with an RCA higher than unity between 1998 and 2007. A focus on 'Nickel tubes and pipes' (HS 7507), 'Electronic printed circuits' (HS 8534), 'Vulcanized rubber plates' (HS 4008) and 'Printers and copiers' (HS 8443) represents a more feasible diversification strategy. 'Nickel tubes and pipes' would lead to a sizeable complexity gain, but such a product was not exported at all by Morocco in 2019.

The value chain results involve countries far from the African continent, even though Moroccan values associated with such exports were not negligible between 2005 and 2015 (with an RCA of up to 0.15 in 2013). 'Electronic printed circuits', which registered export values of around USD 1.6 million in 2019, would benefit from the presence of the set of capabilities developed in the production of electrical boards, semiconductor devices and parts for electrical apparatuses. Exported by only one other LMI country, it entered the export basket of only one country in the period analysed. 'Vulcanized rubber plates' could represent a feasible option for a new entry, as did 'Other articles of vulcanized rubber' in 2010, while the share of 'Printers and copiers' increased in value, year-over-year, as did its RCA index in Morocco's export basket. It could be exported with an RCA higher than unity within a decade. 'Tractors' (HS 8701) might also be a feasible option in terms of sophistication gain, growth in global trade (+12.187 per cent), and low LMI country competition (only one country exports tractors). It has a discrete level of contestability, however (seven new entries).

Table 4: Short jumps with a high path dependence and few competitors

HS CODE	HS DESCRIPTION	PRODUCT SECTOR	COMPLEXITY GAIN ($)	GROWTH IN GLOBAL TRADE (%, 2017-19)	COUNTRIES WITH PRODUCT IN EB (2017-19)	LMI COUNTRIES WITH PRODUCT IN EB (2017-19)	PROD. RELATEDNESS	RELAT. ADVANTAGE	NR NES (1995-2019)
8522	Parts and accessories for video or sound equipment	Electronics	7619.19	-23.887	10	3	0.750	0.400	2
8708	Parts of motor vehicles	Vehicles	9809.29	1.354	23	0	0.739	0.293	1
7507	Nickel tubes and pipes	Metals	23038.39	42.782	11	2	0.545	0.246	1
2819	Chromium oxides and hydroxides	Chemicals	362.67	-5.010	8	1	0.455	0.227	0
8548	Waste and scrap of batteries	Electronics	5707.75	-4.614	17	4	0.556	0.221	8
8473	Parts and accessories for office machines	Machinery	9080.58	3.598	15	2	0.563	0.213	1
8534	Electronic printed circuits	Electronics	18753.75	-0.072	15	2	0.563	0.210	4
3601	Propellant powders	Chemicals	8761.23	-21.483	17	1	0.556	0.205	3
9114	Other clock or watch parts	Machinery	15197.55	8.662	14	3	0.500	0.199	0
7320	Springs of iron or steel	Metals	4201.52	4.134	20	0	0.636	0.198	3
8701	Tractors	Vehicles	11146.76	12.187	21	1	0.619	0.196	7
5005	Yarn from silk waste	Textiles	3791.08	-8.104	5	0	0.400	0.189	0
5514	Woven fabrics of < 85% synthetic staple fibres weighing > 170 g/m2	Textiles	-2434.13	35.811	23	5	0.522	0.184	11
4008	Vulcanized rubber plates	Chemicals	17033.43	3.259	22	2	0.636	0.180	4
6001	Pile fabrics, knit	Textiles	132.58	7.459	12	3	0.462	0.180	11
7224	Other alloy steel in primary form	Metals	8632.05	-1.312	18	1	0.556	0.177	7
8443	Printers and copiers	Machinery	17459.56	-6.528	14	2	0.500	0.176	9
9110	Clock movements, complete, unassembled	Machinery	24986.00	38.069	8	0	0.417	0.172	0
7322	Radiators for central heating of iron or steel	Metals	7140.78	6.207	22	1	0.609	0.168	8
8414	Pumps, compressors, fans, etc.	Machinery	8690.26	5.125	23	1	0.522	0.167	4

Notes: EB = export basket; NEs = new entries in the export basket; LMI = Low middle-income countries (World Bank classification).

Set 3: Long jumps with a low path dependence, high frequency of new entries and few competitors

So-called long jump products, as described above, refers to those products that are not in the export basket and are unrelated to the country's initial specialization pattern. The products reported in the table below are characterized by a low level of path dependence since countries that include them in their export basket usually have very diverse capabilities sets. In line with the need to identify path-departing and high frequency products, the vulnerability metrics are relatively high, although the number of competitors is low. All products would lead to a sophistication upgrade which would primarily involve products in the chemical, textiles and machinery sectors.

Set 4: Long jumps with a high path dependence, low relatedness and relatedness advantage

In this section, we focus on a different set of long jump products that could represent diversification options for Morocco. The list reported in the table below considers potential new entries for which diversification occurs in a path-dependent way, but which are far from Morocco's current specialization (low level of relatedness, so-called long jumps) and closer, on average, to Morocco's current export basket than to those of other LMI countries (relatedness gain).The list reports the set of options for which capabilities matter, but Morocco lacks them in absolute terms, although not in comparison with other LMI countries (higher relatedness vis-à-vis economies at a similar stage of development).
As expected, the extent of relatedness advantage is quite modest, reaching a maximum of 0.07. The products associated with the highest complexity gain are 'Tire cord fabric' (HS 5902), which belongs to the textile sector, 'Acetals and hemiacetals' (HS 2911), 'Saturated acyclic monocarboxylic acids' (HS 2918) and 'Other sugars, chemically pure' (HS 2940), which belong to the chemical sector. Moreover, seven out of 20 products in the list are chemicals, all associated with upscaling product sophistication.

The level of exports of products reported in set 4 during 1995–2019 were very low or even zero for Morocco in many cases. Such new entries would represent long jumps for Morocco, also in terms of level of sophistication, but the relatedness advantage is reflected by the presence in the export basket of certain products that share some production capabilities.

'Textile articles for technical use', which entered Morocco's export basket in 2005, might be related to 'Tire cord fabric' products, especially when considering the degree of complementarity of the production of rubber products. The chemical products in Morocco's export basket have a low level of relatedness such as 'Phosphatic fertilizers' (HS 3103) and 'Glycosides' (HS 2938), but 'Sulfonated, nitrated derivatives of hydrocarbons' (HS 2904), on the other hand, entered the country's export basket in 2008. All these products have a low level of vulnerability, mainly because of their tendency to enter export baskets in a path-dependent way. On the basis of

- ***the sophistication gain***
- ***and the proximity to export specializations already in the export basket***

additional products that might represent interesting diversification strategies for Morocco include 'Insecticides, rodenticides, fungicides, etc.' (HS 3808), 'Carboxylic acids with additional oxygen function' (HS 2918), 'Pharmaceutical goods' (HS 3006) and 'Hydrochloric acid' (HS 2806). Such export specializations are quite ubiquitous and are associated with vulnerability indices higher than 0.4 (0.531, 0.412, 0.495 and 0.418, respectively).

Table 5: Long jumps with a low path dependence, high frequency of new entries and few competitors

HS CODE	HS DESCRIPTION	PRODUCT SECTOR	COMPLEXITY GAIN ($)	GROWTH IN GLOBAL TRADE (%, 2017-19)	COUNTRIES WITH PRODUCT IN EB (2017-19)	LMI COUNTRIES WITH PRODUCT IN EB (2017-19)	PROD. RELATEDNESS	RELAT. ADVANTAGE	NR NES (1995-2019)	PRODUCT INDEX OF VULNERABILITY
5504	Artificial staple fibres, not processed for spinning	Textiles	13432.73	0.408	7	3	0.250	-0.019	5	0.406
3905	Polymers of vinyl acetate	Chemicals	9156.71	9.773	16	3	0.364	0.026	5	0.416
2829	Sodium chlorate	Chemicals	9002.60	-11.531	12	3	0.250	0.000	5	0.498
9613	Cigarette lighters	Machinery	6457.16	-0.972	13	3	0.385	0.086	7	0.495
5803	Gauze	Textiles	5653.87	-5.699	14	4	0.368	0.063	7	0.508
9307	Swords	Machinery	3007.02	15.297	14	4	0.348	0.028	5	0.513
1204	Linseed	Agriculture	2308.22	9.715	14	3	0.292	0.023	8	0.639
2942	Other organic compounds	Chemicals	341.99	3.955	13	3	0.250	0.023	7	0.631

Notes: EB = export basket; NEs = new entries in the export basket; LMI = Low middle-income countries (World Bank classification).

Table 6: Long jumps with a high path dependence, low relatedness and relatedness advantage

HS CODE	HS DESCRIPTION	PRODUCT SECTOR	COMPLEXITY GAIN ($)	GROWTH IN GLOBAL TRADE (%, 2017-19)	COUNTRIES WITH PRODUCT IN EB (2017-19)	LMI COUNTRIES WITH PRODUCT IN EB (2017-19)	PROD. RELATEDNESS	RELAT. ADVANTAGE	NR NES (1995-2019)	PRODUCT INDEX OF VULNERABILITY
2940	Other sugars, chemically pure	Chemicals	13688.45	11.133	15	2	0.375	0.070	5	0.348
5511	Yarn of synthetic staple fibres, for retail sale	Textiles	-3995.55	-16.374	18	6	0.368	0.067	2	0.315
2911	Acetals and hemiacetals	Chemicals	17521.55	0.475	9	2	0.353	0.065	4	0.261
8306	Ornaments, statuettes, etc. of metal	Metals	-5520.25	8.802	14	2	0.308	0.062	1	0.163
6911	Porcelain or china household articles	Stone	7899.11	8.524	19	4	0.375	0.059	1	0.324
6912	Ceramic household articles	Stone	5391.12	4.657	19	2	0.346	0.045	3	0.345
5901	Stiffened textiles	Textiles	-3059.75	13.587	9	2	0.263	0.034	4	0.271
2610	Chromium ore	Minerals	-8679.52	-13.755	12	2	0.240	0.031	1	0.269
5902	Tire cord fabric	Textiles	42435.81	1.411	13	2	0.375	0.031	4	0.256
410	Edible animal products, n.e.c.	Agriculture	947.04	28.784	10	3	0.250	0.031	1	0.101
6602	Walking sticks	Textiles	6414.67	21.389	11	3	0.313	0.029	1	0.263
7227	Bars of other alloy steel	Metals	11255.81	-18.474	14	2	0.333	0.027	5	0.317
4419	Wooden kitchenware	Agriculture	-439.47	18.077	16	6	0.333	0.026	1	0.208
3808	Insecticides, rodenticides, fungicides, etc.	Chemicals	8568.88	3.678	31	4	0.387	0.021	5	0.531
8435	Machines for wine and juice production	Machinery	4178.97	-1.770	15	2	0.333	0.020	1	0.193
2918	Carboxylic acids with additional oxygen function	Chemicals	9453.82	2.074	17	2	0.368	0.018	6	0.412
6501	Hat forms	Textiles	-4978.46	-1.144	10	3	0.250	0.016	1	0.152
2915	Saturated acyclic monocarboxylic acids	Chemicals	14139.81	5.200	13	2	0.353	0.015	3	0.209
3006	Pharmaceutical goods	Chemicals	10561.11	9.996	23	2	0.375	0.012	6	0.495
2806	Hydrochloric acid	Chemicals	8275.00	16.664	25	4	0.346	0.009	2	0.418

Notes: EB = export basket; NEs = new entries in the export basket; LMI = Low middle-income countries (World Bank classification).

CHAPTER 4

INFORMING DIVERSIFICATION POLICIES: CONCLUDING REMARKS

The application of the DIVE tool to Morocco provides insights that could support the design of diversification as well as industrial and innovation policies. The tool can be used to conduct a diagnosis of the evolution of the country's export basket, to analyse its structural vulnerability, i.e. the potential of other countries to specialize in products that currently belong to its export basket, and to determine the ability of jumping over the product space in the direction of unrelated products. The latter is an interesting proxy of the ability to acquire or recombine production capabilities, a core ingredient of structural change. This analysis is unique as it not only provides a quantitative metric for the indicator 'diversification' (for instance, measured as the number of new entries), but also for the assessment of its 'direction', as it can be used to evaluate how far a country could jump over the product space.

The latter part of the analysis provides useful information to inform the direction diversification policies might take in the future. The list of potential products that could represent new sectors/areas of diversification should be considered as a first step in the design of policies. The DIVE tool can provide useful insights and new metrics to analyse specific 'target' products, as reported in Appendix B. The DIVE tool provides a first layer of analysis that offers a useful direction for defining policy targets. A second layer of assessment at the product level with the goal of obtaining a more in-depth analysis of the desirability and feasibility of a diversification strategy is highly recommended.

Finally, DIVE can also be useful as a tool to analyse the market characteristics of specific products. Detailed product-specific information can be helpful for policymakers to evaluate the desirability of certain goods for diversification (see Appendix B for a discussion of two product markets).

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APPENDICES

Appendix A

A. Identification of export baskets

Using HS 4-digit Rev. 1992 trade data, we adopted the Balassa Index of Revealed Comparative Advantage to quantify the degree of export specialization for each product *i*, each country *k* and each year *t*. The index of export specialization is computed as follows:

$$RCA_{ikt} = \frac{x_{ikt} / \sum_i x_{ikt}}{\sum_k x_{ikt} / \sum_i \sum_k x_{ikt}}$$

where X_{ikt} is the export value of product *i* in country *k* at time *t*. The Balassa index is computed for the entire year for which data are available. A product is only included in a country's export basket if the RCA is above unity for at least two years in the interval [*t*,t+2].

B. Computation of distances between products

Following Hidalgo et al. (2007), we computed the network of relatedness as the minimum of the pairwise conditional probability of being co-exported with an RCA above unity in the 3-year period [*t, t+2*]. The relatedness between product *i* and product *j* at time *t* is thus computed as follows:

$$\varphi_{ijt} = min\{P(EB_{it}|EB_{jt}), P(EB_{jt}|EB_{it})\}$$

where EB_{it} denotes the presence of product *i* in the export basket at time *t*. The degree of similarity in the capability required to produce different goods changes over time, thus for computing distances in terms of relatedness, we adopt year-specific networks.

C. New export specializations

A product is a new export specialization at time *t* if:

I. It is exported with an RCA higher than unity at time *t;*

II. It has been exported with an RCA lower than 0.5 for at least two of the previous 5 years;

III. It has never been exported with an RCA higher than unity in the previous 5 years;

IV. Alternatively:

1. it has been exported with an RCA higher than unity for at least 2 years in the following 5 years and has been exported with an RCA lower than 0.5 for no more than once in the following 5 years;
2. it has been exported with an RCA higher than unity for the following 3 years;

V. The average export value in the following 5 years is higher than the average export value in the previous 5 years;

VI. the export value at time *t* is higher than USD 1 million.

D. The option set (OS)

A product is part of the diversification space or option set (OS) if it:

- is exported with an RCA lower than unity at time *t*;
- is exported with an RCA lower than 0.5 for at least two years in the previous 5 years;
- is never exported with an RCA higher than unity in the previous 5 years.
-

In this case, we retrieved information of countries' OS for the period 2000–2019.

E. Distance between new entries/products in the OS and pre-existing export basket

The degree of relatedness between products outside the export basket and those already being exported with an RCA is given by the degree of proximity between such new entries/products in the OS and the closest products among those in the export basket.

$$dist_{i,EB_{kt}} = \max\{\varphi_{ij}\} with\ j \in EB_{kt}$$

where product *i* is the new entry (or alternatively, the product in the diversification set) and *EBkt* is the country's export basket at time *t*. In our approach, we avoid measures of average distance from the overall export basket, e.g. network density metrics. Averaging over the entire set of proximities would underestimate the degree of relatedness of products with high similarities in terms of local capabilities, with only a few existing specializations.
To compute the relatedness of new export specializations and products in the diversification space at time *t*, we adopt relatedness matrices referred to as time *t+5* so that the proximity is computed a priori, thereby avoiding endogeneity.

F. Product index of path departure

To detect the extent to which a product usually follows 'the path', we developed three alternative metrics that capture different aspects of diversification. The three metrics focus on the country-product dimension to capture the country-specific heterogeneity of product path dependence and, subsequently, we aggregate the information on path departure at the product level.
The first step is identifying the average proximity of the products in the OS for each country and each initial year. This represents the threshold for distinguishing between path-dependent and path-defying new entries.

- Relative distance from threshold: the first metrics compute the extent to which a single new entry defies the path and is given by the ratio between the difference in relatedness between the threshold and the new entry value as follows:

$$ipd_{ikt} = \frac{\mu_{kt} - dist_{i,EB_{kt}}}{\mu_{kt}}$$

where μ_{kt} is the country-time-specific threshold and *disti,EBkt* is the distance between the new entry and the pre-existing export basket of country *k* at time *t-5*. The index takes positive values when the new entry has a lower proximity to the export basket than the OS on average.
The metrics obtained thereby are subsequently aggregated at product level for the entire period of analysis as follows:

$$IPD_i = \frac{\sum_t \sum_k ipd_{ikt}}{|NE_i|}$$

where $|NE_i|$ is the number of total new entries of product in the period under scrutiny.

Share of path-defying new entries: by adopting the threshold value introduced above, we assign a dichotomic value to each new entry: if the relatedness is higher than the OS's average proximity, it represents a path-dependent new entry; on the contrary, if the new entry's relatedness is lower than the OS's average proximity, it is labelled as a path-defying new entry.

$$d\_ipd_{ikt} = \begin{cases} 1 \; if \; \mu_{kt} > dist_{i,EB_{kt}} \\ 0 \; otherwise \end{cases}$$

The product-level metrics, similarly to the previous one, is computed as follows:

$$d\_IPD_i = \frac{\sum_t \sum_k d\_ipd_{ikt}}{|NE_i|}$$

- The third metrics takes the entire distribution of the OS's relatedness distribution into consideration. Each new entry's inverse measure of distance from the export basket $(dist_{i,EB_{kt}})$ is assigned a percentile in the OS's distribution, ranging from 0 to 100. Higher values denote path-dependent new entries; we thus transform this value into a measure of path departure as follows:

$$percentile_{ikt} = 1 - rank_{OS,ikt}/100$$

The path departure product-country-time-specific metrics obtained is subsequently transformed into a product-specific measure of path departure as follows:

$$av\_perc\_dep_{it} = \frac{\sum_t \sum_k percentile_{ikt}}{|NE_i|}$$

G. Country index of path departure

All the product indices of path departure presented have been used to obtain a metric that is valid for the entire set of products exported by each country. Irrespective of the measure adopted denoting the product index of path departure, the following country measure is obtained:

$$IPD_k = \sum_i sh_{ik} ipd_i$$

where IPD_k indicates, alternatively, the country's relative distance from path dependence, the share of path-dependent new entries or the average percentile position of the country's export basket.

H. Product and country index of vulnerability

As reported in the main text, a vulnerable product is a product with a high level of path departure (low path dependence suggests that the set of available local capabilities is not difficult to acquire), high ubiquity (due to the fact that capabilities are present in several countries so international competition is high), and high frequency of entry (high level of contestability in the mid- to long run).
All three dimensions are computed using an index with values ranging from 0 to 1. For frequency and ubiquity, the product value is obtained as the relative position (percentile) of its frequency/ubiquity with respect to other products' frequency/ubiquity. The products that have entered most export baskets are assigned a value of 1. Products in the median of the distribution are assigned a value of 0.5.

The value on the degree of product-level path defiance is computed by **i)** comparing new entry relatedness with the country's pre-existing export basket with the OS's relatedness distribution and obtaining a value for each new entry in each country; **ii)** averaging the product-country relative position in the OS distribution with other countries. If a product achieves a value of 1, it means that it has the lowest level of relatedness of all products in the OS.
The three dimensions are joint in a unique index, which is computed as follows:

$$IPV_i = \sqrt{freq_i{}^2 + pathdepa_i{}^2 + ubiq_i{}^2} \Big/ \sqrt{3}$$

where the index of product vulnerability of product is equal to the square root of the sum of the three components' square divided by the square root of 3 (the denominator serves to obtain an index ranging in the [0,1] interval). Based on the product index of frequency, the product index of path departure and the product index of ubiquity as three dimensions represented as a 3x1 vector, the numerator corresponds to its norm.

Moving to the country dimension, we can easily compute the index of structural vulnerability for the export basket. This is obtained as the weighted average of the indices of product vulnerability, where the weights are given by the export shares of product of country *k*.

$$ISV_k = \sum_i sh_{ik} IPV_i$$

I. Country index of structural dynamism

By considering one measure that has already been introduced, i.e. the country index of path departure (as measured by the percentile method) and the number of new entries of each country in the period analysed, we obtain a country index of structural dynamism (ISD_k) which gives a measure of how dynamic the export basket of an economy is during a time interval (in our case, between 1995 and 2019).
We have already introduced the country index of path departure. The number of a country's new entries is normalized in the interval [0.1] by assigning a value to each country, which corresponds to its relative position in the distribution of the number of countries' new entries. In other words, the country that experienced the highest number of new entries over the period analysed, i.e. the country that changed its set of specializations most, has a value equal to 1. If a country has no entries, it has a value very close to 0.

Similarly to the country index of structural vulnerability, we have put together the two dimensions as follows:

$$ISD_i = \sqrt{NE\_rank_i{}^2 + pathdepa_i{}^2} \Big/ \sqrt{2}$$

where NE_rank_i is the relative position of country *i* in the distribution of world economies according to the number of new entries in the period 1995–2019. The denominator serves as correction to obtain an index bounded in the interval [0,1].

APPENDICES

Appendix B

Case 1: Product-level analysis: Refrigerators, freezers (HS 8418)

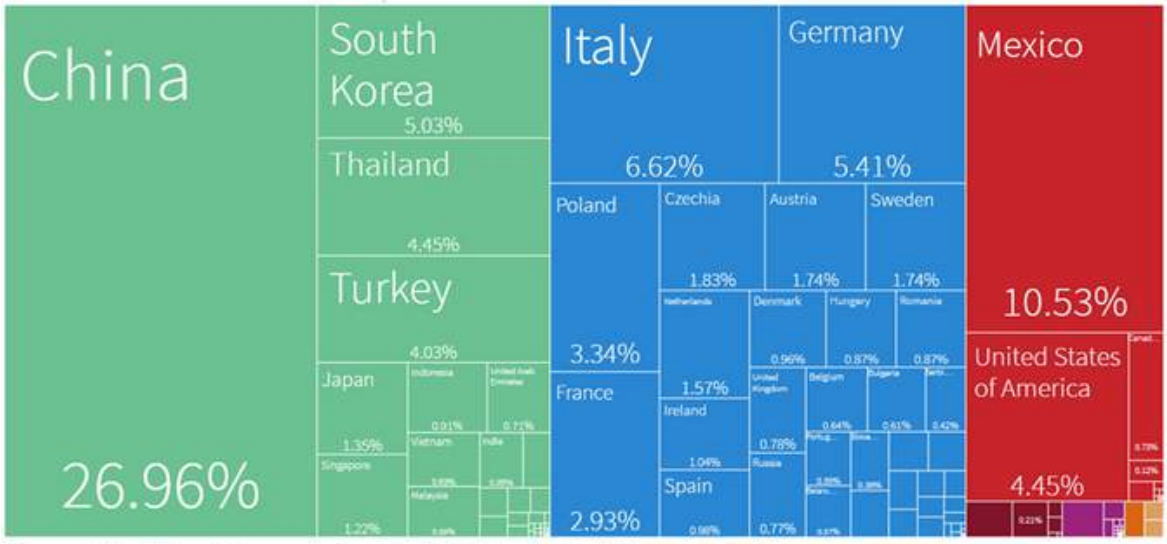
Industrialization processes have often followed common specialization trajectories. Specialization in durable goods, such as televisions, washing machines, refrigerators, cars and computers, is often emblematic of economies that are in an advanced stage of industrialization. We analyse the production of '**Refrigerators, freezers**' (HS 8418) using the tools developed in this Manual.

Although considered a product that is based on mature technology, the global value of its export is relatively large (2.6 per cent of global exports for a total value of USD 46 billion in 2020) with a relatively positive pre-COVID dynamic (+6.29 per cent between 2017 and 2019). As for other apparel, regulatory changes, international quality standards and demand for more efficient and environmentally friendly products have spurred a new wave of innovation and the development of more sophisticated products.

Countries specialized in the production of 'Refrigerators, freezers' (HS 8418) range from old and new industrial powerhouses. The top 10 exporters include developed OECD countries such as Germany, Italy, the United States, the Republic of Korea as well as emerging industrial economies such as China, Mexico, Thailand and Turkey.

In the global economy, 28 countries had a specialization in this product in 2017, of which 16 were high-income countries (57 per cent of the total) and nine were upper and lower middle-income countries (32 per cent). In fact, the product's level of sophistication is relatively high (ProdY equal to USD 21,300 compared to an average of USD 18,800).

Exporters of 'Refrigerators, freezers' (HS8418) in 2020 (% of total export; 46B US$)



Source: The Atlas of Economic Complexity (https://atlas.cid.harvard.edu/)

Global export (USD, current; billions)

2017	2018	2019	Growth rate last 3 years (%)
44.23	*47.05*	*47.01*	*6.29*
Top 10 exporters by value: China, Mexico, Italy, USA, Germany, Rep. of Korea, Thailand, Turkey, France, Poland. **Top 10 exporters by export share:** Turkey, Mexico, Serbia, Thailand, Bulgaria, Romania, Italy, Belarus, Poland, Lebanon.			

Product sophisticatedness

	Refrigerators, freezers – HS 841	*Machinery (n. 174 products)*	*All products (n. 1241 products)*
ProdY (USD; average value 2017–2019)	21,313.46	24,474.17	18,787.82
Source: Authors' elaboration based on UN COMTRADE data			

The **relative importance** of the product in export baskets is **particularly high for emerging countries that are geographically close to main consumption markets** (Turkey and other eastern European countries such as Serbia, Bulgaria, Poland and Romania for Europe; Mexico for the United States; Thailand and Japan for the Asian market). Proximity suggests the importance of access to the goods market as well as the availability of industrial capabilities in engineering a specialization in the production of this good.

Only four countries acquired a new specialization in refrigerators during the period 1995–2019 (Bosnia-Herzegovina, Bulgaria, Sri Lanka and Syria). Not only the frequency of new entries—a measure of the ease of acquiring a comparative advantage in a product–is relatively low (also compared to other products in the broader category of 'machinery'), but our analysis suggests that all these new entries were characterized by a high degree of path dependence. In other words, only countries that already had a specialization in highly related products were able to develop a specialization in 'Refrigerators, freezers' (HS 8418).

The **product-level index of path dependence is 0.324**, a value that is substantially higher than that of other products in the same macro category (the average value for all new entries in the world economy is 0.110 while it is 0.086 for all new entries in the machinery sector). All other metrics of path dependence confirm the importance of the set of initial capabilities for the production of this product.

Our analysis also allows us to identify those countries that currently have an export basket that is related to the product, although they do not yet have a trade specialization in it. These countries—listed below—have the potential of acquiring a specialization in 'Refrigerators, freezers' (HS 8418) in the future. Some of these countries, such as Viet Nam and Malaysia, but also Brazil and Tunisia, have features that resemble those of countries that have recently developed a specialization in the product, namely increasing industrial capabilities and geographical proximity to main export markets (EU, USA and Japan).

Number of countries with a specialization in the production of 'Refrigerators, freezers – HS 8418' in 2017–2019 by income level

	All countries	High-income	Upper middle-income	Lower middle-income	Low-income	Other
Refrigerators, freezers – HS 8418	28	16	9	2	0	1
Machinery (n. 174 products)	16.59	10.74	3.28	1.43	0.38	0.76
All products (n. 1241 products)	22.50	10.74	5.17	4.24	1.43	0.88

Number of new entries in the export basket of 'Refrigerators, freezers – HS 8418' between 1995 and 2019 by income level

	All countries	High-income	Upper middle-income	Lower middle-income	Low-income	Other
Refrigerators, freezers – HS 8418	4	0	2	2	0	0
Machinery (n. 736 new entries)	4.24	20.5	1.21	0.67	0.21	0.10
All products (n. 6975 new entries)	5.64	2.20	1.52	1.40	0.40	0.12

***Source**: Authors' elaboration based on UN COMTRADE data*

Path dependence: Alternative metrics

	Refrigerators, freezers – HS 8418	Machinery (n. 736 new entries)	All products (n. 6975 new entries)
Path dependence (1)	0.342	0.086	0.110
Share of path-dependent new entries	100	67.1	65.4
Average percentile: proximity between new entries and export basket (2)	91.2	61.7	61.3
Average relatedness as new entry	0.511	0.417	0.428

(1) Average distance of product's relatedness from the mean value of countries' OS. Higher values imply a higher degree of path dependence (see methodological section and Coniglio et al., 2022)

(2) Higher values imply a higher degree of proximity or relatedness between new entries and the country's pre-existing export basket (see methodological section and Coniglio et al., 2022)

***Source**: Authors' elaboration based on UN COMTRADE data*

Countries with a highly related export basket in 2019 not specialized in the production of Refrigerators, freezers. (*)

Brazil; Dominica; India; Malaysia; Namibia; Peru; Rep. of Moldova; Tunisia; Ukraine; Vietnam.

(*) *Countries—excluding high-income ones—not specialized in Refrigerators, freezers and with a high level of relatedness*

Although each export surge episode has different drivers, policymakers can draw useful information and lessons from a more in-depth analysis of the factors underlying new entries. As reported below, four countries developed a stable and quantitatively meaningful comparative advantage in the production of 'Refrigerators, freezers' in the period analysed (1995–2019), Bulgaria (from 2001), Syria (from 2004 until the beginning of the conflict), Sri Lanka (from 2009) and Bosnia-Herzegovina (from 2001, although for a limited trade volume).

The local production of refrigerators has a long tradition in Bulgaria (for instance, a local company, MRAZ S.A., has over 40 years of experience in the field of refrigeration), but foreign investors, building on local capabilities, further strengthened the country's industrial capacity. In 1999, the Liebherr Group (a German multinational) set up a large production plant in the city of Radinovo, Liebherr-Hausgeräte Marica EOOD.

Foreign investors were also key in the development of this product specialization in Sri Lanka. A subsidiary of the US-based Singer Corporation, Regnis Lanka, was established in 1988 to commence the production of refrigerators and washing machines. The development of these products was rooted in other core production activities of the company, such as sewing machines.

In Syria, the expansion of the sector was the result of the activities of domestic firms such as L.I.D.A. (founded in 1991) and the Joud Group (a family group with industrial operations in several related industries). Technological partnerships with foreign firms were crucial in the development of the sector as well.

Appendix B

Case 2: Product-level analysis: Unglazed ceramics flags and pavers (HS 6907)

We also analysed **Unglazed ceramics flags and pavers (HS 6907)**, a product characterized by a very low degree of path dependence. In other words, specialization in this product also occurred in countries that do not possess a previous specialization in related products. A limited degree of path dependence signals that the capabilities needed for the production of this good are either relatively easy to acquire or are ubiquitous. In fact, **Unglazed ceramics flags and pavers (HS 6907)** is characterized by relatively low technological barriers. Proximity to a large and growing demand, for instance due to the dynamics of urbanization in an area, and manufacturing tradition seem to play an important role in the development of comparative advantages.

The value of total exports in the world economy in 2020 was USD 17 billion (approximately 1 per cent of global exports; +3.5 per cent between 2017 and 2019). Italy is a leading exporter of unglazed ceramics, in particular in industrial districts in the North of the country, such as the area of Sassuolo and Faenza, with a very high geographical concentration of large, medium and small specialized producers. Chinese producers also have a large market share (22.8 per cent in 2020), followed by Spain (18.8 per cent) and India (8.9 per cent). The geography of production is rapidly changing due to the combination of the industry's maturity and more recently, to the rise in production costs (mostly energy and wages), which has affected producers across countries in an asymmetric way. Italy had a market share of over 60 per cent of the total share 20 years ago (although the value of global exports was substantially lower at USD 1.5 billion). The market share gradually eroded due to competition, firstly from Spain (mainly the industrial district of Castellon de la Plana) and later from China and a mix of low-cost producers in Europe and Asia.

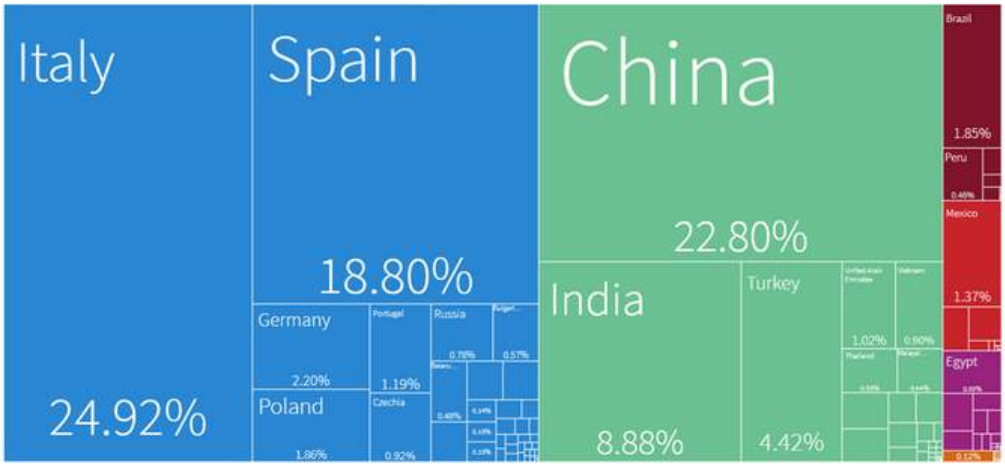
The level of **sophistication of the product is relatively high** and similar to the product described in Box 1 (level of productivity associated with product (sophistication) equal to USD 21,500 compared to an average of USD 18,800). The product is located in the 63th percentile in the distribution of sophistication.

In the period 2017–2019, **18 countries had a specialization in this product.** A relatively high number of upper and lower middle-income countries (seven countries, corresponding to 38.9 per cent) are specialized in this product, while high-income countries (five countries, corresponding to 28 per cent of the total) are underrepresented compared with other specializations in the broader sectoral category (stones).

Only three countries have acquired a new specialization in 'Unglazed ceramics' over the last 20 years (Viet Nam and Poland starting from 2002, and Ukraine from 2008). None of these countries had a pre-existing specialization in related products, suggesting, as mentioned above, the limited relevance of pre-existing production capability for the development of a comparative advantage in this sector.

The **product-level index of path dependence is -0.241**, a value that is substantially lower than that of other products in the same macro category (the average value for all new entries in the world economy is 0.110 while it is 0.058 for all new entries in the stone sector). All the other metrics of path dependence confirm the limited relevance of the set of initial capabilities for the production of this product.

Exporters of 'Unglazed ceramics ' (HS6907) in 2020 (% of total export; 17 B US$)



Source: The Atlas of Economic Complexity (https://atlas.cid.harvard.edu/)

Global export (USD, current; billions)

2017	2018	2019	Growth rate last 3 years (%)
17.02	18.12	17.62	3.51
Top 10 exporters by value: Italy, China, Spain, India, Turkey, Germany, Brazil, Poland, Portugal, Iran **Top 10 exporters by export share:** San Marino, Spain, Italy, Portugal, Iran, Turkey, India, Guatemala, Egypt, Belarus			
Source: *Authors' elaboration based on UN COMTRADE data*			

Product sophistication

	Unglazed ceramics flags and pavers (HS 6907)	Stone (n. 67 products)	All products (n. 1241 products)
ProdY (USD; average value 2017-2019)	21,541.31	19,311.79	18,787.82
Source: *Authors' elaboration based on UN COMTRADE data*			

Number of countries with a specialization in the production of 'Unglazed ceramics flags and pavers (HS 6907)' in 2017–2019 by income level

	All countries	High-income	Upper middle-income	Lower middle-income	Low-income	Other
Unglazed ceramics flags and pavers (HS 6907)	18	5	7	4	0	2
Stone (n. 67 products)	20.96	10.7	5.03	3.13	1.09	0.99
All products (n. 1241 products)	22.50	10.74	5.17	4.24	1.43	0.88
Source: *Authors' elaboration based on UN COMTRADE data*						

Number of new entries in the export basket of 'Unglazed ceramics flags and pavers (HS 6907)' between 1995 and 2019 by income level

	All countries	High-income	Upper middle-income	Lower middle-income	Low-income	Other
Unglazed ceramics flags and pavers (HS 6907)	3	1	0	2	0	0
Stone (n. 67 products)	5.9	2.48	1.55	1.42	0.37	0.07
All products (n. 1241 products)	5.64	2.20	1.52	1.40	0.40	0.12
Source: *Authors' elaboration based on UN COMTRADE data*						

Path dependence: Alternative metrics

	Unglazed ceramics flags and pavers (HS 6907)	Stone (n. 67 products)	All products (n. 1241 products)
Path dependence (1)	-0.241	0.058	0.110
Share of path-dependent new entries	0.00	61.85	65.4
Average percentile: proximity between new entries and export basket (2)	14.99	57.92	61.3
Average relatedness as new entry	0.31	0.41	0.428
(1) Average distance of product's relatedness from the mean value of countries' OS. Higher values imply a higher degree of path dependence (see methodological section and Coniglio et al., 2022) *(2) Higher values imply a higher degree of proximity or relatedness between new entries and the country's pre-existing export basket (see methodological section and Coniglio et al., 2022)* ***Source:*** *Authors' elaboration based on UN COMTRADE data*			

Our analysis suggests that the potential **to acquire a specialization in 'Unglazed ceramics flags and pavers (HS 6907)' is not limited to countries with an export basket with related products, but to other micro- and macro-level conditions that drive product specialization.**

The rise of the industry in **Viet Nam** is related to a combination of internal factors (growing urbanization, labour abundance, availability of raw materials, industrialization) and external factors (WTO accession, attraction of foreign direct investment). The largest producers have installed Italian plants and technologies. **Poland's** export surge followed a similar path. The real estate and construction boom and the process of deeper European integration are the main drivers of specialization in the production of this good. The 'heart' of the ceramics industry in Poland, which is now the third largest European producer after Italy and Spain, is the area of Lodz. The Lodz Special Economic Zones, which attracted several large producers, also played a crucial role.

The production of unglazed ceramics in Ukraine witnessed a steep increase in the period 2008–2014, although the absolute value of exports was limited and never reached above 1 per cent of the global market. The rise of this industry is related to the important role of **Ukraine** as a supplier of raw materials for the ceramics industry (e.g. Kaolin).

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